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June 28, 2012

VIA CERTIFIED MAIL

Thomas A. Benson
Trial Attorney
Environmental Enforcement Section
U.S. Department of Justice
P.O. Box 7611
Washington, D.C. 20044-7611

Mr. Craig Melodia
Associate Regional Counsel
U.S. Environmental Protection Agency - Region 5
77 West Jackson Boulevard (C-14-J)
Chicago, IL 60604-3590

Re: Ashland Superfund Site, Ashland, Wisconsin – Executed Uplands Consent Decree

Dear Messrs. Benson & Melodia:

On behalf of Northern States Power Company, a Wisconsin corporation ("NSPW"), we are enclosing a signed copy of the Consent Decree ("CD") for the Uplands RD/RA area of the Ashland/Northern States Power Lakefront Site (the "Site"), between the United States, the State of Wisconsin, the Tribes, and NSPW (the "Parties"). On behalf of NSPW, you are authorized to lodge the Consent Decree as signed in the U.S. District Court for the Western District of Wisconsin, together with the relevant documents and exhibits.

We appreciate the efforts of all the Parties in negotiating this settlement of claims related to the soil and shallow groundwater in Kreher Park and the Upper Bluff/Filled Ravine and the deep groundwater in the Copper Falls Aquifer (collectively, the "Uplands"), and all claims related to natural resource damages ("NRD") at the Site. We appreciate the agreement of U.S. EPA ("EPA") and the Wisconsin Department of Natural Resources ("WDNR") to accept NSPW's proposal for a phased-approach to the Site, and to solidify the technical aspects of the Uplands remedy *prior* to entry of the CD. We believe that NSPW's request that EPA approve a work plan for the Uplands work prior to entry of the Consent Decree will result in the Uplands work actually beginning sooner at the Site – a common goal we all share.

As you know, the CD for the Uplands is the product of months of negotiations between the Parties, and both sides made compromises to reach an agreement. Fundamentally, NSPW has agreed to perform the RD/RA for the Uplands area **on its own**, with zero participation and minimal to no cooperation from the other named potentially responsible parties ("PRPs").

However, we believe the record for the Site demonstrates that other named **and** unnamed PRPs have a significant share of liability for the Uplands, and for the sediments as well.

For example, according to the record evidence, for decades the City of Ashland utilized portions of the Uplands area as a dump, and allowed others to use the area as a dump, for a variety of waste materials, including the contaminants of concern at the Site. Moreover, the record evidence makes clear that when the City built the waste water treatment plant in the 1950s, and expanded it in the 1970s, large amounts of contaminants were drained into the Bay area during construction activities. The City undertook many other activities establishing their responsibility for the Site. The City is a named PRP at the Site but is not participating in the CD. The contractors who assisted the City in these construction activities also have not been named as PRPs by EPA.

We also believe the record demonstrates that the County of Ashland, Wisconsin, should be named and held liable as a PRP at the Site based on the fact that the County took control of and exercised dominion over the Schroeder Lumber property in the late 1930s. During its period of ownership and control, the County, *inter alia*, licensed and oversaw demolition of Schroeder's operations and facilities, during which time, evidence demonstrates contaminants were released at the Site. The County, however, has not been named as a PRP by EPA.

The railroads - Wisconsin Central, Ltd. and Soo Line Railroad Co. (d/b/a Canadian Pacific - each have ownership shares of certain portions of the Site, and the record of their respective historic operations (or those of their predecessors) at or near the Site suggests regular hauling of tar materials at and around the Site, including shipments of materials in and out of the Schroeder Lumber property. The railroads are named PRPs at the Site but are not participating in the CD.

Schroeder Lumber operated for decades at the Site prior to and including the 1930s, and we believe the evidence demonstrates that Schroeder Lumber engaged in wood treating activities and generated significant waste material at the Site, some of which remains in the subsurface today. As you know, Schroeder is now defunct, which raises the issue of "orphan share" at the Site. While NSPW appreciates the $1.5MM waiver of future oversight costs set forth in the Uplands CD, we also remain very interested in resolving issues related to "orphan share" at the sediment portion of the Site and for past oversight costs. .

In spite of the record regarding other PRPs, NSPW stepped forward and committed to perform the Uplands remedy on its own. We believe this demonstrates our good faith approach to the Site and our commitment to move the Site into cleanup mode as soon as possible. At the same time, please understand that we must pursue all claims against any and all liable PRPs, and it is our intention to do so. In fact, our willingness to step forward on the Uplands portion of the Site is predicated on recovery of costs from these other PRPs.

In terms of the next steps between NSPW, EPA and WDNR, we agreed to resolve the Uplands portion of the Site first, and then enter into discussions about claims related to the sediments in Chequamegon Bay. When the parties agreed to this framework for negotiations, NSPW clarified that it wants a meaningful opportunity to explore a number of settlement options and Site issues related to the sediments. We understand that EPA and WDNR have commited to

substantive, good-faith negotiations regarding the sediment claims for a period of time adequate to allow for a thorough exploration of all of the issues and possible avenues for resolution. We look forward to beginning those discussions in earnest this Summer.

In the meantime, please let me know if there is anything you require from NSPW to finalize and lodge the CD. To the extent that comments are received and/or the Court requests a hearing, NSPW will work with the you to support entry of the CD, as may be necessary. Again, we appreciate your efforts to resolve the Uplands claims and to move the Site forward into active cleanup.

Sincerely,

Karl A. Kang
of Latham & Watkins, LLP

cc: Kris Hess, WDNR

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WISCONSIN

UNITED STATES OF AMERICA and THE STATE OF WISCONSIN, Plaintiffs, v. NORTHERN STATES POWER COMPANY, Defendant.	Civil Action No. _____

CONSENT DECREE BETWEEN THE UNITED STATES, WISCONSIN, NORTHERN STATES POWER COMPANY, AND THE BAD RIVER AND RED CLIFF BANDS OF THE LAKE SUPERIOR TRIBE OF CHIPPEWA INDIANS

TABLE OF CONTENTS

I. BACKGROUND 1
II JURISDICTION 3
III. PARTIES BOUND 3
IV. DEFINITIONS 4
V. GENERAL PROVISIONS 8
VI. PERFORMANCE OF THE WORK BY SETTLING DEFENDANT 10
VII. PHASE 1 REMEDY REVIEW 14
VIII. QUALITY ASSURANCE, SAMPLING, AND DATA ANALYSIS 15
IX. ACCESS AND INSTITUTIONAL CONTROLS 16
X. REPORTING REQUIREMENTS 21
XI. EPA APPROVAL OF PLANS, REPORTS, AND OTHER DELIVERABLES 22
XII. PROJECT COORDINATORS 23
XIII. PERFORMANCE GUARANTEE 23
XIV. CERTIFICATION OF COMPLETION 28
XV. EMERGENCY RESPONSE 30
XVI. TECHNICAL IMPRACTICABILIY 30
XVII. PAYMENTS FOR RESPONSE COSTS 33
XVIII. NATURAL RESOURCE RESTORATION PROJECTS 33
XIX. INDEMNIFICATION AND INSURANCE 40
XX. FORCE MAJEURE 40
XXI. DISPUTE RESOLUTION 41
XXII. STIPULATED PENALTIES 43
XXIII COVENANTS BY PLAINTIFFS AND TRIBES 46
XXIV. COVENANTS BY SETTLING DEFENDANT 50
XXV. EFFECT OF SETTLEMENT; CONTRIBUTION 51
XXVI. ACCESS TO INFORMATION 52
XXVII. RETENTION OF RECORDS 53
XXVIII. NOTICES AND SUBMISSIONS 54
XXIX. RETENTION OF JURISDICTION 57
XXX. APPENDICES 57
XXXI. COMMUNITY INVOLVEMENT 57
XXXII. MODIFICATION 58
XXXIII. LODGING AND OPPORTUNITY FOR PUBLIC COMMENT 58
XXXIV. SIGNATORIES/SERVICE 58
XXXV. FINAL JUDGMENT 59

I. BACKGROUND

A. The United States of America ("United States"), on behalf of the Administrator of the United States Environmental Protection Agency ("EPA") and the Secretaries of the United States Department of the Interior ("DOI") and the United States Department of Commerce ("DOC"), and the State of Wisconsin (the "State"), at the request of the Governor of Wisconsin on behalf of the Wisconsin Department of Natural Resources ("WDNR"), filed a complaint in this matter pursuant to Sections 106 and 107 of the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9606, 9607.

B. The United States and the State in their complaint seek, *inter alia*: (1) reimbursement of costs incurred by EPA and the U.S. Department of Justice ("DOJ") for response actions at the Ashland/Northern States Power Lakefront Site ("Site") in Ashland, Wisconsin, together with accrued interest; (2) performance of response actions by Northern States Power Company, a Wisconsin Corporation ("Settling Defendant") at the Site consistent with the National Contingency Plan, 40 C.F.R. Part 300 (as amended) ("NCP"); and (3) recovery of Natural Resource Damages.

C. In accordance with the NCP and Section 121(f)(1)(F) of CERCLA, 42 U.S.C. § 9621(f)(1)(F), EPA notified the State of negotiations with potentially responsible parties ("PRPs") regarding the implementation of the remedial design and remedial action for the Site, and the State has participated in such negotiations and elected to be a party to this Consent Decree.

D. Pursuant to Executive Order 12580 and the National Contingency Plan, 40 C.F.R. Part 300, the President has delegated authority to act as Federal Trustees for Natural Resources at and near the Site to DOI, as represented by the United States Fish and Wildlife Service, and DOC, as represented by the National Oceanic and Atmospheric Administration.

E. WDNR is a response agency and a State Trustee for Natural Resources at or near the Site.

F. The Bad River and Red Cliff Bands of the Lake Superior Tribe of Chippewa Indians (the "Tribes") are trustees for Natural Resources at or near the Site.

G. In accordance with Section 122(j)(1) of CERCLA, 42 U.S.C. § 9622(j)(1), EPA notified the United States Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, WDNR, and the Tribes (collectively "Trustees") on March 28, 2011 of negotiations with PRPs regarding the release of hazardous substances that is alleged to have resulted in injury to Natural Resources under federal, State, and Tribal trusteeship and encouraged the Trustees to participate in the negotiation of this Consent Decree. The Trustees have participated in the negotiation of this Consent Decree with respect to Natural Resource Damages and support this Consent Decree.

H. The Settling Defendant does not admit any liability to Plaintiffs or the Tribes arising out of the transactions or occurrences alleged in the complaint, nor does it acknowledge that the release or threatened release of hazardous substances at or from the Site constitutes an imminent and substantial endangerment to the public health or welfare or the environment, nor any damage to Natural Resources. Settling Defendant does not admit, and reserves the right to controvert in subsequent proceedings, except as otherwise provided herein, the validity of any findings of fact, conclusions of law, or other determinations of this Consent Decree.

I. Pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, EPA placed the Site on the National Priorities List ("NPL"), set forth at 40 C.F.R. Part 300, Appendix B, by publication in the Federal Register on September 5, 2002, 67 Fed. Reg. 56757-56765.

J. In response to a release or a substantial threat of a release of a hazardous substance(s) at or from the Site, EPA and Settling Defendant commenced on November 14, 2003, a Remedial Investigation and Feasibility Study ("RI/FS") for the Site pursuant to 40 C.F.R. § 300.430 under an Administrative Order on Consent ("AOC").

K. Settling Defendant completed a Remedial Investigation ("RI") Report on February 5, 2008, and completed a Feasibility Study ("FS") Report on December 4, 2008. EPA issued a Notice of Completion for the AOC on December 13, 2010.

L. Pursuant to Section 117 of CERCLA, 42 U.S.C. § 9617, EPA published notice of the completion of the FS and of the proposed plan for remedial action on June 1, 2009, in a major local newspaper of general circulation. EPA provided an opportunity for written and oral comments from the public on the proposed plan for remedial action. A copy of the transcript of the public meeting is available to the public as part of the administrative record upon which the Director of the Superfund Division, EPA Region 5, based the selection of the response action.

M. Pursuant to Section 122(e) of CERCLA, 42 U.S.C. § 9622(e), EPA sent special notice letters to Settling Defendant, Wisconsin Central Ltd., Soo Line Railroad Co., and the City of Ashland, Wisconsin notifying them of their potential liability for the Site, and inviting them to participate in negotiations regarding cleanup of the Site. Wisconsin Central Ltd., Soo Line Railroad Co., and the City of Ashland are not parties to this Consent Decree, and have not otherwise resolved their respective liability at the Site, as of the Effective Date of this Consent Decree. The John Schroeder Lumber Company operated on the Site from approximately 1901 until sometime in the 1930s and is now defunct. Schroeder Lumber might be a potentially responsible party at the Site if still in existence.

N. The decision by EPA on the remedial action to be implemented at the Site is embodied in a final Record of Decision ("ROD"), executed on September 30, 2010, on which the State has given its concurrence. The ROD includes EPA's explanation for any significant differences between the final plan and the proposed plan as well as a responsiveness summary to the public comments. Notice of the final plan was published in accordance with Section 117(b) of CERCLA, 42 U.S.C. § 9617(b).

O. The Site includes four inter-related areas of concern: 1) sediments in Chequamegon Bay; 2) soil and shallow groundwater in Kreher Park; 3) soil and shallow groundwater in the Upper Bluff/Filled Ravine; and 4) deep groundwater in the Copper Falls Aquifer. The remedial design and remedial action to be conducted pursuant to this Consent Decree pertains only to the selected remedy specified in the ROD for the soil and groundwater portions of the Site (items 2-4, above), and not to the sediments in Chequamegon Bay (item 1, above). The Parties agree that the remedy for the sediments in Chequamegon Bay will be addressed separately, and that this Consent Decree does not limit or otherwise affect any rights or defenses Plaintiffs or Settling Defendant may have with respect to Chequamegon Bay, except as set forth in this Consent Decree, such rights and defenses being otherwise fully retained.

P. This Consent Decree also fully and finally resolves any and all Natural Resource Damages recoverable by the United States, the State, or the Tribes from Settling Defendant for

injury to, destruction of, or loss of use or impairment of Natural Resources at the entire Site, including the portion of Chequamegon Bay within the Site, except as otherwise set forth in this Consent Decree.

Q. Based on the information presently available to EPA and the State, EPA and the State believe that the Work will be properly and promptly conducted by Settling Defendant if conducted in accordance with the requirements of this Consent Decree and its appendices.

R. Solely for the purposes of Section 113(j) of CERCLA, 42 U.S.C. § 9613(j), the remedial action set forth in the ROD and the Work to be performed by Settling Defendant shall constitute a response action taken or ordered by the President for which judicial review shall be limited to the administrative record.

S. The Parties recognize, and the Court by entering this Consent Decree finds, that this Consent Decree has been negotiated by the Parties in good faith and implementation of this Consent Decree will expedite the cleanup of the Site and will avoid prolonged and complicated litigation between the Parties, and that this Consent Decree is fair, reasonable, and in the public interest.

NOW, THEREFORE, it is hereby Ordered, Adjudged, and Decreed:

II. JURISDICTION

1. This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §§ 1331 and 1345, and 42 U.S.C. §§ 9606, 9607, and 9613(b). This Court also has personal jurisdiction over Settling Defendant. Solely for the purposes of this Consent Decree and the underlying complaint, Settling Defendant waives all objections and defenses that it may have to jurisdiction of the Court or to venue in this District. Settling Defendant shall not challenge the terms of this Consent Decree or this Court's jurisdiction to enter and enforce this Consent Decree.

III. PARTIES BOUND

2. This Consent Decree applies to and is binding upon the United States, the State, the Tribes, and upon Settling Defendant and its successors and assigns. Any change in ownership or corporate status of Settling Defendant including, but not limited to, any transfer of assets or real or personal property, shall in no way alter Settling Defendant's responsibilities under this Consent Decree, except that Settling Defendant may require third parties to accept responsibility for some or all of its obligations under the Consent Decree. Unless the United States and the State agree otherwise in a Consent Decree modification filed with the Court, Settling Defendant shall remain responsible for all obligations under the Consent Decree, notwithstanding any agreement between Settling Defendant and any third party.

3. Settling Defendant shall provide a copy of this Consent Decree to each contractor hired to perform the Work required by this Consent Decree and to each person representing Settling Defendant with respect to the Work, and shall condition all contracts entered into hereunder upon performance of the Work in conformity with the terms of this Consent Decree. Settling Defendant or its contractors shall provide written notice of the Consent Decree to all subcontractors hired to perform any portion of the Work required by this Consent Decree.

Settling Defendant shall nonetheless be responsible for ensuring that its contractors and subcontractors perform the Work in accordance with the terms of this Consent Decree. With regard to the activities undertaken pursuant to this Consent Decree, each contractor and subcontractor shall be deemed to be in a contractual relationship with Settling Defendant within the meaning of Section 107(b)(3) of CERCLA, 42 U.S.C. § 9607(b)(3).

IV. DEFINITIONS

4. Unless otherwise expressly provided in this Consent Decree, terms used in this Consent Decree that are defined in CERCLA or in regulations promulgated under CERCLA shall have the meaning assigned to them in CERCLA or in such regulations. Whenever terms listed below are used in this Consent Decree or in the appendices attached hereto and incorporated hereunder, the following definitions shall apply solely for purposes of this Consent Decree:

a. "Ashland/Northern States Power Special Account" shall mean the special account, within the EPA Hazardous Substances Superfund, established for the Site (Site ID B5 N5) by EPA pursuant to Section 122(b)(3) of CERCLA, 42 U.S.C. § 9622(b)(3).

b. "CERCLA" shall mean the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601-9675.

c. "Consent Decree" or "Decree" shall mean this Consent Decree and all appendices attached hereto (listed in Section XXX). In the event of conflict between this Consent Decree and any appendix, this Consent Decree shall control.

d. The term "day" shall mean a calendar day unless expressly stated to be a working day. The term "working day" shall mean a day other than a Saturday, Sunday, or federal holiday. In computing any period of time under this Consent Decree, where the last day would fall on a Saturday, Sunday, or federal holiday, the period shall run until the close of business of the next working day.

e. "Effective Date" shall be the date upon which this Consent Decree is entered by the Court as recorded on the Court docket, or, if the Court instead issues an order approving the Consent Decree, the date such order is recorded on the Court docket.

f. "EPA" shall mean the United States Environmental Protection Agency and its successor departments, agencies, or instrumentalities.

g. "Future Oversight Costs" shall mean that portion of Future Response Costs that EPA incurs in monitoring and supervising Settling Defendant's performance of the Work to determine whether such performance is consistent with the requirements of this Consent Decree, including costs incurred in reviewing plans, reports, and other deliverables submitted pursuant to this Consent Decree, WDNR costs billed to EPA by agreement between WDNR and EPA, and costs incurred in overseeing implementation of the Work; however, Future Oversight Costs do not include, *inter alia*: the costs incurred by the United States pursuant to Paragraph 9 (Notice to Successors-in-Title and Transfers of Real Property), Sections VII (Phase 1 Remedy Review), IX (Access and Institutional Controls), XV (Emergency Response), and Paragraph 48 (Funding for Work Takeover), or the costs incurred by the United States in enforcing the terms

of this Consent Decree, including all costs incurred in connection with Dispute Resolution pursuant to Section XXI (Dispute Resolution) and all litigation costs.

h. "Future Response Costs" shall mean all costs, including, but not limited to, direct and indirect costs, that the United States incurs in reviewing or developing plans, reports, and other deliverables submitted pursuant to this Consent Decree, in overseeing implementation of the Work, in performing any aspects of the Work, or otherwise implementing, overseeing, or enforcing this Consent Decree, including, but not limited to, payroll costs, contractor costs, travel costs, laboratory costs, the costs incurred pursuant to Paragraph 9 (Notice to Successors-in-Title and Transfers of Real Property), Sections VII (Phase 1 Remedy Review), IX (Access and Institutional Controls) (including, but not limited to, the cost of attorney time and any monies paid to secure access and/or to secure, implement, monitor, maintain, or enforce Institutional Controls including, but not limited to, the amount of just compensation), XV (Emergency Response), Paragraph 48 (Funding for Work Takeover), Section XXXI (Community Involvement), and WDNR costs billed to EPA by agreement between WDNR and EPA.

i. "Institutional Controls" or "ICs" shall mean restrictions, limitations, or other conditions or action taken under state laws or local laws, regulations, ordinances, zoning restrictions, or other governmental controls or notices to ensure that conditions at the Phase 1 Project Area, and the rest of the Site to the extent described in Paragraph 26(f), remain protective of public health, safety, and welfare and the environment, including, but not limited, to WIS. STAT. § 292.12, that may also: (a) limit land, water, and/or resource use to minimize the potential for human exposure to Waste Material at the Site; (b) limit land, water, and/or resource use to implement, ensure non-interference with, or ensure the protectiveness of the Phase 1 Remedial Action; (c) provide information intended to modify or guide human behavior at the Phase 1 Project Area, and the rest of the Site to the extent described in Paragraph 26(f); and/or (d) require easements or covenants running with the land that (i) limit land, water, or resource use and/or provide access rights and (ii) are created pursuant to common law or statutory law by an instrument that is recorded by the owner in the appropriate land records office (which has commonly been referred to as "Proprietary Controls" by EPA).

j. "Institutional Control Implementation and Assurance Plan" or "ICIAP" shall mean the plan for implementing, maintaining, monitoring, and reporting on the Institutional Controls set forth in the ROD, prepared in accordance with the statement of work ("SOW").

k. "Interest" shall mean interest at the rate specified for interest on investments of the EPA Hazardous Substance Superfund established by 26 U.S.C. § 9507, compounded annually on October 1 of each year, in accordance with 42 U.S.C. § 9607(a). The applicable rate of interest shall be the rate in effect at the time the interest accrues. The rate of interest is subject to change on October 1 of each year.

l. "National Contingency Plan" or "NCP" shall mean the National Oil and Hazardous Substances Pollution Contingency Plan promulgated pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, codified at 40 C.F.R. Part 300, and any amendments thereto.

m. "Natural Resource" or "Natural Resources" means land, resident and anadromous fish, resident and migratory wildlife, biota, air, water, groundwater, sediments, wetlands, drinking water supplies, and other such resources, belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, the State, or the Tribes.

n. "Natural Resource Damages" means any damages recoverable by the United States or the State on behalf of the public, or by the Tribes, for injury to, destruction of, or loss or impairment of Natural Resources at the Site as a result of a release of hazardous substances, including but not limited to: (i) the costs of assessing such injury, destruction, or loss or impairment arising from or relating to such a release; (ii) the costs of restoration, rehabilitation, or replacement of injured or lost Natural Resources or of acquisition of equivalent resources; (iii) the costs of planning such restoration activities; (iv) compensation for injury, destruction, loss, impairment, diminution in value, or loss of use of Natural Resources; and (v) each of the categories of recoverable damages described in 43 C.F.R. § 11.15 and applicable state and tribal law.

o. "Operation and Maintenance" or "O&M" shall mean all activities required to maintain the effectiveness of the Phase 1 Remedial Action as required under the Operation and Maintenance Plan approved or developed by EPA pursuant to Section VI (Performance of the Work by Settling Defendant) and the SOW, and maintenance, monitoring, and enforcement of Institutional Controls as provided in the ICIAP.

p. "Paragraph" shall mean a portion of this Consent Decree identified by an Arabic numeral or an upper or lower case letter.

q. "Parties" shall mean the United States, the State, the Tribes, and Settling Defendant.

r. "Phase 1 Performance Standards" shall mean the cleanup standards for soil and groundwater in the Phase 1 Remedial Action, as set forth in the ROD, the SOW, and the design plans and specifications developed in accordance with the Phase 1 Remedial Design Work Plan and the Phase 1 Remedial Action Work Plan and approved by EPA. The Phase 1 Performance Standards for soil and groundwater shall be established to achieve: (i) the Remedial Action Objectives ("RAOs") described in Section 8.0 of the ROD; (ii) cleanup standards described in Section 12.8 of the ROD, including the table of Cleanup Standards for Soil and Groundwater on page 103 of the ROD (or their equivalent as allowed under ARARs); and (iii) any ARARs identified in Appendix C of the ROD and that are identified during the Phase 1 Remedial Design.

s. "Phase 1 Project Area" shall mean that area of the Site generally comprising Kreher Park; the Upper Bluff/Filled Ravine; and the Copper Falls Aquifer. The Phase 1 Project Area comprises the entire Site except for the portion of Chequamegon Bay within the Site boundary.

t. "Phase 1 Remedial Action" shall mean all activities Settling Defendant is required to perform under the Consent Decree to implement the ROD with respect to the Phase 1 Project Area and to implement the Phase 1 Remedial Action Work Plan to be developed under Paragraph 12 and the SOW, including implementation of Institutional Controls, until the Phase 1 Performance Standards are met, and excluding performance of the Remedial Design, O&M, and the activities required under Section XXVII (Retention of Records). The Phase 1 Remedial Action includes the entire remedy required by the ROD, except that it does not include the implementation of the ROD with respect to sediments in Chequamegon Bay.

u. "Phase 1 Remedial Action Work Plan" shall mean the document developed pursuant to Paragraph 12 (Phase 1 Remedial Action) and approved by EPA, after

consultation with WDNR, and any modifications thereto. WDNR may join EPA in approving the Phase 1 Remedial Action Work Plan.

v. "Phase 1 Remedial Design" shall mean those activities to be undertaken by Settling Defendant to develop the final plans and specifications for the Phase 1 Remedial Action pursuant to the Phase 1 Remedial Design Work Plan.

w. "Phase 1 Remedial Design Work Plan" shall mean the work plan for the design of the Phase 1 Remedial Action approved by EPA, after consultation with WDNR, and any modifications made in accordance with this Consent Decree.

x. "Plaintiffs" shall mean the United States and the State.

y. "RCRA" shall mean the Solid Waste Disposal Act, as amended, 42 U.S.C. §§ 6901-6992 (also known as the Resource Conservation and Recovery Act).

z. "Record of Decision" or "ROD" shall mean the EPA Record of Decision relating to the Site signed on September 30, 2010 by the Director of the Superfund Division, EPA Region 5, and all attachments thereto. The ROD is attached as Appendix A.

aa. "Section" shall mean a portion of this Consent Decree identified by a Roman numeral.

bb. "Settling Defendant" shall mean Northern States Power Company, a Wisconsin corporation.

cc. "Settling Defendant's Related Parties" shall mean: (i) all parents, subsidiaries, and affiliates of Settling Defendant (including, but not limited to, Xcel Energy, Inc., a Minnesota corporation; Xcel Energy Services, Inc., a Delaware corporation; Northern States Power Company, a Minnesota corporation; Southwestern Public Service Company, a New Mexico corporation; and Public Service Company of Colorado, a Colorado corporation), but only to the extent that the alleged liability of such person is based on the alleged liability of the Settling Defendant; and (ii) the former or current officers, directors, employees, general partners, limited partners, members, or shareholders of Settling Defendant and of any entity included in clause (i) of this Paragraph, but only to the extent that the alleged liability of such person is based on acts and/or omissions which occurred within the scope of the person's employment or capacity as an officer, director, employee, general partner, limited partner, member, or shareholder of the Settling Defendant or of any entity included in clause (i) of this Paragraph.

dd. "Site" shall mean the Ashland/Northern States Power Lakefront Site, located in the City of Ashland, Ashland County, Wisconsin, and depicted generally on the map attached as Appendix C. The Site includes both the Phase 1 Project Area and the area of Chequamegon Bay within the Site boundary (as illustrated in Appendix C).

ee. "State" shall mean the State of Wisconsin and each department, agency, and instrumentality of the State of Wisconsin, including WDNR.

ff. "Statement of Work" or "SOW" shall mean the statement of work for implementation of the Phase 1 Remedial Design, Phase 1 Remedial Action, and O&M at the Site, as set forth in Appendix B to this Consent Decree, and any modifications made in accordance with this Consent Decree.

gg. "Supervising Contractor" shall mean the principal contractor retained by Settling Defendant to supervise and direct the implementation of the Work under this Consent Decree.

hh. "Transfer" shall mean to sell, assign, convey, lease, mortgage, or grant a security interest in, or where used as a noun, a sale, assignment, conveyance, or other disposition of any interest by operation of law or otherwise.

ii. "Tribes" shall mean the Red Cliff Band of the Lake Superior Tribe of Chippewa Indians and the Bad River Band of the Lake Superior Tribe of Chippewa Indians.

jj. "Trustees" shall mean the United States Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, WDNR, and the Bad River and Red Cliff Bands of the Lake Superior Tribe of Chippewa Indians.

kk. "United States" shall mean the United States of America and each department, agency, and instrumentality of the United States, including EPA, DOI, DOC, the United States Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration.

ll. "Waste Material" shall mean (1) any "hazardous substance" under Section 101(14) of CERCLA, 42 U.S.C. § 9601(14); (2) any pollutant or contaminant under Section 101(33) of CERCLA, 42 U.S.C. § 9601(33); (3) any "solid waste" under Section 1004(27) of RCRA, 42 U.S.C.§ 6903(27), or WIS. STAT. § 289.01(33); and (4) any "hazardous substance" under WIS. STAT. § 292.01(5).

mm. "WDNR" shall mean the Wisconsin Department of Natural Resources and its successor departments, agencies, or instrumentalities.

nn. "WDNR Database" shall mean the publically accessible database available on the internet as required by WIS. STAT. §§ 292.12, 292.31, and 292.57. The WDNR Database is accessible at http://dnr.wi.gov/org/aw/rr/brrts/index.htm

oo. "Work" shall mean all activities and obligations Settling Defendant is required to perform under this Consent Decree, except the activities required under Section XXVII (Retention of Records).

V. GENERAL PROVISIONS

5. Objectives of the Parties. The objectives of the Parties in entering into this Consent Decree are to protect public health or welfare or the environment by the design and implementation of response actions at the Phase 1 Project Area by Settling Defendant, to pay certain response costs incurred by Plaintiffs with respect to the Phase 1 Project Area, to provide compensation for Natural Resources Damages at the Site, and to resolve the claims of Plaintiffs and Tribes against Settling Defendant as provided in this Consent Decree.

6. Commitments by Settling Defendant. Settling Defendant shall finance and perform the Work in accordance with this Consent Decree, the ROD, the SOW, the Phase 1 Remedial Design Work Plan, and all work plans and other plans, standards, specifications, and schedules set forth in this Consent Decree or developed by Settling Defendant and approved by EPA (and WDNR, as applicable) pursuant to this Consent Decree. Settling Defendant shall pay the United States for Future Response Costs as provided in this Consent Decree and shall provide compensation for Natural Resource Damages as provided in this Consent Decree.

7. Compliance With Applicable Law. All activities undertaken by Settling Defendant pursuant to this Consent Decree shall be performed in accordance with the requirements of all applicable federal, state, and local laws, regulations, and ordinances. Settling Defendant must also comply with all applicable or relevant and appropriate requirements of all federal and state environmental laws as set forth in the ROD and the SOW. The activities conducted pursuant to this Consent Decree, if approved by EPA, shall be deemed to be consistent with the NCP.

8. Permits.

a. As provided in Section 121(e) of CERCLA, 42 U.S.C. § 9621(e), and Section 300.400(e) of the NCP, no permit shall be required for any portion of the Work conducted entirely on-site (i.e., within the areal extent of contamination or in very close proximity to the contamination and necessary for implementation of the Work). Where any portion of the Work that is not on-site requires a federal, state, or local permit or approval, Settling Defendant shall submit timely and complete applications and take all other actions necessary to obtain all such permits or approvals.

b. Settling Defendant may seek relief under the provisions of Section XX (Force Majeure) for any delay in the performance of the Work resulting from a failure to obtain, or a delay in obtaining, any permit or approval referenced in Paragraph 8.a and required for the Work, provided that it has submitted timely and complete applications and taken all other actions necessary to obtain all such permits or approvals.

c. This Consent Decree is not, and shall not be construed to be, a permit issued pursuant to any federal, state, or local statute, regulation, or ordinance.

9. Notice to Successors-in-Title and Transfers of Real Property.

a. For any real property owned or controlled by Settling Defendant located at the Phase 1 Project Area, Settling Defendant shall, within 15 days after the Effective Date, submit to EPA and WDNR for review and EPA approval, after consultation with WDNR, a proposed notice to be filed with the appropriate land records office that provides a description of the real property and provides notice to all successors-in-title that the real property is part of the Site, that EPA has selected a remedy for the Site, and that Settling Defendant has entered into a Consent Decree requiring implementation of the remedy for the Phase 1 Project Area. The notice also shall identify the United States District Court in which the Consent Decree was filed, the name and civil action number of this case, and the date the Consent Decree was entered by the Court. The notice shall also state that information relating to Institutional Controls impacting the property is maintained on the WDNR Database and include the internet address for the WDNR Database. Settling Defendant shall record the notice within ten working days after receiving approval of the notice from EPA and WDNR. Settling Defendant shall provide EPA

and WDNR with a certified copy of the recorded notice within ten working days after recording such notice.

b. Settling Defendant shall, at least 60 days prior to any Transfer of any real property located at the Phase 1 Project Area, give written notice: (1) to the transferee regarding the Consent Decree and any Institutional Controls regarding the real property; and (2) to EPA and WDNR regarding the proposed Transfer, including the name and address of the transferee and the date on which the transferee was notified of the Consent Decree and any Institutional Controls.

c. Settling Defendant may Transfer any real property located at the Phase 1 Project Area only if: (1) any Institutional Controls required by Paragraph 26.c have been placed in the WDNR Database, and recorded, if required, with respect to the real property; or (2) Settling Defendant has obtained an agreement from the transferee, enforceable by Settling Defendant, the United States, and the State and approved in writing by EPA, after consultation with WDNR, to (i) allow access and restrict land/water use, pursuant to Paragraphs 27.a(1) and 27.a(2), (ii) record and place in the WDNR Database any Institutional Controls on the real property, pursuant to Paragraph 27.a(3), and (iii) subordinate transferee's rights to any such Institutional Controls, pursuant to Paragraph 27.a(3). If, after a Transfer of the real property, the transferee fails to comply with the agreement provided for in this Paragraph 9.c, Settling Defendant shall take all reasonable steps to obtain the transferee's compliance with such agreement. The United States and the State may seek the transferee's compliance with the agreement and/or assist Settling Defendant in obtaining compliance with the agreement. Settling Defendant shall reimburse the United States under Section XVII (Payments for Response Costs), for all costs incurred, direct or indirect, by Plaintiffs regarding obtaining compliance with such agreement, including, but not limited to, the cost of attorney time.

d. In the event of any Transfer of real property located at the Phase 1 Project Area, unless the United States, after consultation with the State, otherwise consents in writing, Settling Defendant shall continue to comply with its obligations under the Consent Decree, including, but not limited to, its obligation to provide and/or secure access, to implement, maintain, monitor, and report on Institutional Controls, and to abide by such Institutional Controls. Settling Defendant may require third parties to accept responsibility for some or all of its obligations under the Consent Decree. Unless the United States, after consultation with the State, agrees otherwise in a consent decree modification filed with the Court, Settling Defendant shall remain responsible for all obligations under the Consent Decree, notwithstanding any agreement between Settling Defendant and any third party.

VI. PERFORMANCE OF THE WORK BY SETTLING DEFENDANT

10. Selection of Supervising Contractor.

a. All aspects of the Work to be performed by Settling Defendant pursuant to Sections VI (Performance of the Work by Settling Defendant), VII (Phase 1 Remedy Review), VIII (Quality Assurance, Sampling, and Data Analysis), IX (Access and Institutional Controls), and XV (Emergency Response) shall be under the direction and supervision of the Supervising Contractor, the selection of which shall be subject to disapproval by EPA after consultation with WDNR. Within 5 working days of the Effective Date, Settling Defendant shall notify EPA and

WDNR in writing of the name, title, and qualifications of any contractor proposed to be the Supervising Contractor. With respect to any contractor proposed to be Supervising Contractor, Settling Defendant shall demonstrate that the proposed contractor has a quality assurance system that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995), by submitting a copy of the proposed contractor's Quality Management Plan ("QMP"). The QMP should be prepared in accordance with "EPA Requirements for Quality Management Plans (QA/R-2)" (EPA/240/B-01/002, March 2001, reissued May 2006) or equivalent documentation as determined by EPA. After consultation with WDNR, EPA will issue either a notice of disapproval or an authorization to proceed regarding hiring of the proposed Supervising Contractor. If at any time thereafter, Settling Defendant proposes to change a Supervising Contractor, Settling Defendant shall give such notice to EPA and WDNR and must obtain an authorization to proceed from EPA before the new Supervising Contractor performs, directs, or supervises any Work under this Consent Decree.

b. If EPA disapproves a proposed Supervising Contractor, EPA will notify Settling Defendant in writing. Settling Defendant shall submit to EPA a list of contractors, including the qualifications of each contractor, that would be acceptable to it within 30 days after receipt of EPA's disapproval of the contractor previously proposed. EPA will provide written notice of the names of any contractor(s) that it disapproves and an authorization to proceed with respect to any of the other contractors. Settling Defendant may select any contractor from that list that is not disapproved and shall notify EPA and WDNR of the name of the contractor selected within 21 days after EPA's authorization to proceed.

c. If EPA fails to provide written notice of its authorization to proceed or disapproval as provided in this Paragraph and this failure prevents Settling Defendant from meeting one or more deadlines in a plan approved by EPA pursuant to this Consent Decree, Settling Defendant may seek relief under Section XX (Force Majeure).

11. Phase 1 Remedial Design.

a. The Phase 1 Remedial Design Work Plan has been approved by EPA after consultation with WDNR. The Phase 1 Remedial Design Work Plan shall be incorporated into and enforceable under this Consent Decree. Within 30 days after EPA's issuance of an authorization to proceed under Paragraph 10, Settling Defendant shall submit to EPA and WDNR a Health and Safety Plan for field design activities that conforms to the applicable Occupational Safety and Health Administration and EPA requirements including, but not limited to, 29 C.F.R. § 1910.120.

b. Pursuant to the schedule set forth in the SOW, after submission of the Health and Safety Plan for all field activities to EPA and WDNR, Settling Defendant shall implement the Phase 1 Remedial Design Work Plan. Settling Defendant shall submit to EPA and WDNR all plans, reports, and other deliverables required under the approved Phase 1 Remedial Design Work Plan in accordance with the approved schedule for review and approval pursuant to Section XI (EPA Approval of Plans, Reports, and Other Deliverables).

c. The preliminary design submission shall include, at a minimum, the elements outlined in Section III, Task 2, A. (Preliminary Design) of the SOW, including the following: (1) design criteria; (2) results of treatability studies; (3) results of additional field

sampling and pre-design work; (4) project delivery strategy; (5) preliminary plans, drawings, and sketches; (6) required specifications in outline form; and (7) preliminary construction schedule.

d. The pre-final/final design submission shall include, at a minimum, the elements outlined in Section III, Task 2, B. (Prefinal and Final Design) of the SOW, including the following: (1) final plans and specifications; (2) Operation and Maintenance Plan; (3) Construction Quality Assurance Plan (CQAP); (4) Field Sampling Plan (directed at measuring progress towards meeting Performance Standards); and (5) Contingency Plan. The CQAP, which shall detail the approach to quality assurance during construction activities at the Phase 1 Project Area, shall specify a quality assurance official, independent of the Supervising Contractor, to conduct a quality assurance program during the construction phase of the project.

12. Phase 1 Remedial Action.

a. Within 30 days after the approval of the final design submission, Settling Defendant shall submit to EPA and WDNR the Phase 1 Remedial Action Work Plan. The Phase 1 Remedial Action Work Plan shall provide for construction and implementation of the remedy set forth in the ROD with respect to the Phase 1 Project Area in accordance with this Consent Decree, the ROD, the SOW, the Phase 1 Remedial Design Work Plan, and the design plans and specifications developed in accordance with the Phase 1 Remedial Design Work Plan and approved by EPA and WDNR, if applicable. Upon its approval, the Phase 1 Remedial Action Work Plan shall be incorporated into and enforceable under this Consent Decree. At the same time as it submits the Phase 1 Remedial Action Work Plan, Settling Defendant shall submit to EPA and WDNR a Health and Safety Plan for field activities required by the Phase 1 Remedial Action Work Plan that conforms to the applicable Occupational Safety and Health Administration and EPA requirements including, but not limited to, 29 C.F.R. § 1910.120.

b. The Phase 1 Remedial Action Work Plan shall include the following: (1) schedule for completion of the Phase 1 Remedial Action; (2) method for selection of contractors; (3) schedule for developing and submitting other required Phase 1 Remedial Action plans; (4) groundwater monitoring plan; (5) methods for satisfying permitting requirements; (6) methodology for implementing the Operation and Maintenance Plan; (7) methodology for implementing the Contingency Plan; (8) tentative formulation of the Phase 1 Remedial Action team; (9) CQAP (by construction contractor); and (10) procedures and plans for the decontamination of equipment and the disposal of contaminated materials. The Phase 1 Remedial Action Work Plan also shall include the methodology for implementing the CQAP and a schedule for implementing all Phase 1 Remedial Action tasks identified in the final design submission and shall identify the initial formulation of Settling Defendant's Phase 1 Remedial Action project team (including, but not limited to, the Supervising Contractor).

c. Upon approval of the Phase 1 Remedial Action Work Plan by EPA and WDNR, if applicable, Settling Defendant shall implement the activities required under the Phase 1 Remedial Action Work Plan. As part of the approval of the Phase 1 Remedial Action Work Plan, WDNR may impose restrictions, limitations, or other conditions on the property and place the required Institutional Controls in the WDNR Database. If a party other than Settling Defendant ("Performing Party") performs the remedy for the sediments in Chequamegon Bay, Settling Defendant may (i) install the final cap on the Kreher Park portion of the Site required by the Phase 1 Remedial Design or (ii) elect to reimburse the Performing Party for the costs of installing the final cap on the Kreher Park portion of the Site required by the Phase 1 Remedial

Design. Should EPA be the Performing Party, and Settling Defendant elect to reimburse EPA rather than install the final Kreher Park cap, Settling Defendant shall reimburse EPA for its costs of installing the final Kreher Park cap as Future Response Costs.

d. Settling Defendant shall submit to EPA and WDNR all reports and other deliverables required under the approved Phase 1 Remedial Action Work Plan in accordance with the approved schedule for review and approval pursuant to Section XI (EPA Approval of Plans, Reports, and Other Deliverables). Unless otherwise directed by EPA, Settling Defendant shall not commence physical Phase 1 Remedial Action activities at the Phase 1 Project Area prior to approval of the Phase 1 Remedial Action Work Plan.

13. Settling Defendant shall continue to implement the Phase 1 Remedial Action until the Phase 1 Performance Standards are achieved. Settling Defendant shall implement O&M for so long thereafter as is required by this Consent Decree.

14. Modification of SOW or Related Work Plans.

a. If EPA, after consultation with WDNR, determines that it is necessary to modify the work specified in the SOW and/or in work plans developed pursuant to the SOW to achieve and maintain the Phase 1 Performance Standards or to carry out and maintain the effectiveness of the remedy set forth in the ROD with respect to the Phase 1 Project Area, and such modification is consistent with the scope of the remedy set forth in the ROD with respect to the Phase 1 Project Area, then EPA may issue such modification in writing and shall notify Settling Defendant of such modification. For the purposes of this Paragraph and Paragraphs 50 (Completion of the Phase 1 Remedial Action) and 51 (Completion of the Work) only, the "scope of the remedy set forth in the ROD" is the remedy described in the ROD for the Phase 1 Project Area. If Settling Defendant objects to the modification it may, within 30 days after EPA's notification, seek dispute resolution under Paragraph 80 (Record Review).

b. The SOW and/or related work plans shall be modified: (1) in accordance with the modification issued by EPA; or (2) if Settling Defendant invokes dispute resolution, in accordance with the final resolution of the dispute. The modification shall be incorporated into and enforceable under this Consent Decree, and Settling Defendant shall implement all work required by such modification. Settling Defendant shall incorporate the modification into the Phase 1 Remedial Design or Phase 1 Remedial Action Work Plan under Paragraph 11 (Phase 1 Remedial Design) or Paragraph 12 (Phase 1 Remedial Action), as appropriate.

c. Nothing in this Paragraph shall be construed to limit EPA's authority to require performance of further response actions as otherwise provided in this Consent Decree.

15. Nothing in this Consent Decree, the SOW, or the Phase 1 Remedial Design or Phase 1 Remedial Action Work Plans constitutes a warranty or representation of any kind by Plaintiffs that compliance with the work requirements set forth in the SOW and the Work Plans will achieve the Phase 1 Performance Standards.

16. Off-Site Shipment of Waste Material.

a. Settling Defendant may ship Waste Material from the Site to an off-site facility only if it verifies, prior to any shipment, that the off-site facility is operating in compliance with the requirements of Section 121(d)(3) of CERCLA, 42 U.S.C. § 9621(d)(3), and 40 C.F.R. § 300.440, by obtaining a determination from EPA that the proposed receiving facility is operating in compliance with 42 U.S.C. § 9621(d)(3) and 40 C.F.R. § 300.440.

b. Settling Defendant may ship Waste Material from the Site to an out-of-state waste management facility only if, prior to any shipment, it provides written notice to the appropriate state environmental official in the receiving facility's state and to the EPA and WDNR Project Coordinators. This notice requirement shall not apply to any off-site shipments when the total quantity of all such shipments will not exceed ten cubic yards. The written notice shall include the following information, if available: (1) the name and location of the receiving facility; (2) the type and quantity of Waste Material to be shipped; (3) the schedule for the shipment; and (4) the method of transportation. Settling Defendant also shall notify the state environmental official referenced above and the EPA Project Coordinator of any major changes in the shipment plan, such as a decision to ship the Waste Material to a different out-of-state facility. Settling Defendant shall provide the written notice after the award of the contract for Remedial Action construction and before the Waste Material is shipped.

c. If Settling Defendant intends to transport or manage Waste Material within the State, Settling Defendant shall comply with the applicable requirements of Chapter 289 of the Wisconsin Statutes and Chapters 500 to 538 of the Wisconsin Administrative Code.

VII. PHASE 1 REMEDY REVIEW

17. Periodic Review. Settling Defendant shall conduct any studies and investigations that EPA, after consultation with WDNR, requests in order to permit EPA to conduct reviews of whether the Phase 1 Remedial Action is protective of human health and the environment at least every five years as required by Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and any applicable regulations.

18. EPA Selection of Further Response Actions. If EPA determines, at any time, after consultation with WDNR, that the Phase 1 Remedial Action is not protective of human health and the environment, EPA may select further response actions for the Phase 1 Project Area in accordance with the requirements of CERCLA and the NCP.

19. Opportunity To Comment. Settling Defendant and, if required by Sections 113(k)(2) or 117 of CERCLA, 42 U.S.C. § 9613(k)(2) or 9617, the public, will be provided with an opportunity to comment on any further response actions proposed by EPA as a result of the review conducted pursuant to Section 121(c) of CERCLA and to submit written comments for the record during the comment period.

20. Settling Defendant's Obligation To Perform Further Response Actions. If EPA selects further response actions for the Phase 1 Project Area, EPA may require Settling Defendant to perform such further response actions, but only to the extent that the reopener conditions in Paragraph 97 or Paragraph 98 (United States' Pre- and Post-Certification Reservations) are satisfied. Settling Defendant may invoke the procedures set forth in Section XXI (Dispute Resolution) to dispute (a) EPA's determination that the reopener conditions of Paragraph 97 or Paragraph 98 are satisfied, (b) EPA's determination that the Phase 1 Remedial Action is not protective of human health and the environment, or (c) EPA's selection of the further response actions. Disputes pertaining to whether the Phase 1 Remedial Action is protective or to EPA's selection of further response actions shall be resolved pursuant to Paragraph 80 (Record Review).

21. Submission of Plans. If Settling Defendant is required to perform further response actions pursuant to Paragraph 20, it shall submit a plan for such response action to EPA for approval in accordance with the procedures of Section VI (Performance of the Work by Settling Defendant). Settling Defendant shall also submit the plan to WDNR. Settling Defendant shall implement the approved plan in accordance with this Consent Decree.

VIII. QUALITY ASSURANCE, SAMPLING, AND DATA ANALYSIS

22. Quality Assurance.

a. Settling Defendant shall use quality assurance, quality control, and chain of custody procedures for all treatability, design, compliance, and monitoring samples in accordance with "EPA Requirements for Quality Assurance Project Plans (QA/R5)" (EPA/240/B-01/003, March 2001, reissued May 2006), "Guidance for Quality Assurance Project Plans (QA/G-5)" (EPA/240/R-02/009, December 2002), and subsequent amendments to such guidelines upon notification by EPA to Settling Defendant of such amendment. Amended guidelines shall apply only to procedures conducted after such notification.

b. Prior to the commencement of any monitoring project under this Consent Decree, Settling Defendant shall submit to EPA for approval, after consultation with WDNR, a Quality Assurance Project Plan ("QAPP") that is consistent with the SOW, the NCP, and applicable guidance documents. If relevant to the proceeding, the Parties agree that validated sampling data generated in accordance with the QAPP(s) and reviewed and approved by EPA shall be admissible as evidence, without objection, in any proceeding under this Consent Decree. Settling Defendant shall ensure that EPA and WDNR personnel and their authorized representatives are allowed access at reasonable times to all laboratories utilized by Settling Defendant in implementing this Consent Decree. In addition, Settling Defendant shall ensure that such laboratories shall analyze all samples submitted by EPA and WDNR pursuant to the QAPP for quality assurance monitoring. Settling Defendant shall ensure that the laboratories it utilizes for the analysis of samples taken pursuant to this Consent Decree perform all analyses according to accepted EPA methods. Accepted EPA methods consist of those methods that are documented in the "USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis, ILM05.4," and the "USEPA Contract Laboratory Program Statement of Work for Organic Analysis, SOM01.2," and any amendments made thereto during the course of the implementation of this Decree; however, upon approval by EPA, after opportunity for review and comment by WDNR, Settling Defendant may use other analytical methods that are as stringent as or more stringent than the CLP-approved methods. Settling Defendant shall ensure that all laboratories it uses for analysis of samples taken pursuant to this Consent Decree participate in an EPA or EPA-equivalent quality assurance/quality control ("QA/QC") program. Settling Defendant shall use only laboratories that have a documented Quality System that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995), and "EPA Requirements for Quality Management Plans (QA/R-2)" (EPA/240/B-01/002, March 2001, reissued May 2006) or equivalent documentation as determined by EPA. EPA may consider laboratories accredited under the National Environmental Laboratory Accreditation Program ("NELAP") as meeting the Quality System requirements. Settling Defendant shall ensure that all field methodologies utilized in collecting

samples for subsequent analysis pursuant to this Consent Decree are conducted in accordance with the procedures set forth in the QAPP approved by EPA.

23. Upon request, Settling Defendant shall allow split or duplicate samples to be taken by EPA and WDNR or their authorized representatives. Settling Defendant shall notify EPA and WDNR not less than 28 days in advance of any sample collection activity unless shorter notice is agreed to by EPA. In addition, EPA and WDNR shall have the right to take any additional samples that EPA or WDNR deem necessary. Upon request, EPA and WDNR shall allow Settling Defendant to take split or duplicate samples of any samples they take as part of Plaintiffs' oversight of Settling Defendant's implementation of the Work.

24. Settling Defendant shall submit to EPA and WDNR two copies of the results of all sampling and/or tests or other data obtained or generated by or on behalf of Settling Defendant with respect to the Phase 1 Project Area and/or the implementation of this Consent Decree unless EPA agrees otherwise.

25. Notwithstanding any provision of this Consent Decree, the United States and the State retain all of their information gathering and inspection authorities and rights, including enforcement actions related thereto, under CERCLA, RCRA, Chapter 292 of the Wisconsin Statutes, and any other applicable statutes or regulations.

IX. ACCESS AND INSTITUTIONAL CONTROLS

26. If the Phase 1 Project Area, any portion of the Phase 1 Project Area, or any other real property where access or land/water use restrictions are needed is owned or controlled by Settling Defendant:

a. Settling Defendant shall, commencing on the date of lodging of the Consent Decree, provide the United States, the State, and their representatives, contractors, and subcontractors, with access at all reasonable times to the portions of the Phase 1 Project Area or any other real property owned or controlled by Settling Defendant to conduct any activity regarding the Consent Decree including, but not limited to, the following activities:

(1) Monitoring the Work;

(2) Verifying any data or information submitted to the United States or the State;

(3) Conducting investigations regarding contamination at or near the Site;

(4) Obtaining samples;

(5) Assessing the need for, planning, or implementing additional response actions at or near the Site;

(6) Assessing implementation of quality assurance and quality control practices as defined in the approved CQAP;

(7) Implementing the Work pursuant to the conditions set forth in Paragraph 102 (Work Takeover);

(8) Inspecting and copying records, operating logs, contracts, or other documents maintained or generated by Settling Defendant or its agents, consistent with Section XXVI (Access to Information);

(9) Assessing Settling Defendant's compliance with the Consent Decree;

(10) Determining whether the Site or other real property is being used in a manner that is prohibited or restricted, or that may need to be prohibited or restricted, under the Consent Decree; and

(11) Implementing, monitoring, maintaining, reporting on, and enforcing any Institutional Controls and the requirements of the ICIAP.

b. Commencing on the date of lodging of the Consent Decree, Settling Defendant shall not use the Phase 1 Project Area, or such other real property, in any manner that EPA or WDNR determines will pose an unacceptable risk to human health or to the environment due to exposure to Waste Material or interfere with or adversely affect the implementation, integrity, or protectiveness of the remedy set forth in the ROD for the Site. The restrictions shall include, but not be limited to: prohibition on the use of contaminated groundwater and any excavation, drilling, or digging that could expose buried Waste Materials that remain on-site after completion of the remedy set forth in the ROD for the Site; and

c. Settling Defendant shall:

(1) Grant a right of access to conduct any activity regarding the Consent Decree including, but not limited to, those activities listed in Paragraph 26.a; and grant the right to enforce the land/water use restrictions, conditions, or limitations set forth in Paragraph 26.b, including, but not limited to, the specific restrictions listed therein and any land/water use restrictions listed in the ICIAP, as further specified in this Paragraph 26.c. Access and the right to enforce restrictions, conditions, or limitations shall be granted to one or more of the following persons, as determined by EPA: (i) the United States, on behalf of EPA, and its representatives; (ii) the State and its representatives; and/or (iii) other appropriate grantees. Access and the right to enforce restrictions, conditions, or limitations other than those granted to the United States, shall include a designation that EPA, and/or WDNR as appropriate, is a "third-party beneficiary," allowing EPA and/or WDNR to maintain the right to enforce the access and the right to enforce restrictions, conditions, or limitations without acquiring an interest in real property. If any access or rights to enforce restrictions, conditions, or limitations are granted to Settling Defendant pursuant to this Paragraph 26.c(1), then such Settling Defendant shall monitor, maintain, report on, and enforce such Institutional Controls.

(2) When submitting its final Phase 1 Remedial Design, submit to EPA and WDNR for EPA's review and approval, after consultation with WDNR, regarding such real property: (i) draft Institutional Controls that are enforceable under state or local law; (ii) the information required for the WDNR Database under WIS. STAT. §292.12(3); and (iii) a current title insurance commitment or other evidence of title acceptable to EPA, which shows title to the land affected by the Institutional Controls to be free and clear of all prior liens and encumbrances (except when EPA

waives the release or subordination of such prior liens or encumbrances or when, despite best efforts, Settling Defendant is unable to obtain release or subordination of such prior liens or encumbrances).

(3) Within 15 days of the approval and acceptance of the Phase 1 Remedial Action Work Plan from EPA and WDNR, update the title insurance commitment or other evidence of title acceptable to EPA, and, if it is determined that nothing has occurred since the effective date of the commitment, or other title evidence, to affect the title adversely, Settling Defendant shall provide EPA and WDNR with a final title insurance policy, or other final evidence of title acceptable to EPA. If the Institutional Controls are to be conveyed to the United States or the State, the Institutional Controls and title evidence (including final title evidence) shall be prepared in accordance with the U.S. Department of Justice Title Standards 2001, and approval of the sufficiency of title shall be obtained as required by 40 U.S.C. § 3111.

(4) Should EPA and WDNR determine that the Institutional Controls require modification, draft and finalize revised Institutional Controls as requested by EPA and WDNR. Upon request by EPA or WDNR, Settling Defendant shall execute and record easements or covenants running with the land that (a) limit land, water, or resource use and/or provide access rights and (b) are created pursuant to common law or statutory law by an instrument that is recorded by the owner in the appropriate land records office.

d. Within 15 days of the approval and acceptance of the Phase 1 Remedial Action Work Plan and issuance of an approval letter to Settling Defendant incorporating Institutional Controls, WDNR shall place the Institutional Controls in the WDNR Database.

e. As part of certifying the Completion of Work under Paragraph 51.b, EPA and WDNR may update or impose new restrictions, limitations, or other conditions on the property, and WDNR shall place the required Institutional Controls in the WDNR Database.

f. Commencing on the date of lodging of the Consent Decree, Settling Defendant shall comply with the following requirements of Paragraph 1 of the 1998 Spill Response Agreement ("Spill Agreement") between Settling Defendant and DNR: Activity No. a (related to lakefront warning signs) and Activity No. d (related to warning buoys in Chequamegon Bay). This Consent Decree does not otherwise affect the applicability of any provision of the Spill Agreement. The Spill Agreement is included as Appendix D to this Consent Decree and is incorporated by reference only as to Activity No. a (related to lakefront warning signs) and Activity No. d (related to warning buoys in Chequamegon Bay), as required by this Paragraph 26.f, and does not otherwise affect the provisions of this Consent Decree.

27. For those portions of the Phase 1 Project Area or any other real property where access and/or land/water use restrictions are needed that are owned or controlled by persons other than Settling Defendant:

a. Settling Defendant shall use best efforts to secure from such persons:

(1) an agreement to provide access thereto for the United States, the State, and Settling Defendant, and their representatives, contractors, and subcontractors, to conduct any activity regarding the Consent Decree including, but not limited to, the activities listed in Paragraphs 26.a and 26.f;

(2) an agreement, enforceable by Settling Defendant, the United States, and the State, to refrain from using the Site, or such other real property, in any manner that EPA determines will pose an unacceptable risk to human health or to the environment due to exposure to Waste Material or interfere with or adversely affect the implementation, integrity, or protectiveness of the Phase 1 Remedial Action. The agreement shall include, but not be limited to, the land/water use restrictions listed in Paragraphs 26.b and 26.f; and

(3) the execution of Institutional Controls that can be included in the WDNR Database, that (i) grant a right of access to conduct any activity regarding the Consent Decree including, but not limited to, those activities listed in Paragraph 26.a and 26.f, and (ii) grant the right to enforce the land/water use restrictions set forth in Paragraph 26.b and 26.f, including, but not limited to, the specific restrictions listed therein and any land/water use restrictions listed in the ICIAP. The Institutional Controls shall be granted to one or more of the following persons, as determined by EPA: (i) the United States, on behalf of EPA, and its representatives, (ii) the State and its representatives, (iii) Settling Defendant and its representatives, and/or (iv) other appropriate grantees. The Institutional Controls, other than those granted to the United States, shall include a designation that EPA, and/or WDNR as appropriate, is a third party beneficiary, allowing EPA and/or WDNR to maintain the right to enforce the Institutional Controls without acquiring an interest in real property. If any Institutional Controls are granted to any Settling Defendant pursuant to this Paragraph 27.a(3), then Settling Defendant shall monitor, maintain, report on, and enforce such Institutional Controls.

b. Settling Defendant shall provide notification to such persons of the pending imposition of Institutional Controls for those properties, and placement of the relevant information in the WDNR Database.

c. When submitting its final Phase 1 Remedial Design, Settling Defendant shall submit to EPA and WDNR for EPA approval, after consultation with WDNR, regarding such property: (i) draft Institutional Controls that are enforceable under state or local law; (ii) the information required for the WDNR Database; and (iii) a current title insurance commitment, or other evidence of title acceptable to EPA, which shows title to the land affected by the Institutional Controls to be free and clear of all prior liens and encumbrances (except when EPA waives the release or subordination of such prior liens or encumbrances or when, despite best efforts, Settling Defendant is unable to obtain release or subordination of such prior liens or encumbrances).

d. Within 15 days of the approval and acceptance of the Phase 1 Remedial Action Work Plan from EPA and WDNR, Settling Defendant shall update the title insurance commitment or other evidence of title acceptable to EPA and, if it is determined that nothing has occurred since the effective date of the commitment, or other title evidence, to affect the title adversely, Settling Defendant shall record a notice with the appropriate land records office that states the real property's relationship to the Site, that EPA has selected a remedy for the Site, that a Consent Decree has been entered for the Phase 1 Remedial Action, and that Institutional Controls for the property are set forth in the WDNR Database. The notice also shall identify the United States District Court in which the Consent Decree was filed, the name and civil action number of this case, and the date the Consent Decree was entered by the Court. Within 30 days

after the notice is recorded with the land records office, Settling Defendant shall provide EPA and WDNR with a final title insurance policy, or other final evidence of title acceptable to EPA, as well as a certified copy of the original recorded deed notice showing the register's recording stamp. The Institutional Controls and title evidence (including final title evidence) shall be prepared in accordance with the U.S. Department of Justice Title Standards 2001, and approval of the sufficiency of title must be obtained as required by 40 U.S.C. § 3111.

e. Within 15 days of the approval and acceptance of the Phase 1 Remedial Action Work Plan and issuance of an approval letter to Settling Defendant incorporating Institutional Controls, WDNR shall place the Institutional Controls in the WDNR Database.

f. Should EPA and WDNR determine that the Institutional Controls require modification, Settling Defendant shall draft and finalize revised Institutional Controls as requested by EPA and WDNR. Upon request by EPA or WDNR, Settling Defendant shall execute and record easements or covenants running with the land that (a) limit land, water, or resource use and/or provide access rights and (b) are created pursuant to common law or statutory law by an instrument that is recorded by the owner in the appropriate land records office.

g. As part of certifying the Completion of Work under Paragraph 51.b, EPA and WDNR may update or impose new restrictions, limitations, or other conditions on the property, and WDNR shall place the required Institutional Controls in the WDNR Database.

28. For purposes of Paragraphs 26 and 27, "best efforts" includes the payment of reasonable sums of money to obtain access, an agreement to restrict land/water use, and/or an agreement to release or subordinate a prior lien or encumbrance, except that "best efforts" shall not include payment of money to any party that has received special notice of potential liability related to the Site. If, within 60 days after the Effective Date, Settling Defendant has not: (a) obtained agreements to provide access or restrict land/water use, as required by Paragraph 27.a(1) and 27.a(2); or (b) obtained, pursuant to Paragraph 26.c(2) or 27.c, agreements from the holders of prior liens or encumbrances to release or subordinate such liens or encumbrances, Settling Defendant shall promptly notify Plaintiffs in writing, and shall include in that notification a summary of the steps that Settling Defendant has taken to attempt to comply with Paragraphs 26 or 27. Plaintiffs may, as they deem appropriate, assist Settling Defendant in obtaining access, agreements to restrict land/water use, or the release or subordination of a prior lien or encumbrance. Settling Defendant shall reimburse the United States under Section XVII (Payments for Response Costs) for all costs incurred, direct or indirect, by Plaintiffs in obtaining such access, agreements to restrict land/water use, Institutional Controls, and/or the release/subordination of prior liens or encumbrances including, but not limited to, the cost of attorney time and the amount of monetary consideration paid or just compensation.

29. If EPA or WDNR determines that Institutional Controls in the form of state or local laws, regulations, ordinances, zoning restrictions, or other governmental controls are needed, Settling Defendant shall cooperate with EPA's and the State's efforts to secure and ensure compliance with such governmental controls.

30. Notwithstanding any provision of the Consent Decree, the United States and the State retain all of their access authorities and rights, as well as all of their rights to require Institutional Controls, including enforcement authorities related thereto, under CERCLA, RCRA, Chapter 292 of the Wisconsin Statutes, and any other applicable statute or regulations.

X. REPORTING REQUIREMENTS

31. In addition to any other requirement of this Consent Decree, Settling Defendant shall submit to EPA and WDNR two copies each of written monthly progress reports that: (a) describe the actions that have been taken toward achieving compliance with this Consent Decree during the previous month; (b) include a summary of all results of sampling and tests and all other data received or generated by Settling Defendant or its contractors or agents in the previous month; (c) identify all plans, reports, and other deliverables required by this Consent Decree completed and submitted during the previous month; (d) describe all actions, including, but not limited to, data collection and implementation of work plans, that are scheduled for the next six weeks and provide other information relating to the progress of construction, including, but not limited to, critical path diagrams, Gantt charts, and Pert charts; (e) include information regarding percentage of completion, unresolved delays encountered or anticipated that may affect the future schedule for implementation of the Work, and a description of efforts made to mitigate those delays or anticipated delays; (f) include any modifications to the work plans or other schedules that Settling Defendant has proposed to EPA or that have been approved by EPA; and (g) describe all activities undertaken in support of the Community Involvement Plan during the previous month and those to be undertaken in the next six weeks. Settling Defendant shall submit these progress reports to EPA and WDNR by the tenth day of every month following the lodging of this Consent Decree until EPA notifies Settling Defendant pursuant to Paragraph 51.b of Section XIV (Completion of the Work). The monthly progress reports required by this Paragraph may be submitted electronically unless EPA or WDNR requests otherwise. If requested by EPA or WDNR, Settling Defendant shall also provide briefings for EPA and WDNR to discuss the progress of the Work. Such briefings may occur telephonically if agreed by Settling Defendant and the government agency requesting the briefing.

32. Settling Defendant shall notify EPA and WDNR of any change in the schedule described in the monthly progress report for the performance of any activity, including, but not limited to, data collection and implementation of work plans, no later than seven days prior to the performance of the activity.

33. Upon the occurrence of any event during performance of the Work that Settling Defendant is required to report pursuant to Section 103 of CERCLA, 42 U.S.C. § 9603, or Section 304 of the Emergency Planning and Community Right-to-know Act ("EPCRA"), 42 U.S.C. § 11004, Settling Defendant shall within 24 hours of the onset of such event orally notify the EPA and WDNR Project Coordinators (or their alternates, as necessary), or, in the event that neither the EPA Project Coordinator nor Alternate EPA Project Coordinator is available, the Emergency Response Section, Region 5, United States Environmental Protection Agency. These reporting requirements are in addition to the reporting required by CERCLA Section 103 or EPCRA Section 304.

34. Within 20 days after the onset of such an event, Settling Defendant shall furnish to EPA and WDNR a written report, signed by Settling Defendant's Project Coordinator, setting forth the events that occurred and the measures taken, and to be taken, in response thereto. Within 30 days after the conclusion of such an event, Settling Defendant shall submit a report setting forth all actions taken in response thereto.

35. Settling Defendant shall submit two copies of all plans, reports, data, and other deliverables required by the SOW, the Remedial Design Work Plan, the Remedial Action Work Plan, or any other approved plans to EPA in accordance with the schedules set forth in such plans. Settling Defendant shall simultaneously submit two copies of all such plans, reports, data, and other deliverables to WDNR. Upon request by EPA or WDNR, Settling Defendant shall submit in electronic form all or any portion of any deliverables Settling Defendant is required to submit pursuant to the provisions of this Consent Decree to the entity requesting electronic submission.

36. All deliverables submitted by Settling Defendant to EPA and WDNR that purport to document Settling Defendant's compliance with the terms of this Consent Decree shall be signed by an authorized representative of Settling Defendant.

XI. EPA APPROVAL OF PLANS, REPORTS, AND OTHER DELIVERABLES

37. Initial Submissions.

a. After review of any plan, report, or other deliverable that is required to be submitted for approval pursuant to this Consent Decree, EPA, after reasonable opportunity for review and comment by WDNR, shall: (1) approve, in whole or in part, the submission; (2) approve the submission upon specified conditions; (3) disapprove, in whole or in part, the submission; or (4) any combination of the foregoing.

b. EPA, after consultation with WDNR, also may modify the initial submission to cure deficiencies in the submission if: (1) EPA determines that disapproving the submission and awaiting a resubmission would cause substantial disruption to the Work; or (2) previous submission(s) on the same issue have been disapproved due to material defects and the deficiencies in the initial submission under consideration indicate a bad faith lack of effort to submit an acceptable plan, report, or deliverable.

38. Resubmissions. Upon receipt of a notice of disapproval under Paragraph 37.a(3) or (4), or if required by a notice of approval upon specified conditions under Paragraph 37.a(2), Settling Defendant shall, within 21 days or such longer time as specified by EPA in such notice, correct the deficiencies and resubmit the plan, report, or other deliverable for approval. After review of the resubmitted plan, report, or other deliverable, EPA, after consultation with WDNR, may: (a) approve, in whole or in part, the resubmission; (b) approve the resubmission upon specified conditions; (c) modify the resubmission; (d) disapprove, in whole or in part, the resubmission, requiring Settling Defendant to correct the deficiencies; or (e) any combination of the foregoing.

39. Material Defects. If an initially submitted or resubmitted plan, report, or other deliverable contains a material defect, and the plan, report, or other deliverable is disapproved or modified by EPA under Paragraph 37.b(2) or 38 due to such material defect, then the material defect shall constitute a lack of compliance for purposes of Paragraph 83. The provisions of Section XXI (Dispute Resolution) and Section XXII (Stipulated Penalties) shall govern the accrual and payment of any stipulated penalties regarding Settling Defendant's submissions under this Section.

40. Implementation. Upon approval, approval upon conditions, or modification by EPA under Paragraph 37 (Initial Submissions) or Paragraph 38 (Resubmissions) of any plan,

report, or other deliverable, or any portion thereof: (a) such plan, report, or other deliverable, or portion thereof, shall be incorporated into and enforceable under this Consent Decree; and (b) Settling Defendant shall take any action required by such plan, report, or other deliverable, or portion thereof, subject only to its right to invoke the Dispute Resolution procedures set forth in Section XXI (Dispute Resolution) with respect to the modifications or conditions made by EPA. The implementation of any non-deficient portion of a plan, report, or other deliverable submitted or resubmitted under Paragraph 37 or 38 shall not relieve Settling Defendant of any liability for stipulated penalties under Section XXII (Stipulated Penalties).

XII. PROJECT COORDINATORS

41. Within 20 days after lodging this Consent Decree, Settling Defendant, the State, and EPA will notify each other, in writing, of the name, address, and telephone number of their respective designated Project Coordinators and Alternate Project Coordinators. If a Project Coordinator or Alternate Project Coordinator initially designated is changed, the identity of the successor will be given to the other Parties listed in the prior sentence at least five working days before the change occurs, unless impracticable, but in no event later than the actual day the change is made. Settling Defendant's Project Coordinator shall be subject to disapproval by EPA, after consultation with WDNR, and shall have the technical expertise sufficient to adequately oversee all aspects of the Work. Unless approved by Plaintiffs, Settling Defendant's Project Coordinator shall not be an attorney for Settling Defendant in this matter. A Project Coordinator may assign other representatives, including other contractors, to serve as a Site representative for oversight of performance of daily operations during remedial activities.

42. Plaintiff may designate other representatives, including, but not limited to, EPA and WDNR employees and federal and State contractors and consultants, to observe and monitor the progress of any activity undertaken pursuant to this Consent Decree. EPA's Project Coordinator and Alternate Project Coordinator shall have the authority lawfully vested in a Remedial Project Manager ("RPM") and an On-Scene Coordinator ("OSC") by the NCP, 40 C.F.R. Part 300. EPA's Project Coordinator or Alternate Project Coordinator shall have authority, consistent with the NCP, to halt any Work required by this Consent Decree and to take any necessary response action when he or she determines that conditions at the Site constitute an emergency situation or may present an immediate threat to public health or welfare or the environment due to release or threatened release of Waste Material.

43. EPA's Project Coordinator and Settling Defendant's Project Coordinator will meet, at a minimum, on a monthly basis. Such meetings may occur telephonically by agreement of the Project Coordinators.

XIII. PERFORMANCE GUARANTEE

44. In order to ensure the full and final completion of the Work, Settling Defendant shall establish and maintain a performance guarantee, initially in the amount of $40 million, for the benefit of EPA (hereinafter "Estimated Cost of the Work"). The performance guarantee, which must be satisfactory in form and substance to EPA, shall be in the form of one or more of the following mechanisms (provided that, if Settling Defendant intends to use multiple

mechanisms, such multiple mechanisms shall be limited to surety bonds guaranteeing payment, letters of credit, trust funds, and insurance policies):

a. A surety bond unconditionally guaranteeing payment and/or performance of the Work that is issued by a surety company among those listed as acceptable sureties on federal bonds as set forth in Circular 570 of the U.S. Department of the Treasury;

b. One or more irrevocable letters of credit, payable to or at the direction of EPA, that is issued by one or more financial institution(s) (1) that has the authority to issue letters of credit and (2) whose letter-of-credit operations are regulated and examined by a federal or state agency;

c. A trust fund established for the benefit of EPA that is administered by a trustee (1) that has the authority to act as a trustee and (2) whose trust operations are regulated and examined by a federal or state agency;

d. A policy of insurance that (1) provides EPA with acceptable rights as a beneficiary thereof; and (2) is issued by an insurance carrier (i) that has the authority to issue insurance policies in the applicable jurisdiction(s) and (ii) whose insurance operations are regulated and examined by a federal or state agency;

e. A demonstration by Settling Defendant that it meets the financial test criteria of 40 C.F.R. § 264.143(f) with respect to the Estimated Cost of the Work (plus the amount(s) of any other federal or any state environmental obligations financially assured through the use of a financial test or guarantee), provided that all other requirements of 40 C.F.R. § 264.143(f) are met to EPA's satisfaction; or

f. A written guarantee to fund or perform the Work executed in favor of EPA by one or more of the following: (1) a direct or indirect parent company of a Settling Defendant, or (2) a company that has a "substantial business relationship" (as defined in 40 C.F.R. § 264.141(h)) with Settling Defendant; provided, however, that any company providing such a guarantee must demonstrate to the satisfaction of EPA that it satisfies the financial test and reporting requirements for owners and operators set forth in subparagraphs (1) through (8) of 40 C.F.R. § 264.143(f) with respect to the Estimated Cost of the Work (plus the amount(s) of any other federal or any state environmental obligations financially assured through the use of a financial test or guarantee) that it proposes to guarantee hereunder.

45. Settling Defendant has selected, and EPA has found satisfactory as an initial performance guarantee the financial test pursuant to Paragraph 44.e in the form attached hereto as Appendix E. Within ten days after the Effective Date, Settling Defendant shall execute or otherwise finalize all instruments or other documents required in order to make the selected performance guarantee(s) legally binding in a form substantially identical to the documents attached hereto as Appendix E, and such performance guarantee(s) shall thereupon be fully effective. Within 30 days after the Effective Date, Settling Defendant shall submit copies of all executed and/or otherwise finalized instruments or other documents required in order to make the selected performance guarantee(s) legally binding to the EPA Regional Financial Management Officer in accordance with Section XXVIII (Notices and Submissions), with a copy to the United States, EPA, and the State as specified in Section XXVIII.

46. If, at any time after the Effective Date and before issuance of the Certification of Completion of the Work pursuant to Paragraph 51, Settling Defendant provides a performance

guarantee for completion of the Work by means of a demonstration or guarantee pursuant to Paragraph 44.e or 44.f, Settling Defendant shall also comply with the other relevant requirements of 40 C.F.R. § 264.143(f) relating to these mechanisms unless otherwise provided in this Consent Decree, including but not limited to: (a) the initial submission of required financial reports and statements from the relevant entity's chief financial officer ("CFO") and independent certified public accountant ("CPA"), in the form prescribed by EPA in its financial test sample CFO letters and CPA reports available at:
http://www.epa.gov/compliance/resources/policies/cleanup/superfund/fa-test-samples.pdf;
(b) the annual resubmission of such reports and statements within 90 days after the close of each such entity's fiscal year; and (c) the prompt notification of EPA after each such entity determines that it no longer satisfies the financial test requirements set forth at 40 C.F.R. § 264.143(f)(1) and in any event within 90 days after the close of any fiscal year in which such entity no longer satisfies such financial test requirements. For purposes of the performance guarantee mechanisms specified in this Section XIII, references in 40 C.F.R. Part 264, Subpart H, to "closure," "post-closure," and "plugging and abandonment" shall be deemed to include the Work; the terms "current closure cost estimate," "current post-closure cost estimate," and "current plugging and abandonment cost estimate" shall be deemed to include the Estimated Cost of the Work; the terms "owner" and "operator" shall be deemed to refer to Settling Defendant; and the terms "facility" and "hazardous waste facility" shall be deemed to include the Phase 1 Project Area.

47. In the event that EPA, after consultation with WDNR, determines at any time that a performance guarantee provided by Settling Defendant pursuant to this Section is inadequate or otherwise no longer satisfies the requirements set forth in this Section, whether due to an increase in the estimated cost of completing the Work or for any other reason, or in the event that Settling Defendant becomes aware of information indicating that a performance guarantee provided pursuant to this Section is inadequate or otherwise no longer satisfies the requirements set forth in this Section, whether due to an increase in the estimated cost of completing the Work or for any other reason, Settling Defendant, within 30 days after receipt of notice of EPA's determination or, as the case may be, within 30 days after becoming aware of such information, shall obtain and present to EPA for approval a proposal for a revised or alternative form of performance guarantee listed in Paragraph 44 that satisfies all requirements set forth in this Section XIII; provided, however, that if Settling Defendant cannot obtain such revised or alternative form of performance guarantee within such 30-day period, and provided further that Settling Defendant shall have commenced to obtain such revised or alternative form of performance guarantee within such 30-day period, and thereafter diligently proceeds to obtain the same, EPA shall extend such period for such time as is reasonably necessary for the Settling Defendant in the exercise of due diligence to obtain such revised or alternative form of performance guarantee, such additional period not to exceed 60 days. On day 30, Settling Defendant shall provide to EPA a status report on its efforts to obtain the revised or alternative form of guarantee. In seeking approval for a revised or alternative form of performance guarantee, Settling Defendant shall follow the procedures set forth in Paragraph 49.b(2). Settling Defendant's inability to post a performance guarantee for completion of the Work shall in no way excuse performance of any other requirements of this Consent Decree, including, without limitation, the obligation of Settling Defendant to complete the Work in strict accordance with the terms of this Consent Decree.

48. Funding for Work Takeover. The commencement of any Work Takeover pursuant to Paragraph 102 shall trigger EPA's right to receive the benefit of any performance guarantee(s) provided pursuant to Paragraphs 44.a, 44.b, 44.c, 44.d, or 44.f, and at such time EPA shall have immediate access to resources guaranteed under any such performance guarantee(s), whether in cash or in kind, as needed to continue and complete the Work assumed by EPA under the Work Takeover. Upon the commencement of any Work Takeover, if (a) for any reason EPA is unable to promptly secure the resources guaranteed under any such performance guarantee(s), whether in cash or in kind, necessary to continue and complete the Work assumed by EPA under the Work Takeover, or (b) in the event that the performance guarantee involves a demonstration of satisfaction of the financial test criteria pursuant to Paragraph 44.e or Paragraph 44.f(2), Settling Defendant (or in the case of Paragraph 44.f(2), the guarantor) shall immediately upon written demand from EPA deposit into a special account within the EPA Hazardous Substance Superfund or such other account as EPA may specify, in immediately available funds and without setoff, counterclaim, or condition of any kind, a cash amount up to but not exceeding the estimated cost of completing the remainder of the Work as of such date, as determined by EPA. In addition, if at any time EPA is notified by the issuer of a performance guarantee that such issuer intends to cancel the performance guarantee mechanism it has issued, then, unless Settling Defendant provide a substitute performance guarantee mechanism in accordance with this Section XIII no later than 30 days prior to the impending cancellation date, EPA shall be entitled (as of and after the date that is 30 days prior to the impending cancellation) to draw fully on the funds guaranteed under the then-existing performance guarantee. All EPA Work Takeover costs not reimbursed under this Paragraph shall be reimbursed under Section XVII (Payments for Response Costs).

49. Modification of Amount and/or Form of Performance Guarantee.

a. Reduction of Amount of Performance Guarantee. If Settling Defendant believes that the estimated cost of completing the Work has diminished below the amount set forth in Paragraph 44, Settling Defendant may, on any anniversary of the Effective Date, or at any other time agreed to by EPA and Settling Defendant, petition EPA in writing to request a reduction in the amount of the performance guarantee provided pursuant to this Section so that the amount of the performance guarantee is equal to the estimated cost of completing the Work. Settling Defendant shall submit a written proposal for such reduction to EPA, with a copy to WDNR, that shall specify, at a minimum, the estimated cost of completing the Work and the basis upon which such cost was calculated. In seeking approval for a reduction in the amount of the performance guarantee, Settling Defendant shall follow the procedures set forth in Paragraph 49.b(2) for requesting a revised or alternative form of performance guarantee, except as specifically provided in this Paragraph 49.a. If EPA, after consultation with WDNR, decides to accept Settling Defendant's proposal for a reduction in the amount of the performance guarantee, either to the amount set forth in Settling Defendant's written proposal or to some other amount as selected by EPA, EPA will notify Settling Defendant of such decision in writing. Upon EPA's acceptance of a reduction in the amount of the performance guarantee, the Estimated Cost of the Work shall be deemed to be the estimated cost of completing the Work set forth in EPA's written decision. After receiving EPA's written decision, Settling Defendant may reduce the amount of the performance guarantee in accordance with and to the extent permitted by such written acceptance and shall submit copies of all executed and/or otherwise finalized instruments or other documents required in order to make the selected performance guarantee(s) legally binding in accordance with Paragraph 49.b(2). In the event of a dispute, Settling

Defendant may reduce the amount of the performance guarantee required hereunder only in accordance with a final administrative or judicial decision resolving such dispute pursuant to Section XXI (Dispute Resolution). No change to the form or terms of any performance guarantee provided under this Section, other than a reduction in amount, is authorized except as provided in Paragraphs 47 or 49.b.

b. Change of Form of Performance Guarantee.

(1) If, after the Effective Date, Settling Defendant desires to change the form or terms of any performance guarantee(s) provided pursuant to this Section, Settling Defendant may, on any anniversary of the Effective Date, or at any other time agreed to by EPA and Settling Defendant, petition EPA in writing, with a copy of the petition to WDNR, to request a change in the form or terms of the performance guarantee provided hereunder. The submission of such proposed revised or alternative performance guarantee shall be as provided in Paragraph 49.b(2). Any decision made by EPA on a petition submitted under this Paragraph shall be made in EPA's sole and unreviewable discretion, and such decision shall not be subject to challenge by Settling Defendant pursuant to the dispute resolution provisions of this Consent Decree or in any other forum.

(2) Settling Defendant shall submit a written proposal for a revised or alternative performance guarantee to EPA, with a copy to WDNR, that shall specify, at a minimum, the estimated cost of completing the Work, the basis upon which such cost was calculated, and the proposed revised performance guarantee, including all proposed instruments or other documents required in order to make the proposed performance guarantee legally binding. The proposed revised or alternative performance guarantee must satisfy all requirements set forth or incorporated by reference in this Section. Settling Defendant shall submit such proposed revised or alternative performance guarantee to the EPA Regional Financial Management Officer in accordance with Section XXVIII (Notices and Submissions). EPA, after consultation with WDNR, will notify Settling Defendant in writing of its decision to accept or reject a revised or alternative performance guarantee submitted pursuant to this Paragraph. Within ten days after receiving a written decision approving the proposed revised or alternative performance guarantee, Settling Defendant shall execute and/or otherwise finalize all instruments or other documents required in order to make the selected performance guarantee(s) legally binding in a form substantially identical to the documents submitted to EPA as part of the proposal, and such performance guarantee(s) shall thereupon be fully effective. Settling Defendant shall submit copies of all executed and/or otherwise finalized instruments or other documents required in order to make the selected performance guarantee(s) legally binding to the EPA Regional Financial Management Officer within 30 days after receiving a written decision approving the proposed revised or alternative performance guarantee in accordance with Section XXVIII (Notices and Submissions), with a copy to the United States and EPA and WDNR as specified in Section XXVIII.

c. Release of Performance Guarantee. Settling Defendant shall not release, cancel, or discontinue any performance guarantee provided pursuant to this Section except as provided in this Paragraph. If Settling Defendant receives written notice from EPA in accordance with Paragraph 51 that the Work has been fully and finally completed in accordance

with the terms of this Consent Decree, or if EPA otherwise so notifies Settling Defendant in writing, Settling Defendant may thereafter release, cancel, or discontinue the performance guarantee(s) provided pursuant to this Section. In the event of a dispute, Settling Defendant may release, cancel, or discontinue the performance guarantee(s) required hereunder only in accordance with a final administrative or judicial decision resolving such dispute pursuant to Section XXI (Dispute Resolution).

XIV. CERTIFICATION OF COMPLETION

50. Completion of the Phase 1 Remedial Action.

a. Within 90 days after Settling Defendant concludes that the Phase 1 Remedial Action has been fully performed and the Phase 1 Performance Standards have been achieved, Settling Defendant shall schedule and conduct a pre-certification inspection to be attended by Settling Defendant, EPA, and WDNR. If, after the pre-certification inspection, Settling Defendant still believes that the Phase 1 Remedial Action has been fully performed and the Phase 1 Performance Standards have been achieved, it shall submit a written report requesting certification to EPA for approval, with a copy to WDNR, pursuant to Section XI (EPA Approval of Plans, Reports, and Other Deliverables) within 30 days after the inspection. In the report, a registered professional engineer and Settling Defendant's Project Coordinator shall state that the Phase 1 Remedial Action has been completed in full satisfaction of the requirements of this Consent Decree. The written report shall include as-built drawings signed and stamped by a professional engineer. The report shall contain the following statement, signed by a responsible corporate official of a Settling Defendant or Settling Defendant's Project Coordinator:

> I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If, after completion of the pre-certification inspection and receipt and review of the written report, EPA, after reasonable opportunity for review and comment by WDNR, determines that the Phase 1 Remedial Action or any portion thereof has not been completed in accordance with this Consent Decree or that the Phase 1 Performance Standards have not been achieved, EPA will notify Settling Defendant in writing of the activities that must be undertaken by Settling Defendant pursuant to this Consent Decree to complete the Phase 1 Remedial Action and achieve the Phase 1 Performance Standards, provided, however, that EPA may only require Settling Defendant to perform such activities pursuant to this Paragraph to the extent that such activities are consistent with the "scope of the remedy set forth in the ROD," as that term is defined in Paragraph 14.a. EPA will set forth in the notice a schedule for performance of such activities consistent with the Consent Decree and the SOW or require Settling Defendant to submit a schedule to EPA for approval pursuant to Section XI (EPA Approval of Plans, Reports, and Other Deliverables). Settling Defendant shall perform all activities described in the notice in

accordance with the specifications and schedules established pursuant to this Paragraph, subject to its right to invoke the dispute resolution procedures set forth in Section XXI (Dispute Resolution).

b. If EPA concludes, based on the initial or any subsequent report requesting Certification of Completion of the Phase 1 Remedial Action and after a reasonable opportunity for review and comment by WDNR, that the Phase 1 Remedial Action has been performed in accordance with this Consent Decree and that Phase 1 Performance Standards have been achieved, EPA will so certify in writing to Settling Defendant. This certification shall constitute the Certification of Completion of the Phase 1 Remedial Action for purposes of this Consent Decree, including, but not limited to, Section XXIII (Covenants by Plaintiffs and Tribes). Certification of Completion of the Phase 1 Remedial Action shall not affect Settling Defendant's remaining obligations under this Consent Decree. WDNR may join EPA in certifying completion of the Phase 1 Remedial Action.

51. Completion of the Work.

a. Within 90 days after Settling Defendant concludes that all phases of the Work, other than any remaining activities required under Section VII (Phase 1 Remedy Review), have been fully performed, Settling Defendant shall schedule and conduct a pre-certification inspection to be attended by Settling Defendant, EPA, and WDNR. If, after the pre-certification inspection, Settling Defendant still believes that the Work has been fully performed, Settling Defendant shall submit a written report by a registered professional engineer stating that the Work has been completed in full satisfaction of the requirements of this Consent Decree. The report shall contain the statement set forth in Paragraph 50.a, signed by a responsible corporate official of a Settling Defendant or Settling Defendant's Project Coordinator. If, after review of the written report, EPA, after reasonable opportunity for review and comment by WDNR, determines that any portion of the Work has not been completed in accordance with this Consent Decree, EPA will notify Settling Defendant in writing of the activities that must be undertaken by Settling Defendant pursuant to this Consent Decree to complete the Work, provided, however, that EPA may only require Settling Defendant to perform such activities pursuant to this Paragraph to the extent that such activities are consistent with the "scope of the remedy set forth in the ROD," as that term is defined in Paragraph 14.a. EPA will set forth in the notice a schedule for performance of such activities consistent with the Consent Decree and the SOW or require Settling Defendant to submit a schedule to EPA for approval pursuant to Section XI (EPA Approval of Plans, Reports, and Other Deliverables). Settling Defendant shall perform all activities described in the notice in accordance with the specifications and schedules established therein, subject to its right to invoke the dispute resolution procedures set forth in Section XXI (Dispute Resolution).

b. If EPA concludes, based on the initial or any subsequent request for Certification of Completion of the Work by Settling Defendant and after a reasonable opportunity for review and comment by WDNR, that the Work has been performed in accordance with this Consent Decree, EPA will so notify Settling Defendant in writing. WDNR may join EPA in certifying Completion of the Work.

XV. EMERGENCY RESPONSE

52. If any action or occurrence during the performance of the Work causes or threatens a release of Waste Material from the Site that constitutes an emergency situation or may present an immediate threat to public health or welfare or the environment, Settling Defendant shall, subject to Paragraph 53, immediately take all appropriate action to prevent, abate, or minimize such release or threat of release, and shall immediately notify the EPA and WDNR Project Coordinators (or their alternates, if necessary). If neither EPA's Project Coordinator nor EPA's Alternate Project Coordinator is available, Settling Defendant shall notify the EPA Emergency Response Unit, Region 5. Settling Defendant shall take such actions in consultation with EPA's Project Coordinator or other available authorized EPA officer and in accordance with all applicable provisions of the Health and Safety Plans, the Contingency Plans, and any other applicable plans or documents developed pursuant to the SOW. In the event that Settling Defendant fails to take appropriate response action as required by this Section and EPA or, as appropriate, WDNR takes such action instead, Settling Defendant shall reimburse EPA and WDNR all costs of the response action under Section XXVII (Payments for Response Costs).

53. Subject to Section XXIII (Covenants by Plaintiffs and Tribes), nothing in the preceding Paragraph or in this Consent Decree shall be deemed to limit any authority of the United States or the State to (a) take all appropriate action to protect human health and the environment or to prevent, abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site, or (b) direct or order such action, or seek an order from the Court, to protect human health and the environment or to prevent, abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site.

XVI. TECHNICAL IMPRACTICABILITY

54. Settling Defendant may petition EPA to waive compliance with one or more of the Phase 1 Performance Standards for groundwater contaminants based on a demonstration that it is technically impracticable, from an engineering perspective, to attain those standards.

55. The determination of whether attainment of a particular Phase 1 Performance Standard is technically impracticable will be made by EPA, after consultation with WDNR, and will be based on the engineering feasibility and reliability of the remedy. If Settling Defendant objects to EPA's decision it may, within 30 days after EPA's notification, seek dispute resolution under Paragraph 80 (Record Review).

56. EPA will consider a petition for a waiver of Phase 1 Performance Standards on technical impracticability grounds only after the selected groundwater remedy has been functioning and operational for a sufficiently long time period (longer than five years) to make reliable predictions concerning its ability to achieve the Phase 1 Performance Standards. This determination will be made by EPA based on Site-specific data and conditions. If the first petition is rejected, a subsequent petition will be considered by EPA only if EPA determines that it is based on significant new Site-specific data which could not have been developed at the time the previous petition was submitted.

57. Neither the submission of a petition by Settling Defendant nor the granting of a waiver of one or more Phase 1 Performance Standards by EPA pursuant to this Section shall relieve Settling Defendant of its obligation to (i) continue to operate the groundwater remedy

until the time specified by EPA, (ii) attain Phase 1 Performance Standards for any contaminants for which EPA has not specifically granted a waiver, and (iii) complete any other obligation under this Consent Decree.

58. Such a petition shall include, at a minimum, the information and analyses required by EPA guidance and the site-specific information described in Subparagraphs (a) through (l), as follows:

a. A list of each Phase 1 Performance Standard for which a waiver is sought, and the spatial limits for which it is sought. The justification for a waiver required by items (b) - (l) below must be made for each contaminant or class of contaminants for which a waiver is sought.

b. A description of known or suspected groundwater contaminant sources at the Site, including dense non-aqueous phase liquid ("DNAPL") contaminants. The petition also shall describe source control and removal efforts that have been implemented and the effectiveness of those efforts.

c. Comprehensive groundwater monitoring data and an evaluation of the groundwater remedy implemented, along with any other remediation actions performed which enhanced or affected this remedy. The monitoring data and performance evaluation shall demonstrate, using an appropriate engineering and statistical analysis, that the groundwater remedy has been operating for a sufficiently long period of time, as stated in Paragraph 56, to permit a reliable analysis of its performance and its ability to achieve Phase 1 Performance Standards. The petition also shall demonstrate that the remedy has been designed, constructed, and operated in a manner which is consistent with the Phase 1 Remedial Design Work Plan, the Phase 1 Remedial Action Work Plan, and the conceptual models for Site contamination, and that the system has been modified or enhanced to the extent practicable to optimize its performance in an effort to attain the Phase 1 Performance Standards. Examples of modifications and enhancements which would be applicable here, in addition to the contingency requirements of the ROD, are as follows: [1] Pumping may be discontinued at individual wells where cleanup goals have been attained; [2] Alternating pumping at wells to eliminate stagnation points; [3] Pulse pumping to allow contaminants to aquifer equilibration and encourage adsorbed contaminants to partition into groundwater; and [4] Installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

d. A description of the conceptual model for Phase 1 Project Area contamination, including geologic, hydrogeologic, and geochemical characterizations. A description of the distribution; characteristics; migration, potential migration, and fate; and quantities of contaminants present at the Phase 1 Project Area. These descriptions shall incorporate pertinent data obtained during the design, construction, and operation of the remedial system, as well as information obtained during previous Site characterization efforts.

e. An analysis of the performance of the groundwater remedy which describes the spatial and temporal trends in groundwater contaminant concentrations within the groundwater plume; for example, whether contaminant migration has been effectively prevented, whether there have been changes in the overall size or location of the groundwater plume, and whether the concentrations of contaminants have been slowly decreasing. The petition shall discuss the hydrogeochemical factors which influence the remedy's ability to achieve the Phase

1 Performance Standards, and demonstrate how these factors inhibit the remedial system achieving the Phase 1 Performance Standards.

f. The mass of contaminants removed from the groundwater by the remedial system, and an estimate of the mass of contaminants remaining, including the degree of uncertainty involved in this estimate.

g. A demonstration, including appropriate engineering analysis, that other conventional or innovative technologies which are potentially applicable at the Phase 1 Project Area cannot attain the Phase 1 Performance Standards in a manner that is practicable from an engineering perspective. This demonstration should include a prediction of the level of cleanup other technologies can attain.

h. A predictive analysis of the approximate time frame required to achieve the Phase 1 Performance Standards with the existing groundwater remedy, and any alternative remedial strategies, if applicable, using methods appropriate for the data and the Site-specific conditions. Such analyses also should address the uncertainty inherent in these predictions.

i. For the implemented remedy and for any alternative remedial strategies proposed as part of this petition, identification of the potential pathways by which humans and the environment are or may become exposed to the contaminated groundwater left in place. Contaminant concentration and other data needed for EPA to perform risk analyses shall be provided as part of the petition.

j. A description of the proposed alternative remedial strategy, or a comparison of two or more strategy options, proposed to be implemented by the Settling Defendant if a waiver is granted, and the level of cleanup and control of hazardous substances, pollutants, and contaminants the proposed alternative strategy or strategies will attain. Alternative remedial strategies must attain a level of cleanup and control of further releases which ensure protection of human health and the environment, and prevent further migration of contaminated groundwater. Alternative remedial strategies may include the establishment of alternative performance standards, Site-specific cleanup levels, and other alternative remediation requirements to ensure protectiveness. Proposed modifications to the existing remedy, and any additional response actions proposed to be undertaken, shall be described by the Settling Defendant in detail. EPA will make the final determination regarding the components of the alternative remedial strategy which shall be implemented at the Phase 1 Project Area by the Settling Defendant.

k. A description of any additional groundwater monitoring required to verify compliance with the alternative performance standards or remedial requirements. EPA will make the final determination regarding the scope of the groundwater monitoring requirements under the alternative remedial strategy.

l. Other information or analyses not included above, but which Settling Defendant or EPA considers appropriate to making a determination on the petition.

59. Upon receipt of all information required by Paragraph 58, EPA will review and consider the information in the petition and any other relevant information. After opportunity for review and comment by WDNR, EPA will determine (1) whether compliance with any of the Phase 1 Performance Standards shall be waived; (2) what, if any, alternative remediation requirements, including alternative performance standards and other protective measures, will be

established by EPA; (3) whether modifications to the groundwater portion of the Phase 1 Remedial Action or any additional response actions relating to groundwater contamination are required; and (4) whether revised interim milestone and completion dates are needed for attainment of Phase 1 Performance Standards or alternative performance standards under this Consent Decree. EPA's determination on the petition will be consistent with the National Contingency Plan ("NCP"), Section 121(d) of CERCLA, and any other applicable laws, regulations, and guidance in effect at the time.

60. If EPA, after a reasonable opportunity for review and comment by WDNR, grants any petition or other relief pursuant to this Section, that decision will be reflected in a post-ROD decision document, as required by the NCP. If modification of this Consent Decree or the SOW is required to implement EPA's decision, such modification will be filed and, if necessary, Court approval will be sought in accordance with Section XXXII of this Consent Decree (Modification). Upon issuance of EPA's post-ROD decision document, filing of the revised SOW and Consent Decree with the Court, and if necessary, issuance of a court order approving the modification, Settling Defendant shall implement the modifications selected by EPA to the groundwater portion of the remedial action or additional response actions relating to groundwater contamination, and achieve and maintain all Phase 1 Performance Standards, alternative performance standards, and remediation requirements established pursuant to this Section. Unless expressly modified by EPA's decision on the petition submitted hereunder, all requirements of this Consent Decree, including Settling Defendant's obligation to achieve the alternative performance standards and to conduct long-term groundwater monitoring, shall continue in force and effect.

XVII. PAYMENTS FOR RESPONSE COSTS

61. Payments by Settling Defendant for Future Response Costs. Settling Defendant shall pay to EPA all Future Response Costs not inconsistent with the NCP, excluding the first $1.5 million of Future Oversight Costs.

a. On a periodic basis, EPA will send Settling Defendant a bill requiring payment that includes an itemized cost summary and a DOJ case cost summary. Settling Defendant shall make all payments within 30 days after Settling Defendant's receipt of each bill requiring payment, except as otherwise provided in Paragraph 63, in accordance with Paragraphs 62 (Payment Instructions for Settling Defendant).

b. The total amount to be paid by Settling Defendants pursuant to Paragraph 61.a shall be deposited by EPA in the Ashland/Northern States Power Special Account (Account No. 2751026S062) to be retained and used to conduct or finance response actions at or in connection with the Site, or to be transferred by EPA to the EPA Hazardous Substance Superfund.

62. Payment Instructions for Settling Defendant.

a. All payments shall be made by Fedwire EFT to:

Federal Reserve Bank of New York
ABA = 021030004
Account = 68010727
SWIFT address = FRNYUS33
33 Liberty Street
New York NY 10045
Field Tag 4200 of the Fedwire message should read "D 68010727 Environmental Protection Agency"

b. All payments made shall reference the CDCS Number, Site/Spill ID Number B5 N5, and DOJ Case Number 90-11-2-08879/1. At the time of any payment required to be made, Settling Defendant shall send notice that payment has been made to the United States, and to EPA, in accordance with Section XXVIII (Notices and Submissions), and to the EPA Cincinnati Finance Office by email at acctsreceivable.cinwd@epa.gov, or by mail at 26 Martin Luther King Drive, Cincinnati, Ohio 45268. Such notice shall also reference the CDCS Number, Site/Spill ID Number, and DOJ Case Number.

63. Settling Defendant may contest any Future Response Costs billed under Paragraph 61 (Payments by Settling Defendant for Future Response Costs) if it determines that EPA has made a mathematical error or included a cost item that is not within the definition of Future Response Costs, or if it believes EPA incurred excess costs as a direct result of an EPA action that was inconsistent with a specific provision or provisions of the NCP. Such objection shall be made in writing within 30 days after receipt of the bill and must be sent to the United States pursuant to Section XXVIII (Notices and Submissions). Any such objection shall specifically identify the contested Future Response Costs and the basis for objection. In the event of an objection, Settling Defendant shall pay all uncontested Future Response Costs to the United States within 30 days after Settling Defendant's receipt of the bill requiring payment. Simultaneously, Settling Defendant shall establish, in a duly chartered bank or trust company, an interest-bearing escrow account that is insured by the Federal Deposit Insurance Corporation ("FDIC"), and remit to that escrow account funds equivalent to the amount of the contested Future Response Costs. Settling Defendant shall send to the United States, as provided in Section XXVIII (Notices and Submissions), a copy of the transmittal letter and check paying the uncontested Future Response Costs, and a copy of the correspondence that establishes and funds the escrow account, including, but not limited to, information containing the identity of the bank and bank account under which the escrow account is established as well as a bank statement showing the initial balance of the escrow account. Simultaneously with establishment of the escrow account, Settling Defendant shall initiate the Dispute Resolution procedures in Section XXI (Dispute Resolution). If the United States prevails in the dispute, Settling Defendant shall pay the sums due (with accrued interest) to the United States within five days after the resolution of the dispute. If Settling Defendant prevails concerning any aspect of the contested costs, Settling Defendant shall pay that portion of the costs (plus associated accrued interest) for which it did not prevail to the United States within five days after the resolution of the dispute. Settling Defendant shall be disbursed any balance of the escrow account. All payments to the United States under this Paragraph shall be made in accordance with

Paragraphs 62 (Payment Instructions for Settling Defendant). The dispute resolution procedures set forth in this Paragraph in conjunction with the procedures set forth in Section XXI (Dispute Resolution) shall be the exclusive mechanisms for resolving disputes regarding Settling Defendant's obligation to reimburse the United States for its Future Response Costs.

64. Interest. In the event that any payment for Future Response Costs required under this Section is not made by the date required, Settling Defendant shall pay Interest on the unpaid balance. The Interest on Future Response Costs shall begin to accrue on the date of the bill. The Interest shall accrue through the date of Settling Defendant's payment. Payments of Interest made under this Paragraph shall be in addition to such other remedies or sanctions available to Plaintiffs by virtue of Settling Defendant's failure to make timely payments under this Section including, but not limited to, payment of stipulated penalties pursuant to Paragraph 84.

XVIII. NATURAL RESOURCE RESTORATION PROJECTS

65. As Settling Defendant's full contribution toward Natural Resource Damages, subject to Paragraphs 100 and 101, Settling Defendant shall convey, or cause to be conveyed, on an "As Is, Where Is" basis, certain properties as described below ("Restoration Properties"):

a. Bad River Falls Project. In order to improve Natural Resources in the Bad River Falls area, Settling Defendant shall convey, or cause to be conveyed, by special warranty deed in the form contemplated below in Paragraph 67.a, to the Bad River Band of the Lake Superior Tribe of Chippewa Indians the land owned by Settling Defendant within the Bad River Reservation, totaling approximately 400 acres within the following tracts: part of the NE ¼ of the NE ¼; part of the NW ¼ of the NE ¼; part of the SE ¼ of the NE ¼; part of the NE ¼ of the SW ¼; part of the NW ¼ of the SW ¼; part of the NE ¼ of the SE ¼; and part of the NW ¼ of the SE ¼; all located in Section 36, T47N, R3W, Town of Sanborn, Ashland County, Wisconsin; and part of Govt. Lot 1 in the NE ¼ of the SE ¼; part of Govt. Lots 3 and 4 in the NW ¼ of the SE ¼; part of Govt. Lot 5 in the SW ¼ of the SE ¼; part of Govt. Lot 6 in the NE ¼ of the SW ¼; part of Govt. Lot 7 in the SE ¼ of the SW ¼; and Part of Govt. Lot 11 in the SW ¼ of the NE ¼; all located in Section 25, T47N, R3W, Town of Sanborn, Ashland County, Wisconsin. Settling Defendant (or Settling Defendant's Related Parties) shall be entitled to reserve (or to grant to itself or any of Settling Defendant's Related Parties) an easement, in the form attached as Appendix F, with respect to Settling Defendant's (or Settling Defendant's Related Parties') existing transmission and distribution lines and related equipment and facilities in the Restoration Property described in this Paragraph 65.a.

b. Iron River Project. In order to improve Natural Resources in the Iron River watershed, Settling Defendant shall convey, or cause to be conveyed, by special warranty deed, in the form contemplated below in Paragraph 67.a, lands owned by Setlling Defendant within the following tracts of property, totaling approximately 989.95 acres, to WDNR:

(1) Lake Superior Power Company Lands consisting of approximately 449.98 acres of land, being Lots 1 and 2 of Block 2; Lots 1, 2, 3, 4, 5, 6, 7 of Block 3; Lots 1, 2, 3, 4 of Block 4; Lots 1, 2, 5, 6, 7, 9, 10 of Block 5; all in Orienta Falls Park; and part of the SW¼ of the NE¼; part of the NE¼ of the NW¼; part of the NW¼ of the NW¼; the SW¼ of the NW¼; the SE¼ of the NW¼; the entire SW¼; the NW¼ of the

SE¼; the SW¼ of the SE¼; the SE¼ of the SE¼; all located in Section 10, T49N, R9W, Town of Orienta, Bayfield County, Wisconsin;

(2) Lake Superior Power Company Lands consisting of approximately 480 acres of land, being the entire NE¼; the entire NW¼; and the entire SE¼; all in Section 15, T49N, R9W, Town of Orienta, Bayfield County, Wisconsin;

(3) Lake Superior Power Company Lands consisting of approximately 40 acres of land in SE ¼ of the SE ¼, Section 9, T49N, R9W, Town of Orienta, Bayfield County, Wisconsin; and

(4) Lake Superior Power Company Lands consisting of approximately 19.97 acres of land, being Lots 1, 2, 3, 4 of Block 1 of Orienta Falls Park; and the remainder of the S ½ of the SW ¼ of the SW ¼, all located in Section 3, T49N, R9W, Town of Orienta, Bayfield County, Wisconsin.

Settling Defendant shall be allowed to complete a timber harvest on the properties listed in this Paragraph 65.b, subject to a plan ("Harvest Plan") to be drafted by Settling Defendant and approved by WDNR after consultation with the National Oceanic and Atmospheric Administration and the United States Fish and Wildlife Service. The timber harvest may be performed at various times so long as all harvest activity by Settling Defendant ceases within five years of the Effective Date. The Harvest Plan shall take into consideration WDNR's long-term management goals and objectives to improve Natural Resources in the Iron River watershed. WDNR shall collaborate with Settling Defendant, upon request, to develop the Harvest Plan. The rights under the Harvest Plan shall be recorded in a written agreement signed by the State and Settling Defendant.

c. The legal descriptions for the special warranty deeds and the easement shall be determined, and approximate acreages set forth in Paragraphs 65.a. and 65.b. shall be conformed, based on the results of the surveys and title reports contemplated in Paragraph 67.

66. In exchange for the actions to be taken by Settling Defendant pursuant to Paragraph 65, and pursuant to approval of the Natural Resources Board and the Governor, as provided for in WIS. STAT. §§ 23.15(1) and (2), the State shall convey, or cause to be conveyed, certain properties as described below ("Restoration Properties"):

a. Raspberry River Watershed Project. Pursuant to the approvals above, the State shall convey, or cause to be conveyed, under WIS. STAT. § 23.15, by quitclaim deed, the following property totaling approximately 119.62 acres to the Red Cliff Band of the Lake Superior Tribe of Chippewa Indians in order to improve Natural Resources in the Raspberry River Watershed:

(1) Government Lots 1 and 2 in Section 1, Town 51 North, Range 4 West; and

(2) Government Lot 2 in Section 36, Town 52 North, Range 4 West.

67. Within 60 days of the Effective Date of this Consent Decree:

a. Settling Defendant shall cause the following items to be transferred to the Trustees for review with respect to each of the Restoration Properties described in Paragraph 65:

(1) A draft special warranty deed (limited to the acts of Grantor) enforceable under the laws of the State of Wisconsin, free and clear of monetary liens (excluding taxes not yet due and payable) but subject to encumbrances of record (as long as those encumbrances do not preclude preservation) and matters that would be revealed by an accurate survey;

(2) A current title commitment or report prepared in accordance with customary practice in Ashland and Bayfield Counties, Wisconsin; and

(3) One or more surveys.

b. The State shall cause the following items to be transferred to the Trustees for review with respect to the Restoration Properties described in Paragraph 66:

(1) A draft quitclaim deed enforceable under the laws of the State of Wisconsin; and

(2) A current title commitment or report prepared in accordance with customary practice in Ashland and Bayfield Counties, Wisconsin.

c. Notwithstanding Paragraph 67.a, above, Trustees acknowledge that the lien of that certain Trust Indenture dated April 1, 1974, from Settling Defendant to U.S. Bank National Association, a corporation under the laws of the United States of America f/k/a Firstar Bank National Association, shall remain of record after the execution and delivery of the deeds required by Paragraph 65, but Settling Defendant shall obtain and furnish the relevant Trustees a partial release of said lien within 90 days from the date of delivery of said deeds such that there is no lien applicable to the Restoration Properties in Paragraph 65.

68. Restoration Property Title Transfer and Management.

a. With respect to the Restoration Properties each Party owns, Settling Defendant and the State shall:

(1) Within 45 days after submittal of the relevant draft deeds and other necessary instruments in Paragraphs 67.a and 67.b, cause title searches to be updated.

(2) Within 150 days after submittal of the relevant draft deeds and other necessary instruments in Paragraphs 67.a and 67.b, if it is determined that nothing has occurred since the effective date of the commitments or reports to affect the titles adversely, execute and deliver the deeds (as described in Paragraphs 67.a and 67.b) to the Restoration Properties described in Paragraphs 65 and 66 to the Trustees set forth in Paragraphs 65 and 66, at the sole expense of the transferring Party.

b. After the transfers, the Restoration Properties shall be preserved and managed by the transferee Trustees to protect and enhance the natural resource benefits associated with the Restoration Properties.

69. Dispute Resolution for Natural Resource Restoration Projects. This Paragraph applies solely to disputes under this Section and Paragraph 84.b(11)-(12).

a. Informal Dispute Resolution. Any dispute under this Paragraph shall in the first instance be the subject of informal negotiations between the parties to the dispute. The period for informal negotiations shall not exceed 20 days from the time the dispute arises, unless it is modified by written agreement of the parties to the dispute. This dispute shall be considered to have arisen when one party sends the other parties a written Notice of Dispute.

b. Formal Dispute Resolution. In the event that the parties cannot resolve a dispute under this Paragraph by informal negotiations, then the formal dispute procedures outlined by this Paragraph 69.b shall apply.

(1) The position advanced by Plaintiffs, after consulting with the Trustees, shall be considered binding unless, within 21 days after the conclusion of the informal negotiation period, Settling Defendant invokes the formal dispute resolution procedures of this Section by serving on the Trustees a written Statement of Position on the matter in dispute, including, but not limited to, any factual data, analysis, or opinion supporting that position and any supporting documentation relied upon by Settling Defendant.

(2) Following receipt of Settling Defendant's Statement of Position, Plaintiffs, after consulting with the Trustees, will issue an administrative decision resolving the dispute which shall include or attach any factual data, analysis, opinion, or documentation supporting the decision. Plaintiffs shall compile and maintain an administrative record of the dispute containing Settling Defendant's Statement of Position and Plaintiffs' administrative decision. Plaintiffs' administrative decision shall be binding on Settling Defendant unless, within 30 days after receipt of the administrative decision, Settling Defendant files with the Court and serves on all Parties a motion for judicial review of the decision, based on the administrative record compiled and maintained by Plaintiffs pursuant to this Paragraph 69.b. Any such motion shall include a description of the matter in dispute, the efforts made by the parties to resolve it, the relief requested, and the schedule, if any, within which the dispute must be resolved to ensure orderly implementation of this Consent Decree. Plaintiffs shall provide the Court a copy of the administrative record of the dispute, and may file a response to Settling Defendant's motion.

c. Effect of Invoking Dispute Resolution. The invocation of formal dispute resolution procedures under this Section shall not extend, postpone, or affect in any way any obligation of Settling Defendant under this Consent Decree, not directly in dispute, unless Plaintiffs, after consulting with the Trustees, or the Court agree otherwise. Stipulated penalties with respect to the disputed matter shall continue to accrue but payment shall be stayed pending resolution of the dispute as provided in Paragraph 90. Notwithstanding the stay of payment, stipulated penalties shall accrue from the first day of noncompliance with any applicable provision of this Consent Decree. In the event that Settling Defendant does not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section XXII (Stipulated Penalties).

XIX. INDEMNIFICATION AND INSURANCE

70. Settling Defendant's Indemnification of the United States and the State.

a. The United States and the State do not assume any liability by entering into this Consent Decree or by virtue of any designation of Settling Defendant as EPA's or WDNR's authorized representative under Section 104(e) of CERCLA, 42 U.S.C. § 9604(e), or Chapters 289, 291, and 292 of the Wisconsin Statutes. Settling Defendant shall indemnify, save and hold harmless the United States, the State, and their officials, agents, employees, contractors, subcontractors, or representatives for or from any and all claims or causes of action arising from, or on account of, negligent or other wrongful acts or omissions of Settling Defendant, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on its behalf or under its control, in carrying out activities pursuant to this Consent Decree, including, but not limited to, any claims arising from any designation of Settling Defendant as EPA's or WDNR's authorized representative under Section 104(e) of CERCLA or Chapters 289, 291 and 292 of the Wisconsin Statutes. Further, Settling Defendant agrees to pay the United States and the State all costs they incur including, but not limited to, attorneys' fees and other expenses of litigation and settlement arising from, or on account of, claims made against the United States or the State based on negligent or other wrongful acts or omissions of Settling Defendant, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on its behalf or under its control, in carrying out activities pursuant to this Consent Decree. The United States and the State shall not be held out as a party to any contract entered into by or on behalf of Settling Defendant in carrying out activities pursuant to this Consent Decree. Neither Settling Defendant nor any such contractor shall be considered an agent of the United States or the State.

b. The United States and the State shall give Settling Defendant notice of any claim for which the United States or the State plans to seek indemnification pursuant to this Paragraph 70, and shall consult with Settling Defendant prior to settling such claim.

71. Settling Defendant covenants not to sue and agrees not to assert any claims or causes of action against the United States or the State for damages or reimbursement or for set-off of any payments made or to be made to the United States, arising from or on account of any contract, agreement, or arrangement between Settling Defendant and any person for performance of Work on or relating to the Phase 1 Project Area, including, but not limited to, claims on account of construction delays. In addition, Settling Defendant shall indemnify and hold harmless the United States and the State with respect to any and all claims for damages or reimbursement arising from or on account of any contract, agreement, or arrangement between Settling Defendant and any person for performance of Work on or relating to the Phase 1 Project Area, including, but not limited to, claims on account of construction delays.

72. No later than 15 days before commencing any on-site Work, Settling Defendant shall secure, and shall maintain until the first anniversary after issuance of EPA's Certification of Completion of the Remedial Action pursuant to Paragraph 50.b of Section XIV (Completion of the Phase 1 Remedial Action), commercial general liability insurance with limits of $2 million, for any one occurrence, and automobile liability insurance with limits of $2 million, combined single limit, naming the United States and the State as additional insureds with respect to all liability arising out of the activities performed by or on behalf of Settling Defendant pursuant to this Consent Decree. In addition, for the duration of this Consent Decree, Settling Defendant shall satisfy, or shall ensure that its contractors or subcontractors satisfy, all applicable laws and

regulations regarding the provision of worker's compensation insurance for all persons performing the Work on behalf of Settling Defendant in furtherance of this Consent Decree. Prior to commencement of the Work under this Consent Decree, Settling Defendant shall provide to EPA and WDNR certificates of such insurance and a copy of each insurance policy. Settling Defendant shall resubmit such certificates and copies of policies each year on the anniversary of the Effective Date. If Settling Defendant demonstrates by evidence satisfactory to EPA that any contractor or subcontractor maintains insurance equivalent to that described above, or insurance covering the same risks but in a lesser amount, then, with respect to that contractor or subcontractor, Settling Defendant need provide only that portion of the insurance described above that is not maintained by the contractor or subcontractor.

XX. FORCE MAJEURE

73. "Force majeure," for purposes of this Consent Decree, is defined as any event arising from causes beyond the control of Settling Defendant, of any entity controlled by Settling Defendant, or of Settling Defendant's contractors that delays or prevents the performance of any obligation under this Consent Decree despite Settling Defendant's best efforts to fulfill the obligation. The requirement that Settling Defendant exercise "best efforts to fulfill the obligation" includes using best efforts to anticipate any potential force majeure and best efforts to address the effects of any potential force majeure (a) as it is occurring and (b) following the potential force majeure such that the delay and any adverse effects of the delay are minimized to the greatest extent possible. "Force majeure" does not include financial inability to complete the Work or failure to achieve the Phase 1 Performance Standards.

74. If any event occurs or has occurred that may delay the performance of any obligation under this Consent Decree for which Settling Defendant intends or may intend to assert a claim of force majeure, Settling Defendant shall notify orally EPA's Project Coordinator or, in his or her absence, EPA's Alternate Project Coordinator or, in the event both of EPA's designated representatives are unavailable, the Director of the Superfund Division, EPA Region 5, within 48 hours of when Settling Defendant first knew that the event might cause a delay. Within five days thereafter, Settling Defendant shall provide in writing to EPA and WDNR an explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or the effect of the delay; Settling Defendant's rationale for attributing such delay to a force majeure; and a statement as to whether, in the opinion of Settling Defendant, such event may cause or contribute to an endangerment to public health or welfare, or the environment. Settling Defendant shall include with any notice all available documentation supporting its claim that the delay was attributable to a force majeure. Settling Defendant shall be deemed to know of any circumstance of which Settling Defendant, any entity controlled by Settling Defendant, or Settling Defendant's contractors knew or should have known. Failure to comply with the above requirements regarding an event shall preclude Settling Defendant from asserting any claim of force majeure regarding that event, provided, however, that if EPA, despite the late notice, is able to assess to its satisfaction whether the event is a force majeure under Paragraph 73 and whether Settling Defendant has exercised its best efforts under Paragraph 73, EPA may, in its unreviewable discretion, excuse in writing Settling Defendant's failure to submit timely notices under this Paragraph.

75. If EPA agrees that the delay or anticipated delay is attributable to a force majeure, the time for performance of the obligations under this Consent Decree that are affected by the force majeure will be extended by EPA for such time as is necessary to complete those obligations. An extension of the time for performance of the obligations affected by the force majeure shall not, of itself, extend the time for performance of any other obligation. If EPA does not agree that the delay or anticipated delay has been or will be caused by a force majeure, EPA will notify Settling Defendant in writing of its decision. If EPA agrees that the delay is attributable to a force majeure, EPA will notify Settling Defendant in writing of the length of the extension, if any, for performance of the obligations affected by the force majeure.

76. If Settling Defendant elects to invoke the dispute resolution procedures set forth in Section XXI (Dispute Resolution), it shall do so no later than 15 days after receipt of EPA's notice. In any such proceeding, Settling Defendant shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a force majeure, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that best efforts were exercised to avoid and mitigate the effects of the delay, and that Settling Defendant complied with the requirements of Paragraphs 73 and 74. If Settling Defendant carries this burden, the delay at issue shall be deemed not to be a violation by Settling Defendant of the affected obligation of this Consent Decree identified to EPA and the Court.

XXI. DISPUTE RESOLUTION

77. Unless otherwise expressly provided for in this Consent Decree, the dispute resolution procedures of this Section shall be the exclusive mechanism to resolve disputes regarding this Consent Decree. However, the procedures set forth in this Section shall not apply to actions by the United States or the State to enforce obligations of Settling Defendant that have not been disputed in accordance with this Section.

78. Any dispute regarding this Consent Decree shall in the first instance be the subject of informal negotiations between the parties to the dispute. The period for informal negotiations shall not exceed 20 days from the time the dispute arises, unless it is modified by written agreement of the parties to the dispute. The dispute shall be considered to have arisen when one party sends the other parties a written Notice of Dispute.

79. Statements of Position.

a. In the event that the parties cannot resolve a dispute by informal negotiations under the preceding Paragraph, then the position advanced by EPA shall be considered binding unless, within 21 days after the conclusion of the informal negotiation period, Settling Defendant invokes the formal dispute resolution procedures of this Section by serving on the United States a written Statement of Position on the matter in dispute, including, but not limited to, any factual data, analysis, or opinion supporting that position and any supporting documentation relied upon by Settling Defendant. The Statement of Position shall specify Settling Defendant's position as to whether formal dispute resolution should proceed under Paragraph 80 (Record Review) or Paragraph 81.

b. Within 21 days after receipt of Settling Defendant's Statement of Position, EPA will serve on Settling Defendant its Statement of Position, including, but not limited to, any

factual data, analysis, or opinion supporting that position and all supporting documentation relied upon by EPA. EPA's Statement of Position shall include a statement as to whether formal dispute resolution should proceed under Paragraph 80 (Record Review) or Paragraph 81. Within ten days after receipt of EPA's Statement of Position, Settling Defendant may submit a Reply.

c. If there is disagreement between EPA and Settling Defendant as to whether dispute resolution should proceed under Paragraph 80 (Record Review) or Paragraph 81, the parties to the dispute shall follow the procedures set forth in the paragraph determined by EPA to be applicable. However, if Settling Defendant ultimately appeals to the Court to resolve the dispute, the Court shall determine which paragraph is applicable in accordance with the standards of applicability set forth in Paragraphs 80 and 81.

80. Record Review. Formal dispute resolution for disputes pertaining to the selection or adequacy of any response action and all other disputes that are accorded review on the administrative record under applicable principles of administrative law shall be conducted pursuant to the procedures set forth in this Paragraph. For purposes of this Paragraph, the adequacy of any response action includes, without limitation, the adequacy or appropriateness of plans, procedures to implement plans, or any other items requiring approval by EPA under this Consent Decree, and the adequacy of the performance of response actions taken pursuant to this Consent Decree. Nothing in this Consent Decree shall be construed to allow any dispute by Settling Defendant regarding the validity of the ROD's provisions.

a. An administrative record of the dispute shall be maintained by EPA and shall contain all statements of position, including supporting documentation, submitted pursuant to this Section. Where appropriate, EPA may allow submission of supplemental statements of position by the parties to the dispute.

b. The Director of the Superfund Division, EPA Region 5, will issue a final administrative decision resolving the dispute based on the administrative record described in Paragraph 80.a. This decision shall be binding upon Settling Defendant, subject only to the right to seek judicial review pursuant to Paragraphs 80.c and 80.d.

c. Any administrative decision made by EPA pursuant to Paragraph 80.b shall be reviewable by this Court, provided that a motion for judicial review of the decision is filed by Settling Defendant with the Court and served on all Parties within ten days after receipt of EPA's decision. The motion shall include a description of the matter in dispute, the efforts made by the parties to resolve it, the relief requested, and the schedule, if any, within which the dispute must be resolved to ensure orderly implementation of this Consent Decree. The United States may file a response to Settling Defendant's motion.

d. In proceedings on any dispute governed by this Paragraph, Settling Defendant shall have the burden of demonstrating that the decision of the Superfund Division Director is arbitrary and capricious or otherwise not in accordance with law. Judicial review of EPA's decision shall be on the administrative record compiled pursuant to Paragraph 80.a.

81. Formal dispute resolution for disputes that neither pertain to the selection or adequacy of any response action nor are otherwise accorded review on the administrative record under applicable principles of administrative law, shall be governed by this Paragraph.

a. Following receipt of Settling Defendant's Statement of Position submitted pursuant to Paragraph 79, the Director of the Superfund Division, EPA Region 5, will issue a

final decision resolving the dispute. The Superfund Division Director's decision shall be binding on Settling Defendant unless, within ten days after receipt of the decision, Settling Defendant files with the Court and serves on the parties a motion for judicial review of the decision setting forth the matter in dispute, the efforts made by the parties to resolve it, the relief requested, and the schedule, if any, within which the dispute must be resolved to ensure orderly implementation of the Consent Decree. The United States may file a response to Settling Defendant' motion.

b. Notwithstanding Paragraph R (CERCLA Section 113(j) Record Review of ROD and Work) of Section I (Background), judicial review of any dispute governed by this Paragraph shall be governed by applicable principles of law.

82. The invocation of formal dispute resolution procedures under this Section shall not extend, postpone, or affect in any way any obligation of Settling Defendant under this Consent Decree, not directly in dispute, unless EPA or the Court agrees otherwise. Stipulated penalties with respect to the disputed matter shall continue to accrue but payment shall be stayed pending resolution of the dispute as provided in Paragraph 90. Notwithstanding the stay of payment, stipulated penalties shall accrue from the first day of noncompliance with any applicable provision of this Consent Decree. In the event that Settling Defendant does not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section XXII (Stipulated Penalties).

XXII. STIPULATED PENALTIES

83. Settling Defendant shall be liable for stipulated penalties in the amounts set forth in Paragraphs 84 and 85 to the United States for failure to comply with the requirements of this Consent Decree specified below, unless excused under Section XX (Force Majeure). "Compliance" by Settling Defendant shall include completion of all payments and activities required under this Consent Decree, or any plan, report, or other deliverable approved under this Consent Decree, in accordance with all applicable requirements of law, this Consent Decree, the SOW, and any plans, reports, or other deliverables approved under this Consent Decree and within the specified time schedules established by and approved under this Consent Decree.

84. Stipulated Penalty Amounts – Compliance Milestones.

a. The following stipulated penalties shall accrue per violation per day for any noncompliance identified in Paragraph 84.b:

Penalty Per Violation Per Day	Period of Noncompliance
$1,000	1st through 14th day
$1,500	15th through 30th day
$3,000	31st day and beyond

b. Compliance Milestones.

(1) Failure to timely submit or resubmit the Preliminary, Prefinal or Final Design;

(2) Failure to timely submit or resubmit the Phase 1 Remedial Action Work Plan;

(3) Failure to timely initiate Phase 1 Remedial Action Construction or to complete the Phase 1 Remedial Action;

(4) Failure to timely submit, resubmit, or to implement the Operation and Maintenance Plan;

(5) Failure to conduct Performance Monitoring;

(6) Failure to timely submit, resubmit, or implement the Institutional Control Implementation and Assurance Plan;

(7) Failure to establish or maintain the required performance guarantee pursuant to Section XIII of this Consent Decree;

(8) Failure to make best efforts to obtain or to provide access or to execute the required Institutional Controls and submit them to WDNR pursuant to Section IX of this Consent Decree;

(9) Failure to timely make payment of Future Response Costs pursuant to Section XVII of this Consent Decree;

(10) Failure to initiate or complete any further response actions EPA selects for the Phase 1 Project Area pursuant to Paragraph 20 of this Consent Decree;

(11) Failure to timely submit draft deeds for NRD Property pursuant to Paragraph 67 of this Consent Decree; and

(12) Failure to timely complete the transfers of NRD Property pursuant to Paragraph 68 of this Consent Decree.

85. Stipulated Penalty Amounts - Other Requirements. The following stipulated penalties shall accrue per violation per day for failure to submit timely or adequate reports or other plans or deliverables, other than those specified in the preceding Paragraph, or to satisfy any other requirement of the Consent Decree:

Penalty Per Violation Per Day	Period of Noncompliance
$500	1st through 14th day
$1,000	15th through 30th day
$2,000	31st day and beyond

86. In the event that EPA assumes performance of a portion or all of the Work pursuant to Paragraph 102 (Work Takeover), Settling Defendant shall be liable for a stipulated penalty in the amount of $1.5 million. Stipulated penalties under this Paragraph are in addition to the remedies available under Paragraphs 48 (Funding for Work Takeover) and 102 (Work Takeover).

87. All penalties shall begin to accrue on the day after the complete performance is due or the day a violation occurs, and shall continue to accrue through the final day of the correction of the noncompliance or completion of the activity. However, stipulated penalties shall not accrue: (a) with respect to a deficient submission under Section XI (EPA Approval of Plans, Reports, and Other Deliverables), during the period, if any, beginning on the 31st day after EPA's receipt of such submission until the date that EPA notifies Settling Defendant of any deficiency; (b) with respect to a decision by the Director of the Superfund Division, EPA Region

5, under Paragraph 80.b or 81.a of Section XXI (Dispute Resolution), during the period, if any, beginning on the 21st day after the date that Settling Defendant's reply to EPA's Statement of Position is received until the date that the Director issues a final decision regarding such dispute; or (c) with respect to judicial review by this Court of any dispute under Section XXI (Dispute Resolution), during the period, if any, beginning on the 31st day after the Court's receipt of the final submission regarding the dispute until the date that the Court issues a final decision regarding such dispute. Nothing in this Consent Decree shall prevent the simultaneous accrual of separate penalties for separate violations of this Consent Decree.

88. Following the United States' determination that Settling Defendant has failed to comply with a requirement of this Consent Decree, the United States may give Settling Defendant written notification of the same and describe the noncompliance. The United States may send Settling Defendant a written demand for the payment of the penalties. However, penalties shall accrue as provided in the preceding Paragraph regardless of whether the United States has notified Settling Defendant of a violation.

89. All penalties accruing under this Section shall be due and payable to the United States within 30 days after Settling Defendant's receipt from EPA of a demand for payment of the penalties, unless Settling Defendant invokes the Dispute Resolution procedures under Section XXI (Dispute Resolution) within the 30-day period. All payments to the United States under this Section shall indicate that the payment is for stipulated penalties, and shall be made in accordance with Paragraph 62 (Payment Instructions for Settling Defendant), except that stipulated penalties pursuant to Paragraph 84.b(11)-(12) shall be made to the Financial Litigation Unit of the U.S. Attorney's Office for the Western District of Wisconsin pursuant to instructions to be provided by the Financial Litigation Unit if necessary. Dispute resolution for Paragraph 84.b(11)-(12) shall be conducted pursuant to Paragraph 69 (Dispute Resolution for Natural Resource Restoration Projects).

90. Penalties shall continue to accrue as provided in Paragraph 87 during any dispute resolution period, but need not be paid until the following:

a. If the dispute is resolved by agreement of the Parties or by a decision of EPA that is not appealed to this Court, accrued penalties determined to be owed shall be paid to EPA within 15 days after the agreement or the receipt of EPA's decision or order;

b. If the dispute is appealed to this Court and the United States prevails in whole or in part, Settling Defendant shall pay all accrued penalties determined by the Court to be owed to EPA within 60 days after receipt of the Court's decision or order, except as provided in Paragraph 90.c;

c. If the District Court's decision is appealed by any Party, Settling Defendant shall pay all accrued penalties determined by the District Court to be owed to the United States into an interest-bearing escrow account, established at a duly chartered bank or trust company that is insured by the FDIC, within 60 days after receipt of the Court's decision or order. Penalties shall be paid into this account as they continue to accrue, at least every 60 days. Within 15 days after receipt of the final appellate court decision, the escrow agent shall pay the balance of the account to EPA or to Settling Defendant to the extent that it prevails.

91. If Settling Defendant fails to pay stipulated penalties when due, Settling Defendant shall pay Interest on the unpaid stipulated penalties as follows: (a) if Settling

Defendant has timely invoked dispute resolution such that the obligation to pay stipulated penalties has been stayed pending the outcome of dispute resolution, Interest shall accrue from the date stipulated penalties are due pursuant to Paragraph 90 until the date of payment; and (b) if Settling Defendant fails to timely invoke dispute resolution, Interest shall accrue from the date of demand under Paragraph 89 until the date of payment. If Settling Defendant fails to pay stipulated penalties and Interest when due, the United States may institute proceedings to collect the penalties and Interest.

92. The payment of penalties and Interest, if any, shall not alter in any way Settling Defendant's obligation to complete the performance of the Work required under this Consent Decree.

93. Nothing in this Consent Decree shall be construed as prohibiting, altering, or in any way limiting the ability of the United States or the State to seek any other remedies or sanctions available by virtue of Settling Defendant's violation of this Consent Decree or of the statutes and regulations upon which it is based, including, but not limited to, penalties pursuant to Section 122(*l*) of CERCLA, 42 U.S.C. § 9622(*l*), and Chapters 289, 291, and 292 of the Wisconsin Statutes, provided, however, that the United States shall not seek civil penalties pursuant to Section 122(*l*) of CERCLA or Chapters 289, 291, and 292 of the Wisconsin Statutes for any violation for which a stipulated penalty is provided in this Consent Decree, except in the case of a willful violation of this Consent Decree.

94. Notwithstanding any other provision of this Section, the United States may, in its unreviewable discretion, waive any portion of stipulated penalties that have accrued pursuant to this Consent Decree.

XXIII. COVENANTS BY PLAINTIFFS AND TRIBES

95. Covenants for Settling Defendant by the United States and the State.

a. In consideration of the actions that will be performed and the payments that will be made by Settling Defendant under this Consent Decree, and except as specifically provided in Paragraphs 97 and 98 (United States' Pre- and Post-Certification Reservations), and 101 (General Reservations of Rights), the United States covenants not to sue or to take administrative action against Settling Defendant pursuant to Sections 106 and 107(a) of CERCLA relating to the Phase 1 Project Area. These covenants are conditioned upon the satisfactory performance by Settling Defendant of its obligations under this Consent Decree. These covenants not to sue extend only to the Settling Defendant and do not extend to any other person; provided, however that these covenants not to sue (and the reservations thereto) shall also apply to Settling Defendant's Related Parties.

b. In consideration of the actions that will be performed and the payments that will be made by Settling Defendant under this Consent Decree, and except as specifically provided in Paragraph 101 (General Reservations of Rights), the State covenants not to sue or to take administrative action against Settling Defendant pursuant to Section 107(a) of CERCLA and Wisconsin statutory or common law relating to the Phase 1 Project Area. These covenants are conditioned upon the satisfactory performance by Settling Defendant of its obligations under this Consent Decree. These covenants not to sue extend only to the Settling Defendant and do not

extend to any other person; provided, however that these covenants not to sue (and the reservations thereto) shall also apply to Settling Defendant's Related Parties.

96. Covenants for Natural Resource Damages. In consideration of the actions that will be performed and the land transfers that will be made by Settling Defendant under this Consent Decree, and except as specifically provided in Paragraphs 100 and 101, the United States, the State, and the Tribes covenant not to sue or to take administrative action against Settling Defendant for Natural Resource Damages relating to the Site pursuant to Section 107(f) of CERCLA and Section 311(f) of the Clean Water Act, Wisconsin statutory or common law, or Tribal law. These covenants not to sue shall take effect upon the receipt by the Trustees of the land to be transferred as required by Section XVIII (Natural Resource Restoration Projects). These covenants are conditioned upon the satisfactory performance by Settling Defendant of its obligations under this Consent Decree. These covenants not to sue extend only to the Settling Defendant and do not extend to any other person; provided, however that these covenants not to sue (and the reservations thereto) shall also apply to Settling Defendant's Related Parties.

97. United States' Pre-Certification Reservations. Notwithstanding any other provision of this Consent Decree, the United States reserves, and this Consent Decree is without prejudice to, the right to institute proceedings in this action or in a new action, and/or to issue an administrative order, seeking to compel Settling Defendant to perform further response actions relating to the Phase 1 Project Area and/or to pay the United States for additional costs of response if, (a) prior to Certification of Completion of the Phase 1 Remedial Action, (1) conditions at the Phase 1 Project Area, previously unknown to EPA, are discovered, or (2) information, previously unknown to EPA, is received, in whole or in part, and (b) EPA determines that these previously unknown conditions or information together with any other relevant information indicates that the Phase 1 Remedial Action is not protective of human health or the environment.

98. United States' Post-Certification Reservations. Notwithstanding any other provision of this Consent Decree, the United States reserves, and this Consent Decree is without prejudice to, the right to institute proceedings in this action or in a new action, and/or to issue an administrative order, seeking to compel Settling Defendant to perform further response actions relating to the Phase 1 Project Area and/or to pay the United States for additional costs of response if, (a) subsequent to Certification of Completion of the Phase 1 Remedial Action, (1) conditions at the Site, previously unknown to EPA, are discovered, or (2) information, previously unknown to EPA, is received, in whole or in part, and (b) EPA determines that these previously unknown conditions or this information together with other relevant information indicate that the Phase 1 Remedial Action is not protective of human health or the environment.

99. For purposes of Paragraph 97 (United States' Pre-Certification Reservations), the information and the conditions known to EPA will include only that information and those conditions known to EPA as of the date the ROD was signed and set forth in the ROD for the Site and the administrative record supporting the ROD. For purposes of Paragraph 98 (United States' Post-Certification Reservations), the information and the conditions known to EPA shall include only that information and those conditions known to EPA as of the date of Certification of Completion of the Remedial Action and set forth in the ROD, the administrative record supporting the ROD, the post-ROD administrative record, or in any information received by EPA pursuant to the requirements of this Consent Decree prior to Certification of Completion of the Phase 1 Remedial Action.

100. Trustees' Reservations Regarding Natural Resource Damages. Notwithstanding any other provision of this Consent Decree, the Trustees reserve the right to institute proceedings against Settling Defendant in this action or in a new action seeking recovery of Natural Resource Damages, based on: (1) conditions with respect to the Site, unknown to the Trustees as of the date of lodging of this Consent Decree, that result in releases of hazardous substances that contribute to injury to, destruction of, or loss of Natural Resources ("Unknown NRD Conditions"), or (2) information received by the Trustees after the date of lodging of this Consent Decree which indicates that the releases of hazardous substances at the Site have resulted in injury to, destruction of, or loss of Natural Resources of a type or future persistence that was unknown to the Trustees as of the date of lodging of this Consent Decree ("New NRD Information"). The following shall not be considered Unknown NRD Conditions or New NRD Information for the purpose of this Paragraph: (1) an increase solely in any Trustee's assessment of the magnitude of a known injury to, destruction of, or loss of Natural Resources at the Site; or (2) injury to, destruction of, or loss of Natural Resources at the Site arising from the re-exposure, resuspension, or migration of hazardous substances known to be present at the Site. For the purpose of this Paragraph, the information and conditions known to the Trustees shall include any information or conditions listed or identified in records relating to the Site that were in the possession or under the control of EPA, DOI, DOC, WDNR, or the Tribes as of the Date of Lodging of this Consent Decree.

101. General Reservations of Rights. The United States, the State, and the Tribes reserve, and this Consent Decree is without prejudice to, all rights against Settling Defendant and Settling Defendant's Related Parties with respect to all matters not expressly included within Plaintiffs' covenants. Notwithstanding any other provision of this Consent Decree, the United States and the State reserve, and the Tribes reserve as to Natural Resource Damages, all rights against Settling Defendant with respect to:

a. liability for failure by Settling Defendant to meet a requirement of this Consent Decree;

b. liability arising from the past, present, or future disposal, release, or threat of release of Waste Material outside of the Site;

c. liability based on the ownership or operation of the Site by Settling Defendant when such ownership or operation commences after signature of this Consent Decree by Settling Defendant;

d. liability based on the operation of the Site by Settling Defendant when such operation commences after signature of this Consent Decree by Settling Defendant and does not arise solely from Settling Defendant's performance of the Work;

e. liability based on Settling Defendant's transportation, treatment, storage, or disposal, or the arrangement for the transportation, treatment, storage, or disposal of Waste Material at or in connection with the Site, other than as provided in the ROD, the Work, or otherwise ordered by EPA, after signature of this Consent Decree by Settling Defendant;

f. criminal liability;

g. liability for violations of federal or state law that occur during or after implementation of the Work;

h. liability, prior to Certification of Completion of the Phase 1 Remedial Action, for additional response actions that EPA determines are necessary to achieve and maintain Phase 1 Performance Standards or to carry out and maintain the effectiveness of the remedy set forth in the ROD, but that cannot be required pursuant to Paragraph 14 (Modification of SOW or Related Work Plans);

i. liability for performance of response actions in areas of the Site other than the Phase 1 Project Area;

j. liability for costs that the United States will incur regarding the Site but that are not within the definition of Future Response Costs; and

k. liability for previously incurred costs of response.

102. Work Takeover.

a. In the event EPA, after consultation with WDNR, determines that Settling Defendant has (1) ceased implementation of any portion of the Work, or (2) is seriously or repeatedly deficient or late in its performance of the Work, or (3) is implementing the Work in a manner that may cause an endangerment to human health or the environment, EPA may issue a written notice ("Work Takeover Notice") to Settling Defendant. Any Work Takeover Notice issued by EPA will specify the grounds upon which such notice was issued and will provide Settling Defendant a period of 30 days within which to remedy the circumstances giving rise to EPA's issuance of such notice.

b. If, after expiration of the 30-day notice period specified in Paragraph 102.a, Settling Defendant has not remedied to EPA's satisfaction the circumstances giving rise to EPA's issuance of the relevant Work Takeover Notice, EPA may at any time thereafter assume the performance of all or any portion(s) of the Work as EPA deems necessary ("Work Takeover"). EPA will notify Settling Defendant in writing (which writing may be electronic) if EPA determines that implementation of a Work Takeover is warranted under this Paragraph 102.b. Funding of Work Takeover costs is addressed under Paragraph 48.

c. Settling Defendant may invoke the procedures set forth in Paragraph 80 (Record Review), to dispute EPA's implementation of a Work Takeover under Paragraph 102.b. However, notwithstanding Settling Defendant's invocation of such dispute resolution procedures, and during the pendency of any such dispute, EPA may in its sole discretion commence and continue a Work Takeover under Paragraph 102.b until the earlier of (1) the date that Settling Defendant remedies, to EPA's satisfaction, the circumstances giving rise to EPA's issuance of the relevant Work Takeover Notice, or (2) the date that a final decision is rendered in accordance with Paragraph 80 (Record Review) requiring EPA to terminate such Work Takeover.

103. Notwithstanding any other provision of this Consent Decree, the United States and the State retain all authority and reserves all rights to take any and all response actions authorized by law.

XXIV. COVENANTS BY SETTLING DEFENDANT

104. Covenants Not to Sue by Settling Defendant. Subject to the reservations in Paragraph 106, Settling Defendant and Settling Defendant's Related Parties covenant not to sue and agree not to assert any claims or causes of action against the United States or the State with respect to the Work, Future Response Costs, Natural Resource Damages, and this Consent Decree, including, but not limited to:

a. any direct or indirect claim for reimbursement from the Hazardous Substance Superfund (established pursuant to the Internal Revenue Code, 26 U.S.C. § 9507) through CERCLA Sections 106(b)(2), 107, 111, 112 or 113, or any other provision of law;

b. any claims against the United States, including any department, agency, or instrumentality of the United States, or the State, including any department or agency of the State, under CERCLA Sections 107 or 113, RCRA Section 7002(a), 42 U.S.C. § 6972(a), or state law regarding the Work, Future Response Costs, and this Consent Decree; or

c. any claims arising out of response actions at or in connection with the Phase 1 Project Area, including any claim under the United States Constitution, the Wisconsin Constitution, the Tucker Act, 28 U.S.C. §1491, the Equal Access to Justice Act, 28 U.S.C. § 2412, as amended, or at common law regarding the Work and this Consent Decree.

105. Except as provided Paragraph 114 (Res Judicata and Other Defenses), the covenants in this Section shall not apply if the United States or the State brings a cause of action or issues an order pursuant to any of the reservations in Section XXIII (Covenants by Plaintiffs and Tribes), other than in Paragraphs 101.a (claims for failure to meet a requirement of the Decree), 101.f (criminal liability), and 101.g (violations of federal/state law during or after implementation of the Work), but only to the extent that Settling Defendant's claims arise from the same response action, response costs, or damages that the United States, the State, or the Tribes is seeking pursuant to the applicable reservation and only with respect to the entity bringing the action.

106. Settling Defendant and Settling Defendant's Related Parties expressly reserve all rights and remedies that relate to or arise from issues or matters beyond the scope of this Consent Decree, including, specifically, but not limited to, any claims regarding Chequamegon Bay, except those claims related to Natural Resource Damages in Chequamegon Bay. Except as specifically provided in this Consent Decree, nothing herein shall limit or otherwise alter or affect Settling Defendant's or Settling Defendant's Related Parties' rights, defenses, causes of action, claims or interests, or ability to assert same, whether arising under or pursuant to state, federal, or common law whatsoever, whether against Plaintiffs or others, and all such rights, defenses, claims, causes of action, or interests are hereby fully reserved. Settling Defendant and Settling Defendant's Related Parties reserve, and this Consent Decree is without prejudice to, claims against the United States, subject to the provisions of Chapter 171 of Title 28 of the United States Code, and brought pursuant to any statute other than CERCLA or RCRA and for which the waiver of sovereign immunity is found in a statute other than CERCLA or RCRA, for money damages for injury or loss of property or personal injury or death caused by the negligent or wrongful act or omission of any employee of the United States, as that term is defined in 28 U.S.C. § 2671, while acting within the scope of his or her office or employment under circumstances where the United States, if a private person, would be liable to the claimant in accordance with the law of the place where the act or omission occurred. However, the

foregoing shall not include any claim based on EPA's selection of response actions, or the oversight or approval of Settling Defendant's plans, reports, other deliverables, or activities.

107. Nothing in this Consent Decree shall be deemed to constitute preauthorization of a claim within the meaning of Section 111 of CERCLA, 42 U.S.C. § 9611, or 40 C.F.R. § 300.700(d).

108. Claims Against De Micromis Parties. Settling Defendant agrees not to assert any claims and to waive all claims or causes of action (including but not limited to claims or causes of action under Sections 107(a) and 113 of CERCLA) that it may have for all matters relating to the Site against any person where the person's liability to Settling Defendant with respect to the Site is based solely on having arranged for disposal or treatment, or for transport for disposal or treatment, of hazardous substances at the Site, or having accepted for transport for disposal or treatment of hazardous substances at the Site, if all or part of the disposal, treatment, or transport occurred before April 1, 2001, and the total amount of material containing hazardous substances contributed by such person to the Site was less than 110 gallons of liquid materials or 200 pounds of solid materials.

109. The waiver in Paragraph 108 (Claims Against De Micromis Parties) shall not apply with respect to any defense, claim, or cause of action that a Settling Defendant may have against any person meeting the criteria in Paragraph 108 if such person asserts a claim or cause of action relating to the Site against Settling Defendant. This waiver does not apply to any potential claim Settling Defendant may assert against the City of Ashland, Wisconsin, Soo Line Railroad, or Wisconsin Central Ltd. This waiver also shall not apply to any claim or cause of action against any person meeting the criteria in Paragraph 108 if EPA determines:

a. that such person has failed to comply with any EPA requests for information or administrative subpoenas issued pursuant to Section 104(e) or 122(e) of CERCLA, 42 U.S.C. § 9604(e) or 9622(e), or Section 3007 of RCRA, 42 U.S.C. § 6927, or has impeded or is impeding, through action or inaction, the performance of a response action or Natural Resource restoration with respect to the Site, or has been convicted of a criminal violation for the conduct to which this waiver would apply and that conviction has not been vitiated on appeal or otherwise; or

b. that the materials containing hazardous substances contributed to the Site by such person have contributed significantly, or could contribute significantly, either individually or in the aggregate, to the cost of response action or Natural Resource restoration at the Site.

XXV. EFFECT OF SETTLEMENT; CONTRIBUTION

110. Nothing in this Consent Decree shall be construed to create any rights in, or grant any cause of action to, any person not a Party to this Consent Decree. Each of the Parties expressly reserves any and all rights (including, but not limited to, pursuant to Section 113 of CERCLA, 42 U.S.C. § 9613), defenses, claims, demands, and causes of action that each Party may have with respect to any matter, transaction, or occurrence relating in any way to the Site against any person not a Party hereto. Nothing in this Consent Decree diminishes the right of the United States, pursuant to Section 113(f)(2) and (3) of CERCLA, 42 U.S.C. § 9613(f)(2)-(3), to

pursue any such persons to obtain additional response costs or response action and to enter into settlements that give rise to contribution protection pursuant to Section 113(f)(2).

111. The Parties agree, and by entering this Consent Decree this Court finds, that this Consent Decree constitutes a judicially approved settlement for purposes of Section 113(f)(2) of CERCLA, 42 U.S.C. § 9613(f)(2), and that Settling Defendant and Settling Defendant's Related Parties are entitled, as of the Effective Date, to protection from contribution actions or claims as provided by Section 113(f)(2) of CERCLA, or as may be otherwise provided by law, for "matters addressed" in this Consent Decree. The "matters addressed" in this Consent Decree are the Work, Future Response Costs, and Natural Resource Damages.

112. Settling Defendant shall, with respect to any suit or claim brought by it for matters related to this Consent Decree, notify the United States and the State in writing no later than 5 days after the initiation of such suit or claim.

113. Settling Defendant shall, with respect to any suit or claim brought against it for matters related to this Consent Decree, notify in writing the United States and the State within ten days after service of the complaint on such Settling Defendant. In addition, Settling Defendant shall notify the United States and the State within ten days after service or receipt of any Motion for Summary Judgment and within ten days after receipt of any order from a court setting a case for trial.

114. Res Judicata and Other Defenses. In any subsequent administrative or judicial proceeding initiated by the United States or the State for injunctive relief, recovery of response costs, or other appropriate relief relating to the Site, Settling Defendant shall not assert, and may not maintain, any defense or claim based upon the principles of waiver, res judicata, collateral estoppel, issue preclusion, claim-splitting, or other defenses based upon any contention that the claims raised by the United States or the State in the subsequent proceeding were or should have been brought in the instant case; provided, however, that nothing in this Paragraph affects the enforceability of the covenants not to sue set forth in Section XXIII (Covenants by Plaintiffs and Tribes).

XXVI. ACCESS TO INFORMATION

115. Settling Defendant shall provide to EPA and WDNR, upon request, copies of all records, reports, documents, and other information (including records, reports, documents, and other information in electronic form) created or generated pursuant to the requirements to perform the Work (hereinafter referred to as "Records") within its possession or control or that of its contractors or agents relating to activities at the Site or to the implementation of this Consent Decree, including, but not limited to, sampling, analysis, chain of custody records, manifests, trucking logs, receipts, reports, sample traffic routing, correspondence, or other documents or information created or generated pursuant to the requirements to perform the Work. Settling Defendant shall also make available to EPA and WDNR, for purposes of investigation, information gathering, or testimony, its employees, agents, or representatives with knowledge of relevant facts concerning the performance of the Work.

116. Business Confidential and Privileged Documents.

a. Settling Defendant may assert business confidentiality claims covering part or all of the Records submitted to Plaintiffs under this Consent Decree to the extent

permitted by and in accordance with Section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7), and 40 C.F.R. § 2.203(b). Records determined to be confidential by EPA will be afforded the protection specified in 40 C.F.R. Part 2, Subpart B. If no claim of confidentiality accompanies Records when they are submitted to EPA and WDNR, or if EPA has notified Settling Defendant that the Records are not confidential under the standards of Section 104(e)(7) of CERCLA or 40 C.F.R. Part 2, Subpart B, the public may be given access to such Records without further notice to Settling Defendant.

b. Settling Defendant may assert that certain Records are privileged under the attorney-client privilege or any other privilege recognized by federal law. If Settling Defendant asserts such a privilege in lieu of providing Records, it shall provide Plaintiffs with the following: (1) the title of the Record; (2) the date of the Record; (3) the name, title, affiliation (e.g., company or firm), and address of the author of the Record; (4) the name and title of each addressee and recipient; (5) a description of the contents of the Record; and (6) the privilege asserted by Settling Defendant. If a claim of privilege applies only to a portion of a Record, the Record shall be provided to the United States and the State in redacted form to mask the privileged portion only. Settling Defendant shall retain all Records that it claims to be privileged until the United States and the State have had a reasonable opportunity to dispute the privilege claim and any such dispute has been resolved in the Settling Defendant's favor.

c. No Records created or generated pursuant to the requirements to perform the Work under this Consent Decree shall be withheld from the United States or the State on the grounds that they are privileged or confidential.

117. No claim of confidentiality or privilege shall be made with respect to any data, including, but not limited to, all sampling, analytical, monitoring, hydrogeologic, scientific, chemical, or engineering data, or any other documents or information evidencing conditions at or around the Site.

XXVII. RETENTION OF RECORDS

118. Until ten years after Settling Defendant's receipt of EPA's notification pursuant to Paragraph 51.b (Completion of the Work), Settling Defendant shall preserve and retain all non-identical copies of Records (including Records in electronic form) now in its possession or control or that come into its possession or control that relate in any manner to its liability under CERCLA with respect to the Site, provided, however, that Settling Defendant must retain, in addition, all Records that relate to the liability of any other person under CERCLA with respect to the Site. Settling Defendant must also retain, and instruct its contractors and agents to preserve, for the same period of time specified above all non-identical copies of the last draft or final version of any Records (including Records in electronic form) now in its possession or control or that come into its possession or control that relate in any manner to the performance of the Work, provided, however, that Settling Defendant (and its contractors and agents) must retain, in addition, copies of all data generated during the performance of the Work and not contained in the aforementioned Records required to be retained. Each of the above record retention requirements shall apply regardless of any corporate retention policy to the contrary.

119. At the conclusion of this record retention period, Settling Defendant shall notify the United States and the State at least 90 days prior to the destruction of any such Records, and,

upon request, Settling Defendant shall deliver any such Records to EPA or WDNR. Settling Defendant may assert that certain Records are privileged under the attorney-client privilege or any other privilege recognized by federal law. If Settling Defendant asserts such a privilege, it shall provide EPA and WDNR with the following: (a) the title of the Record; (b) the date of the Record; (c) the name, title, affiliation (e.g., company or firm), and address of the author of the Record; (d) the name and title of each addressee and recipient; (e) a description of the subject of the Record; and (f) the privilege asserted by Settling Defendant. If a claim of privilege applies only to a portion of a Record, the Record shall be provided to the United States and the State in redacted form to mask the privileged portion only. Settling Defendant shall retain all Records that it claims to be privileged until the United States and the State have had a reasonable opportunity to dispute the privilege claim and any such dispute has been resolved in the Settling Defendant's favor. However, no Records created or generated pursuant to the requirements of this Consent Decree shall be withheld on the grounds that they are privileged or confidential.

120. Settling Defendant certifies that, to the best of its knowledge and belief, after thorough inquiry, it has not altered, mutilated, discarded, destroyed, or otherwise disposed of any Records (other than identical copies) relating to its potential liability regarding the Site since the earlier of notification of potential liability by the United States or the State or the filing of suit against it regarding the Site and that it has fully complied with any and all EPA and WDNR requests for information pursuant to Sections 104(e) and 122(e) of CERCLA, 42 U.S.C. §§ 9604(e) and 9622(e), and Section 3007 of RCRA, 42 U.S.C. § 6927.

XXVIII. NOTICES AND SUBMISSIONS

121. Whenever, under the terms of this Consent Decree, written notice is required to be given or a report or other document is required to be sent by one Party to another, it shall be directed to the individuals at the addresses specified below, unless those individuals or their successors give notice of a change to the other Parties in writing. All notices and submissions shall be considered effective upon receipt, unless otherwise provided. Written notice as specified in this Section shall constitute complete satisfaction of any written notice requirement of the Consent Decree with respect to the United States, EPA, the State, WDNR, the Tribes, and Settling Defendant, respectively. Notices required to be sent to EPA, and not to the United States, under the terms of this Consent Decree should not be sent to the U.S. Department of Justice, the U.S. Fish and Wildlife Service, or NOAA. Notices required to be sent to the United States shall be sent to EPA and the U.S. Department of Justice, but shall only be sent to the U.S. Fish and Wildlife Service and NOAA if they involve Natural Resource Damages. Notices required to be sent to Plaintiffs shall be sent to EPA, the U.S. Department of Justice, the State, and DNR, but shall only be sent to the U.S. Fish and Wildlife Service and NOAA if they involve Natural Resource Damages.

As to the United States:

Chief, Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
P.O. Box 7611
Washington, D.C. 20044-7611
Re: DJ # 90-11-2-08879/1

As to EPA:	Richard C. Karl Director, Superfund Division United States Environmental Protection Agency Region 5 77 W. Jackson Blvd. (SR-6J) Chicago, IL 60604-3590
and	Scott Hansen EPA Project Coordinator United States Environmental Protection Agency Region 5 77 W. Jackson Blvd. (SR-6J) Chicago, IL 60604-3590
to the Regional Financial Management Officer:	Richard Hackley United States Environmental Protection Agency Region 5 77 West Jackson Boulevard Mail Code: MF-10J Chicago, IL 60604-3507
As to DOI and the United States Fish and Wildlife Service:	Assistant Solicitor Branch of Environmental Restoration, Division of Parks and Wildlife 1849 C Street, NW, MS- 5311 Washington, DC 20240
and	Field Supervisor U.S. Fish & Wildlife Service 2661 Scott Tower Drive New Franken, WI 54229
As to NOAA	Laurie Lee Office of General Counsel 501 West Ocean Blvd., Suite 4470 Long Beach, CA 90802
and	Todd Goeks Physical Scientist, Region 5 National Oceanic and Atmospheric Administration 77 West Jackson Blvd. (SR-6J) Chicago, IL 60604

As to the State:	Attorney Kristin A. Hess Bureau of Legal Services Wisconsin DNR P.O. Box 7921 101 S. Webster Street Madison, WI 53707-7921
As to WDNR:	Jamie Dunn WDNR Project Manager 810 West Maple Street Spooner, WI 54801
As to the Bad River Tribe:	Mike Wiggins Jr. Tribal Chairman 72682 Maple Street/PO Box 39 Odanah, WI 54861
and	Natural Resources Director and Environmental Specialist 72682 Maple Street/PO Box 39 Odanah, WI 54861
As to the Red Cliff Tribe:	Tribal Chairperson Red Cliff Band of Lake Superior Chippewa Indians 88385 Pike Road Bayfield, Wisconsin 54814
and	Tribal Attorney Red Cliff Legal Department 88385 Pike Road Bayfield, Wisconsin 54814
As to Settling Defendant:	Jerry C. Winslow Xcel Energy Services, Inc., on behalf of NSPW 414 Nicollet Mall, MP7 Minneapolis, MN 55401
and	Kristen Shults Carney Assistant General Counsel Xcel Energy Services, Inc., on behalf of NSPW 1800 Larimer 11th Floor Denver, CO 80202

XXIX. RETENTION OF JURISDICTION

122. This Court retains jurisdiction over both the subject matter of this Consent Decree and Settling Defendant for the duration of the performance of the terms and provisions of this Consent Decree for the purpose of enabling any of the Parties to apply to the Court at any time for such further order, direction, and relief as may be necessary or appropriate for the construction or modification of this Consent Decree, or to effectuate or enforce compliance with its terms, or to resolve disputes in accordance with Section XXI (Dispute Resolution).

XXX. APPENDICES

123. The following appendices are attached to and incorporated into this Consent Decree:

"Appendix A" is the ROD.

"Appendix B" is the SOW.

"Appendix C" is the description and/or map of the Site.

"Appendix D" is the 1998 Spill Response Agreement between Settling Defendant and DNR and is incorporated by reference only as to Activity No. a (related to lakefront warning signs) and Activity No. d (related to warning buoys in Chequamegon Bay), as required by Paragraph 26.f, and does not otherwise affect the provisions of this Consent Decree.

"Appendix E" is the form for the financial test demonstration described in Section XIII (Performance Guarantee).

"Appendix F" is the easement for the Bad River Falls Restoration Property.

XXXI. COMMUNITY INVOLVEMENT

124. If requested by EPA or WDNR, Settling Defendant shall participate in community activities pursuant to the Community Involvement Plan to be developed by EPA, after consultation with WDNR. EPA will determine the appropriate role for Settling Defendant under the Plan. Settling Defendant shall also cooperate with EPA and WDNR in providing information regarding the Work to the public. As requested by EPA or WDNR, Settling Defendant shall participate in the preparation of such information for dissemination to the public and in public meetings that may be held or sponsored by EPA or WDNR to explain activities at or relating to the Phase 1 Project Area. Costs incurred by the United States under this Section, including the costs of any technical assistance grant under Section 117(e) of CERCLA, 42 U.S.C. § 9617(e), shall be considered Future Response Costs that Settling Defendant shall pay pursuant to Section XVII (Payments for Response Costs).

XXXII. MODIFICATION

125. Except as provided in Paragraph 14 (Modification of SOW or Related Work Plans), material modifications to this Consent Decree, including the SOW, shall be in writing, signed by the United States, the State, and Settling Defendant, and shall be effective upon approval by the Court. Except as provided in Paragraph 14, non-material modifications to this Consent Decree, including the SOW, shall be in writing and shall be effective when signed by duly authorized representatives of the United States, the State, and Settling Defendant. A modification to the SOW shall be considered material if it fundamentally alters the basic features of the selected remedy within the meaning of 40 C.F.R. § 300.435(c)(2)(ii). Before providing its approval to any modification to the SOW, the United States will provide the State with a reasonable opportunity to review and comment on the proposed modification. In addition, modifications to Section XVIII (Natural Resource Restoration Projects) shall require signature from authorized representatives of the Tribes.

126. Nothing in this Consent Decree shall be deemed to alter the Court's power to enforce, supervise, or approve modifications to this Consent Decree.

XXXIII. LODGING AND OPPORTUNITY FOR PUBLIC COMMENT

127. This Consent Decree shall be lodged with the Court for a period of not less than 30 days for public notice and comment in accordance with Section 122(d)(2) of CERCLA, 42 U.S.C. § 9622(d)(2), and 28 C.F.R. § 50.7. The United States reserves the right to withdraw or withhold its consent if the comments regarding the Consent Decree disclose facts or considerations that indicate that the Consent Decree is inappropriate, improper, or inadequate. Settling Defendant consents to the entry of this Consent Decree without further notice.

128. If for any reason the Court should decline to approve this Consent Decree in the form presented, this agreement is voidable at the sole discretion of any Party and the terms of the agreement may not be used as evidence in any litigation between the Parties.

XXXIV. SIGNATORIES/SERVICE

129. The undersigned representatives of Settling Defendant, Settling Defendant's Related Parties, the State, and the Tribes, as well as the Assistant Attorney General for the Environment and Natural Resources Division of the Department of Justice each certifies that he or she is fully authorized to enter into the terms and conditions of this Consent Decree and to execute and legally bind such Party to this document.

130. Settling Defendant and Settling Defendant's Related Parties agree not to oppose entry of this Consent Decree by this Court or to challenge any provision of this Consent Decree unless the United States has notified Settling Defendant in writing that it no longer supports entry of the Consent Decree.

131. Settling Defendant shall identify, on the attached signature page, the name, address, and telephone number of an agent who is authorized to accept service of process by mail on behalf of Settling Defendant with respect to all matters arising under or relating to this Consent Decree. Settling Defendant agrees to accept service in that manner and to waive the formal service requirements set forth in Rule 4 of the Federal Rules of Civil Procedure and any

applicable local rules of this Court, including, but not limited to, service of a summons. Settling Defendant need not file an answer to the complaint in this action unless or until the Court expressly declines to enter this Consent Decree.

XXXV. FINAL JUDGMENT

132. This Consent Decree and its appendices constitute the final, complete, and exclusive agreement and understanding among the Parties regarding the settlement embodied in the Consent Decree. The Parties acknowledge that there are no representations, agreements, or understandings relating to the settlement other than those expressly contained in this Consent Decree.

133. Upon entry of this Consent Decree by the Court, this Consent Decree shall constitute a final judgment between and among the United States, the State, and Settling Defendant. The Court enters this judgment as a final judgment under Fed. R. Civ. P. 54 and 58.

SO ORDERED THIS _____ DAY OF _____, 2012.

_____

United States District Judge

FOR THE UNITED STATES OF AMERICA

_____
Date

_____
Ignacia S. Moreno
Assistant Attorney General
Environment and Natural Resources Division
U.S. Department of Justice
Washington, D.C. 20530

_____
Date

_____
Thomas A. Benson
Trial Attorney
Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
P.O. Box 7611
Washington, D.C. 20044-7611

John W. Vaudreuil
United States Attorney
Western District of Wisconsin

Leslie K. Herje
Assistant United States Attorney
Western District of Wisconsin
P.O. Box 1585
Madison, WI 53701-1585]

Date	Richard C. Karl Director Superfund Division, Region 5 U.S. Environmental Protection Agency 77 W. Jackson Blvd. Chicago, IL 60604-3590
Date	Craig Melodia Assistant Regional Counsel U.S. Environmental Protection Agency Region 5 77 W. Jackson Blvd. Chicago, IL 60604-3590

FOR THE STATE OF WISCONSIN

_____
Date

_____
Cathy Stepp
Secretary, Wisconsin Department of Natural Resources
101 S. Webster Street
Madison, WI 53707-7921

J.B. Van Hollen
Attorney General

_____
Date

_____
Cynthia R. Hirsch
Assistant Attorney General
State Bar # 1012870
Wisconsin Department of Justice
Post Office Box 7857
Madison, WI 53707-7857

Signature Page for Consent Decree regarding the Ashland/Northern States Power Lakefront Site

FOR NORTHERN STATES POWER COMPANY, A WISCONSIN CORPORATION

06/22/12
Date

Name (print): Mark E. Stoering
Title: President and Chief Executive Officer, Northern States Power Company, a Wisconsin Corporation
Address: 1414 West Hamilton Ave., PO Box 8, Eau Claire, WI 54702-0008

Agent Authorized to Accept Service on Behalf of Above-signed Party:

Name (print): CSC Lawyers Incorporating Service Company
Title: Registered Agent
Address: 8040 Excelsior Drive, Suite 400
Phone: 608-824-7000
email:

Signature Page for Consent Decree regarding the Ashland/Northern States Power Lakefront Site

FOR SETTLING DEFENDANT'S RELATED PARTIES, SIGNING ONLY AS TO PARAGRAPHS 95, 96, 101, 104, 106, 111, 129, and 130

6/22/12
Date

Scott Wilensky

Name (print): Scott Wilensky
Title: Senior Vice President and General Counsel, for Settling Defendant's Related Parties
Address: 414 Nicollet Mall, Minneapolis, MN 55401

Agent Authorized to Accept Service on Behalf of Above-signed Party:

Name (print): Corporation Service Company
Title: Registered Agent
Address: 380 Jackson Street, Suite 700, St. Paul MN 55101
Phone: 888 690-2882
email:

FOR THE BAD RIVER TRIBE

_____
Date

_____
Name (print):
Title:
Address:

FOR THE RED CLIFF TRIBE

_____
Date

_____
Rose Soulier
Tribal Chairperson
Red Cliff Bank of Lake Superior Chippewa Indians
88385 Pike Road
Bayfield, Wisconsin 54814

APPENDIX A

EPA Region 5 Records Ctr.
378772

Ashland/Northern States Power Lakefront Site

Ashland, Wisconsin
Ashland County

Record of Decision

United States
Environmental Protection Agency

Region 5

September 2010

TABLE OF CONTENTS

List of Acronyms and Abbreviations.....vi

PART I DECLARATION.....1

PART II DECISION SUMMARY.....5

1.0 Site Name, Location, and Brief Description.....5

2.0 Site History and Enforcement Activities.....5
- 2.1 Site History.....5
- 2.2 Previous Investigations.....7
- 2.3 Previous Response Actions.....8
- 2.4 Enforcement Activities.....9

3.0 Community Participation.....9

4.0 Scope and Role of Response Action and Operable Units.....10

5.0 Site Characteristics.....10
- 5.1 Conceptual Site Model for Ashland NSP/Lakefront Site.....10
- 5.2 Site Overview.....11
- 5.3 Sampling Strategy.....12
- 5.4 Source of Contamination.....14
- 5.5 Types of Contaminants, Affected Media and Extent of Contamination.....15

6.0 Current and Potential Future Land and Resource Uses.....20

7.0 Summary of Site Risks.....21
- 7.1 Summary of Human Health Risk Assessment.....21
- 7.2 Identification of Contaminants of Potential Concern.....22
- 7.3 Exposure Assessment.....24
  - 7.3.1 Exposure to COCs in Soil.....24
  - 7.3.2 Exposure to COCs in Indoor Air – Residents and Industrial Workers.....26
  - 7.3.3 Exposure to COCs in Groundwater.....26
  - 7.3.4 Exposure to COCs in Surface Water and Sediments.....27
  - 7.3.5 Exposure to COCs in Fish Tissue.....27
- 7.4 Toxicity Assessment.....27
- 7.5 Risk Characterization.....28
  - 7.5.1 Risk Summary for the Residential Scenario.....31
  - 7.5.2 Risk Summary for the Recreational Scenario.....33
  - 7.5.3 Risk Summary for the Construction Worker Scenario.....37
  - 7.5.4 Risk Summary for the General Industrial Worker.....38
  - 7.5.5 Risk Summary for the Maintenance Worker.....39

TABLE OF CONTENTS (continued)

7.5.6 Risk Summary for the Subsistence Fisherman....39
7.6 Risk Assessment Conclusions....39
7.7 Summary of Ecological Evaluation....40
7.7.1 Scope of Baseline Problem Formulation....40
7.7.2 Results of Previous Ecological Risk Assessments....42
7.7.3 Summary of Studies Conducted for the Remedial Investigation....45
7.8 Ecological Risk Assessment Conclusions....49
7.9 Selection of Final COCs....49

8.0 Remedial Action Objectives....51

9.0 Description of Alternatives....54
9.1 Description of Remedy Components....55
9.2 Common Elements and Distinguishing Features of Each Alternative....61

10.0 Summary of Comparative Analysis of Alternatives....62
10.1 Overall Protection of Human Health and the Environment....65
10.2 Compliance with ARARs....66
10.3 Long-Term Effectiveness and Permanence....67
10.4 Reduction of Toxicity, Mobility, or Volume through Treatment....68
10.5 Short-Term Effectiveness....69
10.6 Implementability....70
10.7 Cost....72
10.8 State Acceptance....73
10.9 Community Acceptance....73

11.0 Principal Threat Wastes....73

12.0 Selected Remedy....74
12.1 Identification of the Selected Remedy and Summary of the Rationale for its Selection....74
12.2 Description of the Selected Remedy....74
12.3 Performance Standards for Selected Sediment Remedy....92
12.4 Remedial Approach for Sediments....94
12.5 Description of Alternative Sediment Remedy....97
12.6 Pre-Design Pilot Test for Dredging of Near Shore Sediments....98
12.7 Summary of the Estimated Remedy Costs and Time Required for Implementation....101
12.8 Expected Outcomes of the Selected Remedy....101

TABLE OF CONTENTS (continued)

13.0 Statutory Determinations....104
- 13.1 Protection of Human Health and the Environment....104
- 13.2 Compliance with Applicable or Relevant and Appropriate Requirements....104
- 13.3 Cost Effectiveness....105
- 13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable....105
- 13.5 Preference for Treatment as a Principal Element....105
- 13.6 Five-Year Review Requirements....105

14.0 Documentation of Significant Changes from Preferred Alternative of Proposed Plan...106

List of References Cited....107

FIGURES

Figure 1-1 Site Location
Figure 1-2 Site Features
Figure 1-3 Former MGP Features
Figure 3-7 Extent of DNAPL in Upper Bluff, Filled Ravine and Copper Falls
Figure 3-8 Extent of DNAPL & LNAPL in Kreher Park
Figure 3-3 Area of Impacted Sediment
Figure 3-4 Sediment Sample Results – Total PAHs- All depths – North-South 1 cross section
Figure 3-5 Sediment Sample Results – Total PAHs- All depths – North-South 2 cross section
Figure 3-6 Sediment Sample Results – Total PAHs- All depths – West-East 1 cross section
Figure 3-1 Cross Section Locations
Figure 3-2 Cross Section A-A'
Figure 3 Cross Section B-B'
Figure 4 Cross Section C-C'
Figure 5 Cross Section D-D'
Figure 6 Cross Section E-E'

APPENDICES

Appendix A Responsiveness Summary
Appendix B Concurrence Letter from WDNR
Appendix C ARARs and TBCs
Appendix D Final Parameters List
Appendix E Standards for each Compound by Media
Appendix F Estimated Volume of Contaminated Media
Appendix G Extent of Contamination
Appendix H COPCs
- H-1 COPCs Identified by HHRA
- H-2 COPCs Identified by BERA

Appendix I Summary of Human Health Risks

TABLE OF CONTENTS (continued)

Appendix J BERA Potential Exposure Pathways
Appendix K BERA Assessment Endpoints and Risk Questions
Appendix L Conclusions of the BERA
Appendix M PRGs
M-1 Development of Sediment PRG
M-2 PRGs for Soil, Surface Water and Groundwater
Appendix N Remedial Alternatives
N-1 Summary Table of Remedial Alternatives by Area of Concern
N-2 Detailed Descriptions of Alternatives by Media
N-3 Summary Table of Integrated Remedial Scenarios
Appendix O Estimated Costs of each Remedial Alternative
Appendix P Cost Breakdown of Scenario 10
Appendix Q Figures Showing Expected Implementation of Components of Remedy
Figure 1A (Draft) Pilot Study Locations
Figure 6-1 Existing Conditions at Upper Bluff area and Kreher Park
Figure 6-2 Engineered Surface Barriers Upper Bluff area and Kreher Park
Figure 6-3 Limited Removal & Off-site Disposal Upper Bluff area and Kreher Park
Figure 7-1 Containment using Engineered Surface & Vertical Barriers
Figure 7-5A In-Situ Chemical Oxidation – Shallow Soil and Groundwater – Upper Bluff Area
Figure 7-5B In-Situ Chemical Oxidation – Shallow Soil and Groundwater – Kreher Park
Figure 7-5C In-Situ Chemical Oxidation – Copper Falls Aquifer
Figure 7-8A Removal using Groundwater Extraction – Copper Falls Aquifer and Ravine Fill
Sheet 8-17 Alternative SED-6 – Combination Remedy – Process Flow Diagram
Figure 8-18 Proposed Construction Elements and Cross Section for SED-6
Figure 8-7 Dredge and Sediment Treatment Layout
Appendix R Administrative Record Index

LIST OF ACRONYMS AND ABBREVIATIONS

ADD	Average Daily Dose
AOC	Administrative Order on Consent
ALM	Adult Lead Model
AR	Administrative Record
ARAR	Applicable or relevant and appropriate requirements
BERA	Baseline Ecological Risk Assessment
bgs	Below ground surface
CDF	Confined disposal facility
CERCLA	Comprehensive Environmental Response. Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response. Compensation and Liability Information System
CFR	Code of Federal Regulations
COC	Contaminants of concern
COPC	Contaminants of potential concern
CR	Cancer risk
CSM	Conceptual Site Model
CTE	Central tendency exposure
DNAPL	Dense non-aqueous phase liquid
dwt	dry weight
EPA	United States Environmental Protection Agency
EPC	Exposure point concentration
ERA	Ecological risk assessment
ERH	Electrical Resistance Heating
ES	Enforcement standard
ESD	Explanation of Significant Differences
ESL	Ecological screening level
FS	Feasibility study
GLWQA	Great Lakes Water Quality Agreement
GW	Groundwater
HHRA	Human health risk assessment
HI	Hazard Index
HQ	Hazard quotient
IC	Institutional control
ICIAP	Institutional control implementation and assurance plan
IEUBK	Integrated Exposure Uptake Biokinetic
LNAPL	Light non-aqueous phase liquid
MCL	Maximum contaminant level
mg/kg	Milligrams per kilogram
MGP	Manufactured gas plant
MNR	Monitored natural recovery
MSL	mean sea level
MW	Monitoring well
NAPL	Non-aqueous phase liquid

NCP	National Contingency Plan
NOC	Normalized-to-organic-carbon
NPL	National Priorities List
NSPW	Northern States Power of Wisconsin
OC	Organic carbon
O&M	Operation and Maintenance
PAH	Polynuclear aromatic hydrocarbon
PAL	Preventive Action Limit
POTW	Publically Owned Treatment Works
PPE	Personal Protective Equipment
ppm	Parts per million
PRB	Permeable reactive barrier
PRG	Preliminary remediation goal
RAGS	Risk Assessment Guidance for Superfund
RAL	Remedial Action Level
RAO	Remedial action objective
RBSC	Risk based screening concentration
RBC	Risk based concentration
RCL	Residual Contaminant Level
RCRA	Resource Conservation and Recovery Act
RfC	Reference concentration
RfD	Reference Dose
RI	Remedial investigation
RI/FS	Remedial investigation/feasibility study
RME	Reasonable maximum exposure
ROC	Receptors of concern
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SF	Slope Factor
SQT	Sediment quality triad
SVOC	Semivolatile organic compound
SWAC	Surface weighted average concentration
TBC	To be considered
TEC	Threshold effects concentration
tPAH	Total PAH
TRV	Toxicity Reference Value
UCL	Upper confidence limit
ug/kg	Micrograms per kilogram
ug/l	Micrograms per liter
UV	Ultraviolet light
VOC	Volatile organic compound
WAC	Wisconsin Administrative Code
WDHFS	Wisconsin Department of Health and Family Services
WDNR	Wisconsin Department of Natural Resources
WWTP	Waste water treatment plant

This Record of Decision (ROD) documents the remedy selected for the Ashland/Northern States Power (NSP) Lakefront Site in the City of Ashland, Ashland County, Wisconsin. The ROD is organized in two sections: Part I contains the *Declaration* for the ROD and Part II contains the *Decision Summary*. The *Responsiveness Summary* is included at Appendix A.

PART I: DECLARATION

This section summarizes the information presented in the ROD and includes the authorizing signature of the United States Environmental Protection Agency (EPA) Region 5 Superfund Division Director.

Site Name and Location

The Ashland/NSP Lakefront Site (CERCLIS # WISFN0507952) is located in Ashland, Ashland County, Wisconsin. The Site consists of land and sediment located along the shore of Lake Superior, in Ashland, Wisconsin. The Site contains: (i) property owned by Northern States Power Company, a Wisconsin corporation (d.b.a. Xcel Energy, a subsidiary of Xcel Energy Inc. (NSPW)); (ii) a portion of Kreher Park, a City-owned property fronting on the bay that includes the former municipal waste water treatment plant (WWTP); (iii) an inlet of Chequamegon Bay containing contaminated sediment directly offshore from the former WWTP; (iv) a railroad right-of-way owned by the Wisconsin Central Ltd., and formerly owned by the Soo Line Railroad; and (v) Our Lady of the Lake Church/School, as well as private residences. The Site is bounded by US Highway 2 (Lake Shore Drive) to the south, Ellis Avenue and its extension to the City marina to the west, Prentice Avenue and its extension to a boat launch to the east, and a line between the north termini of the marina and the boat launch to the north.

Statement of Basis and Purpose

This decision document presents the selected remedy for the Ashland/NSP Lakefront Site. The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Contingency Plan (NCP), 40 CFR Part 300.

Information used to select the remedy is contained in the Administrative Record (AR) file for the Site. The AR file is available for review at the EPA Region 5 Records Center, 77 West Jackson Boulevard, Chicago, Illinois, the Vaughn Public Library, 502 W. Main St., Ashland, Wisconsin, the Bad River Public Library, 100 Maple St., Odanah, Wisconsin, and the Red Cliff EPA Office, 88385 Pike Road, Highway 13, Bayfield, Wisconsin.

Assessment of the Site

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Description of the Selected Remedy

The Ashland/NSP Lakefront Site is being addressed under the framework set forth in CERCLA. The selected remedy specified in this ROD will serve as the final action for soil, groundwater, and sediment contamination at the Site. The Site consists of soils, sediments, and groundwater contaminated by polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs). The most abundant constituents in each of these compounds include benzene, a VOC, and naphthalene, a PAH. Additionally, free phase hydrocarbons (free product) derived from tars are present as non-aqueous phase liquids (NAPL). The free product, or NAPL, is present in underground pockets of tar and other materials that do not readily mix with water. NAPL has also been found in subsurface sediments in the near shore area. Sediment contamination tends to be higher with depth below the sediment/water interface and is highest in the near shore area, decreasing with distance from the shoreline. Much of the contaminated sediment is covered with a layer of wood waste. The selected remedy specifies the following response actions:

- removal and treatment or off-site disposal of contaminated soil, groundwater and sediment, including all NAPL;
- engineered surface and vertical barriers to contain contaminated groundwater;
- groundwater extraction as hydraulic control and restoration and possible in-situ treatment of groundwater;
- long-term groundwater and sediment monitoring;
- institutional controls such as land use controls, to limit future site use to prevent exposure to hazardous substances that will remain at the Site after the remedy is complete.

EPA believes the response actions outlined in this ROD, if properly implemented, will protect human health and the environment.

The Site is divided into four main areas of concern: 1) sediments in Chequamegon Bay; 2) soil and shallow groundwater under Kreher Park; 3) soil and shallow groundwater under the Upper Bluff/Filled Ravine; 4) and deep groundwater in the Copper Falls Aquifer.

The selected remedy for sediments in Chequamegon Bay consists of dry excavation of all near-shore sediment and wood debris and dredging of the remaining contaminated sediment and wood debris that exceeds the Remedial Action Level (RAL) of 2,295 micrograms (ug) total PAH (tPAH)/gram (g) organic carbon (OC) [which is equivalent to 9.5 parts per million (ppm) of tPAH dry weight (dwt) at 0.415% OC]. The selected remedy requires thermally treatment of sediments or stabilization of sediments to transport off site for disposal to a NR 500 licensed landfill. If thermal treatment is determined to be more difficult and not cost effective, then off-site disposal of sediment at a NR 500 licensed landfill will be the alternate remedy. Although EPA has serious concerns with the effectiveness of dredging the near shore area of sediments,

due to significant wood waste/wood debris and the presence of NAPL in the near shore sediments, the excavation/dredging remedy will allow for a pre-design pilot test to determine if dredging can achieve the performance standards in the near-shore area. If the pre-design pilot test indicates that dredging rather than dry excavation within the near-shore area will attain the established performance standards then EPA, in consultation with Wisconsin Department of Natural Resources (WDNR), will recommend that an alternate sediment remedy (dredging) be implemented. If after the pilot test EPA determines that the dredging remedy for near-shore sediments can achieve performance standards and be conducted in a manner protective of human health and the environment, it will publish its decision in an Explanation of Significant Differences (ESD).

The selected remedy for soil in Kreher Park and the Upper Bluff/Filled Ravine consists of limited soil removal with ex-situ thermal treatment. If thermal treatment is determined during pre-design studies to be more difficult to implement and not cost effective, then off-site disposal of soil will be the alternate disposal option. The remedy also includes in-situ treatment of soil using chemical oxidation to address any residual contamination after the soil removal. The remedy for shallow groundwater in Kreher Park and the Upper Bluff/Filled Ravine consists of groundwater containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control. Shallow groundwater extracted from the contained areas will be treated onsite and discharged to the lake or publicly owned treatment works (POTW). The remedy for shallow groundwater will achieve the dual objectives of containment and restoration.

The selected remedy for the Copper Falls Aquifer consists of a groundwater extraction system. The site currently has a limited groundwater extraction system in place. The remedy consists of enhancing the current system by installing additional extraction wells. In addition, the groundwater remedies for the Copper Falls Aquifer, Kreher Park and the Upper Bluff/Filled Ravine includes engineered surface and vertical barriers to contain contamination and prevent further migration and groundwater extraction which includes an in-situ chemical treatment component to possibly enhance the groundwater treatment. In addition, the remedy includes long-term groundwater and sediment monitoring and institutional controls, such as restrictive covenants, to restrict future site use and to restrict the use of site groundwater for potable purposes until such time as groundwater cleanup standards are achieved.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to this remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies (or resource recovery) to the maximum extent practicable. This remedy satisfies the preference for treatment as a principal element of the remedy. Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory five-year review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

Data Certification Checklist

The following information is included in the Decision Summary section (Part II) of this ROD. Additional information can be found in the Administrative Record file for this Site.

- Contaminants of concern and their respective concentrations (Section 5);
- Baseline risk represented by the contaminants of concern (Section 7);
- Cleanup levels established for contaminants of concern and remedial action objectives established for the Site (Section 8);
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessments and ROD (Sections 6 and 7);
- Potential land and groundwater use that will be available at the Site as a result of the selected remedy (Section 12);
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Sections 9, 10 and 12); and
- Key factors that led to selecting the remedy (Sections 10 and 12).

Support Agency Acceptance

The WDNR concurs with the remedy selected in this ROD for the Ashland/NSP Lakefront Site. The WDNR's concurrence letter is provided in Appendix B.

Authorizing Signature

Richard C Karl

Richard C. Karl, Director
Superfund Division
United States Environmental Protection Agency, Region 5

9-30-10
Date

PART II: DECISION SUMMARY

1.0 Site Name, Location, and Brief Description

The Ashland/NSP Lakefront Site is located in Ashland. Ashland County, Wisconsin (see Figure 1-1). The Site consists of property owned by NSPW. Our Lady of the Lake Church/School and private residences, a railroad corridor, a portion of Kreher Park. and sediments in an area of Chequamegon Bay adjacent to Kreher Park. The Site is located in S 33, T 48 N, R 4W in Ashland County, Wisconsin. Existing Site features and the boundary of the Site are shown on Figure 1-2. Figure 1-3 shows the location and features of the former Manufactured Gas Plant (MGP) facility.

The former MGP facility and current NSPW property is located at the south boundary of the Site at 301 Lake Shore Drive East in Ashland, Wisconsin. The facility is approximately 1,000 feet south of the shore of Chequamegon Bay of Lake Superior. The NSPW property is occupied by a small office building and parking lot fronting on Lake Shore Drive, and a larger vehicle maintenance building and parking lot area located south of St. Claire Street between Prentice Avenue and 3rd Avenue East. There is also a gravel-covered parking and storage yard area north of St. Claire Street between 3rd Avenue East and Prentice Avenue. A large microwave tower is located on the north end of the storage yard. The office building and vehicle maintenance building are separated by an alley. The area occupied by the buildings and parking lots is relatively flat, at an elevation of approximately 640 feet above mean sea level (MSL). The total area occupies approximately 2.5 acres. Surface water drainage from the NSPW property is to the north. A residence is located east of the office building and west of the blacktop parking area. Our Lady of the Lake Church and School is located immediately west of 3rd Avenue East. Private homes are located immediately east of Prentice Avenue and north of St. Claire Street. To the northwest the Site slopes abruptly to the railroad right-of-way owned by the Wisconsin Central Ltd. (Canadian National Railway (CN)) and which sits on a bluff that marks the former Lake Superior shoreline, and then to Kreher Park. with approximately 10 acres of impacted soil and groundwater, beyond which is Chequamegon Bay, with approximately 16 acres of impacted sediments. EPA is the lead agency for this Site, and the WDNR is the support agency. The Site is listed on the National Priorities List (NPL). The EPA CERCLIS Number is WISFN0507952.

2.0 Site History and Enforcement Activities

2.1 Site History

Historically, Chequamegon Bay was a vital transportation route for the shipment of various materials to and from Ashland including iron ore, lumber. pulp and coal. During the late 19th and early 20th centuries, Ashland was one of the busiest ports in the Great Lakes. In recent times the shipping volume through the bay has declined because of the decrease in the mining and lumber industries in the region, while recreational activities have increased. The City of Ashland

has a waterfront development plan that includes the impacted portions of Kreher Park and the Chequamegon Bay.

The primary source of contamination at the Site was releases of coal tars from the historic MGP facility. Other historic activities at the Site, such as lumber operations, solid waste disposal and construction of the former WWTP on the lakeshore, contributed to the filling of the lakebed and may have further dispersed contamination from historic activities at the Site.

The former MGP facility is located on the Upper Bluff on NSPW's property. The former MGP building has been incorporated into NSPW's main service facility on St. Claire Street. The former MGP operated predominantly as a manufacturer of water gas and carbureted water gas for street and home lighting and other uses between 1885 and 1947. After 1947 the carbureted water gas process was retired in favor of liquid petroleum (propane). During the entire time gas was manufactured coal tars were produced as a normal co-product. An open ravine ran south/north through the MGP facility, under the current buildings, emptying out by the historic Lake Superior shoreline near what is now the railroad corridor. The ravine was filled by the early 1900s. A 12-inch clay tile pipe was buried in the Filled Ravine and runs south to north from the former MGP facility to an area north of the railroad right of way in Kreher Park. In addition, drawings for construction of the former WWTP show a 2-inch "Tar to Abandon Tar Dump" pipe running in the approximate location of the historic ravine from the MGP to Kreher Park. The WWTP drawings also mark an area in Kreher Park as the "Coal Tar Dump" located south of the former WWTP and north, or downhill, of the Filled Ravine.

Kreher Park, between Prentice and Ellis Avenues was a historic lakebed and was created over the decades as various fill materials were placed into the bay. The southern boundary of the park defined the original lake shoreline. The eastern portion of the park was filled with sawdust, wood waste and other material from sawmills. The lumbering and sawmill activities occurred during the deforestation of the northern portion of Wisconsin around the turn of the century. The John Schroeder Lumber Company owned the eastern portion of Kreher Park from 1901 until 1939 operating a sawmill until approximately 1931. In 1939, Ashland County acquired the tax deed to the Schroeder Lumber property. In 1942, Ashland County transferred the property to the City of Ashland via quit claim deed. Between the 1880s and 1951 the western portion of Kreher Park was used as an open "dump" for solid waste, primarily demolition debris. In 1986 the City of Ashland acquired a number of parcels on the western portion of the park that includes the former open dump. This area is currently used for the storage of boats.

In 1951, the City of Ashland constructed a WWTP in Kreher Park on the shoreline of Chequamegon Bay. The City added secondary treatment facilities to the WWTP in 1972 to 1973, and constructed a lift station at Prentice Avenue in 1992. The WWTP operated until 1992 and is now closed. The buildings of the former WWTP remain, but today Kreher Park is mostly grass with a gravel parking area located on the western end of the park. During the mid-1980s the marina extension of Ellis Avenue was completed to permit establishment of a marina with full service boat slips, fuel and dock facilities and a ship store. Prior to the construction of the marina the area was a rail boat dock used for offloading freight. The dock was used for this purpose beginning with the sawmill operations through the marina construction. The boat

landing jetty extension of Prentice Avenue was originally the log boom associated with the Schroeder sawmill that was located in what is now Kreher Park where the WWTP is currently located.

In 1989, during exploratory work to expand the WWTP, contaminated soil and groundwater were encountered by the City of Ashland. The City notified the WDNR, subsequently closed the WWTP, and built a new WWTP facility a few miles away to the northeast. In 1994, WDNR initiated an investigation and evaluation of the area to characterize the extent of contamination on the property.

The primary contaminants at the Site are derived from manufactured gas plant wastes in the form of coal tars, including VOCs and PAH compounds. Additionally, some free-phase hydrocarbons product (free product) derived from the coal tars is present as NAPL, and have impacted soils, groundwater, and sediments. The NAPL referenced in this document includes both light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL).

DNAPL has been encountered in the upper reaches of the Filled Ravine near the former MGP facility on the NSPW property to the former lake shore, in isolated areas of Kreher Park including the former "seep" area, in the nearshore sediments, and in the upper elevations of the Copper Falls Formation, which behaves as a confined aquifer under the former MGP in the Upper Bluff portion of the Site. DNAPLs encountered in the Filled Ravine (near the former MGP facility) and at isolated areas at Kreher Park were encountered at the base of these fill units overlying the Miller Creek Formation. The Miller Creek Formation is the confining unit for the underlying Copper Falls aquifer. LNAPLs were also observed across much of Kreher Park as oily sheen in the underlying wood waste layer encountered during a test pit investigation at the Park.

DNAPL has also been encountered in sediments in portions of the affected inlet, although the DNAPL is less defined than on-shore locations due to the dynamic conditions in the affected sediments. The most highly contaminated sediments (including areas of DNAPL) are subsurface and nearest the shoreline; however, releases of contamination to the surface water have been documented, specifically during high energy events. It is important to note that nearly all of the significant wood waste/wood debris is located within the most highly contaminated areas of the inlet nearest the shoreline.

DNAPLs in the deep aquifer correspond to high levels of VOCs in groundwater (> 50,000 μg/L), which is surrounded by a dissolved phase contaminant plume that extends north from the NAPL area in the direction of groundwater flow.

2.2 Previous Investigations

In 1994, WDNR initiated an investigation and evaluation to characterize the extent of contamination around the former WWTP, determining that contaminants had migrated from the former MGP to Kreher Park. Upon notification by WDNR of these findings, NSPW also began a series of investigations of its property. These investigations identified subsurface contamination resulting from the historic MGP operations. Contamination exists as dissolved

phase tar constituents in groundwater and as "pools" of DNAPL and LNAPL or free product as referred to in this document. Free product has been encountered at the base of the ravine and in the underlying Copper Falls Aquifer. In the Filled Ravine, free product varying from one to two feet in thickness is present from south of the service facility north of the mouth of the former ravine, commonly referred to as the "seep" area. In the upper Copper Falls Aquifer, free product has been encountered from south of the service facility north to the gravel-covered parking and storage yard area located north of St. Claire Street. It has also been measured in piezometers installed on the Our Lady of the Lake church property west of Third Avenue East.

The WDNR investigations of Kreher Park included several mobilizations to investigate subsurface conditions at the park as well as the affected sediments and concluded with the completion of a Remedial Investigation Report and Feasibility Study in 1998. A distinct free product pool varying in thickness up to five feet was identified in the area of Kreher Park just north of the seep area. A 12-inch clay tile pipe was encountered at the base of the backfilled ravine during investigations NSPW completed between September and November 2001. The clay tile pipe was traced up the Filled Ravine to the area of the former MGP as part of these investigations (see Figure 3-7). The buried clay tile pipe likely behaved as a conduit for the migration of free product as well as contaminated groundwater from the MGP to the seep area after the ravine was filled (both dissolved phase and free product were found in the pipe during the excavations). A significant portion of the clay tile was destroyed during the 2001 investigation activities.

This tile pipe may have been part of a sewer system installed in response to a 1902 City ordinance specifying that manufactured gas plant wastes were to be conveyed underground. Although there is no documentation indicating the exact date the tile pipe was installed or by whom, it presumably would have been installed shortly after the 1902 ordinance since the ravine was filled by the early 1900s, and it most likely was installed by the MGP given the tile's apparent connection to the MGP facility and the fact that it was the only manufactured gas plant in Ashland. The 1902 ordinance also indicates that prior to that time manufactured gas plant waste was conveyed via the open ravine.

After the Site was added to the NPL, EPA and NSPW entered into an administrative order on consent (AOC) dated November 14, 2003. Under the AOC, NSPW conducted a Remedial Investigation and Feasibility Study (RI/FS) to determine the nature and extent of contamination and any threat to the public health or the environment at the Site, to determine and evaluate alternatives for remedial action, and to collect data sufficient for developing and evaluating remedial alternatives. NSPW conducted the RI/FS under EPA oversight. EPA approved the final Feasibility Study on December 4, 2008. EPA's Preferred Alternative presented in the Proposed Plan came from the remedial alternatives evaluated in the Feasibility Study.

2.3 Previous Response Actions

In 2000, NSPW installed an interim action free product recovery system on its property, initially as a pilot test, to remove free product from the Copper Falls Aquifer; the system became fully operational in January 2001. The pumped water is treated at the NSPW property and discharged to the City of Ashland's sanitary sewer, and the free product/NAPL that is separated from the

water is sent off-site for treatment and disposal. More than 11,000 gallons of free product/water emulsification have been removed, and approximately 2.4 million gallons of contaminated groundwater have been treated between January 2001 and June 2010.

In addition, NSPW performed a second interim action during May 2002 to cap the seep area. Capping the seep was necessary to address the threat of direct contact with coal tars/free product seeping to the surface. Activities completed included the excavation and removal of contaminated soil in the seep area, the placement of a low permeability cap over the seep area, and the installation of a groundwater extraction well at the base of the Filled Ravine. Contaminated groundwater collected near the mouth of the Filled Ravine via a fourth extraction well is conveyed to the free product recovery system described above.

2.4 Enforcement Activities

The Site was a State (WDNR) lead for a number of years before EPA became the lead agency. The discovery of contaminants in 1989 at Kreher Park led the WDNR to initiate several investigations that culminated in the identification of the former MGP as a source of contamination and the naming of NSPW as a responsible party. The WDNR also sent the City of Ashland and Wisconsin Central Ltd., responsible party notifications for solid waste disposed on a portion of Kreher Park. WDNR and NSPW subsequently performed a series of independent investigations to assess the extent of contamination at Kreher Park and the NSPW property, respectively. In 1998, EPA was petitioned to evaluate the Site for inclusion on the NPL and cleanup under CERCLA, also known as Superfund. The Site was nominated for inclusion on the NPL in 2000, and was formally added to the NPL in 2002. In 2003, EPA sent NSPW a letter informing it that EPA believed NSPW to be a liable party under CERLCA and inviting NSPW to enter into a cooperative agreement to conduct the RI/FS. NSPW subsequently signed the AOC with EPA in 2003 to conduct the RI/FS at the Site. The RI investigation activities were completed in November 2005. The RI was approved by EPA in October 2007. The FS was approved by EPA in December 2008.

3.0 Community Participation

The Proposed Plan for the Ashland/NSP Lakefront Site was made available to the public for comment from June 17 to August 17, 2009. Copies of the Proposed Plan and the final RI and FS (as well as other supporting documents) were placed in the local Information Repository at the Vaughn Public Library, Bad River Tribal Library and Red Cliff Environmental Office. Documents are also available at the EPA Region 5 Records Center in Chicago, Illinois, and at the WDNR's Spooner Service Center. Copies of the Proposed Plan were sent to about 400 people on the Site mailing list. A note and link to the Proposed Plan on EPA's web page for the Site was emailed to about 120 people and organizations.

A public notice announcing the comment period, public meeting and availability of the Proposed Plan was published in the Ashland Daily Press and in the Evergreen County Shopper on June 15, 2009 and June 29, 2009. A news release was also sent to Ashland media on June 12, 2009. Informational meetings were held at the Bad River Conference Center on June 16, 2009, the Great Lakes Visitor Center on June 17, 2009, the Red Cliff Fire Hall on June 24, 2009 and a

neighborhood listening session was held a the Hotel Chequamegon on June 25, 2009. EPA held a public meeting on June 29, 2009, at the Northern Great Lakes Visitor Center in Ashland to present the Proposed Plan. About 80 people attended including local residents and representatives from the City of Ashland, the WDNR, NSPW and its contractors, and Senator Fiengold's office. Representatives from EPA gave a short presentation, answered questions and accepted comments on the Proposed Plan. On July 8, 2009, NSPW submitted a request to extend the public comment period for an additional thirty days. Pursuant to 40 C.F.R. 300.430(3)(C), EPA extended the comment period for thirty days, until August 17, 2009. The public comment extension was published in the Ashland Daily Press on July 16, 2009, and in the Evergreen Country Shopper on July 20, 2009. Responses to comments received during the public comment period (including those submitted at the public meeting) are included in the Responsiveness Summary attached to this ROD. A transcript of the comments given at the public meeting is also available. These comments were considered prior to selection of the final cleanup plan in this ROD.

In addition to the Proposed Plan mailing and public meeting, EPA, along with WDNR, held numerous information sessions on the RI, FS, and Proposed Plan from 2007 to 2009. In addition, a workshop was held in October 2007 for parties who were interested in the Ashland/NSP Lakefront Site. A public notice was placed in the newspaper and a news release was sent to local media about a week prior to the meeting. A Community Involvement Plan for the Site, the Proposed Plan, news releases, and technical and legal documents have been posted on the Region 5 Web page at http://www.epa.gov/region5/sites/ashland.

4.0 Scope and Role of Response Action and Operable Units

The final cleanup plan selected in this ROD for the Ashland/NSP Lakefront Site has only one operable unit that addresses all contaminated media. The groundwater, soil, and sediment are impacted by high levels of VOC and PAH contamination and all media will be addressed by the selected cleanup action.

5.0 Site Characteristics

5.1 Conceptual Site Model for Ashland NSP/Lakefront Site

The former MGP produced "water gas" for street and home lighting and other uses between 1885 and 1947. Coal tars and oils were a by-product of the manufactured gas process and contain hazardous substances. The likely routes for releases of coal tars and other by-products from the former MGP to the environment were leaks and spills on the MGP property, discharge into the open ravine directly to the lake, and discharge via the 12-inch clay tile pipe after the ravine was filled. The initial discharges may have been directly into the bay and later over land as portions of the lake bed were filled forming the area known as Kreher Park. Additionally, a 2-inch pipe may have discharged to the "Coal Tar Dump" in Kreher Park. It is possible that some of the tar material was entrained in MGP plant wastewater that was discharged to a sewer (e.g., the 12-inch clay tile) directly to the lake. Other tars and free product generated as co-product in the gas manufacturing process (such as releases from gas holders or fuel tanks) discharged directly to the soil and groundwater. Some of these hazardous substances also migrated to the

base of the ravine to Kreher Park and the lake and some migrated into the Copper Falls aquifer. Wastewater and other incidental free product discharged to the sewer were conveyed via the clay pipe network to an open sewer in Kreher Park and then to the bay inlet.

From 1901 to 1931, Schroeder Lumber operated on the eastern portion of Kreher Park. Schroeder Lumber performed active sawmilling and other lumber operations for three decades. Kreher Park was created by the filling of the lakebed with solid waste mainly composed of wood waste from lumber operations on the eastern portion and demolition debris from a dump on the western portion of the park. This wood waste and demolition debris became permeated by the MGP waste.

Additionally, other industrial sources (such as rail car off-loading of feedstocks and raw materials for MGP and other industrial activities) may have contributed to high levels of PAH-rich contaminants at the Lakefront.

In 1947, continued releases of coal tars and free product from the MGP were eliminated when its water gas process was retired. However, remnants of free product (present in the ravine, the "2-inch pipe to waste tar dump," and MGP structures) and contaminated groundwater continued to migrate via the clay tile to the seep area, discharging to the surface during high flow (storms, etc.) conditions. Free product and the associated groundwater plume in the Copper Falls aquifer migrated north towards the lake. A potential stagnation or convergence zone in the Copper Falls aquifer has reduced further movement of the plume to the north and the free product removal system has reduced the mass of the plume in the aquifer.

In 1952, the City of Ashland began construction of the WWTP. During construction a clay core wall was installed at the foundation of the WWTP to prevent groundwater infiltration into basement areas, and a pipe/sewer distribution network to the new WWTP was constructed. The distribution of contaminants in sediments and soil along the shoreline may have been affected by this activity. Other construction actions that occurred after this time that may have further affected contaminant distribution include the WWTP expansion in 1973 and the periodic discharge of water that collected in the WWTP's basement sumps.

The residual contamination in the Filled Ravine continued to discharge to Kreher Park via the buried clay tile pipe and Filled Ravine. Following rainfall events coal tars and free product was observed at the surface in the seep area. The clay tile investigation in 2002 crushed and removed much of this conduit. A removal action in 2002 removed much of the surface contamination at the seep, replaced it with clean fill, and installed an interception well (EW-4) to capture residual contamination migrating through the seep into the mouth of the ravine.

The residual contamination at Kreher Park from the primary free product (DNAPL and LNAPL) source areas continues to migrate to the lake sediments.

5.2 Site Overview

The geologic conditions at the Site have been identified in previous investigations conducted by WDNR and NSPW and in the supplemental investigations completed as part of the RI in 2005.

Historic investigations included the visual classification of subsurface soil units from numerous soil borings, monitoring well boreholes and exploration test pits. Supplemental investigations completed for the RI included the installation of additional monitoring wells, the collection of surface and subsurface soil samples from borings and test pits, and a downhole geophysical survey. Geologic units investigated at the Site include the Miller Creek Formation and underlying Copper Falls Formation. Fill soil units were also encountered at the Upper Bluff and at Kreher Park. At the Upper Bluff area, fill soil was encountered in the Filled Ravine that dissects the Miller Creek Formation in the vicinity of the former MGP facility. Kreher Park consists of material used to fill the former lakebed.

The uppermost water-bearing unit at the Upper Bluff area includes the Miller Creek Formation. Groundwater is also encountered in the fill material used to backfill the former ravine that dissects the Miller Creek Formation in the vicinity of the former MGP facility. The uppermost water-bearing unit at Kreher Park consists of fill material used to fill the former lakebed; this fill material overlies the Miller Creek Formation. The fine-grained low permeability Miller Creek Formation creates an aquitard overlying the Copper Falls aquifer, behaving as a confining unit.

Previous investigations have identified groundwater contamination in the ravine fill, the Kreher Park fill and the underlying Copper Falls aquifer. Contaminants, including free product, migrated to the underlying Copper Falls aquifer in the vicinity of the former MGP facility where the Miller Creek Formation lacks plasticity and where vertical hydraulic gradients indicate downward flow in the Copper Falls aquifer. These migration pathways may have been exacerbated by construction operations during the early life of the MGP. Strong upward gradients have likely limited the vertical migration of contaminants at down gradient locations north of this area. The transition from downward to upward gradients within the Copper Falls aquifer occurs at the alley immediately south of the NSPW service center. Site investigation results indicate that contaminants in the Copper Falls aquifer have migrated laterally along the interface between the Copper Falls aquifer and overlying Miller Creek aquitard.

5.3 Sampling Strategy

Data gathered during the initial investigations by WDNR and NSPW, and additional data collected during the recently completed RI, were used to characterize the nature and extent of contamination at the Site and to evaluate impacts to human health and the environment. Field investigations consisted of the collection of samples from impacted media (i.e., surface soil, subsurface soil, soil vapor, sediment, surface water, and groundwater) from discrete areas of the Site to define physical and biological characteristics of the Site as a whole. Environmental media evaluated include the following:

- Soils at the Upper Bluff/Filled Ravine on the NSPW property near the former MGP facility;
- Soil vapor in the vicinity of the NSPW property;
- Fill soil at Kreher Park;
- Groundwater contamination (aqueous phase and non-aqueous phase) in the ravine fill, Kreher Park fill, and underlying Miller Creek and Copper Falls Formations, and
- Sediment contamination and impacts to surface water and aquatic organisms in the Chequamegon Bay inlet adjacent to Kreher Park.

Activities described in the RI Work Plan and completed during the RI field investigation include the following:

- Installation of additional monitoring wells MW-2C, MW-15A, MW-15B, and MW-21 in December 2003 to further characterize the vertical extent of groundwater contamination at the Upper Bluff/Filled Ravine;
- Installation of additional wells MW-7R, MW-7B, MW-23A, MW-23B, P-24, MW-24, MW-24A, P-25, MW-25, MW-25A, P-26, MW-26, and MW-26A at Kreher Park in May 2004. These wells were installed to evaluate the relationship between surface water and groundwater in the filled lakebed along the shoreline, and to further characterize the lateral extent of groundwater contamination in the underlying Copper Falls aquifer;
- Collection of four rounds of groundwater samples from all wells in the monitoring well network at the Site in June 2004, September 2004, December 2004, and March 2005 to characterize groundwater quality and flow conditions;
- Collection of subsurface soil samples from borings advanced in the vicinity of the former MGP in April 2005 to further characterize the lateral and vertical extent of contamination in the backfilled ravine south of St. Claire Street;
- Collection of subsurface soil samples from borings advanced at Kreher Park in the vicinity of the former "seep" area and monitoring well TW-11 in April 2005 to characterize free product observed at these locations;
- Collection of additional surface soil samples at the Upper Bluff to evaluate the direct contact exposure pathway in the vicinity of the former MGP in June 2005;
- Collection of additional surface soil samples at Kreher Park to evaluate the direct contact exposure pathway in the area in June 2005;
- Completion of an exploration test pit investigation at Kreher Park in June 2005 to characterize the uncontrolled solid waste disposal area, former coal tar "dump" area, the former "seep" area and other potential source and free-product conveyance areas at Kreher Park;
- Completion of a supplemental exploration test pit investigation in Kreher Park in November 2005 to identify the lateral extent of a clay pipe encountered between the former seep area and the former open sewer area;
- Completion of a borehole geophysical survey to verify subsurface geologic units, and a visual (downhole camera) inspection of two artesian wells open to the Copper Falls Aquifer at Kreher Park in November 2005;
- Completion of an air emission investigation at the Upper Bluff between March and July 2005 to evaluate the potential inhalation pathway for exposure to potential soil vapors at this area of the Site where nearby residents may be potentially affected;
- Performance of a wildlife habitat and wetland survey in June 2005 to characterize the terrestrial habitat of the Site;

- Completion of a Sediment Quality Triad (SQT) investigation between May and September 2005 to evaluate bulk sediment chemistry, sediment toxicity and benthic macroinvertebrate community characteristics of Site sediments. This included performance of sediment toxicity tests of benthic invertebrates and fish larvae under both natural and ultraviolet light;
- Collection of surface water samples during low and high energy events in June and November 2005 to evaluate levels of contaminants in surface water in the Chequamegon Bay inlet area adjacent to Kreher Park;
- Collection of fish tissue in April 2004, April 2005, and June 2005 to support the Baseline Ecological Risk Assessment (BERA) and Human Health Risk Assessment (HHRA);
- Completion of a sediment stability analyses that included quantitative (modeling) and an empirical evaluation of sediment stability in aquatic portions of the Site;
- Performance of sediment toxicity tests, fish larva bioassays, and ultraviolet light (UV) studies to evaluate toxicity to selected ecological receptors;
- Completion of the BERA to describe the likelihood, nature and severity of adverse effects to ecological receptors resulting from their exposure to contaminants at the Site under current conditions, and
- Completion of the HHRA to provide a risk-based interpretation of the data collected during the RI and to provide conservative estimates of potential human health risks posed by chemicals that are present at or migrating from the Site.

5.4 Source of Contamination

As discussed in Section 2.1 of this ROD, the source of the contaminants of concern (COCs) at the Site was releases from the former MGP operations from the 1880s to 1947 with potential contributions from historic lumber operations and solid waste disposal. Other activities such as the construction and expansion and operation of the former WWTP may also have redistributed contamination at the Site.

The COCs at the Site are typical by-products of manufactured gas plant processes. The groundwater, soil, and sediment at the Site are contaminated predominantly with VOCs and semivolatile organic compounds (SVOCs). With regard to the SVOCs, the predominant subgroup includes PAHs. The most commonly occurring VOC is benzene and the most commonly occurring PAH is naphthalene. Metals (e.g., lead and arsenic) have been detected at varying concentrations and are associated with natural conditions, fill, and former MGP process wastes. The VOCs and PAHs were derived from the former MGP operations located on the Upper Bluff portion of the Site.

The ongoing sources of the COCs are primarily the free-product zones of non-aqueous phase liquid (NAPL) that have been identified since investigations began at the Site in 1994, and further refined during the RI sampling performed in 2005. These free-product zones consist of

both DNAPL and LNAPL and are consistent with MGP wastes. These MGP wastes are located in the aquifers, subsurface soils and sediments.

5.5 Types of Contaminants, Affected Media and Extent of Contamination

The COCs at the Site include VOCs and a subgroup of the larger list of SVOCs referred to as PAHs. The most abundant compounds from each of these groups include benzene and naphthalene, respectively. Soils and groundwater at the Site are contaminated with these compounds, as are the sediments in the affected inlet. As stated above, the primary source of these COCs is the former MGP.

Additionally, tar/oil is present as NAPL, or free product, in the Filled Ravine, in isolated areas of Kreher Park including the former "seep" area, in the near-shore sediments of the bay in an area parallel to the shoreline and northwest of the former WWTP, and in the upper elevations of the deep Copper Falls aquifer. The free product in the deep aquifer has resulted in a dissolved phase contaminant plume that extends north from the area of the free product in the direction of groundwater flow, toward the bay. However, the thick clay aquitard (the Miller Creek Formation) provides a hydraulic barrier that separates the deep aquifer from the shallow groundwater encountered in Kreher Park fill and the bay waters in the area of the affected inlet. This separation is demonstrated by the strong artesian pressures measured at Kreher Park wells that are screened in the Copper Falls aquifer.

All data from historic investigations and the 2005 RI were compiled into one database. A large dataset of organic compounds were analyzed during the earlier investigations at the Site, with a smaller dataset available for metals and inorganics. The 2005 RI Work Plan required sampling of a smaller set of VOCs, PAHs and metals/inorganic analytes common to all media (a slightly expanded list of PAHs was analyzed for sediments for purposes of ecological evaluation). During preparation of the RI, EPA approved an amended list of compounds which included the analytes listed in the 2005 RI Work Plan and additional compounds previously analyzed that exceeded regulatory limits. These additional compounds were limited to those which were historically measured at least once in excess of 10 times an applicable regulatory standard. The amended final parameter list that was approved by EPA is included in Appendix D, Table 4-1.

Additional information regarding the extent of contamination at each area of the Site (Upper Bluff/Filled Ravine, Kreher Park, Sediments, and the Copper Falls Aquifer) is provided below.

Upper Bluff/Filled Ravine

DNAPL has been encountered at the base of the Filled Ravine located south of St. Claire Street beneath the NSPW service center building and adjacent asphalt courtyard area. Part of this building includes an older section incorporating the former MGP building, and gas holders for the MGP are located within the Filled Ravine (see Figure 1-3). The depth of the center of the Filled Ravine in this area ranges from 15 to 20 feet below ground surface. The former ravine dissected the Miller Creek formation, which is the uppermost unconsolidated geologic unit in the Ashland area. This low permeability silty-clay/clayey silt unit is encountered at the base and flanks of the Filled Ravine. A perched

aquifer has formed in the Filled Ravine because the fill material, which includes cinders, debris, and other locally derived detritus, is more permeable than the surrounding native soil unit. Groundwater encountered within four to six feet of the ground surface is in hydraulic connection with the regional water table that extends across the Site within the Miller Creek formation.

Soil and groundwater in the Filled Ravine are contaminated largely by contact/proximity with the DNAPL on the south side of St. Claire Street. Contamination within the Filled Ravine downgradient from this area has also been encountered. Figure 3-7 depicts the lateral extent of DNAPL at the Upper Bluff/Filled Ravine, as shown by the green lines on that figure. DNAPL was encountered in and around a 12-inch clay tile encountered at the base of the Filled Ravine on the north side of St. Claire Street during a 2001 investigation (see Figure 3-7). This clay tile was found to extend beyond the mouth of the Filled Ravine to the former seep area in Kreher Park. This discharge was eliminated in 2002 with the installation of an interception well (EW-4) at the mouth of the former ravine following the removal of contaminated soil and cap installation at the seep area, previously described in Section 2.3 of this ROD. Although DNAPL or LNAPL has not been encountered in EW-4, groundwater extracted from the Filled Ravine is conveyed to the existing tar removal system for treatment prior to discharge to the sanitary sewer.

Kreher Park

The impacted area of Kreher Park consists of a flat terrace adjacent to the Chequamegon Bay shoreline. The surface elevation of the park varies approximately 10 feet, from 601 feet above MSL, to about 610 feet above MSL at the base of the bluff overlooking the park. The bluff rises to an elevation of about 640 feet above MSL, which corresponds to the approximate elevation of the NSPW property. The lake elevation has historically fluctuated about two feet, from 601 to 603 feet above MSL. Currently the park area is predominantly grass covered. A gravel overflow parking area for the Ashland Marina occupies the west end of the park, while a miniature golf facility formerly occupied the east end of the park. The City of Ashland former WWTP and associated structures front the shoreline on the north side of the park. The impacted area of Kreher Park occupies approximately 13 acres and is bounded by Prentice Avenue and a jetty extension of Prentice Avenue to the east, the Wisconsin Central Ltd. to the south, Ellis Avenue and the marina extension of Ellis Avenue to the west, and Chequamegon Bay to the north.

At Kreher Park, DNAPL is limited to the seep area and the former coal tar dump area north of the mouth of the Filled Ravine at Kreher Park. DNAPL-contaminated soil above the wood waste layer was removed from the seep area in 2002 and replaced with clean fill. In the former coal tar dump area, DNAPL-contaminated soil was encountered beneath several feet of clean fill overlying the wood waste layer. In both areas, DNAPL remains in the underlying wood waste layer, which underlies the entire park. The lateral extent of DNAPL at Kreher Park is shown on Figure 3-8, depicted by the dark blue lines on that figure. Figure 3-8 also shows the location of the former coal tar dump area.

Although the lateral extent of the DNAPL zone is limited, contaminated soil and groundwater conditions are widespread across the entire park area. In areas of Kreher Park outside of the DNAPL zone, contaminants were encountered in the wood waste layer beneath several feet of clean surficial soil. An LNAPL sheen was observed in this wood waste layer, which was encountered at test pits locations throughout Kreher Park during test pit investigations. Areas at Kreher Park with LNAPL yielded total VOC concentrations in groundwater less than 5,000 μg/l, which is significantly lower than VOC concentrations associated with DNAPL (> 50,000 μg/l). The lateral extent of the LNAPL contamination is shown on Figure 3-8, depicted by the green lines on that figure.

Sediments

The area of impacted sediments is located in a small bay created by the Prentice Avenue jetty and marina extensions previously described. For the most part, contaminated sediments are confined within this small bay by the northern edge of the line between the Prentice Avenue jetty and the marina extension. The affected sediments consist of lake bottom sand and silts, and are mixed with wood debris likely originating from former log rafting and lumbering operations. The wood debris layer is up to seven feet thick in areas, with an average thickness of nine inches. Wood debris overlays approximately 95% of the impacted sediments. The FS report estimated that the entire area of impacted sediments encompasses approximately sixteen acres based upon a preliminary remediation goal (PRG) for sediment of 9.5 ppm tPAH /g @0.415% OC.

NAPL is also present in some sediments in the offshore zone along the Kreher Park shoreline, mainly at the sand/wood waste interface (i.e. the historic lakebed). The most NAPL is in the area between the marina and an area north of the former WWTP from 100 to 300 feet from the shore. In this area NAPL is found at depths up to four feet below the sediment/wood waste and water interface. NAPL is also encountered in sediments at depths up to 10 feet below the top of the wood waste between the former WWTP and the boat launch where the overlying wood waste layer is thickest. The lateral extent of the impacted sediments and the extent of NAPL and/or sheens are depicted on Figure 3-3. The vertical extent of the impacted sediments is shown on Figures 3-4, 3-5 and 3-6, which depict three different cross sections that are defined on the Cross Section Overview Map on each figure. Two of the cross sections run north-south, perpendicular to the shoreline (see Figures 3-4 and 3-5) and the third runs east-west, parallel to the shoreline (see Figure 3-6). In all three figures, the dashed blue line depicts the approximate vertical extent of sediments that exceed 9.5 ppm tPAH /g @0.415% OC.

Copper Falls Aquifer

A DNAPL mass is present underlying the Miller Creek Formation in the area of the NSPW service center. This material is found within the upper reaches of the Copper Falls aquifer, a sandy, coarse grained unit. DNAPL extends from depths of approximately 30 to 70 feet. The greatest thickness of DNAPL is present directly south of St. Claire Street within the main access drive of the NSPW service center, and the

DNAPL thins in all directions from this area. The lateral extent of DNAPL in the underlying Copper Falls aquifer is shown on Figure 3-7, as shown by the dark blue line on that figure. The vertical extent of the DNAPL contamination is depicted on a series of five cross-sections which are defined on Figure 3-1. Figures 3-2 and Figures 3, 4, 5 and 6 show cross sections A-A', B-B', C-C', D-D' and E-E', respectively. Cross sections A-A', B-B' and E-E' show the largest volumes of DNAPL, as those cross sections run through the NSPW service center area. (No NAPL appears on cross section D-D' which runs roughly parallel to the shoreline.)

NSPW has maintained a free product recovery system consisting of three extraction wells since the system was installed in 2000. The system is a low-flow pumping system, which uses groundwater as a carrier to remove the free product. An oil water separator is then used to separate NAPL from water. NAPL is placed in a storage tank and periodically transported off-site for treatment (incineration) and disposal, and contaminated groundwater is treated by carbon filtration prior to discharge to the sanitary sewer system. Through June 2010, 2.4 million gallons of contaminated groundwater were removed from the Copper Falls aquifer, and more than 11,000 gallons of NAPL (approximately 0.5% of the total volume removed) was separated out for off-site treatment and disposal.

Hydrogeologic conditions at the Site have restricted the migration of contaminants in the underlying Copper Falls aquifer. The fine grained low permeability of the Miller Creek Formation behaves as a confining unit (aquitard) for the Copper Falls as indicated by strong upward vertical gradients that increase with depth in nested wells screened in this unit.

The estimated volume of soil, groundwater and sediment contamination at the Site is shown in the table below.

Estimated Volumes and Areal Extent of Contaminated Media		
Media	Volume (cubic yards)	Assumptions
Soil		
Upper Bluff/Filled Ravine Area		
Upper Bluff Area	28,000	Areal extent of contamination at Upper Bluff where benzene exceeds the NR 720 Residual Contaminant Level (RCL) is approximately 1.72 acres, and thickness is 10 feet. (Includes soil contamination beneath former MGP building).
Filled Ravine Volume	20,700	Areal extent of Filled Ravine is approximately 1.28 acres, and thickness is 10 feet.
Former Gas Holder Area	9,400	Areal extent of contamination is 130 by 130 feet, and thickness is 15 feet.
Former Clay Tile Area	150	Areal extent of contamination is 75 by 10 feet, and thickness is 5 feet.
Kreher Park		
Kreher Park	224,600	Areal extent of all fill is approximately 11.6 acres and thickness is 12 feet.
Unsaturated Zone Soil Volume	83,700	Areal extent of contamination is approximately 10.38 acres, and average thickness is 5 feet.
Saturated Zone Soil Volume	117,200	Areal extent of contamination is approximately 10.38 acres, and average thickness is 7 feet (includes the wood waste layer).
Former Coal Tar Dump Area	4,800	Areal extent of contamination is 260 feet by 100 feet (approximately 0.5 acres), and layer is 5 feet thick.
Groundwater		
Upper Bluff Area	65,600	Areal extent of contamination is approximately 2.71 acres, and saturated thickness is 15 feet.
Kreher Park	133,900	Areal extent of contamination is approximately 10.38 acres, and saturated zone is 7 feet.
Copper Falls Aquifer	Upper Bluff 366,700 Kreher Park 133,500 Total 500,200	Areal extent of contamination is 6.9 acres, average thickness of 35 feet beneath Kreher Park, and 50 feet beneath Upper Bluff area.
Sediment		
Sediment exceeding 10 ppm* PAH	133,900	Approximate areal extent of contamination is 16 acres, and includes removal of wood waste and all contaminated sediment to maximum depth of 10 feet.

* For purposes of estimating sediment volume, the 9.5 ppm PRG was rounded to 10 ppm and it was assumed that the concentration was on a dry weight basis. Due to the spatial distribution of sample locations, interpolation was used to estimate the areal extent of contamination. Rounding to 10 ppm is not expected to result in a significant underestimate of the contaminated sediment volume.

Appendix G contains additional details about the extent of contamination at the Site, including the range of concentrations detected and the frequency of detections for the COCs in each affected media and each separate area of the Site. Appendix G cites instances where sample results exceeded various standards (such as specific Wisconsin standards, Region 3 or Region 9 industrial or residential PRGs, etc.). Appendix E contains those various standards for each COC in each media: soil and sediment standards are contained in Table 4-2, groundwater standards are contained in Table 4-3, surface water standards are contained in Table 4-4, and soil vapor standards are contained in Table 4-5 of Appendix E.

6.0 Current and Potential Future Land and Resource Uses

Currently the Upper Bluff/Filled Ravine portion of the Site is occupied by the NSPW facilities, residential properties, as well as a church and school. Currently, Kreher Park has a walking path along the lakefront as well as a gravel parking lot for the marina. The marina is located to the west of the inlet and is separated from the inlet by a break wall and is not part of the Site. The inlet contains the contaminated sediments that are part of the Site. The entry to the inlet is posted to prevent boats from entering and disturbing the contaminated sediments. In addition, signs posted along the shoreline of the inlet warn the public against wading or swimming. An RV park and swimming beach is located east of the inlet and is also separated by a break wall and is not part of the Site.

Future use of Kreher Park does not include a residential scenario. However, the City of Ashland has proposed a bike path along the railroad corridor that runs east/west through the Site and has a Waterfront Development Plan for the lakefront that includes Kreher Park and would expand the existing marina and make the location of the former WWTP the centerpiece of the Ashland bayfront by creating a visitor's center, and Great Lakes education center and meeting facilities.

The City of Ashland adopted a Comprehensive Plan in October 2004 which sets policy for the direction that the community would like to develop over the next 20 years. For the areas within the Ashland/NSP Lakefront Superfund Site, the City's Comprehensive Plan calls for the areas north of the bluff to be redeveloped as Planned Waterfront. For areas south of the bluff, this area is to be redeveloped as City Center with the following potential actions: relocate existing industrial uses to other areas of the City; promote water-oriented commercial uses that are respectful of existing and future residential uses; provide a sensitive mix of residential uses, including medium and high-density housing; develop an attractive, pedestrian-oriented character to this area that is strongly oriented to the waterfront; and incorporate pedestrian corridors through this area that link the waterfront and Main Street areas.

Lake Superior is a source of drinking water for many area communities including Ashland; however, the water intake is several thousand feet out into the Chequamegon Bay and is not located in the inlet containing contaminated sediments that are part of the Site. Thus, surface water as a source of drinking water is not an issue at the Site.

Currently, groundwater at the Site is not used, however, future groundwater use is an issue that will be addressed by containment, groundwater extraction and treatment, and institutional

controls to restrict future use of the groundwater until it is restored to its beneficial use. The City of Ashland has two artesian wells located in the Kreher Park area. They were taken out of use during implementation of the RI when it was determined that the wells could potentially intercept contamination. Data from the RI show that COCs from the Site were detected, however, the results were below State and/or Federal groundwater quality standards. The City is very interested in utilizing these artesian wells in the future.

In addition, the Lake Superior basin is one of the most pristine and unique ecosystems in North America. Containing the largest surface area of any freshwater lake in the world, Lake Superior has some of the most breathtaking scenery in the Great Lakes and serves as a backdrop to a wide range of recreational and outdoor activities enjoyed by people from all over the world. Sparsely populated even today, Lake Superior has not experienced the same level of development, urbanization, or pollution as the other Great Lakes. Recognizing this unique and invaluable resource, the federal, state, provincial, and U.S. tribal governments, First Nations, environmental groups, industry and the public have taken steps to protect this great legacy for generations to come. This partnership serves as a model the world over for cooperative binational resource management. The Great Lakes Water Quality Agreement (GLWQA) between the United States and Canada commits the two countries (the Parties) to address the water quality issues of the Great Lakes in a coordinated fashion.

7.0 Summary of Site Risks

As part of the RI, NSPW prepared a Human Health Risk Assessment and a Baseline Ecological Risk Assessment for the Ashland/NSP Lakefront Site to evaluate potential risks to human health and the environment if no action is taken. The HHRA and BERA characterize current and future threats or risks to human health and the environment posed by contaminants at the Site. The risk assessments provide the basis for taking action and identify the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the HHRA and BERA. The HHRA and BERA determined that the COCs for the Site are PAHs and VOCs in soils, sediment and groundwater and that cleanup to levels within EPA's risk range will be protective of human health and the environment at the Site for current and future use. The COCs developed for the Site through the HHRA and BERA are listed in Section 7.9 of this ROD.

In accordance with EPA guidance on preparing RODs, the information presented here focuses on the information that is driving the need for the response action at the Ashland/NSP Lakefront Site and does not necessarily summarize the entire HHRA and BERA. Further information is contained in the risk assessments within the RI report, included in the Administrative Record for the Site.

7.1 Summary of Human Health Risk Assessment

The risk assessment estimates what risks a site poses if no action is taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the risk assessment for the Site. The HHRA was prepared in accordance with *Risk Assessment Guidance*

for Superfund: Volume 1 Human Health Evaluation Manual, Part D (EPA 540-R-97-033, December 2001) (hereafter referred to as "*RAGS Part D*"). The results of the HHRA for the Site indicate that seven exposure pathways result in estimated risks that exceed EPA's target risk range (an incremental cancer risk [CR] of 10^{-4} to 10^{-6} and a hazard index [HI] ≤ 1) and eight exposure pathways result in estimated risks that are either equivalent to or exceed the WDNR's threshold (CR $\leq 1\times10^{-5}$ and HI ≤ 1). These exposure pathways are listed below.

Exceeds EPA Threshold (CR $\geq 1\times10^{-4}$ or HI >1)	**Exceeds WDNR Threshold (CR $\geq 1\times10^{-5}$ or HI >1)**
Residents (Soil [0-3 feet and all soil depths] - Cancer)	Residents (Soil [0-3 feet and all soil depths] - Cancer)
--	Residential Child (Soil – Noncancer)
Construction Worker (Soil [0-10 feet bgs]/Groundwater)	Construction Worker (Soil [0-10 feet bgs]/Groundwater)
Construction Worker (Trench Air)	Construction Worker (Trench Air)
Adult Swimmer (Surface Water)	Adult Swimmer (Surface Water)
Adult Wader (Surface Water/Oil Slicks)	Adult Wader (Surface Water/Oil Slicks/Sediment)
Industrial Worker (Indoor Air)	Industrial Worker (Indoor Air)
Subsistence Fisher (Biota)	Subsistence Fisher (Biota)

HI: Hazard index for noncarcinogenic effects

7.2 Identification of Contaminants of Potential Concern

A screening process was used to identify the contaminants of concern. First, contaminants of potential concern (COPCs) were identified for further evaluation in the HHRA. The process involves comparison of site data to conservative criteria which, if not exceeded, show that risks/hazards are insignificant. The COPCs selected for further evaluation are listed in Appendix H-1 and include VOCs and PAHs. Benzene is the most commonly occurring VOC. The PAHs consist of a group of SVOCs. The most commonly occurring SVOC at the Site is naphthalene. Some metals (lead, thallium and arsenic) and inorganic compounds (cyanides) have also been found.

In the HHRA, the toxicity assessment provides a framework for characterizing the relationship between the magnitude of exposure to a chemical and the nature and likelihood of adverse health effects that may result from such exposure. Chemical toxicity is typically divided into two categories: carcinogenic and noncarcinogenic. Potential health effects are evaluated separately for these two categories, because their toxicity criteria are based on different mechanistic assumptions and associated risks are expressed in different units. Thus, the COPC list was refined using toxicology, pathways, and exposure during the HHRA for the Site. No COPCs were identified in the HHRA for groundwater because groundwater is not used as a potable water supply, though construction worker exposure to groundwater is possible. At the former WWTP, trespassers who enter the buildings can potentially inhale vapors and have direct dermal

contact with contaminated groundwater and NAPLs that have infiltrated the flooded lower level of the facility. The COPCs identified for surface water include PAHs. The COPCs identified for sediment include metals and PAHs. PAHs were found to be COPCs in fish. Several volatile compounds were identified as COPCs in indoor air.

The COPCs identified in the HHRA for this Site are primarily metals, SVOCs, and limited VOCs. A summary of the COPCs by receptor and medium is presented in Appendix H-1. Tables 10 to 19 in Appendix H-1 present the detailed screening summary tables by receptor and medium.

Although many chemicals may be identified in samples collected during a site investigation, the results of a baseline HHRA typically identify a few chemicals that are the "risk drivers" at a site. To streamline the HHRA process and focus efforts on important issues, several methods have been developed by the regulatory agencies and the scientific community for the identification of chemicals and pathways that contribute significantly to the total risks posed by a site. A tiered, risk-based approach was used for the selection of COPCs to be further evaluated in the detailed HHRA for the Site. This approach is based on EPA-developed methodology and follows standard HHRA procedures.

The maximum detected concentration of a chemical was compared with chemical- and medium-specific risk-based screening concentrations (RBSCs), defined as concentrations that are not expected to result in any adverse impact based on exposure conditions which served as the basis for the calculation. A chemical was selected as a COPC if its maximum detected concentration value exceeds the RBSC.

However, because there were no data collected that are representative of the oily materials in groundwater and surface water, laboratory analytical data collected from the product stream recovered from the active free product recovery system for the Copper Falls aquifer were used to evaluate risks to the construction worker, recreational swimmer and recreational wader receptors. Because there are no readily available risk-based screening values for oily materials, all chemicals that were detected in the product stream were selected as COPCs.

For the evaluation of construction worker dermal and inhalation exposures to VOCs in a trench, the maximum detected groundwater concentration at three domains (Kreher Park, Upper Bluff, Filled Ravine) was used to estimate risk. All chemicals detected in groundwater were identified as COPCs. The groundwater data were not screened against RBSCs prior to risk characterization. This approach potentially overestimates risks to construction worker receptors as not all chemicals detected were present at concentrations greater than their RBSC.

For purposes of this project, the PRGs derived by EPA Region 9 (EPA, 2004b) were adopted as the primary source of RBSCs because they are based on conservative assumptions of exposure scenarios.

For those chemicals lacking an RBSC (i.e., PRG or risk-based concentration [RBC]) the standard practice of selecting surrogate chemicals based on similarities in structure was used to determine if a chemical should be included as a COPC.

It should also be noted that RBSCs that are protective of noncarcinogenic effects were adjusted by a factor of 0.1 (i.e., divided by a factor of 10) to account for possible additive effects of multiple chemicals. All RBSCs for the protection of carcinogenic effects were based on a target cancer risk of 1×10^{-6}.

7.3 Exposure Assessment

The exposure assessment identifies potential pathways by which people may be exposed to contaminants at the Site. This process involves consideration of constituent concentrations in site-related media (e.g., soils, groundwater, and sediment) and potentially exposed populations and their activity patterns. The exposure assessment is contained in Section 3 of the HHRA.

The assumptions used to identify the exposure scenarios evaluated in the HHRA were based on EPA guidance, Site history, current land use, and anticipated future use of the Site. If land use changes in the future (e.g., the City of Ashland rezones Kreher Park for residential development), the HHRA may need to be revisited to determine the risks associated with the new land use. The exposure pathways are summarized below.

7.3.1 Exposure to COCs in Soil

a. Residential Land Use Scenario: Child and Adult Residents

Upper Bluff - There is a residential area located upgradient of Kreher Park on the Upper Bluff northeast of the Filled Ravine. The three exposure scenarios in the HHRA for the residential receptors are:

Exposure to surface soil (0-1 foot).

The residential neighborhoods adjacent to the Site are established neighborhoods and are expected to remain so in the future. According to the Ashland Wisconsin Waterfront Development Plan, the future use of the Kreher Park portion of the Site does not include a residential scenario. In an established residential setting and without intrusive activities, receptors would most likely be exposed to surface soil.

Exposure to soil in top 3 feet (0-3 feet).

For informational purposes, COCs in soil between 0 and 3 feet below ground surface (bgs) were also considered for residential receptors based on the assumption that receptors could potentially be exposed to soil from 0-3 feet bgs when performing landscaping or gardening activities.

For the purpose of the HHRA, child and adult residents were assumed to be exposed to COCs in soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Exposure to subsurface soil (1 - 10 feet).

For the purpose of the HHRA, this assumption was made because new construction would involve excavation of soil for the construction of footings or basements.

Therefore, subsurface soil would be brought to the surface resulting in a potential exposure pathway for residential receptors. This scenario represents the worst case for residential receptors, but is not likely to be the actual scenario associated with the Site. In an established residential setting and without intrusive activities, receptors would most likely not be exposed to subsurface soil.

b. Recreational Use Scenario: Child, Adolescent and Adult Visitors

Kreher Park is now zoned as City parkland. It is assumed, therefore, that the primary exposure scenario for Kreher Park is recreational, and that people will temporarily visit but not live in this area of the Site. In addition, other exposure scenarios are possible (e.g., maintenance and construction) and were developed as discussed below. Child, adolescent and adult visitors are assumed to be exposed to COCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

c. Industrial/Commercial Land Use Scenario: Maintenance Workers

Although the final Work Plan indicated maintenance workers currently access the Site, additional information collected during the RI indicates that City workers and utility maintenance personnel do not access the Site. However, the City may develop the area by expanding the existing marina and creating a museum/education/conference facility on the affected area. Therefore, a potential future maintenance worker was considered a receptor to surface soil at Kreher Park. In addition, maintenance workers are a receptor to surface soil in unpaved portions of the Upper Bluff area. It is conservatively assumed that maintenance workers may be exposed to COCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

d. Industrial/Commercial Land Use Scenario: General Industrial Workers

Except for the NSPW facility, no other industrial/commercial facilities exist within the Site. For this HHRA, general workers are defined as NSPW employees involved with non-intrusive, operational activities. Current and potential future general workers are not likely to be subject to significant exposure to environmental media in the normal course of their daily work. Although the potential for exposure to occur is expected to be low, general workers are assumed to be exposed to COCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

e. Industrial/Commercial Land Use Scenario: Construction Workers

Upper Bluff and Kreher Park - It is conservatively assumed that construction activities could take place at every area of the Site and it is possible for construction workers to be exposed to COCs in surface and subsurface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways. For this HHRA, subsurface soil is defined as a depth of 10 feet or less, which is a conservative estimate of the limit to which construction activities may occur based on the current and proposed future land use at the Site.

7.3.2 Exposure to COCs in Indoor Air – Residents and Industrial Workers

Upper Bluff - The residential area located upgradient from Kreher Park on the Upper Bluff area northeast of the Filled Ravine was evaluated. For the purpose of the HHRA, child and adult residents were assumed to be potentially exposed to COCs volatilizing from soil and groundwater and entering the residences located near the Filled Ravine. In addition, potential exposures to COCs in indoor air were also evaluated for industrial workers who may enter the NSPW service center/vehicle maintenance building periodically.

Kreher Park – Trespassers who enter the former WWTP can potentially inhale vapors released to contaminated groundwater and NAPLs that have infiltrated the flooded lower level of the facility. The potential health risks associated with this exposure pathway was part of the RI/FS work plan but was not quantitatively evaluated by the HHRA and is a data gap. This exposure pathway was not quantitatively evaluated because access to the interior of the plant was restricted during the RI/FS study and no samples could be collected. Additionally, earlier indoor air analyses results collected by the City of Ashland (2002) were not available for review as part of the HHRA. Despite this shortcoming, direct contact exposures to NAPL or "free-product" in groundwater may pose an unacceptable health risk.

7.3.3 Exposure to COCs in Groundwater:

a. Trespassing Land Use Scenario

The final Work Plan indicated that groundwater in the seep area was a potential exposure point for trespassers. However, this exposure point was eliminated because the seep area was capped as part of the 2002 interim action response. This exposure pathway is no longer complete and was not quantitatively evaluated in the HHRA.

Another potential point of exposure to groundwater is the former WWTP building where groundwater has infiltrated into the basement. The building is locked and the perimeter is partially fenced. A quantitative evaluation for potential trespasser exposures to the indoor air and water inside the former WWTP building was not performed due to the lack of data.

b. Industrial/Commercial Land Use Scenario: Construction Workers

Kreher Park - It was conservatively assumed that construction activities could take place at every area included in the evaluation and it is possible for construction workers to be exposed to COCs in shallow groundwater at Kreher Park via incidental ingestion, inhalation of vapors, and dermal contact pathways. For the HHRA, shallow groundwater was defined as a depth of 10 feet or less, which is a conservative estimate of the limit to which construction activities may occur based on the current and proposed future land use at the Site.

c. Residential and Industrial/Commercial Land Use Scenarios

Groundwater is present in both the water table aquifer and a confined deep aquifer. Currently the shallow groundwater is not used as a potable water source. There are two artesian wells in the Site vicinity—one located near Prentice Avenue on the eastern boundary of the Site and the other located near the marina on the western boundary. Both wells draw water from the Copper Falls aquifer. the confined deep aquifer that is separated from the shallow groundwater by the Miller Creek Formation. The City of Ashland restricted public access to these wells for public use in August 2004. To date water from these wells have met all federal and state safe drinking water standards. Water from these artesian wells is considered safe to drink as Site-related chemicals have not been detected in these wells at levels of concern.

Except for the two artesian wells, the Copper Falls aquifer is not used for drinking water and is not considered a source of human exposure. Shallow groundwater at the Site is not a drinking water source for the City of Ashland. Drinking water at the Site is provided by the City of Ashland that draws its water from intakes in Lake Superior, located approximately one mile northeast of the Site outside the known extent of surface water contamination. Therefore. there are no known receptors to shallow groundwater beneath the Site.

7.3.4 Exposure to COCs in Surface Water and Sediments

Recreational Use Scenario: Child, Adolescent and Adult Visitors to Kreher Park and Chequamegon Bay

The Site is surrounded by facilities that draw the public to the lakefront – a City marina, public swimming beach. a boat ramp and an RV park and campground. Child, adolescent and adult visitors are assumed to be exposed to COCs in surface water and sediments via incidental ingestion, inhalation of vapors, and dermal contact pathways while swimming, wading, fishing, or boating. However, only risks associated with swimming and wading activities were quantified in the HHRA. This is because they represent activities that have the greatest contact with impacted media and are considered more conservative than exposures associated with fishing and boating.

7.3.5 Exposure to COCs in Fish Tissue

Subsistence fishers were selected as the fishing receptors because there are two Chippewa Bands (the Bad River Band and the Red Cliff Band of Lake Superior Chippewa) who may use Chequamegon Bay as their source of fish. For the HHRA it was conservatively assumed that adult subsistence fishers may be exposed to COCs via ingestion of locally-caught fish. Although this scenario was selected based on the presence of the two Chippewa Bands, this exposure scenario and the selected exposure parameters are applicable to any subsistence fisher ingesting fish from Chequamegon Bay.

7.4 Toxicity Assessment

The toxicity assessment identifies the potential effects that are generally associated with exposure to a given chemical. To quantify carcinogenic effects. EPA has derived slope factors

(SFs) for those chemicals found to cause a dose-related, statistically significant increase in tumor incidence in an exposed population relative to the incidence of tumors observed in unexposed populations. SFs are typically developed based on oral toxicity studies and are reported as risk per unit dose in units of inverse milligrams per kilogram body weight per day [$(mg/kg\text{-}day)^{-1}$]. The SFs are used to quantify the potential risk of cancer associated with a given exposure (EPA, RAGS Part D).

To quantify non-carcinogenic hazards, EPA has derived reference doses (RfDs) that represent a threshold of toxicity in units of mg/kg-day. RfDs are intended to represent an exposure that the human population could be exposed to daily for an entire lifetime without appreciable risk of harmful effects (EPA, RAGS Part D).

Because most oral SFs and RfDs are based on an administered dose, the toxicity values are sometimes adjusted (expressed as an absorbed dose) when evaluating the dermal exposure scenarios. In accordance with EPA's *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual* (Part E, Supplemental Guidance for Dermal Risk Assessment) Final (540-R-99-005, July 2004) the oral SF is adjusted only when the gastrointestinal absorption of the compound is less than 50%.

There were several chemicals detected at the Site for which there are only provisional toxicity values. The EPA process for developing provisional toxicity values is inherently conservative and is not subject to the same vigorous review process as toxicity criteria that have been verified. For the HHRA, 2-methylnaphthalene is a risk driver based on its provisional toxicity value. Because the toxicity values are based on limited animal and human data, the true risks associated with these chemicals is not completely known.

There were several chemicals (1-methylnaphthalene, acenaphthylene, benzo[e]pyrene, benzo[g,h,i]perylene, phenanthrene, 1,2,3-trimethylbenzene, p-isopropyltoluene) that were detected at the Site and for which there are no toxicity values. Because of the lack of information available for these chemicals, the true risk to potential receptors at the Site is not completely known. However, because these chemicals were detected in areas where primary risk drivers are located, it is likely that any remediation based on known risk drivers will address chemicals for which there is a lack of toxicity data.

7.5 Risk Characterization

The risk characterization integrates the results of the data evaluation, toxicity assessment, and exposure assessment to evaluate potential risks/hazards associated with the Site. Consistent with EPA guidance, carcinogenic risks and non-carcinogenic hazards are evaluated separately.

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

Where: risk = a unitless probability (e.g., 2 x 10-5) of an individual's developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

SF = slope factor, expressed as (mg/kg-day)-1.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1 x10-6). An excess lifetime cancer risk of 1 x 10-6 indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been established to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 10-4 to 10-6.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with a reference dose derived for a similar exposure period. An RfD represents a level than an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index is generated by adding the HQs for all chemicals of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI>1 indicates that site-related exposures may present a risk to human health.

Methodology for Evaluating Carcinogenic Effects

For purposes of assessing risks associated with potential carcinogens, EPA has adopted the science policy position of "no-threshold;" i.e., there is essentially no level of exposure to a carcinogen which will not result in some finite possibility of tumor formation. This approach requires the development of dose-response curves correlating risks associated with given levels of exposure. Linear dose-risk response curves are generally assumed.

Carcinogenic risks associated with a given level of exposure to potential carcinogens are typically extrapolated based on slope factors or unit risks. SFs are the upper 95% confidence limit of the slope of the dose-response curve, expressed in terms of risk per unit dose [given in $(mg/kg\text{-}day)^{-1}$]. Unit risks relate the risk of cancer development with the concentration of carcinogen in the given medium, expressed as either risk per unit concentration in air [given in $(\mu g/m^3)^{-1}$] or drinking water [given in $(\mu g/L)^{-1}$].

Current EPA Superfund guidance for calculating a dermal SF is to adjust the oral SF with an oral absorption factor specific for that chemical. It should be noted that the oral absorption factor used in the calculation refers to absorption of the chemicals in the species upon which the SF is based; i.e., generally not absorption data in humans.

The equation for extrapolation of a default dermal SF is as follows:

$$\text{Default Dermal SF}\left[(\text{mg/kg-day})^{-1}\right] = \text{Oral SF}\left[(\text{mg/kg-day})^{-1}\right] \div \text{Oral Absorption Factor (\%)}$$

Regulatory agencies have policies and guidelines to determine the significance of these calculated risk levels. EPA uses 1×10^{-6} to 1×10^{-4} as a "target range within which the Agency strives to manage risks as part of a Superfund cleanup" (EPA, 1991).

Methodology for Evaluating Non-carcinogenic Effects

EPA has adopted the science policy position that protective mechanisms (such as repair, detoxification, and compensation) must be overcome before the adverse systemic health effect is manifested. Therefore, a range of exposures exists from zero to some finite value that can be tolerated by the organism without appreciable risk of expressing adverse effects.

The approach used by EPA to gauge the potential non-carcinogenic effects is to identify the upper boundary of the tolerance range (threshold) for each chemical and to derive an estimate of the exposure below which adverse health effects are not expected to occur. Such an estimate calculated for the oral route of exposure is an oral reference dose, and for the inhalation route of exposure is an inhalation reference concentration (RfC). The oral RfD is typically expressed as mg chemical per kg body weight per day, and the inhalation RfC is usually expressed in terms of concentration in the air (i.e., mg chemical per m^3 of air). However, for purposes of baseline HHRAs, inhalation RfC values can be converted to units of dose by multiplying by the inhalation rate (20 m^3/day, an upper-bound estimate for combined indoor-outdoor activity) and dividing by the body weight (70 kg, average body weight), as detailed in the following equation:

$$\textit{Inhalation}\ \text{RfD}\,(\text{mg/kg-day}) = \text{RfC}\,(\text{mg/m}^3) \times 20\ {}^{m^3}\!/_{day} \div 70\,\text{kg}$$

Currently, two types of oral RfDs/inhalation RfCs are available, depending on the length of exposure being evaluated (chronic or subchronic). Chronic oral RfDs/inhalation RfCs are specifically developed to be protective for long-term exposure to a compound, and are generally used to evaluate the non-carcinogenic effects associated with exposure periods between seven years (approximately 10% of an average lifespan) and a lifetime. Subchronic oral RfDs/inhalation RfCs are useful for characterizing potential non-carcinogenic effects associated with shorter-term exposures. Current guidelines for Superfund program risk assessment requires that subchronic oral RfDs/inhalation RfCs be used to evaluate the potential non-carcinogenic effects of exposure periods between two weeks and seven years.

Toxicological criteria specifically derived for gauging potential human health concerns associated with the dermal route of exposure have not been developed by EPA. For purposes of this HHRA, default dermal RfD values were extrapolated from oral RfDs (EPA 1989), if:

- Health effects following exposure are not route-specific.
- Portal-of-entry effects (e.g., dermatitis associated with dermal exposure and respiratory effects associated with inhalation exposure) are not the principal effects of concern.

Exposures with the dermal route are generally calculated as absorbed doses, while oral RfDs are expressed as administered doses. Current EPA Superfund guidance is to adjust the oral RfD with an oral absorption factor (i.e.. percent chemical that is absorbed) to extrapolate a default dermal RfD, which is expressed in terms of absorbed dose. It should be noted that the oral absorption factor used in the calculation refers to absorption of the chemicals in the species upon which the RfD is based (i.e., generally not absorption data in humans).

The equation for extrapolation of a default dermal RfD is as follows:

$$\textit{Default}\ \text{Dermal RfD}\ (\text{mg/kg-day}) = \text{Oral RfD}\ (\text{mg/kg-day}) \times \text{Oral Absorption Factor}\ (\%)$$

Risks were compared to both EPA target risk ranges (CR of 10^{-4} to 10^{-6} and HI ≤ 1) as well as the target risk thresholds for WDNR. Where the calculated carcinogenic and noncarcinogenic risks exceed either threshold it is noted in the text discussion below. Attachment D in the HHRA provides a detailed presentation of the carcinogenic and noncarcinogenic risk calculations. A summary of the risks are shown in Tables 20 – 45 in Appendix I of this ROD.

7.5.1 Risk Summary for the Residential Scenario

Risks associated with exposure to surface and subsurface soil for residents are a CR of 5×10^{-4} and an HI of 15 for samples collected within the Filled Ravine of the former MGP. These risks exceed the EPA target risk range of 10^{-4} to 10^{-6} and the WDNR threshold of 10^{-5} for cancer and an HI of 1 for noncancer endpoints, respectively. The resulting cancer risk of 5×10^{-4} is primarily attributed to benzo(a)pyrene (65%) and dibenzo(a,h)anthracene (10%). Upon review of the data gathered for benzo(a)pyrene, 10 sampling locations (located in both the Filled Ravine and the Upper Bluff) with detectable concentrations ranging from 22 to 340 mg/kg at intervals between 1 to 8 feet bgs are the main contributors to the benzo(a)pyrene cancer risk. In addition, one sample location for dibenzo(a,h)anthracene (CP110) with a reported concentration of 3.8 mg/kg (1 to 3 feet bgs) is the main contributor to the dibenzo(a,h)anthracene cancer risk. The resulting HI of 15 is primarily attributed to naphthalene (with an HI of 11).

Based on the results of the Integrated Exposure Uptake Biokinetic (IEUBK) model inputting an average lead concentration in soil of 90.5 mg/kg, the percentage of children predicted to have a blood lead concentration greater than 10 µg/dL is 0.11, which is within EPA's target criteria of no more than 5% above the concern threshold of 10 µg/dL concentration. While one soil location (GP-110 (1-3')) had a highly elevated lead concentration of 4000 mg/kg, only one other sample (GP-115 (1-3') had a concentration (480 mg/kg) that exceeded the screening level of 400 mg/kg. Thus, while there are elevated concentrations in the loading dock area of the NSPW property, the average concentration is below the screening level.

Indoor Air Pathway (Vapor Intrusion)

The inhalation pathway for potential exposure to hazardous vapors was evaluated during the RI by installing vapor probes in the unsaturated zone and collecting vapor samples in the vicinity of the former MGP. Thirteen vapor probes were installed at 10 exterior and one interior location. The results of soil gas samples collected from probes were evaluated using the most recent

revision of the Johnson and Ettinger models (U.S. EPA, 2002). Indoor air samples were also collected from the NSPW service center building to further characterize potential vapor intrusion. The soil gas data were then compared to the indoor air sample results and relevant indoor air quality criteria.

Measured concentrations in soil vapor samples collected from subsurface soil within the Filled Ravine area of the Site did not exceed the EPA's risk target shallow soil vapor screening concentrations at a target risk level of 10^{-5}, indicating that subsurface vapors are not migrating toward the residential area at St. Claire Street and Prentice Avenue.

Residential Risk Discussion

PAHs appear to be the primary risk drivers for the residential receptor within the Filled Ravine area of the former MGP. The highest concentrations of PAHs, and thus the highest risks, are associated with PAHs detected at depths of 0 to 3 feet bgs. However, residents are not currently located in this area of the Site and residential areas are not likely to be established at this part of the Site in the future.

For the HHRA, it was conservatively assumed that the residential receptors would be exposed to both surface and subsurface soil. This assumption was made because new construction would involve excavation of soil for the construction of basements or foundations. Therefore, soil with high chemical concentrations would be brought to the surface resulting in a potential exposure pathway for residential receptors. This scenario represents the worst case for residential receptors, but is not likely to be the actual scenario associated with the Site. The residential neighborhoods adjacent to the Site are established neighborhoods and are expected to remain so in the future. According to the Ashland Wisconsin Waterfront Development Plan, the future use of the Kreher Park portion of the Site does not include a residential scenario. Therefore, residential receptors would only be exposed to surface soil. If it is assumed that residential receptors adjacent to the Site tend gardens, then it is possible that the first three feet of soil will represent the most likely exposure point.

Re-evaluating the residential receptor using exposure point concentrations (EPCs) derived based on the exposure to surface soil and soil to a depth of 3 feet indicates that carcinogenic and noncarcinogenic risks fall within EPA's target risk range of 10^{-4} to 10^{-6} for cancer endpoints and below an HI of 1 for noncancer endpoints. For soils to a depth 0 to 3 feet bgs, the carcinogenic risk exceeds EPA's target risk range of 10^{-4} to 10^{-6}. The estimated cancer risk for surface soil is also above the WDNR threshold of 10^{-5}.

Receptor	Table in Appendix I	Soil	
		CR	HI
Resident (Surface Soil only)	33	1×10^{-5}	0.2
Residential (0-3 feet bgs)	34	3×10^{-4}	0.9

The resulting CR of 1×10^{-5} for exposure to surface soil only is primarily attributed to arsenic (76%). Upon review of the data, one sampling location (lSS19) with a reported concentration of 8.5 mg/kg is the main contributor to arsenic cancer risk.

Seventy eight percent of the resulting CR of 3×10^{-4} (exposure to soil between 0 and 3 feet bgs) is attributed to benzo(a)pyrene. Upon review of the data, 12 sampling locations within the Filled Ravine area with reported concentrations ranging from 0.19 to 220 mg/kg (at depths greater than 1 foot bgs) are the main contributors to cancer risk.

7.5.2 Risk Summary for the Recreational Scenario

The following pathways were considered for the recreational scenarios:

- Recreational adults, adolescent, and children exposed to surface soil
- Recreational adult, adolescent, and child waders exposed to sediment and surface water
- Recreational adult and adolescent swimmers exposed to sediments and surface water

In general, risks associated with COPC exposures to surface soils for recreational users were estimated to have CRs ranging between 1×10^{-5} and 1×10^{-6}, and HIs ranging between 0.002 and 0.04. Risks associated with swimmer and wader exposures to COPCs in sediments were estimated to have CRs between 1×10^{-5} and 3×10^{-9}, and HIs between 0.002 and 0.00002. For the adult swimmer and wader exposure to oily materials in surface water, the CR was 9×10^{-2} and 5×10^{-2}, and the HI was 6 and 4, respectively. Risks associated with each medium and recreational receptor are discussed below.

Risk Summary for Recreational Users Exposed to Surface Soil

Only limited metals and carcinogenic PAHs were identified as COPCs for recreational user exposure to surface soil. Cancer and noncancer risks to recreational adults and adolescents exposed to surface soil are generally a CR between 1×10^{-6} and 1×10^{-4} and less than an HI of 1. Cancer risks to a recreational child exposed to surface soil are 1×10^{-4}, but less than a noncancer risk of an HI of 1. The primary risk driver for the recreational adult, adolescent and child is benzo(a)pyrene.

Recreational Adults

Risks associated with exposure to surface soil for recreational adults are a CR of 3×10^{-6} and an HI of 0.002 for samples collected within Kreher Park. Both the cancer and noncancer risks are within the EPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively. These calculated risks are below the carcinogenic and noncarcinogenic WDNR thresholds. Approximately 76% of the resulting CR of 3×10^{-6} is attributed to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the Site, four sampling locations (located in Kreher Park, one of which is located within the Former Coal Tar Dump, sample TP-118) with detectable concentrations ranging from 7.4 to 68 mg/kg at intervals between 0 to 1 foot bgs are the main contributors to the benzo(a)pyrene cancer risk.

Recreational Adolescents

Risks associated with exposure to surface soil for recreational adolescents are a CR of 2×10^{-6} and an HI of 0.003 for samples collected within Kreher Park. Both the cancer and noncancer risk are within the EPA target CR of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints,

respectively. These calculated risks are below the carcinogenic and noncarcinogenic WDNR thresholds.

Approximately 76% of the resulting cancer risk is attributable to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the Site, four sampling locations (located in Kreher Park., one of which is located within the Former Coal Tar Dump, sample TP-118) with detectable concentrations ranging from 7.4 to 68 mg/kg at intervals between 0 to 1 foot bgs are the main contributors to the benzo(a)pyrene cancer risk.

Recreational Children

Risks associated with exposure to surface soil for recreational children are a CR of 1×10^{-5} and an HI of 0.04 for samples collected within Kreher Park. Both the cancer and noncancer risks are within the EPA target CR range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively. The calculated carcinogenic risk is equal to the carcinogenic WDNR threshold, but less than the noncarcinogenic WDNR threshold. Approximately 74% of the resulting cancer risk is attributed to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the Site, four sampling locations (located in Kreher Park, one of which is located within the Former Coal Tar Dump, sample TP-118) with detectable concentrations ranging from 7.4 to 68 mg/kg at intervals between 0 to 1 foot bgs are the main contributors to the benzo(a)pyrene cancer risk.

Risk Summary of Recreational Swimmers Exposed to Sediment and Surface Water

Surface water in the Chequamegon Bay has a number of issues associated with the existing data set. First, 2005 surface water data does not confirm the 1998 SEH sampling data which indicate that carcinogenic PAHs are present at concentrations greater than screening levels. Second, oil slicks have been visually observed within Chequamegon Bay. No analytical data is available which measures the levels of chemicals which might be present in oil slick surface water. Therefore, surface water exposures were evaluated using both the 1998 SEH data and analytical data collected from the product stream from the active free product recovery system for the Copper Falls Aquifer or chemical-specific solubility values detected in the DNAPL sample. This approach was used to provide a range of risks associated with the 1998 SEH sampling data and the "oil slicks."

Adult and Adolescent Swimmers Exposed to Surface Water

Wisconsin Department of Health and Family Services (WDHFS) calculated risks associated with exposures to the 1998 surface water data. Because no COPCs were identified in the 2005 RI data set, only the 1998 data were used for estimating risks. Detailed calculations using 1998 surface water data and exposure parameters consistent with the Site are presented in Attachment K of the HHRA and are summarized below for the recreational adult and adolescent swimmers.

Receptor	Calculated Risks using 1998 SEH Surface Water Data	
	CR	Noncancer Risk
Adult swimmer	6×10^{-5}	NE
Adolescent swimmer	3×10^{-5}	NE

NE – Not evaluated. Only carcinogenic PAHs were present in surface water at concentrations greater than the RBSC.

Adult and Adolescent Swimmers Exposed to Oil Slicks in Surface Water

Risks associated with exposures to oil slicks in surface water were evaluated. This pathway was evaluated because a tar slick was reported and photographed by a citizen. Although no slicks were observed by sample collectors and the subsequent data does not indicate notable surface water impacts, the 1998 SEH report calculated unacceptable levels of current and future health risks for workers, trespassers, and people engaged in recreational activities on the Site. Since this exposure pathway poses one of the greatest potential health risks at the Site, the HHRA report includes an evaluation of exposures to "oil slicks" in surface water in addition to the evaluation of the 1998 SEH data.

Risks associated with exposures to oil slicks in surface water were estimated for the recreational swimmers using concentrations of DNAPLs collected from the product stream recovered from the active free product recovery system for the Copper Falls aquifer. Risks associated with exposure to oil slicks in surface water are a CR of 9×10^{-2} and an HI of 6. The primary carcinogenic risk drivers are benzo(a)pyrene (62%) and dibenzo(a,h)anthracene (29%). The primary noncarcinogenic risk drivers are 2-methylnaphthalene (54%), naphthalene (12%) and benzene (16%).

Adult Swimmers Exposed to Sediment

Risks associated with exposure to sediment for adult swimmers are a CR of 4×10^{-5} and an HI of 0.05 for samples collected within Chequamegon Bay. Both the cancer and noncancer risk are below the EPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively. However, the cancer risk is greater than the WDNR target risk of 1×10^{-5}.

Adolescent Swimmers Exposed to Sediment

Risks associated with exposure to sediment for adolescent swimmers are a CR of 2×10^{-5} and an HI of 0.05 for samples collected within Chequamegon Bay. Both the cancer and noncancer risk are below the EPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively. However, the cancer risk is greater than the WDNR target risk of 1×10^{-5}.

Risk Summary for Recreational Waders Exposed to Sediment and Surface Water

Surface water in the Chequamegon Bay has a number of issues associated with the existing data set. First, 2005 surface water data do not confirm the 1998 SEH sampling data which indicate that carcinogenic PAHs are present at concentrations greater than screening levels. Second, oil slicks have been visually observed within Chequamegon Bay. No analytical data is available which measures the levels of chemicals which might be present in oil slick surface water. Therefore, surface water exposures were evaluated using both the 1998 SEH data and analytical data collected from the product stream from the active free product recovery system for the Copper Falls Aquifer or chemical-specific solubility values detected in the DNAPL sample. This approach was used to provide a range of risks associated with the 1998 SEH sampling data and the "oil slicks."

Adult and Adolescent Waders Exposed to Surface Water

WDNR calculated the risks associated with exposures to the 1998 surface water data. Because no COPCs were identified in the 2005 RI data set, only the 1998 data were used for estimating risks. Detailed calculations using 1998 surface water data and exposure parameters consistent with the Site are presented in Attachment K of the HHRA and are summarized below for the recreational adult and adolescent waders.

Receptor	Calculated Risks using 1998 SEH Surface Water Data	
	CR	Noncancer Risk
Adult wader	4×10^{-5}	NE
Adolescent wader	2×10^{-5}	NE

NE – Not evaluated. Only carcinogenic PAHs were present in surface water at concentrations greater than the RBSC.

Adult Waders Exposed to Oil Slicks in Surface Water

Risks associated with exposures to oil slicks in surface water were estimated for the adult waders using concentrations of DNAPLs collected from the product stream recovered from the active free product recovery system for the Copper Falls aquifer. Risks associated with exposure to oil slicks in surface water are a CR of 5×10^{-2} and an HI of 4. The primary carcinogenic risk drivers are benzo(a)pyrene (62%) and dibenzo(a,h)anthracene (29%). The primary noncarcinogenic risk drivers are 2-methylnaphthalene (54%), naphthalene (12%) and benzene (16%).

Adult Waders Exposed to Sediment

Risks associated with exposure to sediment for adult waders are a CR of 4×10^{-5} and an HI of 0.05 for samples collected within Chequamegon Bay. The cancer risk is within the EPA target risk range of 10^{-4} to 10^{-6} for cancer, and noncancer risk is less than the target HI of 1 for noncancer endpoints. However, the cancer risk is greater than the WDNR target risk of 1×10^{-5}.

Approximately 82% of the resulting cancer risk is attributable to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the Site, three sampling locations (220N-1600E, 2250N-1400E, 2400N-1200E) with detectable concentrations ranging from 10.5 to 26 mg/kg at intervals between 0 to 2 feet bgs are the main contributors to the benzo(a)pyrene cancer risk.

Adolescent Waders Exposed to Oil Slicks in Surface Water

Risks associated with exposures to oil slicks in surface water were estimated for the adolescent waders using concentrations of DNAPLs collected from the product stream recovered from the active free product recovery system for the Copper Falls aquifer. Risks associated with exposure to oil slicks in surface water are a CR of 2×10^{-2} and an HI of 4. The primary carcinogenic risk drivers are benzo(a)pyrene (62%) and dibenzo(a,h)anthracene (29%). The primary noncarcinogenic risk drivers are 2-methylnaphthalene (54%), naphthalene (12%) and benzene (16%).

Adolescent Waders Exposed to Sediment

Risks associated with exposure to sediment for adolescent waders are a CR of 2×10^{-5} and an HI of 0.05 for samples collected within Chequamegon Bay. The cancer risk is within the EPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints. However, the cancer risk is greater than the WDNR target risk of 1×10^{-5}.

Approximately 82% of the resulting cancer risk is attributable to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the site, three sampling locations (220N-1600E, 2250N-1400E, 2400N-1200E) with detectable concentrations ranging from 10.5 to 26 mg/kg at intervals between 0 to 2 feet bgs are the main contributors to the benzo(a)pyrene cancer risk.

7.5.3 Risk Summary for the Construction Worker Scenario

Soil Exposures

PAHs appear to be the primary cancer risk drivers for the construction scenario within the Kreher Park area of the Site. Of the calculated CR of 1×10^{-1}, approximately 71% is attributable to benzo(a)pyrene and 11% is attributable to dibenzo(a,h)anthracene. Upon review of the data, 27 sampling locations (located in both the Filled Ravine and Kreher Park) with detectable concentrations ranging from 205 to 3,000 mg/kg at intervals between 1 to 8 feet bgs are the main contributors to the benzo(a)pyrene cancer risk. In addition, 24 sample locations for dibenzo(a,h)anthracene (located in Kreher Park) with detectable concentrations ranging from 28 to 250 mg/kg (2 to 8 feet bgs) are the main contributors to the dibenzo(a,h)anthracene cancer risk.

The resulting HI of 38 is primarily attributed to naphthalene (with an HI of 31 and 2-methylnaphthalene (with a HI of 1). Because the HI exceeds 1, the noncancer risk for this receptor was re-calculated based on target organs affected by each chemical.

Based on the results of the Adult Lead Model (ALM), the percentage of developing fetuses predicted to have a blood lead concentration greater than 10 µg/dL is 1.5, which is within EPA's target criteria of no more than 5% of fetuses of adult female workers above the concern threshold of 10 µg/dL.

Based on the results of the ALM inputting an average lead concentration of 88.7 mg/kg, the percentage of developing fetuses predicted to have a blood lead concentration greater than 10 µg/dL is 1.5, which is within EPA's target criteria of no more than 5% of fetuses of adult female workers above the concern threshold of 10 µg/dL. While one location (GP-110 (1-3')) had a highly elevated lead concentration of 4000 mg/kg, only one other sample (GP-115 (1-3')) had a concentration (480 mg/kg) that exceeded the screening level of 400 mg/kg. Thus, while there are elevated concentrations in the loading dock area of the NSPW, the average concentration is below the screening level.

For the HHRA, it was assumed that the construction receptors would be exposed to both surface and subsurface soil. This assumption was made based on the definition of the construction scenario, which would involve the construction of residential or commercial structures at the Site. This represents the worst case scenario and is not likely to occur at the Site given both its current and future land use. Kreher Park is an established park and is expected to remain so in

the future. Any expansion to the recreational areas of the Site would likely be associated with activities such as the installation of landscaping, sidewalks, and parking lots, all of which do not involve excavation to significant depths. Therefore, construction receptors would most likely be exposed to shallow soils.

Groundwater Exposures

Cancer and noncancer risks associated with the exposure to "oily materials" in groundwater are a CR of 7×10^{-3} and an HI of 60, respectively. Benzo(a)pyrene (64 percent) and dibenzo(a,h)anthracene (27%) are the primary carcinogenic risk drivers. The primary noncarcinogenic risk drivers are 2-methylnaphthalene (54%), naphthalene (12%), and benzene (16%).

Trench Air

Cancer and noncancer risks associated with exposure to VOCs in trench air are presented below.

Domain	Trench Air	
	CR	**HI**
Kreher Park	8.34×10^{-3}	17152
Upper Bluff	2.14×10^{-5}	228
Filled Ravine	3.29×10^{-2}	646601

The primary Trench Air cancer risk drivers at Kreher Park are benzene (77%) and benzo(a)pyrene (23%) and the primary non-cancer risk drivers are naphthalene (87%) and benzene (11%). The primary Trench Air cancer risk driver at the Upper Bluff is benzene (100%) and the primary non-cancer risk drivers are naphthalene (92%) and benzene (3%). The primary Trench Air cancer risk drivers at the Filled Ravine are benzene (47%) and benzo(a)pyrene (53%) and the primary non-cancer risk driver is naphthalene (99%).

7.5.4 Risk Summary for the General Industrial Worker

For the industrial worker, samples collected within a 0-2 foot depth interval were included in the 0-1 ft dataset. as the average sample depth was 1 foot (i.e., , GP-137, GP-131, GP-120). A conservative evaluation of the risks was performed using the average concentration of benzo(a)pyrene at these locations as the EPC since the concentrations of these samples were greater than maximum detected concentration within the industrial worker dataset. Risks from ingestion and dermal contact exposure were calculated.

Cancer and noncancer risks associated with the exposure to surface soil for the general industrial worker receptor are a CR of 1×10^{-6} and an HI of 0.007. Cancer and noncancer risks associated with exposure to indoor air are a CR of 8×10^{-5} and an HI of 3, respectively. The primary cancer risk drivers are trichloroethylene (44%) and benzene (3%). The resulting HI of 3 is primarily attributed to 1,2,4-trimethylbenzene with an HI of 2.

7.5.5 Risk Summary for the Maintenance Worker

Cancer and noncancer risks associated with the exposure to surface soil for the maintenance worker receptor are a CR of 1×10^{-6} and an HI of 0.001. Risks for this receptor are within the target risk levels.

Based on the results of the ALM, the percentage of developing fetuses predicted to have a blood lead concentration greater than 10 µg/dL is 1.6, which is within EPA's target criteria of no more than 5% of fetuses of adult female workers above the concern threshold of 10 µg/dL.

7.5.6 Risk Summary for the Subsistence Fisherman

Risks associated with the ingestion of locally-caught fish from Chequamegon Bay is a CR of 1×10^{-4}, which is just within the EPA target cancer risk range of 10^{-4} to 10^{-6} for cancer endpoints, but greater than the WDNR threshold of 10^{-5}. Although the primary risk drivers for this scenario are the carcinogenic PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[e]pyrene, dibenzo[a,h]anthracene, and indeno[1,2,3-cd]pyrene), individual cancer risks for each detected carcinogenic PAH are between 1×10^{-5} and 1×10^{-6}.

7.6 Risk Assessment Conclusions

The results of the HHRA for the Site indicate that seven exposure pathways result in estimated risks that exceed EPA's target risk range (CR of 10^{-4} to 10^{-6} and an HI ≤ 1) and eight exposure pathways result in estimated risks that are either equivalent to or exceed the WDNR's threshold (CR $\leq 1\times10^{-5}$ and HI ≤ 1).

Cancer risks to a subsistence fisher (finfish) are equivalent to the upper-end of the EPA target risk range, but greater than the WDNR threshold of a CR of 1×10^{-5}. Noncarcinogenic risk is within acceptable limits for both EPA and WDNR.

Risks to recreational children (surface soil) are equivalent to the WDNR risk threshold. However, risks to adolescent and adult receptors exposed to surface soil are below the EPA acceptable risk range and below the WDNR risk threshold.

Risks to waders and swimmers (sediments), industrial workers (surface soil), and maintenance workers (surface soil) are all within EPA's target risk range of 10^{-4} to 10^{-6} for lifetime cancer risk and a target HI of less than or equal to 1 for non-cancer risk, but are greater than the WDNR threshold of 1×10^{-5} for lifetime cancer risk.

These include estimates for the reasonable maximum exposure (RME) scenarios for potential cancer risks and non-cancer risks. The conclusions are based on assumed exposures to soil in the Filled Ravine area (for residential receptors) and the Filled Ravine, Upper Bluff and Kreher Park area (for construction worker receptors), and to indoor air samples collected at the NSPW Service Center. Carcinogenic risks based on central tendency evaluation (CTE) scenarios indicate that only the residential receptor exposure to soil (all soil depths to 10 feet bgs) is estimated to be at a CR of 1×10^{-4}, which is at the upper-end of the EPA target risk range and greater than the WDNR threshold. Noncarcinogenic risks for the residential receptor (for soil depths 0-1 foot and 0-3 feet bgs) and risks associated with the construction scenario are within

acceptable levels. However, residential receptor exposure to subsurface soil is not expected given the current and potential future land use of the Site. Residential risks associated with exposures to surface soil (0 to 1 foot bgs) are within the target risk ranges.

Although the results of the HHRA indicate risks for the construction workers under the RME conditions exceed EPA's target risk levels, the assumptions used to estimate risks to this population were conservative and assumed the worst case. Given both the current and future land use of the Site it is unlikely that construction workers would be exposed to soil in the Filled Ravine and Upper Bluff. The most likely scenario for the future construction worker is exposure to soil within 0 to 4 feet below ground surface at Kreher Park (a typical depth for the installation of underground utility corridors), as most activities associated with the implementation of the future land use would be associated with regrading, landscaping, and road or parking lot construction.

At the request of the WDHFS, risks were also estimated for construction workers exposed to "oily materials" in groundwater via dermal contact and swimmers and waders who may be exposed to oil slicks in surface water via ingestion and dermal contact. Because no media-specific concentrations are available for either scenario, risks were estimated using analytical data collected from the product stream from the active NAPL recovery system for the Copper Falls aquifer or chemical-specific solubility values detected in the DNAPL sample. Risks to construction workers exposed to "oily material" in groundwater and adult swimmers and waders exposed to "oil slicks" in surface water is greater than both the EPA upper risk range (CR 1×10^{-4} and HI of 1) and WDNR threshold (CR 1×10^{-5} and HI of 1).

The response actions selected in this ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

7.7 Summary of Ecological Evaluation

A Baseline Ecological Risk Assessment was conducted to describe the likelihood, nature and severity of adverse effects to ecological receptors resulting from their exposure to contaminants at the Ashland/NSP Lakefront Site under current conditions. The BERA was prepared following EPA Guidance including, *Ecological Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final.* (EPA 1997).

The BERA supplemented two other ecological risk assessments that were conducted for this Site. In 1998, SEH completed an Ecological Risk Assessment (ERA) of the contaminated sediments adjacent to Kreher Park (SEH 1998). A supplemental ecological risk assessment (ERA) was performed in 2001 (SEH 2002) during which additional sediment toxicity testing was conducted to provide information for determining cleanup goals for the sediments.

7.7.1 Scope of Baseline Problem Formulation

Problem formulation was the systematic planning process that identified the factors to be addressed in the BERA and consisted of several activities, including:

- Refinement of the preliminary list of COPCs at the Site (i.e., those that were identified during the screening level ecological risk assessment);
- Development of management goals and objectives that provide an explicit statement of the desired condition of the valued entity being protected;
- Identification of assessment endpoints;
- Review and refinement of the information relating to the fate and transport of COPCs, potential exposure pathways, and the information on receptors potentially at risk;
- Development of a conceptual model with risk questions that the risk assessment will address; and
- Identification of lines of evidence and measurement endpoints to address the risk hypotheses.

Aquatic Toxicity, Fate and Transport of PAHs

Individual ecological toxicity benchmark values do not exist for many individual PAH compounds. However. PAHs in general appear to have a similar mode of action in many organisms. In general, PAHs are toxic to membrane function, and cause a "narcosis" type of toxicity. Therefore the toxicity is treated as additive and a total PAH exposure and toxicity estimate is used to characterize the ecological risk for many ecological endpoints. The mechanism of toxicity for the high molecular weight PAHs also can operate within the cell, resulting in damage to DNA and proteins. This damage may result in carcinogenesis. teratogenesis, or disturbance of hormone regulation.

As a generality PAHs tend not to biomagnify (i.e., increase in concentration through the food chain or strongly bioconcentrate). This is because many organisms (including mammals and fish) can effectively metabolize these compounds. Additionally, many of these compounds are apparently not actively or effectively taken into organisms. Certainly bioconcentration factors (BCFs) of much greater than 1 are documented, but the maintenance of the resulting tissue concentrations relies upon continued exposure. For these reasons field bioaccumulation studies (e.g. fish tissue measurements) are not typically conducted as it is anticipated that little bioaccumulated PAHs will be found and that the fish tissue will not be a substantive component of a dietary exposure route to an ecological consumer of fish. When PAHs are found in tissues such as fish this finding indicates a complete exposure pathway and a strong indication of active release of these contaminants.

One- and two- ring aromatics do not persist in the environment; three-, four- and five-ring aromatics can persist in the natural environment. The higher molecular weight PAHs are not volatile, not soluble, and degrade much more slowly. As a generality, at a PAH concentration of 10% (10,000 ug/g) biological degradation is inhibited; this concentration is consistent with the presence of NAPL.

7.7.2 Results of Previous Ecological Risk Assessments

In 1998, SEH completed an ecological risk assessment of the contaminated sediments adjacent to Kreher Park (SEH 1998). The 1998 ERA concluded that sediment at the Site is contaminated to a degree that is harmful to benthic organisms living in sediment.

Several lines of evidence were used in the 1998 investigation including:

1) a literature search conducted to select relevant sediment effects benchmarks for evaluation of Site data and to identify ecological effects documented at other sites with similar contaminants and exposures;
2) sediment and surface water samples collected, analyzed, and compared to sediment and surface water effects benchmarks for the contaminants identified;
3) collection of fish for analysis of tissue chemical concentrations;
4) a limited survey conducted of the benthic community at contaminated and reference locations; and
5) a series of laboratory bioassays conducted to characterize the effects of short-term exposure to contaminated and reference sediment samples.

A supplemental ERA was performed in 2001 (SEH 2002) during which additional sediment toxicity testing was conducted to provide information for determining cleanup goals for the sediments.

The following sections summarize the various lines of evidence used and the conclusions of the two preliminary ecological risk assessments.

Sediment and Surface Water Chemical Data Evaluation

Sediment chemical data from the Site were compared to several sets of effects levels for both dry weight units (µg/g) and normalized-to-organic-carbon (NOC) units (µg/gOC). SVOCs and VOCs sediment benchmarks were exceeded for several chemicals at several locations in the shallow bioactive zone sediments (0-15 cm) and deeper sediments. Based on this comparison, the ERA concluded there was a high probability of adverse effects to aquatic life from the contaminated sediments.

The presence of quantifiable PAHs in surface water samples appears to be related to high energy events. One unfiltered water column sample collected on May 14, 1998, when wave heights were estimated to be between 60 and 90 cm, had benzo(a)anthracene and benzo(a)pyrene levels that exceeded secondary chronic and acute water quality criteria values, respectively. Other water samples, collected when wave heights were significantly lower, did not contain quantifiable levels of PAHs. These results are consistent with the documentation of the occurrence of slicks within Chequamegon Bay during high energy events.

Fish Tissue Study

As part of the SEH 1998 ERA, a study was conducted to evaluate levels of PAHs in fish caught at the Site and to evaluate the condition of the fish at the Site. Results from this

study indicated that there was no evidence of external deformities in the fish. Of 27 fish collected on May 18, 1998, October 14, 1998, and May 28, 1999, fewer than 50% had measurable levels of any PAHs (Correspondence from Henry Nehls-Lowe to Jamie Dunn, et al., January 12, 2000). The PAHs detected were low molecular weight PAHs including naphthalene, acenaphthene, anthracene, fluorene, and phenanthrene. Total PAH concentrations ranged as high as 483 µg/kg in the whole fish samples.

Both walleye and smelt were collected to generate fish consumption exposure data for the risk assessments. Both of these species are highly mobile species, which would be anticipated to have limited residence time within the area of the Site and thereby limited Site exposure. Fish collected at the Site had measurable PAH concentrations within the fish. The study findings are strong evidence of Site-related exposure to PAHs. As noted, PAHs do not bioconcentrate because they are not actively accumulated and are metabolized by fish. The presence of these compounds within a fish indicates recent exposure to the contaminants. The results therefore indicate an active release of PAHs into Lake Superior. The fact that both of the species in this study are expected to reside at the Site for only a limited time reinforces a conclusion of active contaminant release.

Benthic Community Evaluation

A limited benthic community survey was conducted in 1998 (SEH 1998). The results of the benthic community studies were confounded with sediment substrate differences (presence of wood material and sediment grain size) which could not be isolated from the PAH contamination distribution.

Bioassays

Bioassays were conducted in 1998 on several sediment samples collected from the same two contaminated wood and sand stations and two reference wood and sand stations (SEH 1998). These were the same two stations where the benthic community samples were collected. Bulk sediment toxicity tests were conducted on the following benthic species: *Hyalella azteca*, *Chironomous dilutus* (formerly *C. tentans*), and *Lumbriculus variegatus*. Sediment elutriate preparations from these sites were also used in tests on *Pimephales promelas* and *Daphnia magna*. The results of these tests generally showed that growth and survival of test organisms decreased as the HA-28 NOC toxic units increased. In addition at least one sampling location studied demonstrated acute mortality with effectively complete 100% mortality within the test.

In an effort to develop sediment PRGs, supplemental bioassay toxicity studies were conducted in 2001 using *H. azteca*, *C. dilutus*, and *P. promelas* exposed to bulk sediments collected from four contaminated stations and two reference stations (SEH 2002). Parallel tests were conducted utilizing a dilution methodology in which various proportions of sediments from impacted sites were mixed with sediments from reference sites to obtain a range of exposure concentrations. In some instances control and reference station survival was less than test acceptance criteria.

Test results were evaluated for effects on survival and growth, and graphically compared to PAH toxic units. Statistically significant differences in survival and/or growth between

each sample were documented. The SEH report concluded that toxic effects appeared to correlate well to the magnitude of toxic units. SEH concluded that results from both the bulk sediment dilution tests and the sediment elutriate dilution tests supported the exposure concentration/effects characterization.

SEH also reported that comparison of phototoxic PAH concentrations at the Site to reference levels in the literature indicated the potential for phototoxic effects at the Site. Phototoxicity studies using UV light were performed in 1998 and 2001 in conjunction with standard toxicity test organisms exposed to bulk sediment or sediment elutriate samples collected from the Site. While there was no documentation of how well the UV regime during the bioassay compared to what ecological receptors would be exposed to at the Site, SEH concluded that under the conditions in which the bioassay was conducted there was evidence of enhanced phototoxicity effects for benthic organisms, zooplankton, and fish larvae.

Risk Characterization

The conclusions of the BERA and the data generated within the RI investigation support a conclusion that ecological risk exists. The lines of evidence used to support this conclusion include: 1) PAH concentrations in sediments exceeding several sediment effects benchmarks; 2) evidence from field studies that benthic community impairment may exist in the contaminated areas; 3) results of standard and photo-enhanced bioassay tests that indicated acutely toxic sediments do exist within the Site, and that the likelihood of ecological effects increase with exposure to increased contaminant concentrations in sediments and surface waters over the sediments; 4) the exceedance of secondary acute and chronic water quality criteria in one surface water sample collected during heavy wave action, based on field sampling and elutriate studies; 5) sediment concentrations of PAHs similar to those at other sites where bioaccumulation and mutagenic effects have been observed in fish; and 6) evidence of low molecular weight PAHs in some fish tissues collected from the Site, which indicates active release of contaminants into Lake Superior waters.

The risk characterization also concluded that levels of PAHs in subsurface sediments are higher than in the bioactive zone and that future disturbance and exposure of the deeper contaminated sediments to the sediment-water interface and water column by either natural (e.g., storms, ice scouring) or uncontrolled anthropogenic (e.g., boat prop wash, shoreline maintenance) forces could potentially release contaminants from subsurface sediments and transport them from the Site.

The 2001 ERA (SEH 2002) also proposed PRGs for the contaminated substrates present (wood chips and sand) that were based on the results of these lines of evidence.

Contaminants of Potential Concern

SEH (1998) screened data on contaminants found in sediment samples collected in 1996 against several sediment quality benchmarks, including those developed by the Ontario Ministry of the Environment (Persaud 1993) and Long and Morgan (1991). Concentrations of most PAHs, as well as total PAHs, and some VOCs exceeded

screening values. Metals found in this sampling campaign did not exceed guideline values at any location (SEH 2003); cyanide exceeded a sediment quality guideline in one location.

Further sampling in 2001 detected phenolic compounds in a few samples although these were not specifically screened against sediment quality benchmarks.

SEH (2003) reported additional screening was conducted for contaminants associated with surface sediments collected during 2003. In addition to exceeding sediment quality benchmarks for PAHs and some VOCs (primarily benzene, toluene, ethylbenzene, and xylenes [BTEX]), it was concluded that copper, lead, mercury, zinc and cyanide also exceeded some sediment quality benchmarks. SEH (2003) concluded that COPCs for the RI studies should include VOCs, SVOCs and copper, lead, mercury, zinc, and cyanide.

No screening of contaminants in other media was conducted in these previous risk assessments.

As part of the BERA, all media were re-screened to select COPCs.

7.7.3 Summary of Studies Conducted for the Remedial Investigation

As part of the RI, a number of investigations were conducted and the results were used, along with historical information, to support the BERA. All of the historical and current data were used as discussed below to screen for COPCs. Investigations conducted during the RI included:

1) Surface soil samples collected in the vicinity of Kreher Park;
2) Sediment samples collected as part of the supplemental sediment sampling and sediment quality triad investigations;
3) Sediment toxicity testing;
4) Benthic macroinvertebrate community studies;
5) Collection of fish tissue;
6) Surface water collection; and
7) Characterization of wetlands and terrestrial habitats.

The details of these investigations are in the reports appended to the BERA or in other reports submitted separately to EPA.

Screening of Contaminants of Potential Concern

As the first task in the Baseline Problem Formulation, data for all media, including all historical data, were screened to select COPCs. Screening was conducted using the following benchmarks using the maximum concentration measured:

- **Sediment:** Contaminants in sediment were screened using Wisconsin's sediment quality guidelines (WDNR 2003). If benchmarks for Site contaminants were not

available from WDNR the following were used, in order of precedence: EPA Region V Ecological Screening Levels (ESLs) (EPA 2003a); TLM=Target Lipid Model (DiToro and McGrath 2000); T50 =Logistic model point estimate of T50 concentrations (concentration at which 50% of samples are predicted to be toxic) (Field et al. 2002); NOAA Screening Quick Reference Table (SQuiRT- http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html); and other available sources.

- **Surface Water:** Region V ESLs (EPA 2003a) were used as the primary source of screening criteria. If ESLs were not available, then the following criteria were used, in order of precedence: ORNL Tier II values; EPA Region IV Water Quality Standards and structure-activity relationships using chronic values for fish (ECOSAR).
- **Soil:** EPA Ecological Soil Screening Levels (ECO-SSLs) (USEPA 2003b; 2005a) were the primary screening criteria for evaluating soils. If ECO-SSLs were not available, then the following criteria were used, in order of precedence: Region V ESLs (EPA 2003a); and other available sources.

Because EPA advises that some chemicals that also function as nutrients (e.g., calcium, magnesium, sodium and potassium) typically pose no ecological risk when present at relatively low concentrations that allow them to function in this manner, these chemicals were not screened.

If any PAH exceeded its individual screening criterion, PAHs as a group were retained as COPCs because the mode of action is similar for all PAHs and their toxicity is additive.

The chemicals that were retained for further analysis in the BERA are included in Appendix H-2, which provides a list of the COPCs by medium.

Exposure Assessment

As part of the *Problem Formulation*, an overall risk management goal was developed as the basis for evaluating risk at the Site:

> *Maintenance (or provision) of soil, sediment and water quality as well as food source, and habitat conditions capable of supporting a "functioning ecosystem" for the aquatic and terrestrial plant and animal populations (including individuals of protected species) inhabiting or utilizing the Ashland/NSP Lakefront Superfund Site area.*

Exposure assessment endpoints were developed based upon this risk management goal.

A conceptual site model (CSM) was developed that describes the following:

- The source of contamination;
- Release and transport mechanisms;
- Contact point and exposure media;
- Routes of entry; and

- Key receptors.

The potential exposure pathways are illustrated in the CSM, which is depicted in Figures 3-1 and 3-2 in Appendix J. Assessment endpoints, risk questions and measurement endpoints were selected as the basis for the BERA. These are summarized in Table ES-2 in Appendix K.

Based upon these risk questions and endpoints a number of Receptors of Concern (ROCs) were selected, as shown in the table below.

Receptors of Concern

ROC Category	ROC	Habitat
Aquatic Habitat		
Benthic macroinvertebrate community	Generic	Littoral portions of Chequamegon Bay
Fish Community	Generic	Littoral portions of Chequamegon Bay
Omnivorous birds	Black Duck	Littoral portions of Chequamegon Bay
Insectivorous birds	Tree swallow	Upland and riparian
Piscivorous birds	Double-crested cormorant Osprey (State endangered)	Littoral portions of Chequamegon Bay
Insectivorous mammals	Big brown bat	Upland and riparian
Piscivorous mammals	Mink	Upland and riparian
Terrestrial Habitat		
Omnivorous birds	Red-winged blackbird	Upland and riparian
Omnivorous mammals	White-footed mouse	Upland and riparian

Ecological Effects Analysis

The effects analysis consisted of an evaluation of available toxicity or other effects information that could be used to relate the exposure estimates to a level of adverse effects. Stressor-response (i.e., effects) data that were used to evaluate ecological risks in this BERA were of three types: (1) literature-derived toxicity data, (2) site-specific ambient media toxicity tests (e.g. sediment toxicity tests), and (3) site-specific biological community surveys.

The focus of the majority of the effort for the BERA was on aquatic portions of the Site. For the evaluation of Site sediment, all three lines of evidence were integrated into a Sediment Quality Triad approach (Triad) (Long and Chapman 1985; Chapman et al. 1987). The Triad evaluates sediment quality by integrating spatially and temporally matched sediment chemistry, biological, and toxicological information. Benthic invertebrate community analysis and sediment toxicity testing provided site-specific information regarding potential ecological effects of exposure of ecological receptors to COPCs in the Site sediment. These additional lines of evidence supplement traditional

bulk sediment chemistry data to provide a more relevant, site-specific assessment of risks.

The evaluation of bulk sediment chemistry data involved comparison of Site sediment chemistry data to effects levels published by WDNR (2003), derived from relevant studies reported in published literature, or from studies performed for this BERA. Site-specific sediment toxicity tests were conducted with aquatic receptors that are representative surrogates for those living on the Site and the results of this testing provided information on potential toxic effects that were observed in Site-relevant organisms exposed to Site sediment. Site-specific surveys of the benthic macroinvertebrate community also were conducted for the Site. In addition to these three lines of evidence that focus primarily on the benthic environment at the Site, surface water quality data and fish tissue data were collected from Site waters.

For upland portions of the Site, only two lines of evidence were used in the BERA. One was the comparison of bulk soil chemistry to soil quality benchmarks used as generic criteria, e.g., the soil ECO-SSLs (EPA 2005a), or derived from relevant studies reported in published literature. The second was the comparison of doses accumulated through the food chain that terrestrial and aquatic prey-dependent wildlife (i.e., birds and mammals) may feed upon. These doses were compared to toxicity reference values (TRVs) derived from the primary scientific literature.

The result of the ecological effects analysis was a range of TRVs that were compared with the dose estimates (birds and mammals) or toxicological benchmarks that were compared with estimated EPCs (benthic invertebrates and fish) to estimate potential risks in the risk characterization.

Ecological Exposure Analysis

In the exposure analysis, the relationship between receptors at the Site and potential stressors (chemical, biological, or physical entities that may result in adverse effects to one or more receptors or groups of receptors) were evaluated. Exposure point concentrations used to estimate exposure were calculated as the mean and 95% upper confidence limit of the mean concentration (UCL_{95}) of the exposure medium. EPCs calculated for surface water, sediment, soil, or tissue residues were based directly upon the levels of contaminants in these media.

Exposure estimates for birds and mammals were calculated using food chain models. Simplified food chain models were developed to calculate average daily doses (ADDs) of COCs that selected receptor groups experience through exposure to surface water, sediment, and surface soil at the Site. The ADD represents the dose of a chemical that a receptor may ingest if it foraged within designated exposure units. ADDs for wildlife receptors are calculated using (1) EPCs for prey and media developed for each, (2) COC-specific bioaccumulation factors or bioaccumulation models for dietary items, and (3) receptor-specific exposure parameters and food chain model assumptions, (e.g., diet composition. foraging area, amount of incidental soil or sediment ingested, etc.).

Ecological Risk Characterization

Risk characterization was the final phase of the BERA. In the risk characterization, the information from the effects and exposure analyses was used to determine a probability of adverse effects to ROCs and discuss the strengths. weaknesses, and assumptions in the BERA. Risk estimates (or Hazard Quotients) were developed for each assessment endpoint based upon comparison of site-specific media concentrations and/or estimated ingested contaminant dose estimates (the latter for wildlife) to effects levels (generic criteria, benchmarks and TRVs) for the various ROCs. Finally risk was characterized for each assessment endpoint by integrating the risk estimate with the results of other lines of evidence, if available. A detailed summary of the risk characterization is in Section 6 of the BERA which is part of the AR.

7.8 Ecological Risk Assessment Conclusions

The results of the risk characterization indicated that there are unacceptable risks to the benthic macroinvertebrate community from exposure to contaminated sediment at the Site. Two lines of evidence, bulk sediment chemistry and sediment toxicity testing. indicate an unacceptable risk to the benthic community. Effects observed from field surveys of the existing benthic community indicated effects that were less dramatic than those demonstrated in the laboratory toxicity studies, but interpretation of the field survey data is made very difficult by a high degree of variability and lack of comparability between reference and site stations.

However, the fact that hydrocarbons are sporadically released from the Site sediment during some high energy meteorological events or when disturbed by other activities indicates the potential for impact to the benthic community that may not have been fully measured by the benthic community studies conducted to support the RI. Since the impact from releases was not fully measured during the RI and there is no evidence that shows impairment of populations and communities of these receptors inhabiting the waters of Chequamegon Bay, the full impact from these releases remains a source of uncertainty. However, the presence of this continuing source of site-related contaminants in sediments presents an unacceptable risk that could impair the healthy functioning of the aquatic community in the Chequamegon Bay area of the Site.

In addition, if normal lake front activities (i.e, wading, boating etc.) were not presently prohibited, the disturbance of sediments and contaminant release of subsurface COCs would increase. This could lead to greater impacts than were measured during these RI/FS studies.

Table 7-1 in Appendix L summarizes the results of the BERA.

The response actions selected in this ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

7.9 Selection of Final COCs

Based on the results of the HHRA and the BERA, final COCs were determined for the Site. The list of final COCs determined by the HHRA and BERA are listed in the table below.

List of Final COCs Identified by the HHRA and BERA

Surface Water	Groundwater	Sediment	Soil	Fish	Indoor Air
Benzo(a)anthracene	1-Methylnaphthalene	Antimony	1-Methylnaphthalene	1-Methylnaphthalene	1,2,4-Trimethylbenzene
Benzo(a)pyrene	2-Methylnaphthalene	Iron	2-Methylnaphthalene	Benzo(a)anthracene	1,4-Dichlorobenzene
Benzo(b)fluoranthene	Acenaphthene	Manganese	Acenaphthene	Benzo(a)pyrene	Benzene
Benzo(k)fluoranthene	Benzo(a)anthracene	Vanadium	Benzo(a)anthracene	Benzo(e)pyrene	Carbon tetrachloride
Chrysene	Benzo(a)pyrene	1-Methylnaphthalene	Benzo(a)pyrene	Benzo(b)fluoranthene	Trichloroethylene
Dibenzo(a,h)anthracene	Benzo(b)fluoranthene	2-Methylnaphthalene	Benzo(b)fluoranthene	Dibenzo(a,h)anthracene	
Indeno(1,2,3-cd)pyrene	Benzo(k)fluoranthene	Benzo(a)anthracene	Benzo(k)fluoranthene	Dibenzofuran	
	Chrysene	Benzo(a)pyrene	Chrysene		
	Dibenzo(a,h)anthracene	Benzo(b)fluoranthene	Dibenzo(a,h)anthracene		
	Dibenzofuran	Benzo(k)fluoranthene	Dibenzofuran		
	Fluoranthene	Indeno(1,2,3-cd)pyrene	Fluoranthene		
	Fluorene	Naphthalene	Fluorene		
	Indeno(1,2,3-cd)pyrene	Total PAHs	Indeno(1,2,3-cd)pyrene		
	Naphthalene	Dibenzofuran	Naphthalene		
	Phenanthrene	m-Cresol	Phenanthrene		
	Pyrene	o-Cresol	Pyrene		
	1,2,4-Trichlorobenzene	p-Cresol	1,2,4-Trichlorobenzene		
	1,2,4-Trimethylbenzene	1,2,4-Trimethylbenzene	1,2,4-Trimethylbenzene		
	1,3,5-Trimethylbenzene	1,3,5-Trimethylbenzene	1,3,5-Trimethylbenzene		
	Benzene	Benzene	Benzene		
	Ethylbenzene	Ethylbenzene	Ethylbenzene		
	Toluene	Toluene	Toluene		
	Total Xylenes	Total Xylenes	n-Butylbenzene		
		Arsenic	sec-Butylbenzene		
		Barium	Total Xylenes		
		Cadmium	Arsenic		

Surface Water	Groundwater	Sediment	Soil	Fish	Indoor Air
		Copper	Lead		
		Lead	Thallium		
		Mercury	Total PAHs		
		Nickel	Antimony		
		Selenium	Barium		
		Silver	Cadmium		
		Thallium	Chromium		
		Zinc	Copper		
		Cyanide	Manganese		
			Mercury		
			Selenium		
			Silver		
			Zinc		
			Cyanide		

8.0 Remedial Action Objectives

Remedial Action Objectives (RAOs) are remedial goals for protecting human health and the environment. These objectives are used in the development of specific remedial alternatives (i.e., alternatives are developed in consideration of site objectives), and later as a criterion in the evaluation of the various remedial alternatives (i.e., evaluation of the extent to which each alternative would achieve the RAOs). The specific RAOs developed for the Ashland/NSP Lakefront Site are:

RAOs for Soil

- Protect human health by reducing or eliminating exposure (ingestion/direct contact/inhalation) to soil having COCs representing an excess cancer risk greater than 10^{-6} as a point of departure (with cumulative excess cancer risks not exceeding 10^{-5}) and a hazard index (HI) greater than 1 for reasonably anticipated future land use scenarios.
- Ensure future beneficial commercial/industrial use of the Site and recreational use of Kreher Park.
- Protect populations of ecological receptors or individuals of protected species by eliminating exposure (direct contact with or incidental ingestion of soils or prey) to soil with levels of COCs that would pose an unacceptable risk.
- Conduct NAPL removal whenever it is necessary to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, land, sediments or water (groundwater and surface water).

- Protect the environment by minimizing/eliminating the migration of contaminants in the soil to groundwater, sediments or to surrounding surface water bodies.

RAOs for Groundwater

- Protect human health by eliminating exposure (direct contact, ingestion, inhalation) to groundwater with COCs in excess of regulatory or risk-based standards.
- Restore groundwater to its beneficial use by reducing contaminant levels in groundwater to meet maximum contaminant levels (MCLs) and State of Wisconsin Drinking Water Standards.
- Protect the environment by controlling the off-site migration of contaminants in groundwater to surrounding surface water bodies which would result in exceedance of applicable or relevant and appropriate requirements (ARARs) for COCs in surrounding surface waters.
- Conduct NAPL removal whenever it is necessary to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, land, sediments or water.
- Protect the environment by minimizing/eliminating the migration of contaminants in the groundwater to soil, sediments or to surrounding surface water bodies.

No COPCs were initially identified in the HHRA for groundwater because groundwater is not used as a potable water supply. However, currently there is no restriction on groundwater use in the area of known contamination. Exposure to contaminated groundwater and accompanying NAPLs can potentially occur via the following exposure scenarios:

- Construction worker exposure to shallow groundwater infiltrating trenches at Kreher Park; and
- Trespasser exposure to groundwater infiltrating the lower level of the former WWTP.

NAPL encountered in the Kreher Park fill, ravine fill, NSPW property and Copper Falls aquifer are a source for the dissolved phase plumes identified in groundwater in each unit at the Site. RAOs for NAPL within these units are based on Chapter NR 708.13, Wisconsin Administrative Code (WAC), which states the following:

Responsible parties shall conduct free product removal whenever it is necessary to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, lands or waters of the state. When required, free product removal shall be conducted, to the maximum extent practicable, in compliance with all of the following requirements:

> *1) Free product removal shall be conducted in a manner that minimizes the spread of contamination into previously uncontaminated zones using recovery and disposal techniques appropriate to the hydrologic conditions at the site or facility, and properly reuses or treats discharges of recovery*

byproducts in compliance with applicable state and federal laws.

2) *Free product removal systems shall be designed to abate free product migration.*
3) *Any flammable products shall be handled in a safe and competent manner to prevent fires or explosions.*

RAOs for Sediment

In general, the RAO is to reduce or remove contaminated sediments at the Site in order to prevent human ingestion or direct contact with sediments having COCs which pose an unacceptable risk to human health. Similarly, for ecological receptors, the general goal is to prevent direct contact with or ingestion of contaminated sediments at levels of COCs that would pose an unacceptable risk to populations of ecological receptors or individuals of protected species.

Remedial action objectives for sediment include:

- Protect human health by eliminating exposure (direct contact, ingestion, inhalation, fish ingestion) to sediment with COCs in excess of regulatory or risk-based standards;
- Conduct NAPL (source) removal whenever it is necessary to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, land or water; and
- Protect populations of ecological receptors or individuals of protected species by eliminating exposure (direct contact with sediment or ingestion of sediment or prey) to sediment with COCs that would pose an unacceptable risk.

With the exception of iron, the cumulative risks estimated for the human health recreational receptor exposures to sediments were below EPA's target risk levels, but the cancer risk is greater than the WDNR target of $1x10^{-5}$.

For ecological receptors, EPA established a PRG of 2295 µg tPAH/g OC, which is equivalent to 9.5 ppm tPAH dwt at 0.415% OC. This value was based on a best professional evaluation of sediment chemistry, bioassay, and benthic community study data collected at the Site. In addition, when it developed the sediment PRG, EPA stated that, "This PRG does not include the added effects of UV and is based on a water depth of 6 feet or more. If the final depth of sediments will be less than 6 feet, the PRG for any active remedial intervention will be adjusted downward as based upon UV extinction coefficients measured in Site waters." More detailed information about the derivation of the sediment cleanup goal(s) can be found in Appendix M-1.

Based on the results of the Site-specific HHRA, PRGs were also derived for soil and surface water for exposure scenarios that exceeded a cumulative cancer risk of 10^{-5} or a cumulative noncancer risk of a hazard index (HI) of 1. PRGs were also developed for groundwater. The PRG tables for soil, surface water and groundwater are summarized in Appendix M-2.

Thus, the focus of the RAOs is to minimize exposure to site soils, sediments and groundwater potentially posing a risk to human health and the environment.

Potential ARARs and other to-be-considered material (TBCs) that were developed during the FS for various soil, groundwater and sediment alternatives are summarized in Appendix C.

9.0 Description of Alternatives

Following development of the RAOs, a screening and evaluation of potential remedial alternatives was conducted as part of the FS in accordance with CERCLA and the NCP and is included in the FS Report.

The technologies were assembled into remedial alternatives that meet RAOs and satisfy ARARs. The specific details of the remedial components discussed for each alternative are intended to serve as representative examples. As mentioned in Part I of this ROD, the Site was divided into four areas of concern as described in the RI report:

1. Upper Bluff/Filled Ravine
2. Copper Falls Aquifer
3. Kreher Park
4. Bay Sediments

First, a number of potential remedial alternatives were developed as part of the FS to address soil, groundwater and sediment at the Site considering available and applicable remedial technologies. The alternatives were developed in consultation with WDNR. As described in more detail below, appropriate alternatives were then considered for each area of the Site depending on the affected media in those areas.

The Upper Bluff/Filled Ravine and Kreher Park include remedial alternatives for both soil and groundwater. Remedial alternatives for the Copper Falls aquifer are limited to groundwater, and remedial alternatives for the bay are limited to sediments. Appendix N-1 lists all the potential remedial alternatives that were considered in the FS for each area of concern based on the affected media in each area. A detailed description of each potential remedial alternative for each affected media is provided in Appendix N-2. Six major remedial alternatives were developed for soil (S-1 though S-6), with three of them (S-3, S-4 and S-5) having "A" and "B" variations. Nine major remedial alternatives were developed for groundwater (GW-1 through GW-9), with two of them (GW-2 and GW-9) having "A" and "B" variations. Six major remedial alternatives were developed for sediment (SED-1 through SED-6), with four of them (SED-3, SED-4, SED-5 and SED-6) having either "A" and "B" or "A", "B", "C" and "D" variations.

To organize all of these remedial alternatives for soil, groundwater and sediment into workable combinations that would address the entire Site, the FS formed ten integrated cleanup "scenarios." The cleanup alternatives were evaluated in the FS in the detailed analysis of alternatives using the nine evaluation criteria described in the NCP at 40 CFR Part 300.430(e)(9)(iii).

9.1 Description of Remedy Components

Each of the ten integrated cleanup scenarios is briefly described below. Appendix N-3 contains a table of the ten integrated remedial scenarios from the FS that shows which media-specific alternatives were considered for each scenario to address the four areas of concern at the Site (Bay, Kreher Park, Upper Bluff/Filled Ravine, and Copper Falls Aquifer). More detailed information about each of the integrated remedial alternatives, including cost estimates for each alternative, can be found in Section 9.2 of the FS report, which is included in the Administrative Record for the Site.

Scenario 1 – No Action

As previously discussed, the NCP at 40 CFR §300.430(e)(6) provides that the no action alternative should be considered at every site. Implementation of no further action consists of leaving contaminated soil, groundwater and sediment in place; no engineering, maintenance, or monitoring would be required. This combined no action remedial scenario is included here only as a baseline to which other remedial scenarios can be compared. In addition, this alternative contains no restrictions on future use of the Site.

Scenario 2

- **Sediments:** Alternative SED-3 – Mechanically dredge top four feet of sediments and install subaqueous cap. After dredging is completed, place six inches of clean sediment on dredged areas. Transport contaminated sediment off site for landfill disposal. Dispose of or burn wood debris separately, and discharge treated wastewater from sediment de-watering to lake.
- **Kreher Park:** Alternative S-2 - Containment using surface barriers to prevent infiltration and direct contact with subsurface contamination. Surface barriers at former coal tar dump and seep area, at the solid waste disposal area, and the well TW-11 area.
- **Upper Bluff/Filled Ravine:** Alternative S-2 - Containment using surface barriers to prevent infiltration and direct contact with subsurface contamination. Asphalt pavement over Filled Ravine area.
- **Copper Falls Aquifer:** Alternative GW-9A - Operate existing NAPL recovery system.
- **Conduct O&M and Long-Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site with groundwater. Check monitoring wells for presence of NAPL. Collect sediment and surface water samples to ensure contaminants are not migrating through subaqueous cap. Complete annual inspections to ensure integrity of surface barriers and subaqueous cap and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional Controls:** Implement land use controls as part of a remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface and for the subaqueous cap.

Scenario 3

- **Sediments:** Alternative SED-4 - Remove wood debris from sediments and mechanically dredge impacted sediments. After dredging is completed, place six inches of clean sediment on dredged areas. Precautions will be taken to ensure that the

contaminated sediments do not impact the underlying soil in the sediment staging area. De-water, stabilize and thermally treat sediments at Kreher Park area and treat wastewater; discharge treated wastewater to lake. Transport decontaminated sediment off site for landfill disposal or beneficial re-use. Dispose or burn wood debris separately.

- **Kreher Park**: Limited soil/source removal and off-site disposal (Alternative S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), and enhanced groundwater extraction (Alternative GW-9B). Shallow groundwater extracted from within the contained area would be treated on-site prior to discharge to the lake.
- **Upper Bluff/Filled Ravine:** Limited soil/source removal and off-site disposal (Alternative S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), and groundwater extraction using the existing system (GW-9A). Site restoration would include surface barriers to restrict groundwater recharge. Shallow groundwater would be extracted from existing well EW-4 located at the mouth of the Filled Ravine to limit discharge to the contained area at Kreher Park.
- **Copper Falls Aquifer**: In-situ treatment of groundwater and NAPL via ozone sparge (Alternative GW-3) or surfactant injection and dual phase recovery (GW-4), with continued operation of existing groundwater extraction system (GW-9A), or in-situ chemical oxidation (GW-6), electrical resistance heating (ERH)(GW-7), steam injection (GW-8), or enhanced groundwater extraction (GW-9B).
- **Conduct O&M and Long-Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site with groundwater. Check monitoring wells for presence of NAPL. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional Controls:** Implement land use controls where contaminants remain in subsurface following remedial response at Upper Bluff and Kreher Park and for shallow groundwater and Copper Falls aquifer.

Scenario 4

- **Sediments**: Alternative SED-4 - Remove wood debris from sediments and mechanically or hydraulically dredge impacted sediments. After dredging is completed, place six inches of clean fill on dredged areas for stabilization. Precautions will be taken to ensure that the contaminated sediments do not impact the underlying soil in the sediment staging area. Dewater and stabilize sediments at Kreher Park area and treat wastewater; discharge treated wastewater to lake. Transport stabilized sediments off site to NR 500 licensed landfill or thermal treatment. Dispose of or burn wood debris separately.
- **Kreher Park:** –Limited soil/source removal and off-site disposal (Alternative S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), and engineered surface and vertical barriers with groundwater extraction as hydraulic control (Alternative GW-2A) or a permeable reactive barrier (PRB) wall (Alternative GW-5). Alternative GW-2A includes partial caps at Kreher Park to limit groundwater recharge. Shallow groundwater extracted from the contained area for hydraulic control would be treated onsite and discharged to the lake or would be treated as it passes through the PRB wall.

- **Upper Bluff/Filled Ravine:** Limited soil/source removal and off-site disposal (Alternative S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), and engineered surface and vertical barriers with groundwater extraction as hydraulic control (Alternative GW-2A) or a PRB wall (Alternative GW-5) at Kreher Park. Shallow groundwater would discharge to Kreher Park for groundwater extraction or treatment via the PRB wall.
- **Copper Falls Aquifer:** In-situ treatment via ozone sparge (Alternatives GW-3), or surfactant injection and dual phase recovery (GW-4), and continued operation of the existing groundwater extraction system (GW-9A), or in-situ chemical oxidation (GW-6), in-situ thermal treatment via ERH (GW-7) or steam injection (GW-8), or enhanced groundwater extraction (GW-9B).
- **Conduct O&M and Long Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site or from the contained area with groundwater. Check monitoring wells for presence of NAPL. Fluid levels within the contained area will also need to be monitored to ensure that groundwater remains at or below the design elevation. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface and for shallow groundwater in contained areas.

Scenario 5

- **Sediments:** Alternative SED-2 - Construct NR 504. WAC conforming confined disposal facility (CDF) over approximately seven acres of lake bed and all of Kreher Park. Dredge remaining impacted sediments and dispose in CDF. After dredging is completed, place six inches of clean fill on dredged areas outside of CDF. Dewater sediment, treat wastewater and discharge to lake. Dispose of or burn wood debris separately. Precautions will be taken to ensure that the contaminated sediments do not impact the underlying soil in the sediment staging area.
- **Kreher Park:** Alternative GW-2B – Engineered surface and vertical barriers would be used in conjunction with the on-site CDF. Implement hydraulic control around periphery of CDF, which will include groundwater extraction from the contained area for on-site treatment prior to discharge to the lake.
- **Upper Bluff/Filled Ravine:** Alternative S-4 - Conduct limited (Alternative S-4A) or unlimited excavation (Alternative S-4B) of contaminated soil in saturated and unsaturated zone at Upper Bluff, dispose of these soils in CDF. Continued groundwater extraction from EW-4 located at the mouth of the Filled Ravine (GW-9A).
- **Copper Falls Aquifer:** In-situ treatment via ozone sparge (Alternatives GW-3), or surfactant injection and dual phase recovery (GW-4), and continued operation of the existing groundwater extraction system (GW-9A), or in-situ chemical oxidation (GW-6), in-situ thermal treatment via ERH (GW-7) or steam injection (GW-8), or enhanced groundwater extraction (GW-9B).
- **Conduct O&M and Long Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site with groundwater. Check monitoring wells for presence of NAPL. Collect sediment and surface water samples to ensure contaminants

are not migrating through CDF. Complete annual inspections to ensure integrity of surface barriers and CDF and repair damage as needed. Conduct MNR monitoring of sediments.

- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface.

Scenario 6

- **Sediments:** Alternative SED-5 - Construct offshore sheetpile or rock breakwater enclosure and dewater impacted areas; remove wood debris and excavate impacted sediments; dewater and stabilize sediments at Kreher Park area and treat wastewater and discharge to lake. Precautions will be taken to ensure that the contaminated sediments do not impact the underlying soil in the sediment staging area. Transport stabilized sediments to NR 500 licensed landfill. Dispose or burn wood debris separately.
- **Kreher Park:** Limited soil/source removal and off-site disposal (Alternative S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), and engineered surface and vertical barriers with hydraulic control (Alternative GW-2A or 2B) or a PRB wall (Alternative GW-5). Alternative GW-2A includes partial caps at Kreher Park, and Alternative GW-2B includes capping the entire park. Shallow groundwater extracted for hydraulic control for Alternatives GW-2A and 2B would be treated onsite and discharged to the lake, or for Alternative GW-5 it would be treated as it passes through the PRB wall.
- **Upper Bluff/Filled Ravine:** –Limited soil/source removal and off-site disposal (Alternative S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or soil washing (S-6), and groundwater remediation via engineered surface and vertical barriers with hydraulic control (Alternative GW-2A) or a PRB wall (Alternative GW-5) at Kreher Park. Shallow groundwater would discharge to Kreher Park for groundwater extraction or pass through the PRB wall at Kreher Park.
- **Copper Falls Aquifer:** In-situ treatment via ozone sparge (Alternative GW-3), or surfactant injection and dual phase recovery (GW-4), and continued operation of the existing groundwater extraction system (G-9A), or in-situ chemical oxidation (GW-6), in-situ thermal treatment via ERH (GW-7) or steam injection (GW-8).
- **Conduct O&M and Long Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site with groundwater. Check monitoring wells for NAPL. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface.

Scenario 7

- **Sediments:** Alternative SED-5 - Construct offshore sheetpile or rock breakwater enclosure and dewater impacted areas; remove debris and excavate impacted sediments; dewater and stabilize sediments at Kreher Park area and treat wastewater and discharge to lake. Precautions will be taken to ensure that the contaminated sediments do not impact the underlying soil in the sediment staging area. Transport stabilized sediments to NR 500 licensed landfill. Dispose or burn wood debris separately.

- **Kreher Park:** Limited soil/source removal and off-site disposal (Alternative S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), or in-situ treatment of source area via chemical oxidation (GW-6), ERH (GW-7), or steam injection (GW-8), and groundwater remediation via ozone sparge (GW-3), or enhanced groundwater extraction (GW-9B).
- **Upper Bluff/Filled Ravine:** Limited soil/source removal and off-site disposal (Alternative S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), or in-situ treatment of source area via chemical oxidation (GW-6), ERH (GW-7), or steam injection (GW-8), and groundwater remediation via ozone sparge (GW-3), or continued groundwater extraction from EW-4 located at the mouth of the Filled Ravine (GW-9A).
- **Copper Falls Aquifer:** Alternative GW-9B - Enhanced groundwater extraction, to remove NAPL and contaminated groundwater, which would include additional extraction wells and an upgraded on-site treatment system.
- **Conduct O&M and Long Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site with groundwater. Check monitoring wells for NAPL. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface.

Scenario 8

- **Sediments:** Alternative SED-4 - Prior to dredging, construct a breakwater at the northern boundary of the contaminated sediment area. It is assumed this breakwater will be later utilized by the City in the expansion of the marina as proposed in the City's Lakefront Development Plan. Remove wood debris and dredge contaminated sediments. After dredging is completed, place six inches of clean fill on dredged areas for stabilization. Dewater and stabilize sediments at Kreher Park area and treat wastewater and discharge to lake. Precautions will be taken to ensure that the contaminated sediments do not impact the underlying soil in the sediment staging area. Transport stabilized sediments to NR 500 licensed landfill. Dispose or burn wood debris separately.
- **Kreher Park:** Limited soil/source removal and off-site disposal (Alternatives S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), or in-situ treatment of source area via chemical oxidation (GW-6), ERH (GW-7), or steam injection (GW-8), and groundwater remediation via engineered surface and vertical barriers with hydraulic control (Alternative GW-2B) or a PRB wall (Alternative GW-5). Alternative GW-2B includes capping the entire park. Shallow groundwater extracted for hydraulic control for Alternatives GW-2B would be treated onsite and discharged to the lake, or for Alternative GW-5 it would be treated as it passes through the PRB wall.
- **Upper Bluff/Filled Ravine:** Limited soil/source removal and off-site disposal (Alternatives S-3A), or beneficial reuse as backfill following ex-situ thermal treatment (S-5A), offsite incineration (S-5B), or ex-situ soil washing (S-6), or in-situ treatment of source area via chemical oxidation (GW-6), ERH (GW-7), or steam injection (GW-8), and groundwater remediation via engineered surface and vertical barriers with hydraulic

control (Alternative GW-2A) or a PRB wall (Alternative GW-5) at Kreher Park.

- **Copper Falls Aquifer:** In-situ treatment via ozone sparge (Alternatives GW-3), or surfactant injection and dual phase recovery (GW-4), and continued operation of the existing groundwater extraction system (GW-9A), or in-situ chemical oxidation (GW-6), in-situ thermal treatment via ERH (GW-7), steam injection (GW-8), or enhanced groundwater extraction (GW-9B).
- **Conduct O&M and Long Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site with groundwater. Check monitoring wells for NAPL. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface.

Scenario 9

- **Sediments:** Alternative SED-5 - Construct offshore sheetpile or rock breakwater enclosure and dewater impacted areas; remove debris and excavate impacted sediments; dewater and stabilize sediments at Kreher Park area and treat wastewater and discharge to lake. Precautions will be taken to ensure that the contaminated sediments do not impact the underlying soil in the sediment staging area. Transport stabilized sediments to NR 500 licensed landfill. Dispose or burn wood debris separately.
- **Kreher Park:** Alternative S-3B - Remove all fill material including wood waste and underlying impacted media at Kreher Park. Treat/stabilize soil and transport decontaminated soils off site for disposal. Dispose the wood waste at an offsite facility.
- **Upper Bluff/Filled Ravine:** Alternative S-3B - Removal entire fill and impacted soil including gas holders from the ravine and Upper Bluff, dispose of these soils to NR500 landfill.
- **Copper Falls Aquifer:** Alternative GW-9B - Enhanced groundwater extraction and treatment of NAPL and groundwater from Copper Falls Aquifer; discharge treated groundwater to sanitary sewer (alternative may also include in-situ treatment of NAPL prior to extraction).
- **Conduct O&M and Long Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off-site with groundwater. Check monitoring wells for NAPL. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface. Conduct MNR monitoring of sediments.

Scenario 10

- **Sediments:** Alternative SED-6 – Using excavation equipment, remove in the dry all near shore sediment and wood debris. In addition, remove wood debris from offshore sediments and mechanically or hydraulically dredge remaining offshore sediments. After dredging/excavation is completed, place six inches of clean fill on dredged areas for lakebed stabilization. Dewater and stabilize sediments at Kreher Park area and treat wastewater; discharge treated wastewater to lake. Transport stabilized sediments off site to NR 500 licensed landfill or thermal treatment. Dispose of or burn wood debris

separately.

- **Kreher Park:** Limited soil/source removal with ex-situ thermal treatment (Alternative S-5A) and containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control (Alternative GW-2A). Alternative GW-2A includes caps at Kreher Park to limit groundwater recharge. Shallow groundwater extracted from the contained area for hydraulic control would be treated onsite and discharged to the lake or POTW. In-situ chemical oxidation (GW-6) can be used to possibly enhance groundwater treatment.
- **Upper Bluff/Filled Ravine:** Limited soil removal with ex-situ thermal treatment (Alternative S-5A) and containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control (Alternative GW-2A). Alternative GW-2A includes caps to limit groundwater recharge. Shallow groundwater extracted from the contained area for hydraulic control would be treated onsite and discharged to the lake or POTW. In-situ chemical oxidation (GW-6) can also be used to possibly enhance groundwater treatment.
- **Copper Falls Aquifer:** Enhance existing groundwater extraction system (GW-9B). In-situ chemical oxidation (GW-6) or in-situ treatment via ozone sparge (GW-3) can be used to possibly enhance groundwater treatment.
- **Conduct O&M and Long-Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site or from the contained area with groundwater. Fluid levels within the contained area will also need to be monitored to ensure that groundwater remains at or below the design elevation. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface and for shallow groundwater in contained areas.

9.2 Common Elements and Distinguishing Features of Each Alternative

A common element of most of the cleanup scenarios is institutional controls to limit the future use of portions of the Site to prevent contact with contamination that remains at the Site or to ensure that the contaminated water is not used for drinking water purposes after construction of the remedy until groundwater cleanup goals are attained. In addition, most alternatives include long-term monitoring and maintenance of the surface barriers and caps to make sure remaining buried pollution is not moving off-site. None of the cleanup alternatives EPA considered rely exclusively on institutional controls to achieve protectiveness. Monitoring and institutional controls to ensure the effectiveness of the cleanup are elements of all the cleanup alternatives except the "no action" alternative.

Another common element of most of the cleanup scenarios is containment, removal and in-situ treatment of contaminated soil, sediments and groundwater. This will result in the generation of solid waste (soil and sediment) and wastewater (from sediment de-watering, excavation de-watering, and long-term groundwater extraction). The solid waste will have to be treated or disposed off-site, and the wastewater will have to be treated before being discharged under most of the cleanup scenarios. Each of the remedies will include a vertical barrier (e.g., sheet pile) at

Kreher Park. This barrier will help prevent further migration of source materials to the sediments and surface water of Chequamegon Bay and Lake Superior. In addition, most of the sediment remedies will require six inches of cover for lakebed stabilization.

The estimated time for completion of remedial actions for Scenarios 2 through 10 will be 3 to 4 years, although groundwater treatment will be an ongoing activity for a longer period of time. The estimated total cost for Scenario 1 is $0. The estimated total costs for Scenarios 2 through 10 range from $40 million up to $123 million.

10.0 Summary of Comparative Analysis of Alternatives

This section explains EPA's rationale for selecting the preferred alternative. To support the selection of a remedial action EPA must document in a record of decision all facts, analyses of facts, and site-specific policy determinations considered in selecting the remedy, including an explanation of how the nine evaluation criteria were used to select the remedy. (40 CFR 300.430(f)(5)(i)) EPA must consider nine criteria when evaluating remedial alternatives to ensure that important considerations are factored into remedy selection decisions. (40 CFR 300.430(f)(5)(i)) These criteria, described in detail in the NCP at 40 CFR 300.430(e)(9)(iii), are derived from the statutory requirements of Section 121 of CERCLA, 42 USC § 9621, the NCP, as well as other technical and policy considerations that have proven to be important when selecting remedial alternatives. When selecting a remedy for a site, EPA conducts a detailed analysis of the remedial alternatives consisting of an assessment of the individual alternatives against each of the nine evaluation criteria and a comparative analysis focusing upon the relative performance of each alternative against those criteria. This section summarizes the comparative analysis of alternatives presented in the detailed analysis section of the RI/FS Report.

The nine evaluation criteria are described in more detail below.

Threshold Criteria

Threshold criteria are standards that all alternatives must meet in order to be eligible for selection as a remedy for the Site. (NCP §300.430(f)(1)(i)(A)) There is little flexibility in meeting the threshold criteria. If ARARs cannot be met, a waiver may be obtained where one or more site exceptions occur as defined in the NCP.

Overall Protection of Human Health and the Environment. Protectiveness is the main requirement that remedial actions must meet under CERCLA. It is an assessment of whether each alternative achieves and maintains adequate protection of human health and the environment. A remedy is protective if it eliminates, reduces, or controls all current and potential risks posed by the site through each exposure pathway. Treatment, engineering controls, and/or institutional controls can be implemented to control exposure and thereby ensure reliable protection of human health and the environment over time. In addition, implementation of a remedy cannot result in unacceptable short-term risks or cross-media impacts on human health and the environment.

Compliance with ARARs. Section 121(d) of CERCLA and the NCP at 40 CFR 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites must attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations (referred to as "ARARs") identified at the time of ROD signature unless such ARARs are waived under CERCLA section 121(d)(4) and the NCP at 40 CFR 300.430(f)(1)(ii)(C). Compliance with ARARs is a statutory requirement of remedy selection. This criterion is used to determine whether the selected alternative would meet the ARARs identified in Appendix C to this ROD. A discussion of the compliance of each alternative with chemical-, location-, and action-specific ARARs is included.

Primary Balancing Criteria

Five balancing criteria are used to compare alternatives. (40 CFR 300.430(f)(1)(i)(B)) These represent the standards upon which the detailed evaluation and comparative analysis of alternatives are based. A high rating for one criterion may compensate for a low rating on another of the balancing criteria

Long-Term Effectiveness and Permanence. Long-term effectiveness and permanence reflects CERCLA's emphasis on implementing remedies that will protect human health and the environment in the long term. Under this criterion, results of a remedial alternative are evaluated in terms of the risk remaining at the Site after the remedial action is complete. The primary focus of the evaluation is the extent and effectiveness of the actions or controls that may be required to manage the risk posed by treatment residuals or untreated wastes.

Factors to be considered and addressed are magnitude of residual risk, adequacy of controls, and reliability of controls. Magnitude of residual risk is the assessment of the risk remaining from untreated waste or treatment residuals after remediation. Adequacy and reliability of controls is the evaluation of the controls that can be used to manage treatment residuals or untreated wastes that remain onsite.

Reduction of Toxicity, Mobility, or Volume through Treatment. This criterion addresses the statutory preference for remedies that employ treatment to significantly reduce the toxicity, mobility, or volume of the hazardous substances. That preference is satisfied when treatment is used to reduce the principal threats at a site by destroying toxic chemicals or reducing the total mass or total volume of affected media. This criterion is specific to evaluating only how the treatment reduces toxicity, mobility, and volume. Specifically, the analysis will examine the magnitude, significance and irreversibility of reductions.

Short-Term Effectiveness. This criterion examines the short-term impacts associated with implementing the alternative. Implementation may affect workers, the neighboring community, or the surrounding environment. Short-term effectiveness also includes potential threats to human health and environment associated with excavation, treatment and transportation of hazardous substances;

potential cross-media impacts of the remedy; and the time required to achieve protection of human health and the environment.

Implementability. Implementability considerations include technical and administrative feasibility of the alternatives, as well as the availability of goods and services (including treatment, storage or disposal capacity) associated with the alternative. Implementability considerations often affect the timing of remedial actions (for example, limitations on the season in which the remedy can be implemented, the number and complexity of material handling steps, and the need to secure technical services). Onsite activities must comply with the substantive parts of applicable permitting regulations.

Cost. The detailed cost analysis of alternatives includes capital costs (both direct and indirect) and annual operation and maintenance costs incurred over a period of 50 years in accordance with EPA guidance *Guide to Developing and Documenting Cost Estimates During the Feasibility Study*. The focus during the detailed analysis is on the net present value of these costs.

The cost estimates are prepared to have accuracy in the range of –30 to +50 percent. The exact accuracy of each cost estimate depends upon the assumptions made and the availability of costing information. Net present value will be calculated assuming the current discount rate established by the Office of Management and Budget.

Modifying Criteria

Modifying criteria are evaluated by addressing comments received after the state and the public have reviewed and commented on the Proposed Plan. (40 CFR 300.430(f)(1)(i)(C))

State Acceptance. This criterion evaluates the degree to which the state supports the various remedial alternatives, primarily the selected remedy. This criterion also may evaluate any technical and administrative concerns the state has expressed.

Community Acceptance. This criterion evaluates the issues and concerns the public may have regarding the various remedial alternatives presented in the Proposed Plan.

The full text of the detailed analysis of the ten remedial alternatives against the nine evaluation criteria (including both the individual analysis and the comparative analysis) is contained in the FS Report for the Ashland/NSP Lakefront Site, which is part of the Administrative Record for the Site. Because the two Modifying Criteria could not be fully evaluated until the public comment period was over, they were not evaluated in the FS. The State's acceptance of the selected remedy is documented in the letter at Appendix B). The community's acceptance of the selected remedy is documented in the public comments received and the Responsiveness Summary at Appendix A, that contains a more detailed discussion of public comments received.

This section of the ROD presents a comparative analysis of the remedial alternatives presented for the Site. The purpose of the comparative analysis is to identify the relative advantages and/or disadvantages of each remedial action alternative.

10.1 Overall Protection of Human Health and the Environment

Soil Alternatives: ***Alternative S-1*** (no action) offers no additional protection for human health and the environment because no additional actions would be taken to address soil contamination at the Site. ***Alternative S-3B*** (unlimited removal and off-site disposal) offers the highest level of protection of human health and the environment in the long term because all fill and contaminated soil would be removed. ***Alternative S-3A*** (limited soil/source removal and off-site disposal), ***Alternative S-5A*** (limited removal and on-site thermal treatment), and ***Alternative S-5B*** (limited removal and off-site incineration) would also offer a high level of protection because these remedial responses would result in the removal of a significant mass of contaminated soil that exceeds regulatory or risk-based standards. ***Alternative S-6*** (limited removal and treatment by soil washing) would offer a moderate to high level of overall protection if this technology can be implemented to effectively reduce contaminant concentrations. ***Alternative S-2*** (containment using engineered surface barriers) would eliminate the direct contact exposure route, but would provide a low level of overall protection because soil (and groundwater) contamination would remain. ***Alternatives S-4A*** and ***S-4B*** (limited and unlimited removal and on-site disposal) would provide a moderate level of protection because highly contaminated material from the Upper Bluff area and the former coal tar dump area would be consolidated into a disposal cell at Kreher Park.

Although unlimited removal for ***Alternative S-3B*** (unlimited removal and off-site disposal) would provide a high level of human health and environmental protection, limited soil/source removal for Alternatives S-3A, S-5A, S-5B, and S-6 would also provide a high level of protection because these remedial responses would result in the removal of a significant mass of contaminated soil in excess of regulatory or risk-based standards. Although Alternatives S-2 and S-4 would result in the containment of contaminated materials, which would be inaccessible to humans or biota, thereby reducing risk, the overall level of protection is lower because there is no reduction of contaminant mass.

Groundwater Alternatives: ***Alternative GW-1*** (no action) offers no additional protection for human health and the environment because no additional actions would be taken to address groundwater contamination at the Site. ***Alternatives GW-2A and GW-2B*** (containment using surface and vertical barriers) and ***Alternative GW-5*** (in-situ treatment using PRB walls) offer an overall moderate level of protection because contaminants will be left on site. Under these alternatives shallow ground water contamination would be contained and inaccessible to humans or biota, thereby reducing risk, but the alternatives offer no protection for the underlying Copper Falls aquifer. ***Alternatives GW-9A and GW-9B*** (removal using groundwater extraction wells) can be used for shallow and deep groundwater, but offer a moderate level of protection of human health and the environment in the long term because operation will require an extended period to achieve RAOs. ***Alternatives GW-4*** (surfactant injection and removal), ***GW-6*** (chemical oxidation), ***GW-7*** (ERH) ***and GW-8*** (steam injection), which all use in-situ treatment methods, offer adequate levels of protection because each alternative would result in the removal of

significant contaminant mass, NAPL in particular, from the subsurface. ***Alternative GW-3*** (ozone sparge) is not effective in addressing NAPL.

Sediment Alternatives: ***Alternative SED-1*** (no action) offers the least protection of human health and the environment, as no additional actions would be taken to address contaminated sediments in the bay. ***Alternative SED-2*** (CDF) assures protection of human health and the environment by eliminating access to impacted sediment. Under this alternative, there is no destruction of COCs, but these materials would be permanently contained and inaccessible to humans or biota, thereby reducing risk. ***Alternative SED-3*** (subaqueous capping of a portion of the sediment and removal of the remainder) is also protective of human health and the environment, because it would isolate a portion of the contaminated sediments from exposure to humans or biota and would remove the remaining contaminated sediments. If that portion is thermally treated it reduces its volume and permanently eliminates its toxicity by treatment. If the sediment were to be sent off-site for disposal without treatment, then this alternative reduces in-situ volume and eliminates exposure to humans and biota by transfer of these materials to an environment where access is controlled. There is no reduction in toxicity if the sediment that is removed is disposed in a landfill, although because a landfill is designed to prevent migration of or exposure to the contaminated sediments there would be no further releases to the environment or exposure to humans or ecological receptors. ***Alternative SED-4*** (dredging) could also be protective of human health and the environment, because it results in decontamination of sediment above the RAL and removes it from the aquatic environment. Due to the large amount of wood waste and free product in the near shore sediments, however, dredging this area would likely result in releases of COCs into the water column recontaminating on-site sediments and potentially impacting off-site areas. These conditions make it very difficult to implement a wet dredge remedy that would achieve the cleanup goal and performance standards established in this ROD to protect human health and the environment. ***Alternatives SED-5 and SED-6*** (dry excavation or combination of dredging and dry excavation) are protective of human health and the environment, because it results in decontamination of sediment above the RAL and removes it from the aquatic environment. ***Alternative SED-6***, dry excavation of the near shore area, is also a more protective alternative than ***SED-4*** (wet dredge) to remove near shore contamination because of the presence of large amounts of wood waste and free product in the near shore area that could be released during dredging operations into the water column and environment exposing humans or ecological receptors to COCs. ***Alternatives SED-5 and SED-6***, therefore, are more protective of human health and the environment than ***Alternative SED-4*** (wet dredge) or any other alternative that employs wet dredging of sediments in the near shore areas.

10.2 Compliance with ARARs

Soil Alternatives: ***Alternative S-1*** (no action) would not achieve compliance with ARARs and TBCs. ***Alternatives S-2, S-4A,*** and ***S-4B*** (surface barriers, and limited and unlimited removal and on-site disposal) must be implemented with a groundwater remedial response to achieve compliance. If properly implemented, the remaining remedial responses could achieve compliance with ARARs and TBCs for soil. Implementation would require that engineering and construction actions be developed and completed in compliance with Federal and State ARARs in Appendix C to this ROD.

Groundwater Alternatives: ***Alternative GW-1*** (no action) would not achieve compliance with ARARs and TBCs. Compliance with ARARs and TBCs would be met for the remaining remedial alternatives for groundwater. Implementation would require that engineering and construction actions be developed and completed in compliance with Federal and State ARARs in Appendix C to this ROD.

Sediment Alternatives: ***Alternative SED-1*** (no action) would not comply with ARARs and TBCs. ***Alternatives SED-2 and SED-3*** (CDF and subaqueous capping of a portion of the sediment and removal of the remainder) would require placement of a structure or deposit on the bed of navigable waters. The placement of a structure or deposit must not be detrimental to the public interest, must not materially reduce the flood flow capacity of a stream, and must not materially obstruct navigation. A confined disposal facility on the bed of Lake Superior does not meet these requirements for approval and, according to WDNR, cannot be permitted by the Department under Section 30.12, WI Statutes. A bulkhead line may be established under Section 30.11, WI Statute, however that bulkhead line must be in the public interest and shall conform as nearly as practicable to the existing shoreline. The proposed confined disposal facility in ***Alternative SED-2*** (CDF) would not follow the shoreline and would not meet the public interest standards and therefore cannot be established using this statutory authority. ***Alternatives SED-4 SED-5, and SED-6*** (dredging, dry excavation or combination of dredging and dry excavation) would be similar with respect to meeting ARARs and TBCs, as engineering and construction actions would be developed and completed in compliance with federal and state regulations.

All the ARARs are presented in Appendix C to this ROD.

10.3 Long-Term Effectiveness and Permanence

Soil Alternatives: ***Alternative S-1*** (no action) would not provide any long-term benefit; no additional actions would be taken to address soil contamination at the Site. ***Alternative S-3B*** (unlimited removal and off-site disposal) would provide the highest effectiveness and permanence over the long term because all contaminated material and fill soil would be removed. ***Alternative S-3A*** (limited removal and off-site disposal), ***Alternative S-5A*** (limited removal and ex-situ thermal treatment), and ***Alternative S-5B*** (limited removal and incineration) would also be highly effective and permanent over the long term because these responses will result in the removal of a significant mass of contamination in excess of regulatory or risk-based standards. ***Alternative S-6*** (limited removal and treatment by soil washing) would provide a moderate level of effectiveness and permanence over the long term; effectiveness would depend upon the reduction in contaminant concentrations that can be achieved with this technology. The long-term effectiveness of ***Alternatives S-4A*** and ***S-4B*** (limited and unlimited removal and on-site disposal) is considered low to moderate because contaminants would remain on site in a disposal cell constructed at Kreher Park. The long-term effectiveness of ***Alternative S-2*** (containment using engineered surface barriers) is considered low because constituents would remain at the site beneath the surface barriers. However, for ***Alternatives S-2***, ***S-4A***, and ***S-4B***, contaminated material would be contained and inaccessible to humans or biota, thereby reducing risk. If properly implemented, a range of long-term effectiveness and permanence for all alternatives (except ***Alternative S-1)*** can be achieved for all active remedial responses for soil.

Alternative S-2 (surface barriers) must be implemented in conjunction with a remedial response for groundwater.

Groundwater Alternatives: ***Alternative GW-1*** (no action) would not provide any long-term benefit; no additional actions would be taken to address groundwater contamination at the site. ***Alternatives GW-2*** and ***GW-5*** (containment using surface and vertical barriers and in-situ treatment using PRB walls) offer low levels of effectiveness and permanence over the long term. Although risk would be reduced by containment of contaminated material, contaminants would be left on site. Additionally, both are limited to shallow groundwater; neither is a feasible alternative for the underlying Copper Falls aquifer. ***Alternative GW-9*** (removal using groundwater extraction wells) would provide a moderate level of effectiveness and permanence over the long term; operation would be required for an extended period to achieve RAOs. The remaining alternatives have high levels of effectiveness and permanence over the long term because each technology would result in the removal of a significant contaminant mass, NAPL in particular, from the subsurface.

Sediment Alternatives: ***Alternative SED-1*** (no action) would not provide any long-term benefit, as no remedial action would be taken and any potential risk associated with impacted sediment would remain. Although there would be no reduction in volume or toxicity of the contaminated sediment, ***Alternative SED-2*** (CDF) still provides a moderate level of permanence and effectiveness over the long term. Since no sediment is treated, the toxicity of the material remains the same, however accessibility and exposure to humans and biota is eliminated through containment. ***Alternative SED-3*** (subaqueous capping of a portion of the sediment and removal of the remainder) provides a high level of long-term effectiveness and permanence for that sediment which is removed and treated. For the contaminated sediment that is capped there is no destruction of COCs, but these materials are permanently contained and inaccessible to humans or biota, thereby reducing risk. If the sediment that is removed is not treated but disposed in an NR500 licensed landfill exposure to humans and biota is eliminated through access restrictions. ***Alternatives SED-4, SED-5 and SED-6*** (dredging, dry excavation or combination of dredging and dry excavation) would provide the highest effectiveness and permanence over the long term due to the permanent removal of the largest volume of sediment. However, due to sediment residuals after removal, it might take longer to reach long-term effectiveness and permanence using dredging under ***Alternatives SED-4 and SED-6***. If treated, thermal treatment of the sediment would eliminate toxicity, reduce volume and is permanent. If the sediment that is removed is not treated but disposed in a licensed landfill, exposure to humans and biota is eliminated through access restrictions.

10.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Soil Alternatives: ***Alternative S-1*** (no action), ***S-2*** (containment using engineered surface barriers), ***S-3A*** (limited removal and off-site disposal), ***S-3B*** (unlimited removal and off-site disposal), ***S-4A*** (limited removal and on-site disposal), ***and S-4B*** (unlimited removal and on-site disposal) do not include treatment as a component of the remedy. Therefore, these alternatives would not result in a reduction in the toxicity, mobility, or volume of contamination at the Site. ***Alternative S-5A*** (limited removal and ex-situ thermal treatment), and ***Alternative S-5B*** (limited removal and incineration) would reduce toxicity, mobility and volume of approximately 14,000

cubic yards of contaminated soil which would be removed and either incinerated or thermally treated. ***Alternative S-6*** (limited removal and treatment by soil washing) would result in a moderate degree of reduction of toxicity, mobility, and volume of contaminated soil, but would depend upon the reduction in contaminant concentrations that can be achieved with this technology.

Groundwater Alternatives: ***Alternative GW-1*** (no action) and ***Alternatives GW-2A and GW-2B*** (containment using surface and vertical barriers) do not include treatment as a component of the remedy. Therefore, these alternatives would not result in a reduction in the toxicity, mobility, or volume of contamination at the Site. However, ***Alternatives GW-2A*** and ***GW-2B*** would reduce contaminant mobility for shallow groundwater, but not for the Copper Falls. ***Alternatives GW-9A and GW-9B*** (removal using groundwater extraction wells) would result in a reduction in the toxicity, mobility, and volume of contaminant mass through NAPL recovery and treatment, but operation would be required for an extended period to achieve RAOs. Implementation of the remaining in-situ treatment alternatives ***Alternatives GW-3*** (In-situ treatment using ozone sparge), ***GW-4*** (In-situ treatment using surfactant injection and removal using dual phase recovery), ***GW-5*** (In-situ treatment using permeable reactive barrier walls), ***GW-6*** (In-situ treatment using chemical oxidation), ***GW-7*** (In-situ treatment using electrical resistance heating), ***and GW-8*** (In-situ treatment using steam injection) would reduce the toxicity, mobility, and volume of contaminated groundwater. However, the amount of volume reduction would vary for each of the in-situ treatment alternatives.

Sediment Alternatives: ***Alternatives SED-1*** (no action) and ***SED-2*** (CDF) do not include treatment as a component of the remedy. Therefore, these alternatives would not result in a reduction in the toxicity, mobility, or volume of contamination at the Site. ***Alternative SED-3*** (subaqueous capping of a portion of the sediment and removal of the remainder) would reduce toxicity, mobility and volume of approximately 78,000 cubic yards of sediment which would be permanently removed from the environment and thermally treated. The sediment remaining under the cap would have reduced mobility and since it would be inaccessible to humans or biota, it would eliminate exposure and risk. The inherent toxicity of that sediment remaining under the cap would not be reduced. ***Alternatives SED-4, SED-5, and SED-6*** (dredging, dry excavation or combination of dredging and dry excavation) would have the greatest degree of reduction of toxicity, mobility, and volume of contaminated material. Approximately 134,000 cubic yards will be removed and thermally treated. However, due to sediment residuals after removal via dredging of near shore sediments and free product co-located with wood waste, ***Alternative SED-4*** would not reduce toxicity, mobility or volume of contaminated sediments as well as ***Alternatives SED-5 and SED-6***.

10.5 Short-Term Effectiveness

Soil Alternatives: Implementation of ***Alternative S-1*** (no action) would not achieve RAOs or improve environmental impacts in the short term. Because there is no remediation, there would be no exposure to the community and workers during implementation. The remaining alternatives would improve environmental impacts in the short term, but require varying degree of effort to protect the community and workers during remediation. Implementation of ***Alternative S-3B*** (unlimited removal and off-site disposal) would result in the most significant

on and off-site disturbance and require the highest levels of effort for this protection. ***Alternatives S-4A*** and ***S-4B*** (limited removal and on-site disposal) would result in no off-site disturbance; site disturbance would be limited to the site, and would require a moderate level of effort for protection. ***Alternative S-2*** (containment using engineered surface barriers) would result in minimal on-site disturbance, and no off-site disturbance. Because the remaining alternatives include limited removal of highly contaminated soil, they would require high levels of effort for worker and community protection. Engineered controls and monitoring would be implemented as needed for all alternatives to maximize short-term effectiveness for soil. ***Alternative S-2*** (surface barriers) must be implemented in conjunction with a remedial response for groundwater.

Groundwater Alternatives: Implementation of ***Alternative GW-1*** (no action) would not achieve RAOs or improve environmental impacts in the short-term, but it would not pose any implementation risks to the community and workers during remediation. The short-term effectiveness for the remaining alternatives is considered high. Each alternative can achieve RAOs and would reduce environmental impacts in the short term by removing contaminant mass or preventing the off-site migration of contaminants. The containment, in-situ, and removal technologies evaluated would require minimal effort to protect the community and workers during remediation.

Sediment Alternatives: ***Alternative SED-1*** (no action) would have the least short-term impact on human health and the environment, as impacted sediment would not be disturbed, and contaminants would not potentially be released into surface water and air. Of the five active remedial options. ***Alternative SED-2*** (CDF) would have the least short-term impact, as sediment would not be brought to shore for dewatering or treatment, but would be disposed in a CDF, a portion of which is subaqueous. Adequate controls would be in place to ensure worker and community safety during remedial activities. All other alternatives would have the potential of some short-term risk from release of volatile emissions during debris removal and onshore dewatering and/or treatment and transportation. In addition, ***Alternatives SED-3, SED-4 and SED-6*** could have some short-term risk from the COCs being re-suspended in the water column during dredging of sediments and impacts to the community during dewatering of sediments on-shore. The dry excavation of sediments in ***Alternatives SED-5 and SED-6*** are the best methods to quickly remove COCs and achieve protection, but there are increased concerns with worker safety in a dry excavation scenario, but dry excavation is a commonly used technology and there are effective and reliable mitigative measures that will be developed during the design phase for the remedial action. ***Alternative SED-5*** presents greater difficulty in implementing mitigative measures because it would require a dry excavation of the entire bay, not just the near shore areas under ***Alternative SED-6***.

10.6 Implementability

Soil Alternatives: ***Alternative S-1*** (no action) would require the least amount of effort, as no remedy would be implemented. ***Alternative S-3B*** (unlimited removal and off-site disposal) would result in significant site disturbance, and would be the most difficult to implement. ***Alternative S-6*** (limited removal and treatment by soil washing) may require a bench scale treatability study and pilot test to evaluate its implementability. ***Alternatives S-4A and S-4B***

(limited removal and on-site disposal) would require a variance from the State of Wisconsin for siting the landfill at Kreher Park. Obtaining a variance from the State of Wisconsin may be difficult, which could cause a significant delay in implementing the remedial response action. The remaining limited removal alternatives are highly implementable.

Groundwater Alternatives: ***Alternative GW-1*** (no action) would require the least amount of effort, as no remedy would be implemented. ***Alternatives GW-2*** and ***GW-5*** (containment using surface and vertical barriers and in-situ treatment) have a very high degree of implementability. The remaining alternatives have a high degree of implementability. However, buried structures in the Upper Bluff area and the wood waste layer at Kreher Park may limit the effectiveness of in-situ treatment for shallow and deep groundwater in these areas. Removal of the buried structures concurrent with remedial alternatives evaluated for soil may ease implementation of the in-situ treatment and removal alternatives for the Copper Falls. If removal and disposal (on- or off-site) or on-site treatment is selected as a remedial response for soil, or if containment is selected for shallow groundwater, in-situ treatment and/or removal would not be necessary for soil and shallow groundwater contamination because the contamination is being addressed. However, one or more of the in-situ and/or removal technologies evaluated would be required for the Copper Falls aquifer.

Sediment Alternatives: Implementation of ***Alternative SED-1*** (no action) would be easy, as no action would be performed. ***Alternative SED-2*** (CDF) would be more difficult to implement than ***Alternative SED-1***. The technology and equipment that would be used for this alternative is readily available, and has proven to be reliable at other similar sites. However, because WDNR has indicated that the Governor and Legislature must approve ***Alternatives SED-2 and SED-3*** (CDF and subaqueous capping of a portion of the sediment and removal of the remainder), obtaining authorization to proceed is uncertain. The impact on schedule for implementation of the remedy would also be significant. ***Alternatives SED-2, SED-3, and SED-4*** (dredging), require confirmation sampling and possible redredging if performance standards are not met as the dredging proceeds. The need for confirmation sampling and possible redredging makes implementation more difficult. ***Alternatives SED-3 and SED-4***, which mechanically or hydraulically dredge about four feet of wood debris and sediment before capping, or mechanically or hydraulically dredge all sediments greater than 9.5 ppm, would be difficult to implement, as additional equipment, technology, and permitting would be required to perform the dewatering, thermal treatment, and disposal of sediment as well as for implementation of engineering controls for volatilization. The amount of wood waste and presence of free product also present difficult implementation challenges in order to control the release of contaminants and recontamination of sediments. Furthermore, the capping component included as part of Alternative SED-3 would add additional complexity to the implementation of this alternative. ***Alternative SED-5 and SED-6*** (dry excavation or combination of dredging and dry excavation) would be difficult to implement because of the need to install safe and watertight enclosures, pump the surface water out, keep water out (from seepage and precipitation), and engineering controls for volatilization. ***Alternative SED-5*** is more difficult to implement in this regard since it involves the entire bay whereas ***Alternative SED-6*** would only require these controls in the near shore area. A dry excavation of the whole bay or inner bay, however, is an efficient and effective way to remove the significant amount of wood waste and free product since work is not taking place in the "wet" (i.e., in water) making it possible to see what is being removed without

the need to control for the release of free product to the water column resulting in the recontamination of sediment and volatilization of surface sheens and releases to the outer bay.

10.7 Cost

Soil Alternatives: There are no costs associated with ***Alternative S-1*** (no action) because no remedial activities would be conducted. For the Upper Bluff area, the ***Alternatives S-3B*** (unlimited removal and off-site disposal) and ***S-5B*** (limited removal and incineration) yield the highest costs. ***Alternative S-6*** (limited removal and treatment by soil washing) yields the next highest cost, followed by ***Alternative S-5A*** (unlimited removal and on-site thermal treatment), ***Alternative S-3A*** (limited removal and off-site disposal), and ***Alternatives S-4A*** and ***S-4B*** (limited and unlimited removal and on-site disposal) yielded lowest costs for the Upper Bluff area. ***Alternative S-2*** (containment using engineered surface barriers) would be the lowest cost remedial response for soil in the Upper Bluff area, but would likely need to be completed in conjunction with a groundwater remedial response to be effective. ***Alternative S-3B*** (unlimited removal and off-site disposal) also yields a high cost for Kreher Park. ***Alternative S-4B*** (unlimited removal and on-site disposal at Kreher Park) yields the next highest cost followed by ***Alternative S-6*** (limited removal and treatment by soil washing), ***Alternative S-5A*** (limited removal and on-site thermal treatment), ***Alternative S-2*** (containment using engineered surface barriers), ***Alternative S-5B*** (limited removal and off-site incineration), and ***Alternative S-4A*** (limited removal and on-site disposal). ***Alternative S-3A*** (limited removal and off-site disposal) yields the lowest cost.

Groundwater Alternatives: There are no costs associated with ***Alternative GW-1*** (no action) because no remedial activities would be conducted. For shallow groundwater, ***Alternatives GW-2*** and ***GW-5*** (containment using surface and vertical barriers and in-situ treatment) have high installation costs. Annual O&M costs for ***GW-2*** are high due to long-term groundwater recovery and disposal costs, but low for ***GW-5***, which relies on in-situ treatment. Cost for implementation of the in-situ treatment ***Alternatives GW-6*** (chemical oxidation), ***GW-7*** (ERH), and ***GW-8*** (steam injection) are also high with low annual O&M costs. ***Alternative GW-3*** (ozone sparging) has low implementation and annual O&M costs. Implementation costs for ***Alternative GW-9*** are the lowest, but it has high annual O&M costs for continued operation, which may be required for an extended period of time.

For the Copper Falls aquifer, in-situ treatment ***Alternatives GW-6*** (chemical oxidation), ***GW-7*** (ERH), and ***GW-8*** (steam injection) have high implementation costs. ***GW-6*** has high O&M costs, and ***GW-7*** and ***GW-8*** have low O&M annual costs. In-situ treatment ***Alternatives GW-3*** (ozone sparging), and ***GW-4*** (surfactant injection) have low implementation costs, but high annual O&M costs. As with shallow groundwater, implementation costs for ***Alternative GW-9*** are the lowest, but it has high annual O&M cost for continued operation, which may be required for an extended period of time.

Sediment Alternatives: ***Alternative SED-1*** (no action) would be the lowest cost alternative. The cost for ***Alternative SED-2*** (CDF) would be greater than costs for Alternative SED-1 and SED-3 if construction of the CDF is required to meet ch. NR 504, WAC specifications and armouring to the top of the sheet pile is required on the lake side. The cost to implement

Alternative SED-3 (subaqueous capping of a portion of the sediment and removal of the remainder) would range between approximately $34 to 46 million depending upon whether the sediment is thermally treated or not. The cost to implement ***Alternative SED-4*** (dredging) would range between approximately $45 to 64 million depending upon whether the sediment is mechanically or hydraulically dredged and whether it is thermally treated. Costs for implementation of ***Alternative SED-5*** (dry excavation) are the highest among the alternatives and range between approximately $74 to 88 million depending upon whether the sediment is thermally treated. Costs for ***Alternative SED-6*** (combination of dredging and dry excavation) would range between $63 and 77 million depending upon how the sediment is dredged and whether it is thermally treated. Alternative capping designs, for instance a three-foot cap (two feet of sand and one foot of rock for erosion control) with a carbon mat (three-feet of sand and one-foot of rock) would be several million dollars less than the four-foot cap upon which the cost estimates for ***Alternative SED-3*** is based.

The tables in Appendix O of this ROD (and in Appendix F of the FS) summarize the estimated costs associated with each of the remedial alternatives presented above.

10.8 State Acceptance

The State Agency, WDNR, was the lead agency at the Site prior to EPA taking the lead, and has continued to be involved in all steps of the RI/FS for the Site. The WDNR concurs with the selection of Scenario 10. A letter of concurrence from the State can be found in Appendix B.

10.9 Community Acceptance

During the public comment period on the Proposed Plan, the community expressed a few concerns with the proposed remedy for the Ashland/NSP Lakefront Site, but overall expressed strong support for EPA's preferred alternative. In general, the community raised concerns with the cost of the cleanup, but also expressed a preference for a remedy that is permanent and removes as much of the contamination as possible to prevent exposure and protect public health and the environment. NSPW and its consultants expressed concerns with implementing a dry excavation sediment alternative based on engineering and cost considerations. This ROD includes a responsiveness summary that summarizes the public comments and EPA's response to those comments. The responsiveness summary is included as Appendix A.

11.0 Principal Threat Wastes

The NCP establishes an expectation that EPA will use treatment to address the principal threat wastes posed by a site wherever practicable. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Benzene was detected in the sediments approximately 1,000 times higher than the WDNR threshold effects concentration (TEC) and total PAHs were detected in the sediments approximately 6,000 times higher than the WDNR TEC. Oil slicks continue to form on the surface of the Chequamegon Bay during high-wind events due to the NAPL in sediments. The PAH and VOC free product and NAPLs found in the soils, groundwater and sediment at the

Ashland/NSP Lakefront Site are highly toxic. The NAPL and free product materials act as a reservoir for migration of contamination to groundwater, surface water, soil and sediment, and represent a potential source for direct exposure. Therefore, the NAPL and free product materials represent the principal threat waste at the Site.

The selected remedy described in Section 12 of this ROD incorporates treatment of the principal threat wastes found in soils, groundwater and sediments to the maximum extent practicable. For example, the NAPL removed from the soil, sediment and groundwater will be sent off-site for treatment. The NAPL currently being extracted from the groundwater from the interim groundwater extraction system is sent to an off-site facility for treatment.

12.0 Selected Remedy

This section describes the selected remedy and provides EPA's reasoning behind its selection. Alternatives can change or be modified if new information is made available to EPA through further investigation or research. An appropriate range of alternatives was developed, based upon initial screening of technologies, potential for contaminants to impact the environment, and site-specific RAOs and goals. Appendix Q includes Figures showing what the various components of the selected remedy and alternate sediment remedy (SED-4) are expected to look like during implementation of the remedy.

12.1 Identification of the Selected Remedy and Summary of the Rationale for its Selection

Based on the analysis of the nine criteria as summarized in Section 10 of this ROD, the selected remedy for the Ashland/NSP Lakefront Site is Scenario 10 as described in Section 9.1 of this ROD. This alternative represents the best balance of overall protectiveness, compliance with ARARs, long-term effectiveness and permanence, cost, and other criteria. It is also the scenario favored by the WDNR and the community. Figures in Appendix Q show the expected implementation of the various components of the selected remedy. The selected remedy described in this section may change as a result of the remedial design and construction processes. Any changes to the remedy selected in this ROD will be properly documented using a technical memorandum in the Administrative Record, an ESD, or a ROD amendment, as appropriate.

12.2 Description of the Selected Remedy

The selected remedy is Scenario 10, which as described in Section 9.1 includes the following components:

- **Sediments**: Alternative SED-6 – Using excavation equipment, remove in the dry all nearshore sediment and wood debris. In addition, remove wood debris from offshore sediments and mechanically or hydraulically dredge remaining offshore sediments. After dredging/excavation is completed, place six inches of clean fill on dredged areas for lakebed stabilization. Dewater and stabilize sediments at Kreher Park area and treat wastewater; discharge treated wastewater to lake. Transport stabilized sediments off site

to NR 500 licensed landfill or thermal treatment. Dispose of or burn wood debris separately.

- **Kreher Park:** Limited soil/source removal with ex-situ thermal treatment (Alternative S-5A) and containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control (Alternative GW-2A). Alternative GW-2A includes caps at Kreher Park to limit groundwater recharge. Shallow groundwater extracted from the contained area for hydraulic control would be treated onsite and discharged to the lake or POTW. The remedy will serve to restore the shallow groundwater to its beneficial use by reducing contaminant levels in groundwater. In-situ chemical oxidation (GW-6) can be used to possibly enhance groundwater treatment.
- **Upper Bluff/Filled Ravine:** Limited soil removal with ex-situ thermal treatment (Alternative S-5A) and containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control (Alternative GW-2A). Alternative GW-2A includes caps to limit groundwater recharge. Shallow groundwater extracted from the contained area for hydraulic control would be treated onsite and discharged to the lake or POTW. The remedy will serve to restore the shallow groundwater to its beneficial use by reducing contaminant levels in groundwater. In-situ chemical oxidation (GW-6) can also be used to possibly enhance groundwater treatment.
- **Copper Falls Aquifer:** Enhance existing groundwater extraction system (GW-9B). In-situ chemical oxidation (GW-6) or in-situ treatment via ozone sparge (GW-3) can be used to possibly enhance groundwater treatment. Enhancing the existing groundwater extraction and treatment system (and possibly using in-situ treatment) will hydraulically control the groundwater contamination and NAPL in the aquifer. The remedy will also serve to make progress toward restoring groundwater to beneficial use.
- **Conduct O&M and Long-Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site or from the contained area with groundwater. Fluid levels within the contained area will also need to be monitored to ensure that groundwater remains at or below the design elevation. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments.
- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff and Kreher Park where contaminants remain in subsurface and for shallow groundwater in contained areas.

Each of these components of the selected remedy is described in greater detail below.

Sediments: Alternative SED-6 – (Dry Excavation near shore/Dredging offshore) - Using excavation equipment, remove in the dry all near shore sediment and wood debris that exceeds the RAL of 2,295 ug tPAH/g OC (9.5 ppm tPAH dwt at 0.415% OC). In addition, remove wood debris from sediments outside the dry excavation area and mechanically or hydraulically dredge all targeted sediments that exceed the RAL. After dredging is completed, place six inches of clean fill/sand on dredged areas for stabilization. Dewater and stabilize sediments at Kreher Park area and treat wastewater to meet state and federal discharge limits; discharge treated wastewater to the lake or POTW. Thermally treat sediments or stabilize sediments to transport off site for disposal to a NR 500 licensed landfill. If thermal treatment is determined to be more difficult and not cost effective. then off-site disposal of sediment at a NR 500 licensed landfill will be the

alternate remedy. Thermal treatment will be determined during the pre-design phase. Dispose of or burn wood debris separately. If a pre-design pilot test for wet dredging of the near shore area is conducted and indicates that dredging rather than dry excavation within the near shore area will attain the established performance standards and can be conducted in a manner protective of human health and the environment, then EPA, in consultation with WDNR, will recommend that an a ternate sediment remedy (dredging) be implemented for both near shore and outer shore sediments and EPA will publish its decision in an ESD.

This alternative consists of the following components, the specifications of which may vary and will be finalized during the Remedial Design:

1) Determine sediment with concentrations of PAH greater than 9.5 ppm tPAH/g dwt at 0.415% OC.
2) Delineation of near shore areas that contain NAPL-impacted sediments and substantial wood debris will be done during pre-design testing and may be refined during Remedial Action. This will become the boundary of the near shore dry excavation area and the offshore dredging area. For purposes of this conceptual plan the boundary is assumed to be approximately 200 feet from the shoreline. Sheet piling would be constructed along the boundary between the near shore dry excavation area and the offshore dredging area.
3) In order to control wave action on the near shore area containment wall (sheet pile), a wave attenuation flotation device or breakwater wall will be installed at the outer boundary of the area to be remediated (north of 2900N).
4) Lake water within the sheet pile containment would be removed with two 500 gpm, stand-alone pumps. Lake water pumped from within the containment will be managed/treated by an adsorbent liquid phase activated carbon system sized to adequately remove contaminants of concern. The untreated lake water will be tested to provide contaminant mass loading data and the carbon will be changed out and regenerated based upon the contaminant load and testing for contaminants. The treated effluent will be discharged directly to Lake Superior following laboratory testing that shows compliance with WDNR water quality criteria and meet the substantive requirements for NPDES permit.
5) Variable rate discharge pumps will be used to assist with dewatering sediments. Wastewater obtained from sediment dewatering will be managed/treated with filtration of the solids followed by contaminant adsorption with liquid phase activated carbon filters. The wastewater will flow through bag or sand filters and will then flow into a liquid phase activated carbon system sized to remove contaminants of concern from the water. The wastewater will be tested to estimate the contaminant mass loading on the carbon, and the carbon will be changed out and regenerated on an as needed basis based on testing for contaminants. In addition, the effluent will be tested to show compliance with WDNR water quality criteria, and discharged to the lake. Alternatively, if surface water criteria are not initially met, the water will be contained and re-treated, and the system will be adjusted to treat the water fully.
6) Wood debris and sediment will be prepared for loading and disposal by one of the following methods: Stabilizing wet, fine grained (silt and clay) sediments with reagents such as Type C fly ash and/or Portland cement and excavation of wood debris and

granular (sand and gravel) sediments on an impermeable asphalt pad to allow drainage of fluids by gravity flow.

7) Sediment excavation/stabilization/dewatering will be performed with heavy equipment such as a crane with drag-line and/or tracked excavator and/or wheeled conveyor and displacement with a bull dozer. It is anticipated that all of the sediment volume will be thermally treated or disposed off site.
8) Imported clean sand will be used as backfill in the area where removal of sediment and wood debris is performed in the dry. Heavy equipment will be used to place the sand. Techniques for placement of the sand may include: pushing the sand into the excavation created by removal of the sediment and wood debris and/or placing sand from long-stick excavators positioned adjacent to the sheet piling or the shoreline. Temporary sand berms may be constructed to support equipment used for excavation. Material from these berms may later be used for backfill.
9) Sediment outside the near shore containment will be removed using barge-based hydraulic or mechanical dredging. Dredge material will be conveyed to shore-based dewatering facility.
10) Excavated and dredged sediment will be dewatered on site using a settling pond and mechanical separation followed by on-site treatment of sediment and liquid and/or off-site disposal of untreated sediment;
11) If sediment is treated using thermal desorption or incineration it would be sent for off-site disposal at a solid waste or other landfill after treatment;
12) If sediment is not treated on site but only stabilized, it would be sent to a NR 500 permitted landfill for off-site disposal;
13) Wastewater will be treated using flocculation, clarification, sand filtering, and carbon filtering and discharged to the Ashland WWTP. Alternatively it could be discharged directly to Lake Superior if it meets DNR surface water criteria and the substantive requirements of an NPDES permit;
14) Groundwater removed from a trench system that parallels the sheet pile wall on the land side will be treated with filtration, oil/water separation followed by treatment with liquid phase activated carbon. As with the other water that will enter the activated carbon system, water will be treated to comply with WDNR water quality criteria and discharged into the lake.
15) Sediment areas outside of the dredge area where concentrations of PAH are greater than 5.6 μg tPAH/g dwt at 0.415% OC will be monitored.

Equipment that may be used for implementation of this alternative includes:

- Construction of wave attenuation floatation device on lakeside of containment wall
    - Barge equipped with crane, pile driving hammer and steel sheet piles with interlock seal
    - Barge equipped with crane and carriage lift for placement of stone and barges loaded with blasted rock/cut limestone, or barges equipped with crane for placement of wave attenuation device and dead-man
    - Hydrocarbon collection booms
- Construction of landside containment wall
    - Crane, pile driving hammer and sheet piles with interlock seal

    - Hydrocarbon collection booms
- Dewatering equipment – for removing water from bay, groundwater collection trench and sediment
    - Trailer mounted 500 gpm pumps
    - Variable rate (10-100 gpm) sump pumps
    - Sump pump for collection of drained sediment fluids from asphalt drainage pad
    - Mechanical dewatering equipment
- Water treatment equipment
    - Piping to lake or WWTP for treatment of water and collected fluids
    - Water treatment system
        - Oil/water separator
        - Bag filtration
        - Activated carbon adsorption
        - Sand Filtration
- Sediment excavation equipment
    - Modular barges to provide access throughout containment areas, if necessary
    - Geotechnical mats (e.g., Durabase) may be needed on crest of sand berms to provide support to heavy equipment
    - Bulldozers
    - Excavators
    - Crane equipped with drag–line to move sediment into position for handling and stabilization
    - Wheel mounted conveyors
- Sediment dredging equipment
    - Hydraulic
    - Mechanical
- Sediment stabilization/drainage equipment
    - Backhoes
    - Compressors
    - Tanker trucks containing reagent
    - Asphalt drainage pad and sump
- Disposal equipment
    - Transport to disposal location
        - Truck
- Monitoring equipment – to evaluate effectiveness of remedy
    - Groundwater monitoring wells
    - Piezometers for water level measurements
    - Sediment sampling equipment
    - Surface water sampling equipment

Concept

Under this alternative, sediments greater than 9.5 ppm tPAH/g dwt at 0.415% OC would be removed regardless of depth. In some areas, sediments as deep as ten feet would be removed. Sediment removal under this alternative would be conducted with excavators, mechanical dredges and hydraulic dredges. In some near shore areas, caissons could be constructed to

enable dewatering near shore areas, which would allow use of shore-based excavators to remove sediment. The efficacy of this latter approach could be determined during a pilot scale project.

Engineering controls would need to be implemented to minimize volatilization of VOCs during dredging. This can best be evaluated during a pilot scale project. During dredging operations, turbidity curtains and floating hydrocarbon booms or sheet piling, if necessary based on the results of a potential pilot study that would be conducted during pre-design phase, would be deployed to minimize dispersal of suspended sediments or floating free phase. Site restoration would include placing at a minimum six inches of clean fill/sand on all areas that have been dredged.

Removal is technically feasible for the Site, although several issues would have to be addressed in the design of a dredging alternative, including control of the release of free-phase product and dispersal and volatilization of VOCs during dredging activities, as well as management of dredging residuals and handling of a substantial amount of wood debris. Some aspects of the Site are more disposed to the use of mechanical dredges or excavators (e.g., debris removal), while other aspects favor hydraulic dredges, (e.g., capture of free phase and minimization of volatilization).

Implementation of Remedy

Mobilization/Demobilization

This includes mobilization and demobilization of all the equipment and facilities needed to implement this alternative.

Construction of Temporary Wave Attenuation Device

Wave dampening will be required to minimize dynamic forces on the containment wall that will enclose the near shore area. A partially assembled wave attenuator will be shipped to the Site on flat bed trailers. The device will be unloaded and placed onto a work barge for assembly along the proposed alignment. Installation along the alignment will occur by placing concrete dead-men along the alignment. The exposed rebar extending from the dead-men would be connected to metal shackles that are connected to a metal cable which connects to the metal rods on the wave attenuator. Adjustment of the cables length would be performed to maximize wave attenuation.

During winter the wave attenuator could remain in-place or be pulled below the surface of the water to a depth that would be below the bottom of the ice that customarily forms in the bay. After ice out in the spring, the attenuator could be returned to its initial position by adjusting the cable attached to the dead-men. At the completion of the project the attenuator could be anchored to the bottom or cleaned and sold.

A breakwater wall could also be utilized to minimize the wave action on the near shore area containment wall. In addition, if a breakwater wall is constructed, it could also be utilized as a

semi-permanent confinement system during the dredging of offshore sediments (as described in the "*Dredging of Offshore Sediments*" section below).

Containment Wall Installation

Landside containment wall construction will be performed by driving steel sheet piling that utilizes an interlock sealant to minimize seepage. The lake and landside sheet piling will be driven into the underlying Miller Creek formation approximately 20 feet and 5 feet, respectively. Prior to driving the sheet piling, an exploratory trench will be excavated along the land wall alignment to a depth of approximately 10 feet below ground surface to remove obstacles or debris that would prevent the sheeting from being installed.

The lakeside containment wall will be constructed from a barge by driving PZ-35 steel sheeting. Preliminary structural analysis of the PZ-35 wall system without the use of a breakwater wall indicates excessive deflections (around 12 to 14 inches of deflection at the top of the wall) when lateral forces from the lake waves are applied to the sheeting. Use of a wave attenuator or breakwater wall decreases the wall deflection to a more desired defection of approximately 6 inches or less. Decreasing wall deflection will also help reduce the volume of seepage through the wall located in the bay. The final design of the lakeside containment wall will be determined at the Remedial Design stage after geotechnical data is collected along the alignment.

Following completion of the containment wall system, the water within the containment will be removed using trailer mounted 500 gpm pumps. The discharged water from initial pumping within the containment wall will be transported via pipeline to the WWTP and processed with minimal treatment. Variable rate discharge pumps will be deployed to reduce the water content of the sediments within the containment. This water will also be piped to the WWTP and treated before discharge. Details of treatment will be developed during Remedial Design.

Excavation/stabilization/disposal of near shore sediments

The excavation of the wood debris in the near shore area will be performed with tracked mounted excavators and a crane equipped with a dragline and bucket. The excavated wood debris and some of the sediments that underlie the debris will be placed on the impermeable asphalt drying pad to allowing additional drainage of trapped fluids. The drained wood debris will be loaded into trucks for transport to the disposal facility or off-site facility for burning. Fluids collected at the drainage pad will be transferred to the WWTP and treated before being discharged.

The silty/clayey sediments underlying the wood deposits will be stabilized with reagents prior to being loaded onto trucks for disposal. The reagent(s) will be of a type that will help to absorb the majority of the remaining fluids within the silty/clayey sediments. Concrete Jersey barriers will be used to separate the stabilization activity from other activities. Stabilization of the sediments will be performed by using a compressor to transfer the reagent provided in tanker trucks to the stabilization area. Mixing of the reagent with the sediments will be performed

using an excavator bucket and/or bulldozers. The stabilized sediments will be loaded by excavator into trucks for transport to the disposal facility.

The underlying sandy granular sediments will be removed and placed on an asphalt drainage pad to allow additional drainage of fluids. The sandy material will be moved to the drainage pad using wheel mounted conveyors and/or tracked excavators and bull dozers. Drained sandy sediments will be loaded onto trucks for transport in closed watertight containers to a disposal facility. Fluids collected at the drainage pad will be transferred to the WWTP and treated before being discharged.

As with other sediment alternatives, controls for minimization of volatile releases are available for onshore operations; however, volatilization control for near shore dry excavation would have to be investigated further during the pre-design phase .

Dredging of Offshore Sediments

Sediments outside of near shore excavation area will be dredged using conventional dredging technology. Dredging operations further from shore will require a semi-permanent confinement system in the bay (e.g., sheet pile wall, breakwater wall) at the outer edge (north) of the Site work area to minimize dispersal of suspended sediments or floating free phase. The details of the system and exact requirements will be fully delineated during the pre-design phase and Remedial Design for the sediment remedy. Sediments in this area are less contaminated and have less debris than the near shore excavation area, therefore, it is anticipated that there will be less potential for dispersal of contaminated sediment. However, during dredging operations, turbidity curtains and floating hydrocarbon booms would be deployed to minimize dispersal of resuspended sediments or free-phase product.

During Remedial Design dredging performance objectives will be developed for allowable rates of sediment resuspension during dredging based upon water quality standards that are protective of ecological receptors. These will be used for operational control of dredging. Typically, performance objectives for resuspension are two or three-tiered and specify how dredging operations need to be modified if the action levels are exceeded.

Sections 12.3 and 12.4 of this ROD discuss dredging performance standards and the remedial approach for sediments, respectively, including specifying under what conditions re-dredging would be necessary.

Dredge material will be conveyed hydraulically or by barge to dewatering areas onshore.

After dredging is completed, six inches of clean fill/sand would be placed on areas that are dredged for purposes of providing lakebed stabilization. A side benefit is that it will also provide a better habitat for recruitment of benthic macroinvertebrates and for spawning of fish. The issue of dredged residuals management is discussed in Section 12.4.

Volatilization and Odor Control

There is a potential for volatilization during dry excavation of near shore sediments since areas would be exposed to the air. Although a dry excavation scenario was not explicitly modeled in the Air Emissions Treatability Study, volatiles could disperse beyond the immediate vicinity of excavation and onshore treatment operations, depending upon ambient weather conditions. With the proximity of a relatively large population in Ashland, this presents the possibility of unacceptable exposure unless volatiles can be controlled.

Engineering controls would need to be implemented to minimize volatilization of VOCs during dredging. The need for and design of engineering controls for volatilization would need to be evaluated during a pilot scale project.

Controls for minimization of volatile releases are available for dry excavation and onshore operations; however, volatilization control for operations on the water would likely have to be investigated further during a pilot scale project during pre-design, since tenting over working dredges on the water is difficult and would add complexity to maintaining efficient dredge production rates. Beyond controls that can be employed by the dredge operator to minimize exposure of sediment to air there is little precedent for implementing engineering controls for volatilization at the dredge platform. Dredging areas with a high potential for release of volatiles during cooler periods of the year or when winds are predominantly offshore also may help minimize transport of volatiles to residential areas. However, it is likely that dredging will be shut down in the colder months of the year and wind directions in the Ashland area are variable and sometimes unpredictable.

Sediment Dewatering

Dewatering of the sediment will be performed using variable rate discharge pumps that are placed in sumps pits located within the containment area and adjacent to the outermost containment wall. Additional drainage of wood debris and sandy granular sediments will be provided by placing these materials on the asphalt drainage pad built at the Kreher Park area. Sediment dewatering and seepage through the containment wall are estimated at 7,000 gal/day.

Wastewater Treatment

Water treatment includes bag/sand filtration, oil/water separation, adsorption with activated carbon filter and related testing for O&M and discharge. Most of the systems are closed and should have minimal impact on air emissions. Discharge will be to the City of Ashland WWTP or to Lake Superior if it meets WDNR water quality criteria. Estimated total treatment quantity for the dredge in the dry option is 60,000,000 gallons. The total treatment volume is based on a project duration of 2 years.

Sediment Treatment

Sediment treatment includes either stabilization for disposal in a NR 500 permitted landfill or alternatively, thermal treatment before land filling in a solid waste landfill. Both processes have

the potential to create some emissions in handling the dewatered sediment feed to the stabilization or thermal treatment systems. However, there is likely much lower emissions associated with sediment treatment than with the dewatering operations unless there is an upset in the operations. HTTD is again assumed to be the most cost effective thermal method and is the basis for cost estimates for thermal treatment at this time. However additional design testing would be needed to evaluate this choice.

Sediment Disposal

The disposal process will include the loading of sediment following drying and treatment/stabilization at the Site, and transportation to a commercial/industrial landfill or NR 500 permitted landfill. Several scenarios were evaluated for this option, assuming a sediment quantity of 133,000 cy based upon the sediment PRG. For purposes of cost estimation it is assumed one cubic yard of sediment will weigh 1.5 tons.

Other Disposal Alternatives

NSPW also may initiate siting of landfill per chapter NR 500 requirements in the Ashland area for solid materials removed from the Lakefront Site. This disposal option is dependent on the material volume. An analysis of siting a landfill per chapter NR 500 requirements in the Ashland area is presented in Appendix H of the FS.

Ancillary Solid Wastes

Waste such as PPE, construction debris and other types of solid wastes generated during the conduct of remedial activities can be disposed of at a local municipal landfill. The quantity generated will depend on the remedial alternative. PPE will be evaluated and handled in accordance with EPA guidance document to handle investigation derived waste (EPA 2007).

Wood Waste

Under this alternative there is the potential for generating a substantial quantity of wood waste. The wood waste ranges in size from sawdust and chips to timber. Potentially, the larger debris could be burned as fuel at the NSP Bayfront Power Plant located in Ashland. Some additional maintenance at the plant would be required to accommodate the wood debris but this is considered a viable option at this time and will evaluated further during remedial design.

Kreher Park and Upper Bluff/Filled Ravine: For soils, Alternative S-5A – Limited soil/ source removal with ex-situ thermal treatment. Excavated soil would likely be treated on site by a mobile unit. Debris must be separated by size from material suitable for thermal treatment and transported off site for disposal. Consequently, wood waste at Kreher Park and fly-ash and cinders in the Filled Ravine at the Upper Bluff area must be separated from NAPL-contaminated material encountered in these areas. Thermal treatment by LTTD or HTTD will be completed for suitable NAPL-contaminated fill material, and contaminated material not suitable for thermal treatment will be transported off-site for disposal. Fill material including fly ash and cinders that is not contaminated with VOC and PAH compounds will be returned to the excavation.

Thermal treatment will be performed on suitable fill material from areas with the highest levels of contamination. This includes the former gas holder area at the Upper Bluff, the NAPL in the Filled Ravine and contaminated soil encountered above the wood waste layer at Kreher Park; the underlying wood waste layer would not be suitable for thermal treatment. Key elements of the conceptual design for ex-situ thermal treatment of material removed from these areas follows:

1. A mobile unit and ancillary equipment will be set up at Kreher Park because inadequate space is available at the Upper Bluff area.
2. Demolition of the center section of the NSPW service center for excavation south of St. Claire Street will be required to access contaminated soil beneath this building at the Upper Bluff area.
3. Removal of existing asphalt pavement in the alley and courtyard area will also be required.
4. All shallow water table wells screened in the fill soil unit will be abandoned prior to excavation. Piezometers screened in the underlying Copper Falls aquifer will be protected during excavation and backfilling activities and remain in place for future use.
5. Removal will include the excavation of soil containing NAPL, and the removal of buried structures (i.e. former gas holders) at the Upper Bluff area south of St. Claire Street. This area includes the excavation of unsaturated and saturated zone soils to a depth between 12 and 15 feet for an area approximately 130 feet by 130 feet, yielding between 7,600 and 9,400 cubic yards. Also included for removal will be soil containing NAPL in the Filled Ravine on the north side of St. Claire Street. This will include the excavation of saturated zone soil from the bottom five feet of the Filled Ravine where the clay tile and NAPL were encountered. At the surface, this excavation area will be approximately 30 by 75 feet wide. An estimated 75 to 150 cubic yards of NAPL-contaminated soil will be removed from the base of the Filled Ravine.
6. Removal will also include the excavation of unsaturated and saturated zone soils at the former coal tar dump area. This includes approximately 5 feet of contaminated soil in an area approximately 260 feet by 100 feet, yielding approximately 4,800 cubic yards.
7. Deep excavations or excavations completed near facility buildings may require shoring to support sidewalls.
8. Groundwater seeping into the excavation will be collected, temporarily placed in holding tanks, and treated by the on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
9. Saturated and unsaturated zone material will be thermally treated to reduce contaminant mass and toxicity and returned to the excavation as backfill. Material unsuitable for thermal treatment will be transported off site for landfill disposal. Fill material not contaminated with VOC and PAH compounds will be returned to the excavation as backfill.
10. Site restoration at the Upper Bluff area will include the installation of new asphalt pavement as a surface barrier over the excavated area on both sides of St. Claire Street, and new asphalt pavement at the gravel covered courtyard area on the north side of the street. The existing street (inspected for water tightness and sealed or replaced as

needed) and new asphalt pavement on the NSPW property will prevent exposure to fill material beneath St. Claire Street and the NSPW storage yard.

11. Site restoration at Kreher Park will include backfilling excavated areas with clean fill material and installation of a new RCRA Subtitle D (ch. NR 500) cap over the excavated area.

Long-term operation and maintenance of backfilled areas will include groundwater monitoring, cap maintenance including the periodic inspection and repair of all asphalt and soil caps.

For groundwater, Alternative GW-2A - Containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control. Containment for groundwater contamination consists of engineered surface barriers, vertical barrier walls installed in the aquifer, and extraction wells (hydraulic barrier wells). Surface barriers eliminate the direct contact exposure pathway. They also can reduce contaminant leaching from the unsaturated zone, by restricting infiltrating water from contacting contaminated soil at areas where contaminated soil is present. Vertical barrier walls and barrier wells prevent the off-site migration of contaminants with groundwater. Institutional controls will be implemented as part of this remedial response to prevent exposure to groundwater contamination remaining within the contained area until such time as groundwater cleanup standards are achieved. Long-term operation and maintenance will include groundwater monitoring to confirm contaminants are not migrating from the contained area. This will include fluid level monitoring and groundwater extraction to ensure the hydraulic head within the confined area remains at or below lake level.

Engineered surface barriers, vertical barrier walls, and barrier wells are described below.

Engineered Surface Barriers

Engineered surface barriers are considered passive containment alternatives because the contaminated zone is not disturbed, and only minimal maintenance is required following implementation. Surface barriers include the following:

- Asphalt cap;
- Low permeability soil cap (i.e. 2 feet of clay with hydraulic conductivity of less than 10^{-7} cm/sec);
- Multi-layer cap with a minimum two-foot thick clay barrier, drainage layer, soil and vegetated top soil cover; and
- Multi-layer cap with geomembrane (a minimum two-foot thick clay barrier, geomembrane, drainage layer, soil and vegetated top soil cover.

At the Upper Bluff area, asphalt caps over the Filled Ravine as surface barriers will be compatible with existing and future site use. At Kreher Park, a low permeability soil cap could be placed over the entire 11.6 acre parcel, but installation of a clay cap over the entire park will require the removal of the existing marina parking lot, Marina Drive, and the former WWTP. New asphalt roads, parking lots, and/or slab on grade buildings could be then constructed on top of a larger cap, or installed at select areas in place of a cap for the entire park. These smaller surface barriers will be designed to be compatible with existing and future site use, and include

asphalt pavement for the marina parking lot and a low permeability cap for the former coal tar dump. Asphalt pavement over the gravel covered marina parking lot will reduce infiltration at this area. A surface barrier over the former coal tar dump area will reduce contaminant leaching from the unsaturated zone if contaminated soil remains in place. If the WWTP is removed, a clay cap or asphalt pavement could be installed at this area.

Multi-layer caps will be compatible with on-site areas of unexcavated soil, especially at Kreher Park. Single layer asphalt and low permeability caps will meet 40 CFR Subtitle D requirements, and multi-layer caps will meet 40 CFR Subtitle C requirements.

Groundwater Extraction/Barrier Wells

Barrier wells are considered active hydraulic containment alternatives. Long-term operation (groundwater extraction), maintenance, and monitoring will be required. Down gradient barrier wells will be used for groundwater at the Upper Bluff and for the saturated fill unit at Kreher Park. These wells will prevent contaminants from migrating off site with groundwater.

Vertical Barrier Walls

Vertical barrier walls consist of a slurry wall or sheet piling installed around the perimeter of the contaminated groundwater zone. A slurry wall is a low permeability barrier constructed by placing a low permeability material (slurry) in a trench around the perimeter of the contaminated groundwater mass. Sheet piling will consist of inter-locking sheets of steel pilings that form a continuous wall installed around the perimeter of the contaminated groundwater mass.

For shallow groundwater, both types of vertical barriers could be anchored into the underlying low permeability Miller Creek Formation to create a barrier that will prevent contaminants in the shallow fill units from migrating off site with groundwater. However, because groundwater in the Filled Ravine discharges to Kreher Park, vertical barriers will be used to funnel groundwater from the Filled Ravine to Kreher Park, which will be enclosed by vertical barrier walls. Engineered surface barriers will be used with vertical barriers to minimize groundwater recharge to contained areas from infiltration. Key elements for the conceptual design of a sheet pile vertical barrier wall around the perimeter of Kreher Park follows:

1. Site preparation will include clearing and grubbing of small trees and bushes along the bluff and near the former seep area as needed.
2. Although the former wastewater treatment plant will be located within the contained area, demolition of this dormant facility may be required.
3. A vertical barrier wall will be placed around the perimeter of Kreher Park. This vertical barrier will consist of a sheet pile wall anchored into the underlying Miller Creek Formation.
4. The sheet pile wall along the shoreline will be installed at an approximate depth of 25 feet below existing grade to allow the off-shore removal of sediment to a depth of ten feet adjacent to the sheet pile wall. The sheet pile wall on the south, east, and west sides of Kreher Park will be installed at an approximate depth of 16 feet below existing grade.

5. Surface barriers will be installed over the Filled Ravine to minimize groundwater recharge from infiltration, and the sheet pile wall on the south side of Kreher Park will terminate on the east and west flanks of the Filled Ravine to create a "funnel" for shallow groundwater discharge into Kreher Park.
6. A groundwater diversion trench will be installed between the remainder of the south wall and the Upper Bluff area to divert groundwater that currently seeps from the Upper Bluff area into the Kreher Park fill unit.
7. At Kreher Park, site restoration will include installation of new asphalt pavement over the marina parking lot to minimize infiltration in this area. Additionally, a low permeability soil cap will be placed over the former coal tar dump area, and if applicable, a soil cap over the disposal cell.
8. Regrading and a storm water basin will be constructed within the confined area to manage storm water and restrict infiltration. The storm water basin will be lined to minimize seepage.
9. Long-term operation and maintenance of the facility will include the removal of contaminated groundwater, and annual inspection of surface barriers. A minimum of 15 groundwater extraction wells will be installed to remove groundwater and reduce the hydraulic head within the confined area. Contaminated groundwater will be conveyed to a treatment system constructed on-site prior to discharge to a sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
10. The treatment system will include an oil water separator, transfer pumps, and air stripper. This remediation equipment will be housed in a small on-site treatment building.

In-Situ Chemical Oxidation

In addition to the remedial components described above, in-situ chemical oxidation (GW-6) can be used to possibly enhance groundwater treatment. This will be determined during the pre-design phase. Chemical oxidation introduces strong oxidizing chemicals such as permanganate and peroxide into the subsurface to degrade VOCs and PAH compounds to CO_2 and H_2O end products. Permanganate or peroxide could be injected as liquid reagents through boreholes, wells, or mixed with a backhoe in shallow trenches. Chemical oxidation has an added benefit of enhancing biodegradation by increasing oxygen concentrations in the subsurface. Chemical oxidation could be performed on saturated and unsaturated zone soils by injecting chemicals into the subsurface via borings or wells.

In-situ chemical oxidation could be used for unsaturated and saturated zone contamination at the Upper Bluff. However, existing conditions at the Upper Bluff area (the NSPW facility building and buried gas holders) and at Kreher Park (wood waste layer) may limit implementability. Mixing reagent in shallow trenches would be the most effective treatment method at Kreher Park because contamination is present at shallow depths at the former coal tar dump area, and would be easily accessible. Because in-situ chemical oxidation reactions can result in the generation of off-gases, primarily CO_2, passive venting or an active SVE system may be required to capture off-gases. The presence of NAPL may require multiple applications to lower contaminant concentrations to acceptable levels. Key elements for the conceptual design for in-situ chemical oxidation for shallow soil and groundwater at the Site follow:

1. Demolition of the center section of the NSPW service center south of St. Claire Street would be required to access contaminated soil beneath the building at the Upper Bluff area.
2. Between 200 and 300 injection borings would be advanced in the Filled Ravine using a direct push drill rig.
3. It is assumed that approximately 1,500 gallons of reagent would be injected into each boring.
4. Injections would be completed in a controlled manner and monitored to ensure that reaction off-gases do not create unsafe conditions (i.e. explosive conditions). A minimum of 10 passive vent wells would be installed in the Filled Ravine to allow off-gases to escape, which would minimize the subsurface migration of gases. Each vent well would be installed to an approximate depth of 20 feet with well screens 10 feet in length. Because the water table would intersect the well screen, these wells may also be used to recover fluids that rise to the surface in response to chemical reactions taking place in the subsurface. Recovered fluids would be placed in a holding tank and discharged to the on-site treatment system.
5. Site restoration at the Upper Bluff area would include replacement of existing asphalt pavement and new pavement over the footprint of the demolished building south of St. Claire Street. New pavement on the north of St. Claire Street would also be installed to prevent infiltration into this section of the Filled Ravine.
6. At Kreher Park, site preparation would include clearing and grubbing small trees and bushes along the bluff and near the former seep area as needed.
7. Chemical oxidation at Kreher Park would be completed above and in the wood waste layer where DNAPL is encountered and at the former coal tar dump area by mixing reagent in a shallow excavation.
8. Additionally, between 100 and 150 injection borings would be advanced at the former seep area and near TW-11 where DNAPL has been encountered. A direct push drill rig would be used to advance these borings, and approximately 1,500 gallons of reagent would be injected into each boring. Existing wells MW-7 and TW-11 would be used as passive vent wells in these areas.
9. Site restoration would include installation of new asphalt pavement over the marina parking lot and a low permeability soil cap over the former coal tar dump area to minimize potential exposure to subsurface contamination and minimize infiltration.
10. Regrading and a storm water basin would be constructed within the confined area to manage storm-water and restrict infiltration.
11. Multiple applications may be needed to reduce contaminant levels to the extent practicable. Two applications were assumed for cost-estimating purposes. The first application would be completed in a regular grid pattern over the treatment area, but additional applications would be completed within the treatment area as needed.

Although chemical oxidation applications can be completed within a short period of time, the groundwater extraction system may be operated for several years. Long-term groundwater monitoring to evaluate natural attenuation and institutional controls would be included with this remedial response.

Copper Falls Aquifer: Alternative GW-9B – NAPL Removal using Enhanced Groundwater Extraction System. Groundwater extraction uses water as a carrier to remove both NAPL and dissolved phase contamination. The existing interim groundwater extraction system currently extracts groundwater from one well installed at the mouth of the Filled Ravine, and groundwater and DNAPL from three low-flow wells installed in the underlying Copper Falls aquifer. Enhanced removal at the Upper Bluff area will include installation of additional low-flow extraction wells in the Copper Falls aquifer to increase DNAPL removal rates, and continued operation of existing wells EW-1, EW-2, and EW-3. This will also include continued operation of EW-4. Key elements for enhanced groundwater and NAPL extraction in the Upper Bluff area follow.

1. A minimum of 12 extraction wells will be installed in the Copper Falls aquifer.
2. Installation of lateral piping between each extraction well and the existing treatment building.
3. Replacement of existing asphalt pavement south of St. Claire Street and new pavement north of St. Claire Street will be installed to reduce infiltration into the ravine fill.
4. Recovered fluids will be treated on site prior to discharge to the sanitary or storm sewer. NAPL that is separated from the recovered fluids will be sent off-site for treatment and disposal. Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit. This will require upgrades to the existing treatment system (i.e. new oil water separator, and air stripper for increased volume).

The groundwater extraction system at the Upper Bluff area may be operated for an extended period of time. Long-term groundwater monitoring will be required to evaluate natural attenuation and institutional controls will also be implemented as part of this option. Based on the historical operation of the existing system, a combined groundwater extraction rate of two to three gallons per minute (gpm) was used to evaluate long-term operation and maintenance costs. Additional wells will result in an increase of the combined flow rate to 10 to 15 gpm, which will require an upgrade to the existing treatment system.

In addition, implementation of in-situ chemical oxidation (GW-6) for the underlying Copper Falls would be more extensive; it may require groundwater extraction rather than soil vapor extraction. EPA's SITE program completed a demonstration pilot test to fully evaluate the implementability of this alternative at the Site. This will be determined during the pre-design phase. Chemical oxidation may also increase the mobility of NAPL recovered by extraction wells resulting in the removal of significant contaminant mass in a short time frame. Preliminary results from the SITE program pilot test indicate that injection into areas with NAPL contaminants resulted in an initial vigorous reaction followed by an increase in the mobility and recovery of NAPL. Key elements for the conceptual design for in-situ chemical oxidation for the Copper Falls aquifer follow:

1. Between 250 and 500 injection borings would be advanced in the Copper Falls aquifer using a direct push drill rig.
2. It is assumed that approximately 1,500 gallons of reagent would be injected into each boring.

3. Existing extraction wells EW-1, EW-2, and EW-3 would continue to operate during and after reagent injection.
4. A minimum of 7 additional extraction wells would be installed in the Copper Falls aquifer in borings advanced with hollow stem auger using a rotary drill rig.
5. Recovered fluids would be treated on site prior to discharge to the sanitary or storm sewer. This would require upgrades to the existing treatment system. Discharge to the sanitary sewer system would require approval from the City wastewater treatment plant, and discharge to a storm sewer would require a WPDES permit.
6. Multiple applications may be needed to reduce contaminant levels to the extent practicable. Two applications were assumed for cost-estimating purposes. The first application would be completed in a regular grid pattern over the treatment area, but additional applications would be completed within the treatment area as needed.

Although chemical oxidation applications can be completed within a short period of time, the groundwater extraction system may be operated for several years. Long-term groundwater monitoring to evaluate natural attenuation and institutional controls would be included with this remedial response.

Ozone Sparging

Ozone sparging is an in-situ chemical oxidation technology that can be used to oxidize and degrade contaminants in groundwater. Because ozone is a gas, it can be injected into the saturated zone as a gas via sparging. Sparging consists of injecting air or oxygen rich ozone into an aquifer as a gas through small diameter sparge wells. Commercially, ozone is generated by a high voltage discharge through air or oxygen in an ozone generator. Generally, yields are on the order of 1 to 3-percent ozone by volume in air and 2 to 6-percent ozone by volume in oxygen. In water, ozone decomposes to form free radicals. These free radicals are strong oxidizers and react with contaminants in water to form carbon dioxide and water. As an additional benefit, ozone treatment increases the dissolved oxygen level in the water when any un-reacted free radicals combine to form water and oxygen; the dissolved oxygen content in groundwater promotes biodegradation of contaminants.

Ozone sparging is typically used for dissolved phase contamination, but is typically not used in areas where NAPL is present. If used for NAPL contamination, groundwater extraction will likely be needed because ozone/air injection may displace NAPL and/or cause a chemical reaction increasing the mobility of NAPL. This mobilized material is then recovered via extraction wells. It will be determined during pre-design whether ozone sparging will be used for the Copper Falls aquifer. Key elements for the conceptual design of an ozone sparging system follow:

1. All sparge wells would be installed in soil borings advanced with a hollow stem auger by a rotary drill rig.
2. Sparge wells would be installed on approximate 50-foot diameter centers, and one control panel will inject ozone into a cluster of 12 sparge wells.
3. Six control panels would be needed for groundwater in the underlying Copper Falls aquifer.

4. All air lines between the sparge wells and control panels would be buried in shallow trenches.
5. For the Copper Falls aquifer, the groundwater extraction system would be operated concurrent with the ozone sparge system to recover NAPL.

The ozone sparge system may need to be operated for several years. Long-term groundwater monitoring would be required to evaluate the effectiveness of the sparging and subsequent natural attenuation, and institutional controls would be included with this remedial response.

Conduct O&M and Long-Term Monitoring: Collect groundwater samples to ensure contaminants are not migrating off site or from the contained area with groundwater. Fluid levels within the contained area will also need to be monitored to ensure that groundwater remains at or below the design elevation. Complete annual inspections to ensure the integrity of surface barriers and repair damage as needed. Conduct MNR monitoring of sediments. The long-term monitoring will evaluate achievement of the specified action levels and will ascertain whether the remedial actions objectives were achieved. The sampling endpoints, monitoring frequency and criteria will be part of the approved O&M plan.

Institutional Controls: Implement land use controls as provided under chapter 292 of the Wisconsin Statutes, as part of the remedial action to prohibit use of contaminated groundwater and restrict use of land at the Filled Ravine, Upper Bluff and Kreher Park to prevent exposure to contaminants that remain in groundwater and soil after implementation of the remedial action. Institutional controls to prohibit use of groundwater will be required until groundwater cleanup goals are achieved.

Institutional Controls (ICs) are necessary to prevent interference with the remedy and to reduce human or ecological receptors' exposure to contaminants. ICs are defined as non-engineered instruments, such as administrative and legal controls, that help minimize potential for exposure to contamination and protect the integrity of the remedy. ICs are also required to assure long-term protectiveness for those areas that do not allow for unlimited use and unrestricted exposure. ICs are also required to maintain the integrity of the remedy. At this Site, ICs are required to protect the cap (engineered remedy), and reduce potential exposure for all areas where residual contamination will remain. Also, interim ICs may be necessary to prevent exposure to contaminants which may be released during construction activities such as dredging, capping and placing of covers. Long-term protectiveness requires compliance with effective ICs. Hence, effective ICs must be implemented, monitored and maintained.

Institutional controls will be identified as part of the remedial design process in an Institutional Control Implementation and Assurance Plan (ICIAP) for review and approval by EPA and WDNR. The required ICs may include property use controls (such as easements and restrictive covenants), governmental controls (including zoning ordinances and local permits), and informational devices (including signage and fish consumption advisories). The ICIAP shall identify parties responsible (i.e., federal, State or local authorities or private entities) for implementation, enforcement, and monitoring and long-term assurance of each institutional control including costs, both short-term and long-term, and methods to fund the costs and responsibilities for each step.

The ICIAP shall include maps, which shall describe coordinates of the restricted areas on paper and provide shape files in an acceptable GIS format (i.e., NAD 83) depicting all areas that do not allow unlimited use/unrestricted exposure, where dredging is not allowed, and areas where ICs have been implemented along with a schedule for updating them. The maps and information about the ICs shall be made available to the public in at least several ways, such as a website that is easily accessible to the public and posted in the public library. In addition the ICIAP shall identify reporting requirements associated with each institutional control which shall include at a minimum an annual certification to EPA regarding the status and effectiveness of the ICs. The ICIAP shall also provide additional information to the public to assure protectiveness of the remedy (such as fish consumption advisories).

12.3 Performance Standards for Selected Sediment Remedy

The following table shows the relationship between the RAL and the overall cleanup goal for the selected sediment remedy, which is based on a surface weighted average concentration (SWAC).

Relationship Between Remedial Action Level and Cleanup Goal

	Concentration	Concentration Based on Organic Carbon Content of 0.415%*	Requirement
Remedial Action Level (RAL)	2,295 ug tPAH/g OC	9.5 ppm	Excavate/dredge (depending on area) all sediments exceeding the RAL, as determined by the characterization data collected during the RI and/or additional pre-design sampling.
Cleanup Goal (SWAC)	2,295 ug tPAH/g OC surface weighted average concentration across entire remedial footprint No sample to exceed 5,324 ug tPAH/g OC (also known as the "not-to-exceed threshold")	9.5 ppm surface weighted average concentration across entire remedial footprint No sample to exceed 22 ppm (also known as the "not-to-exceed threshold")	SWAC to be measured following excavation/dredging actions, but prior to placement of lakebed stabilization layer. SWAC to be reconfirmed following placement of lakebed stabilization layer.

* Based on the data collected during the RI, 0.415% OC was determined to be the best representation of the OC content of the existing sandy-type sediments at the site. The sediments that will be present at the site following completion of the excavation/dredging actions is anticipated to be similar to those upon which the 0.415% OC determination was based, but will need to be evaluated. If the OC content of the top layer of sediments is lower than 0.415%, then a cleanup goal of 9.5 ppm for those sediments would not be protective. If necessary, the 9.5 ppm cleanup goal will be adjusted based on the OC content of the sediments so that the 2,295 ug/g OC cleanup goal is achieved.

The sediment remedy implemented at the Site shall meet the following performance standards, or other equivalent performance standards approved by EPA:

- All NAPL source material shall be removed.
- All targeted sediments with PAH concentrations exceeding the RAL, as determined by the characterization data collected during the RI and additional pre-design sampling data, shall be excavated/dredged (depending on the area).
- Upon completion of excavation/dredging activities and prior to placement of a lakebed stabilization layer, the SWAC cleanup goal (including the not-to-exceed threshold) shall be achieved, averaged across the entire remedial footprint.
- For dredging actions, surface water quality standards, as identified as ARARs, shall not be exceeded outside the containment area(s) or turbidity curtains and floating hydrocarbon booms, including releases of NAPL sheens and/or turbidity. (A pre-design pilot test is needed to determine whether turbidity curtains and floating hydrocarbon booms are sufficient to control releases during dredging in the further offshore areas, or whether sheet piling is needed to contain the area(s) being dredged. Sheet piling must be used for any dredging, including pilot test dredging, within the heavily-contaminated near shore area.)
- For dredging actions, surface water quality standards, as identified as ARARs, shall be achieved within and throughout the containment area(s) prior to any water within the containment area(s) being released to the larger water body.
- Air quality standards, as identified as ARARs, shall not be exceeded outside the exclusion zone (work/handling) or during the transport of contaminated media.
- All local, state and federal permitting requirements, if necessary, shall be followed.
- Sediment, wood debris, NAPL, carriage and contact water, and waste generated by the project shall be managed to prevent the release of contaminants and potential contamination off-site to land and waters.
- Following the achievement of the sediment cleanup goal, the lakebed throughout the remedial footprint shall be stabilized with a suitable granular material (sand/gravel) approved by EPA and WDNR.
- Any waste that is to be discharged to a publicly-owned treatment system shall meet all requirements set forth in that facility's permit including pretreatment standards.
- Appropriate measures to control airborne particulate matter shall be taken during all excavation/dredging and materials handling activities.
- Local, state, and federal noise pollution requirements shall be met.
- All investigation derived waste shall be handled in accordance with EPA guidance and EPA's offsite rule.

As described above, the overall goal of the sediment cleanup is to achieve the SWAC cleanup goal following excavation/dredging, prior to the placement of the lakebed stabilization layer. (The SWAC is then to be reconfirmed following placement of the lakebed stabilization layer.) However, in the event that the SWAC cleanup goal cannot be met prior to placement of the lakebed stabilization layer, despite the utilization of best efforts and best available excavation and dredging technologies and techniques (as determined by EPA and WDNR), the Agencies may decide to allow use of the lakebed stabilization layer as a sediment residual cover to assist in meeting the SWAC.

12.4 Remedial Approach for Sediments

The remedy adopts sediment removal (discussed below) as the remedial approach for sediments exceeding the RAL.

- **Sediment removal requirements.** All sediment with total PAH concentrations exceeding the RAL, as determined by the characterization data collected during the RI and additional pre-design sampling, will be targeted for removal in Chequamegon Bay. More specifically, in each sediment removal area, sediment shall be removed to a target elevation that: (1) encompasses all contaminated sediment exceeding the RAL, including an overdredge allowance, as appropriate; and (2) removes additional sediment to ensure that side slopes are stable for the remaining sediment.

- **Sediment removal methods and precautions.** The more heavily contaminated near shore sediments, which contain NAPLs and have the greatest amount of wood debris, shall be removed in the dry using conventional excavation equipment. Excavation in the dry will require the construction of impermeable barriers such as steel sheet piling to enclose the area(s) to be excavated, and dewatering within those area(s). The less contaminated sediment further from shore will be removed using mechanical or hydraulic dredging equipment or other appropriate sediment removal technologies. Dredging operations further from shore will require a semi-permanent confinement system in the bay (e.g., sheet pile wall, breakwater wall) at the outer edge (north) of the Site work area to minimize dispersal of suspended sediments or floating free product. The details of the system and exact requirements will be fully delineated during the pre-design phase and Remedial Design for the sediment remedy. In addition, during dredging operations turbidity curtains and floating hydrocarbon booms will be deployed to minimize dispersal of resuspended sediments or free product. Using only silt curtains and hydrocarbon booms during dredging operations further from shore will not likely provide adequate protection to keep contamination from being released from the Site and entering Chequamegon Bay and Lake Superior outside the Site boundaries, and therefore, a sound containment system (i.e., sheet pile, breakwater) will be necessary to protect the waters of Chequamegon Bay and Lake Superior. If sheet piling is utilized, the sheet pile will not be removed until water concentrations within the enclosure have returned to ambient or protective levels. Kreher Park will be used as a staging area for sediment removal activities.

- **Sediment dewatering, water treatment and disposal.** Thermal desorption of sediment may be needed to pre-treat contaminated media prior to off-site disposal. The on-site treatment of contaminated sediment will reduce the volume of material transported off-site for disposal if used as backfill for excavated areas.

  Superfund cleanups are required to meet substantive discharge requirements of the Clean Water Act, but National Pollutant Discharge Elimination System (NPDES) permits are not required for on-site work. Thus, water generated by dredging and dewatering operations will be treated prior to discharge back to the Lake and will meet all state and federal water quality standards. Such treatment may include (but is not limited to) bag filter and granulated activated carbon (GAC) treatment. Treated water will be sampled and analyzed to verify compliance with the appropriate discharge requirements.

  The existing treatment system at the Upper Bluff can be utilized to treat wastewater generated during dewatering activities. The rate of water removed from the dewatering will likely exceed the influent treatment rate, but storage tanks can be used for temporary water storage. However, this system will not be adequate to treat wastewater generated from sediment dewatering. Dredged sediment will require dewatering and stabilization prior to treatment and/or off-site disposal. This will require temporary on-site wastewater treatment. Equipment used for treatment of wastewater resulting from sediment dewatering can also be used to treat groundwater recovered during excavation dewatering activities, and later can be used for the long-term treatment of groundwater at Kreher Park.

- **Post-removal confirmatory surveys and sampling.** After removal of sediments from a particular area, surveys and sampling in the area will be done to determine whether the sediment removal requirements specified above are met. The post-removal surveys and sampling will initially be conducted when the party implementing the remedy believes it has removed the sediments to the specified targeted elevation. If the surveys and/or sampling shows that the sediment removal requirements (including the sediment cleanup goal) are not met in an area, then additional sediment in the area shall be removed until compliance with the sediment removal requirements is achieved. If, despite the utilization of best efforts and best available excavation and dredging technologies and techniques (as determined by EPA and WDNR), the sediment cleanup goal cannot be met, then post-removal dredge residuals management measures may be needed, and the Agencies may decide to allow use of the lakebed stabilization layer as a sediment residual cover to assist in meeting the SWAC cleanup goal.

  <u>Sampling of Dredged Areas</u>

  Definitions: For purposes of this ROD, "generated residuals" means sediment that, as a result of dredging operations, is resuspended and re-deposited on the surface of the newly-dredged area (e.g., within the top six inches of the sediment). The term "undisturbed residuals" (also known as "undredged inventory") means sediment that is more than six inches below the sediment surface in a newly dredged area.

Sampling: The post dredge core samples will extend at least twelve inches into the sub-aqueous material. The samples to be analyzed will be a top 6-inch layer representing the generated residuals layer and extending the full 6 inches (i.e., the 0 to 6 inch depth from the top of the post-dredge sediments), and a second 6-inch layer representing the top of the undisturbed residual (undredged inventory) layer (i.e., the 6 to 12 inch depth from the top of the post-dredge sediments). Both samples will be composited and analyzed separately.

- **Post-removal residuals management for dredged areas**

If post-dredging confirmatory sampling detects generated residuals with tPAH concentrations that will not allow the SWAC cleanup goal over the entire remedial footprint to be met, or if any sample of generated residuals exceeds the not-to-exceed threshold: or if confirmatory sampling results of the undisturbed residuals exceed the RAL: or if evidence of residual free product in the form of sheen or globules are present in the samples, then the following actions will be taken:

  - Generated residuals with a tPAH concentration greater than the not-to-exceed threshold at any sampling location must be removed (typically by hydraulic re-dredging) until the not-to-exceed threshold is met, and/or additional generated residuals must be removed until the SWAC cleanup goal over the entire remedial footprint can be met.

  - Undisturbed residuals with a tPAH concentration exceeding the RAL at any sampling location must be removed (typically by re-dredging) in accordance with the sediment removal requirements specified above.

  - Generated or undisturbed residuals showing evidence of free product shall be removed until all NAPL material is removed and sampling shows no evidence of free product.

- **Other Features of the Sediment Remedy**

  - **Site Preparation.** Staging areas will be required for facilities associated with sediment dewatering, sediment handling, and water treatment. Specific staging areas will be identified during the remedial design process. Site preparation at the staging areas will include collecting soil samples, securing onshore property equipment staging, and constructing necessary onshore facilities for sediment management and transportation. Docking facilities for dredging equipment and ancillary equipment may need to be constructed and multiple staging areas may be necessary. Preparation for remedial actions shall also include obtaining needed access agreements and landfill disposal agreements, if necessary.

  - **Demobilization and Site Restoration.** Demobilization, site restoration, and decontamination of all equipment will require removing all equipment from the staging and work areas and restoring the Site to a condition acceptable to EPA,

WDNR and the property owner. The sheet piling placed in the Chequamegon Bay will be removed only after contaminant concentrations within the enclosure have returned to ambient conditions or below protective levels.

- **Long-term monitoring of surface water, sediment, lakebed stabilization layer, fish and benthic community.** Although the SWAC cleanup goal is to be achieved immediately upon successful implementation of the remedy, long-term monitoring of surface water and sediment is required to ensure that the containment components of the land-based remedy are functioning properly and not releasing additional contamination into the bay. Long-term monitoring and maintenance of the lakebed stabilization layer is also required to ensure its integrity over time. In addition, fish sampling and benthic community surveys are required to assess the effect of the sediment cleanup on those communities. A detailed Long-Term Monitoring and Maintenance Plan, specifying the types and frequency of monitoring and maintenance, will be developed during the remedial design process.

12.5 Description of Alternate Sediment Remedy

As mentioned above in Section 12.2, if a pre-design pilot test for wet dredging of the near shore area is conducted and indicates that dredging rather than dry excavation within the near shore area will attain the established performance standards and can be conducted in a manner protective of human health and the environment, then EPA, in consultation with WDNR, will recommend that an alternate sediment remedy (Alternative SED-4, dredging) be selected. A more detailed description of Alternative SED-4 is included in Appendix N-2. The remaining components of the remedy for Kreher Park, Upper Bluff/Filled Ravine, and the Copper Falls aquifer would be the same as described in Section 12.2 of this ROD.

Alternative SED-4 would remove wood debris from sediments and mechanically or hydraulically dredge sediments that exceed the RAL. After dredging is completed, six inches of clean fill/sand will be placed on dredged areas for lakebed stabilization. Precautions will be taken to ensure that the contaminated sediments do not impact the underlying soil in the sediment staging area. Dewater and stabilize sediments at Kreher Park area and treat wastewater to meet state and federal discharge limits; discharge treated wastewater to the lake. Transport stabilized sediments off-site to NR 500 licensed landfill or thermal treatment. Dispose or burn wood debris separately. Alternative SED-4, if selected as the sediment remedy in an ESD, would use the same performance standards and remedial approach as described in Sections 12.3 and 12.4 of this ROD.

A description of the pre-design pilot test for wet dredging of the near shore areas, if such a pilot test is to be conducted, as well as the performance standards that would be used to judge the success of such a pilot test, are contained in Section 12.6 below.

12.6 Pre-design Pilot Test for Dredging of Near Shore Sediments

Before EPA would consider selecting the alternate sediment remedy discussed above, a pre-design pilot test would need to be conducted to determine whether wet dredging for the near-shore sediments will meet performance standards and can be conducted in a manner protective of human health and the environment. The draft pilot test locations are depicted on Figure 1A in Appendix Q. If a pilot test is to be conducted, the final/actual pilot test locations must be approved by EPA and WDNR.

- **Performance standards for pilot test**

  The following table shows the relationship between the RAL and the pilot test average concentration cleanup level.

Relationship Between Remedial Action Level and Cleanup Level for Pilot Test

	Concentration	Concentration Based on Organic Carbon Content of 0.415%*	Requirement
Remedial Action Level (RAL)	2,295 ug tPAH/g OC	9.5 ppm	Dredge all sediments in pilot test area exceeding the RAL, as determined by the characterization data collected during the RI and/or additional pre-design sampling.
Pilot Test Cleanup Level	2,295 ug tPAH/g OC surface weighted average concentration over dredged pilot test area No sample to exceed 5,324 ug tPAH/g OC (also known as the "not-to-exceed threshold")	9.5 ppm surface weighted average concentration over dredged pilot test area No sample to exceed 22 ppm (also known as the "not-to-exceed threshold")	Concentration to be measured following dredging activities in pilot test area

* Based on the data collected during the RI, 0.415% OC was determined to be the best representation of the OC content of the existing sandy-type sediments at the site. The sediments that wil be present at the site following completion of the excavation/dredging actions is anticipated to be similar to those upon which the 0.415% OC determination was based, but will need to be evaluated. If the OC content of the top layer of sediments is lower than 0.415%, then a cleanup level of 9.5 ppm for those sediments would not be protective. If necessary, the 9.5 ppm cleanup level will be adjusted based on the OC content of the sediments so that the 2,295 ug/g OC cleanup level is achieved.

The following performance standards, or other equivalent standards approved by EPA, would need to be met in order for the pre-design pilot test to be judged a success.

- All NAPL source material shall be removed.
- All targeted sediments with PAH concentrations exceeding the RAL, as determined by the characterization data collected during the RI and/or additional pre-design sampling, shall be dredged.
- Upon completion of dredging activities, post-dredging confirmatory sampling results must show that the cleanup level (including the "not-to-exceed threshold") identified in the table above has been achieved.
- Surface water quality standards, as identified as ARARs, shall not be exceeded outside the containment area(s) including releases of NAPL sheens and/or turbidity.
- Surface water quality standards, as identified as ARARs, shall be achieved within and throughout the containment area(s) prior to any water within the containment area(s) being released to the larger water body.
- Air quality standards, as identified as ARARs, shall not be exceeded outside the exclusion zone (work/handling) or during the transport of contaminated media.
- All local, state and federal permitting requirements, if necessary, shall be followed.
- Sediment, wood debris, NAPL, carriage and contact water, and waste generated by the project shall be managed to prevent the release of contaminants and potential contamination off-site to land and waters.
- Any waste that is to be discharged to a publicly-owned treatment system shall meet all requirements set forth in that facility's permit including pretreatment standards.
- Appropriate measures to control airborne particulate matter shall be taken during all dredging and materials handling activities.
- Local, state, and federal noise pollution requirements shall be met.
- All investigation derived waste shall be handled in accordance with EPA guidance and EPA's offsite rule.

- **Remedial Approach for Pilot Test**

Sediment removal requirements. All sediment in the pilot test area with total PAH concentrations exceeding the RAL, as determined by the characterization data collected during the RI and/or additional pre-design sampling, will be targeted for removal. More specifically, in each pilot test area, sediment shall be removed to a target elevation that: (1) encompasses all contaminated sediment exceeding the RAL, including an overdredge allowance, as appropriate; and (2) removes additional sediment to ensure that side slopes are stable for the remaining sediment. The pilot test area will be a portion of the containment area sufficient in size to demonstrate the effectiveness of the pilot approach.

The lakebed areas within the containment area but outside of the test area will require some dredging in insure stable side slopes at the conclusion of the pilot and the removal of the containment walls. Side slope dredging will also need to insure the removal of all NAPL to prevent the recontamination of the pilot test area. The size of the containment area and test area will be approved by EPA and WDNR.

Sediment Removal Methods and Precautions. Dredging will be conducted within impermeable barriers such as steel sheet piling to contain releases. Fabric curtains or booms alone will not be sufficient within the heavily-contaminated near shore area because they permit water and sediments to travel below them and soluble contaminants to travel through them. Sheet piling will not be removed until water concentrations within the enclosure have returned to ambient or protective levels.

Sediment Dewatering, Treatment and Disposal. Same as described in Section 12.4.

Post-Removal Confirmation Surveys and Sampling for Pilot Test. After removal of sediments from the pilot test areas, surveys and sampling in the areas will be done to determine whether the sediment removal requirements specified above are met. The post-removal surveys and sampling will initially be conducted when the party conducting the pilot test believes it has removed the sediments to the specified targeted elevation. If the surveys and/or sampling shows that the sediment removal requirements (including the pilot test cleanup level) were not met in the pilot test area, then additional sediment in the area shall be removed until compliance with the sediment removal requirements is achieved.

Sampling of Dredged Areas

Definitions: For purposes of this ROD, "generated residuals" means sediment that, as a result of dredging operations, is resuspended and re-deposited on the surface of the newly-dredged area (e.g., within the top six inches of the sediment). The term "undisturbed residuals" (also known as "undredged inventory") means sediment that is more than six inches below the sediment surface in a newly dredged area.

Sampling: The post dredge core samples will extend at least twelve inches into the sub-aqueous material. The samples to be analyzed will be a top 6-inch layer representing the generated residuals layer and extending the full 6 inches (i.e., the 0 to 6 inch depth from the top of the post-dredge sediments), and a second 6-inch layer representing the top of the undisturbed residual (undredged inventory) layer (i.e., the 6 to 12 inch depth from the top of the post-dredge sediments). Both samples will be composited and analyzed separately.

Post-removal residuals management for pilot test

If post-dredging confirmatory sampling detects generated residuals with tPAH concentrations exceeding the pilot test cleanup level (see table above, including the not-to-exceed threshold), or if confirmatory sampling results of the undisturbed residuals exceed the RAL; or if evidence of residual free product in the form of sheen or globules are present in the samples, then the following actions will be taken:

- Generated residuals with a tPAH concentration greater than the not-to-exceed threshold at any sampling location must be removed (typically by hydraulic re-dredging) until the not-to-exceed threshold is met, and/or additional generated residuals must be removed until the pilot test cleanup level for the dredged area is met.

- Undisturbed residuals with a tPAH concentration exceeding the RAL at any sampling location must be removed (typically by re-dredging) in accordance with the sediment removal requirements specified above.

- Generated or undisturbed residuals showing evidence of free product shall be removed until all NAPL material is removed and sampling shows no evidence of free product.

12.7 Summary of the Estimated Remedy Costs and Time Required for Implementation

The estimated cost of the selected remedy for the Ashland/NSP Lakefront Site is $83 to $97 million. The remedial design is expected to take 9 to 12 months to complete, and the remedial action is expected to take at least three years to complete. Appendix P contains the cost breakdown for Scenario 10.

The information in Appendix P and the cost estimate summary table is based on the best available information regarding the scope of the selected remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedy. Changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment, as appropriate. The cost estimate is expected to be within +50 to -30 percent of the actual project cost.

12.8 Expected Outcomes of the Selected Remedy

The selected remedy for the Ashland/NSP Lakefront Site, Scenario 10, will achieve the RAOs for the Site as described in Section 8 of this ROD. The selected remedy will be protective of human health and the environment and will comply with ARARs. The following are the expected outcomes that will be achieved by implementing Scenario 10:

- The former MGP facility property will be available for beneficial commercial/industrial use, and Kreher Park will be available for recreational use.

- Soil and sediment at the Site will have PAH and VOC concentrations below specified cleanup levels, which will reduce the potential human health and ecological risks to acceptable levels. Cleanup standards for various COCs in soil are listed in the table at the end of this section. The cleanup goal for sediments is specified in the table in Section 12.3 of this ROD.

- Elevated concentrations of metals in groundwater (e.g., arsenic) will be removed since nearly all of the elevated metals that were detected in the upper aquifer are located within the areas that will be excavated under the "limited soil removal" component of the remedy. The groundwater cleanup standards for metals are listed in the table at the end of this section.

- For shallow groundwater at Kreher Park and the Upper Bluff/Filled Ravine, the remedy will achieve the dual objectives of containment and restoration. The remedy, which includes engineered surface and vertical barriers and a groundwater extraction and treatment system (and possibly in-situ treatment), will meet the containment objective by controlling the source of contamination and preventing additional contamination from migrating to Chequamegon Bay. The remedy will also serve to restore the groundwater to its beneficial use by reducing contaminant levels in groundwater to meet MCLs and State of Wisconsin Drinking Water Standards over time. The cleanup standards for various COCs in groundwater are listed in the table at the end of this section.

- For the Copper Falls Aquifer, the remedy will serve the dual objectives of containment and restoration. Enhancing the existing groundwater extraction and treatment system (and possibly using in-situ treatment) will hydraulically control the groundwater contamination and NAPL in the aquifer. The remedy will also serve to make progress toward restoring groundwater to beneficial use. However, given the large quantity of NAPL in the Copper Falls Aquifer, it may end up being technically impracticable to restore the aquifer. If that is the case and EPA decides to waive the requirement to meet the specified groundwater cleanup standards within a certain zone due to technical impracticability, then EPA will properly document that decision in accordance with Agency guidance. The cleanup standards for various COCs in groundwater are listed in the table at the end of this section.

- There are anticipated beneficial socio-economic and community impacts that will result from the remediation. The City of Ashland is currently interested in revitalization of the area. The City has a proposed Waterfront Development Plan for the lakefront and Kreher Park area that includes a possible new marina and an updated park. Any planned projects will not move forward until the areas are remediated.

Cleanup Standards for Soil and Groundwater					
Analyte	**Soil (units as shown)**	**Groundwater (ug/L)**	**Analyte**	**Soil (units as shown)**	**Groundwater (ug/L)**
1,2,4-Trichlorobenzene	62.160 ug/kg		Dibenzofuran	145.263 ug/kg	
1,2,4-Trimethylbenzene	51.608 ug/kg	480 (total)	Ethylbenzene	395.000 ug/kg	700
1,3,5-Trimethylbenzene	21.253 ug/kg		Fluoranthene	600.000 ug/kg	400
1-Methylnaphthalene	1.100.000 ug/kg		Fluorene	600.000 ug/kg	400
2-Methylnaphthalene	600.000 ug/kg		Indeno(1,2,3-cd)pyrene	88 ug/kg	
Acenaphthene	900.000 ug/kg		Iron	23.463 mg/kg	300
Acenaphthylene	18.000 ug/kg		Lead	50 mg/kg	15
Anthracene	5.000.000 ug/kg	3000	Manganese	1.762 mg/kg	50
Antimony	31.3 mg/kg	6	Mercury		2
Arsenic	0.039 mg/kg	10	Methylene Chloride		5
Barium		2000	Naphthalene	20.000 ug/kg	100
Benzene	643 ug/kg	5	n-Butyl benzene	240.000 ug/kg	
Benzo(a)anthracene	88 ug/kg		Nickel	1.564 mg/kg	100
Benzo(a)pyrene	8.8 ug/kg	0.2	Pentachlorophenal	2.979 ug/kg	1
Benzo(b)fluoranthene	88 ug/kg	0.2	Phenanthrene	18.000 ug/kg	
Benzo(g,h,i)perylene	1.800 ug/kg		Phenol	18.330.929 ug/kg	6000
Benzo(k)fluoranthene	800 ug/kg		Pyrene	500.000 ug/kg	250
Beryllium	154 mg/kg	4	Pyridine		10
Cadmium	8 mg/kg	5	Selenium		50
Chloroform		6	Silver	391 mg/kg	50
Chloromethane		3	Styrene		100
Chromium		100	Thallium		2
Chrysene	8.800 ug/kg	0.2	Toluene	520.000 ug/kg	1000
Cobalt		40	Vanadium	78.2 mg/kg	30
Copper	3.129 mg/kg	1300	Xylenes(total)	27.063 ug/kg	10000
Cyanide		200	Zinc	23.463 mg/kg	5000
Dibenzo(a,h)anthracene	8.8 ug/kg				

13.0 Statutory Determinations

Under CERCLA Section 121 and the NCP, remedies are required to be protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a waiver is justified) and be cost effective. The following subsections discuss how the selected remedy for the Ashland/NSP Lakefront Site meets these statutory requirements.

13.1 Protection of Human Health and the Environment

The current and potential future risks at the Ashland/NSP Lakefront Site are due to the presence of elevated concentrations of PAHs and VOCs in soils, groundwater and sediment. Implementation of the selected remedy will be protective of human health and the environment, as described in the NCP, through the removal and possible treatment of contaminated soils and sediment, and through groundwater cleanup actions that will serve to contain areas of contaminated groundwater and restore groundwater to its beneficial use. Implementation of the selected remedy will reduce exposure levels to protective ARARs and EPA and WDNR acceptable ranges for carcinogenic and non-carcinogenic risk. Implementation of the selected remedy will also protect benthic organisms and other ecological receptors. The site-specific RAOs were developed to protect current and future receptors that are potentially at risk from contaminants at the Site. The selected remedy will meet the RAOs. The Site will be available for reuse at the completion of the remedial action as described in Section 12.8 above, and institutional controls will be required to ensure that the remedy remains protective.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

CERCLA, as amended by SARA, specifies that Superfund remedial actions must comply with the substantive requirements of federal and state environmental laws. Such requirements may be ARARs. In addition to ARARs, federal and state advisories and guidance documents exist that, although not binding regulations, contain information "to be considered" (TBC). ARARs and TBCs are important in developing remedial objectives that comply with regulatory requirements or guidance (as appropriate). The identification of site-specific ARARs is based on specific constituents at a site, the various response actions proposed, and the general site characteristics. As such, ARARs are classified into three general categories:

Chemical-specific ARARs – specific to the type(s) of constituents, pollutants, or hazardous substances at a site; include state and federal requirements that regulate contaminant levels in various media;

Action-specific ARARs – specific to the cleanup activities being considered; usually technology- or activity-based; regulatory requirements that define acceptable excavation, treatment, and disposal procedures; and

Location-specific ARARs – *specific to actions at the geographic location; requirements for* contaminant concentrations or remedial activities resulting from a site's physical location (e.g., wetlands or floodplains).

Section 121(d) of CERCLA requires that Superfund remedial actions meet ARARs. Appendix C provides all ARARs identified for the Site which will be met under this ROD. In addition to ARARs, non-enforceable guidelines, criteria, and standards may be useful in designing the selected remedy. As described above, these guidelines, criteria, and standards are known as TBCs. The selected remedy will comply with the ARARs for the Site.

13.3 Cost Effectiveness

EPA has determined that the selected remedy for the Ashland/NSP Lakefront Site is cost effective and represents value for the money to be spent. A cost effective remedy in the Superfund program is one whose costs are proportional to its overall effectiveness. The overall effectiveness of the potential remedial alternatives for the Site was evaluated in the FS by considering the following three criteria: 1) long-term effectiveness and permanence; 2) reduction in toxicity, mobility and volume through treatment; and 3) short-term effectiveness. The overall effectiveness was then compared to cost to determine whether an alternative is cost effective. Of the remedial alternatives evaluated for the Site, Scenario 10 provided the highest degree of cost effectiveness. It is important to note that more than one cleanup alternative can be cost-effective, and the Superfund program does not mandate the selection of the most cost-effective cleanup alternative. Rather, the cost-effectiveness is concerned with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs compared to other available options.

13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment are practicable at the Ashland/NSP Lakefront Site. Treatment technologies will be utilized in certain components of the selected remedy and might be utilized in others. The selected remedy utilizes technologies with proven long-term permanence and effectiveness. The selected remedy also permanently removes the contamination from portions of the Site and safely contains the remaining contamination, allowing for reuse of the property. In addition, the selected remedy is favored by the State and local community.

13.5 Preference for Treatment as a Principal Element

This remedy satisfies the preference for treatment as a principal element of the remedy for the following reasons: (1) the treatment of contaminated PAH and VOC soils and sediment has been demonstrated for long term permanence and effectiveness, (2) the chosen remedy is a permanent remedy that is widely accepted by the community, (3) source materials consisting of principal threat wastes will be addressed within the scope of this action, and (4) NAPL that is removed from the groundwater will be sent off-site for treatment and disposal.

13.6 Five-Year Review Requirements

The NCP requires that the remedial action be reviewed no less often than every five years if the remedial action results in hazardous substances, pollutants, or contaminants remaining at the Site

above levels that allow for unlimited use and unrestricted exposure. Because this remedy will result in hazardous substances, pollutants, or contaminants in groundwater and soil remaining on-site above levels that allow for unlimited use and unrestricted exposure, including Wisconsin Preventive Action Limits (PALs), a five-year review will be required for this remedial action.

14.0 Documentation of Significant Changes from Preferred Alternative of Proposed Plan

The Proposed Plan for Ashland/NSP Lakefront Site was released for public comment on June 12, 2009, and the public comment period ran from June 17 through August 17, 2009. The Proposed Plan identified Scenario 10 as the preferred alternative for the Site. During the public comment period, comments were submitted by NSPW that stated the sediment remedy SED-6 (dry excavation near shore and dredging offshore) might be more difficult to implement and costs would be significantly higher than those estimated in the FS. Based on a comparison of the SED-6 alternative to the other alternatives using the nine criteria, it was determined that, without confirmation of the ability of dredging in near shore areas to attain performance standards, SED-6 (dry excavation near shore and dredging offshore) represents a good balance of all the options. The nine criteria analysis indicated that SED-4 (dredging) was comparable to SED-6, with the possibility of lower implementation costs, but this is subject to a successful pilot test showing that dredging can be effective for the heavily-contaminated near shore areas. Therefore, the selected remedy includes the option to conduct a pre-design pilot test to demonstrate that dredging the near shore areas can meet the performance standards and be protective of human health and the environment. If a pre-design pilot test indicates that dredging rather than excavation within the near shore area will attain the established performance standards and can be conducted in a manner protective of human health and the environment, then EPA, in consultation with WDNR, will recommend that an alternate sediment remedy (SED-4, dredging) be implemented and EPA will publish its decision in an ESD.

In addition, the Proposed Plan stated that, "the purpose of this groundwater cleanup alternative is hydraulic containment within the waste management area and restoration of the aquifer outside the waste management area" In this ROD, EPA is not designating any areas of the Site as waste management areas, and the RAOs for groundwater include meeting MCLs and State of Wisconsin drinking water standards. The selected groundwater remedy will serve the dual objectives of containment and restoration. For shallow groundwater at Kreher Park and the Upper Bluff/Filled Ravine, the engineered surface and vertical barriers and a groundwater extraction and treatment system (and possibly in-situ treatment) remedy will meet the containment objective by controlling the source of contamination and preventing additional contamination from migrating to Chequamegon Bay. The remedy will also serve to restore the groundwater to its beneficial use by reducing contaminant levels in groundwater to meet MCLs and State of Wisconsin drinking water standards over time. For the Copper Falls Aquifer, enhancing the existing groundwater extraction and treatment system (and possibly using in-situ treatment) will hydraulically control the groundwater contamination and NAPL in the aquifer, and will also serve to make progress toward restoring groundwater to beneficial use. However, given the large quantity of NAPL in the Copper Falls Aquifer, it may end up being technically impracticable to restore the aquifer. If that is the case and EPA decides to waive the requirement to meet the specified groundwater cleanup standards within a certain zone due to technical impracticability, EPA will properly document that decision in accordance with Agency guidance.

LIST OF REFERENCES CITED*

Long, E.R. and P.M. Chapman. 1985. A Sediment Quality Triad: Measures of sediment contamination, toxicity, and infaunal community composition in Puget Sound. Marine Pollution Bulletin. 16:405-415.

Long, E. R,. and L. G. Morgan 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program, NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. ISBN 0-7729-9248-7. Standards Development Branch. Ontario Ministry of Environment and Energy. Toronto, Ontario. 27 pp.

SEH. 1998. Ecological Risk Assessment. Problem Formulation. April 1998.

SEH. 2002. Ecological Risk Supplement. Ashland Lakefront Property – Contaminated Sediments. February 2002.

SEH. 2003. Remedial Investigation Work Plan: Ashland/NSP Lakefront Site, Ashland, WI. October 2003.

SEH, 1998. *Ashland Lakefront Property. Baseline Human Health Risk Assessment. Ashland, Wisconsin*. June 1998.

USEPA. 1997. Ecological Risk Assessment Guidance for Superfund (ERAGS): Process for designing and Conducting Ecological Risk Assessments. USEPA 540-R-97-006.

USEPA. 2003a. Ecological Screening Levels (ESLs). U.S. Environmental Protection Agency, Region 5, August 2003.

USEPA. 2003b. Draft Ecological Soil Screening Levels (ECO-SSLs). In: Kapustka, L., W. Clements, L. Zicardi, P. Paquin, M. Sprenger, and D. Wall. 2004. Issue Paper on Ecological Effects of Metals. Submitted to U.S. EPA Risk Assessment Forum. Washington, DC.

USEPA. 2005a. Ecological soil screening level (Eco-SSL) (various metals) guidance and documents. http://www.epa.gov/superfund/programs/risk/ecorisk/ecossl.htm

USEPA, 1989. *Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual. Part A. Interim Final, December 1989.* EPA/540/1-89/002.

USEPA, 1991. *Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). December 1991.* EPA/540/R-92/003.

USEPA. 2001a. *RAGS Part D. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) Interim.* January 1998. Publication 9285.7-01D.

USEPA. 2001b. *Supplemental Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway (Vapor Intrusion Guidance)* Draft. October 2001.

USEPA. 2004a. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment.* July 2004. EPA/540/R/99/005, OSWER 9285.7-02EP, PB99-963312.

USEPA. 2004b. *Region 9 Preliminary Remediation Goals (PRGs).* USEPA, Region 9.

Wisconsin Department Natural Resources (WDNR). 2003. Consensus-based Sediment Quality Guidelines. Recommendations for Use and Application: Interim Guidance. WT-723 2003.

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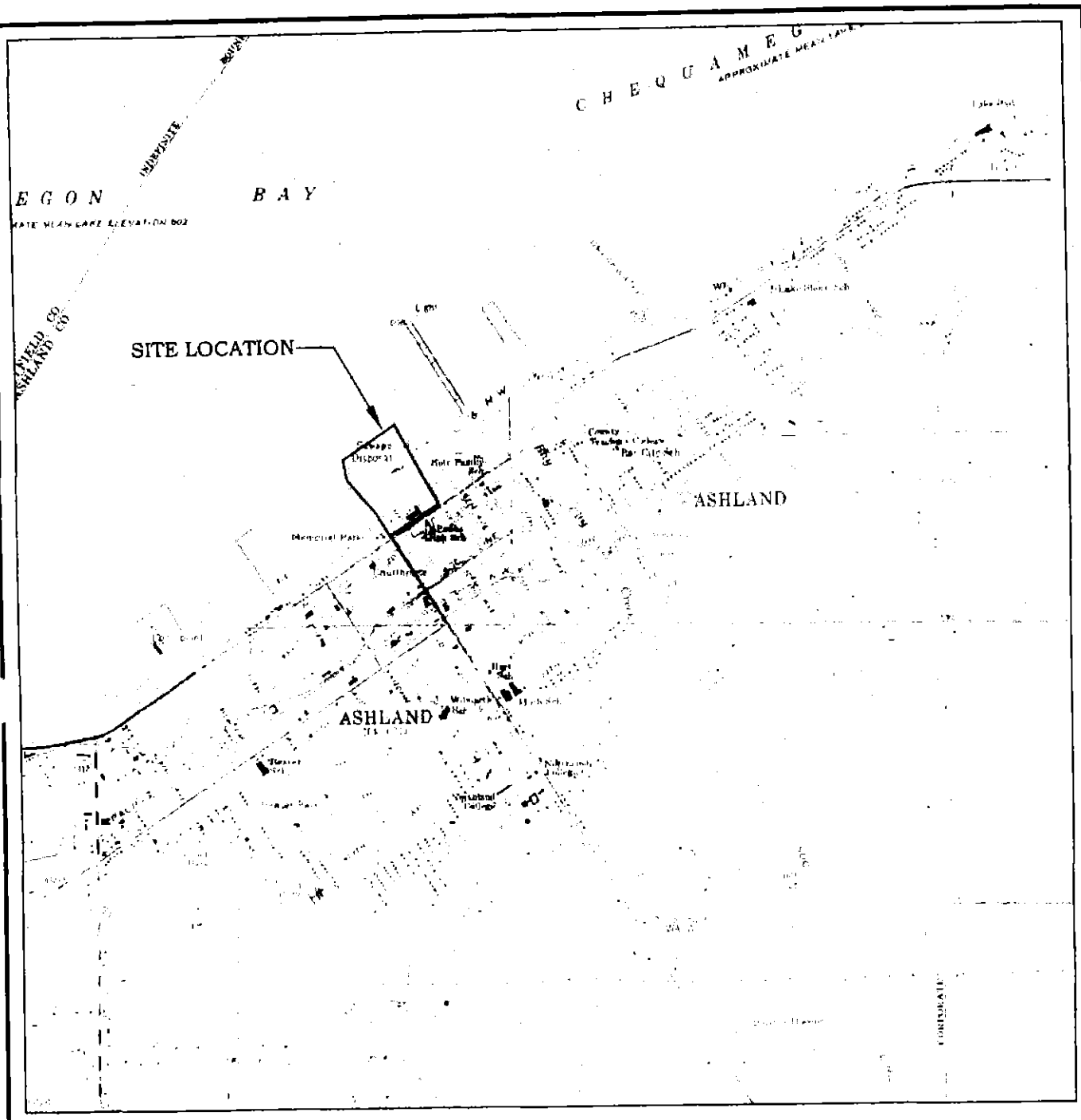
* The U.S. EPA guidance documents considered in the selection of the remedy as described in this ROD are hereby incorporated by reference into the Administrative Record for the Ashland/Northern States Power Lakefront Site.

FIGURES



BASE MAP SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE, ASHLAND, WISCONSIN, DATED 1964, PHOTOREVISED 1975.

QUADRANGLE LOCATION

NORTH

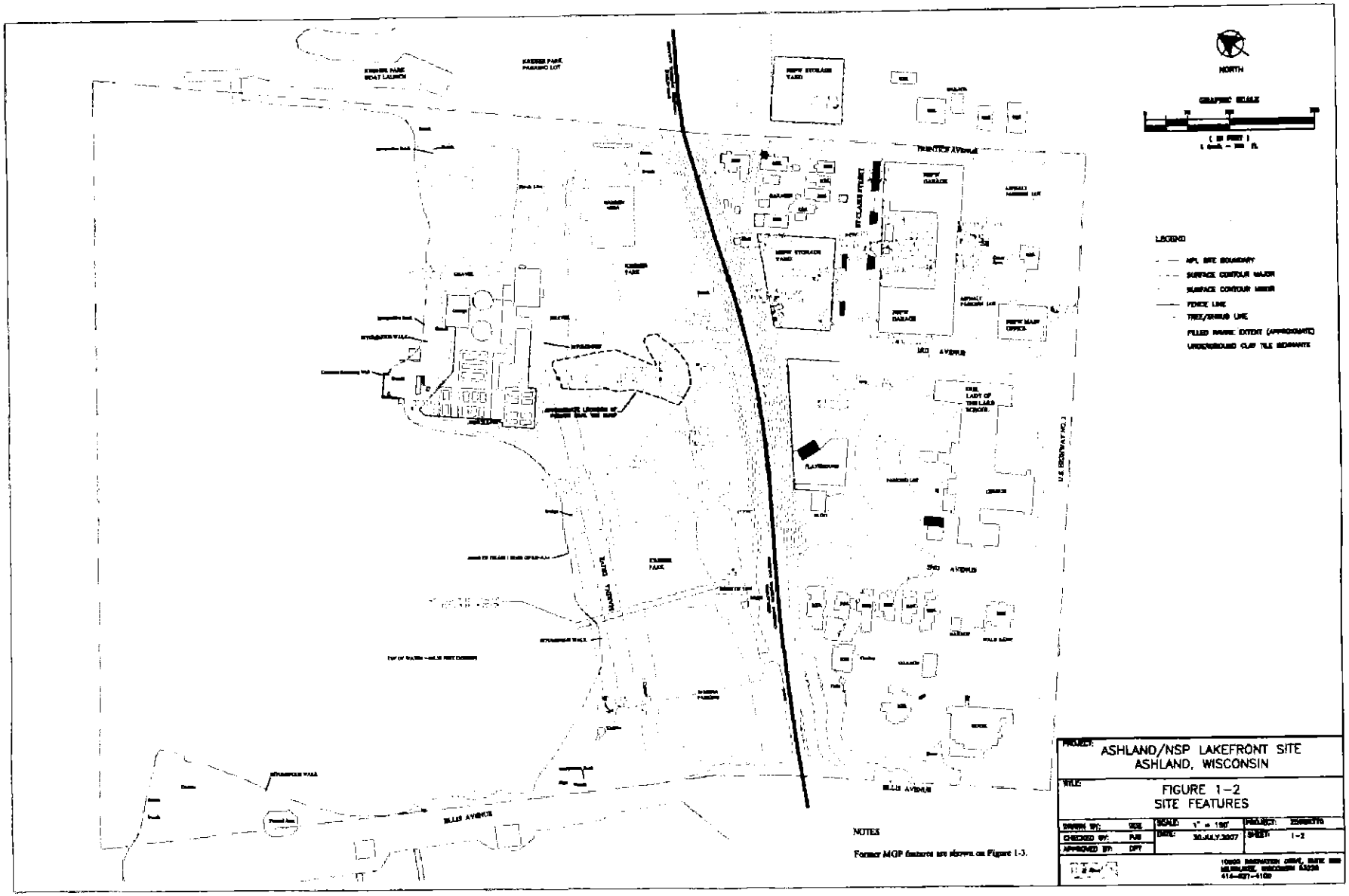
0 1320 2640 5280

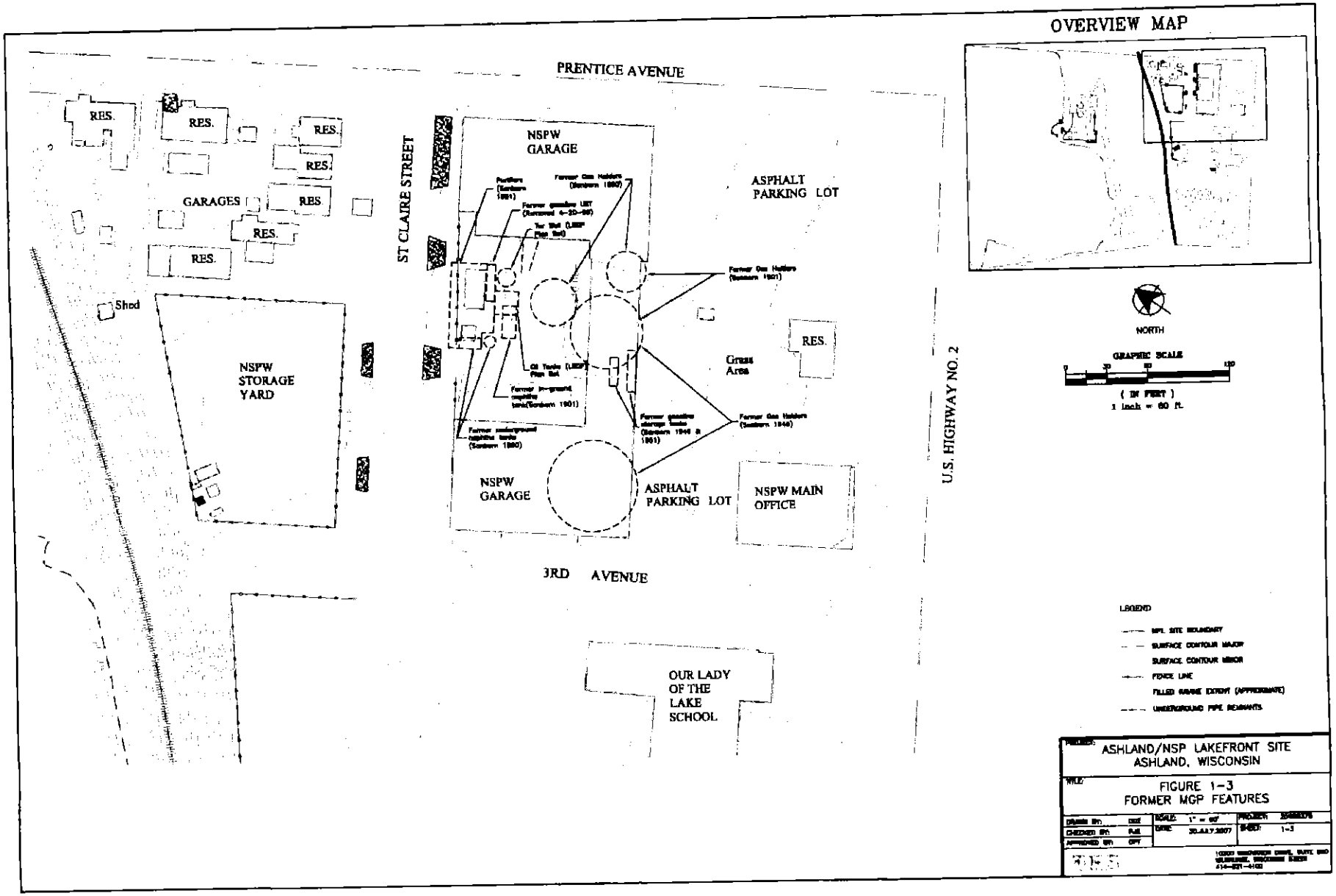
SCALE IN FEET

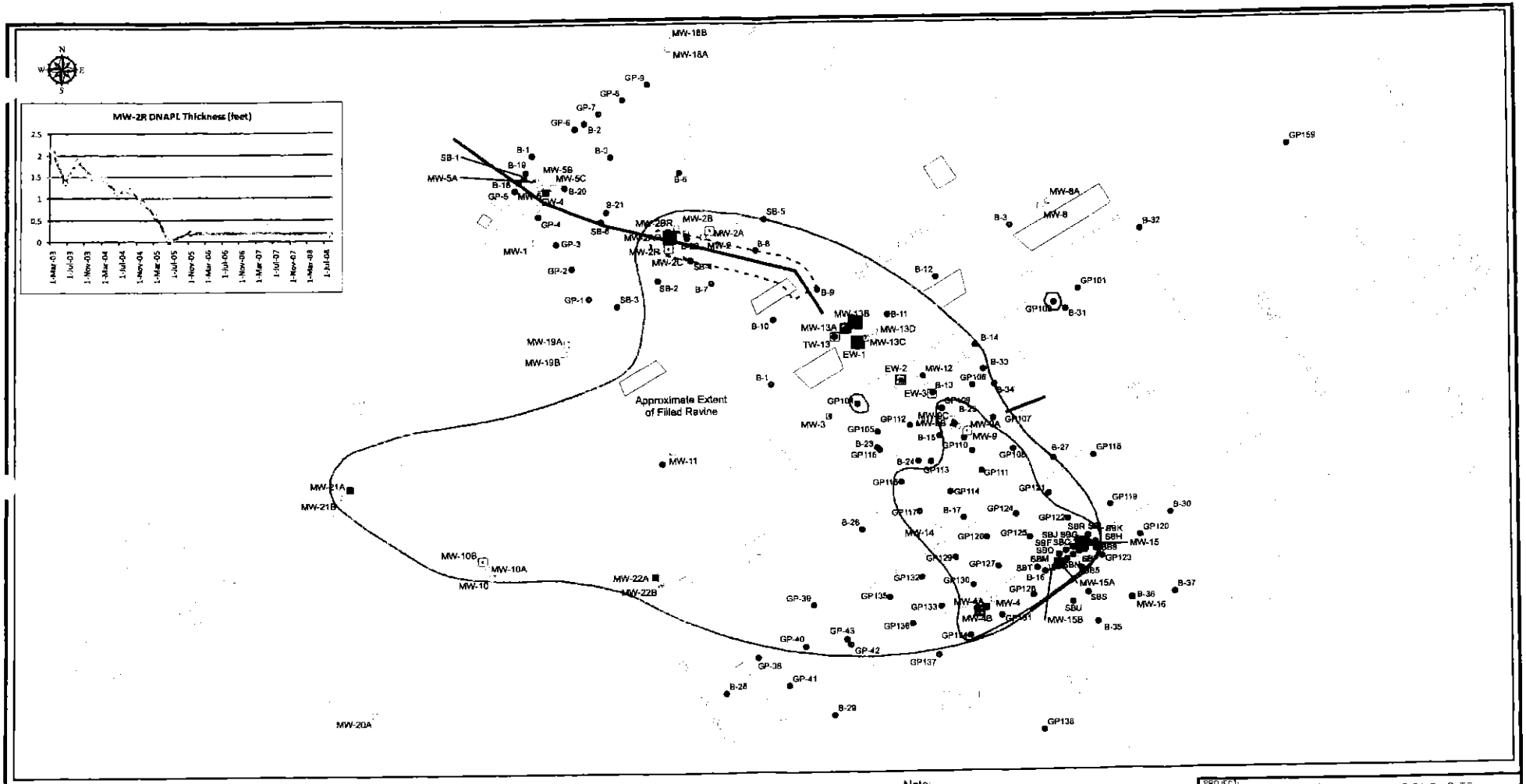
PROJECT: ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN		
TITLE: FIGURE 1-1 SITE LOCATION		
DRAWN BY: DDZ	SCALE: 1" = 2640'	PROJ. NO. 25688375
CHECKED BY: PJS	DATE: 30.JULY.2007	SHEET: 1-1
APPROVED BY: DPT		

URS

10200 INNOVATION DRIVE, SUITE 500
MILWAUKEE, WISCONSIN 53226
414-831-4100


NORTH
GRAPHIC SCALE
LEGEND
NPL SITE BOUNDARY
SURFACE CONTOUR MAJOR
SURFACE CONTOUR MINOR
FENCE LINE
TREE/SHRUB LINE
FILLED WAVE EXTENT (APPROXIMATE)
UNDERGROUND CLAY TILE SEDIMENTS
TRENTON AVENUE
ST CLAIRE STREET
3RD AVENUE
ELLIS AVENUE
U.S. HIGHWAY NO. 2
NOTES
Former MGP features are shown on Figure 1-3.
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN
TITLE: FIGURE 1-2
SITE FEATURES
DRAWN BY: GCE
CHECKED BY: PJB
APPROVED BY: DPT
SCALE: 1" = 150'
DATE: 30 JULY 2007
SHEET: 1-2

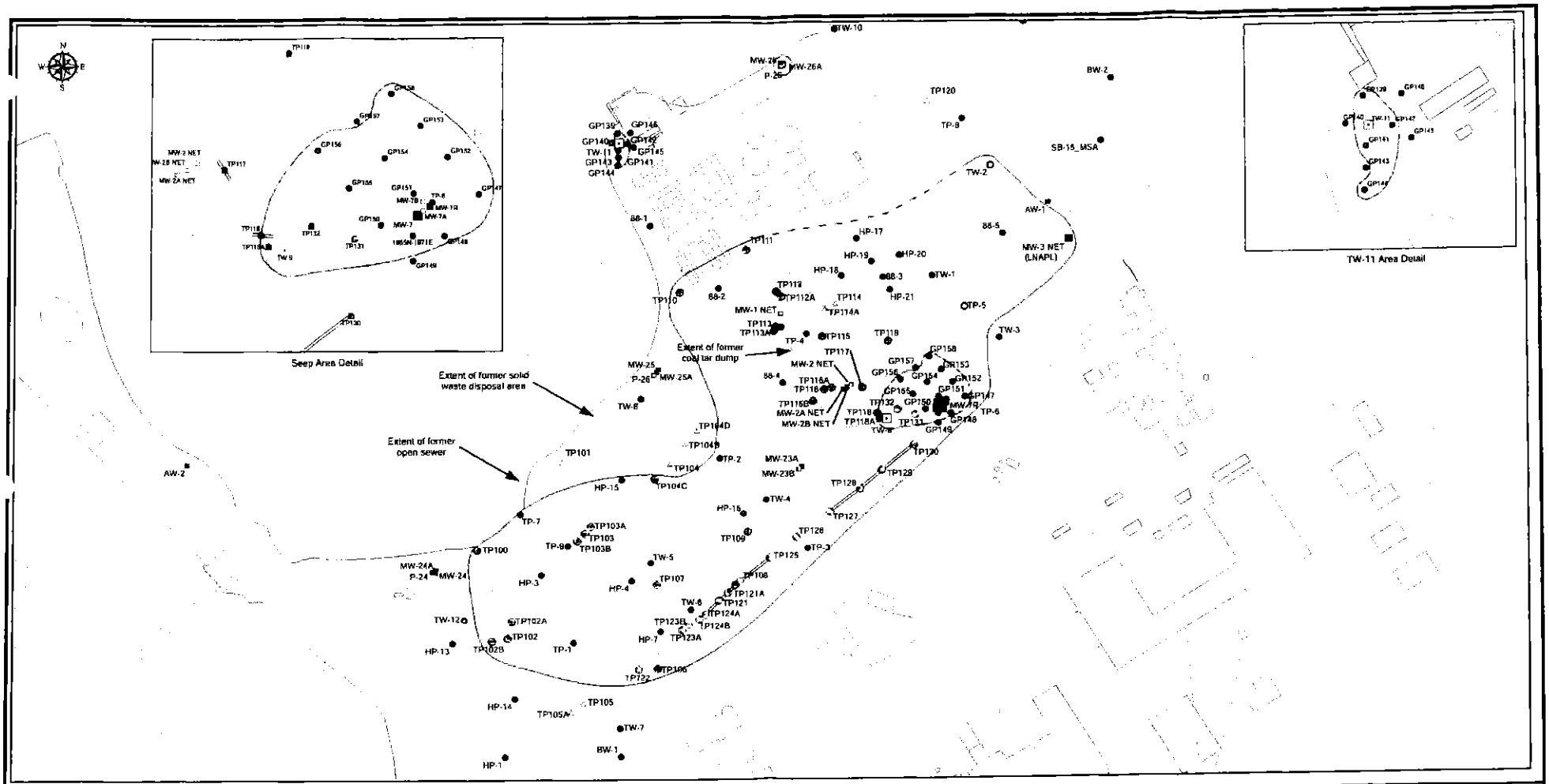

OVERVIEW MAP
PRENTICE AVENUE
RES.
RES.
RES.
RES.
GARAGES
RES.
RES.
RES.
Shed
ST CLAIRE STREET
NSPW GARAGE
ASPHALT PARKING LOT
RES.
Grass Area
NSPW STORAGE YARD
NSPW GARAGE
ASPHALT PARKING LOT
NSPW MAIN OFFICE
U.S. HIGHWAY NO. 2
3RD AVENUE
OUR LADY OF THE LAKE SCHOOL
NORTH
GRAPHIC SCALE
(IN FEET)
1 inch = 60 ft.
LEGEND
SURFACE CONTOUR MAJOR
SURFACE CONTOUR MINOR
FENCE LINE
UNDERGROUND PIPE REMNANTS
ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN
FIGURE 1-3
FORMER MGP FEATURES



Note:
Free product extent between TW-13 and MW-2R is based on recent data, which indicates the free product plume in this area is significantly declining (dashed line where inferred). See graph of MW-2R historical free product measurements at upper left.
Free product is assumed to approximate trace of clay tile which was removed in 2001.
Wells MW-2, MW-2A, and MW-2B were abandoned during the 2001 clay tile investigation.
Historical soil borings indicate locations with no associated laboratory data.

PROJECT:	ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN
TITLE:	Figure 3-7 Extent of DNAPL in Upper Bluff, Filled Ravine, and Copper Falls
DRAWN BY: DDZ	SCALE: AS SHOWN
CHECKED BY: VSM	DATE: 24 OCT 2008
APPROVED BY: JPL	
PROJECT: 25688375	SHEET: 3-7

URS
10200 INNOVATION DRIVE, SUITE 500
MILWAUKEE, WISCONSIN 53226
414-837-4100



Legend

Free Product thickness (feet)

Maximum by well

- 0
- 0.1 - 1
- 1.1 - 5
- 5.1 - 10
- 10.1 - 26.3

2005 RI clay pipe investigation

DNAPL Extent

LNAPL Extent (dashed where inferred)

- Soil Sample Locations
- Historical Soil Borings
- 1994 Locations

Test Pit locations with LNAPL

Event Date

- Nov 2005
- June 2005

Test Pit locations without LNAPL

Event Date

- Nov 2005
- June 2005

Note:
Defined boundaries shown at seep area and TW-11 indicate probable extent of DNAPL.
DNAPL in well MW-26 (0.25 ft.) was first encountered on August 18, 2008.
Symbols denoting LNAPL where encountered in borings and test pits are shown separately.
Well MW-7 was abandoned during the 2002 seep remediation.
Historical soil borings indicate locations with no associated laboratory data.
1994 locations shown indicated oily sheen in soil cuttings in TW-2 and oil present on wood pieces in TP-5.

PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 3-8
Extent of DNAPL & LNAPL in Kreber Park

DRAWN BY:	JOZ	SCALE:	AS SHOWN	PROJECT:	25088375
CHECKED BY:	MSM	DATE:	24 OCT 2008	SHEET:	3-8
APPROVED BY:	DPT				

URS

10200 INNOVATION DRIVE, SUITE 500
MILWAUKEE, WISCONSIN 53226
414-831-4100

Legend

Extent of NAPL and/or sheen

Extent of contamination

All Sed Results - Total PAH ppm

Total PAH ppm

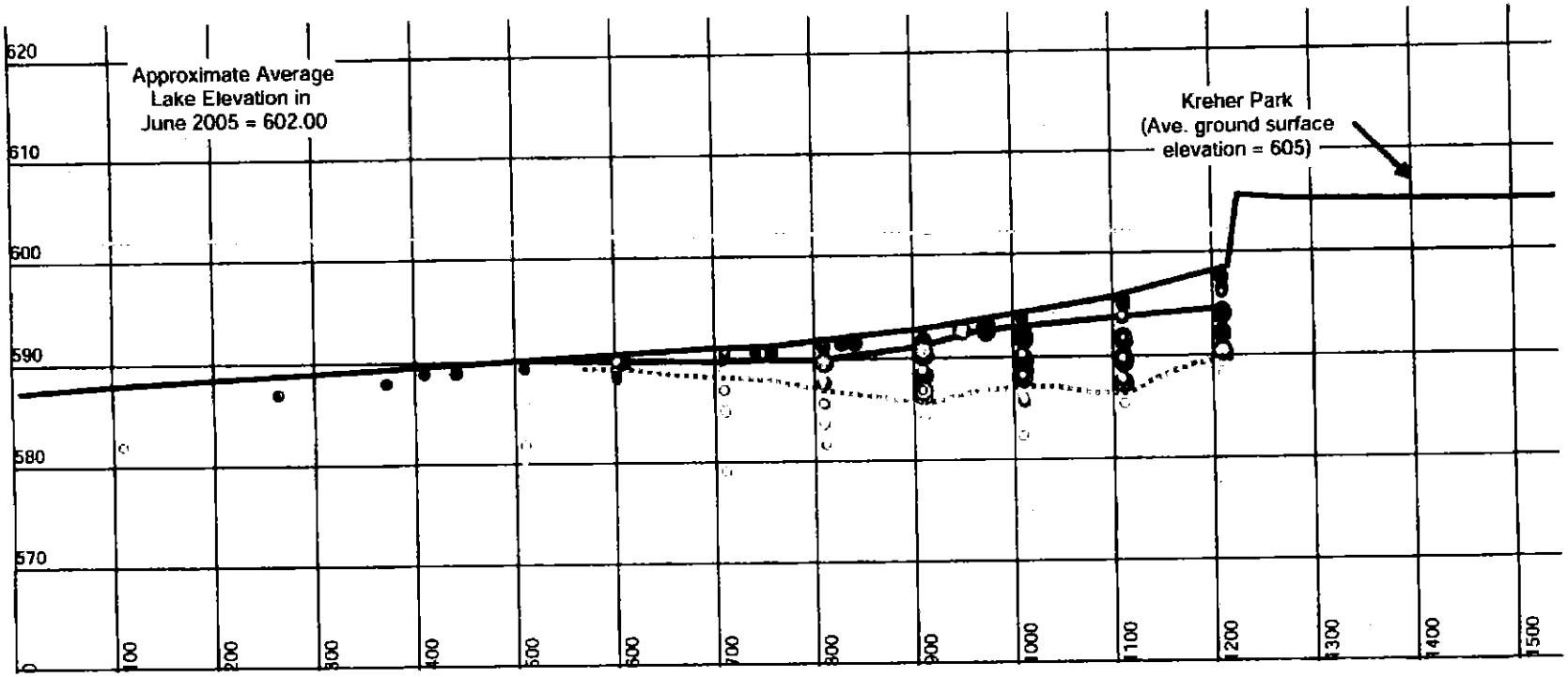
- 0
- 1 - 5
- 6 - 9.4
- 9.5 - 100
- 101 - 200
- 201 - 1000
- >1000

0 62.5 125 250 375 500 Feet

PROJECT: ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN					
TITLE: Figure 3-3 Area of Impacted Sediment					
DRAWN BY:	DDZ	SCALE:	AS SHOWN	PROJECT:	25688375
CHECKED BY:	MSM	DATE:	24.OCT.2008	SHEET:	3-3
APPROVED BY:	DPT				

URS

6737 W. WASHINGTON ST, SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100



Legend

XS Total PAH ppm - NS1

total PAH - mg/kg

- ND
- 1 - 5
- 6 - 9.4
- 9.5 - 100
- 101 - 200
- 201 - 1000
- >1000

Surface Type

Type

- Top of Surface
- Water Surface
- Top of wood surface
- XY Grid (feet)

0 25 50 100 150 200 Feet

Cross Section Overview Map

Note: sample results shown depict locations within 200 feet of either side of given transect line.

Blue dashed line depicts approximate vertical extent of 9.5 ppm total PAHs

PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 3-4
Sediment Sample Results - Total PAHs - all depths
North-South 1 cross section

DRAWN BY:	DDZ	SCALE:	AS SHOWN	PROJECT:	25688375
CHECKED BY:	WSB	DATE:	24.OCT.2008	SHEET:	3-4
APPROVED BY:	DPT				

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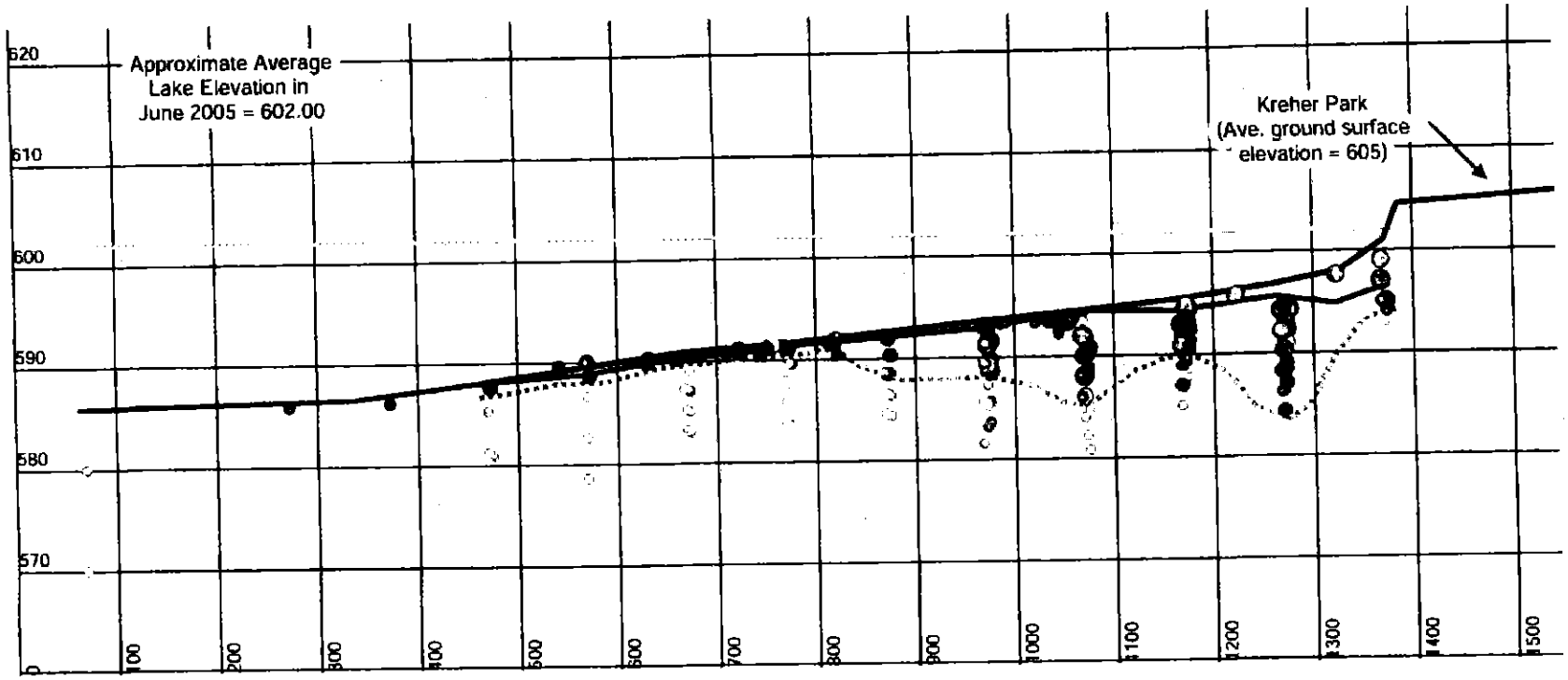
6737 W. WASHINGTON ST, SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100



Legend

XS Total PAH ppm - NS2

total PAH - mg/kg

- ND
- 1 - 5
- 6 - 9.4
- 9.5 - 100
- 101 - 200
- 201 - 1000
- >1000

Surface Type

Type

- Top of Surface
- Water Surface
- Top of wood surface
- XY Grid (feet)

0 25 50 100 150 200 Feet

Cross Section Overview Map

Note: sample results shown depict locations within 200 feet of either side of given transect line.

Blue dashed line depicts approximate vertical extent of 9.5 ppm total PAHs

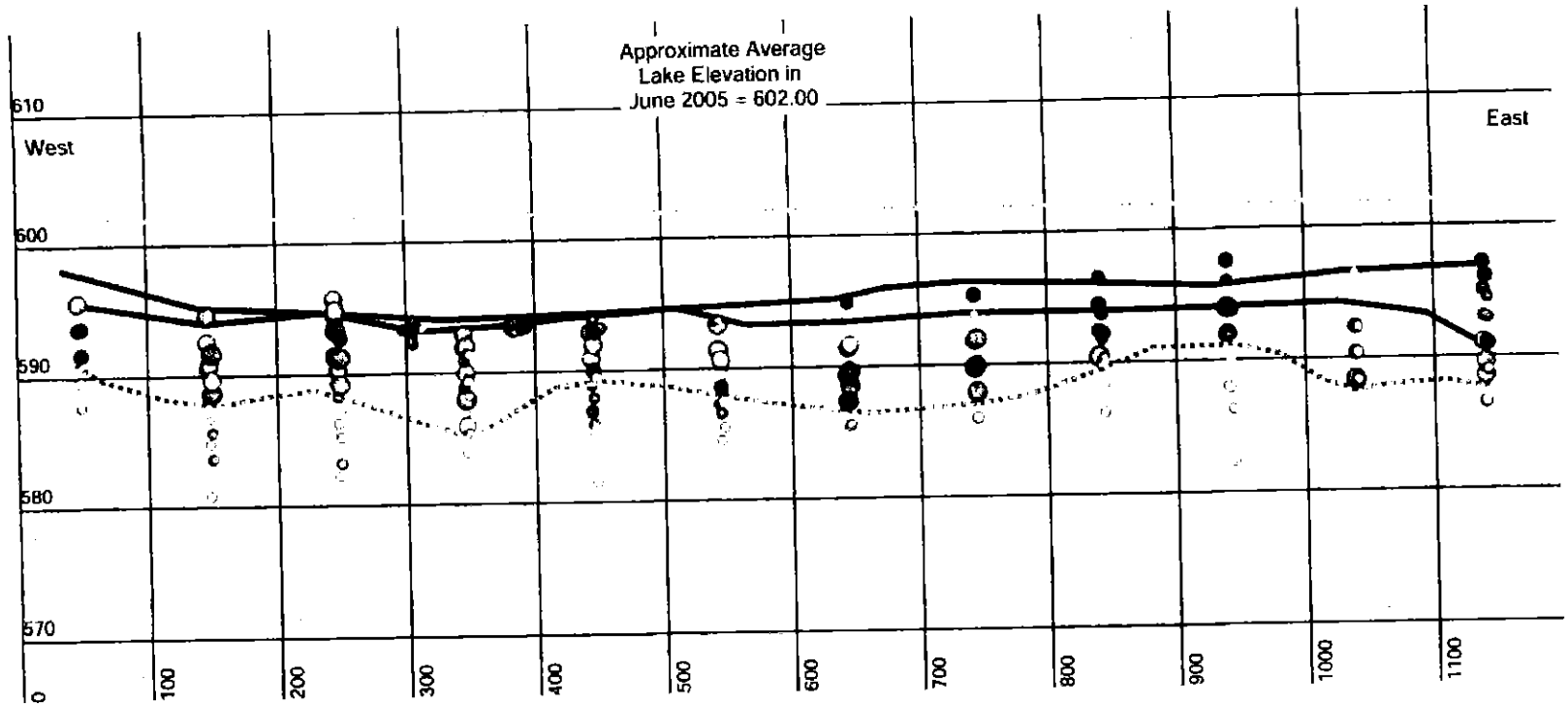
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 3-5
Sediment Sample Results - Total PAHs - all depths
North-South 2 cross section

DRAWN BY:	DDZ	SCALE:	AS SHOWN	PROJECT:	25688375
CHECKED BY:	WSB	DATE:	24.OCT.2008	SHEET:	3-5
APPROVED BY:	DPT				

URS

6737 W. WASHINGTON ST, SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100



Legend

XS Total PAH ppm - WE1

total PAH - mg/kg

- 0
- 1 - 5
- 6 - 9.4
- 9.5 - 100
- 101 - 200
- 201 - 1000
- 1001 - 12870000

Surface Type

Type

- Top of Surface
- Water Surface
- Top of wood surface
- XY Grid (feet)

0 25 50 100 150 200 Feet

Cross Section Overview Map

Note:
Cross section includes samples collected within 150 feet of projected cross section line; samples shown above the surface water/sediment surface interface were collected within this 300 foot width.

Blue dashed line depicts approximate vertical extent of 9.5 ppm total PAHs

PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 3-6
Sediment Sample Results - Total PAHs - all depths
West-East 1 cross section

DRAWN BY:	DDZ	SCALE:	AS SHOWN	PROJECT:	25688375
CHECKED BY:	WSB	DATE:	24.OCT.2008	SHEET:	3-6
APPROVED BY:	DPT				

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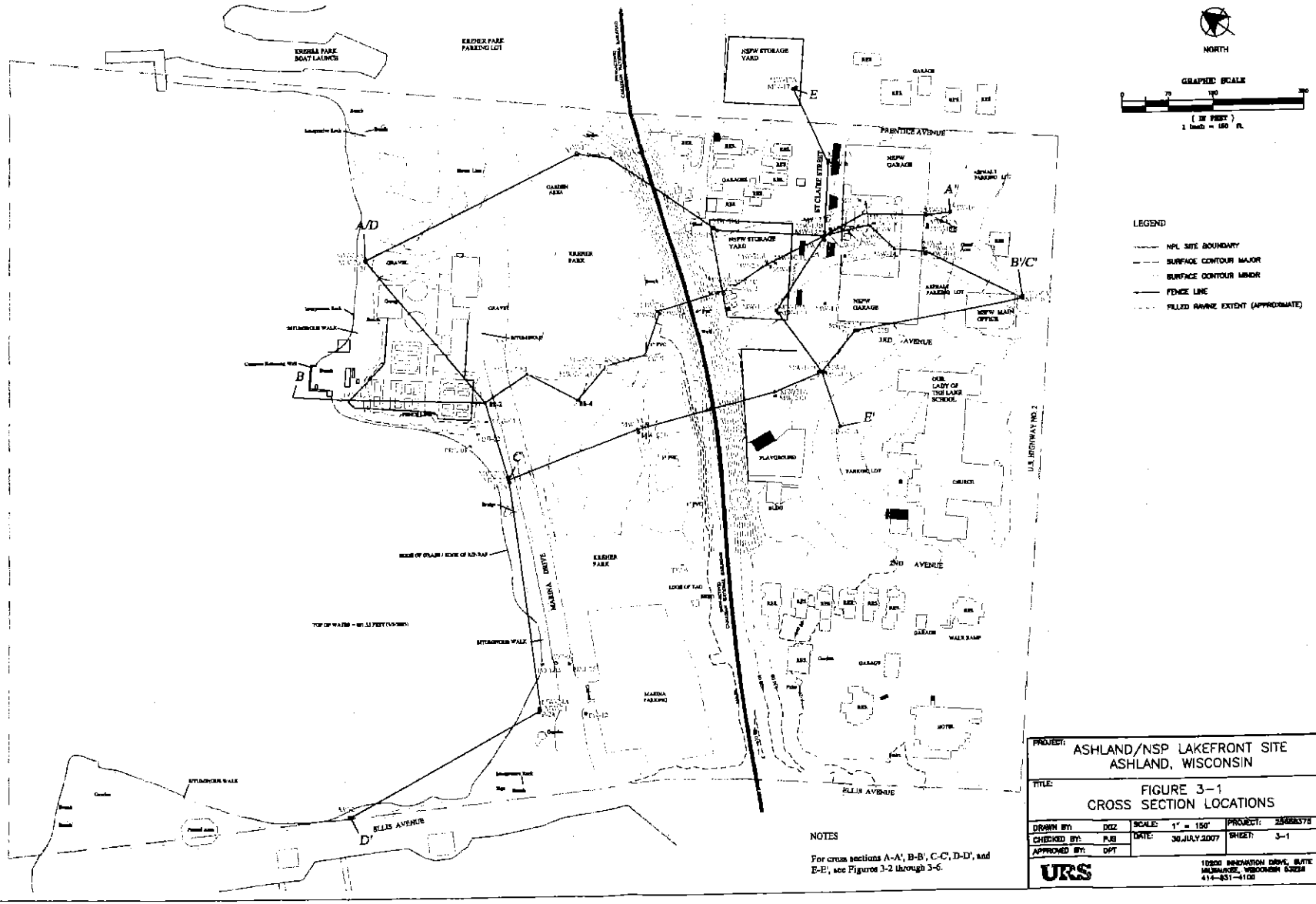
6737 W. WASHINGTON ST, SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100



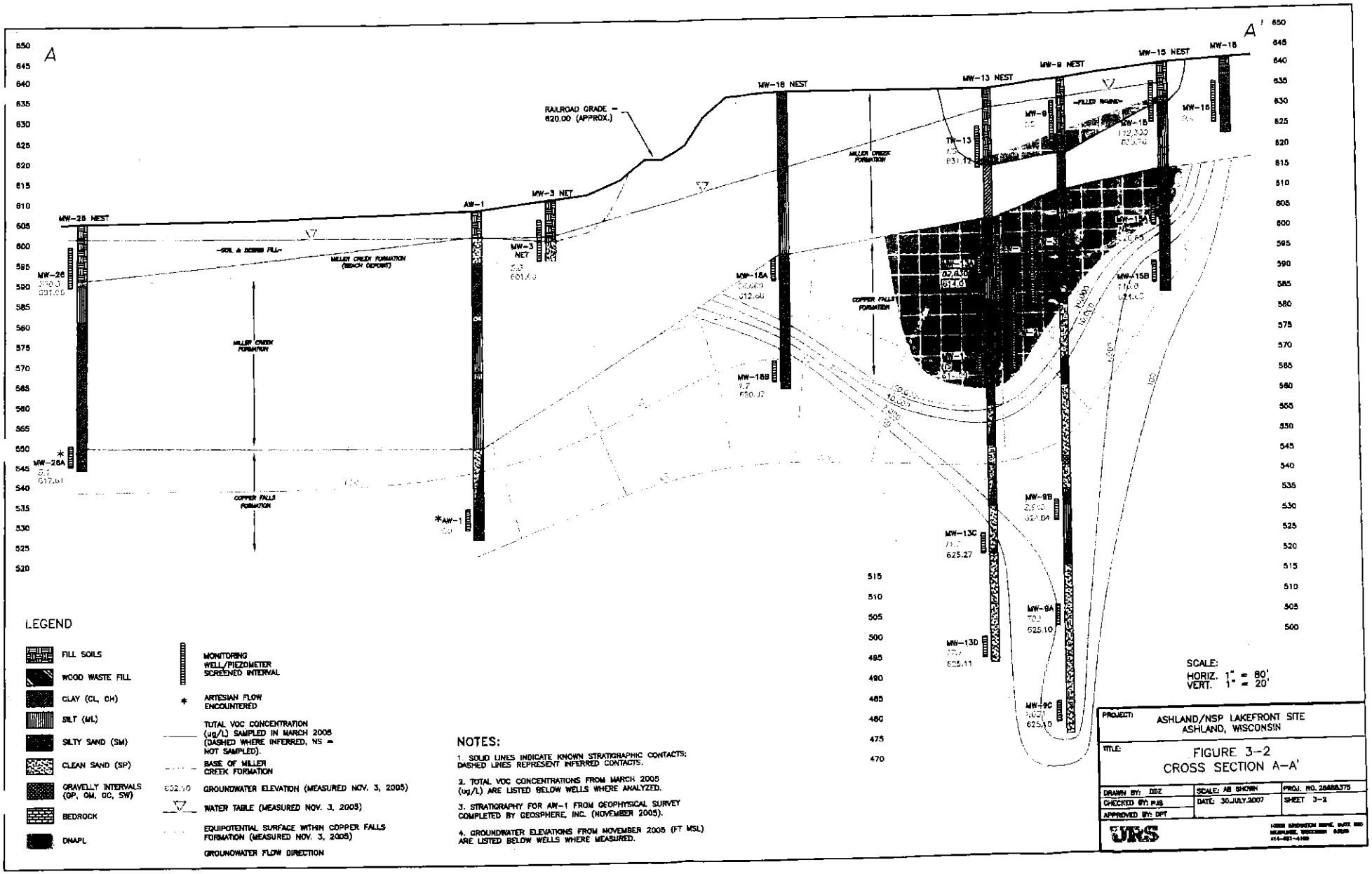
NOTES

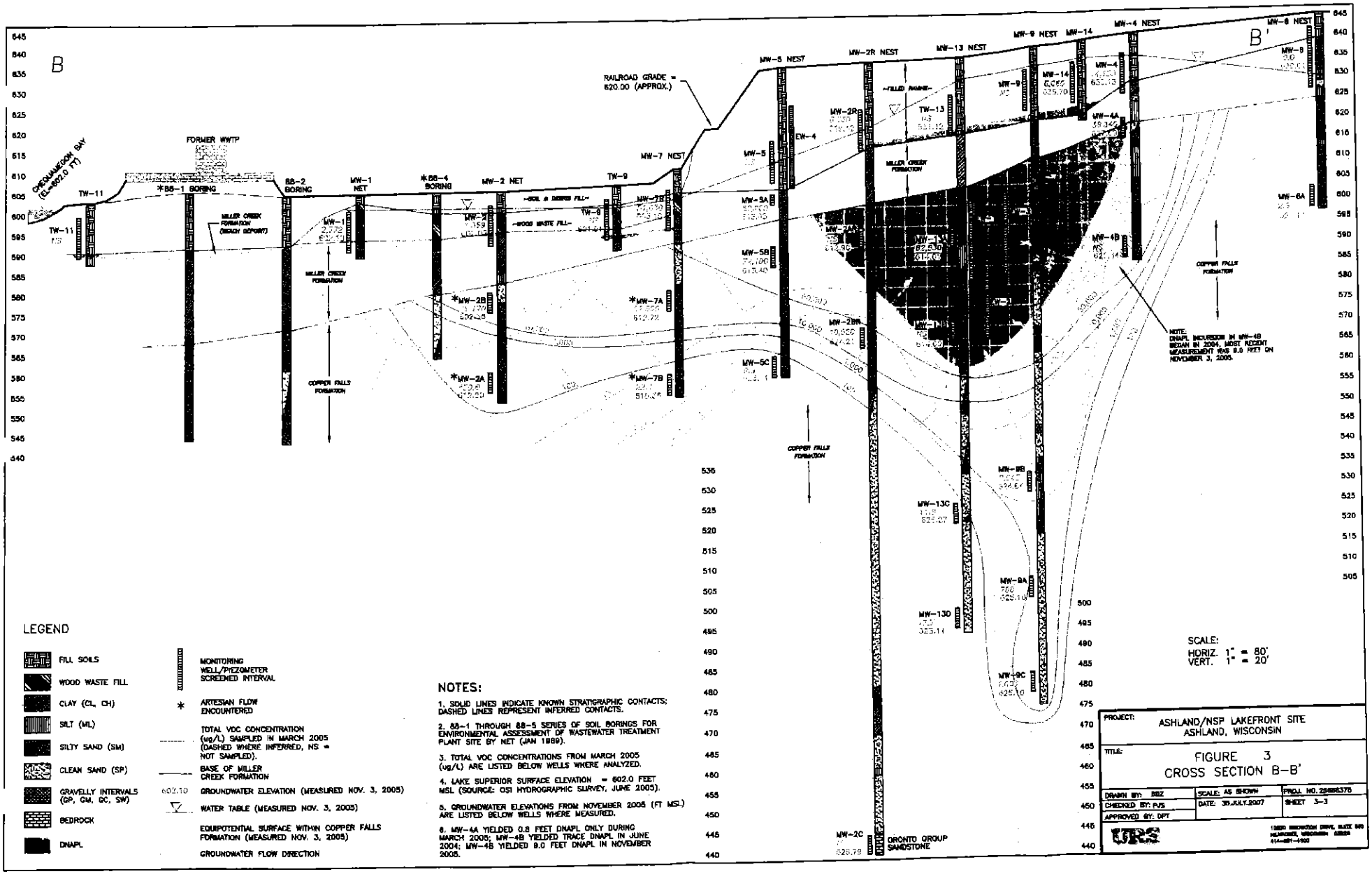
For cross sections A-A', B-B', C-C', D-D', and E-E', see Figures 3-2 through 3-6.

PROJECT: ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN			
TITLE: FIGURE 3-1 CROSS SECTION LOCATIONS			
DRAWN BY: DEZ	SCALE: 1" = 150'	PROJECT: 25466378	
CHECKED BY: FJS	DATE: 30 JULY 2007	SHEET: 3-1	
APPROVED BY: DPT			

URS

10200 INNOVATION DRIVE, SUITE 500
MILWAUKEE, WISCONSIN 53226
414-651-4100


A
A'
MW-26 NEST
MW-26
MW-26A
AW-1
MW-3 NET
MW-18 NEST
MW-18A
MW-18B
MW-13 NEST
MW-13C
MW-13D
MW-9 NEST
MW-9
MW-9B
MW-9A
MW-9C
MW-15 NEST
MW-15
MW-15A
MW-15B
MW-16
TW-13
RAILROAD GRADE = 620.00 (APPROX.)
-SOIL & DEBRIS FILL-
MILLER CREEK FORMATION (BEACH DEPOSIT)
MILLER CREEK FORMATION
COPPER FALLS FORMATION
-FILLED RAVINE-
LEGEND
FILL SOILS
WOOD WASTE FILL
CLAY (CL, CH)
SILT (ML)
SILTY SAND (SM)
CLEAN SAND (SP)
GRAVELLY INTERVALS (GP, GM, GC, SW)
BEDROCK
DNAPL
MONITORING WELL/PIEZOMETER SCREENED INTERVAL
ARTESIAN FLOW ENCOUNTERED
TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
BASE OF MILLER CREEK FORMATION
GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)
WATER TABLE (MEASURED NOV. 3, 2005)
EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED NOV. 3, 2005)
GROUNDWATER FLOW DIRECTION
NOTES:
1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
3. STRATIGRAPHY FOR AW-1 FROM GEOPHYSICAL SURVEY COMPLETED BY GEOSPHERE, INC. (NOVEMBER 2005).
4. GROUNDWATER ELEVATIONS FROM NOVEMBER 2005 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.
SCALE:
HORIZ. 1" = 80'
VERT. 1" = 20'
PROJECT: ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN
TITLE: FIGURE 3-2 CROSS SECTION A-A'
DRAWN BY: DDZ
CHECKED BY: PJB
APPROVED BY: DPT
SCALE: AS SHOWN
DATE: 30 JULY 2007
PROJ. NO. 26488375
SHEET 3-2
URS



LEGEND

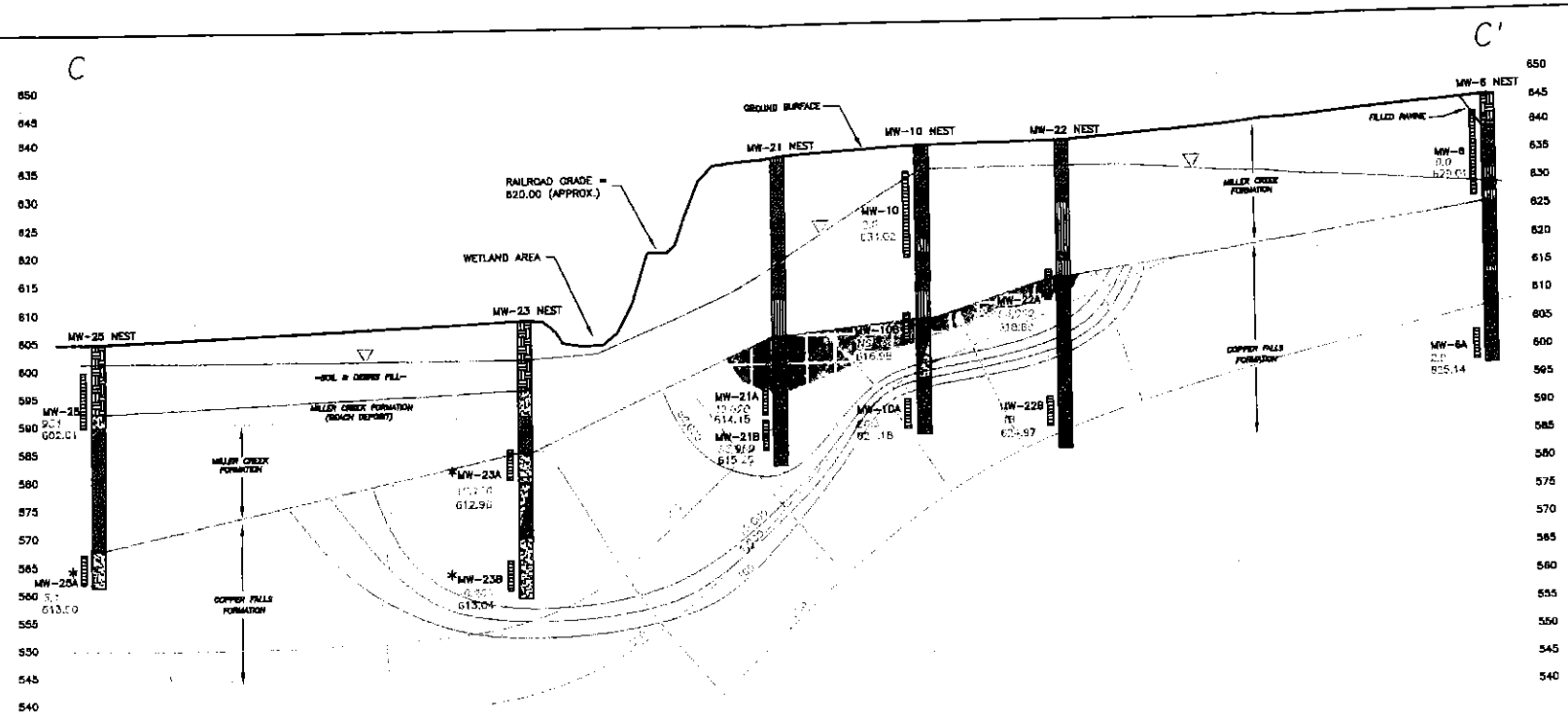
- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- DNAPL
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
- BASE OF MILLER CREEK FORMATION
- 602.10 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)
- WATER TABLE (MEASURED NOV. 3, 2005)
- EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED NOV. 3, 2005)
- GROUNDWATER FLOW DIRECTION

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. SB-1 THROUGH SB-5 SERIES OF SOIL BORINGS FOR ENVIRONMENTAL ASSESSMENT OF WASTEWATER TREATMENT PLANT SITE BY NET (JAN 1989).
3. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
4. LAKE SUPERIOR SURFACE ELEVATION = 602.0 FEET MSL (SOURCE: GSI HYDROGRAPHIC SURVEY, JUNE 2005).
5. GROUNDWATER ELEVATIONS FROM NOVEMBER 2005 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.
6. MW-4A YIELDED 0.8 FEET DNAPL ONLY DURING MARCH 2005; MW-4B YIELDED TRACE DNAPL IN JUNE 2004; MW-4B YIELDED 9.0 FEET DNAPL IN NOVEMBER 2005.

PROJECT:	ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN
TITLE:	FIGURE 3 CROSS SECTION B-B'
DRAWN BY: BBZ	SCALE: AS SHOWN
CHECKED BY: PJS	DATE: 30 JULY 2007
APPROVED BY: DPT	
PROJ. NO. 28486378	SHEET 3-3

URS



LEGEND

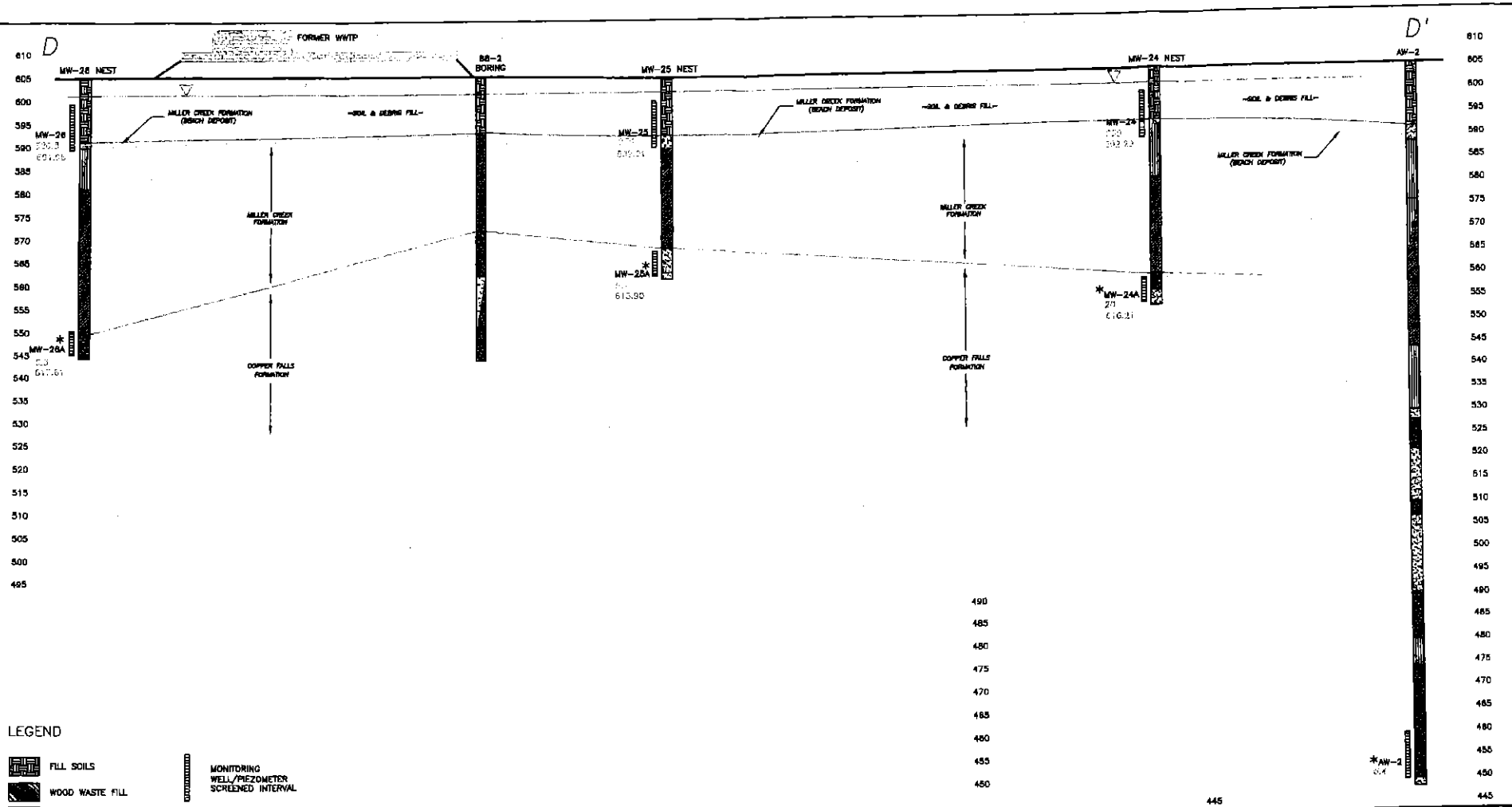
- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- DNAPL
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
- BASE OF MILLER CREEK FORMATION
- 602.10 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)
- WATER TABLE (MEASURED NOV. 3, 2005)
- EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED NOV. 3, 2005)
- GROUNDWATER FLOW DIRECTION

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
3. GROUNDWATER ELEVATIONS FROM NOVEMBER 2005 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.

SCALE:
HORIZ. 1" = 60'
VERT. 1" = 20'

PROJECT: ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN		
TITLE: FIGURE 4 CROSS SECTION C–C'		
DRAWN BY: DDZ	SCALE: AS SHOWN	PROJ. NO. 25688378
CHECKED BY: PJS	DATE: 30 JULY 2007	SHEET 3–4
APPROVED BY: DPT		
URS		



LEGEND

- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
- BASE OF MILLER CREEK FORMATION
- WATER TABLE (MEASURED NOV. 3, 2005)
- 617.61 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)

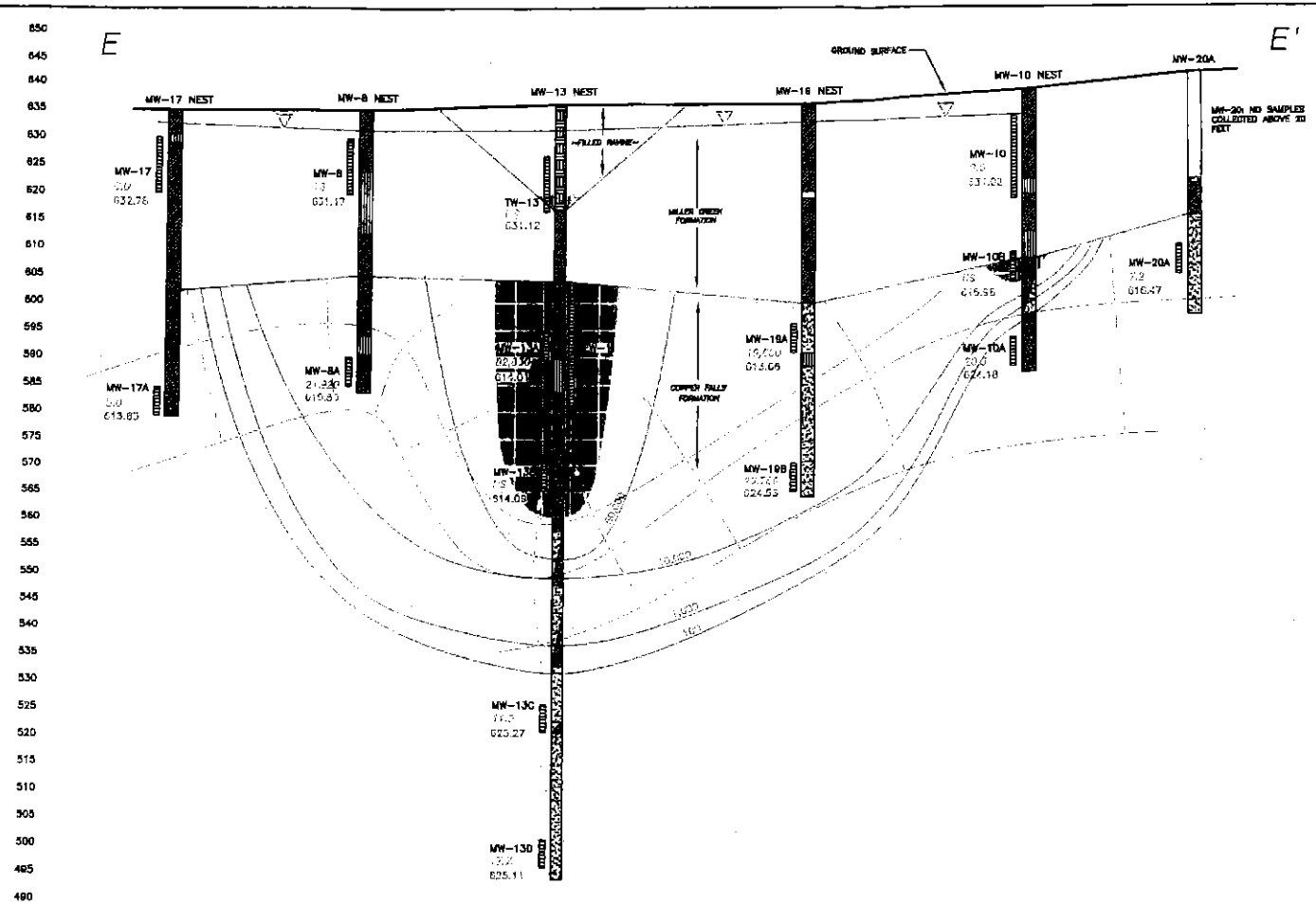
NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. 88-1 THROUGH 88-5 SERIES OF SOIL BORINGS FOR ENVIRONMENTAL ASSESSMENT OF WASTEWATER TREATMENT PLANT SITE BY NET (JAN 1988).
3. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
4. STRATIGRAPHY FOR AW-2 FROM GEOPHYSICAL SURVEY COMPLETED BY GEOSPHERE, INC. (NOVEMBER 2005).

SCALE:
HORIZ. 1" = 80'
VERT. 1" = 20'

PROJECT:	ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN
TITLE:	FIGURE 5 CROSS SECTION D-D'
DRAWN BY: BRZ	SCALE: AS SHOWN / PROJ. NO. 25688375
CHECKED BY: PJB	DATE: 30 JULY 2007 / SHEET 3-5
APPROVED BY: DPT	

URS



LEGEND

- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- DNAPL
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
- BASE OF MILLER CREEK FORMATION
- 602.10 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)
- WATER TABLE (MEASURED NOV. 3, 2005)
- EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED NOV. 3, 2005)
- GROUNDWATER FLOW DIRECTION

SCALE:
HORIZ. 1" = 80'
VERT. 1" = 20'

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
3. GROUNDWATER ELEVATIONS FROM NOVEMBER 2005 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.

PROJECT:	ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN
TITLE:	FIGURE 6 CROSS SECTION E-E'
DRAWN BY: BDZ	SCALE: AS SHOWN
CHECKED BY: PJS	DATE: 30 JULY 2007
APPROVED BY: DPT	
PROJ. NO. 25488375	
SHEET 3-6	

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APPENDIX A
Responsiveness Summary

RESPONSIVENESS SUMMARY
for the Ashland/NSP Lakefront Site

This Responsiveness Summary provides both a summary of the public comments the United States Environmental Protection Agency (EPA) received regarding the Proposed Plan for the Ashland/NSP Lakefront Site and EPA's responses to those comments. The Proposed Plan was released to the public on June 12, 2009, and the public comment period ran from June 17 through August 17, 2009. The Wisconsin Department of Natural Resources (WDNR) provided support on the Proposed Plan. EPA held a public meeting regarding the Proposed Plan on June 29, 2009, at the Northern Great Lakes Visitor Center in Ashland, Wisconsin. WDNR participated in the public meeting, assisted in responding to questions, and provided support at the meeting.

EPA received written comments (via regular and electronic mail) and verbal comments (at the public meeting) during the public comment period. In total, EPA received comments from approximately 20 different people. Copies of all the comments received during the public meeting (including the verbal comments reflected in the transcript of the public meeting) are included in the Administrative Record for the Site. EPA carefully considered all comments prior to selecting the final Site remedy documented in the Record of Decision (ROD).

This Responsiveness Summary does not repeat verbatim each individual comment. Rather, the comments are summarized and grouped by the type of issue raised. The comments fell within several different categories: support for the proposed remedy, future use of the Site, concerns during the Site cleanup, concerns with the proposed remedy and requests for different alternatives.

The Responsiveness Summary contains a summary of the comments EPA received and EPA's responses to those comments, grouped by category.

I. SUPPORT FOR THE PROPOSED REMEDY

A majority of the comments expressed support of the cleanup of the Ashland/NSP Lakefront Site and indicated that the need for protection to human health and the environment from any contaminants existing on the Site is a high priority.

II. FUTURE USE OF THE SITE

Reuse of the property continues to be part of the City of Ashland's plan for the neighborhood. The City has a Waterfront Development Plan that includes the possible development of a marina at the Site. Most of the comments received were in agreement with the City's Waterfront Development Plan which includes the possible development of a marina at the Site.

III. CONCERNS DURING SITE CLEANUP

A couple of comments expressed concern with exposure to air pollutants during cleanup. EPA will require a comprehensive air management plan during cleanup activities. The air management plan will be reviewed by EPA and the state regulatory agencies.

Another commenter was concerned with increased truck traffic and damage to the new Highway 2 if that is the route used. A designated traffic route for trucks coming on or off site will be included in the Remedial Design. EPA will make every effort to notify the community about truck traffic and possible routes. In addition, there were a number of comments expressing concern that the cleanup be done right the first time. EPA will ensure that the cleanup at the Site will be protective of human health and the environment.

IV. CONCERNS WITH THE PROPOSED REMEDY

Most concerns expressed in the comments were the estimated cost of the remedy and how it will affect utility ratepayers. Unfortunately, EPA does not control how the costs are handed down to the ratepayers if Potentially Responsible Parties (PRPs) agree to do the remedial action. The Public Service Commission (PSC) will determine the future rates.

Another commenter recommended cleanup goals for soil and sediment to background levels. They do not agree with the EPA process of utilizing an "acceptable risk" level to calculate cleanup levels that leave residual contamination. They feel that there is no level of "acceptable risk" for increased rates of cancer or health effects due to contamination. It would be too costly and not feasible to clean up the soil. groundwater, and sediment to background levels. As stated above, EPA will ensure that the cleanup will be protective of human health and the environment even if the cleanup is not to background levels.

V. PREFERENCE FOR DIFFERENT ALTERNATIVE

There were a number of comments that indicated a preference for a different sediment alternative. Some of these comments focused on possible safety issues with conducting a dry excavationremedy of near-shore sediments (sediment alternative SED-6), due to the need to install containment walls, pump out lake water and keep lake water out while the contaminated sediments are removed, and from possible exposure of nearby residents to air pollution due to volatilization as contaminated sediments are exposed. Other concerns with a dry excavation of near shore sediments focused on implementation/engineering and costs. These comments stated that the other sediment alternatives (e.g., dredging of the entire bay) would be easier and more cost-effective. Some of the comments suggested a pilot test should be allowed to determine if a wet dredge of near-shore sediments will be as effective and still meet the established Preliminary Remediation Goal (PRG) and performance standards. Based upon EPA's evaluation of all of the sediment cleanup options, EPA believes that the sediment remedy SED-6 (dry excavation

near-shore and dredging off-shore) recommended in the Proposed Plan is the better option to deal with the free product and wood waste in the sediments but since some comments requested a pilot test to see whether another option can be implemented and be just as effective, EPA, in consultation with WDNR, decided to include in the ROD the option to conduct a pilot test for wet dredging near-shore sediments. The ROD includes SED-6 as a final remedy for sediments. However, a pilot test for dredging can be conducted to see if the dredging alternative will meet the established cleanup goal and attain performance standards. If the pre-design pilot test indicates that dredging will attain the established cleanup goal and performance standards then EPA, in consultation with WDNR, will recommend that an alternate sediment remedy SED-4 (dredging) be implemented. If the alternative sediment remedy is determined to be successful in meeting the cleanup goal and performance standards, EPA will publish its decision in an Explanation of Significant Differences (ESD).

VI. COMMENTS

In addition to the summary of comments provided above, EPA is providing detailed responses to the comments received from Northern States Power Company, d/b/a NSPW Energy ("NSPW") in its August 17, 2009, comment letter and attachments. EPA also received joint comments from the contracting firms of Burns & McDonnell, DCI Environmental, and Stevenson Environmental Services. Those joint comments are in a cover letter and report dated August 17, 2009, submitted as part of a team that "was formed for the sole purpose of developing the business opportunities related to the design and construction of the remediation activities that may be completed at the site." NSPW's cover letter "adopts and incorporates by this reference those comments submitted by Burns & McDonnell, DCI Environmental, and Stevensons (the 'Burns Team') that specifically address the concerns and potential problems associated with the proposed implementation of a 'dry' excavation sediment remedy as compared with hydraulic or wet dredging." As NSPW "adopts and incorporates" the Burns Team's comments, EPA will respond to the Burns Team comments, to the extent appropriate, in its responses to NSPW's comments. Many of the comments from the Burns Team, however, are at the level of detail appropriate for the Remedial Design phase of the project. Combined, these comments form a voluminous amount of information that is critical of EPA's Proposed Plan and preferred remedy and require a detailed response.

It is important to note that EPA's Proposed Plan and remedy selected in the ROD are based on the remedial alternatives contained in the Feasibility Study that was produced and submitted by NSPW for EPA approval under the 2003 Administrative Order on Consent.

A. *NSPW's August 17, 2009 Cover Letter*:

NSPW's cover letter summarizes comments that appear in greater detail in its Attachment A, however, a few of the comments in NSPW's letter are highlighted here. Comment 5 asks that "Performance Standards and clear criteria for selecting contingent remedial options need to be defined in the ROD." EPA has considered this comment and included

clear performance standards for selecting contingent remedial options for sediments. Comment 6 states the "ROD should allow for the conduct of pilot tests to collect data needed to optimize the remedial design." EPA has considered this comment and the ROD provides for a pilot test for a hydraulic or wet dredge of near shore sediments to optimize the sediment remedy. Comment 7 states the "PRAP overstates the role of the MGP in causing the contamination observed at the Site and does not fully acknowledge the existence of other potentially responsible parties and the contribution from other sources." EPA does not consider this to be a comment on the Proposed Plan or preferred remedy as it pertains to liability issues that are not part of the remedy selection process or the ROD.

NSPW's comment 8 states that "[a]ll prior NSPW submittals to EPA (and/or WDNR) are incorporated into the Administrative Record." EPA does not agree with this comment. The comment states that, "NSPW hereby incorporates into these comments and into the Administrative Record all prior submittals to EPA (and/or WDNR) related to the Site and expresses its intent to rely on those prior submittals, including but not limited to those documents listed in Attachment B." The National Contingency Plan (NCP), 40 C.F.R. 300.800, states that the lead agency (EPA) shall establish an administrative record "that contains the documents that form the basis for the selection of a response action." Under the regulations EPA is responsible for establishing and maintaining the Administrative Record for the Site and for deciding the contents of that file. NSPW, therefore, cannot add or incorporate documents into the Administrative Record. The contents of the Administrative Record for the Site are listed in the Administrative Record Index. The NCP, 300.810(a), lists the types of documents that typically will be in an administrative record for selection of a response action, including documents containing factual information that may form a basis for the selection of a response action, guidance documents, documents received, published or made available to the public, EPA decision documents and enforcement orders and an index of the documents included in the administrative record. The NCP, 40 C.F.R. 300.810(b), specifically states that the lead agency is not required to include documents in the administrative record which do not form a basis for the selection of the remedy. NSPW's Attachment B lists documents that do not form a basis for the selection of the remedy and that are not properly part of the Administrative Record. Examples include EPA oversight bills to NSPW pursuant to the Administrative Order on Consent, responses to EPA information requests pursuant to Section 104(e) of CERCLA, and a Stipulation and Order for Judgment for settlement of a WDNR cost recovery case. In addition, NSPW has submitted documents and correspondence to EPA marked as confidential for settlement purposes only that NSPW presumably would not want EPA to include in the Administrative Record.

B. ***NSPW Specific Comments:***

Comment: The EPA-derived sediment PRG is highly uncertain and is being misapplied. (NSPW Comments, Attachment A, 2.1)

Response: EPA does not agree with the comment for the following reasons:

- The RI Report submitted by Northern States Power Company (d/b/a NSPW Energy) (NSPW), included a Baseline Ecological Risk Assessment (BERA) Report and Remedial Action Objectives Report (RAO) Technical Memorandum proposed a sediment preliminary remediation goal. EPA modified the sediment PRG through a *Technical Memorandum of the Derivation of Sediment PRG for the Ashland/NSP Lakefront Site* (Tech Memo). The Tech Memo and EPA-derived sediment PRG included all of the data collected by NSPW and WDNR over three iterations of sediment investigations. In addition, the Tech Memo considered well established information on PAH toxicity to benthic organisms to supplement the sediment data. Based upon the sediment data showing the range of contaminant concentrations and the expected effects to the benthic communities, EPA proposed an alternate PRG (2,295 ug PAH/g OC; 9.5 ug PAH/g dwt at 0.415% OC) for the sediment portion of the Site. The Tech Memo is part of the RI Report and is included in the Administrative Record (AR)
- The derivation of the PRG considered all of the sediment toxicity data collected, not just a subset. As illustrated in Figure 1 of the Tech Memo, all toxicity data were plotted on a single figure so they could be compared to the proposed PRG range and evaluated for consistency with that range.
- The PRG derivation was not unusually dependent on limited samples. Responses to site sediments represent an exposure response gradient across the range of PAH contamination represented by site samples. Whenever one attempts to find a threshold for response within this response range, the data points that bracket the response threshold are going to have the greatest influence on the estimated threshold. This is not unique to the site, nor is it different from the approach used by NSPW in deriving their draft BERA and associated draft PRG.
- It was the failure of the sampling program conducted by NSPW to capture sediment samples with contamination near the threshold that left the assessment without high data density in the most important part of the exposure range. Therefore, it is inappropriate for NSPW to criticize EPA's assessment, which utilized the data collected by NSPW, as having insufficient data near the response threshold.
- It was the failure of NSPW's testing program to successfully complete sediment toxicity tests with midge that greatly reduced the amount of data available to confidently establish a response threshold for midge. Again, to criticize EPA's analysis for lacking robust data when NSPW failed to provide the data called for in its own sampling and analysis plan is unreasonable.
- The exclusion of woody debris sites from the PRG derivation was based on an explicit request by NSPW to do so. Note that the woody debris sites were not used as a basis for PRG development in NSPW's draft risk assessment either.
- It is not true that data from the 1998 and 2001 investigations were not used for PRG development. All data were examined (see Tech. Memo in AR). Even if the 1998 and 2001 had not been used by EPA, it would be

unreasonable to criticize EPA on this basis, since in previous comments NSPW characterized those data as being inappropriate for developing ecological risk estimates and chose to rely solely on 2005-2006 data it developed for its own draft risk assessment.

- The comment that EPA relied on too few data is also unreasonable since NSPW's proposed sediment PRG from its draft BERA only relied on two sediment samples. SQT7 and a dilution of SQT1. EPA used five different methods to estimate the PRG (see Tech. Memo in AR) using data from different sources and different sets of assumptions. The fact that this range of methods produced estimates within less than a factor of 3 of one another (1340 to 3930 ug PAH/g OC) lends confidence to the appropriateness of EPA's PRG derivation, which is much more robust than that proposed previously by NSPW.

Comment: The PRG does not adequately reflect site conditions. (NSPW Comments, Attachment A, 2.1.1)

Response: EPA disagrees with this comment for the following reasons:

- The reliance on data for sandy sediments for establishing the PRG was in direct response to a request from NSPW to do so. At the time NSPW was asserting that the results from the woody debris sites were unreliable and should not be used for PRG development. NSPW also used only data for sandy sediments in developing its proposed PRG. To suggest otherwise now is not accurate.
- At the time of PRG development NSPW indicated its preference that only the sandy sediment sites be used to develop a PRG based on organic carbon-normalized data, then those concentrations would be converted to a dry weight PAH concentration to be used as the PRG. At the time of this suggestion, EPA told the NSPW representatives that was a mistake and might be over-protective of woody debris sediments, a concern NSPW dismissed. However, EPA allowed NSPW to develop the PRGs in this way so long as a dry weight PRG based on sandy sediment data should be protective of woody sediments as well.
- The comment also states that the sediment PRG does not account for "background sediment toxicity." EPA also disagrees with his portion of the comment. First, background toxicity was not observed in the 1998 or 2001 studies, so those data would be unaffected. Second, while some of the off-site reference stations selected by the PRP for the 2005-2006 sampling performed more poorly than control sediment, the on-site sandy sediment stations with low levels of PAH contamination did not differ from control; therefore, even if there were a source of background toxicity to *Hyalella* in the off-site reference stations, it was apparently not present at the site itself, or the on-site stations with low levels of PAH contamination would have demonstrated toxicity, which they did not (SQT3, SQT6). Further still, there was no evidence of "background toxicity" in tests conducted with *Lumbriculus*, yet *Lumbriculus* tests conducted by NSPW showed toxicity of the same samples (SQT1, SQT7) that showed toxicity to *Hyalella*, indicating that a similar PRG

would be derived even if the PRP *Hyalella* data were excluded from the analysis.

Comment: The PRG derivation from the toxicity studies was not based on proven methods or sound science. (NSPW Comments, Attachment A, 2.1.2)

Response: EPA disagrees with the comment for the following reasons:

- It is true that interpolation/extrapolation methods were necessary to estimate a PRG from the available data. The primary reason extrapolation methods were necessary was the failure of NSPW's 2005-2006 sampling and analysis to 1) obtain samples over the portion of the contamination gradient most critical to PRG development; and 2) to successfully complete sediment toxicity tests with *Chironomus* as specified in NSPW's Work Plan. At the time the *Chironomus* tests failed NSPW did not repeat the failed tests, hence extrapolation approaches were necessary.
- NSPW asserts that the PRG development should have considered *Hyalella* as more sensitive than *Chironomus*. This is an inaccurate reading of the evidence. While the figures NSPW cites from the EPA 2003b document are correct, they fail to take note that:
  1) the data in the EPA 2003b document were for acute (4-d) tests rather than the 10-d and 28-d tests conducted at the site and by Schuler et al.;
  2) that the data in the EPA 2003b document were taken from studies conducted in different laboratories, at different times, and under different conditions, as compared to the SEH 2001 and Schuler et al. data which used the same test protocols used for the Ashland BERA and represent data collected in parallel in the same laboratory at the same time, a much better basis for comparison;
  3) that one of the tests comprising the *Chironomus* GMAV from EPA 2003b was not even the same species (*Chironomus riparius* rather than *Chironomus tentans* aka *Chironomus dilutus*); and
  4) that using the species relationship NSPW prefers would be in direct contradiction to site-specific data showing that *Chironomus* was more sensitive to site contamination than were *Hyalella* (SEH 2001 data; note also in this context that the failure of NSPW to successfully complete the *Chironomus* testing specified in its Work Plan prevents the species comparison from being expanded further).
- If one assumed that the sensitivity of *Hyalella* really was a factor of 68.4/13.9 = 4.92 greater than *Chironomus*, as asserted by NSPW, then one would logically calculate a PRG by dividing the site-specific Chironomus LC20 of 3760 ug PAH/g OC (SEH 2001) by NSPW's suggesting species sensitivity factor of 4.92 to arrive at a PRG of 764 ug PAH/g OC, which equates to 3.17 ug PAH/g dwt at 0.415% OC. The logical outcome of following this comment, therefore, is a much lower sediment PRG than the one EPA proposed in the Tech Memo.
- NSPW's suggestion that EPA's methods for extrapolation among endpoints within a species or among endpoints between species has no precedent in the

toxicological literature reflects a misunderstanding of toxicological methods. The interpretation of slopes of potency or exposure/response curves as an inferential tool is widely accepted and an established methodology. For example, as early as 1985, EPA used ratios between LC50s and statistical detection thresholds to derive the factor of 2 used to convert a final acute value (based on LC50 values) to a lower concentration (the CMC) not expected to cause substantial acute toxicity (see Stephan et al. 1985). At an even more fundamental level, the very modeling of exposure response curves to produce point estimates for varying effect level is a form of using response curves to estimate other levels of effect; few toxicity tests actually contain a treatment that provides exactly 20 or 50 percent effect, but that does not prevent modeling of the exposure/response slope to estimate those levels of effect from other levels of effect. Using response correlations among species is also common; as just one example, see the Interspecies Correlation Estimation model at http://www.epa.gov/ceampubl/fchain/webice/index.html . In fact a simple Google search for "read across methods toxicity" reveals a long list of applications of endpoint and species extrapolation tools analogous to the approaches EPA used to estimate an EC20 for *Chironomus* from the available data.

Comment: The PRG should reflect current understanding of PAH-associated toxicity to benthic invertebrates at the MGP sites, and the PRG should be applied on an OC-normalized basis to shallow sediments. (NSPW Comments, Attachment A, 2.1.3 and 2.1.4)

Response: These comments are irrelevant to the derivation of the sediment PRG for the following reasons:

- EPA is well aware of the referenced issues regarding black carbon and NAPL partitioning. Dave Mount, an aquatic biologist in EPA's Environmental Effects Research Laboratory in Duluth, Minnesota, is one of the authors of U.S. EPA 2003a, *Procedures for the Derivation of Site-Specific Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Nonionic Organics"* (Office of Research and Development, EPA-600-R-02-012), one of the documents referenced in NSPW's comments critiquing the sediment PRG. Dave Mount was consulted and helped develop the sediment PRG for the Ashland Site. While black carbon and NAPL can affect PAH partitioning, it is incorrect to suggest that these factors negatively affect the PRG development. This comment is irrelevant because four of the five methods used to estimate the *Chironomus* EC20 (see PRG Tech. Memo. in AR) were based on sediment toxicity data from the Site sediments themselves. Accordingly, any influences of black carbon or NAPL on PAH bioavailability in Site sediments were incorporated into the empirical measurement of toxicity in the Site sediments – there is no need to additionally correct these data for black carbon or NAPL. The extrapolations applied to these Site values are relative, and assume only that PAHs are the cause of the observed toxicity, regardless of the nature of the partitioning in the

sediment. So, whatever effects of black carbon or NAPL were operative in the Site sediments, it is accounted for in EPA's sediment PRG derivation.

- One of the 5 methods used to estimate the *Chironomus* EC20 (the value of 2020 ug PAH/g OC in Table 1 of the PRG Tech. Memo.) was based on a literature effect endpoint that would not have considered black carbon or NAPL effects on partitioning. However, it is interesting to note that this estimate derived from literature data, which does not consider black carbon or NAPL partitioning, yielded an estimate of the *Chironomus* EC20 that lies in the mid-range of the estimates based on site-specific data. This implies that while the effects of black carbon and NAPL on PAH partitioning were incorporated empirically, they must not have been very large effects, or there would have been disparity between the literature-derived values and those derived from site-specific sediment data.
- Although the responses above make clear that not using a 3- or 4-phase partitioning model is irrelevant, it is important to note the inconsistency in this comment. NSPW's own draft BERA did not use such models, in fact the assessment of bioaccumulation data by NSPW used the same two-phase approach (OC normalization).
- It is even more inappropriate to criticize EPA for not using a 3- or 4-phase partitioning model because NSPW's own sampling and analysis plan did not include the measurements necessary to create and calibrate such a model. For example, while NSPW references the work of Kreitinger et al. 2007 in criticizing EPA's PRG, NSPW did not include in its work plan the interstitial water PAH measurements that would be necessary to consider a comparable assessment approach as a means to estimate an appropriate PRG. To criticize EPA for not using methods when NSPW failed to collect the necessary data to support such methods is disingenuous.

To put the criticisms of EPA's sediment PRG development in perspective, it is instructive to compare the approach EPA used with the approach NSPW proposed in the draft BERA.

- *NSPW Approach:* The draft BERA prepared by NSPW arrived at a sediment PRG of 5,300 ug PAH/g OC, and converted this to 53 ug PAH/g dwt based on an assumption of 1% organic carbon. The value of 5,300 ug PAH/g OC was based on the geometric mean between two results from one study of sediment toxicity to *Hyalella*. This PRG considered only sandy sediments, and converted this to a single dwt value.

EPA objected to this approach on two primary grounds: 1) the PRG did not consider all of the available toxicity data (e.g., it focused only on *Hyalella* to the exclusion of other species, and relied only on 2005-2006 data); and 2) it used an organic carbon content (1%) for dwt conversion that was higher than that in the sediments used to derive the PRG. In fact, SQT7, a sediment sample the NSPW BERA conceded was unacceptably toxic, would not have exceeded NSPW's proposed PRG. Adopting a PRG that would allow such a toxic concentration

would not comply with the remedial purposes of CERCLA and the RAOs for the Site.

- *EPA Approach:* Like NSPW (in fact, at its request), EPA's PRG development focused on sandy sediments. However, EPA considered the evidence that both *Hyalella* and other species would be unacceptably affected by sediments at the NSPW-proposed 53 ug PAH/g dwt. Accordingly, EPA used available data to estimate a threshold for toxicity (EC20) for the most sensitive organism to Site contamination in sandy sediments, as demonstrated in Site-specific toxicity testing (*Chironomus).* This value, expected to protect against toxicity not only *Hyalella* but other tested organisms as well, was converted to a dwt value using the measured organic content found in Site sediments closest in contamination to the estimated threshold (0.415% OC).

This comparison shows that the methods proposed previously by NSPW and used by EPA were very similar, differing only in EPA estimating a threshold for all species instead of just *Hyalella*, and in using the appropriate site-specific organic carbon content to convert to a dwt value, instead of a generic 1% value used by NSPW.

The comparison of the two approaches shows that the criticism of EPA's sediment PRG is misplaced:

- NSPW criticizes EPA for using too little data to establish the PRG, but the approach proposed by NSPW relied on only two samples (SQT7 and a dilution of SQT1).
- NSPW criticizes EPA for using toxicity data for *Hyalella* on the assertion that there was background contamination, yet NSPW used those same samples to establish its proposed PRG.
- NSPW criticizes EPA for using only sandy sediment data for deriving the sediment PRG, but NSPW also used only sandy sediment data for deriving its proposed PRG.
- NSPW criticizes EPA for applying a single dry-weight based PRG to all Site sediments without separately considering woody sediments; NSPW's proposed PRG did exactly the same thing.
- NSPW criticizes EPA for not applying a three- or four-phase partitioning model to Site sediments, but NSPW's draft BERA did not use a three- or four-phase partitioning model, used the exact same organic carbon normalization, and used exactly the same OC normalization as EPA.

Comment: Sediments and surface water do not pose a risk to human health. Sheen chemical concentration estimates in surface water are unreliable. Sheen risks inappropriately assumed frequent exposure. (NSPW Comments, Attachment A, 2.2, 2.2.1 and 2.2.2)

Response: EPA disagrees with the comments for the following reasons:

NSPW's comment states there is "uncertainty as to whether DNAPL in the sediment is actually the source of sheens that have been observed in the bay. Although DNAPL in the sediment is a potential source, there are other potential sources in the area that could release sheens to the bay. These include discharges from storm sewers and combined sewer overflows, subsurface migration from upland sources in Kreher Park, as well as marina use."

According to NSPW's own calculations (see letters in the administrative record from Dames & Moore dated March 2, 1998 and December 4, 1998), there are over 2,000,000 gallons of coal tar/oils in the sediments. The formation of slicks has been observed in the areas where coal tar/oil in sediments is present suggesting that the slick source is the coal tar in the sediments. Also formation of slicks has been documented during sediment sampling performed by NSPW. Furthermore, the slicks are associated with coal tar odors suggesting coal tar/oils in sediment as the source for the slicks. Therefore, all information (location of slicks, presence of coal tar/oils in the sediments, odor associated with the slicks etc.) presents a strong basis for the conclusion that coal tar/oils in the sediments are the primary source of slicks observed in the bay.

In addition, the comment also states "there are no unacceptable human health risks to either a swimmer or wader from exposure to sediments or surface water," and bases this statement solely on the exposure risk calculations presented in NSPW's September 2007 Human Health Risk Assessment (HHRA) report, but dismisses the report's hypothetical risk calculations for non-aqueous phase liquids (NAPL) in surface water as "unrealistic, technically unjustifiable, and not based on *any* sheen data." EPA disagrees with this comment and finds that the surface water and sediment conditions at the Ashland/NSP Lakefront site pose a *human health hazard.*

In a letter to EPA dated October 4, 2009, the Wisconsin Department of Health Services (DHS) strongly disagreed with NSPW's comments and conclusion that sediment and surface water at the Site do not pose a risk to human health. The DHS letter is included in the Administrative Record for the Site and is quoted below:

> "In 2007 DHS provided comments on various drafts of NSPW Energy's Remedial Investigation (RI) and HHRA reports. DHS noted a substantial shortcoming with the draft RI report that sampling efforts failed to collect surface water data that adequately characterized the constituents of coal tar slick/NAPL events at the site. While the release from impacted sediments to surface water of such coal tar slick events are not common at the site, they can be generated by either human or natural forces, have been observed during sediment sampling (both from watercraft and through ice during winter months), and described by community members, and on one occasion were photographically documented.
>
> "DHS has also expressed concerns that the various drafts of the HHRA report did not adequately address and assess the human health risks of direct contact with

coal tar slick impacted surface water. NSPW acknowledged that coal tar slick/NAPL events do occur on surface water at the site, but was unable to collect a sample that characterized the concentrations of constituents during these events. NSPW then approached state and federal agencies and proposed the alternative method of substituting NAPL-impacted groundwater data from the Copper Falls aquifer and using this data to calculate hypothetical human health risks from exposure to coal tar slicks in surface water. To avoid further delays in completing the RI and HHRA, the agencies concurred with this proposal.

"In comments on the proposed plan, NSPW now inaccurately implies this approach was requested by agencies, declares this data substitution to be "inadequate", and rejects the findings of their own proposed model for the human health risk assessment of surface water at the site. In their comments, NSPW puts forth a more recently developed approach for estimating the qualitative and quantitative aspects of contaminant constituents in coal tar slicks in surface water at the site, which results in findings that drastically differ from NSPW's September 2008 HHRA. While there may be some merit to this latest NSPW proposed estimate for deriving contaminant concentrations in surface water, it is very unusual to derive environmental contaminant data following such an approach. Furthermore, NSPW should have proposed this approach prior to completing the RI and HHRA reports. DHS does not support nor concur with NSPW's recently proposed approach. Until coal-tar slick impacted surface water is collected at the site, DHS recommends using the approach for assessing human health risks to surface water coal-tar slicks that was previously brought forward by NSPW and described in the their own September 2007 HHRA report.

"The NSPW Proposed Plan comments are also critical of the exposure time, frequency, and duration used by the HHRA for estimating risks for exposure to coal-tar slicks/NAPL in surface water. It is the opinion of DHS that coal tar slicks pose the greatest human health risks of contaminated environmental media at the Ashland/NSP Lakefront site, and this includes unacceptable acute health risks from a *single* exposure. An inherent flaw and shortcoming of all quantitative human health risk assessments conducted for coal-tar contaminated sediments at former manufactured gas plants (MGP) is the difficulty of quantifying the acute human health risks from direct, dermal contact with wide ranging mixture of aromatic volatiles and semivolatiles (PAHs) typical of non-aqueous coal tar slicks that are released from impacted sediments. The empirical data is clear that a single instance of direct dermal contact with constituents common in coal tar slicks/NAPL can cause irritation and damage to the skin. DHS' opinion is supported by the findings of the 2003 Public Health Assessment for the Ashland/Northern States Power, as issued by the U.S. Agency for Toxic Substances and Disease Registry. The Public Health Assessment concluded that tar slicks in surface water are a 'human health hazard,' due to clear evidence of adverse health effects from regular or a single instance of direct contact."

Comment: EPA has not demonstrated that NAPLs present in deep Chequamegon Bay sediments are a Principal Threat Waste. (NSPW Comments, Attachment A, 2.3)

Response: EPA disagrees with the comment for the following reasons:

According to EPA guidance, "Principal Threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained..."

"Source material is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water..."

As described in the final RI, free product in sediment samples has been observed in the form of emulsions. In general, these sediment samples where emulsions were observed correspond to both high VOC and PAH levels. Emulsions observed in sediment samples generally correspond to total PAH levels greater than 1,000,000 µg/kg. Benzene and total PAHs were detected in the sediments and wood waste higher than the WDNR threshold effects concentration (TEC), approximately 1,000 and 6,000 times higher, respectively. The PAH and VOC contamination (free product, NAPLs) found in the sediment at the Ashland/NSP Lakefront Site is considered to be highly toxic. In addition, oil slicks continue to form on the surface water in the Chequamegon Bay during high-wind events or when the sediment is disturbed which means the source material is highly mobile.

Comment: Appropriate sediment performance standards must be established in the ROD. (NSPW Comments, Attachment A, 3)

Response: The sediment performance standards are included in the ROD.

Comment: The sediment PRG is not a remedy performance standard, and the PRG is a value that needs to be met on average, not on a point-by-point basis. (NSPW Comments, Attachment A, 3.1 and 3.2)

Response: The PRG is the sediment cleanup goal that was established for the Ashland/NSP Lakefront Site during the remedial investigation/feasibility study. (Note that, upon issuance of the ROD, the sediment cleanup goal is no longer considered a "preliminary cleanup goal.") This goal was established utilizing site specific data (see PRG Tech. Memo in AR). The ROD states that the remediation should try to attain the cleanup goal by removing all sediment with a PAH concentration above the sediment remedial action level (RAL). The performance standards specified in the ROD, as well as in EPA letters to the PRP that are part of the Administrative Record for the Site, state that upon completion of removal activities a surface weighted average concentration (SWAC) of 9.5 ppm total PAHs needs to be achieved with no sample exceeding 22 ppm total PAHs.

Comment: EPA's proposed sediment remedy does not objectively satisfy NCP criteria. Sed-6 fails the NCP short-term effectiveness (health and safety) criterion relative to Sed-4. (NSPW Comments, Attachment A, 4 and 4.1)

Response: EPA disagrees with the comments for the following reasons:

NSPW states that sediment remedial alternatives SED-4, SED-5 and SED-6 all meet the first two ("Threshold Criteria") of the nine criteria for the detailed analysis of alternatives in the National Contingency Plan (NCP), 40 C.F.R. § 300.430(e)(9)(iii). NSPW asserts, however, that SED-4 is clearly superior to SED-6 with respect to the short-term effectiveness and implementability criteria (two of the five "Balancing Criteria") and considering community acceptance (one of the two "Modifying Criteria"). NSPW states that "Sed-6 will take longer to implement than Sed-4, causing greater disruption to the community and greater short-term health and safety risks." *(NSPW Comments, Attachment A, 4)* NSPW also claims the dry dredge technology in SED-6 has not been proven safe or effective at a sediment dredge project of this size in the open waters of the Great Lakes. NSPW also states that several public comments question SED-6 as more expensive than SED-4.

First, SED-6 (dry excavation near shore, mechanical or hydraulic dredge offshore) does satisfy the NCP criteria and was determined by EPA to be a better alternative than SED-4 (mechanical or hydraulic dredge both near shore and offshore sediments) considering the short-term effectiveness and implementability criteria. As discussed in the Proposed Plan and ROD, the location of the coal tar/oils in the sediment beneath and mixed with large amounts of wood debris make dry excavation the superior remediation technology to safely remove contaminated sediments, including free product, and achieve the remedial action objectives (RAOs) for the Site. Dry excavation technology will allow workers to visually observe conditions to safely remove wood debris and free product whereas wet dredging is not effective for removing tars and oils beneath or mixed with wood waste as workers will not be able to visually observe conditions as sediments are resuspended and coal tars and oils cloud the water. If SED-4 were to be implemented using a hydraulic dredge technology, wood debris would likely cause interruptions and extend the length of the project as machinery is clogged and has to be cleared and repaired. If SED-4 were to be implemented mechanically this would result in the resuspension of large quantities of contaminated sediment and coal tar and oils, including surface sheens, threatening a release to the greater bay. In order to address this threat much time and money would have to be dedicated to containing the surface sheens, disturbed free product, and resuspended sediments. In addition, a wet dredge would result in the need for confirmation sampling and possible re-dredging to remove contaminated sediment that is resuspended and then settles back onto the lakebed at levels above the established performance standards. Storms and wave action would also require suspension of dredging activities as equipment located on barges could not operate safely further delaying the project. NSPW's comments do not account for these factors when evaluating the short-term effectiveness and implementability of wet dredge technologies in removing NAPL-contaminated sediments that are co-located with thick deposits of wood debris and the resuspension of contaminated sediments and the resultant

recontamination of the lake bed that would necessitate additional sampling and dredging of the residual sediments.

NSPW's comment states "the significantly longer duration and increased labor required for Sed-6 *versus* Sed-4 carries with it increased risk to worker health and safety during remedy implementation." *(NSPW Comments, Attachment A, 4.1)* According to Table 8-11, *Evaluation of Short Term Effectiveness for Potential Remedial Alternatives for Sediment*, in NSPW's Final FS, however, there is no mention that SED-6 will take any longer to complete than SED-4. Both SED-6 and SED-4 should have similar short-term risks to the public and worker health and safety during implementation. Worker and community protection will be required and engineering controls will be needed for all sediment remedies during dredging, dewatering and treatment. Table 8-11 of the FS states that "[d]redging could also agitate sediments, lead to resuspension, dissolution and dispersal. Nearby residents may experience increased exposure to VOCs during dredging or excavation and onshore sediment treatment operations." There are short-term health and safety concerns, therefore, associated with both alternatives that will be addressed during the remedy design.

Despite EPA's concerns about the short-term effectiveness and implementability of wet dredge technologies to remove the near-shore sediments, in the ROD, EPA has allowed for a wet dredge pilot test for the near-shore sediments to address NSPW's concerns with SED-6. The pilot test would be used to determine whether wet dredge technologies can effectively be implemented to remove contaminated sediments and achieve the established remedial action objectives (RAOs). The performance standards in the ROD would be used to evaluate the effectiveness and implementability of SED-4. If the wet dredge proved effective and implementable through the pilot test, the ROD states that EPA would then recommend SED-4 as the alternate remedy for the contaminated sediment portion of the Site.

Comment: "There are dry dredge safety and environmental impact concerns from basal heave failure." (NSPW Comments, Attachment A, 4.1.1)

Response: EPA agrees that there are safety and environmental impact concerns with any of the sediment remediation alternatives and that these concerns will be addressed during the Remedial Design phase, but disagrees that concerns from basal heave should cause EPA to not select SED-6 for the following reasons:

The issue of basal heave was brought up by NSPW in its comments on the Proposed Plan, and was not looked at or included in the Feasibility Study. For this reason EPA did not address this issue in the Proposed Plan. Based on this comment, however, EPA did a more extensive evaluation of basal heave based on Site-specific data (see *Technical Memorandum Conceptual Geotechnical Assessment for Sediment Removal*, Weston, November 20, 2009). The study conducted by Weston on behalf of EPA and included in the Administrative Record concluded that the near-shore bay bottom sediments can be safely removed using dry excavation techniques assuming that conceptual planning, final design engineering and implementation of the construction work are all properly

executed. However, in order for the final design of the dry excavation alternative to be properly completed, additional geotechnical data on the clay layer in the Chequamegon Bay is required. Therefore, EPA will ensure that the issue of basal heave is thoroughly investigated and evaluated during the pre-design phase.

Comment: "Safety risks of implementing Sed-6 significantly exceed safety risk of Sed-4." (NSPW Comments, Attachment A, 4.1.2)

Response: EPA agrees there are safety risks with any of the sediment remediation alternatives and that these risks will be addressed by taking necessary safety precautions and use of appropriate engineering controls, but disagrees that the safety risks of implementing SED-6 significantly exceed safety risks of SED-4 for the following reasons:

The safety risks were not identified in the PRP-prepared FS. Safety risks are inherent with any construction or remedial action project. The safety risks are either addressed by taking appropriate safety precautions or use of appropriate engineering controls. The PRP will be required to evaluate the safety risks during remedial action and will be required to minimize or eliminate the risks by taking appropriate safety measures or through use of appropriate engineering controls. For the remedial action, a health and safety plan and contingency plan will be required. These plans will address safety risks associated with the selected remedy. It is important to note that the table presented in NSPW's comment that shows an increased occupational risks of death or injuries of 23% associated with implementing SED-6 versus SED-4 *(NSPW Comments, Attachment A, 4.1.2 at 27)* is based purely on an assumption of increased man hours and not on riskier or more dangerous technologies or processes required to implement SED-6 versus SED-4. Statements of an increased risk to workers associated with SED-6 are misleading and inappropriate and any sediment remedy will require a health and safety plan and contingency plan.

Comment: "Air emissions from Sed-6 exceed emissions for Sed-4." (NSPW Comments, Attachment A, 4.1.3)

Response: EPA disagrees with the comment for the following reasons:

There is no basis for the assertion that air emissions from SED-6 exceed emissions for SED-4 because SED-6 was never evaluated in the bench scale emission test (Appendix B3 for the FS). Review of the bench scale emission test results, which are based on worst case scenario assumptions, would tend towards a conclusion that the two alternatives would likely result in the same amount of air emissions. However, nothing definitive can be stated at this time because as pointed out, SED-6 was not evaluated by NSPW for air emissions. Further, this will be addressed during pre-design and design phase of the remedial action. However, use of appropriate engineering controls will be utilized to minimize or reduce air emissions.

Comment: "Community Disruption Greater Due to Much Longer Duration of Sed-6 Relative to Sed-4.

The Sed-6 alternative will require one to two or more years than Sed-4 to implement (based on the FS-estimated durations of approximately four versus two years), with associated community impacts such as noise, odors, loss of Kreher Park use, delay of implementation of the City's Waterfront Redevelopment Plan and truck traffic during that longer time period. Significant additional elements required for the Sed- 6 alternative that are not necessary for the Sed-4 alternative and will result in prolonging the project unnecessarily include the following:

- *Conduct pre-trenching along proposed landward sheet pile alignment;*
- *Move/abandon existing utilities on the east and west sides on the upland areas;*
- *Install wave attenuator(s) or break wall;*
- *Install reinforced sheetpile in lake and along the east and west sides (this is structurally stronger than the sheetpile that potentially will be installed as part of Sed-4 to control dispersion);*
- *Operate lake water removal system and treatment plant for water inside of containment to drain bay prior to dry excavation and maintain bay drained during excavation; and*
- *Remove more extensive piling in bay and on the east and west sides, upon project completion.*

In addition, the schedule could be significantly extended further for a variety of reasons under the Sed-6 scenario, such as a need to construct coffer dam cells to prevent cross contamination and mud flows; failure of the lakeside sheetpile due to ice damage in the spring which may be avoided in Sed-4; failure of the sheet pile wall due to groundwater upwelling; flooding conditions caused by excessive wall leakage, basal heave or storm events; potentially lower productivity due to higher worker health and safety personal protection levels related to higher emissions in the excavation area and water management tasks; and equipment or power failures affecting the dewatering equipment." (NSPW Comments, Attachment A, 4.1.4)

Response: EPA disagrees with the comments for the following reasons:

As mentioned above, the timelines presented in the FS are rough estimates just as the costs are. EPA feels that the difference in duration of SED-4 and SED-6 is very small if the technology used achieves the performance standards. Therefore, the community disruption should be similar for SED-4 and SED-6.

The ROD includes SED-6 (dry excavation near shore, mechanical or hydraulic dredge offshore) as the primary remedy for sediments. However, a pilot test for dredging (SED-4) can be conducted during the pre-design to see if the dredging alternative will meet the cleanup goal and performance standards specified in the ROD. If a pre-design pilot test indicates that dredging will attain the established cleanup goal and performance standards

then EPA, in consultation with WDNR, will recommend that an alternate sediment remedy SED-4 (dredging) be implemented.

Either SED-6 or SED-4 will require a semi-permanent confinement system in the bay (sheet pile, breakwater wall) at the outer edge (north) of the Site work area. The details of the system and exact requirements will be fully delineated during the Remedial Design for the sediment remedy. EPA and WDNR repeatedly informed NSPW of this requirement during preparation of the FS. With the quantity of free product (over 2,000,000 gallons of coal tar/oils in the sediments, per NSPW documents dated March 2, 1998, and December 4, 1998) and high concentrations of contaminated sediments, an outer containment system is essential so that these contaminants do not migrate off-site to areas of Chequamegon Bay or Lake Superior outside the Site boundaries. Silt curtains and hydrocarbon booms are not expected to provide adequate protection to keep contamination from being released from the Site and entering Chequamegon Bay and Lake Superior outside the remedial response area, and therefore, a sound containment system (i.e., sheet pile) will be necessary to protect the waters of Chequamegon Bay and Lake Superior.

The NSPW comment states that installing a wave attenuator or breakwater and installing reinforced sheet piling on the east and west sides of the bay are required for SED-6, but not SED-4. Both sheet piling and a breakwater are elements of a sediment remedy regardless of whether SED-6 or SED-4 is selected. Additional sheet piling or coffer dams would be required for SED-6 as determined during the Remedial Design, but both SED-6 and SED-4 require a breakwater and sheet piling. As a result, many of the issues the comment highlights regarding scheduling and technical issues associated with installing a breakwater and sheet piling are not unique to SED-6 and also exist with SED-4.

The comment also incorrectly states that a water removal system and treatment facility for the dry excavation is a unique element of SED-6, when in fact SED-4 would also require operation of a water removal system and treatment facility for the dewatering of contaminated sediments following dredging.

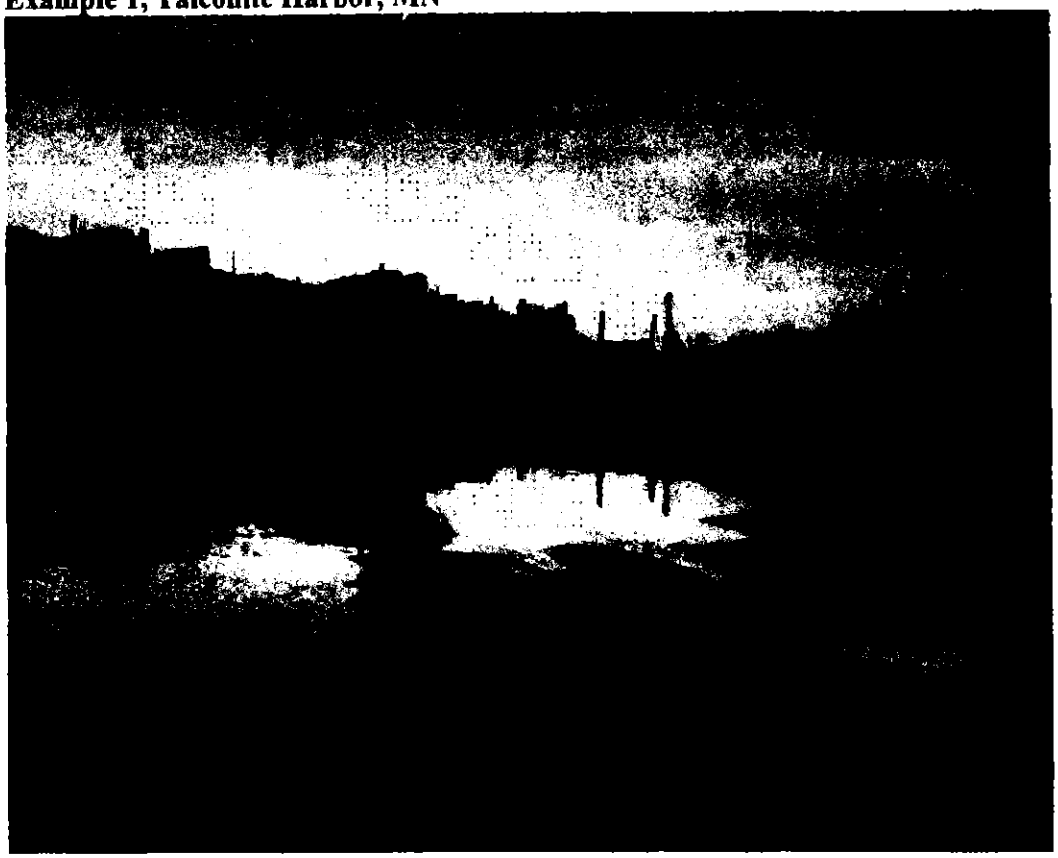
Comment: "Sed-6 fails the NCP Implementability Criterion Relative to Sed-4. While dry excavation has been successfully used, the majority of sites where it has been implemented are on small bodies of water (e.g., wetlands, streams, or ponds), which can be dewatered or rerouted relatively easily to facilitate removal by conventional excavation equipment. There is little, if any, precedent for using dry excavation at open coastal sites (i.e., either marine or large lakes), which involves removal of large quantities of sediment (> 10,000 cubic yards). A review of EPA Region V sediment sites indicated that sediment removal was undertaken by wet dredging at the majority of these sites (Table 4.1). Thus, the selection of Sed-6 remains an unproven remediation option..." (NSPW Comments, Attachment A, 4.2)

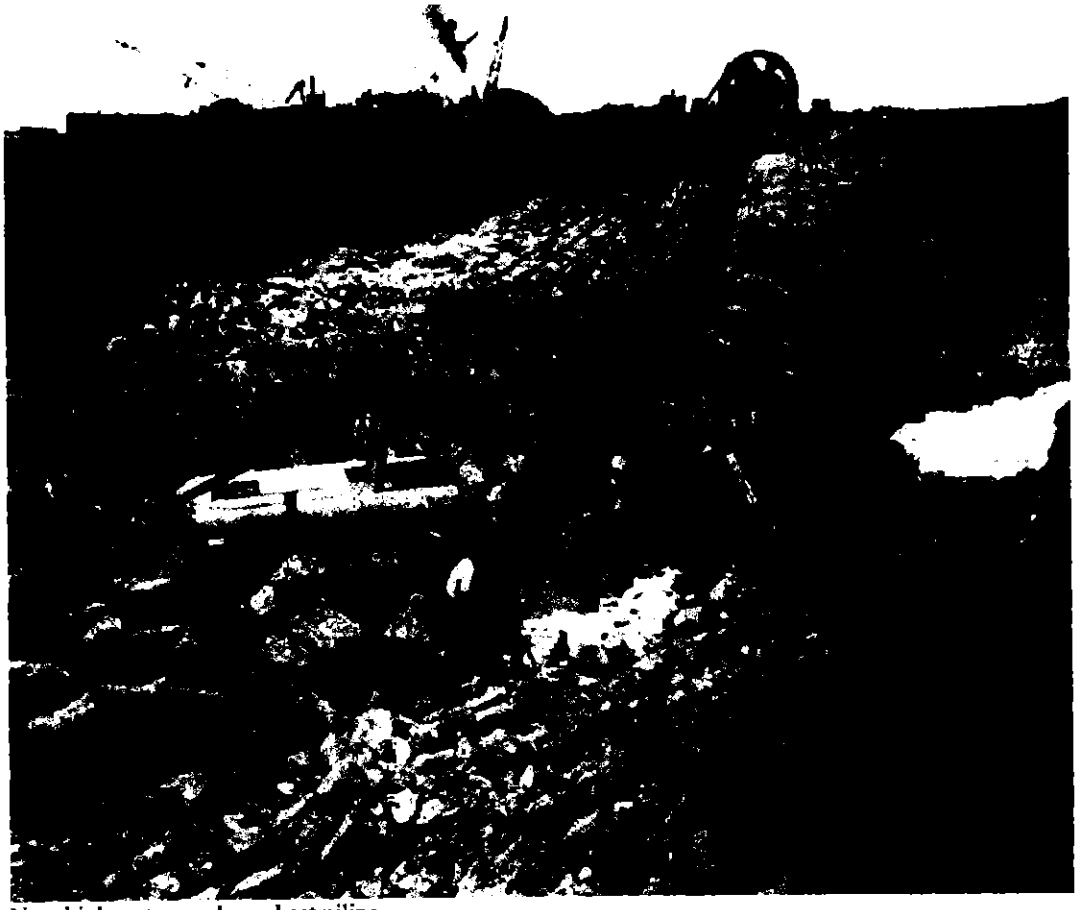
Response: EPA disagrees with this comment for the following reasons:

According to Table 8-12, *Evaluation of Implementability for Potential Sediment Remedial Alternatives* in the FS, SED-6 will be more difficult to implement due to the installation of safe and watertight enclosures. However, it does not state that SED-6 is not implementable. In addition, in the column describing Reliability of Technology for SED-4 and SED-6, it states that the technologies and process options used as part of this alternative have been used on many contaminated sediment sites with success. In the Availability of Services and Materials column, it states that services necessary for this alternative are readily available and proven technologies. Therefore, the FS determined that SED-6 is implementable and a proven technology which means that it does not fail the NCP implementability criterion.

In addition, dry excavation has been used successfully around the world in both large and small water bodies, including Lake Superior. Much of the excavations at Taconite Harbor in Minnesota were carried out in the 1950s – 60s in a dry dredge scenario using sheet piles to hold back Lake Superior. Most lock and dam work is carried out in the dry. The technology and problems are the same for environmental dredging as it is for civil engineering. Below are some examples of dry excavation projects.

Example 1, Taconite Harbor, MN





Note high water mark on sheet piling

Example 2
VELSICOL CHEMICAL CORP. (MICHIGAN)
EPA ID# MID000722439
Last Updated: November, 2008

On June 8, 1998, U.S. EPA signed an Action Memorandum for a time-critical removal action to address the most highly-contaminated sediments in the Pine River. The Action Memorandum called for dredging/ excavating sediments containing 3,000 ppm total DDT or greater (the hot spot), treatment of the sediments with a stabilizing/drying agent, and offsite disposal of the sediments. The removal action also included building necessary infrastructure such as roads, a staging pad, and a water treatment plant. Construction of the infrastructure was substantially complete by November 1998. Sediment removal began in the spring of 1999 and was completed in October 1999.

For the remaining contaminated sediments not addressed by the removal action, a streamlined Remedial Investigation and Feasibility Study (RI/FS) Report and Proposed Plan were made available to the public in August 1998. U.S. EPA signed a Record of Decision (ROD) on February 12, 1999, selecting Alternative 4 (Hydraulic Modification

of the Pine River, Excavation of Sediments, Dewatering and Water Treatment) and Alternatives 5 and 6 (disposal of contaminated sediments in either a Resource Conservation and Recovery Act Subtitle D or C landfill). The ROD contemplated the use of temporary cofferdams and the dry excavation of sediments, but also recognized that the installation of temporary cofferdams might not be implementable in all locations in the St. Louis Impoundment and that some of the sediment removal might need to be completed using mechanical or hydraulic dredging. In accordance with the ROD, remedial action work in the Pine River would include the following components: installation of temporary cofferdams in the St. Louis Impoundment; dewatering of the areas within the cofferdams; dry excavation of the sediments; stabilization of the sediments with a drying agent; treatment of the water removed from the excavation areas; ongoing monitoring of operations to ensure protection of workers and the community; ongoing water column and air monitoring; and sediment sampling after completion of the excavation work to ensure the completion of the project. In addition, the State of Michigan would continue to monitor fish levels until the fish advisory can be removed.

U.S. EPA began Phase I remedial action work in the fall of 1999 with the installation of sheet piling to construct cofferdams and to divide the southern half of the river into manageable cells. Phase I cleanup activities were completed during the 2003 construction season. Within the Phase I area, an access road with 20 seven-foot diameter culverts was built. This access road would later be utilized during the Phase II remedial action activities in order to reach the northern half of the river. U.S. EPA began dewatering and sediment removal in the northern half of the river (Phase II) in the summer of 2004 and completed the work in 2005, with the removal of the northern sheet piling completed in early 2006. During the 2006 construction season, U.S. EPA again dewatered the southern half of the river so that the in-river haul roads could be removed and the remaining contamination in the equalization basin could be excavated and shipped offsite for disposal. The remedial action work in the river was completed by the end of 2006.

The use of dry excavation methods for cleanup of the Pine River sediments facilitated the discovery that the slurry wall around the 52-acre former plant site was failing, and Dense Non-Aqueous Phase Liquid (DNAPL) was migrating from the main plant site into the glacial till underlying the river sediments. Adaptive change management during the Pine River remedial action handled the discovery of DNAPL without losing construction time. By the end of 2006, a total of approximately 4,355 gallons of DNAPL had been pumped from the river bottom (3,275 gallons of which were pumped out during 2002), approximately 640,000 cubic yards of sediment had been removed, an estimated 222 tons of DDT had been removed from the river, and approximately 1,400 linear feet of interceptor trench had been installed along the riverbank to collect DNAPL migrating from the plant site (including an additional section of interceptor trench installed in 2006 in the area near the former equalization basin). Laterals to the trench were installed to extend into the cells where residual DNAPL within the till was left in place due to the proximity to the lower water table. U.S. EPA also constructed a clay cap over the areas of the river bottom with residual DNAPL to isolate the contaminants from the river.

Dry excavation like the remediation project that done at the Pine River costs about $145 per cubic yard, while dredging the bottom without removing the water costs $100 to $400 per cubic yard. Another method, at only $50 per cubic yard, is to leave the sediment in the water and cover it with sand and rocks.

Example 3
Eyemouth Harbour Development
Berwickshire, UK

Project outline

A deep water basin extension to the historic fishing harbour, providing greater facilities and access for larger fishing boats at all states of the tide. After marine site investigations, the conceptual design was tested and validated by model studies before proceeding to detailed design, approvals, consents and tendering.

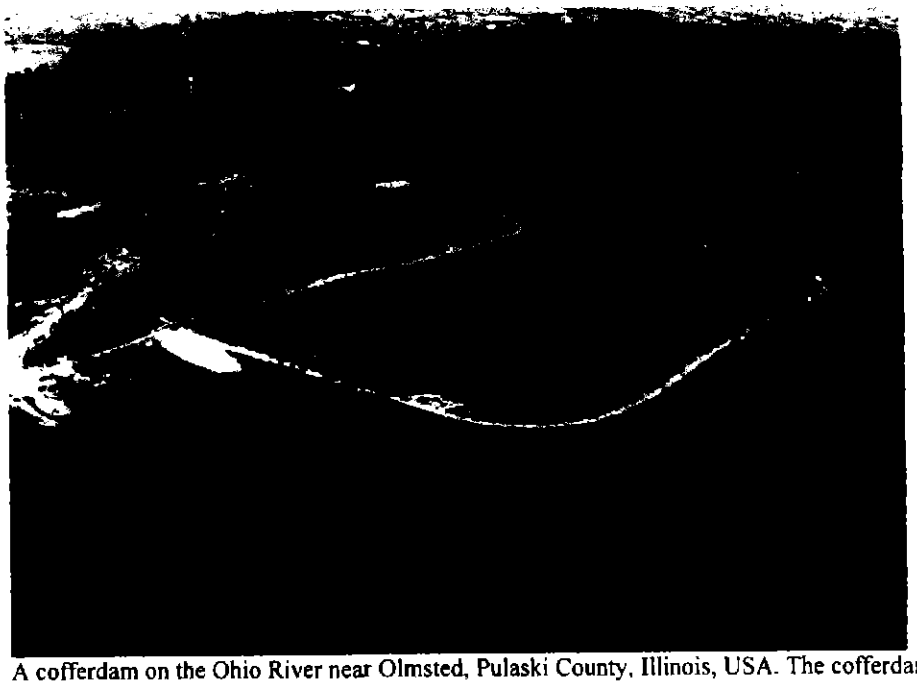
Construction comprised the following main elements:

- Dredging harbour approach and navigation channel
- Main basin work done in the dry behind cofferdam
- Excavation of 60,000 m3 of rock for new basin

Additional Examples of Dry Excavation Projects:

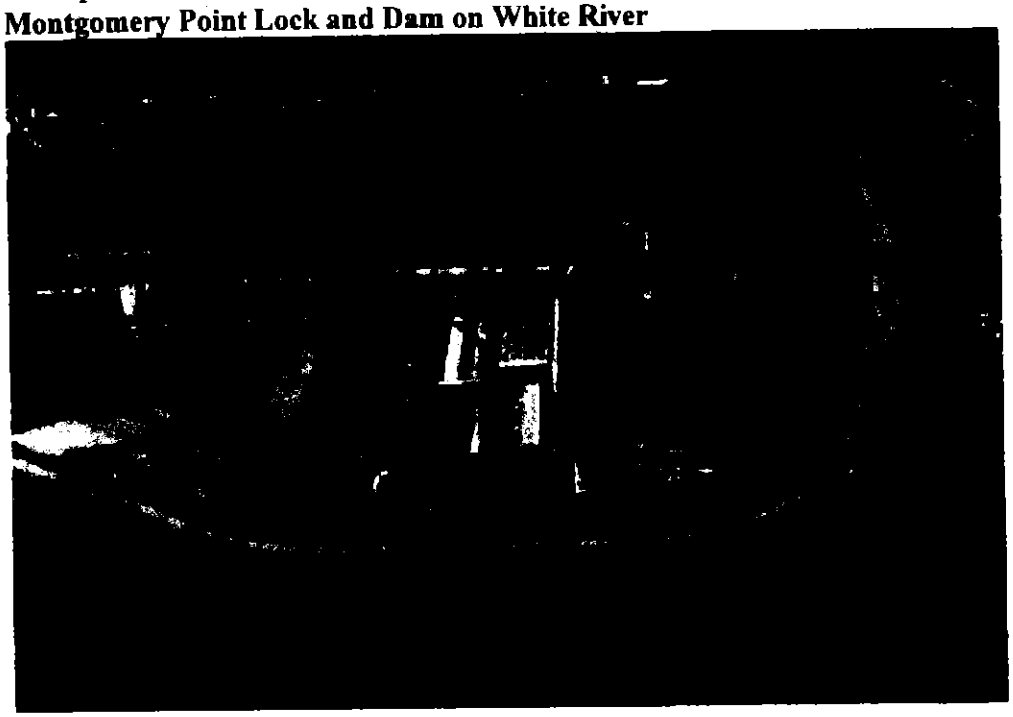
Example 4

Olmstead Lock and Dam on Ohio River



A cofferdam on the Ohio River near Olmsted, Pulaski County, Illinois, USA. The cofferdam was constructed by the U.S. Army Corps of Engineers for the purpose of constructing the Olmstead Lock and Dam on the Ohio River.

Example 5
Montgomery Point Lock and Dam on White River



Cofferdam, Montgomery Point Lock and Dam, White River, Arkansas

Example 6
Bryant mill pond/Kalamazoo River:
[illegible]

Example 7
Newburgh Lake/Rouge River, MI
http://www.rougeriver.com/techtop/newburgh/index.html

Comment: "Sed-6 Fails the NCP Cost-Effectiveness Criterion Relative to Sed-4." (NSPW Comments, Attachment A, 4.3)

Response: EPA disagrees with the comment for the following reasons:

As stated in the Final FS, the estimated costs were prepared in accordance with the EPA guidance document *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study (EPA and USACE, OSWER 9355.0-75, July 2000)* ("Cost Guidance"). The Cost Guidance explains that "[d]uring the FS, cost estimates are developed for each remedial action alternative for comparison purposes. The accuracy of these estimates is linked to the quality of the RI data, which helps define the scope of each alternative. Because the RI/FS cannot remove all uncertainty no matter how good the data may be, the expected accuracy of cost estimates during the FS is less than that of estimates developed during later stages of the Superfund Process. *Cost Guidance* at 2-4.

The NCP, 40 C.F.R § 300.430(e)(7)(iii), states that at the screening-level of the FS "[a]lternatives providing effectiveness and implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated." The Cost Guidance explains that at the "[sc]reening-level cost estimates are used to screen out disproportionately expensive alternatives in determining what alternatives should be retained for detailed analysis." *Cost Guidance* at 2-5. The FS retained SED-6 for the detailed analysis.

The Cost Guidance describes the cost estimating process in the detailed analysis stage of the FS as follows:

> "Cost estimates developed during the detailed analysis phase are used to compare alternatives and support remedy selection. The NCP includes the following language in its description of the cost criterion for the detailed analysis and remedy selection:
>
> > 'The types of costs that shall be assessed include the following: (1) Capital costs, including both direct and indirect costs (2) Annual operations and maintenance costs; and (3) Net present value of capital and O&M costs.' (40 CFR 300.430 (e)(9)(iii)(G))
>
> Remedial action alternative cost estimates for the detailed analysis are intended to provide a measure of total resource costs over time (i.e., "life cycle costs") associated with any given alternative. As such, these estimates generally are based on more detailed information and should achieve a greater level of accuracy than screening-level estimates. The detailed analysis level accuracy range of –30 to +50 percent means that, for an estimate of $100,000, the actual cost of an alternative is expected to be between $70,000 and $150,000."

Cost Guidance at 2-5 to 2-6.

All the remedies described in the FS were within the range described above. The NCP then requires that the selected alternative be "cost-effective," provided it is protective of human health and the environment and attains ARARs. 40 C.F.R. § 300.430(f)(ii)(D). Cost-effectiveness is determined by evaluating long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, and short-term effectiveness. Finally, "overall-effectiveness" is then compared to cost to ensure the remedy is cost-effective. "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." 40 C.F.R. § 300.430(f)(ii)(D)

Following the NCP and Cost Guidance, SED-6 does not fail the cost-effectiveness criterion relative to SED-4. SED-6 was retained during the screening phase of the FS and a cost estimate was developed during the detailed analysis phase. Finally, SED-6 was determined to be cost-effective at the remedy selection phase following an evaluation of the long-term effectiveness and permanence, reduction of toxicity, mobility and volume, and short-term effectiveness of a dry excavation of near shore sediments. As mentioned

previously, EPA and WDNR have determined that a dry excavation of the near-shore sediments is the most effective technology to remove large quantities of contaminated sediment and free product that is co-located with wood debris. The dry-excavation technology is also the best way to achieve the established cleanup goal and control the resuspension of contaminants in the water and avoid surface sheens and possible migration of contaminants to waters outside the Site boundaries. The overall-effectiveness of SED-6 was then determined to be cost-effective.

It is important to note that SED-5 is the most costly sediment remediation alternative, not SED-6. The ROD has included SED-6 as the primary sediment remedy and SED-4 as a possible contingent remedy. If a pre-design pilot test indicates that dredging will attain the established cleanup goal and performance standards then EPA, in consultation with WDNR, will recommend that an alternate sediment remedy, SED-4 (dredging of the entire bay), be implemented.

Comment: "Alternative sediment remedy (Sed-4) is NCP-compliant and can achieve RAOs." (NSPW Comments, Attachment A, 5)

Response: The ROD provides for a pilot test to show that SED-4 can achieve the performance standards and RAOs.

Based upon EPA's evaluation of all of the sediment cleanup options, EPA believes that the sediment remedy SED-6 (dry excavation near-shore and dredging off-shore) recommended in the Proposed Plan is the better option to deal with the free product and wood waste in the sediments, but given NSPW's objections to SED-6 and the public's interest in implementing a cheaper remedy if it proves to be as effective as dry exavation, EPA, in consultation with WDNR, has decided to include in the ROD that a pilot test for wet dredging can be conducted. The ROD includes SED-6 as a final remedy for sediments. If a pre-design pilot test indicates that dredging will attain the established cleanup goal and performance standards then EPA, in consultation with WDNR, will recommend that an alternate sediment remedy SED-4 (dredging) be implemented.

Comment: "The Proposed Groundwater Remedy Contains Unjustified Elements."

" The objective of the proposed groundwater remedy remains unclear, as pointed out previously by the NRRB in its comments. The PRAP (pg. 26) states that "the purpose of this groundwater cleanup alternative is hydraulic containment within the waste management area and restoration of the aquifer outside the waste management area" (pg. 26), yet EPA has defined neither the lateral nor the vertical extent of the "waste management area," so the locations to which the "containment" and "restoration" objectives apply are undefined. Selecting a groundwater remedy without adequately defining the areas to which remedial objectives apply is premature and does not allow adequate weighting of alternatives according to NCP criteria." (NSPW Comments, Attachment A, 6.2)

"The NCP-Compliant GW-5 is Superior to GW-2A based on the cost-effectiveness Criterion, is More Sustainable and is Less Restrictive for Site Redevelopment and more cost effective."

" NSPWs preferred alternative (GW-5, possibly with GW-3 or GW-6) also includes the use of engineered surface and vertical barriers for hydraulic containment, but a PRB would be used for groundwater treatment [i.e., a "funnel and gate" system, described in the FS, p. 7-10, "The non-permeable funnel (vertical barriers) serves to lead the contaminated groundwater to the highly permeable gate (PRB) which contains a reactive agent"]. The PRB will also provide hydraulic containment with passive groundwater flux through its filter media, eliminating the need for groundwater extraction and treatment. Flow through the filter media will also remove contaminants prior to discharge to the bay. However, this alternative will cost significantly less than GW-2A because it will reduce long-term operation costs inherent with an active pump and treatment system; it will only require replacement of PRB filter media as needed." (NSPW Comments, Attachment A, 6.2.1)

"GW-9B is Unjustified."

"NSPW objects to the unjustified addition of a dozen extraction wells for 'perpetual remediation' of contaminated groundwater. EPA has not adequately assessed the NCP cost criterion for the pump and treat system because its duration is undefined by EPA – 'The actual length of time necessary to operate extraction and treatment systems will be determined by considering the progress of the system during the cleanup period' (US EPA, 2009, p. 27). Pump and treat systems, particularly when NAPL is present, are both inefficient and cost prohibitive for aquifer restoration. The ineffectiveness of pump and treat systems at meeting MCLs, especially at NAPL sites, has been presented in many documents including those authored by EPA (Mackay, 1998; US EPA, 1993 ;). Mackay (1998) indicates that many studies show the use of groundwater pump and treat systems are ineffective as a NAPL source removal tool due to the adsorbent characteristics of the heavier hydrocarbons on aquifer media. He proposes the use of in situ technologies to destroy or mobilize the NAPL for focused extraction." (NSPW Comments, Attachment A, 6.2.2)

Response: EPA disagrees in part and agrees in part with the comments for the following reasons:

The Proposed Plan stated that, "the purpose of this groundwater cleanup alternative is hydraulic containment within the waste management area and restoration of the aquifer outside the waste management area." In the selected remedy, EPA is not designating any areas of the Site as waste management areas, and the RAOs for groundwater include meeting MCLs and State of Wisconsin drinking water standards in groundwater. The selected groundwater remedy will serve the dual objectives of containment and restoration. For shallow groundwater at Kreher Park and the Upper Bluff/Filled Ravine, the engineered surface and vertical barriers and a groundwater extraction and treatment system (and possibly in-situ treatment) remedy will meet the containment objective by controlling the source of contamination and preventing additional contamination from

migrating to Chequamegon Bay. The remedy will also serve to restore the groundwater to its beneficial use by reducing contaminant levels in groundwater to meet MCLs and State of Wisconsin drinking water standards over time. For the Copper Falls Aquifer, enhancing the existing groundwater extraction and treatment system (and possibly using in-situ treatment) will hydraulically control the groundwater contamination and NAPL in the aquifer. The remedy will also serve to make progress toward restoring groundwater to beneficial use. However, given the large quantity of NAPL in the Copper Falls Aquifer, it may end up being technically impracticable to restore the aquifer. If that is the case and EPA decides to waive the requirement to meet the specified groundwater cleanup standards within a certain zone due to technical impracticability, then EPA will properly document that decision in accordance with Agency guidance.

The Kreher Park and filled ravine have significant amounts of contamination (source material) DNAPL and LNAPL and a "passive" system such as a permeable reactive barrier wall may not be adequate to remediate groundwater within a reasonable period of time. Furthermore, due to the presence of NAPL and high concentrations of contaminants in the shallow groundwater, the NAPL may routinely foul the PRB treatment media, and therefore, would require regular replacement. If in-situ chemical oxidation (ISCO) were used in conjunction with a PRB, bio-fowling could also be a problem.

An active groundwater removal system in conjunction with ISCO will remediate the shallow groundwater much faster and is a proven technology in this situation.

An interim measure pump and treat system installed at the Site to assess the "pumpability" of the free product has shown the ability to remove free product MGP wastes from the Copper Falls aquifer. NSPW has estimated NAPL to be approximately 200,000 gallons in the Copper Falls. As the comment states "many studies show the use of groundwater pump and treat systems are ineffective as a NAPL source removal tool due to the adsorbent characteristics of the heavier hydrocarbons on aquifer media. [Mackay] proposes the use of *in situ* technologies to destroy or mobilize the NAPL for focused extraction." EPA concurs that in-situ technology can eliminate or minimize the contamination levels so that they do not pose threat to human health and environment. For this purpose, a pilot study will be necessary during pre-design to see if this goal can be achieved. If the in situ technology can achieve the goal then pump and treat may not be necessary, however, if this goal cannot be achieved then pump and treat will need to be designed for installation. The current interim system has recovered approximately 10,000 gallons of free product in 10 years. Relying on that system would be perpetual remediation. However, by adding more recovery wells (not necessarily a dozen extraction wells) the free product removal timeline would be shortened to meet the ARARs of free product removal and groundwater restoration in a reasonable period of time. Monitored natural attenuation may be considered at a later stage once the significant threat from the source is reduced.

Comment: "The PRAP Mischaracterizes the Sources of Site Contamination." (NSPW Comments, Attachment A, 8)

Response: The comments on the sources of contamination in NSPW's Comment 8 are not relevant for remedy selection, but EPA disagrees with this comment for the following reason:

The discussion in the Proposed Plan of the source of contamination comes directly from the EPA-approved RI prepared by NSPW. *"The source of the contamination at the Site was caused by releases from the historic MGP operations with potential addition of contamination from the multiple industrial activities (e.g., possible wood treatment, spills from the railroad) that began in the 1880's and continued until the mid 20th century."*

Comment: "All prior NSPW submittals to EPA (and/or WDNR) are incorporated into the Administrative Record."

Response: While many of the documents NSPW has submitted to EPA and WDNR are part of the Administrative Record, EPA disagrees that all prior submittals are incorporated into the Administrative Record.

Based on the RI/FS Work Plan, all the work that was completed on the Site since 1995 was to be used in the RI/FS process to help characterize the extent of contamination at the Site and provide for a range of potential remedial options. Therefore, all the historical data from NSPW and WDNR submittals is included in the 2007 RI which is part of the Administrative Record (AR). In addition, since all comments received during the public comment period are included in the AR, then your list of submittals will be part of the AR, but as discussed above in Section VI.A of this responsiveness summary, under the NCP, EPA establishes and maintains the AR and not all of the documents listed in NSPW's Attachment B are appropriate for inclusion in the AR.

C. Additional Comments:

Comment: "Kreher Park will be shut down for a period of time. No consideration has been given to the loss of revenue to the city."

Response: The Kreher Park that EPA refers to in the proposed plan is not the Kreher Park that is used for the campsite/RVs. The campsite is located east of the area that will be cleaned up. So, at this time, the area used for campsite/RVs will be open to the public. However, due to the possibility of increased traffic, noise and odors during cleanup activities, there may be times when access to Kreher Park is limited.

Comment: "There is a need to install restored habitat structures so that aquatic organisms can thrive in the area after cleanup. Rather than simply installing silt curtains or driving temporary sheet piling along the lake perimeter of the site, the cleanup may be more effective if wood and rock cribs similar to those on the west side of the Ashland marina were installed.

Response: Restoration details will be determined during the Remedial Design.

On April 20, 2010, Northern States Power Company, a Wisconsin corporation, d/b/a Xcel Energy (NSPW) submitted additional comments on EPA's Proposed Plan, dated June 2009. The responses are provided below.

Comment: TPAH performance standards should apply to the habitat restoration layer on a Surface Weighted Average Concentration (SWAC) basis. not at the dredge "cut line"

Response: The requirement to meet 9.5 ppm tPAH on a SWAC basis will be applied at the generated residuals layer (cut line), not at the six-inch cover layer (lakebed stabilization layer). EPA believes the 9.5 ppm requirement at the cut line is necessary in order to protect human health and the environment. After dredging is completed, six inches of clean fill will be placed on areas that are dredged for purposes of providing lakebed stabilization. A side benefit is that it could also provide a better habitat for recruitment of benthic macroinvertebrates and for spawning of fish (habitat restoration layer).

EPA's selected remedy is to remove free product and contaminated sediments above 9.5 ppm tPAH on a SWAC basis and does not allow for a cap to contain contamination above the established cleanup level. Furthermore, the lakebed stabilization layer is not a cap and is not designed to withstand natural forces (e.g., ice scour) or human forces (e.g., prop wash, anchoring) and therefore cannot be expected to contain contamination above the SWAC cleanup goal. The overall goal of the sediment cleanup is to achieve the SWAC cleanup goal following excavation/dredging, prior to the placement of the lakebed stabilization layer. The SWAC is then to be reconfirmed following placement of the lakebed stabilization layer. However, in the event that the SWAC cleanup goal cannot be met prior to placement of the lakebed stabilization layer, despite the utilization of best efforts and best available excavation and dredging technologies and techniques (as determined by EPA and WDNR), the Agencies may decide to allow use of the lakebed stabilization layer as a sediment residual cover to assist in meeting the SWAC.

Comment: The establishment of a "maximum" single sample cleanup goal is neither necessary nor practicable.

Response: EPA believes the 22 ppm "maximum" requirement is necessary in order to protect human health and the environment. In addition, the Wisconsin Department of Natural Resources (WDNR) Probable Effects Concentration (PEC) is 22 ppm. The 22 ppm is further supported by the iterative ecological risk assessment data collected during the life of the project as shown in the attached Figure 1. Figure 1 shows that concentrations above 22 ppm can have a toxic effect on benthic organisms resulting in mortality.

The 22 ppm maximum is consistent with, and in some cases less stringent than, the standard established at similar sites. For example, the Newton Creek and Hog Island Inlet sediment remediation project under the Great Lakes Legacy Act established a more

stringent maximum than the 22 ppm maximum that is proposed here. The Hog Island Inlet was segregated into units composed of a 100-foot by 100-foot grid, for effective excavation of the sediment and for statistically verifiable sample collection. The decision statement for the Inlet specified that additional excavation of a unit within the Inlet would be warranted:

- if the average concentration of TPAH in any of the 100x100 foot units was greater than or equal to 2.6 mg/kg (ppm);
- if a single result was greater than 7.5 mg/kg; or
- if a single result was greater than 5 mg/kg, then additional excavation *may* be warranted based on observed concentrations in surrounding units and available data from pre-remediation assessments.

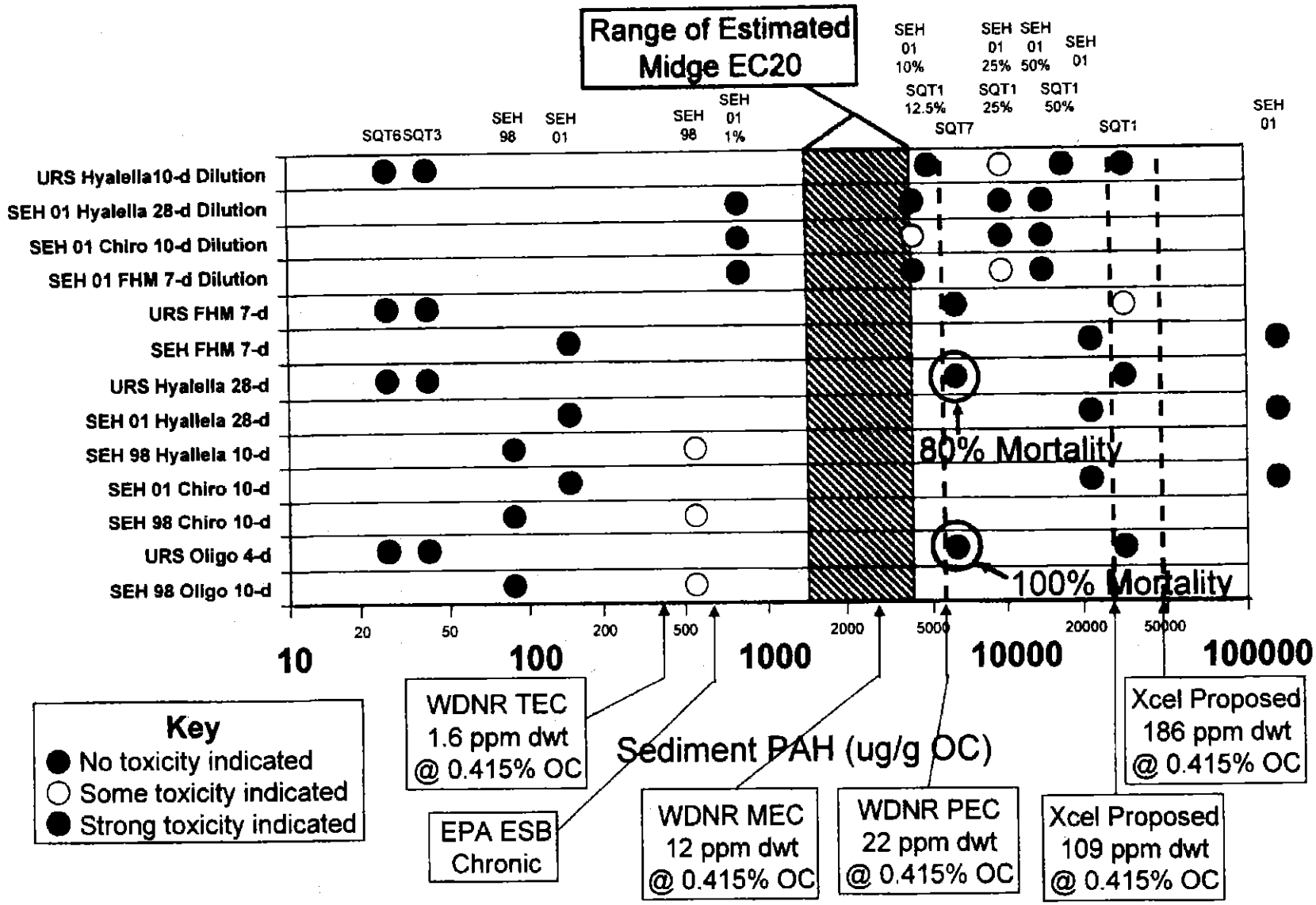
Comment: The presence of sheens/globules should trigger appropriate control measures not re-dredging.

Response: One of the Remedial Action Objectives (RAOs) for sediment, as described in the final RI/FS, is to conduct NAPL (source) removal whenever it is necessary to halt or contain the discharge of a hazardous substance or to minimize the harmful effects of the discharge to the air, land or water. Since the presence of a sheen/globule indicates NAPL (source) material is still present then it must be removed either by re-dredging or any other control measure that will help meet the RAO for sediment.

Comment: A pilot project should be used to optimize the full scale wet dredge remedy, and performance standards need to be selected that are practical and implementable.

Response: The ROD allows for the conduct of a pre-design pilot test to determine whether wet dredging for the sediments will meet performance standards and can be conducted in a manner protective of human health and the environment. If the pilot test results show that wet dredging can meet the established standards and EPA, in consultation with WDNR, recommends wet dredging as the sediment remedy, then the site-specific operations data from the pilot project will be used to help optimize a future, full-scale wet dredge remedy.

Figure 1 -- Summary of Toxicity Data for Sandy Sediments



APPENDIX B
Concurrence Letter from WDNR

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN
DEPT. OF NATURAL RESOURCES

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Matthew J. Frank, Secretary

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FAX 608-267-3579
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September 13, 2010

IN REPLY REFER TO: BRRTS 02-02-000013

Mr. Richard C. Karl, Director
Superfund Division
U.S. EPA Region 5
77 West Jackson Street
Chicago, IL 60604

SUBJECT: Concurrence on the Record of Decision
Ashland/Northern States Power Lakefront Site,
Ashland, Ashland County, Wisconsin

Dear ~~Mr.~~ Rick Karl:

This letter is provided by the Wisconsin Department of Natural Resources (WDNR) to document the State's concurrence with the September 2010 Record of Decision (ROD) for the Ashland/Northern States Power Superfund site. We believe the remedy selected in the ROD is consistent with the requirements of Wisconsin statutes and administrative rules and is protective of human health and the environment.

Thank you for your support and cooperation in addressing the contamination at the Ashland/Northern States Power Lakefront Superfund site. Please feel free to contact me at (608) 267-7562 or John Robinson at (715) 365-8976 if you have any questions.

Sincerely,

Mark F. Giesfeldt

Mark F. Giesfeldt, P.E., Director
Remediation and Redevelopment Bureau

C: Sue Bangert, AD/8
Bruce Baker, AD/8
John Gozdzialski, NOR Spooner
Dan Graff, LS/8
Connie Antonuk, NOR Rhinelander
Tom Jerow, NOR Rhinelander
John Robinson, NOR Rhinelander
Jamie Dunn, NOR Spooner
Scott Hanson, U.S. EPA Region 5
Mark Gordon, RR/5
Nancy Larson, NOR Superior

APPENDIX C
ARARs and TBCs

APPENDIX C

ARARS AND TBCS FOR THE ASHLAND/NSP LAKEFRONT SITE

ARAR Summary
For Potential Soil Remedial Alternatives

ARAR / TBC	Alternative S-2		Alternative S-3A and 3B		Alternative S-4A and S-4B		Alternative S-5A and 5B		Alternative S-6	
	Containment Using Surface Barriers		Limited and Unlimited Removal and Off-site Disposal		Limited Removal and On-site Disposal		Limited Removal and Ex-situ Thermal Treatment		Limited Removal and Ex-situ Soil Washing	
	Apply	Comply	Apply	Comply	Apply	Comply	Apply	Comply	Apply	Comply
Chemical Specific										
RCRA – Definition of Hazardous Waste 40 CFR 261	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clean Air Act National Primary and Secondary Ambient Air Quality Standards (NAAQS) 40 CFR Part 50	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clean Air Act National Emissions Standards for Hazardous Air Pollutants (NESHAP) 40 CFR Part 61	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Hazardous Substance Spill Law and Soil Cleanup Standards. WI State Stats. Ch. 292.11. WAC NR 720	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Groundwater Quality –WAC NR140	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

WI Pollutant Discharge Elimination Systems - WAC NR 200 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Air Pollution Control Regulations – WAC NR 400-499 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Soil Cleanup Standards – WAC NR 720	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Guidance for Generic Soil PAH Cleanup Levels (WDNR PUBL-RR-519-97, April 1997)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Lab Certif. – WAC NR 149	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Action Specific										
CERCLA - Procedures for Planning and Implementing Off-site Response Actions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RCRA - Subtitle D Non-hazardous Waste Standards 40 CFR 257	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RCRA - Manifesting, Transport, and Record keeping Requirements 40 CFR 262	Yes	Yes	Yes	Yes	Yes	Yes	No	NA	No	NA
RCRA - Wastewater Treatment System Standards 40 CFR 264	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RCRA - Excavation and Fugitive Dust	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary
For Potential Soil Remedial Alternatives

ARAR / TBC	Alternative S-2		Alternative S-3A and 3B		Alternative S-4A and S-4B		Alternative S-5A and 5B		Alternative S-6	
	Containment Using Surface Barriers		Limited and Unlimited Removal and Off-site Disposal		Limited Removal and On-site Disposal		Limited Removal and Ex-situ Thermal Treatment		Limited Removal and Ex-situ Soil Washing	
	Apply	Comply	Apply	Comply	Apply	Comply	Apply	Comply	Apply	Comply
Requirements 40 CFR 264										
RCRA - Storage Requirements 40 CFR 264, 265	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Air Pollution Control Regulations WAC NR 400 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Solid Waste Management Regs WAC NR 500 Series	Yes	Yes	Yes	Yes	Yes	Yes	No	NA	No	NA
WI Hazardous Waste Regulations – NR 600	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Sites with Residual Contamination WI State Stats. Ch. 292.12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Free Product Removal – WAC NR 708.13	Yes	Yea	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Invest. & Remed. of Env. Contamination – WAC NR 700 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Guidance for Cover Systems (Cover Systems as Soil Performance Standard Remedies (WDNR PUBL-RR-709. . an. 2007)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Guidance for Management of Investigation Derived Waste (Interim Guidelines for the Management of Investigation – Derived Waste (WDNR PUBL-RR- 556-93, May 1993)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

WDNR Groundwater Discharge Requirements (Informational Document for Wisconsin Discharge Permit: Contaminated Groundwater from Remedial Action Operations (WDNR PUBL- RR-583-01, May 2001)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Management of Waste from Remediation of Manufactured Gas Plants (Draft Management of Waste from Remediation of Manufactured Gas Plants (WDNR PUBL – RR – 768, Feb 2007)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OSHA Occupational Safety and Health Standards	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DOT Haz Mat Transport	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Storm Water Discharge – WAC NR 216	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary
For Potential Soil Remedial Alternatives

ARAR / TBC	**Alternative S-2**		**Alternative S-3A and 3B**		**Alternative S-4A and S-4B**		**Alternative S-5A and 5B**		**Alternative S-6**	
	Containment Using Surface Barriers		**Limited and Unlimited Removal and Off-site Disposal**		**Limited Removal and On-site Disposal**		**Limited Removal and Ex-situ Thermal Treatment**		**Limited Removal and Ex-situ Soil Washing**	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**
Location Specific										
Landfill Siting and Approval Processes WI Statutes Ch. 289	No	NA	No	NA	Yes	Yes	No	NA	No	NA
Solid Waste Management Regs – WAC NR 500 Series	Yes	Yes	Yes	Yes	Yes	Yes	No	NA	No	NA
To Be Considered										

WI Water Quality Regs – WAC NR 300 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Safe Drinking Water Act	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Great Lakes Water Quality Agreement	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clean Water Act 303(d)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EPA Contaminated Management Strategy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EPA Contaminated Management Guidance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Great Lakes Water Quality Initiative	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local Permits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Groundwater Remedial Alternatives

ARAR / TBC	**Alt. GW-2** Containment using Surface and Vertical Barriers		**Alt. GW-3** In-situ Treatment using Ozone Sparge		**Alt. GW-4** In-situ Treatment using Surfactant Injection		**Alt. GW-5** In-situ Treatment using Permeable Reactive Barrier Walls		**Alt. GW-6** In-situ Treatment using Chemical Oxidation		**Alt. GW-7** In-situ Treatment using Electrical Resistance Heating		**Alt. GW-8** In-situ Treatment using Dynamic Underground Stripping/Steam Injection		**Alt. GW-9** Removal using Groundwater Extraction Wells	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**						
Chemical Specific																
RCRA – Definition of Hazardous Waste 40 CFR 261	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clean Air Act National Primary and Secondary Ambient Air Quality Standards (NAAQS) 40 CFR Part 50	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Clean Air Act National Emissions Standards for Hazardous Air Pollutants (NESHAP) 40 CFR Part 61	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Hazardous Substance Spill Law and Soil Cleanup Standards – WI State Stats. Ch. 292.11. WAC NR 720	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Groundwater Quality –WAC NR140	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Pollutant Discharge Elimination Systems - WAC NR 200 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Air Pollution Control Regulations – WAC NR 400-499	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Soil Cleanup Standards – WAC NR 720	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Soil Cleanup Standards – WAC NR 720	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Guidance for	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Groundwater Remedial Alternatives																
ARAR / TBC	**Alt. GW-2** Containment using Surface and Vertical Barriers		**Alt. GW-3** In-situ Treatment using Ozone Sparge		**Alt. GW-4** In-situ Treatment using Surfactant Injection		**Alt. GW-5** In-situ Treatment using Permeable Reactive Barrier Walls		**Alt. GW-6** In-situ Treatment using Chemical Oxidation		**Alt. GW-7** In-situ Treatment using Electrical Resistance Heating		**Alt. GW-8** In-situ Treatment using Dynamic Underground Stripping/Steam Injection		**Alt. GW-9** Removal using Groundwater Extraction Wells	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**						
Generic Soil PAH Cleanup Levels (WDNR PUBL-RR519-97, April 1997)																
WI Lab Certif. – WAC NR 149	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Action Specific																
CERCLA - Procedures for Planning and Implementing Off-site Response Actions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RCRA - Subtitle D Non-hazardous Waste Standards 40 CFR 257	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RCRA - Manifesting, Transport, and Record keeping Requirements 40 CFR 262	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RCRA - Wastewater Treatment System Standards 40 CFR 264	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RCRA - Excavation and Fugitive Dust Requirements 40 CFR 264	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

RCRA - Storage Requirements 40 CFR 264, 265	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Air Pollution Control Regulations – WAC NR 400 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Solid Waste Management Regs –	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Groundwater Remedial Alternatives

ARAR / TBC	**Alt. GW-2** Containment using Surface and Vertical Barriers		**Alt. GW-3** In-situ Treatment using Ozone Sparge		**Alt. GW-4** In-situ Treatment using Surfactant Injection		**Alt. GW-5** In-situ Treatment using Permeable Reactive Barrier Walls		**Alt. GW-6** In-situ Treatment using Chemical Oxidation		**Alt. GW-7** In-situ Treatment using Electrical Resistance Heating		**Alt. GW-8** In-situ Treatment using Dynamic Underground Stripping/Steam Injection		**Alt. GW-9** Removal using Groundwater Extraction Wells	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**						
WAC NR 500 Series																
WI Hazardous Waste Regulations – WAC NR 600 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Sites with Residual Contamination WI State Stats. Ch. 292.12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Free Product Removal – WAC NR 708.13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Invest. & Remed. of Env. Contamination – WAC NR 700 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

WDNR Guidance for Cover Systems (Cover Systems as Soil Performance Standard Remedies; WDNR PUBL-RR-709, Jan. 2007)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Guidance for Management of Investigation Derived Waste (Interim Guidelines for the Management of Investigation – Derived Waste; WDNR PUBL-RR- 556-93, May 1993	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Groundwater Discharge Requirements (Informational Document for Wisconsin Discharge Permit; Contaminated Groundwater from Remedial Action Operations; WDNR PUBL- RR-583-01, May 2001)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Management of Waste from	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Groundwater Remedial Alternatives																
ARAR / TBC	Alt. GW-2 Containment using Surface and Vertical Barriers		Alt. GW-3 In-situ Treatment using Ozone Sparge		Alt. GW-4 In-situ Treatment using Surfactant Injection		Alt. GW-5 In-situ Treatment using Permeable Reactive Barrier Walls		Alt. GW-6 In-situ Treatment using Chemical Oxidation		Alt. GW-7 In-situ Treatment using Electrical Resistance Heating		Alt. GW-8 In-situ Treatment using Dynamic Underground Stripping/Steam Injection		Alt. GW-9 Removal using Groundwater Extraction Wells	
	Apply	Comply	Apply	Comply	Apply	Comply	Apply	Comply	Apply	Comply						
Remediation of Manufactured Gas Plants (Draft Management of Waste from Remediation of Manufactured Gas Plants; WDNR PUBL – RR – 768. Feb 2007)																
OSHA – Occupational Safety and Health Standards	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DOT Haz Mat Transport	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Storm Water Discharge – WAC NR 216	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location Specific																
Landfill Siting and Approval Process WI State Statutes Ch. 289	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI Sites with Residual Contamination WI State Stats. Ch. 292.12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Solid Waste Management Regs – WAC NR 500 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

To Be Considered																
WI Water Quality Regs – WAC NR 300 Series	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Safe Drinking Water Act	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Great Lakes Water Quality Agreement	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clean Water Act 303(d)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EPA Contaminated Management Strategy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EPA Contaminated Management Guidance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Groundwater Remedial Alternatives

ARAR / TBC	**Alt. GW-2** Containment using Surface and Vertical Barriers		**Alt. GW-3** In-situ Treatment using Ozone Sparge		**Alt. GW-4** In-situ Treatment using Surfactant Injection		**Alt. GW-5** In-situ Treatment using Permeable Reactive Barrier Walls		**Alt. GW-6** In-situ Treatment using Chemical Oxidation		**Alt. GW-7** In-situ Treatment using Electrical Resistance Heating		**Alt. GW-8** In-situ Treatment using Dynamic Underground Stripping/Steam Injection		**Alt. GW-9** Removal using Groundwater Extraction Wells	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**						
Great Lakes Water Quality Initiative	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local Permits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Sediment Remedial Alternatives						
ARAR/TBC	Alt. SED-2		Alt. SED-3		Alt. SED-4 and SED-5	
	Dredge, place in CDF		Dredge, Cap		Dredge-All	
	Apply	Comply	Apply	Comply	Apply	Comply
Chemical Specific						
Clean Water Act Section 304, Ambient Water Quality Criteria, US EPA 1986	Yes	Yes	Yes	Yes	Yes	Yes
Clean Water Act Section 303, Water Quality Standards, 40 CFR 131	Yes	Yes	Yes	Yes	Yes	Yes
Clean Water Act Section 304, Sediment Quality Criteria, US EPA 1991	No	NA	No	NA	No	NA
RCRA - Definition of Hazardous Waste, 40 CFR 261	No	NA	No	NA	No	NA
Clean Air Act, National Primary and Secondary Ambient Air Quality Standards (NAAQS), 40 CFR Part 50	Yes	Yes	Yes	Yes	Yes	Yes
Clean Air Act, National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR 61	No	NA	No	NA	No	NA
WDNR Water Quality Standards for Wisconsin Surface Waters, WAC NR 102-105	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Wisconsin Groundwater Quality, WAC NR 140	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Wisconsin State Air Pollutant Control Regulations, WAC NR 400-499	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Wisconsin State Soil Cleanup Standards, WAC NR 720	No	NA	No	NA	No	NA

WDNR Soil Cleanup Levels for PAHs Interim Guidance, WDNR PUBL RR519-97, April 1997	No	NA	No	NA	No	NA
Location Specific						
Rivers and Harbors Act 33 CFR 320	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Sediment Remedial Alternatives						
ARAR/TBC	**Alt. SED-2**		**Alt. SED-3**		**Alt. SED-4 and SED-5**	
	Dredge, place in CDF		**Dredge, Cap**		**Dredge-All**	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**
WDNR Designated Waters Special Natural Resources Interest. WAC NR 1.05(4) and Wisconsin State Statutes Ch. 30.01(1 am)	No	NA	No	NA	No	NA
WDNR Landfill Siting and Approval Process, Wisconsin State Statutes Ch. 289	Yes	Maybe	Yes	Yes/permit	Yes	Yes/permit
WI Sites with Residual Contamination WI State Stats. Ch. 292.12	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Permits in Navigable Waters. Wisconsin State Statutes Ch. 30	Yes	Maybe	Yes	Maybe	Yes	Yes
Local Permits (building, zoning, other)	TBD	TBD	TBD	TBD	TBD	TBD
Action Specific						
Clean Water Act Section 401. National Pollutant Discharge Elimination System	Yes	Yes/permit	Yes	Yes/permit	Yes	Yes/permit
Clean Water Act Section 301(b). Effluent Standards- Technology Based Discharge Requirements	No	NA	No	NA	No	NA

CERCLA Procedures for Planning and Implementing Off-site Response Actions. 40 CFR 300.440	No	NA	Yes	Yes	Yes	Yes
RCRA- Manifesting, Transport and Recordkeeping Requirements, 40 CFR 262	No	NA	No	NA	No	NA
RCRA- Wastewater Treatment System Standards. 40 CFR 264	No	NA	No	NA	No	NA
RCRA- Storage Requirements. 40 CFR 264 and 265	No	NA	No	NA	No	NA
RCRA- Subtitle D Non-hazardous Waste Standards, 40 CFR 257	Yes	Yes	Yes	Yes	Yes	Yes
RCRA- Excavation and Fugitive Dust Requirements, 40 CFR 264	Yes	Yes	Yes	Yes	Yes	Yes
DOT Rules for Hazardous Materials Transport, 49 CFR 107-171	No	NA	Yes	Yes	Yes	Yes
OSHA Occupational Safety and Health Standards, 29 CFR 1910.120, 1910.132, 1910.134 and 1910.138	Yes	Yes	Yes	Yes	Yes	Yes
Clean Air Act National Primary and Secondary Ambient Air Quality Standards (NAAQS), 40 CFR Part 50	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Sediment Remedial Alternatives

ARAR/TBC	**Alt. SED-2**		**Alt. SED-3**		**Alt. SED-4 and SED-5**	
	Dredge, place in CDF		**Dredge, Cap**		**Dredge-All**	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**
Clean Air Act National Emissions Standards for Hazardous Air Pollutants (NEHSHAP), 40 CFR 61	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Designated Waters of Special Natural Resources Interest, WAC NR 1.05(4) and Wisconsin State Statutes Ch. 30.01(1am)	No	NA	No	NA	No	NA
WDNR Plans and Specifications Review of Projects and Operations, WAC NR 108	Yes	Yes	Yes	Yes	Yes	Yes

WDNR Environmental Analysis and Review Procedures. WAC NR 150	No	NA	No	NA	No	NA
WDNR Laboratory Certification and Registration, WAC NR 149	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Wisconsin Pollutant Discharge Elimination System. WAC NR 200	Yes	Yes/permit	Yes	Yes/permit	Yes	Yes/permit
WDNR Water Quality Antidegradation. WAC NR 207	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Water Quality Antidegradation: Waste Load Allocated, Water Quality-Related Effluent Standards and Limitations. WAC NR 212-220	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Lining of Industrial Lagoons and Design of Storage Structures, WAC NR 213	No	NA	No	NA	No	NA
WDNR Wisconsin's General Permit Program for Certain Water Regulatory Permits. WAC NR 322	Yes	Yes/permit	Yes	Yes/permit	Yes	Yes/permit
WDNR Shoreline Protection. WAC NR 328	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Dredging Contract Fees. WAC NR 346	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Sediment Sampling and Analysis, Monitoring Protocol and Disposal Criteria for Dredging Projects. WAC NR 347	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Wisconsin State Air Pollutant Control Regulations. WAC NR 400-499	Yes	Yes	Yes	Yes	Yes	Yes
WI Sites with Residual Contamination WI State Stats. Ch. 292.12	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Solid Waste Management. WAC NR 500-520	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Sediment Remedial Alternatives						
ARAR/TBC	Alt. SED-2		Alt. SED-3		Alt. SED-4 and SED-5	
	Dredge, place in CDF		Dredge, Cap		Dredge-All	
	Apply	Comply	Apply	Comply	Apply	Comply
WDNR Hazardous Waste Management. WAC NR 600-685	No	NA	No	NA	No	NA
WDNR Investigation of Remediation of Environmental Contamination. WAC NR 700 Series	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Notification of the Discharge of Hazardous Substances. WAC NR 706	Yes	Yes	Yes	Yes	Yes	Yes
Free Product Removal - WAC NR 708.13	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Public Information and Participation. WAC NR 714	No	NA	No	NA	No	NA
WDNR Standard for Selecting Remedial Actions. WAC NR 722	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Remedial and Interim Action design, Implementation. Operation, Maintenance and Monitoring Requirements. WAC NR 724	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Great Lakes Water Quality Initiative WAC 102 and 106 USEPA Great Lakes Water Quality Initiative, 1995	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Assessing Sediment Quality in Water Bodies Associated with Manufactured Gas Plant Sites. WDNR PUBL-WR-447-96, March 1996	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Guidance for Cover Systems as Soil Performance Standard Remedies. WDNR-PUBL-RR-709. April 2004	No	NA	No	NA	No	NA
WDNR Consensus-Based Sediment Quality Guidelines: Recommendations for Use and Application Interim Guidance. WDNR-PUBL-WT-732. 2003	Yes	Yes	Yes	Yes	Yes	Yes

WDHFS Health-Based Guidelines for Air Management. Public Participation and Risk Communication During the Excavation of Former Manufactured Gas Plants, 2004	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Sediment Remediation Implementation Guidance Strategic Directions Report. 1995	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Low-Hazard Solid Waste Exemption. Wisconsin State Statutes Ch. 289.43	Yes	Yes	Yes	Yes	Yes	Yes

ARAR Summary for Potential Sediment Remedial Alternatives						
ARAR/TBC	**Alt. SED-2**		**Alt. SED-3**		**Alt. SED-4 and SED-5**	
	Dredge, place in CDF		**Dredge, Cap**		**Dredge-All**	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**
WDNR Interim Guidelines for the Management of Investigation-Derived Waste. WDNR-PUBL_RR-556-93, May 1993	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Informational Document for Wisconsin Discharge Permit; Contaminated Groundwater from Remedial Action Operations. WDNR-PUBL-RR-583-01 May 2001	No	NA	No	NA	No	NA
WDNR Draft Management of Wastes from Remediation of Manufactured Gas Plants. WDNR-PUBL-RR-768, February 2007	Yes	Yes	Yes	Yes	Yes	Yes
To Be Considered						
US EPA Contaminated Sediment Management Strategy. EPA823-R-98-001	Yes	Yes	Yes	Yes	Yes	Yes
US EPA Contaminated Sediment Management Guidance. EPA-540-R-05-012	Yes	Yes	Yes	Yes	Yes	Yes
US Public Health Service. Agency for Toxic Substances and Disease Registry *(no citation)*	Yes	Yes	Yes	Yes	Yes	Yes

Clean Water Act Section 118(c)(7), Great Lakes Critical Program Act of 1990-Assessment of Remediation of Contaminated Sediments (ARCS) Program, 40 CFR 132 Appendix E	Yes	Yes	Yes	Yes	Yes	Yes
US EPA Contaminated Sediment Management Strategy, EPA823-R-98-001	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Beneficial Reuse Solid Waste Exemption, WAC NR 500.08	No	NA	Yes	Yes	Yes	Yes
Clean Water Act, Section 404, Dredge and Fill Requirements-Inland Testing Manual	Yes	Yes/permit	Yes	Yes/permit	Yes	Yes/permit
WDNR Dredge and Fill Requirements, 1985 and 1990	Yes	Yes/permit	Yes	Yes/permit	Yes	Yes/permit
WDNR Solid Waste Management, Beneficial Reuse Solid Waste Exemption, WAC NR 500.08	No	NA	Yes	Yes	Yes	Yes

ARAR Summary for Potential Sediment Remedial Alternatives						
ARAR/TBC	**Alt. SED-2**		**Alt. SED-3**		**Alt. SED-4 and SED-5**	
	Dredge, place in CDF		**Dredge, Cap**		**Dredge-All**	
	Apply	**Comply**	**Apply**	**Comply**	**Apply**	**Comply**
WDNR Assessing Sediment Quality in Water Bodies Associated with Manufactured Gas Plant Sites, WDNR PUBL-WR-447-96, March 1996	Yes	Yes	Yes	Yes	Yes	Yes
WDNR Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application, Interim Guidance, WDNR PUBL-WT-732, 2003	Yes	Yes	Yes	Yes	Yes	Yes
International Joint Commission (IJC), IJC, 1992	No	NA	No	NA	No	NA

APPENDIX D
Final Parameters List

Table 4-1
Amended List of Final Compounds for Regulatory Exceedances
Sediment, Soil, and Groundwater Samples
Ashland Lakefront Site - Ashland, Wisconsin

VOCs				SVOCs[1]				Inorganics			
	Sed[4]	Soil	GW		Sed.	Soil	GW		Sed.	Soil	GW
Benzene	√	√	√	Acenaphthene (LMW)	√	√		Arsenic	√	√	√
Ethylbenzene		√	√	Acenaphthylene (LMW)	√	√		Antimony	√		√
Styrene			√	Anthracene (LMW)	√	√	√	Barium			√
Toluene	√	√	√	Benzo(a)Anthracene (HMW)	√	√		Beryllium		√	√
1,2,3-Trimethylbenzene			√[2]	Benzo(a)Pyrene (HMW)	√	√	√	Cadmium	√	√	√
1,2,4-Trimethylbenzene		√	√[2]	Benzo(b)Fluoranthene (HMW)	√	√	√	Chromium (+3)	√[5]		√[3]
1,3,5-Trimethylbenzene		√	√[2]	Benzo (k) Fluoranthene (HMW)	√	√		Chromium (+6)	√[5]		√[3]
Total Xylenes	√	√	√	Benzo(g,h,i)Perylene (HMW)	√	√		Cobalt			√
1,2,4-Trichlorobenzene	√	√		Chrysene (HMW)	√	√	√	Copper	√		√
Chloroform			√	Dibenzo(a,h)Anthracene (HMW)	√	√		Cyanide			√
Chloromethane			√	Fluoranthene (HMW)	√	√	√	Iron	√	√	√
Methylene Chloride			√	Fluorene (LMW)	√	√	√	Lead	√	√	√
n-Butyl benzene		√		Indeno(1,2, 3-cd)Pyrene (HMW)	√	√		Manganese	√	√	√
				1-Methyl Naphthalene		√		Mercury	√		√
				2-Methyl Naphthalene (LMW)	√	√		Nickel	√		√
				Naphthalene (LMW)	√	√	√	Selenium			√
				Pentachlorophenol	√		√	Silver	√		√
				Phenanthrene (LMW)	√	√		Thallium			√
				Pyrene (HMW)	√	√	√	Vanadium		√	√
				Dibenzofuran	√	√		Zinc	√		√
				Phenol	√	√	√				
				Pyridine			√				
				Benzo(e)Pyrene (HMW)	√						
				Total PAHs	√						

[1] (HMW) – Heavy molecular weight PAHs; (LMW) – Low molecular weight PAHs.
[2] Trimethylbenzene in groundwater will be presented as total TMB per the WI ch. NR 140 standard.
[3] Chromium in groundwater will be presented as total chromium per the WI ch. NR 140 standard.
[4] Compounds listed for sediments from WDNR Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application, Interim Guidance, December 2003.
[5] Chromium in sediment will be presented as total chromium per the WDNR Consensus-Based Sediment Quality Guidelines December 2003.

APPENDIX E
Standards for each Compound by Media

Table 4-2
Soil and Sediment Standards List
Ashland Lakefront Site, Ashland, Wisconsin

Analyte	Abbrev	Soil_res3	Soil_Ind3	Soil_res9	Soil_Ind9	WisGWpath	WisNonInd	WisInd	Sed_TEC	Sed_PEC
1,2,4-Trichlorobenzene	TCB124	782,142	10,220,000	62,160	215,925				8	18
1,2,4-Trimethylbenzene	TMB124	3,900,000	51,000,000	51,608	170,272				627	
1,3,5-Trimethylbenzene	TMB135	3,900,000	51,000,000	21,253	69,712				627	
1-Methylnaphthalene	methylnaph1					23,000	1,100,000	70,000,000		
2-Methylnaphthalene	methylnaph2	312,857	4,088,000			20,000	600,000	40,000,000		240
Acenaphthene	Acenaphth	4,692,857	61,320,000	3,681,706	29,219,327	38,000	900,000	60,000,000	6.7	89
Acenaphthylene	Acenaphthyl					700	18,000	360,000	5.9	128
Anthracene	Anthracene	23,464,285	306,600,000	21,896,121	100,000,000	300,000	5,000,000	300,000,000	57	845
Antimony	Antimony	31,000	410,000	31.3	408.8				2	25
Arsenic	Arsenic	0.43	1.9	0.39	1.6		0.039	1.6	9.8	33
Benzene	Benzene	11,613	52,029	643	1,409	5.5			57	110
Benzo(a)anthracene	BaAnthrac	220	3,920	621	2,110	17,000	88	3,900	108	1,050
Benzo(a)pyrene	BaPyrene	22	392	62	211	48,000	8.8	390	150	1,450
Benzo(b)fluoranthene	BbFluora	220	3,920	621	2,110	360,000	88	3,900	240	13,400
Benzo(e)pyrene	BePyrene								150	1450
Benzo(g,h,i)perylene	BghiPeryl					6,800,000	1,800	39,000	170	3,200
Benzo(k)fluoranthene	BkFluora	2,200	39,200	6,215	21,096	870,000	880	39,000	240	13,400
Beryllium	Beryllium	158	2,044	154	1,941				122	
Cadmium	Cadmium	39.1	511	37.0	451		8	510	0.89	5
Chromium	Chromium								43	110
Chrysene	Chrysene	22,000	390,000	62,146	210,962	37,000	8,800	390,000	166	1,290
Copper	Copper	3,100,000	41,000,000	3,129	40,876				32	150
Dibenzo(a,h)anthracene	DiBahAnthrac	22	392	62	211	38,000	8.8	390	33	135
Dibenzofuran	Dibenzofuran	160,000	2,000,000	145,263	1,563,342				150	580
Ethylbenzene	EthBen	7,821,428	102,200,000	395,000	395,000	2,900			175	
Fluoranthene	Fluoranth	3,128,571	40,880,000	2,293,610	22,000,353	500,000	600,000	40,000,000	423	2,230
Fluorene	Fluorene	3,128,571	40,880,000	2,747,107	26,281,433	100,000	600,000	40,000,000	77	536
Indeno(1,2,3-cd)pyrene	IND123cdPyr	220	3,920	621	2,110	680,000	88	3,900	200	3,200
Iron	Iron	23,464	306,600	23,463	100,000				20,000	40,000
Lead	Lead			400	800		50	500	36	130
Manganese	Manganese	1,564	20,440	1,762	19,458				460	1,100
Mercury	Mercury								0.18	1.1
Naphthalene	Naphth	1,564,285	20,440,000	55,916	187,691	400	20,000	110,000	176	561
n-Butyl benzene	nButylbenz	3,100,000	41,000,000	240,000	240,000					
Nickel	Nickel	1,600,000	20,000,000	1,564	20,439				23	49
Pentachlorophenol	PCP	5300	24000	2,979	8,998				150	200
Phenanthrene	Phenanthrene					1,800	18,000	390,000	204	1,170
Phenol	Phenol	23,464,000	306,600,000	18,330,929	100,000,000				4,200	12,000
Pyrene	Pyrene	2,346,428	30,660,000	2,315,951	29,126,201	8,700,000	500,000	30,000,000	195	1,520
Silver	Silver	390,000	5,100,000	391	5110				1.6	2.2
Toluene	Toluene	6,257,142	81,760,000	520,000	520,000	1,500			890	1,800
Vanadium	Vanadium	78.2	1,022	78.2	1,022				57	
Xylenes (total)	Xylenes	15,642,857	204,400,000	27,063	420,000	4,100			25	50
Zinc	Zinc	23,000,000	310,000,000	23,463	100,000				120	460

All units in ug/kg, except metals, which are shown in mg/kg.
Abbrev = abbreviation for analyte name used in result summary tables.
Soil_Res3 = USEPA Region 3 Residential RBC for soil.
Soil_Ind3 = USEPA Region 3 Industrial RBC for soil.
Soil_Res9 = USEPA Region 9 Residential PRG for soil (ug/kg)
Soil_Ind9 = USEPA Region 9 Industrial PRG for soil.
WisGWpath = Wisconsin Publication RR 519-97 groundwater pathway soil standard.
WisNonInd = Wisconsin NR 720/Publication RR 519-97 Non-industrial soil standard.
WisInd = Wisconsin NR 720/Publication RR 519-97 Industrial soil standard.

Sed_TEC = Threshold Effects Concentration from WDNR 2003 Consensus-Based Sediment Quality Guidelines Recommendations for Use & Application Interim Guidance (dry weight normalized basis at 1% organic carbon).
Sed_PEC = Probable Effects Concentration from WDNR 2003 Consensus-Based Sediment Quality Guidelines Recommendations for Use & Application Interim Guidance (dry weight normalized basis at 1% organic carbon).

Table 4-3
Groundwater Standards List
Ashland Lakefront Site, Ashland, Wisconsin

Analyte	Abbrev	FedMCL	Reg3Tap	Reg9Tap	WisGWES	WisGWPAL
Anthracene	Anthracene		1825	1825	3000	600
Antimony	Antimony	6	14.6	14.6	6	1.2
Arsenic	Arsenic	10	0.04	0.04	10	1
Barium	Barium	2000	7330	2555	2000	400
Benzene	Benzene	5	0.34	0.35	5	0.5
Benzo(a)pyrene	BaPyrene	0.2	0.003	0.009	0.2	0.02
Benzo(b)fluoranthene	BbFluora		0.03	0.09	0.2	0.02
Beryllium	Beryllium	4	73	73	4	0.4
Cadmium	Cadmium	5	18.3	18.2	5	0.5
Chloroform	Chloroform		0.2	0.2	6	0.6
Chloromethane	Chlorometh		190	158	3	0.3
Chromium	Chromium	100			100	10
Chrysene	Chrysene		3	9	0.2	0.02
Cobalt	Cobalt		730	730	40	8
Copper	Copper	1300	1460	1460	1300	130
Cyanide	Cyanide	200	730	730	200	40
Ethylbenzene	EthBen	700	1340	1340	700	140
Fluoranthene	Fluoranth		1460	1460	400	80
Fluorene	Fluorene		243	243	400	80
Iron	Iron		10950	10950	300	150
Lead	Lead	15			15	1.5
Manganese	Manganese		730	876	50	25
Mercury	Mercury	2		11	2	0.2
Methylene chloride	Methchlor	5	4	4	5	0.5
Naphthalene	Naphth		6.5	6.2	100	10
Nickel	Nickel		730	730	100	20
Pentachlorophenol	PCP	1	0.6	0.6	1	0.1
Phenol	Phenol		10950	10950	6000	1200
Pyrene	Pyrene		183	183	250	50
Pyridine	Pyridine		36.5	36.5	10	2
Selenium	Selenium	50	183	182	50	10
Silver	Silver		183	182	50	10
Styrene	Styrene	100	1623	1641	100	10
Thallium	Thallium	2	2.6	2.4	2	0.4
Toluene	Toluene	1000	2271	723	1000	200
Trimethylbenzene (total)	TMB_total				480	96
Vanadium	Vanadium		36.5	36.5	30	6
Xylenes (total)	Xylenes	10000	213	206	10000	1000
Zinc	Zinc		10950	10950	5000	2500

All units in ug/L.
Abbrev = abbreviation for analyte name used in result summary tables.
FedMCL = USEPA Federal MCL for drinking water.
Reg3Tap = USEPA Region 3 RBC for tapwater.
Reg9Tap = USEPA Region 9 PRG for tapwater.
WisGWES = Enforcement Standard per Wisconsin Admin. Code sec. NR 141.10.
WisGWPAL = Preventive Action Limit per Wisconsin Admin. Code sec. NR 141.10.

Table 4-4
Surface Water Standards List
Ashland Lakefront Site, Ashland, Wisconsin

Analyte	Abbrev	FedMCL	Reg3Tap	Reg9Tap	AshlandSW
1,2,4-Trimethylbenzene	TMB124		12.3	12.3	438
1,3,5-Trimethylbenzene	TMB135		12.3	12.3	438
1-Methylnaphthalene	methylnaph1				433
2-Methylnaphthalene	methylnaph2		24.3		433
Acenaphthene	Acenaphth		365	365	38
Anthracene	Anthracene		1825	1825	0.035
Benzene	Benzene	5	0.34	0.35	11.4
Benzo(a)anthracene	BaAnthrac		0.03	0.09	0.025
Benzo(a)pyrene	BaPyrene	0.2	0.003	0.009	0.014
Benzo(b)fluoranthene	BbFluora		0.003	0.09	0.42
Benzo(g,h,i)perylene	BghiPeryl				7.64
Benzo(k)fluoranthene	BkFluora		0.3	0.92	0.14
Chrysene	Chrysene		3	9.2	0.07
Dibenzo(a,h)anthracene	DIBahAnthrac		0.003	0.009	0.04
Dissolved Organic Carbon (DOC)	DOC				
Ethylbenzene	EthBen	700	1340	1340	14
Fluoranthene	Fluoranth		1460	1460	1.9
Indeno(1,2,3-cd)pyrene	IND123cdPyr		0.03	0.092	4.31
m & p-Xylenes	mpXylenes				
Naphthalene	Naph		6.5	6.2	13
Phenanthrene	Phenanthrene				3.6
Pyrene	Pyrene		182.5	182.5	0.3
Sulfide	Sulfide				
Toluene	Toluene	1000	2271	723	253
Total Suspended Solids (TSS)	TSS				
Turbidity	Turb				
Xylenes (total)	Xylenes	10000	213	206	27

All units shown in ug/L, except the following:
Dissolved Organic Carbon (DOC) and Total Suspended Solids (TSS) are shown in mg/L.
Turbidity is shown in NTU units.
Abbrev = abbreviation for analyte name used in result summary tables.
FedMCL = USEPA Federal MCL for drinking water.
Reg3Tap = USEPA Region 3 RBC for tapwater.
Reg9Tap = USEPA Region 9 PRG for tapwater.
AshlandSW = Miscellaneous standards from draft Baseline Ecogical Risk Assessment, May 2006.

Table 4-5
Soil Vapor Standards List
Ashland Lakefront Site, Ashland, Wisconsin

Analyte	Abbrev	Reg9Air	Reg3Air	IndoorAir	SoilGas
1,1,1-Trichloroethane	TCA111	2300	1022	2200	22000
1,2,4-Trimethylbenzene	TMB124	6.2		6.0	60
1,3,5-Trimethylbenzene	TMB135	6.2		6.0	60
1,4-Dichlorobenzene	DCB14	0.31	0.28	800	8000
Benzene	Benzene	0.25	0.23	0.31	3.1
Carbon tetrachloride	Carbontet	0.13	0.12	0.16	1.6
Chloroform	Chloroform	0.08	0.08	0.11	1.1
Chloromethane	Chlorometh	94.9	94.9	2.4	24
Dichlorodifluoromethane	DiChlDiFlumeth	209	183	200	2000
Ethylbenzene	EthBen	1059	1059	2.2	22
m & p-Xylenes	mpXylenes	105.9	110		
Methylene chloride	Methchlor	4.1	3.8	5.2	52
o-Xylene	oXylene	105.9	110	7000	70000
Styrene	Styrene	1059	1044	1000	10000
Toluene	Toluene	402	5110	400	4000
Trichloroethylene	TCE	0.017	0.016	0.022	0.22
Trichlorofluoromethane	TriChlflumeth	730	730	700	7000

Notes:

All units shown in ug/m^3.

Abbrev = abbreviation for analyte name used in result summary tables.

Reg9Air = USEPA Region 9 PRG for ambient air.

Reg3Air = USEPA Region 3 RBC for ambient air.

IndoorAir = USEPA OSWER Subsurface Vapor Intrusion Draft Guidance, Table 2C: Question 4, November 2002.

SoilGas = USEPA OSWER Subsurface Vapor Intrusion Draft Guidance, Table 2C: Question 4, November 2002.

APPENDIX F
Estimated Volume of Contaminated Media

NSPW Ashland
Lateral Extent and Volume of Contaminated Media Estimates

Soil

Upper Bluff Area	Area (sq. ft.)	Area (acres)	Thickness (ft)	Volume (cubic yds)	Approximate Volume1	Assumptions
Lateral Extent - Upland Area	75,000	1.72	10	27,778	28,000	Lateral extent (2.02 acres) where benzene exceeded RCL. Average thickness of plume is 10 feet.
Former Gas Holder Area	16,000	0.38	15	9,389	9,400	Area south of St. Claire Street is 130 by 130 feet. Average depth is 15 feet.
Former Clay Pipe Area	750		5	139	150	Area north of St. Claire Street is 10 by 75 feet at base of ravine, and 5 feet thick. (Includes saturated and unsaturated zone soil.)

Kreher Park	Area (sq. ft.)	Area (acres)	Thickness (ft)	Volume (cubic yds)	Approximate Volume1	Assumptions
Lateral Extent - Kreher Park	500,910	11.50	12	222,640	222,700	Lateral extent (11.5 acres) of all fill in Kreher Park
Lateral Extent - Kreher Park	452,150	10.38	5	83,732	83,900	Lateral extent (10.38 acres) where benzene exceeded RCL. Average thickness is 5 feet.
Former Coal Tar Dump Area	21,250	0.49	5	3,935	4,000	Area is 85 by 250 feet. Thickness above wood waste layer is 5 feet. (Includes saturated and unsaturated zone soil.)

Groundwater and Saturated Soil Media

Upper Bluff Area	Area (sq. ft.)	Area (acres)	Thickness (ft)	Volume (cubic yds)	Approximate Volume1	Assumptions
Lateral Extent - Upland Area	118,000	2.71	15	65,556	65,600	Lateral extent (2.71 acres) where benzene exceeds ES. Average thickness of plume is 15 feet.

Kreher Park	Area (sq. ft.)	Area (acres)	Thickness (ft)	Volume (cubic yds)	Approximate Volume1	Assumptions
Lateral Extent - Kreher Park	500,910	11.50	7	129,873	129,900	Lateral extent (11.5 acres) where benzene exceeds ES. Average thickness of plume is 7 feet.

Copper Falls Aquifer	Area (sq. ft.)	Area (acres)	Thickness (ft)	Volume (cubic yds)	Approximate Volume1	Assumptions
Lateral Extent - Upland Area	199,000	4.55	50	366,667	366,700	Lateral extent (4.55 acres) where benzene exceeds ES. Average thickness of plume is 50 feet.
Lateral Extent - Kreher Park	103,500	2.36	35	133,519	133,500	Lateral extent (2.36 acres) where benzene exceeds ES. Average thickness of plume is 35 feet.
	301,500	6.91		500,185	500,200	Sum of Kreher Park and Upland Area plume volumes.

Sediment

	Area (sq. ft.)	Area (acres)	Thickness (ft)	Volume (cubic yds)	Approximate Volume1	Assumptions 2
Lateral Extent - Total PAH > 53 ppm	390,800	9.0	0 - 4	57,888	57,900	Lateral extent (8.97 acres) where total PAH > 53 ppm. Removal of all contaminated media up to 4 feet.
Lateral Extent - Total PAH > 53 ppm	390,800	9.0	0 - 10	77,435	77,400	Lateral extent (8.97 acres) where total PAH > 53 ppm. Removal of all contaminated media up to 10 feet.
Lateral Extent - Total PAH > 12 ppm	480,400	11.0	0 - 4	71,163	71,200	Lateral extent (11.03 acres) where total PAH > 12 ppm. Removal of all contaminated media up to 4 feet.
Lateral Extent - Total PAH > 12 ppm	480,400	11.0	0 - 10	103,805	103,800	Lateral extent (11.03 acres) where total PAH > 12 ppm. Removal of all contaminated media up to 10 feet.

1 Rounded to nearest 100 cubic yards.
2 Not all sediment between 4 and 10 feet has total PAH exceedanaces above 12 or 53 ppm.
Wood waste layer included in all volume calculations.
See Section 4.3 of Alternative Screening Technical Memorandum for further explanation.

APPENDIX G
Extent of Contamination

Extent of Free Product

Free product is found within the four primary areas of concern (Upper Bluff/Filled Ravine, Kreher Park, Copper Falls Aquifer, and Sediments in the Bay), but at discrete locations within each area.

DNAPLs at the upland areas are found with an associated LNAPL (floating) fraction. In general, these combined DNAPL/LNAPL zones are associated with groundwater quality values with total VOC concentrations (primarily benzene) more than 50,000 µg/l (during the historic monitoring at the site, wells were not sampled for groundwater quality if more than one foot of DNAPL was measured). However, LNAPL zones devoid of associated DNAPL are extensive at the Park area. LNAPLs in the form of sheens have been observed in several monitoring wells and test pits advanced at the Park where DNAPLs have been absent. These separate LNAPL zones at Kreher Park, unlike those found associated with DNAPL, have yielded associated total VOC concentrations in groundwater less (below 5,000 µg/l) than those areas where DNAPLs are present.

Free-product measurements in sediments have been less well-documented because of the limitations caused by sampling sediments with hollow-core and grab sampling techniques. Regardless, free-product in these samples has been observed in the form of emulsions. In general, these sediment samples where emulsions were observed correspond to both high VOC and PAH levels. Emulsions observed in sediment samples generally correspond to total PAH levels greater than 1,000,000 µg/kg.

Extent of Contamination (COCs)

Soils in Upper Bluff/Filled Ravine

***Surface Soils** – Metals and Inorganics*

Applying the most stringent (residential) action levels to this data indicates that only arsenic, lead and iron concentrations exceed their respective action levels in surface soil samples. Although the upper bluff/filled ravine sample set is limited because of access, a summary of the arsenic, lead and iron exceedances follows:

- Arsenic exceeds the 0.039 mg/kg Wisconsin standard (nonInd) in each of the four background samples; concentrations range from 1.4 – 2.9 mg/kg;
- Arsenic exceeds the standard in four of the five upper bluff samples; concentrations range from 1.9 – 8.5 mg/kg;
- Arsenic exceeds the standard in two of the three filled ravine samples; concentrations range from 1.6 – 3.6 mg/kg.
- Lead exceeds the 50 mg/kg Wisconsin standard (nonInd) in three of the four background samples; values range from 85 – 440 mg/kg;
- Lead exceeds the standard in one of the five upper bluff samples (on the east side of the NSPW service center outside the flanks of the ravine); the level is 140 mg/kg.
- Lead does not exceed the standard in any of the three filled ravine samples;

- Iron exceeds the 23,463 mg/kg Region 3 standard in one background sample; at 24,000 mg/kg;
- Iron does not exceed the standard in any of the five upper bluff samples;
- Iron exceeds the standard in two of the three filled ravine samples; values range from 25,000 – 26,000 mg/kg.

***Surface Soils** – Organics - VOCs*
The only VOCs detected in background samples are trimethylbenzenes (TMB), toluene and xylenes. Toluene is the only VOC found to exceed the Wisconsin RCL. None of the surface soil samples were analyzed for trichlorobenzene (TCB). No VOCs are found in samples collected from the filled ravine. Low levels of ethylbenzene, 1,2,4-TMB, toluene and xylenes are present in surface soil, east of the NSPW service center. Toluene was found in two other samples outside the ravine, none of these detections are in excess of regulatory criteria.

***Surface Soils** - Organics - SVOCs*
Naphthalene, the most common PAH at the Site and a low molecular weight (LMW) compound, is only found in one background sample, at trace levels (51 µg/kg), less than the most stringent standard of 400 µg/kg (Wisconsin groundwater path) . The heavy molecular weight (HMW) PAHs benzo(a)anthracene (BaA), benzo(a)pyrene (BaP), and benzo(b)fluoranthene (BbF), show exceedances compared to the most stringent standards (Wisconsin non industrial path) in the four background samples. None of the other SVOCs are at levels exceeding standards in background samples. The range of values for the HMW PAHs in these four background samples are as follows:

- BaA ranges from 82 to 160 µg/kg compared to the standard of 88 µg/kg;
- BaP ranges from 85 to 170 µg/kg compared to the standard of 8.8 µg/kg;
- BbF ranges from 120 to 240 µg/kg compared to the standard of 88 µg/kg.

The upper bluff samples outside the ravine yield low levels of PAHs below the individual compound standards; only one sample yields values for the three HMW PAHs (BaA, BaP and BbF) above the respective standards, but at levels comparable to the background samples. None of the other upper bluff soils yield detections of PAHs above standards. Similar levels to those found in the surface soil background samples for the HMW PAHs are found in one sample collected from within the ravine; an exceedance for BbF was also measured. No other PAHs from ravine surface soil samples are measured in excess of the most stringent standards.

***Subsurface Soils** - Organics-VOCs*
Background samples analyzed for VOCs yielded no detections except for toluene measured in three separate samples. Corresponding measurements were 9,300, 55 and 4,000 µg/kg (the Wisconsin GW path standard is 1,500 µg/kg). Although toluene is an identified COC at the Site, its frequency of occurrence in samples has been problematic due to lab inconsistencies. VOCs found above the regulatory limits in subsurface soil samples from the upper bluff data set (outside the filled ravine) included benzene, ethylbenzene, toluene and xylene. A summary of these detections follows:

• Benzene exceeds the 5.5 µg/kg Wisconsin GW path standard in 22 of 46 samples; values range from 18 – 52,000 µg/kg;
• Ethylbenzene exceeds the 2,900 µg/kg Wisconsin GW path standard in one sample; the value is 6,490 µg/kg;
• Toluene exceeds the Wisconsin standard in 4 of 46 samples; values range from 2,600 to 72,000 µg/kg;
• Xylene exceeds the 4,100 µg/kg Wisconsin GW path standard in one sample; the value is 33,600 µg/kg.

The highest benzene and toluene levels are found in the same sample, at an area of an identified free-product mass east of the ravine at the former MGP. The ethylbenzene and xylene exceedences are in the same sample, a sample southwest of the ravine within a former gas holder.

VOCs that exceed regulatory limits in subsurface samples from within the filled ravine include benzene, ethylbenzene, 1,2,4-TCB, 1,2,4- and 1,3,5-TMB, toluene and xylenes. A summary of these detections follows:

• Benzene exceeds the Wisconsin GW path standard in 64 of 95 samples; values range from 16 – 230,000 µg/kg; the highest levels of these exceedences were measured in areas where free-product has been identified
• Ethylbenzene exceeds the Wisconsin standard in 25 of 88 samples; values range from 3,300 – 170,000 µg/kg;
• 1,2,4-TCB exceeds the 62,160 µg/kg Region 9 standard in three of 17 samples; values range from 62,900 – 120,000 µg/kg; The highest levels are within free product areas;
• 1,2,4-TMB exceeds the 51,608 µg/kg Region 9 standard in two of 72 samples; values range from 54,000 – 100,000 µg/kg;
• 1,3,5-TMB exceeds the 21,253 µg/kg Region 9 standard in four of 92 samples; values range from 22,600 – 560,000 µg/kg;
• Toluene exceeds the Wisconsin standard in 30 of 95 samples; values range from 1,500 – 320,000 µg/kg;
• Xylene exceeds the Wisconsin standard in 22 of 95 samples; values range from 4,500 – 320,000 µg/kg; the xylene distribution is similar to that of toluene.

The distribution of these data indicate that the greatest contaminant levels correspond to free product zones within the length of the ravine, as well as other areas near the former gas holders/gas plant.

***Subsurface Soils** - Organics-SVOCs*
Background subsurface soil samples analyzed for PAHs yield no detections for any of the subject analytes. However, upper bluff samples collected from outside the ravine fill yield several exceedances as follows:

• Acenaphthylene exceeds the 700 µg/kg (Wisconsin GW path) standard in four of 46 samples; values range from 1,000 – 280,000 µg/kg; The highest level is found at a sample east of the ravine where free product has been identified;

• BaA exceeds the 88 µg/kg (Wisconsin nonInd) standard in 11 of 46 samples; values range from 110 – 20,000 µg/kg;
• BaP exceeds the 8.8 µg/kg standard in 14 of 46 samples: values range from 60 – 170,000 µg/kg;
• BbF exceed the 88 µg/kg standard in 12 of 46 samples: values range from 100 – 170,000 µg/kg.
• B(ghi)P exceeds the 1,800 µg/kg standard in one of 46 samples; the value was 4,100 µg/kg;
• BkF exceeds the 880 µg/kg standard in three of 46 samples; values range from 1,100 – 170,000 µg/kg;
• Chrysene exceeds the 8,800 µg/kg standard in one of 46 samples; the value is 220,000 µg/kg;
• Di(ah)A exceeds the 8.8 µg/kg standard in two of 46 samples; values range from 120 – 300 µg/kg;
• Fluoranthene exceeds the 500,000 µg/kg (Wisconsin GW path) standard in one of 46 samples; the value is 790,000 µg/kg;
• Fluorene exceeds the 100,000 µg/kg (Wisconsin GW path) standard in one of 46 samples; the value is 320,000;
• Indeno(123) exceeds the 88 µg/kg (Wisconsin nonInd) standard in seven of 46 samples; values range from 150 – 100,000 µg/kg;
• Methylnaph2 exceeds the 20,000 µg/kg (Wisconsin GW path) standard in one of 46 samples; the value is 380,000;
• Naphthalene exceeds the 400 µg/kg standard in 11 of 46 samples; values range from 414 – 2,220,000 µg/kg
• Phenanthrene exceeds the 1,800 µg/kg standard in six of 46 samples; values range from 2,500 – 1,200,000 µg/kg
• Pyrene exceeds the 500,000 µg/kg (Wisconsin nonInd) standard in one of 46 samples; the value is 520,000.

Inspection of the upper bluff data indicates these PAH exceedances predominantly correspond to samples collected from shallow fill. The extent of the PAH exceedances is primarily associated with source areas in the area of the free product mass east of the ravine (at the former MGP), the southeast gas holder, and a smaller source area present at the large southwest gas holder.

The highest levels and greatest number of PAH exceedances are found in fill soils recovered and analyzed from the filled ravine. The following summarizes the ravine fill SVOC exceedances:

• Acenaphthene exceeds the 38,000 µg/kg (Wisconsin GW path) standard in 13 of 90 samples; values range from 40,000 – 670,000 µg/kg;
• Acenaphthylene exceeds the 700 µg/kg standard in 38 of 95 samples; values range from 790 – 910,000 µg/kg;
• Anthracene exceeds the 300,000 µg/kg standard in two of 95 samples; values range from 310,000 – 750,000 µg/kg;
• BaA exceeds the 88 µg/kg (Wisconsin nonInd) standard in 52 of 95 samples; values range from 160 – 520,000 µg/kg;

• BaP exceeds the 8.8 µg/kg standard in 55 of 95 samples; values range from 45 – 340,000 µg/kg;
• BbF exceeds the 88 µg/kg standard in 48 of 95 samples; values range from 110 – 410,000 µg/kg;
• B(ghi)P exceeds the 1,800 µg/kg standard in 19 of 95 samples; values range from 2,400 – 190,000 µg/kg;
• BkF exceeds the 880 µg/kg standard in 24 of 95 samples; values range from 1,000 – 130,000 µg/kg;
• Chrysene exceeds the 8,800 µg/kg standard in 17 of 95 samples; values range from 11,000 – 470,000 µg/kg;
• Di(ah)A exceeds the 8.8 µg/kg standard in eight of 90 samples; the values range from 97 – 10,600 µg/kg;
• Dibenzofuran exceeds the 145,263 µg/kg (Region 9) standard in one of 72 samples; the value is 280,000 µg/kg;
• Fluoranthene exceeds the 500,000 µg/kg (Wisconsin GW path) standard in one of 95 samples; the value is 1,400,000 µg/kg;
• Fluorene exceeds the 100,000 µg/kg standard in eight of 95 samples; values range from 100,000 – 1,200,000 µg/kg;
• Indeno(123) exceeds the 88 µg/kg (Wisconsin nonInd) standard in 30 of 95 samples; values range from 95 – 61,000 µg/kg;
• Methylnaph1 exceeds the 23,000 µg/kg (Wisconsin GW path) standard in 20 of 81 samples; values range from 24,000 – 3,800,000 µg/kg;
• Methylnaph2 exceeds the 20,000 µg/kg (Wisconsin GW path) standard in 25 of 95 samples; the values range from 21,000 – 3,800,000 µg/kg;
• Naphthalene exceeds the 400 µg/kg standard in 53 of 97 samples; values range from 470 – 1,400,000 µg/kg;
• Phenanthrene exceeds the 1,800 µg/kg standard in 43 of 95 samples; values range from 2,100 – 3,700,000 µg/kg
• Pyrene exceeds the 500,000 µg/kg (Wisconsin nonInd) standard in four of 95 samples; values range from 545,000 - 2,000,000 µg/kg.

The extent of contamination of SVOCs at the upper bluff and filled ravine is fairly well defined and resembles the extent identified for the VOCs.

Soils in Kreher Park

Surface Soils – *Metals and Inorganics*

Metal and inorganic results are similar to comparable samples collected from upper bluff/filled ravine soils. Exceedences were measured for arsenic, cadmium, lead, and iron (compared to the Wisconsin nonInd standard). A summary of the exceedences for these compounds follows:

• Arsenic exceeds the 0.039 mg/kg Wisconsin nonInd standard in 33 of 36 samples; values range from 1.1 – 13.9 mg/kg;
• Cadmium exceeds the 8.0 mg/kg Wisconsin nonInd standard in one sample; the value is 12 mg/kg;
• Iron exceeds the 23,463 mg/kg Region 9 standard in eight of 35 samples; values range from 24,000 – 94,000 mg/kg;

• Lead exceeds the 50 mg/kg Wisconsin nonInd standard in 18 of 36 samples; values range from 53 – 950 mg/kg.

The arsenic results range from values similar to background values to about seven times greater than background. The extent of arsenic above regulatory standards is ubiquitous throughout Kreher Park and is likely associated with urban fill and MGP process wastes.

***Surface Soils** – Organics - VOCs*
A larger set of samples was collected from surface soil at Kreher Park compared to the upper bluff, and detections for each of the subject VOCs were measured in at least one of these samples. Toluene and xylenes were detected most often, with fewer detections of TCB, ethylbenzene, n-butylbenzene and TMB. However, benzene is the only VOC measured that exceeds its respective standard, as follows:

• Benzene exceeds the 5.5 µg/kg Wisconsin GW path standard in four of 35 samples; values range from 23 – 495 µg/kg.

Each of these samples was collected from the area of the seep, where high levels of contaminants/free product have been observed. The extent of VOC contamination in surface soils at Kreher Park is limited to benzene at the seep area.

***Surface Soils** – Organics - SVOCs*
PAH exceedances in surface soils at Kreher Park are limited primarily to the HMW PAHs, although a few exceedances of acenaphthylene naphthalene, and phenanthrene were measured. A summary of these detections follows:

• Acenaphthylene exceeds the 700 µg/kg (Wisconsin GW path) standard in 4 of 35 samples; values range from 1,700 – 27,000 µg/kg;
• BaA exceeds the 88 µg/kg (Wisconsin nonInd) standard in 16 of 35 samples; values range from 240 – 25,000 µg/kg;
• BaP exceeds the 8.8 µg/kg standard in 17 of 35 samples; values range from 290 – 68,000 µg/kg;
• BbF exceeds the 88 µg/kg standard in 17 of 35 samples; values range from 330 – 53,000 µg/kg;
• B(ghi)P exceeds the 1,800 µg/kg standard in five of 35 samples; values range 3,240 – 57,000 µg/kg;
• BkF exceeds the 880 µg/kg standard in three of 35 samples; values range from 1,500 – 15,000 µg/kg;
• Chrysene exceeds the 8,800 µg/kg standard in one of 35 samples; the value is 32,000 µg/kg;
• Indeno(123) exceeds the 88 µg/kg standard in 9 of 35 samples; values range from 190 – 33,000µg/kg;
• Naphthalene exceeds the 400 µg/kg (Wisconsin GW path) standard in two of 35 samples; values range from 1,768 – 2,144 µg/kg;
• Phenanthrene exceeds the 1,800 µg/kg standard in two of 35 samples; values range from 2,600 – 6,800 µg/kg.

The predominant exceedances are from HMW PAHs. The majority of the exceedances are found in the area of the seep and the former coal tar dump. However, exceedances of BaA, BaP, and BbF are widespread through Kreher Park.

***Subsurface Soils** – Metals and Inorganics*
Exceedances for metals and inorganics in subsurface soils at Kreher Park are limited to arsenic, cadmium, iron, lead and manganese. A summary of these detections are as follows:

- Arsenic exceeds the 0.039 mg/kg Wisconsin nonInd standard in 33 of 66 samples; values range from 0.83 – 36 mg/kg;
- Cadmium exceeds the 8.0 mg/kg standard in one of 94 samples; the value is 24.8 mg/kg;
- Iron exceeds the 23,463 mg/kg Region 9 standard in six of 65 samples; values range from 24,000 – 31,000 mg/kg;
- Lead exceeds the 50 mg/kg Wisconsin nonInd standard in 21 of 95 samples; values range from 50 – 1,321 mg/kg.
- Manganese exceeds the 1,564 mg/kg Region 3 standard in one of 34 samples; the value is 2,000 mg/kg.

The arsenic results range from values similar to background values to values more than an order of magnitude greater than background values. The extent of arsenic above regulatory standards is widespread throughout Kreher Park, but not evident at all sampling locations. The arsenic concentrations are likely associated with urban fill and MGP process wastes. The one cadmium exceedance is likely associated with Kreher Park fill material and the extent in subsurface soil is limited to this one location. The iron exceedances and extents are clustered in samples collected from the seep area at the base of the ravine, and at the area north of the former WWTP.

The manganese exceedance, which is the only exceedance in soil across the entire Site, does not appear to be associated with known COCs. This detection was made at the seep; the lack of other manganese exceedances in other samples indicates it is not likely associated with known contaminant sources at the Site.

The extent of lead exceedances above regulatory standards is clustered at the seep at the base of the ravine, and at various locations across Kreher Park. The high lead concentrations are associated with Site source material, at the seep area, and potentially other sources, such as the Kreher Park fill material. High lead levels are also found in samples at locations where free product has not been observed; these locations are where no free product (sheens) were observed, but high lead levels were measured. These samples were collected in the area north and east of the solid waste area. Although elevated lead is also found in samples from free product areas, the highest lead levels at Kreher Park do not appear associated with tar materials.

***Subsurface Soils** – Organics – VOCs*
VOC exceedances in subsurface soils at Kreher Park include benzene, ethylbenzene, nbutylbenzene, toluene, TCB, 1,3,5-TMB and xylenes. The summary of these exceedances follows:

• Benzene exceeds the 5.5 µg/kg (Wisconsin GW path) standard in 23 of 78 samples; values range from 11 – 645,000 µg/kg;
• Ethylbenzene exceeds the 2,900 µg/kg (Wisconsin GW path) standard in 7 of 94 samples; values range from 4,000 – 2,973,000 µg/kg;
• n-butylbenzene exceeds the 240,000 µg/kg (Regions 3 and 9) standards in one of 60 samples; the value is 648,000;
• 1,2,4-TCB exceeds the 62,160 µg/kg (Region 9) standard in two of 60 samples; the values range from 157,000 – 2,994,000 µg/kg;
• 1,3,5-TMB exceeds the 21,253 µg/kg (Region 9) standard in one of 94 samples; the value is 742,000 µg/kg;
• Toluene exceeds the 1,500 µg/kg (Wisconsin GW path) standard in eight of 94 samples; values range from 1,500 – 2,007,000 µg/kg;
• Xylene exceeds the 4,100 µg/kg (Wisconsin GW path) standard in seven of 130 samples; values range from 4,400 – 4,981,000 µg/kg.

These VOC exceedences are from locations where free product has been observed, either as DNAPL or LNAPL.

Subsurface Soils – *Organics -SVOCs*
Exceedences for all the SVOC compounds on the analyte list are present in subsurface soils as follows:

• Acenaphthene exceeds the 38,000 µg/kg (Wisconsin GW path) standard in 18 of 110 samples; values range from 46,400 – 8,200,000 µg/kg; 12 of these exceedances range between 750,000 – 8,200,000 µg/kg and are found within the area of the coal tar dump, along the pipe found at the bluff face, and the solid waste area;
• Acenaphthylene exceeds the 700 µg/kg standard in 34 of 110 samples; values range from 827 – 9,700,000 µg/kg; exceedances are found at the coal tar dump, the pipe at the bluff, the solid waste area, with lower values near the WWTP; the highest levels are measured at the coal tar dump and along the pipe trace (1,300,000 – 9,700,000 µg/kg);
• Anthracene exceeds the 300,000 µg/kg standard in 12 of 110 samples; values range from 324,000 – 4,100,000 µg/kg; the distribution of the exceedances are nearly the same as acenaphthene; nine exceedances in samples from the coal tar dump and the pipe trace range from 1,500,000 – 4,100,000 µg/kg;
• BaA exceeds the 88 µg/kg (Wisconsin nonInd) standard in 67 of 110 samples; values range from 110 – 2,400,000 µg/kg; the exceedance distribution is similar to acenaphthylene; only areas west of the solid waste area and east of the coal tar dump yield no exceedances;
• BaP exceeds the 8.8 µg/kg standard in 61 of 110 samples; values range from 21.9 – 1,800,000 µg/kg; the exceedance distribution is nearly the same as acenaphthylene and BaA;
• BbF exceeds the 88 µg/kg standard in 53 of 93 samples; values range from 158 – 1,200,000 µg/kg; the distribution is nearly the same as acenaphthylene, BaA, and BaP;
• B(ghi)P exceeds the 1,800 µg/kg standard in 30 of 110 samples; the values range from 2,440 – 1,200,000 µg/kg; the distribution is the same as the acenaphthylene, BaA, BaP,

and BbF compounds, with the exception that there are few exceedances near the WWTP area;

• BkF exceeds the 880 µg/kg standard in 34 of 110 samples; values range from 972 – 1,500,000 µg/kg; the distribution is the same as the acenaphthylene, BaA, BaP, BbF, and B(hgi)P compounds;

• Chrysene exceeds the 8,800 µg/kg standard in 20 of 110 samples; the values range from 12,000 – 2,300,000 µg/kg; the distribution is the same as the acenaphthylene, BaA, BaP, BbF, B(hgi)P, and BkF compounds;

• Di(ah)A exceeds the 8.8 µg/kg standard in 20 of 93 samples; the values range from 253 – 290,000 µg/kg; the distribution shows exceedances tend to be limited to the coal tar dump and the pipe trace for this compound;

• Dibenzofuran exceeds the 145,263 µg/kg (Region 9) standard in 9 of 67 samples; the values range from 160,000 to 1,400,000 µg/kg; exceedances are found at the coal tar dump and along the pipe trace; the exceedance distribution is similar to that of Di(ah)A;

• Fluoranthene exceeds the 500,000 µg/kg (Wisconsin GW path) standard in 10 of 110 samples; the values range from 605,000 – 5,400,000 µg/kg; the exceedance distribution is limited to the coal tar dump and pipe trace;

• Fluorene exceeds the 100,000 µg/kg standard in 15 of 110 samples; the values range from 113,000 – 4,600,000 µg/kg; the exceedance distribution is similar to dibenzofuran;

• Indeno(123) exceeds the 88 µg/kg (Wisconsin nonInd) standard in 43 of 110 samples; values range from 96 – 1,200,000 µg/kg; the exceedance distribution is similar to B(ghi)P;

• Methylnaph1 exceeds the 23,000 µg/kg (Wisconsin GW path) standard in 12 of 67 samples; the values range from 200,000 – 21,000,000 µg/kg; exceedances are found at the coal tar dump, the pipe trace, the seep, and near the WWTP;

• Methylnaph2 exceeds the 20,000 µg/kg (Wisconsin GW path) standard in 20 of 96 samples; the values range from 30,000 – 30,000,000 µg/kg; this distribution is similar to methynaph1, with additional exceedances within the solid waste area;

• Naphthalene exceeds the 400 µg/kg standard in 46 of 110 samples; values range from 504 – 37,000,000 µg/kg; naphthalene exceedances are found across the entire Kreher Park area, with the highest levels at the coal tar dump. Lower concentrations and fewer exceedances are found at the solid waste area;

• Phenanthrene exceeds the 1,800 µg/kg standard in 42 of 110 samples; values range from 1,900 – 14,000,000 µg/kg; the exceedance distribution is similar to B(ghi)P and Indeno(123); and

• Pyrene exceeds the 500,000 µg/kg (Wisconsin nonInd) standard in 13 of 110 samples; values range from 616,000 - 7,600,000 µg/kg; the exceedance distribution is similar to fluoranthene.

In general, the extent of SVOC exceedences includes much of Kreher Park. The exceedences are associated with free-product, which is also located throughout much of Kreher Park.

Groundwater in Upper Bluff/Filled Ravine

Groundwater *– Metals and Inorganics –UpperBluff*

In general, the Wisconsin ch. NR 140 standards yield the most stringent limits (with a few exceptions), although EPA standards are more inclusive. Concentrations of all the metal parameters were measured at levels above the most stringent sample in at least one sample collected from wells at the upper bluff, with the exception of beryllium, cyanide, mercury selenium and zinc. A summary of these detections follows:

- Antimony exceeds the 1.2 µg/l (Wisconsin PAL) standard in six of 20 samples; values range from 3.2 - 17 µg/l;
- Arsenic exceeds the 0.04 µg/l (Regions 3 and 9) standard in 13 of 32 samples; values range from 1.8 – 30 µg/l;
- Barium exceeds the 400 µg/l (Wisconsin PAL) standard in eight of 20 samples; values range from 490 – 1,800 µg/l;
- Cadmium exceeds the 0.5 µg/l (Wisconsin PAL) standard in four of 22 samples; values range from 0.98 – 6.3 µg/l;
- Chromium exceeds the 10 µg/l (Wisconsin PAL) standard in 14 of 32 samples; values range from 11 – 490 µg/l;
- Cobalt exceeds the 8 µg/l (Wisconsin PAL) standard in nine of 20 samples; values range from 16 – 160 µg/l;
- Copper exceeds the 130 µg/l (Wisconsin PAL) standard in six of 32 samples; values range from 142 – 470 µg/l;
- Iron exceeds the 150 µg/l (Wisconsin PAL) standard in 25 of 32 samples; values range from 200 – 310,000 µg/l; elevated levels were measured during multiple events;
- Lead exceeds the 1.5 µg/l (Wisconsin PAL) standard in 21 of 32 samples; values range from 1.55 – 110 µg/l; multiple exceedances were measured at every well;
- Manganese exceeds the 25 µg/l (Wisconsin PAL) standard in 19 of 20 samples; values range from 120 – 5,700 µg/l;
- Nickel exceeds the 20 µg/l (Wisconsin PAL) standard in 10 of 30 samples; values range from 24 – 340 µg/l;
- Silver exceeds the 10 µg/l (Wisconsin PAL) standard in one sample, MW- 8 during one event (20 µg/l);
- Thallium exceeds the 0.4 µg/l (Wisconsin PAL) standard in one sample, MW-16 during one event (5.7 µg/l);
- Vanadium exceeds the 6 µg/l (Wisconsin PAL) standard in 18 of 20 samples; all wells show multiple exceedences.

Groundwater *– Metals and Inorganics - Filled Ravine*

The filled ravine data for the metals and inorganics group do not yield significant variations from the upper bluff. Exceedances are found for 17 of the 19 metals compounds from the approved list. Concentrations of arsenic, iron, lead, manganese and vanadium are again the dominant metals that exceed standards. An additional compound frequently detected but not found in the upper bluff network wells is cyanide. A summary of the metals detections at this network follows:

- Antimony exceeds the 1.2 µg/l (Wisconsin PAL) standard in 14 of 32 samples; values range from 2.4 - 13 µg/l;

• Arsenic exceeds the 0.04 µg/l (Regions 3 and 9) standard in 42 of 78 samples; values range from 1.16 – 77 µg/l; multiple exceedances were measured at all wells with the exception of one well at the down gradient edge of the ravine;
• Barium exceeds the 400 µg/l (Wisconsin PAL) standard in 15 of 32 samples; values range from 430 – 1,600 µg/l;
• Cadmium exceeds the 0.5 µg/l (Wisconsin PAL) standard in 17 of 52 samples; values range from 0.5 – 5.3 µg/l;
• Chromium exceeds the 10 µg/l (Wisconsin PAL) standard in 19 of 76 samples; values range from 12 – 236 µg/l;
• Cobalt exceeds the 8 µg/l (Wisconsin PAL) standard in nine of 32 samples; values range from 8.5 – 42 µg/l;
• Copper exceeds the 130 µg/l (Wisconsin PAL) standard in three of 76 samples; values range from 150 – 327 µg/l;
• Cyanide exceeds the 40 µg/l (Wisconsin PAL) standard in 30 of 50 samples; values range from 44 – 5,340 µg/l;
• Iron exceeds the 150 µg/l (Wisconsin PAL) standard in 66 of 76 samples; values range from 340 – 150,000 µg/l; variable levels were measured during multiple events at every well;
• Lead exceeds the 1.5 µg/l (Wisconsin PAL) standard in 41 of 75 samples; values range from 1.6 – 1,160 µg/l; multiple exceedances were measured at every well, but trends are variable across the network;
• Manganese exceeds the 25 µg/l (Wisconsin PAL) standard in 32 of 32 samples; values range from 380 – 16,000 µg/l;
• Mercury exceeds the 0.2 µg/l (Wisconsin PAL) standard in three of 32 samples;
• Nickel exceeds the 20 µg/l (Wisconsin PAL) standard in 12 of 50 samples; values range from 20 – 152 µg/l;
• Selenium exceeds the 10 µg/l (Wisconsin PAL) standard in three of 49 samples, values range from 12 – 19 µg/l;
• Silver exceeds the 10 µg/l (Wisconsin PAL) standard in one sample;
• Thallium exceeds the 0.4 µg/l (Wisconsin PAL) standard in three of 32 samples, values range from 3.3 – 5.1 µg/l; each exceedance was measured at different wells;
• Vanadium exceeds the 6 µg/l (Wisconsin PAL) standard in 22 of 32 samples; values range from 6 – 170 µg/l.

***Groundwater** - Organics – VOCs - Upper Bluff*
Exceedences for VOCs at the upper bluff well network are limited to benzene and chloroform. A summary follows:

• Benzene exceeds the 0.34 µg/l (Region 3) standard in eight of 31 samples; values range from 0.49 – 120 µg/l;
• Chloroform exceeds the 0.2 µg/l (Region 3 and 9) standard in one of four samples; the exceedance was measured at 4.7 µg/l.

***Groundwater** - Organics – SVOCs – Upper Bluff*
Exceedences for PAHs at the upper bluff well network are limited to BaP, BbF and naphthalene. A summary follows:

• BaP exceeds the 0.003 µg/l (Region 3) standard in one of 38 samples; the detection was made at MW-10 (0.23 µg/l);
• BbF exceeds the 0.02 µg/l (Wisconsin PAL) standard in one of 38 samples; the detection was made at MW-10 (0.12 µg/l);
• Naphthalene exceeds the 6.2 µg/l (Region 9) standard in six of 39 samples; values range from 9.3 – 570 µg/l.

Groundwater *- Organics – VOCs - Filled Ravine*
Six VOCs were measured above regulatory standards during multiple events at the filled ravine well network. These include benzene, ethylbenzene, styrene, TMB, toluene, and xylenes. The summary follows:

• Benzene exceeds the 0.34 µg/l (Region 3) standard in 74 of 92 samples; values ranged from 0.34 – 86,000 µg/l; multiple exceedance measurements were made at all the wells in the network;
• Ethylbenzene exceeds the 140 µg/l (Wisconsin PAL) standard in 41 of 84 samples; values range from 140 – 3,400 µg/l; the same general pattern as that shown for benzene exceedances are shown for ethylbenzene;
• Styrene exceeds the 10 µg/l (Wisconsin PAL) standard in four of 44 samples; values range from 17 – 890 µg/l;
• TMB exceeds the 96 µg/l (Wisconsin PAL) standard in eight of 18 samples; values ranged from 111 – 5,000 µg/l;
• Toluene exceeds the 200 µg/l (Wisconsin PAL) standard in 37 of 93 samples; values range from 490 – 36,000 µg/l;
• Xylenes exceed the 206 µg/l (Region 9) standard in 44 of 89 samples; values range from 207.7 – 11,500 µg/l.

The occurrence and frequency of the greatest VOC concentrations correspond to wells in proximity of known free product areas.

Groundwater *- Organics – SVOCs – Filled Ravine*
Exceedences were measured at the filled ravine well network for each of the SVOCs (PAHs and PCP). The summary is as follows:

• Anthracene (LMW PAH) exceeds the 600 µg/l (Wisconsin PAL) standard in nine of 93 samples; values range from 950 – 120,000 µg/l;
• BaP (HMW PAH) exceeds the 0.003 µg/l (Region 3) standard in 36 of 93 samples; values range from 0.028 – 71,000 µg/l;
• BbF (HMW PAH) exceeds the 0.02 µg/l (Wisconsin PAL) standard in 35 of 93 samples;
values range from 0.11 – 31,000 µg/l; the pattern and trend of exceedances are nearly identical to that of BaP;
• Chrysene (HMW PAH) exceeds the 0.02 µg/l (Wisconsin PAL) standard in 25 of 98 samples; values range from 0.14 – 66,000 µg/l;
• Fluoranthene (HMW PAH) exceeds the 80 µg/l (Wisconsin PAL) standard in 15 of 98 samples; values range from 110 – 140,000 µg/l;

• Fluorene (LMW PAH) exceeds the 80 µg/l (Wisconsin PAL) standard in 16 of 98 samples; values range from 83 – 150,000 µg/l;
• Naphthalene (LMW PAH) exceeds the 6.2 µg/l (Region 9) standard in 75 of 104 samples; values range from 14 – 1,700,000 µg/l;
• PCP exceeds the 0.1 µg/l (Wisconsin PAL) standard in one of 12 samples; the measurement was 76 µg/l;
• Phenol exceeds the 1,200 µg/l (Wisconsin PAL) standard in one of 78 samples; the measurement was 4,500 µg/l;
• Pyrene (HMW PAH) exceeds the 50 µg/l (Wisconsin PAL) standard in 25 of 98 samples; values range from 54 – 180,000 µg/l;
• Pyridine exceeds the 2 µg/l (Wisconsin PAL) standard in two of 14 samples; this is a small sample set, but the measured values are 5.9 µg/l and 20 µg/l.

The extent of VOC and SVOC contamination at the upper bluff and filled ravine is mainly located within the filled ravine from the source area (near MW-4 and MW-15), to the north including the entire ravine.

Groundwater in Kreher Park

Groundwater – Metals and Inorganics – Kreher Park

This compound group yields data similar to that found in the filled ravine groundwater. These levels reflect the persistence of these particular compounds in the fill. The other compounds from this group, which yielded anomalous detections at the upper bluff are found less frequently at the Park. A summary of the exceedences of metals and inorganics in groundwater at Kreher Park is as follows:

• Antimony exceeds the 1.2 µg/l (Wisconsin PAL) standard in 8 of 32 samples; values range from 2.3 – 4.6 µg/l; all the exceedance measurements were made during the most recent event (March 2005) across the well network;
• Arsenic exceeds the 0.04 µg/l (Regions 3 and 9) standard in 45 of 112 samples; values range from 1.18 – 24.6 µg/l; multiple exceedances were measured at nearly all the permanent wells in the network;
• Barium exceeds the 400 µg/l (Wisconsin PAL) standard in eight of 32 samples; values range from 420 – 1,100 µg/l;
• Cadmium exceeds the 0.5 µg/l (Wisconsin PAL) standard in eight of 107 samples; values range from 0.51 – 60.8 µg/l; the 60.8 µg/l value was from a one-time sample in the southwest area of the Park; the next highest value is 9.4 µg/l from the seep;
• Chromium exceeds the 10 µg/l (Wisconsin PAL) standard in 26 of 112 samples; values range from 10 – 250 µg/l;
• Cobalt exceeds the 8 µg/l (Wisconsin PAL) standard in 14 of 32 samples; values range from 8.1 – 51 µg/l; multiple exceedances were measured at MW-3(NET), -7R -24, -25 and -26; the highest level was measured at MW-24; no trends are seen, except at MW-25 which shows a slight downward trend;
• Copper exceeds the 130 µg/l (Wisconsin PAL) standard in one of 112 samples; the exceedance was measured in one sample;
• Cyanide exceeds the 40 µg/l (Wisconsin PAL) standard in one of 67 samples; the sample was collected at the seep (125 µg/l);

• Iron exceeds the 150 µg/l (Wisconsin PAL) standard in 64 of 112 samples; values range from 190 – 70,000 µg/l; the highest levels were measured at wells along the shoreline;
• Lead exceeds the 1.5 µg/l (Wisconsin PAL) standard in 47 of 112 samples; values range from 1.5 – 120 µg/l; the highest levels were measured at wells along the shoreline;
• Manganese exceeds the 25 µg/l (Wisconsin PAL) standard in 32 of 32 samples; values range from 660 – 3,400 µg/l; values are highest along the shoreline;
• Nickel exceeds the 20 µg/l (Wisconsin PAL) standard in 13 of 37 samples; values range from 20 – 340 µg/l;
• Selenium exceeds the 10 µg/l (Wisconsin PAL) standard in one of 83 samples; the sample was collected at the seep (790 µg/l);
• Thallium exceeds the 0.4 µg/l (Wisconsin PAL) standard in two of 32 samples, values range from 2.6 – 2.7 µg/l;
• Vanadium exceeds the 6 µg/l (Wisconsin PAL) standard in 24 of 32 samples; values range from 7.7 – 220 µg/l; the highest levels were measured at wells along the shoreline;
• Zinc exceeds the 2,500 µg/l (Wisconsin PAL) standard in one of 124 samples; the sample was collected at the seep (3,600 µg/l).

The majority of these compounds yield levels comparable to those found in the filled ravine. The elevated concentrations of a number of these inorganics are clustered near the base of the ravine, and near the seep area.

***Groundwater** – Organics – VOCs – Kreher Park*
Six VOCs exceed groundwater standards at Kreher Park. The summary of these measurements is as follows:

• Benzene exceeds the 0.34 µg/l (Region 3) standard in 105 of 126 samples; values range from 0.8 – 36,000 µg/l; multiple exceedance measurements were made at all the wells in the network; the highest levels were measured where free product has been detected;
• Ethylbenzene exceeds the 140 µg/l (Wisconsin PAL) standard in 54 of 127 samples; values range from 173 – 4,400 µg/l;
• Styrene exceeds the 10 µg/l (Wisconsin PAL) standard in five of 38 samples; values range from 29 – 1,300 µg/l;
• TMB exceeds the 96 µg/l (Wisconsin PAL) standard in three of eight samples; values range from 97 – 440 µg/l; free product first appeared at this well beginning in 2003);
• Toluene exceeds the 200 µg/l (Wisconsin PAL) standard in 13 of 126 samples; values range from 200 – 16,000 µg/l;
• Xylenes exceed the 206 µg/l (Region 9) standard in 39 of 134 samples; values range from 238 – 4,800 µg/l.

Similar to the findings in the filled ravine, data shows the highest levels in proximity to the free product areas. Total VOCs approaching 50,000 µg/l (primarily benzene) are found near the DNAPL zones. However, several areas at the Park where free-product is limited to LNAPL show groundwater total VOCs an order of magnitude less than the DNAPL areas.

These figures show that VOCs are located throughout most of Kreher Park. This distribution correlates directly with the distribution of DNAPL and LNAPL. LNAPL is also located in most locations throughout the Park.

***Groundwater** – Organics – SVOCs – Kreher Park*
Exceedances were measured at Kreher Park in groundwater for each of the SVOCs with the exception of PCP and phenol. The summary is as follows:

- Anthracene (LMW PAH) exceeds the 600 µg/l (Wisconsin PAL) standard in 22 of 119 samples; values range from 700 – 16,100 µg/l;
- BaP (HMW PAH) exceeds the 0.003 µg/l (Region 3) standard in 73 of 119 samples; values range from 0.388 – 7,754 µg/l; the highest levels are found at the seep,
- BbF (HMW PAH) exceeds the 0.02 µg/l (Wisconsin PAL) standard in 70 of 119 samples; values range from 0.096 – 6,260 µg/l; as with the ravine fill, the pattern of exceedances are nearly identical to that of BaP;
- Chrysene (HMW PAH) exceeds the 0.02 µg/l (Wisconsin PAL) standard in 71 of 119 samples; values range from 1.19 – 7,298 µg/l; the relative strength of concentrations and the pattern of exceedances were the same as for BaP and BbF;
- Fluoranthene (HMW PAH) exceeds the 80 µg/l (Wisconsin PAL) standard in 49 of 119 samples; values range from 80.5 – 32,400 µg/l; the pattern of exceedances are similar to BaP, BbF, and chrysene; the highest levels are found at the seep, the solid waste area and along the pipe trace;
- Fluorene (LMW PAH) exceeds the 80 µg/l (Wisconsin PAL) standard in 42 of 119 samples; values range from 80.1 – 20,200 µg/l; the strength of contaminant levels and the pattern of exceedances are similar to that for BaP, BbF, chrysene, and fluoranthene;
- Naphthalene (LMW PAH) exceeds the 6.2 µg/l (Region 9) standard in 103 of 128 samples; values range from 8.6 – 39,749 µg/l; exceedances were measured across the entire Park area; the highest levels were measured at the free product areas (the seep);
- Pyrene (HMW PAH) exceeded the 50 µg/l (Wisconsin PAL) standard in 60 of 111 samples; values range from 51.5 – 56,200 µg/l; the pattern of exceedances are similar to BaP, BbF, chrysene, fluoranthene, and fluorene.

The concentrations of these compounds have the same relative relationship and indicate a potential similar source as that found in the filled ravine. Groundwater quality at Kreher Park shows widespread contaminant distribution, but the highest levels again correspond to the approximate locations where free-product (primarily DNAPL) has been measured.

In general, SVOC contamination is prevalent throughout most of Kreher Park, with elevated concentrations directly correlated to the free-product (both DNAPL and LNAPL) found throughout the Park.

Groundwater in Copper Falls Aquifer
***Groundwater** – Metals and Inorganics*
The inorganic water quality in the Copper Falls aquifer is generally less impacted when compared to the upper bluff, ravine fill or Kreher Park. However, unlike the organic

compounds, analyses of the majority of inorganic compounds have only been performed since the remedial investigation began. Exceedence measurements for the inorganic compounds on the list were found with the exception of mercury, selenium, silver and zinc. A summary of these exceedences follows:

- Antimony exceeds the 1.2 µg/l (Wisconsin PAL) standard in 23 of 201 samples; values range from 2 – 19 µg/l; similar to the measurements at Kreher Park;
- Arsenic exceeds the 0.04 µg/l (Regions 3 and 9) standard in 163 of 237 samples; values range from 1.45 – 14 µg/l; multiple exceedances were measured at all the wells in the network;
- Barium exceeds the 400 µg/l (Wisconsin PAL) standard in 42 of 201 samples; values range from 420 – 1,100 µg/l;
- Beryllium exceeds the 0.4 µg/l (Wisconsin PAL) standard in two of 201 samples; one was measured during December 2003 (0.66 µg/l), the other during June 2004 (0.71 µg/l);
- Cadmium exceeds the 0.5 µg/l (Wisconsin PAL) standard in six of 219 samples; values range from 0.52 – 1.75 µg/l;
- Chromium exceeds the 10 µg/l (Wisconsin PAL) standard in 17 of 236 samples; values range from 10 – 140 µg/l;
- Cobalt exceeds the 8 µg/l (Wisconsin PAL) standard in 13 of 201 samples; values ranged from 8.2 – 60 µg/l;
- Copper exceeds the 130 µg/l (Wisconsin PAL) standard in four of 238 samples; values range from 130 – 500 µg/l;
- Cyanide exceeds the 40 µg/l (Wisconsin PAL) standard in 37 of 367 samples; values range from 40 – 360 µg/l;
- Iron exceeds the 150 µg/l (Wisconsin PAL) standard in 145 of 236 samples; values range from 190 – 110,000 µg/l; the maximum levels appear to be clustered in the area of the former MGP;
- Lead exceeds the 1.5 µg/l (Wisconsin PAL) standard in 81 of 239 samples; values range from 1.5 – 70 µg/l; maximum levels are similar to iron, which are clustered in the area of the former MGP;
- Manganese exceeds the 25 µg/l (Wisconsin PAL) standard in 191 of 201 samples; values range from 25 – 3,200 µg/l;
- Nickel exceeds the 20 µg/l (Wisconsin PAL) standard in 13 of 214 samples; values range from 20 – 120µg/l;
- Thallium exceeds the 0.4 µg/l (Wisconsin PAL) standard in four of 201 samples, values range from 2.6 – 8.3 µg/l;
- Vanadium exceeds the 6 µg/l (Wisconsin PAL) standard in 37 of 201 samples; values range from 6.5 – 230 µg/l.

The data indicates that inorganic groundwater quality has been impacted in the area of the former MGP. It is evident that the greatest inorganic concentrations detected occur in areas associated within the dissolved phase halo surrounding the DNAPL plume.

Inorganic COCs appear to be limited to cyanide, iron and lead. Cyanide is not measured beyond the wells in the immediate vicinity of the MGP. Arsenic, iron and lead are measured beyond the MGP and not all measurements are associated with releases from the MGP.

However, much higher levels of arsenic, iron, and lead are measured at the MGP wells indicating that these metals are likely released into solution as a result of contact with Site source material. The high metals content at MGP wells may be caused by cation exchange with soil in the presence of the primary contaminant plume and may be associated with MGP process wastes.

***Groundwater** -- Organics – VOCs*
Eight VOCs were measured at Copper Falls wells in excess of the most stringent standards. The summary of these data follows:

- Benzene exceeds the 0.34 µg/l (Region 3) standard in 376 of 497 samples; values range from 0.34 – 63,000 µg/l; multiple exceedance measurements were made at all the wells in the network with the exception of the two artesian wells; these data confirm the earlier descriptions of the relationship between the benzene levels and the measurement of free-product (DNAPL) in groundwater;
- Chloroform exceeds the 0.2 µg/l (Regions 3 and 9) standard in four of 28 samples; values range from 0.66 – 9.4 µg/l;
- Ethylbenzene exceeds the 140 µg/l (Wisconsin PAL) standard in 206 of 497 samples; values range from 140 – 5,300 µg/l; multiple exceedances were measured at the wells in proximity of the free-product plume, but the lower mobility of ethylbenzene (compared to benzene) shows declining levels with distance from the free product; these persistent high levels of ethylbenzene at this well may indicate a source material associated with these tanks as compared to the larger mass of MGP tar;
- Methylene chloride exceeds the 0.5 µg/l (Wisconsin PAL) standard in six of 10 samples; values range from 3.2 – 920 µg/l;
- Styrene exceeds the 10 µg/l (Wisconsin PAL) standard in 103 of 221 samples; values range from 15 – 5,300 µg/l;
- TMB exceeds the 96 µg/l (Wisconsin PAL) standard in 31 of 98 samples; values range from 98 – 980 µg/l;
- Toluene exceeds the 200 µg/l (Wisconsin PAL) standard in 244 of 497 samples; values range from 220 – 30,000 µg/l; the highest levels were measured at wells containing or near free product zones;
- Xylenes exceed the 206 µg/l (Region 9) standard in 224 of 487 samples; values range from 220 – 9,700 µg/l; the pattern and occurrence of exceedances is essentially the same as toluene.

The VOC data in the Copper Falls aquifer identifies a dissolved phase "halo" surrounding the free-product plume. The benzene distribution, shows that contamination associated with the MGP sources is widespread throughout the Copper Falls aquifer.

***Groundwater** -- Organics –SVOCs*
Exceedances were measured at Copper Falls wells for each of the SVOCs with the exception of PCP. The summary is as follows:

- Anthracene (LMW PAH) exceeds the 600 µg/l (Wisconsin PAL) standard in seven of 489 samples; values range from 1,200 – 28,000 µg/l;
- BaP (HMW PAH) exceeds the 0.003 µg/l (Region 3) standard in 28 of 486 samples;

values range from 0.12 – 14,000 µg/l;
• BbF (HMW PAH) exceeds the 0.02 µg/l (Wisconsin PAL) standard in 20 of 498 samples;values range from 0.06 – 10,300 µg/l; the pattern of exceedances are nearly identical to BaP,
• Chrysene (HMW PAH) exceeds the 0.02 µg/l (Wisconsin PAL) standard in 26 of 498 samples; values range from 0.13 – 13,000 µg/l; the pattern of exceedances is essentially the same as that for BaP;
• Fluoranthene (HMW PAH) exceeded the 80 µg/l (Wisconsin PAL) standard in nine of 498 samples; values range from 100 – 28,000 µg/l;
• Fluorene (LMW PAH) exceeds the 80 µg/l (Wisconsin PAL) standard in 13 of 498 samples; values range from 93 – 39,000 µg/l;
• Naphthalene (LMW PAH) exceeds the 6.2 µg/l (Region 9) standard in 340 of 515 samples; values range from 6.2 – 493,000 µg/l;
• Phenol exceeds the 1,200 µg/l (Wisconsin PAL) standard in nine of 469 samples; values range from 1,200 – 3,300 µg/l;
• Pyrene (HMW PAH) exceeds the 50 µg/l (Wisconsin PAL) standard in 13 of 493 samples; values range from 54 – 36,000 µg/l;
• Pyridine exceeds the 2 µg/l (Wisconsin PAL) standard in three of 30 samples; values range from 18 – 24 µg/l.

The pattern of naphthalene exceedences is similar to that for benzene. Although naphthalene is much less soluble than benzene, water quality data shows the same relative relationship for wells screened at the contact of the Miller Creek/Copper Falls.

Flow of the dissolved phase plume beyond the halo surrounding the free product/DNAPL zone is potentially restricted by the flow conditions in the aquifer.

Sediments

***Sediment** - Metals and Inorganics*

Inspection of the data summary tables indicates that the average concentrations in the 0 – 6 inch interval are greater than the average concentrations in the 0 – 24 inch interval; however, the majority of metals and inorganic compounds yield concentrations less than the Threshold Effects Concentration (TEC). A summary of the exceedances for inorganic sediment quality, all collected at separate sampling stations from 0 – 0.5 feet is as follows:

• Antimony exceeds the 2 mg/kg TEC in nine of 91 samples; values range from 2 – 5.1 mg/kg; three samples were from reference stations outside the affected area;
• Arsenic exceeds the 9.8 mg/kg TEC in three of 101 samples; values range from 10 – 30 mg/kg;
• Cadmium exceeds the 0.99 mg/kg TEC in two of 101 samples; values range from 1 – 1.1 mg/kg;
• Copper exceeds the 32 mg/kg TEC in 39 of 101 samples; values range from 33 – 700 mg/kg; three were at reference stations outside the affected area;
• Iron exceeds the 20,000 mg/kg TEC in 11 of 91 samples; values range from 20,000 – 93,000 mg/kg;
• Lead exceeds the 36 mg/kg TEC in 20 of 101 samples; values range from 36 – 200

mg/kg;
• Manganese exceeds the 460 mg/kg TEC in one of 91 samples; the value was 460 mg/kg,
• Mercury exceeds the 0.18 mg/kg TEC in 12 of 91 samples; values range from 0.18 – 1.3 mg/kg;
• Nickel exceeds the 23 mg/kg TEC in three of 101 samples; values range from 23 – 52 mg/kg;
• Silver exceeds the 1.6 mg/kg TEC in one of 91 samples; the value was 2.5 mg/kg;
• Zinc exceeds the 120 mg/kg TEC in four of 101 samples; values range from 130 – 140 mg/kg.

***Sediment** - Organics – VOCs*
Four VOCs that were analyzed as part of the approved parameter list are included on the WDNR sediment guidance. These parameters are benzene, 1,2,4 TCB, toluene and xylenes. Each of these compounds were detected at levels exceeding the respective TEC. The summary of these exceedences follow:

• Benzene exceeds the 57 µg/l TEC in 63 of 454 samples; values range from 57 – 55,000 µg/l;
• 1,2,4 TCB exceeds the 8 µg/l TEC in two of 216 samples; the values were measured at 2 – 4 feet and 4- 6 feet at the same station (2300N-1300E) during the 2001 sampling event;
• Toluene exceeds the 890 µg/l TEC in 37 of 453 samples; values range from 1,200 – 220,000 µg/l;
• Xylenes exceed the 25 µg/l TEC in 133 of 454 samples; values range from 43 – 590,000 µg/l; the distribution is similar to that for benzene, although there are a greater number of exceedances.

The extent of VOC exceedances follows the shoreline. The highest concentration of contaminants are found immediately offshore from the WWTP. This distribution generally parallels the zones where wood waste is thickest (greater than two feet).

***Sediment** - Organics – SVOCs*
For the LMW and HMW PAHs, the WDNR guidance describes TEC and Probable Effects Concentration (PEC) standards in terms of total PAHs. The following summarizes the exceedances measured in sediments for the SVOC compounds (there were no exceedances measured for pentachlorophenol or phenol):

• Dibenzofuran exceeds the 150 µg/kg TEC in 29 of 276 samples; values ranged from 160 – 130,000 µg/kg; the highest levels were measured in one sedflume core sample collected northwest of the WWTP, it is also found south of 2400N, at a sample cluster near the northeast corner of the marina, and along the 2300E line parallel to the Prentice Avenue boat launch; one reference station collected outside the affected area yielded a value of 330 µg/kg;
• Total PAHs exceed the 1,610 µg/kg TEC in 272 of 636 samples; values range from 1,630 – 10,100,000 µg/kg (values are not normalized for 1 percent organic carbon);

exceedences are found across the affected area at the majority of stations, including those at the northwest periphery of the affected area (3500N); the highest levels are found offshore from the WWTP to the west and north; the distribution of exceedences above 10,000 μg/kg is essentially the same as that for benzene and xylene (these measurements are found south of the 2400N line, along a lobe northwest of the WWTP, and east of the WWTP south of the 2300N line); this indicates the highest levels correspond to that area where more than two feet of wood waste has been measured; exceedences are measured in the full range of sample depths to 10 feet.

In general, the extent of contamination is located south of a line drawn from the north end of the Ellis Avenue Marina to the north end of the Prentice Avenue boat launch. The highest levels of organic compounds are found parallel to the entire shoreline between the marina and Prentice Avenue. These measurements correspond to some of the thickest zones where wood waste was measured during exploratory drilling. During these investigations free product was observed in sediments both as sheens and emulsions.

APPENDIX H
COPCs

APPENDIX H-1
COPCs Identified by HHRA

List of COPCs Identified by the HHRA					
Surface Water	**Groundwater**	**Sediment**	**Soil**	**Fish**	**Indoor Air**
Benzo(a)anthracene	1-Methylnaphthalene	Antimony	1-Methylnaphthalene	1-Methylnaphthalene	1,2,4-Trimethylbenzene
Benzo(a)pyrene	2-Methylnaphthalene	Iron	2-Methylnaphthalene		1,4-Dichlorobenzene
Benzo(b)fluoranthene	Acenaphthene	Manganese	Acenaphthene	Benzo(a)anthracene	Benzene
Benzo(k)fluoranthene	Benzo(a)anthracene	Vanadium	Benzo(a)anthracene		Carbon tetrachloride
Chrysene	Benzo(a)pyrene	1-Methylnaphthalene	Benzo(a)pyrene	Benzo(e)pyrene	Trichloroethylene
Dibenzo(a,h)anthracene	Benzo(b)fluoranthene	2-Methylnaphthalene	Benzo(b)fluoranthene	Benzo(b)fluoranthene	
Indeno(1,2,3-cd)pyrene	Benzo(k)fluoranthene	Benzo(a)anthracene	Benzo(k)fluoranthene	Dibenzo(a,h)anthracene	
	Chrysene	Benzo(a)pyrene	Chrysene	Dibenzofuran	
	Dibenzo(a,h)anthracene	Benzo(b)fluoranthene	Dibenzo(a,h)anthracene		
	Dibenzofuran	Benzo(k)fluoranthene	Dibenzofuran		
	Fluoranthene	Indeno(1,2,3-cd)pyrene	Fluoranthene		
	Fluorene	Naphthalene	Fluorene		
	Indeno(1,2,3-cd)pyrene		Indeno(1,2,3-cd)pyrene		
	Naphthalene		Naphthalene		
	Phenanthrene		Phenanthrene		
	Pyrene		Pyrene		
	1,2,4-Trichlorobenzene		1,2,4-Trichlorobenzene		
	1,2,4-Trimethylbenzene		1,2,4-Trimethylbenzene		
	1,3,5-Trimethylbenzene		1,3,5-Trimethylbenzene		
	Benzene		Benzene		
	Ethylbenzene		Ethylbenzene		
	Toluene		Toluene		
	Total Xylenes		n-Butylbenzene		
			sec-Butylbenzene		
			Total Xylenes		
			Arsenic		
			Lead		
			Thallium		

Summary of the COPCs by Receptor and Medium

Chemical[a]	Residential				Commercial/Industrial			Construction Worker	Recreational			
					General Industrial Worker		Maintenance Worker		Recreational User	Swimmer Wader		Fisherman
	SS & SB	SS	S:0-3	IA	SS	IA	SS	SS & SB & OA & GW	SS	SD	SW	Fish
Inorganics												
Antimony												
Arsenic	×	×	×		×		×	×	×			
Cadmium									×			
Iron										×		
Lead	×	×	×				×	×	×			
Manganese										×		
Thallium	×								×			
Vanadium										×		
SVOCs												
1-Methylnaphthalene	×		×					×		×		×
2-Methylnaphthalene	×							×		×		
Acenaphthene	×							×		×		
Benzo(a)anthracene	×		×				×	×	×	×	×	×
Benzo(a)pyrene	×	×	×		×		×	×	×	×	×	×
Benzo(e)pyrene												×
Benzo(b)fluoranthene	×		×				×	×	×	×	×	×
Benzo(k)fluoranthene	×		×					×	×	×	×	
Chrysene	×							×		×	×	
Dibenzo(a,h)anthracene	×		×					×		×	×	×
Dibenzofuran	×							×				×
Fluoranthene	×		×					×		×		
Fluorene	×							×		×		
Indeno(1,2,3-cd)pyrene	×		×				×	×	×	×	×	
Naphthalene	×		×					×		×		
Phenanthrene	×											
Pyrene	×		×					×		×		

Chemical[a]	Residential				Commercial/Industrial			Construction Worker	Recreational			
					General Industrial Worker		Maintenance Worker		Recreational User	Swimmer Wader		Fisherman
	SS & SB	SS	S:0-3	IA	SS	IA	SS	SS & SB & OA & GW	SS	SD	SW	Fish
VOCs												
1,2,4-Trichlorobenzene	×							×				
1,2,4-Trimethylbenzene	×		×			×		×				
1,3,5-Trimethylbenzene	×		×					×				
1,4-Dichlorobenzene						×						
Benzene	×		×			×		×				
Ethylbenzene								×				
n-Butyl benzene								×				
sec-Butyl benzene								×				
Carbon tetrachloride						×						
Methylene chloride										×		
Toluene								×				
Trichloroethylene						×						
Xylenes (total)	×							×		×		

Notes:
SS – surface soil
SB – subsurface soil
S:0-3 – soil (0 to 3 foot depth)
GW – shallow groundwater
IA – indoor air
OA – outdoor air
SD – sediment
SW – surface water

Table 10
Selection of Chemicals of Potential Concern
Residential Receptors Exposed to Surface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Residential Soil PRG (mg/kg)	Basis	Exceeds?	Notes
Inorganics							
Antimony	1.2 - 2	0.41 - 1.3	9 / 86	3.13E+00	nc	No	
Arsenic	0.87 - 23.4	0.325 - 2.165	87 / 103	3.90E-01	ca	Yes	
Beryllium	0.071 - 7.5	0.065 - 0.465	81 / 95	1.54E+01	nc	No	
Cadmium	0.29 - 0.63	0.09 - 0.195	14 / 95	3.70E+00	nc	No	
Chromium (VI)	0.091 - 2.4	0.07 - 0.105	42 / 95	3.01E+01	ca	No	
Cyanide	0.097 - 32	0.0175 - 0.615	43 / 113	1.22E+02	nc	No	
Lead	6 - 4000	1.95 - 3.15	82 / 103	4.00E+01	nc	Yes	
Mercury	0.083 - 0.84	0.034 - 0.055	17 / 95	2.35E+00	nc	No	
Selenium	1.2 - 2.7	0.38 - 1.2	11 / 95	3.91E+01	nc	No	
Silver	0.87 - 3.5	0.175 - 0.385	2 / 95	3.91E+01	nc	No	
Thallium	1.5 - 1.8	0.485 - 1.05	2 / 86	5.16E-01	nc	Yes	
Zinc	5.5 - 402	0.95 - 3.65	107 / 112	2.35E+03	nc	No	
SVOCs							
1-Methylnaphthalene	0.051 - 3800	0.016 - 0.8	38 / 86	5.59E+01	surr	Yes	a
2,4-Dimethylphenol	8.2 - 8.2	0.00011 - 23	1 / 15	1.22E+02	nc	No	
2-Methylnaphthalene	0.0078 - 3300	0.0155 - 0.8	47 / 102	5.59E+01	surr	Yes	a
Acenaphthene	0.00059 - 670	0.016 - 19.5	33 / 101	3.68E+02	nc	Yes	
Acenaphthylene	0.084 - 910	0.00011 - 30.5	41 / 110	3.68E+03	surr	No	b
Anthracene	0.00047 - 750	0.019 - 19.5	39 / 110	2.19E+03	nc	No	
Benzo(a)anthracene	0.044 - 520	0.00011 - 34	50 / 102	6.21E-01	ca	Yes	
Benzo(a)pyrene	0.06 - 340	0.00011 - 34	50 / 104	6.21E-02	ca	Yes	
Benzo(b)fluoranthene	0.07 - 410	0.00011 - 37.5	50 / 102	6.21E-01	ca	Yes	
Benzo(e)pyrene	0.059 - 260	0.019 - 38	38 / 95	–	–	No	
Benzo(g,h,i)perylene	0.061 - 190	0.00011 - 32.5	36 / 111	2.32E+03	surr	No	c
Benzo(k)fluoranthene	0.045 - 170	0.00011 - 38	35 / 102	6.21E+00	ca	Yes	
Chrysene	0.059 - 470	0.00011 - 35.5	47 / 102	6.21E+01	ca	Yes	
Dibenzo(a,h)anthracene	0.12 - 3.8	0.00011 - 42.5	6 / 102	6.21E-02	ca	Yes	
Dibenzofuran	0.079 - 280	0.016 - 31.5	14 / 86	1.45E+01	nc	Yes	
Fluoranthene	0.047 - 1400	0.00011 - 1.5	57 / 103	2.29E+02	nc	Yes	
Fluorene	0.0015 - 1200	0.016 - 19.5	34 / 101	2.75E+02	nc	Yes	
Indeno(1,2,3-cd)pyrene	0.037 - 100	0.00011 - 39	32 / 102	6.21E-01	ca	Yes	
Naphthalene	0.00024 - 2900	0.0065 - 0.75	62 / 123	5.59E+00	nc	Yes	
o-Cresol	0.05 - 0.055	0.00011 - 32.5	2 / 110	3.06E+02	nc	No	
Phenanthrene	0.0054 - 3700	0.01 - 19.5	60 / 104	2.19E+03	nc	Yes	
Phenol	1.2 - 1.2	0.00011 - 35	1 / 110	1.83E+03	nc	No	
Pyrene	0.048 - 2000	0.00011 - 0.355	64 / 104	2.32E+02	nc	Yes	
VOCs							
1,2,3-Trimethylbenzene	0.037 - 37	0.0095 - 0.19	25 / 95	5.16E+01	surr	No	d
1,2,4-Trichlorobenzene	0.0097 - 120	0.05 - 25	7 / 16	6.22E+00	nc	Yes	
1,2,4-Trimethylbenzene	0.02 - 100	0.0075 - 0.0365	43 / 87	5.16E+00	nc	Yes	
1,3,5-Trimethylbenzene	0.0079 - 560	0.008 - 12.5	37 / 103	2.13E+00	nc	Yes	
Benzene	0.016 - 230	0.0025 - 3.8	49 / 104	6.43E-01	ca	Yes	
Ethylbenzene	0.014 - 170	0.0025 - 0.0385	40 / 98	3.95E+02	sat	No	
Isopropylbenzene	0.095 - 4.3	0.0135 - 25	4 / 16	5.72E+01	nc	No	
m & p-Xylenes	0.03 - 150	0.0125 - 1.25	40 / 96	2.71E+02	sat	No	
n-Butyl benzene	0.0094 - 17	0.0135 - 50	5 / 17	2.40E+02	sat	No	
n-Propyl benzene	0.13 - 14	0.0135 - 25	4 / 16	2.40E+02	sat	No	
o-Xylene	0.017 - 78	0.0065 - 0.032	45 / 95	2.71E+02	surr	No	e
p-Isopropyltoluene	0.072 - 1.8	0.025 - 25	5 / 16	5.70E+02	surr	No	f
sec-Butyl benzene	0.041 - 65	0.0095 - 50	9 / 111	2.20E+02	sat	No	
Styrene	1.3 - 13	0.0085 - 4.3	2 / 95	1.70E+03	sat	No	

Table 10
Selection of Chemicals of Potential Concern
Residential Receptors Exposed to Surface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Residential Soil PRG (mg/kg)	Basis	Exceeds?	Notes
Toluene	0.014 - 320	0.0025 - 2.65	85 / 113	5.20E+02	sat	No	
Xylenes (total)	0.046 - 320	0.0025 - 75	7 / 18	2.71E+01	nc	Yes	

Notes:

All units are milligrams per kilogram (mg/kg).

All non-detects are presented as one-half the detection limit.

PRG – Preliminary Remediation Goal

nc – PRG based on noncarcinogenic (systemic) effects

ca – PRG based on carcinogenic effects

sat – PRG based on the soil saturation concentration

SVOC – Semi-volatile organic compound

VOC – Volatile organic compound

surr – No toxicity information is available for this chemical. The value presented is a surrogate value selected based on structural similarities. The surrogates used are defined below.

a – Naphthalene used as a surrogate for 1-methylnaphthalene and 2-methylnaphthalene.

b – Acenaphthene used as a surrogate for acenaphthylene.

c – Pyrene used as a surrogate for benzo(g,h,i)perylene.

d – 1,2,4-Trimethyl benzene used as a surrogate for 1,2,3-trimethylbenzene.

e – Isopropylbenzene used as a surrogate for p-isopropyltoluene.

f – Total xylenes used as a surrogate for m-, o-, & p-xylenes.

Table 11
Selection of Chemicals of Potential Concern
Recreational Receptors Exposed to Surface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Residential Soil PRG (mg/kg)	Basis	Exceeds?	Notes
Inorganics							
Aluminum	870 - 14000	-	24 / 24	7.61E+03	nc	Yes	
Antimony	1.4 - 2.1	0.6 - 1.05	3 / 24	3.13E+00	nc	No	
Arsenic	1.3 - 13.9	0.47 - 0.7	30 / 33	3.90E-01	ca	Yes	
Barium	10 - 420	-	24 / 24	5.37E+02	nc	No	
Beryllium	0.1 - 8.3	1.7 - 1.7	23 / 24	1.54E+01	nc	No	
Cadmium	0.145 - 12	0.095 - 0.15	18 / 33	3.70E+00	nc	Yes	
Chromium	2.6 - 29	-	33 / 33	2.11E+02	ca	No	
Chromium (III)	2.6 - 29	-	24 / 24	1.00E+05	max	No	
Chromium (VI)	0.11 - 0.65	0.08 - 0.095	20 / 24	3.01E+01	ca	No	
Cobalt	0.91 - 12	-	24 / 24	9.03E+02	ca	No	
Copper	2.2 - 120	-	33 / 33	3.13E+02	nc	No	
Cyanide	0.055 - 1.4	0.05 - 0.06	11 / 25	1.22E+02	nc	No	
Iron	4100 - 94000	-	33 / 33	2.35E+03	nc	Yes	
Lead	5.2 - 950	2.25 - 2.25	32 / 33	4.00E+01	nc	Yes	
Manganese	100 - 670	-	24 / 24	1.76E+02	nc	Yes	
Mercury	0.13 - 0.8	0.01 - 0.044	14 / 33	2.35E+00	nc	No	
Nickel	2 - 33	-	24 / 24	1.56E+02	nc	No	
Selenium	1.4 - 2.1	0.55 - 1.2	3 / 24	3.91E+01	nc	No	
Silver	0.72 - 7.6	0.19 - 0.375	6 / 24	3.91E+01	nc	No	
Thallium	2.4 - 2.4	0.7 - 1.25	1 / 24	5.16E-01	nc	Yes	
Vanadium	8.9 - 63	-	24 / 24	7.82E+00	nc	Yes	
Zinc	4.3 - 4100	-	33 / 33	2.35E+03	nc	Yes	
SVOCs							
Acenaphthene	0.49 - 0.49	0.016 - 3.25	1 / 24	3.68E+02	nc	No	
Acenaphthylene	0.19 - 27	0.0155 - 0.75	7 / 25	3.68E+02	surr	No	a
Anthracene	0.68 - 1.6	0.019 - 3.85	2 / 24	2.19E+03	nc	No	
Benzo(a)anthracene	0.24 - 25	0.017 - 0.85	15 / 27	6.21E-01	ca	Yes	
Benzo(a)pyrene	0.29 - 68	0.01 - 0.85	16 / 33	6.21E-02	ca	Yes	
Benzo(b)fluoranthene	0.33 - 53	0.019 - 0.95	16 / 27	6.21E-01	ca	Yes	
Benzo(e)pyrene	0.25 - 49	0.019 - 0.95	11 / 24	-	-	No	
Benzo(g,h,i)perylene	0.165 - 57	0.0165 - 0.6	10 / 27	2.32E+02	surr	No	b
Benzo(k)fluoranthene	0.19 - 15	0.019 - 0.95	5 / 24	6.21E+00	ca	Yes	
Chrysene	0.27 - 32	0.018 - 0.9	14 / 27	6.21E+01	ca	No	
Fluoranthene	0.25 - 25	0.0185 - 0.95	16 / 27	2.29E+02	nc	No	
Fluorene	0.57 - 0.57	0.016 - 3.25	1 / 24	2.75E+02	nc	No	
Indeno(1,2,3-cd)pyrene	0.155 - 33	0.0155 - 0.8	9 / 27	6.21E-01	ca	Yes	
Naphthalene	0.04 - 2.144	0.01 - 3.05	6 / 33	5.59E+00	nc	No	
Phenanthrene	0.41 - 6.6	0.01 - 3.65	6 / 33	2.19E+03	surr	No	c
Pyrene	0.22 - 52	0.01 - 0.9	17 / 33	2.32E+02	nc	No	
VOCs							
1,2,4-Trichlorobenzene	0.035 - 0.302	-	3 / 3	6.22E+00	nc	No	
1,2,4-Trimethylbenzene	0.019 - 0.019	0.0075 - 0.0075	1 / 24	5.16E+00	nc	No	
1,3,5-Trimethylbenzene	0.077 - 0.114	0.008 - 0.008	2 / 26	2.13E+00	nc	No	
Benzene	0.023 - 0.495	0.0025 - 0.0075	3 / 33	6.43E-01	ca	No	
Ethylbenzene	0.025 - 0.301	0.0025 - 0.0075	4 / 33	3.95E+02	sat	No	
m & p-Xylenes	0.034 - 0.051	0.0125 - 0.0125	3 / 24	2.71E+01	surr	No	d
n-Butyl benzene	0.065 - 0.259	-	3 / 3	2.40E+02	sat	No	

Table 11
Selection of Chemicals of Potential Concern
Recreational Receptors Exposed to Surface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Residential Soil PRG (mg/kg)	Basis	Exceeds?	Notes
o-Xylene	0.016 - 0.029	0.0065 - 0.0065	3 / 24	2.71E+01	surr	No	d
p-Isopropyltoluene	0.047 - 0.075	-	2 / 2	5.70E+01	surr	No	e
Toluene	0.012 - 0.405	0.0025 - 0.0055	16 / 33	5.20E+02	sat	No	
Trichlorofluoromethane	0.038 - 0.046	-	3 / 3	3.86E+01	nc	No	
Xylenes (total)	0.029 - 1.104	0.0025 - 0.0025	6 / 9	2.71E+01	nc	No	

Notes:

All units are milligrams per kilogram (mg/kg).

All non-detects are presented as one-half the detection limit.

PRG – Preliminary Remediation Goal

nc – PRG based on noncarcinogenic (systemic) effects
ca – PRG based on carcinogenic effects
sat – PRG based on the soil saturation concentration
max – PRG based on a ceiling limit
SVOC – Semi-volatile organic compound
VOC – Volatile organic compound
surr – No toxicity information is available for this chemical. The value presented is a surrogate value selected based on structural similarities. The surrogates used are defined below
a – Acenaphthene used as a surrogate for acenaphthylene.
b – Pyrene used as a surrogate for benzo(g,h,i)perylene.
c – Anthracene used as a surrogate for phenanthrene.
d – Total xylenes used as a surrogate for m-, o-, &p-xylenes.
e – Isopropylbenzene used as a surrogate for p-isopropyltoluene.

Table 12
Selection of Chemicals of Potential Concern
Industrial Worker Receptors Exposed to Surface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Industrial Soil PRG (mg/kg)	Basis	Exceeds?	Notes
Inorganics							
Antimony	1.8 - 1.9	0.5 - 0.75	2 / 12	4.09E+01	nc	No	
Arsenic	1.4 - 8.5	0.55 - 0.55	11 / 12	1.59E+00	ca	*Yes*	
Cadmium	0.36 - 0.62	0.11 - 0.145	4 / 12	4.51E+01	nc	No	
Chromium (VI)	0.16 - 0.33	0.08 - 0.09	8 / 12	6.40E+01	ca	No	
Cyanide	0.12 - 0.67	0.055 - 0.06	6 / 12	1.23E+03	nc	No	
Lead	22 - 440	2.8 - 2.8	11 / 12	8.00E+02	ca	No	
Mercury	0.083 - 0.4	0.034 - 0.0475	2 / 12	3.07E+01	nc	No	
SVOCs							
1-Methylnaphthalene	0.051 - 0.089	0.016 - 0.16	2 / 12	1.88E+02	surr	No	a
2-Methylnaphthalene	0.066 - 0.19	0.0155 - 0.155	3 / 12	1.88E+02	surr	No	a
Benzo(a)anthracene	0.082 - 0.35	0.017 - 0.17	6 / 12	2.11E+00	ca	No	
Benzo(a)pyrene	0.085 - 0.39	0.017 - 0.17	6 / 12	2.11E-01	ca	*Yes*	
Benzo(b)fluoranthene	0.12 - 0.56	0.019 - 0.19	7 / 12	2.11E+00	ca	No	
Benzo(e)pyrene	0.11 - 0.33	0.019 - 0.19	5 / 12	-	-	No	
Benzo(g,h,i)perylene	0.082 - 0.09	0.0165 - 0.165	4 / 12	2.91E+04	surr	No	b
Benzo(k)fluoranthene	0.07 - 0.21	0.019 - 0.19	3 / 12	2.11E+01	ca	No	
Chrysene	0.11 - 0.41	0.018 - 0.18	6 / 12	2.11E+02	ca	No	
Fluoranthene	0.15 - 0.77	0.0185 - 0.185	8 / 12	2.20E+03	nc	No	
Indeno(1,2,3-cd)pyrene	0.05 - 0.05	0.0155 - 0.155	1 / 12	2.11E+00	ca	No	
Naphthalene	0.051 - 0.051	0.0155 - 0.155	1 / 12	1.88E+01	nc	No	
o-Cresol	0.05 - 0.05	0.013 - 0.13	1 / 12	3.08E+03	nc	No	
Phenanthrene	0.1 - 0.62	0.0185 - 0.185	7 / 12	1.00E+05	max	No	
Pyrene	0.16 - 0.77	0.018 - 0.09	9 / 12	2.91E+03	nc	No	
VOCs							
1,2,4-Trimethylbenzene	0.02 - 0.043	0.0075 - 0.0075	2 / 12	1.70E+01	nc	No	
Ethylbenzene	0.02 - 0.02	0.0075 - 0.0075	1 / 12	3.95E+02	sat	No	
m & p-Xylenes	0.034 - 0.065	0.0125 - 0.0125	3 / 12	4.20E+02	sat	No	
o-Xylene	0.018 - 0.06	0.0065 - 0.0065	4 / 12	4.20E+02	surr	No	c
Toluene	0.014 - 2.1	0.0055 - 0.0055	7 / 12	5.20E+02	sat	No	

Notes:

All units are milligrams per kilogram (mg/kg).

PRG – preliminary remediation goal

surr – No toxicity information is available for this chemical. The value presented is a surrogate value selected based on structural similarities. The surrogates used are defined below.

nc – PRG based on noncarcinogenic (systemic) effects

ca – PRG based on carcinogenic effects

sat – PRG based on the soil saturation concentration

max – PRG based on a ceiling limit

a – Naphthalene used as a surrogate for 1-methylnaphthalene and 2-methylnaphthalene.

b – Pyrene used as a surrogate for benzo(g,h,i)perylene.

c – Total xylenes used as a surrogate for m-, o-, &p-xylenes.

Table 13
Selection of Chemicals of Potential Concern
Maintenance Worker Receptors Exposed to Surface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Industrial Soil PRG (mg/kg)	Basis	Exceeds?	Notes
Inorganics							
Aluminum	870 - 14000	-	33 / 33	1.00E+05	max	No	
Antimony	0.7 - 2.1	0.5 - 1.05	6 / 33	4.09E+01	nc	No	
Arsenic	1.3 - 13.9	0.47 - 0.7	38 / 42	1.59E+00	ca	Yes	
Barium	10 - 420	-	33 / 33	6.66E+03	nc	No	
Beryllium	0.1 - 8.3	1.7 - 1.7	32 / 33	1.94E+03	ca	No	
Cadmium	0.145 - 12	0.095 - 0.15	21 / 42	4.51E+01	nc	No	
Chromium	2.6 - 29	-	42 / 42	4.48E+02	ca	No	
Chromium (III)	2.6 - 29	-	33 / 33	1.00E+05	max	No	
Chromium (VI)	0.095 - 0.65	0.08 - 0.09	28 / 33	6.40E+01	ca	No	
Cobalt	0.91 - 12	-	33 / 33	1.92E+03	ca	No	
Copper	2.2 - 120	-	42 / 42	4.09E+03	nc	No	
Cyanide	0.055 - 1.4	0.05 - 0.06	15 / 34	1.23E+03	nc	No	
Iron	4100 - 94000	-	42 / 42	1.00E+05	max	No	
Lead	5.2 - 950	2.25 - 2.8	40 / 42	8.00E+01	nc	Yes	
Manganese	100 - 670	-	33 / 33	1.95E+03	nc	No	
Mercury	0.0385 - 0.8	0.01 - 0.044	16 / 42	3.07E+01	nc	No	
Nickel	2 - 33	-	33 / 33	2.04E+03	nc	No	
Selenium	1.4 - 2.1	0.47 - 1.2	3 / 33	5.11E+02	nc	No	
Silver	0.72 - 7.6	0.19 - 0.375	6 / 33	5.11E+02	nc	No	
Thallium	2.4 - 2.4	0.6 - 1.25	1 / 33	6.75E+00	nc	No	
Vanadium	8.9 - 63	-	33 / 33	1.02E+02	nc	No	
Zinc	4.3 - 4100	-	42 / 42	1.00E+05	max	No	
SVOCs							
1-Methylnaphthalene	0.051 - 0.051	0.016 - 3.15	1 / 33	3.08E+03	surr	No	a
2-Methylnaphthalene	0.066 - 0.19	0.0155 - 3.1	2 / 33	3.08E+03	surr	No	a
Acenaphthene	0.49 - 0.49	0.016 - 3.25	1 / 33	2.92E+03	nc	No	
Acenaphthylene	0.19 - 27	0.0155 - 0.75	7 / 34	2.92E+03	nc	No	
Anthracene	0.68 - 1.6	0.019 - 3.85	2 / 33	1.00E+05	max	No	
Benzo(a)anthracene	0.16 - 25	0.017 - 0.85	18 / 36	2.11E+00	ca	Yes	
Benzo(a)pyrene	0.17 - 68	0.01 - 0.85	19 / 42	2.11E-01	ca	Yes	
Benzo(b)fluoranthene	0.23 - 53	0.019 - 0.95	20 / 36	2.11E+00	ca	Yes	
Benzo(e)pyrene	0.14 - 49	0.019 - 0.95	14 / 33	-	-	No	
Benzo(g,h,i)perylene	0.082 - 57	0.0165 - 0.8	12 / 36	3.08E+03	surr	No	b
Benzo(k)fluoranthene	0.07 - 15	0.019 - 0.95	8 / 33	2.11E+01	ca	No	
Chrysene	0.18 - 32	0.018 - 0.9	17 / 36	2.11E+02	ca	No	
Fluoranthene	0.25 - 25	0.0185 - 0.95	21 / 38	2.20E+03	nc	No	
Fluorene	0.57 - 0.57	0.016 - 3.25	1 / 33	2.63E+03	nc	No	
Indeno(1,2,3-cd)pyrene	0.05 - 33	0.0155 - 0.8	10 / 36	2.11E+00	ca	Yes	
Naphthalene	0.04 - 2.144	0.01 - 3.05	7 / 42	1.88E+01	nc	No	
o-Cresol	0.05 - 0.05	0.013 - 2.6	1 / 33	3.08E+03	nc	No	
Phenanthrene	0.1 - 6.8	0.01 - 3.65	10 / 42	1.00E+05	surr	No	c
Pyrene	0.22 - 52	0.01 - 0.9	23 / 42	2.91E+03	nc	No	
VOCs							
1,2,4-Trichlorobenzene	0.035 - 0.302	-	3 / 3	2.16E+01	nc	No	
1,2,4-Trimethylbenzene	0.019 - 0.043	0.0075 - 0.0075	3 / 33	1.70E+01	nc	No	
1,3,5-Trimethylbenzene	0.077 - 0.114	0.008 - 0.008	2 / 35	6.97E+00	nc	No	

Table 13
Selection of Chemicals of Potential Concern
Maintenance Worker Receptors Exposed to Surface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Industrial Soil PRG (mg/kg)	Basis	Exceeds?	Notes
Benzene	0.023 - 0.495	0.0025 - 0.0075	3 / 42	1.41E+00	ca*	No	
Ethylbenzene	0.02 - 0.301	0.0025 - 0.0075	5 / 42	3.95E+02	sat	No	
m & p-Xylenes	0.034 - 0.065	0.0125 - 0.0125	5 / 33	1.41E+00	surr	No	d
n-Butyl benzene	0.065 - 0.259	-	3 / 3	2.40E+02	sat	No	
o-Xylene	0.016 - 0.06	0.0065 - 0.0065	5 / 33	3.95E+02	surr	No	d
p-Isopropyltoluene	0.047 - 0.075	-	2 / 2	1.98E+02	surr	No	e
Toluene	0.012 - 0.405	0.0025 - 0.0055	20 / 42	5.20E+02	sat	No	
Trichlorofluoromethane	0.038 - 0.046	-	3 / 3	2.00E+03	sat	No	
Xylenes (total)	0.029 - 1.104	0.0025 - 0.0025	6 / 9	4.20E+02	sat	No	

Notes:

All units are milligrams per kilogram (mg/kg).
All non-detects are presented as one-half the detection limit.

PRG – Preliminary Remediation Goal

nc – PRG based on noncarcinogenic (systemic) effects
ca – PRG based on carcinogenic effects
sat – PRG based on the soil saturation concentration
max – PRG based on a ceiling limit
SVOC – Semi-volatile organic compound
VOC – Volatile organic compound
surr – No toxicity information is available for this chemical. The value presented is a surrogate value selected based on structural similarities. The surrogates used are defined below.
a – Naphthalene used as a surrogate for 1-methylnaphthalene and 2-methylnaphthalene.
b – Pyrene used as a surrogate for benzo(g,h,i)perylene.
c – Anthracene used as a surrogate for phenanthrene.
c – Total xylenes used as a surrogate for m-, o-, &p-xylenes.
d – Isopropylbenzene used as a surrogate for p-isopropyltoluene.

Table 14
Selection of Chemicals of Potential Concern
Construction Worker Receptors Exposed to Surface and Subsurface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Industrial Soil PRG (mg/kg)	Basis	Exceeds?	Notes
Inorganics							
Aluminum	750 - 21000	-	124 / 124	1.00E+05	max	No	
Antimony	0.5 - 2.1	0.41 - 1.05	14 / 116	4.09E+01	nc	No	
Arsenic	0.83 - 23.4	0.325 - 2.165	126 / 165	1.59E+00	ca	Yes	
Barium	10 - 420	-	126 / 126	6.66E+03	nc	No	
Beryllium	0.071 - 11	0.07 - 1.7	110 / 124	1.94E+03	ca	No	
Cadmium	0.145 - 24.8	0.095 - 0.195	43 / 142	4.51E+01	nc	No	
Chromium	2.4 - 42	-	153 / 153	4.48E+02	ca	No	
Chromium (III)	2.1 - 38	-	124 / 124	1.00E+05	max	No	
Chromium (VI)	0.075 - 2.4	0.07 - 0.105	71 / 124	6.40E+01	ca	No	
Cobalt	0.91 - 14	-	124 / 124	1.92E+03	ca	No	
Copper	2.2 - 190	0.5 - 0.5	151 / 165	4.09E+03	nc	No	
Cyanide	0.055 - 25	0.0175 - 0.615	53 / 144	1.23E+03	nc	No	
Iron	3800 - 94000	-	151 / 151	1.00E+05	max	No	
Lead	3.32 - 4000	0.5 - 3.15	151 / 182	8.00E+01	nc	Yes	
Manganese	12 - 2000	-	124 / 124	1.95E+03	nc	Yes	
Mercury	0.0239 - 1.1	0.01 - 0.06	34 / 147	3.07E+01	nc	No	
Nickel	1.5 - 52	-	142 / 142	2.04E+03	nc	No	
Selenium	1.4 - 16.5	0.38 - 1.2	14 / 125	5.11E+02	nc	No	
Silver	0.245 - 7.6	0.185 - 0.385	12 / 124	5.11E+02	nc	No	
Thallium	1.5 - 2.4	0.485 - 1.25	3 / 124	6.75E+00	nc	No	
Vanadium	8.3 - 110	-	124 / 124	1.02E+02	nc	Yes	
Zinc	4.3 - 4100	0.5 - 3.65	146 / 165	1.00E+05	max	No	
SVOCs							
1-Methylnaphthalene	0.04 - 21000	0.016 - 3.15	63 / 150	1.88E+01	surr	Yes	a
2,3,5-Trimethylnaphthalene	0.057 - 1600	-	26 / 26	-		No	
2,4-Dimethylphenol	8.2 - 8.2	0.00011 - 23	1 / 16	1.23E+03	nc	No	
2,6-Dimethylnaphthalene	0.09 - 5600	-	26 / 26	-		No	
2-Methylnaphthalene	0.0076 - 30000	0.0155 - 3.1	85 / 178	1.88E+01	surr	Yes	a
Acenaphthene	0.00059 - 8200	0.016 - 19.5	76 / 180	2.92E+03	nc	Yes	
Acenaphthylene	0.045 - 9700	0.00011 - 30.5	89 / 180	2.92E+03	surr	Yes	b
Anthracene	0.00047 - 4100	0.019 - 19.5	83 / 180	1.00E+05	max	No	
Benzo(a)anthracene	0.0173 - 2400	0.00011 - 34	116 / 193	2.11E+00	ca	Yes	
Benzo(a)fluoranthene	0.55 - 640	-	26 / 26	-		No	
Benzo(a)pyrene	0.0219 - 1800	0.00011 - 34	118 / 209	2.11E-01	ca	Yes	
Benzo(b)fluoranthene	0.0149 - 1200	0.00011 - 37.5	118 / 192	2.11E+00	ca	Yes	
Benzo(b)fluorene	0.34 - 1100	-	26 / 26	-		No	
Benzo(e)pyrene	0.054 - 1200	0.019 - 38	77 / 150	-		No	
Benzo(g,h,i)perylene	0.0099 - 1200	0.00011 - 32.5	93 / 190	2.91E+03	surr	No	c
Benzo(k)fluoranthene	0.00669 - 1500	0.00011 - 38	87 / 185	2.11E+01	ca	Yes	
Biphenyl	0.038 - 1700	-	26 / 26	2.33E+03	nc	No	
Chrysene	0.0118 - 2300	0.00011 - 35.5	108 / 188	2.11E+02	ca	Yes	
Dibenzo(a,h)anthracene	0.12 - 290	0.00011 - 42.5	37 / 172	2.11E-01	ca	Yes	
Dibenzofuran	0.042 - 1400	0.016 - 31.5	41 / 150	1.56E+02	nc	Yes	
Fluoranthene	0.047 - 5400	0.00011 - 1.5	126 / 196	2.20E+03	nc	Yes	
Fluorene	0.0015 - 4600	0.016 - 19.5	80 / 183	2.63E+03	nc	Yes	
Hopane (T19)	0.18 - 6.8	0.15 - 1.85	15 / 26	-	surr	No	d
Indeno(1,2,3-cd)pyrene	0.0113 - 1200	0.00011 - 39	89 / 189	2.11E+00	ca	Yes	
m & p-cresols	0.045 - 47	0.0275 - 70	18 / 150	3.08E+04	surr	No	e
Naphthalene	0.00024 - 37000	0.0065 - 3.05	130 / 246	1.88E+01	nc	Yes	
o-Cresol	0.0076 - 22	0.00011 - 32.5	20 / 166	3.08E+03	nc	No	
Pentachlorophenol	0.011 - 1.8	0.016 - 1.4	11 / 26	9.00E+00	ca	No	
Phenanthrene	0.0054 - 14000	0.01 - 19.5	119 / 209	1.00E+05	surr	No	f
Phenol	0.022 - 9.8	0.00011 - 35	26 / 166	1.00E+05	max	No	
Pyrene	0.042 - 7600	0.00011 - 0.9	137 / 209	2.91E+03	nc	Yes	
Retene	0.16 - 12	0.105 - 1.8	12 / 26	-	surr	No	d
VOCs							
1,2,3-Trimethylbenzene	0.037 - 37	0.0095 - 0.19	23 / 124	1.70E+01	surr	Yes	g
1,2,4-Trichlorobenzene	0.0097 - 2994	0.05 - 25	21 / 31	2.16E+01	nc	Yes	

Table 14
Selection of Chemicals of Potential Concern
Construction Worker Receptors Exposed to Surface and Subsurface Soil

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Industrial Soil PRG (mg/kg)	Basis	Exceeds?	Notes
1,2,4-Trimethylbenzene	0.019 - 100	0.0075 - 0.0365	47 / 125	1.70E+01	nc	Yes	
1,3,5-Trimethylbenzene	0.0079 - 742	0.008 - 12.5	47 / 152	6.97E+00	nc	Yes	
Acetone	0.014 - 0.014	-	1 / 1	5.43E+03	nc	No	
Benzene	0.005 - 645	0.0025 - 3.8	68 / 183	1.41E+00	ca	Yes	
Ethylbenzene	0.014 - 2973	0.0025 - 0.0385	54 / 167	3.95E+02	sat	Yes	
Isopropylbenzene	0.029 - 190	0.0135 - 25	10 / 23	1.98E+02	nc	No	
m & p-Xylenes	0.028 - 150	0.0125 - 1.25	43 / 125	4.20E+02	surr	No	h
Methylene chloride	0.005 - 0.102	-	2 / 2	2.05E+01	ca	No	
n-Butyl benzene	0.0094 - 648	0.0135 - 50	18 / 31	2.40E+02	sat	Yes	
n-Propyl benzene	0.053 - 101	0.0135 - 25	11 / 24	2.40E+02	sat	No	
o-Xylene	0.016 - 78	0.0065 - 0.032	48 / 124	4.20E+02	surr	No	h
p-Isopropyltoluene	0.019 - 213	0.025 - 25	20 / 32	1.98E+02	surr	Yes	i
sec-Butyl benzene	0.03 - 2688	0.0095 - 50	10 / 143	2.20E+02	sat	Yes	
Styrene	0.023 - 13	0.0085 - 4.3	3 / 124	1.70E+03	sat	No	
Toluene	0.0055 - 2007	0.0025 - 2.65	122 / 183	5.20E+02	sat	Yes	
Trichlorofluoromethane	0.038 - 0.046	-	3 / 3	2.00E+03	sat	No	
Xylenes (total)	0.029 - 4981	0.0025 - 75	24 / 59	4.20E+02	sat	Yes	

Notes:

All units are milligrams per kilogram (mg/kg).

All non-detects are presented as one-half the detection limits.

PRG – Preliminary Remediation Goal

nc – PRG based on noncarcinogenic (systemic) effects

ca – PRG based on carcinogenic effects

sat – PRG based on the soil saturation concentration

max – PRG based on a ceiling limit

SVOC – Semi-volatile organic compound

VOC – Volatile organic compound

surr – No toxicity information is available for this chemical. The value presented is a surrogate value selected based on structural similarities. The surrogates used are defined below.

a – Naphthalene used as a surrogate for 1-methylnaphthalene and 2-methylnaphthalene.

b – Acenaphthene used as a surrogate for acenaphthylene.

c – Pyrene used as a surrogate for benzo(g,h,i)perylene.

d – No risk-based screening values are available for Hopane (T19) and Retene.

e – m-Cresol used as a surrogate for m & p-cresol.

f – Anthracene used as a surrogate for phenanthrene.

g – 1,2,4-Trimethyl benzene used as a surrogate for 1,2,3-trimethylbenzene.

h – Total xylenes used as a surrogate for m-, o-, &p-xylenes.

i – Isopropylbenzene used as a surrogate for p-isopropyltoluene.

Table 15
Selection of Chemicals of Potential Concern
Recreational Receptors Exposed to Chequamegon Bay Sediment

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Residential Soil PRG (mg/kg)	Basis	Exceeds?	Notes
Inorganics							
Aluminum	980 – 1800	–	2 / 2	7.61E+03	nc	No	
Ammonia (as N)	97 – 97	–	1 / 1	No Value			
Antimony	2.3 – 2.3	2 – 2	1 / 2	3.13E+00	nc	No	
Arsenic	3.1 – 10	–	2 / 2	1.59E+00			
Barium	65 – 110	–	2 / 2	5.37E+02	nc	No	
Beryllium	0.15 – 0.37	–	2 / 2	1.54E+01	nc	No	
Cadmium	0.48 – 0.61	–	2 / 2	3.70E+00	nc	No	
Calcium	4400 – 14300	–	2 / 2	Essential Nutrient			
Chromium	5.4 – 5.9	–	2 / 2	2.11E+02	ca	No	
Chromium (III)	5.4 – 5.9	–	2 / 2	2.11E+02	ca	No	
Cobalt	1.9 – 2.5	–	2 / 2	9.03E+02	ca	No	
Copper	33 – 44	–	2 / 2	3.13E+02	nc	No	
Cyanide	0.61 – 0.61	0.65 – 0.65	1 / 2	1.22E+02	nc	No	
Iron	9000 – 27000	–	2 / 2	2.35E+03	nc	Yes	
Lead	57 – 200	–	2 / 2	4.00E+02			
Magnesium	960 – 1300	–	2 / 2	Essential Nutrient			
Manganese	110 – 300	–	2 / 2	1.76E+02	nc	Yes	
Mercury	0.087 – 0.088	–	2 / 2	2.35E+00	nc	No	
Nickel	5.7 – 6.4	–	2 / 2	1.56E+02	nc	No	
Potassium	200 – 2[illegible]0	–	2 / 2	Essential Nutrient			
Selenium	1.3 – 2	–	2 / 2	3.91E+01	nc	No	
Sodium	210 – 580	–	2 / 2	Essential Nutrient			
Vanadium	9 – 9.7	–	2 / 2	7.82E+00	nc	Yes	
Zinc	110 – 140	–	2 / 2	2.35E+03	nc	No	
SVOCs							
1-Methylnaphthalene	0.084 – 19		3 / 3	5.59E+00	surr	Yes	a
2-Methylnaphthalene	0.059 – 2380	0.55 – 10	7 / 13	5.59E+00	surr	Yes	a
Acenaphthene	0.12 – 833	0.55 – 10	8 / 14	3.68E+02	nc	Yes	
Acenaphthylene	0.076 – 75	0.55 – 15.5	4 / 13	3.68E+02	surr	No	b
Anthracene	0.13 – 360	0.55 – 10.5	7 / 14	2.19E+03	nc	No	
Benzo(a)anthracene	0.86 – 150	0.55 – 10.5	8 / 14	6.21E-01	ca	Yes	
Benzo(a)pyrene	0.88 – 100	0.55 – 15.5	7 / 14	6.21E-02	ca	Yes	
Benzo(b)fluoranthene	0.99 – 50	0.55 – 15.5	5 / 14	6.21E-01	ca	Yes	
Benzo(e)pyrene	0.68 – 10	–	3 / 3	No Value	-		
Benzo(g,h,i)perylene	0.79 – 6.2	0.55 – 21	4 / 14	2.32E+02	surr	No	c
Benzo(k)fluoranthene	0.8 – 71	0.55 – 15.5	5 / 14	6.21E+00	ca	Yes	
Chrysene	0.96 – 130	0.55 – 10.5	8 / 14	6.21E+01	ca	Yes	
Dibenzo(a,h)anthracene	0.27 – 1.9	0.55 – 21	3 / 13	6.21E-02	ca	Yes	
Dibenzofuran	0.016 – 1.8	–	3 / 3	1.45E+01	nc	No	
Fluoranthene	1.6 – 330	0.55 – 3.15	4 / 14	2.29E+02	nc	Yes	
Fluorene	0.047 – 500	0.55 – 10.5	6 / 13	2.75E+02	nc	Yes	
Indeno(1,2,3-cd)pyrene	0.6 – 5.3	0.55 – 21	4 / 13	6.21E-01	ca	Yes	
Naphthalene	0.094 – 2710	0.0295 – 0.0295	13 / 14	5.59E+00	nc	Yes	
p-Cresol	0.15 – 0.15	0.0165 – 0.0175	1 / 3	3.06E+01	nc	No	
Phenanthrene	0.44 – 917	0.01 – 3.15	9 / 14	2.19E+03	surr	No	d
Pyrene	1.6 – 410	0.55 – 3.15	9 / 14	2.32E+02	nc	Yes	

Table 15
Selection of Chemicals of Potential Concern
Recreational Receptors Exposed to Chequamegon Bay Sediment

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	Region 9 Residential Soil PRG (mg/kg)	Basis	Exceeds?	Notes
VOCs							
1,2,4-Trimethylbenzene	0.11 – 1.43	0.005 – 25	8 / 13	5.16E+00	nc	No	
1,3,5-Trimethylbenzene	0.055 – 0.27	0.005 – 25	4 / 13	2.13E+00	nc	No	
Benzene	0.098 – 0.54	0.005 – 25	3 / 13	6.43E-01	ca	No	
Ethylbenzene	0.018 – 31.1	0.0025 – 25	3 / 13	3.95E+02	sat	No	
Isopropylbenzene	0.07 – 0.07	0.0295 – 25	1 / 10	5.72E+01	nc	No	
Methylene chloride	0.15 – 36.8	0.0295 – 25	5 / 10	9.11E+00	ca	Yes	
p-isopropyltoluene	0.11 – 13.9	0.0295 – 25	7 / 10	5.72E+01	surr	No	e
Toluene	0.016 – 2.2	0.005 – 25	8 / 14	5.20E+02	sat	No	
Xylenes (total)	0.069 – 31.1	0.0025 – 37.5	5 / 14	2.71E+01	nc	Yes	

Notes:
All units are milligrams per kilogram (mg/kg).
All non-detects are presented as one-half the detection limits.

PRG – Preliminary Remediation Goal

nc – PRG based on noncarcinogenic (systemic) effects
ca – PRG based on carcinogenic effects
sat – PRG based on the soil saturation concentration
max – PRG based on a ceiling limit
SVOC – Semi-volatile organic compound
VOC – Volatile organic compound
surr – No toxicity information is available for this chemical. The value presented is a surrogate value selected based on structural similarities. The surrogates used are defined below.
a – Naphthalene used as a surrogate for 1-methylnaphthalene and 2-methylnaphthalene.
b – Acenaphthene used as a surrogate for acenaphthylene.
c – Pyrene used as a surrogate for benzo(g,h,i)perylene.
d – Anthracene used as a surrogate for phenanthrene.
e – Isopropylbenzene used as a surrogate for p-isopropyltoluene.

Table 16
Selection of Chemicals of Potential Concern
Recreational Receptors Exposed to Chequamegon Bay Surface Water

Analyte	Detection Range (mg/kg)	Nondetect Range (mg/kg)	Detection Frequency	AWQC[a] Human Health (µg/L)	Basis	Exceeds AWQC?	Notes
High Energy Event							
SVOCs							
1-Methylnaphthalene	1.1 – 1.1	0.55 – 0.55	2 / 10	**6.2**	surr	No	a, b
2-Methylnaphthalene	1.1 – 1.2	0.55 – 0.55	2 / 10	**6.2**	surr	No	a, b
Acenaphthene	1.1 – 1.1	0.55 – 0.55	1 / 10	990	nc	No	
Naphthalene	1.1 – 1.8	0.55 – 0.55	5 / 19	**6.2**	nc	No	a
VOCs							
1,2,4-Trimethylbenzene	0.17 – 0.17	0.08 – 0.08	1 / 8	**12**	nc	No	a
1,3,5-Trimethylbenzene	0.23 – 0.23	0.075 – 0.075	1 / 8	**12**	nc	No	a
Benzene	0.15 – 0.74	0.07 – 0.07	5 / 8	51	ca	No	
Ethylbenzene	0.19 – 0.48	0.085 – 0.085	6 / 8	2,100	nc	No	
m & p-Xylenes	0.37 – 0.44	0.175 – 0.175	2 / 8	206	nc	No	
Toluene	0.14 – 0.31	0.125 – 0.125	2 / 8	15000	nc	No	
Low Energy Event							
SVOCs							
Anthracene	0.1 – 0.1	0.49 – 0.49	1 / 13	40000	nc	No	
Benzo(a)anthracene	0.29 – 0.29	0.46 – 0.46	1 / 13	0.018	ca	Yes	
Benzo(a)pyrene	0.33 – 0.33	0.5 – 0.5	1 / 13	0.018	ca	Yes	
Benzo(b)fluoranthene	0.17 – 0.17	0.46 – 0.46	1 / 13	0.018	ca	Yes	
Benzo(g,h,i)perylene	0.22 – 0.22	0.5 – 0.5	1 / 13	4000	surr	No	b
Benzo(k)fluoranthene	0.095 – 0.095	0.6 – 0.6	1 / 13	0.018	ca	Yes	
Chrysene	0.27 – 0.27	0.5 – 0.5	1 / 13	0.018	ca	Yes	
Dibenzo(a,h)anthracene	0.17 – 0.17	0.495 – 0.495	1 / 13	0.018	ca	Yes	
Fluoranthene	0.46 – 0.46	0.485 – 0.485	1 / 13	140	nc	No	
Indeno(1,2,3-cd)pyrene	0.42 – 0.42	0.47 – 0.47	1 / 13	0.018	ca	Yes	
Phenanthrene	0.66 – 0.66	0.49 – 0.49	1 / 13	40000	surr	No	b
Pyrene	0.7 – 0.7	0.47 – 0.47	1 / 13	4000	nc	No	
VOCs							
Benzene	0.26 – 0.47	0.07 – 0.07	4 / 13	51	ca	No	
Ethylbenzene	0.32 – 0.32	0.085 – 0.085	1 / 13	2,100	nc	No	
Toluene	0.25 – 0.355	0.125 – 0.125	6 / 13	15,000	nc	No	
Xylenes (total)	1.54 – 1.54	No data	1 / 5	**210**	nc	No	a

Notes:
All units are micrograms per liter (µg/L).
All non-detects are presented as one-half the detection limits.

nc – AWQC based on noncarcinogenic (systemic) effects
ca – AWQC based on carcinogenic effects
SVOC – Semi-volatile organic compound
VOC – Volatile organic compound

a – For those chemicals lacking an AWQC, the Region 9 tap water PRG was used as the screening value. PRG values are presented in bold.
b – Naphthalene used as the surrogate for 1-methylnaphthalene and 2-methylnaphthalene.
Anthracene used as a surrogate for phenanthrene.
Pyrene used as a surrogate for benzo(g,h,i)perylene.

Table 17
Selection of Chemicals of Potential Concern
Residential Receptors Exposed to Chemicals in Soil Gas

Analyte	Detection Range (ug/m³)	Maximum	Detection Frequency	Target Shallow Gas[a] Concentration (ug/m³)	Basis	Exceeds Target Concentration?	Notes
1,2,4-Trimethylbenzene	2.01 - 2.01	2.01	1 / 7	6.00E+01	nc	No	
Benzene	1.69 - 1.69	1.69	1 / 7	3.10E+01	ca	No	
Chloromethane	1.3 - 1.3	1.3	1 / 7	2.40E+02	ca	No	
Dichlorodifluoromethane	2.57 - 16.82	16.82	6 / 7	2.00E+03	nc	No	
Ethylbenzene	2.17 - 2.17	2.17	1 / 7	2.20E+02	ca	No	
m & p-Xylenes	1.65 - 5.2	5.2	2 / 7	7.00E+04	nc	No	b
o-Xylene	1.73 - 1.73	1.73	1 / 7	7.00E+04	nc	No	
Toluene	1.85 - 7.15	7.15	3 / 7	4.00E+03	nc	No	
Trichlorofluoromethane	1.4 - 9.52	9.52	5 / 7	7.00E+03	nc	No	

Notes:

a – Target Shallow Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor Equals 0.1.

b – The concentration for m-xylene was used for the comparison.

nc – noncarcinogenic

ca – carcinogenic

Table 18
Selection of Chemicals of Potential Concern
Subsistence Fisher Exposed to Chemical in Finfish Tissue

Chemical	Frequency of Detection	Range of Detected Concentrations (mg/kg)	Range of Detected Limits (ug/kg)	Region 3 Fish Ingestion RBC (mg/kg)	Basis	Exceeds RBC?
Shorthead Redhorse & Walleye						
Naphthalene	16 / 16	0.0029 – 0.33	2 – 2	2.70	nc	No
2-Methylnaphthalene	16 / 16	0 – 0.23	2 – 2	0.54	nc	No
1-Methylnaphthalene	16 / 16	0.0 – 0.62	2 – 2	0.54	surr	Yes
Biphenyl	13 / 16	0.0 – 0.049	2 – 2	6.76	nc	No
2,6 Dimethylnaphthalene	15 / 16	0.0 – 0.23	2 – 2	0.54	surr	No
Acenaphthylene	7 / 16	0.0 – 0.019	2 – 2	8.11	surr	No
Acenaphthene	15 / 16	0.0 – 0.58	2 – 2	8.11	nc	No
2,3,5 Trimethylnaphthalene	14 / 16	0.0 – 0.051	2 – 2	0.54	surr	No
Fluorene	14 / 16	0.0 – 0.17	2 – 2	5.41	nc	No
Phenanthrene	15 / 16	0.0 – 0.24	2 – 2	40.56	nc	No
Anthracene	14 / 16	0 – 0.043	2 – 2	40.56	nc	No
1-Methylphenanthrene	4 / 16	0.0 – 0.0043	2 – 2	NV	–	–
Fluoranthene	14 / 16	0.0 – 0.017	2 – 2	5.41	nc	No
Pyrene	14 / 16	0.0 – 0.0097	2 – 2	4.06	nc	No
Smelt						
Naphthalene	9 / 9	0.014 – 0.026	2 – 2	2.70	nc	No
2-Methylnaphthalene	9 / 9	0.012 – 0.024	2 – 2	0.54	nc	No
1-Methylnaphthalene	9 / 9	0.012 – 0.032	2 – 2	0.54	surr	No
Biphenyl	5 / 9	0.0021 – 0.0032	2 – 2	6.76	nc	No
2,6 Dimethylnaphthalene	9 / 9	0.004 – 0.011	2 – 2	0.54	surr	No
Acenaphthylene	0 / 9	0 – 0	2 – 2	8.11	surr	No
Acenaphthene	9 / 9	0.0097 – 0.028	2 – 2	8.11	nc	No
2,3,5 Trimethylnaphthalene	3 / 9	0.002 – 0.003	2 – 2	0.54	surr	No
Fluorene	9 / 9	0.004 – 0.01	2 – 2	5.41	nc	No
Phenanthrene	8 / 9	0.0079 – 0.018	2 – 2	40.56	nc	No
Anthracene	8 / 9	0.0021 – 0.0051	2 – 2	40.56	nc	No
1-Methylphenanthrene	2 / 9	0.002 – 0.003	2 – 2	NV	–	–
Fluoranthene	8 / 9	0.0028 – 0.03	2 – 2	5.41	nc	No
Pyrene	8 / 9	0.0032 – 0.027	2 – 2	4.06	nc	No
Benzo(a)anthracene	3 / 9	0.0021 – 0.017	2 – 2	0.0043	ca	Yes
Chrysene	2 / 9	0.0026 – 0.017	2 – 2	0.43	ca	No
Benzo(b)fluoranthene	2 / 9	0.0034 – 0.019	2 – 2	0.0043	ca	Yes
Benzo(k)fluoranthene	2 / 9	0.0027 – 0.017	2 – 2	0.04	ca	No
Benzo(e)pyrene	1 / 9	0.0098 – 0.0098	2 – 2	0.00043	ca	Yes
Benzo(a)pyrene	2 / 9	0.0024 – 0.015	2 – 2	0.00043	ca	Yes
Perylene	1 / 9	0.0042 – 0.0042	2 – 2	NV	–	No
Indeno(1,2,3-cd)pyrene	1 / 9	0.0076 – 0.0076	2 – 2	0.0043	ca	Yes
Dibenzo(a,h)anthracene	1 / 9	0.0026 – 0.0026	2 – 2	0.00043	ca	Yes
Benzo(g,h,i)perylene	1 / 9	0.0075 – 0.0075	2 – 2	4.06	nc	No

Notes:

All units are milligrams per kilogram (mg/kg).

RBC – Region 3 Risk-based Concentration (USEPA, October 2005).

nc – Region 3 RBC based on noncarcinogenic effects.

surr – An RBC is not available for this chemical. A surrogate chemical was selected for this chemical based on structural similarities.

ca – Region 3 RBC is based on carcinogenic effects.

Table 19
Selection of Chemicals of Potential Concern
Industrial Worker Receptors Exposed to Volatile Organic Chemicals in Indoor Air

Analyte	Detection Range (µg/m3)	Detection Frequency	Max	Region 9 Ambient Air PRG (µg/m3)	Basis	Notes	Exceeds?
Indoor Air							
1,1,1-Trichloroethane	12.51 - 12.51	1 / 2	12.51	2.30E+03	nc		No
1,2,4-Trimethylbenzene	3.97 - 38.76	2 / 2	38.76	6.21E+00	nc		*Yes*
1,3,5-Trimethylbenzene	9.32 - 9.32	1 / 2	9.32	6.21E+00	nc		*Yes*
1,4-Dichlorobenzene	41.47 - 961.57	2 / 2	961.57	3.06E-01	ca		*Yes*
Benzene	7.98 - 38.32	2 / 2	38.32	2.49E-01	ca		*Yes*
Carbon tetrachloride	10.7 - 10.7	1 / 2	10.70	1.28E-01	ca		*Yes*
Chloromethane	2.68 - 4.13	2 / 2	4.13	9.49E+01	nc		No
Dichlorodifluoromethane	5.44 - 20.28	2 / 2	20.28	2.09E+02	nc		No
Ethylbenzene	11.27 - 26.87	2 / 2	26.87	1.06E+03	nc		No
m & p-Xylenes	39 - 73.67	2 / 2	73.67	1.06E+02	nc	a	No
Methylene chloride	4.86 - 4.86	1 / 2	4.86	4.09E+00	ca		*Yes*
o-Xylene	7.8 - 18.63	2 / 2	18.63	1.06E+02	nc	a	No
Styrene	5.53 - 5.53	1 / 2	5.53	1.06E+03	nc		No
Toluene	101.66 - 109.19	2 / 2	109.19	4.02E+02	nc		No
Trichloroethylene	3.16 - 3.16	1 / 2	3.16	1.68E-02	ca		*Yes*
Trichlorofluoromethane	2.63 - 8.4	2 / 2	8.40	7.30E+02	nc		No
Ambient Air							
Chloromethane	1.78 - 8.05	2 / 3	8.05	9.49E+01	ca		No
Dichlorodifluoromethane	3.26 - 14.84	3 / 3	14.84	2.09E+02	ca		No
Toluene	1.43 - 1.43	1 / 3	1.43	4.02E+02	nc		No
Trichlorofluoromethane	1.57 - 1.9	2 / 3	1.90	7.30E+02	nc		No

Notes:
All units are microgram per cubic meter (µg/m^3).

PRG – Preliminary Remediation Goal
nc – PRG based on noncarcinogenic (systemic) effects
ca – PRG based on carcinogenic effects

a – Total xylenes used as a surrogate for m-, o-, & p-xylenes.

APPENDIX H-2
COPCs Identified by BERA

List of COPCs by Medium Based upon the Maximum Detected Concentration.

Surface Water	Sediment	Soil
None	Total PAHs	Total PAHs
	Dibenzofuran	Benzene
	m-Cresol	Antimony
	o-Cresol	Barium
	p-Cresol	Cadmium
	1,2,4-Trimethylbenzene	Chromium
	1,3,5-Trimethylbenzene	Copper
	Benzene	Lead
	Ethylbenzene	Manganese
	Toluene	Mercury
	Total Xylenes	Selenium
	Antimony	Silver
	Arsenic	Thallium*
	Barium	Zinc
	Cadmium	Cyanide
	Copper	
	Iron	
	Lead	
	Manganese	
	Mercury	
	Nickel	
	Selenium	
	Silver	
	Thallium	
	Vanadium	
	Zinc	
	Cyanide*	

* Eliminated as a COPC based upon frequency of detection (<5%).

APPENDIX I
Summary of Human Health Risks

Table 20
Residential Risk Summary (0-10 feet)
Reasonable Maximum Exposure

	Total Carcinogenic Risk								Total Noncarcinogenic Risk							
Equation unitless	CR unitless	=	Ingestion unitless	+	Dermal Contact unitless	+	Inhalation unitless	Target Organs	HQ unitless	=	Ingestion unitless	+	Dermal Contact unitless	+	Inhalation unitless
Inorganics															
Arsenic	1.31E-05	=	1.19E-05	+	1.18E-06	+	1.72E-09	*Skin, Circulatory*	2.35E-01	=	2.16E-01	+	1.91E-02	+	NA
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Thallium	NA	=	NA	+	NA	+	NA	*Systemic*	1.31E-02	=	1.31E-02	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	3.74E-02	=	2.74E-02	+	9.98E-03	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	5.69E-01	=	4.60E-01	+	1.29E-01	+	NA
Acenaphthene	NA	=	NA	+	NA	+	NA	*Systemic*	1.06E-03	=	7.76E-04	+	2.82E-04	+	NA
Benzo(a)anthracene	3.96E-05	=	2.81E-05	+	1.15E-05	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	3.14E-04	=	2.23E-04	+	9.14E-05	+	1.36E-09		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	3.43E-05	=	2.43E-05	+	9.97E-06	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	1.63E-06	=	1.16E-06	+	4.74E-07	+	NA		NA	=	NA	+	NA	+	NA
Chrysene	3.77E-07	=	2.67E-07	+	1.10E-07	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	5.02E-05	=	3.56E-05	+	1.46E-05	+	NA		NA	=	NA	+	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	+	NA	*Systemic*	8.66E-02	=	6.35E-02	+	2.31E-02	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	*Systemic, Circulatory*	2.77E-03	=	2.03E-03	+	7.40E-04	+	NA
Fluorene	NA	=	NA	+	NA	+	NA	*Circulatory*	2.00E-03	=	1.47E-03	+	5.34E-04	+	NA
Indeno(1,2,3-cd)pyrene	8.61E-06	=	6.11E-06	+	2.50E-06	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	*Respiratory, Systemic*	1.10E+01	=	1.19E-01	+	4.33E-02	+	1.08E+01
Phenanthrene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Pyrene	NA	=	NA	+	NA	+	NA	*Systemic*	4.98E-03	=	3.65E-03	+	1.33E-03	+	NA
VOCs															
1,2,4-Trichlorobenzene	NA	=	NA	+	NA	+	NA	*Systemic, Adrenal*	2.96E-01	=	3.79E-02	+	NA	+	2.58E-01
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	9.29E-01	=	1.55E-03	+	NA	+	9.27E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	2.93E-01	=	4.02E-04	+	NA	+	2.92E-01
Benzene	1.94E-05	=	1.23E-06	+	NA	+	1.82E-05	*Circulatory*	7.92E-01	=	4.57E-02	+	NA	+	7.46E-01
Xylenes (total)	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	5.90E-01	=	1.87E-03	+	NA	+	5.88E-01
Soil CR	5E-04	=	3E-04	+	1E-04	+	2E-05	**Soil HI**	15	=	1.0	+	0.2	+	14

Target Organ HI

Respiratory	1E+01
Systemic	1E+01
Circulatory	1E+00
Adrenal	3E-01
CNS	2E+00
Skin	2E-01

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index
CNS – Central Nervous System

Table 21
Risk Summary - Recreational Adult Exposed to Surface Soil
Reasonable Maximum Exposure

	Total Carcinogenic Risk							Total Noncarcinogenic Hazard						
Equation unitless	CR unitless	=	Ingestion unitless	+	Dermal unitless	+	Inhalation unitless	HQ unitless	=	Ingestion unitless	+	Dermal unitless	+	Inhalation unitless
Aluminum	NA	=	NA	+	NA	+	NA	5.06E-04	=	4.85E-04	+	NA	+	2.06E-05
Arsenic	2.49E-07	=	1.79E-07	+	6.94E-08	+	1.09E-10	1.29E-03	=	9.30E-04	+	3.60E-04	+	NA
Cadmium	1.13E-11	=	NA	+	NA	+	1.13E-11	1.03E-04	=	6.89E-05	+	3.37E-05	+	1.61E-08
Iron	NA	=	NA	+	NA	+	NA	4.32E-03	=	4.32E-03	+	NA	+	NA
Lead	NA	=	NA	+	NA	+	NA	NA	=	NA	+	NA	+	NA
Manganese	NA	=	NA	+	NA	+	NA	2.01E-04	=	1.26E-04	+	NA	+	7.52E-05
Thallium	NA	=	NA	+	NA	+	NA	6.60E-05	=	6.60E-05	+	NA	+	NA
Vanadium	NA	=	NA	+	NA	+	NA	2.66E-04	=	2.66E-04	+	NA	+	NA
Zinc	NA	=	NA	+	NA	+	NA	7.82E-05	=	7.82E-05	+	NA	+	NA
Benzo(a)anthracene	1.49E-07	=	5.74E-08	+	9.13E-08	+	NA	NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	2.93E-06	=	1.13E-06	+	1.80E-06	+	2.90E-11	NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	2.83E-07	=	1.09E-07	+	1.74E-07	+	NA	NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	7.95E-09	=	3.07E-09	+	4.88E-09	+	NA	NA	=	NA	+	NA	+	NA
Indeno(1,2,3-cd)pyrene	1.95E-07	=	7.52E-08	+	1.20E-07	+	NA	NA	=	NA	+	NA	+	NA
Soil CR	4E-06	=	2E-06	+	2E-06	+	1E-10	Soil HI 0.006	=	0.01	+	0.0004	+	8E-05

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

Table 22
Risk Summary - Recreational Adolescent Exposed to Surface Soil
Reasonable Maximum Exposure

	Total Carcinogenic Risk							Total Noncarcinogenic Hazard						
Equation unitless	CR unitless	=	Ingestion unitless	+	Dermal unitless	+	Inhalation unitless	HQ unitless	=	Ingestion unitless	+	Dermal unitless	+	Inhalation unitless
Aluminum	NA	=	NA	+	NA	+	NA	7.53E-04	=	7.23E-04	+	NA	+	3.07E-05
Arsenic	1.16E-07	=	1.07E-07	+	9.54E-09	+	6.52E-11	1.92E-03	=	1.39E-03	+	5.36E-04	+	NA
Cadmium	6.74E-12	=	NA	+	NA	+	6.74E-12	1.53E-04	=	1.03E-04	+	5.03E-05	+	2.40E-08
Iron	NA	=	NA	+	NA	+	NA	6.43E-03	=	6.43E-03	+	NA	+	NA
Lead	NA	=	NA	+	NA	+	NA	NA	=	NA	+	NA	+	NA
Manganese	NA	=	NA	+	NA	+	NA	3.00E-04	=	1.88E-04	+	NA	+	1.12E-04
Thallium	NA	=	NA	+	NA	+	NA	9.83E-05	=	9.83E-05	+	NA	+	NA
Vanadium	NA	=	NA	+	NA	+	NA	3.96E-04	=	3.96E-04	+	NA	+	NA
Zinc	NA	=	NA	+	NA	+	NA	1.17E-04	=	1.17E-04	+	NA	+	NA
Benzo(a)anthracene	4.67E-08	=	3.42E-08	+	1.26E-08	+	NA	NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	9.20E-07	=	6.73E-07	+	2.47E-07	+	1.73E-11	NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	8.89E-08	=	6.50E-08	+	2.39E-08	+	NA	NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	2.50E-09	=	1.83E-09	+	6.71E-10	+	NA	NA	=	NA	+	NA	+	NA
Indeno(1,2,3-cd)pyrene	6.12E-08	=	4.48E-08	+	1.65E-08	+	NA	NA	=	NA	+	NA	+	NA
Soil CR	1E-06	=	9E-07	+	3E-07	+	9E-11	**Soil HI** 0.009	=	0.009	+	0.001	+	1E-04

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

Table 23
Risk Summary - Recreational Child Exposed to Surface Soil
Reasonable Maximum Exposure

	Total Carcinogenic Risk							Total Noncarcinogenic Hazard						
Equation unitless	CR unitless	=	Ingestion unitless	+	Dermal unitless	+	Inhalation unitless	HQ unitless	=	Ingestion unitless	+	Dermal unitless	+	Inhalation unitless
Aluminum	NA	=	NA	+	NA	+	NA	1.82E-02	=	1.81E-02	+	NA	+	1.16E-04
Arsenic	1.46E-06	=	1.34E-06	+	1.18E-07	+	1.23E-10	3.78E-02	=	3.47E-02	+	3.07E-03	+	NA
Cadmium	1.27E-11	=	NA	+	NA	+	1.27E-11	2.86E-03	=	2.57E-03	+	2.88E-04	+	9.03E-08
Iron	NA	=	NA	+	NA	+	NA	1.61E-01	=	1.61E-01	+	NA	+	NA
Lead	NA	=	NA	+	NA	+	NA	NA	=	NA	+	NA	+	NA
Manganese	NA	=	NA	+	NA	+	NA	5.14E-03	=	4.71E-03	+	NA	+	4.21E-04
Thallium	NA	=	NA	+	NA	+	NA	2.46E-03	=	2.46E-03	+	NA	+	NA
Vanadium	NA	=	NA	+	NA	+	NA	9.92E-03	=	9.92E-03	+	NA	+	NA
Zinc	NA	=	NA	+	NA	+	NA	2.92E-03	=	2.92E-03	+	NA	+	NA
Benzo(a)anthracene	5.84E-07	=	4.28E-07	+	1.56E-07	+	NA	NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	1.15E-05	=	8.44E-06	+	3.07E-06	+	3.25E-11	NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	1.11E-06	=	8.15E-07	+	2.96E-07	+	NA	NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	3.12E-08	=	2.29E-08	+	8.34E-09	+	NA	NA	=	NA	+	NA	+	NA
Indeno(1,2,3-cd)pyrene	7.66E-07	=	5.61E-07	+	2.04E-07	+	NA	NA	=	NA	+	NA	+	NA
Soil CR	2E-05	=	1E-05	+	4E-06	+	2E-10	**Soil HI** 0.22	=	0.2	+	0.003	+	4E-04

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

Table 24
Adult Swimmer Risk Summary
Reasonable Maximum Exposure

Equation unitless	Total Carcinogenic Risk: CR unitless	=	Ingestion unitless	+	Dermal Contact unitless	Total Noncarcinogenic Risk: HQ unitless	=	Ingestion unitless	+	Dermal Contact unitless
Iron	NA	=	NA	+	NA	1.18E-05	=	1.18E-05	+	NA
Manganese	NA	=	NA	+	NA	8.45E-07	=	8.45E-07	+	NA
Vanadium	NA	=	NA	+	NA	1.28E-06	=	1.28E-06	+	NA
1-Methylnaphthalene	NA	=	NA	+	NA	NA	=	NA	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	3.64E-02	=	1.80E-05	+	3.64E-02
Acenaphthene	NA	=	NA	+	NA	1.07E-03	=	4.05E-07	+	1.07E-03
Benzo(a)anthracene	4.29E-06	=	2E-09	+	4.29E-06	NA	=	NA	+	NA
Benzo(a)pyrene	3.10E-05	=	1E-08	+	3.10E-05	NA	=	NA	+	NA
Benzo(b)fluoranthene	1.63E-06	=	6E-10	+	1.63E-06	NA	=	NA	+	NA
Benzo(k)fluoranthene	2.07E-07	=	8E-11	+	2.07E-07	NA	=	NA	+	NA
Chrysene	3.83E-08	=	1E-11	+	3.83E-08	NA	=	NA	+	NA
Dibenzo(a,h)anthracene	2.06E-06	=	8E-10	+	2.06E-06	NA	=	NA	+	NA
Fluoranthene	NA	=	NA	+	NA	7.49E-04	=	2.84E-07	+	7.49E-04
Fluorene	NA	=	NA	+	NA	9.75E-04	=	3.70E-07	+	9.75E-04
Indeno(1,2,3-cd)pyrene	5.74E-07	=	2E-10	+	5.74E-07	NA	=	NA	+	NA
Naphthalene	NA	=	NA	+	NA	9.92E-03	=	3.77E-06	+	9.92E-03
Pyrene	NA	=	NA	+	NA	3.86E-05	=	4.83E-07	+	3.81E-05
Methylene chloride	5.49E-12	=	5E-12	+	NA	2.85E-08	=	2.85E-08	+	NA
Xylenes (total)	NA	=	NA	+	NA	6.77E-09	=	6.77E-09	+	NA
Sediment CR	**4E-05**	=	2E-08	+	4E-05	**Sediment HI** **0.05**	=	4E-05	+	0.05

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

Table 25
Adolescent Swimmer Risk Summary
Reasonable Maximum Exposure

Equation unitless	Total Carcinogenic Risk: CR unitless	=	Ingestion unitless	+	Dermal Contact unitless		Total Noncarcinogenic Risk: HQ unitless	=	Ingestion unitless	+	Dermal Contact unitless
Iron	NA	=	NA	+	NA		1.76E-05	=	1.76E-05	+	NA
Manganese	NA	=	NA	+	NA		1.26E-06	=	1.26E-06	+	NA
Vanadium	NA	=	NA	+	NA		1.90E-06	=	1.90E-06	+	NA
1-Methy naphthalene	NA	=	NA	+	NA		NA	=	NA	+	NA
2-Methy naphthalene	NA	=	NA	+	NA		3.87E-02	=	2.67E-05	+	4E-02
Acenaphthene	NA	=	NA	+	NA		1.13E-03	=	0.00E+00	+	1E-03
Benzo(a)anthracene	1 82E-06	=	1E-09	+	2E-06		NA	=	NA	+	NA
Benzo(a)pyrene	1 32E-05	=	7E-09	+	1E-05		NA	=	NA	+	NA
Benzo(b)fluoranthene	6 93E-07	=	4E-10	+	7E-07		NA	=	NA	+	NA
Benzo(k)fluoranthene	8 81E-08	=	5E-11	+	9E-08		NA	=	NA	+	NA
Chrysene	1 63E-08	=	9E-12	+	2E-08		NA	=	NA	+	NA
Dibenzo(a,h)anthracene	8 75E-07	=	5E-10	+	9E-07		NA	=	NA	+	NA
Fluoranthene	NA	=	NA	+	NA		7.96E-04	=	4.24E-07	+	8E-04
Fluorene	NA	=	NA	+	NA		1.04E-03	=	5.51E-07	+	1E-03
Indeno(1,2,3-cd)pyrene	2 44E-07	=	1E-10	+	2E-07		NA	=	NA	+	NA
Naphthalene	NA	=	NA	+	NA		1.05E-02	=	5.61E-06	+	1E-02
Pyrene	NA	=	NA	+	NA		4.12E-05	=	7.19E-07	+	4E-05
Methylene chloride	3.27E-12	=	3E-12	+	NA		4.24E-08	=	4.24E-08	+	NA
Xylenes (total)	NA	=	NA	+	NA		1.01E-08	=	1.01E-08	+	NA
Sediment CR	**2E-05**	=	9E-09	+	2E-05	**Sediment HI**	**0.05**	=	6E-05	+	0.05

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

Table 26
Adult Wader Risk Summary
Reasonable Maximum Exposure

Equation unitless	Total Carcinogenic Risk: Total Risk unitless	=	Ingestion unitless	+	Dermal Contact unitless	Total Noncarcinogenic Risk: Total Hazard unitless	=	Ingestion unitless	+	Dermal Contact unitless
Iron	NA	=	NA	+	NA	2.37E-05	=	2.37E-05	+	NA
Manganese	NA	=	NA	+	NA	8.45E-07	=	8.45E-07	+	NA
Vanadium	NA	=	NA	+	NA	1.28E-06	=	1.28E-06	+	NA
1-Methylnaphthalene	NA	=	NA	+	NA	NA	=	NA	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	3.64E-02	=	1.80E-05	+	3.64E-02
Acenaphthene	NA	=	NA	+	NA	1.07E-03	=	2.19E-09	+	1.07E-03
Benzo(a)anthracene	4.29E-06	=	3.26E-09	+	4.29E-06	NA	=	NA	+	NA
Benzo(a)pyrene	3.10E-05	=	2.35E-08	+	3.10E-05	NA	=	NA	+	NA
Benzo(b)fluoranthene	1.63E-06	=	1.24E-09	+	1.63E-06	NA	=	NA	+	NA
Benzo(k)fluoranthene	2.07E-07	=	1.57E-10	+	2.07E-07	NA	=	NA	+	NA
Chrysene	3.83E-08	=	2.91E-11	+	3.83E-08	NA	=	NA	+	NA
Dibenzo(a,h)anthracene	2.06E-06	=	1.56E-09	+	2.06E-06	NA	=	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	1.73E-04	=	6.58E-08	+	1.73E-04
Fluoranthene	NA	=	NA	+	NA	7.49E-04	=	3.29E-09	+	7.49E-04
Fluorene	NA	=	NA	+	NA	9.75E-04	=	3.29E-09	+	9.75E-04
Indeno(1,2,3-cd)pyrene	5.75E-07	=	4.36E-10	+	5.74E-07	NA	=	NA	+	NA
Naphthalene	NA	=	NA	+	NA	9.92E-03	=	3.77E-06	+	9.92E-03
Pyrene	NA	=	NA	+	NA	8.29E-07	=	4.83E-07	+	3.46E-07
Methylene chloride	5.49E-12	=	5.49E-12	+	NA	2.85E-08	=	2.85E-08	+	NA
Xylenes (total)	NA	=	NA	+	NA	6.77E-09	=	6.77E-09	+	NA
Sediment CR	**4E-05**	=	3E-08	+	4E-05	**Sediment HI** 0.05	=	5E-05	+	0.046

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

Table 27
Adolescent Wader Risk Summary
Reasonable Maximum Exposure

Equation unitless	Total Carcinogenic Risk: CR unitless	=	Ingestion unitless	+	Dermal Contact unitless	Total Noncarcinogenic Risk: HQ unitless	=	Ingestion unitless	+	Dermal Contact unitless
Iron	NA	=	NA	+	NA	4E-05	=	3.53E-05	+	NA
Manganese	NA	=	NA	+	NA	3E-06	=	2.52E-06	+	NA
Vanadium	NA	=	NA	+	NA	4E-06	=	3.80E-06	+	NA
1-Methylnaphthalene	NA	=	NA	+	NA	NA	=	NA	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	4E-02	=	5.35E-05	+	4E-02
Acenaphthene	NA	=	NA	+	NA	1E-03	=	0.00E+00	+	1E-03
Benzo(a)anthracene	2E-06	=	2E-09	+	2E-06	NA	=	NA	+	NA
Benzo(a)pyrene	1E-05	=	1E-08	+	1E-05	NA	=	NA	+	NA
Benzo(b)fluoranthene	7E-07	=	7E-10	+	7E-07	NA	=	NA	+	NA
Benzo(k)fluoranthene	9E-08	=	9E-11	+	9E-08	NA	=	NA	+	NA
Chrysene	2E-08	=	2E-11	+	2E-08	NA	=	NA	+	NA
Dibenzo(a,h)anthracene	9E-07	=	9E-10	+	9E-07	NA	=	NA	+	NA
Fluoranthene	NA	=	NA	+	NA	8E-04	=	8.47E-07	+	8E-04
Fluorene	NA	=	NA	+	NA	1E-03	=	1.10E-06	+	1E-03
Indeno(1,2,3-cd)pyrene	2E-07	=	3E-10	+	2E-07	NA	=	NA	+	NA
Naphthalene	NA	=	NA	+	NA	1E-02	=	1.12E-05	+	1E-02
Pyrene	NA	=	NA	+	NA	4E-05	=	7.19E-07	+	4E-05
Methylene chloride	3E-13	=	3E-13	+	NA	3E-09	=	3.26E-09	+	NA
o-Xylene	NA	=	NA	+	NA	1E-09	=	9.79E-10	+	NA
sec-Butyl benzene	NA	=	NA	+	NA	5E-09	=	4.90E-09	+	NA
Styrene	NA	=	NA	+	NA	1E-09	=	9.79E-10	+	NA
Xylenes (total)	NA	=	NA	+	NA	1E-08	=	1.01E-08	+	NA
Sediment CR	2E-05	=	2E-08	+	2E-05	**Sediment HI** 0.05	=	1E-04	+	0.052

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

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Table 28
Industrial Worker Risk Summary
Reasonable Maximum Exposure

	Carcinogenic Risk							Noncarcinogenic Hazard						
Equation	CR	=	Ingestion	+	Dermal	+	Inhalation	HI	=	Ingestion	+	Dermal	+	Inhalation
Units	unitless		unitless		unitless		unitless	unitless		unitless		unitless		unitless
Inorganics														
Arsenic	1E-06	=	9.58E-07	+	2.00E-07	+	3.03E-10	7.20E-03	=	5.96E-03	+	1.24E-03	+	NA
SVOCs														
Benzo(a)pyrene	2E-07	=	2.31E-07	+	NA	+	3.07E-12	NA	=	NA	+	NA	+	NA
Soil CR	1E-06	=	1E-06	+	2E-07	+	3E-10	**Soil HI** 0.007	=	0.01	+	0.001	+	NA

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index
SVOC – Semivolatile organic compound

Table 29
Industrial Worker Indoor Air Risk Summary
Reasonable Maximum Exposure

	Carcinogenic Risk unitless	Target Organs	Noncarcinogenic Hazard unitless
1,2 4-Trimethylbenzene	NA	*Systemic, CNS*	1.77E+00
1,3.5-Trimethylbenzene	NA	*CNS*	4.27E-01
1,4-Dichlorobenzene	NA	*Systemic*	3.29E-01
Benzene	2.92E-05	*Circulatory*	3.50E-01
Carbon tetrachloride	1.57E-05		NA
Methylene chloride	2.24E-07	*CNS*	4.44E-04
Trichloroethylene	3.53E-05	*Systemic, CNS*	2.17E-02
Air CR	**8E-05**	**Air HI**	**3**

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Target Organ HI	
Circulatory	4E-01
CNS	2E+00
Systemic	3E+00

Table 30
Maintenance Worker Risk Summary
Reasonable Maximum Exposure

	Carcinogenic Risk							Noncarcinogenic Hazard						
Equation	CR	=	Ingestion	+	Dermal	+	Inhalation	HQ	=	Ingestion	+	Dermal	+	Inhalation
Units	unitless		unitless		unitless		unitless	unitless		unitless		unitless		unitless
Arsenic	1.39E-07	=	1.15E-07	+	2.40E-08	+	6.98E-11	8.65E-04	=	7.16E-04	+	1.49E-04	+	NA
Lead	NA	=	NA	+	NA	+	NA	NA	=	NA	+	NA	+	NA
Benzo(a)anthracene	5.9E-08	=	3.17E-08	+	2.72E-08	+	NA	NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	1.2E-06	=	6.37E-07	+	5.47E-07	+	1.63E-11	NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	1.1E-07	=	5.89E-08	+	5.05E-08	+	NA	NA	=	NA	+	NA	+	NA
Indeno(1,2,3-cd)pyrene	7.5E-08	=	4.06E-08	+	3.48E-08	+	NA	NA	=	NA	+	NA	+	NA
Soil CR	2E-06	=	9E-07	+	7E-07	+	9E-11	Soil HI 0.0009	=	0.0007	+	0.0001	+	NA

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Table 31
Construction Worker Risk Summary
Reasonable Maximum Exposure

	Carcinogenic Risk							Target Organs	Noncarcinogenic Hazard						
Equation	CR	=	Ingestion	+	Dermal	+	Inhalation		HQ	=	Ingestion	+	Dermal	+	Inhalation
Units	unitless		unitless		unitless		unitless		unitless		unitless		unitless		unitless
Inorganics															
Arsenic	3.38E-07	=	3.12E-07	+	1.73E-08	+	8.32E-09	*Skin, Circulatory*	5.13E-02	=	4.86E-02	+	2.69E-03	+	NA
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Manganese	NA	=	NA	+	NA	+	NA	*CNS*	1.92E-01	=	7.11E-03	+	NA	+	1.85E-01
Vanadium	NA	=	NA	+	NA	+	NA	*Skin*	1.45E-02	=	1.45E-02	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	8.13E-02	=	6.62E-02	+	1.51E-02	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	1.51E+00	=	1.29E+00	+	2.26E-01	+	NA
Acenaphthene	NA	=	NA	+	NA	+	NA	*Systemic*	2.55E-03	=	2.08E-03	+	4.74E-04	+	NA
Acenaphthylene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)anthracene	7.05E-06	=	5.74E-06	+	1.31E-06	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	5.07E-05	=	4.13E-05	+	9.41E-06	+	4.62E-06		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	3.08E-06	=	2.51E-06	+	5.72E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	3.82E-07	=	3.11E-07	+	7.09E-08	+	NA		NA	=	NA	+	NA	+	NA
Chrysene	6.31E-08	=	5.14E-08	+	1.17E-08	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	7.59E-06	=	6.18E-06	+	1.41E-06	+	NA		NA	=	NA	+	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	+	NA	*Systemic*	1.96E-01	=	1.60E-01	+	3.64E-02	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	*Systemic, Circulatory*	2.80E-03	=	2.28E-03	+	5.20E-04	+	NA
Fluorene	NA	=	NA	+	NA	+	NA	*Circulatory*	2.85E-03	=	2.32E-03	+	5.29E-04	+	NA
Indeno(1,2,3-cd)pyrene	2.78E-06	=	2.26E-06	+	5.16E-07	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	*Respiratory, Systemic*	3.07E+01	=	1.89E-01	+	4.30E-02	+	3.05E+01
Pyrene	NA	=	NA	+	NA	+	NA	*Systemic*	5.23E-03	=	4.26E-03	+	9.71E-04	+	NA
VOCs															
1,2,3-Trimethylbenzene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
1,2,4-Trichlorobenzene	NA	=	NA	+	NA	+	NA	*Systemic, Adrenal*	1.13E+00	=	8.54E-02	+	NA	+	1.04E+00
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	2.90E-01	=	2.72E-04	+	NA	+	2.90E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	1.65E-01	=	1.27E-04	+	NA	+	1.65E-01
Benzene	1.22E-06	=	3.83E-08	+	NA	+	1.19E-06	*Circulatory*	3.67E-01	=	1.22E-02	+	NA	+	3.55E-01
Ethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, Teratology*	2.90E-02	=	1.48E-03	+	NA	+	2.76E-02
n-Butylbenzene	NA	=	NA	+	NA	+	NA	*Systemic*	4.78E-03	=	4.78E-03	+	NA	+	NA
p-Isopropyltoluene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
sec-Butylbenzene	NA	=	NA	+	NA	+	NA	*Systemic*	4.05E-03	=	4.05E-03	+	NA	+	NA
Toluene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	2.41E-02	=	5.43E-05	+	NA	+	2.40E-02
Xylenes (total)	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	1.19E+00	=	2.13E-03	+	NA	+	1.19E+00
Soil CR	7E-05	=	6E-05	+	1E-05	+	1E-06	**Soil HI**	36	=	2	+	0.3	+	34

Target Organ HI

Respiratory	3E+01
Circulatory	4E-01
Systemic	3E+01
Adrenal	1E+00
CNS	2E+00
Teratology	3E-02
Skin	1E-02

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index
CNS – Central Nervous System

Table 32
Subsistence Fisher Risk Summary
Reasonable Maximum Exposure

	Carcinogenic Risk unitless	Noncarcinogenic Hazard unitless
Shorthead Redhorse & Walleye		
1-Methylnaphthalene	NA	0.01
Smelt		
Benzo(a)anthracene	5.90E-05	NA
Benzo(a)pyrene	5.21E-05	NA
Benzo(b)fluoranthene	6.60E-06	NA
Benzo(e)pyrene	NA	NA
Dibenzo(a,h)anthracene	9.03E-06	NA
Indeno(1,2,3-cd)pyrene	2.64E-06	NA
Fish CR	**1E-04**	**Fish HI** 0.01

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

Table 33
Residential Risk Summary (0-1 feet)
Reasonable Maximum Exposure

Chemical	Total Carcinogenic Risk: Total Risk	=	Ingestion	+	Dermal Contact	+	Inhalation	Total Noncarcinogenic Risk: Total Hazard	=	Ingestion	+	Dermal Contact	+	Inhalation
Inorganics														
Arsenic	9.47E-06	=	8.61E-06	+	8.58E-07	+	1.25E-09	1.70E-01	=	1.56E-01	+	1.38E-02	+	NA
Lead	NA	=	NA	+	NA	+	NA	NA	=	NA	+	NA	+	NA
SVOCs														
Benzo(a)pyrene	2.93E-06	=	2.08E-06	+	8.53E-07	+	1.27E-11	NA	=	NA	+	NA	+	NA
Soil CR	1E-05	=	1E-05	+	2E-06	+	1E-09	**Soil HI** 0.2	=	0.2	+	0.01	+	NA

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Table 34
Residential Risk Summary (0-3 feet)
Reasonable Maximum Exposure

Equation unitless	Total Carcinogenic Risk: Total Risk unitless	=	Ingestion unitless	+	Dermal Contact unitless	+	Inhalation unitless	Total Noncarcinogenic Risk: Total Hazard unitless	=	Ingestion unitless	+	Dermal Contact unitless	+	Inhalation unitless
Inorganics														
Arsenic	9.65E-06	=	8.78E-06	+	8.74E-07	+	1.27E-09	1.73E-01	=	1.59E-01	+	1.41E-02	+	NA
Lead	NA	=	NA	+	NA	+	NA	NA	=	NA	+	NA	+	NA
SVOCs														
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	4.14E-03	=	3.03E-03	+	1.10E-03	+	NA
Benzo(a)anthracene	2.19E-05	=	1.55E-05	+	6.36E-06	+	NA	NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	2.60E-04	=	1.84E-04	+	7.55E-05	+	1.12E-09	NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	2.17E-05	=	1.54E-05	+	6.31E-06	+	NA	NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	6.81E-07	=	4.83E-07	+	1.98E-07	+	NA	NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	1.23E-05	=	8.70E-06	+	3.57E-06	+	NA	NA	=	NA	+	NA	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	1.15E-03	=	8.46E-04	+	3.08E-04	+	NA
Indeno(1,2,3-cd)pyrene	5.47E-06	=	3.88E-06	+	1.59E-06	+	NA	NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	3.80E-01	=	4.13E-03	+	1.50E-03	+	3.75E-01
Pyrene	NA	=	NA	+	NA	+	NA	2.73E-03	=	2.00E-03	+	7.29E-04	+	NA
VOCs														
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	2.01E-01	=	3.35E-04	+	NA	+	2.00E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	8.92E-03	=	1.23E-05	+	NA	+	8.91E-03
Benzene	2.62E-06	=	1.66E-07	+	NA	+	2.45E-06	1.07E-01	=	6.17E-03	+	NA	+	1.01E-01
Soil CR	*3E-04*	=	2E-04	+	9E-05	+	2E-06	**Soil HI** 0.9	=	0.2	+	0.02	+	0.7

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Table 35
Residential Risk Summary (0-10 feet)
Central Tendency Evaluation

Equation / Units	Total Carcinogenic Risk: CR unitless	=	Ingestion unitless	+	Dermal Contact unitless	+	Inhalation unitless	Target Organs	Total Noncarcinogenic Risk: HQ unitless	=	Ingestion unitless	+	Dermal Contact unitless	+	Inhalation unitless
Inorganics															
Arsenic	4.24E-06	=	4.10E-06	+	1.45E-07	+	NA	*Skin, Circulatory*	9.48E-02	=	9.16E-02	+	3.24E-03	+	NA
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Thallium	NA	=	NA	+	NA	+	NA	*Systemic*	6.26E-02	=	6.26E-02	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	7.38E-03	=	6.88E-03	+	1.00E-03	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	1.43E-01	=	1.29E-01	+	1.44E-02	+	NA
Acenaphthene	NA	=	NA	+	NA	+	NA	*Systemic*	2.56E-03	=	2.32E-03	+	3.38E-04	+	NA
Benzo(a)anthracene	7.78E-06	=	6.78E-06	+	9.91E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	6.53E-05	=	5.70E-05	+	8.31E-06	+	3.61E-10		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	6.93E-06	=	6.05E-06	+	8.83E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	3.38E-07	=	2.95E-07	+	4.31E-08	+	NA		NA	=	NA	+	NA	+	NA
Chrysene	7.46E-08	=	6.51E-08	+	9.50E-09	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	1.08E-05	=	9.42E-06	+	1.37E-06	+	NA		NA	=	NA	+	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	+	NA	*Systemic*	1.71E-02	=	1.49E-02	+	2.17E-03	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	*Systemic, Circulatory*	6.73E-03	=	5.87E-03	+	8.55E-04	+	NA
Fluorene	NA	=	NA	+	NA	+	NA	*Circulatory*	4.64E-03	=	4.05E-03	+	5.90E-04	+	NA
Indeno(1,2,3-cd)pyrene	1.83E-06	=	1.59E-06	+	2.33E-07	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	*Respiratory, Systemic*	2.76E+00	=	1.55E-02	+	2.26E-03	+	2.74E+00
Phenanthrene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Pyrene	NA	=	NA	+	NA	+	NA	*Systemic*	1.20E-03	=	1.05E-03	+	1.53E-04	+	NA
VOCs															
1,2,4-Trichlorobenzene	NA	=	NA	+	NA	+	NA	*Systemic, Adrenal*	3.52E-01	=	9.87E-03	+	NA	+	3.42E-01
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	2.64E-01	=	4.82E-04	+	NA	+	2.64E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	5.60E-01	=	8.80E-04	+	NA	+	5.59E-01
Benzene	2.94E-07	=	2.94E-07	+	NA	+	1.01E-15	*Circulatory*	2.69E-01	=	1.34E-02	+	NA	+	2.56E-01
Xylenes (total)	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	1.36E-01	=	1.86E-03	+	NA	+	1.34E-01
ILCR	*1E-04*	=	9E-05	+	1E-05	+	4E-10	**Soil HI**	5	=	0.4	+	0.03	+	4

Target Organ HI

Respiratory	3E+00
Systemic	4E+00
Circulatory	4E-01
Adrenal	4E-01
CNS	1E+00
Skin	9E-02

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index
CNS – Central Nervous System

Table 36
Residential Risk Summary (0-3 feet)
Central Tendency Evaluation

	Total Carcinogenic Risk								Total Noncarcinogenic Risk							
Equation	CR	=	Ingestion	+	Dermal Contact	+	Inhalation		HQ	=	Ingestion	+	Dermal Contact	+	Inhalation
Units	unitless		unitless		unitless		unitless		unitless		unitless		unitless		unitless
Inorganics															
Arsenic	2.93E-06	=	2.83E-06	+	1.00E-07	+	4.27E-10		7.45E-02	=	6.33E-02	+	1.12E-02	+	NA
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA		1.14E-03	=	6.58E-04	+	4.79E-04	+	NA
Benzo(a)anthracene	3.07E-06	=	2.68E-06	+	3.91E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	3.71E-05	=	3.24E-05	+	4.73E-06	+	2.05E-10		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	3.26E-06	=	2.84E-06	+	4.15E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	1.05E-07	=	9.19E-08	+	1.34E-08	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	2.10E-06	=	1.83E-06	+	2.67E-07	+	NA		NA	=	NA	+	NA	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA		3.09E-04	=	1.79E-04	+	1.30E-04	+	NA
Indeno(1,2,3-cd)pyrene	8.22E-07	=	7.17E-07	+	1.05E-07	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA		1.19E-01	=	9.00E-04	+	6.55E-04	+	1.18E-01
Pyrene	NA	=	NA	+	NA	+	NA		7.03E-04	=	4.07E-04	+	2.96E-04	+	NA
VOCs															
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA		6.76E-02	=	7.84E-05	+	NA	+	6.75E-02
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA		3.12E-03	=	2.98E-06	+	NA	+	3.12E-03
Benzene	5.10E-07	=	3.12E-08	+	NA	+	4.78E-07		3.49E-02	=	1.43E-03	+	NA	+	3.35E-02
Soil CR	***5E-05***	=	4E-05	+	6E-06	+	5E-07	**Soil HI**	*0.3*	=	0.07	+	0.01	+	0.2

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Table 36
Residential Risk Summary (0-1 feet)
Reasonable Maximum Exposure

Chemical	Total Carcinogenic Risk: Total Risk	=	Ingestion	+	Dermal Contact	+	Inhalation	Total Noncarcinogenic Risk: Total Hazard	=	Ingestion	+	Dermal Contact	+	Inhalation
Inorganics:														
Arsenic	3.62E-06	=	3.50E-06	+	1.24E-07	+	5.27E-10	8.09E-02	=	7.82E-02	+	2.76E-03	+	NA
Lead	NA	=	NA	+	NA	+	NA	NA	=	NA	+	NA	+	NA
SVOCs														
Benzo(a)pyrene	9.69E-07	=	8.46E-07	+	1.23E-07	+	5.35E-12	NA	=	NA	+	NA	+	NA
Soil CR	5E-06	=	4E-06	+	2E-07	+	5E-10	**Soil HI** 0.1	=	0.1	+	0.00	+	NA

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Table 38
Construction Worker Risk Summary
Reasonable Maximum Exposure

	Carcinogenic Risk							Target Organs	Noncarcinogenic Hazard						
Equation	CR	=	Ingestion	+	Dermal	+	Inhalation		HQ	=	Ingestion	+	Dermal	+	Inhalation
Units	unitless		unitless		unitless		unitless		unitless		unitless		unitless		unitless
Inorganics															
Arsenic	9.42E-08	=	8.29E-08	+	5.05E-09	+	6.31E-09	*Skin, Circulatory*	1.37E-02	=	1.29E-02	+	7.86E-04	+	NA
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Manganese	NA	=	NA	+	NA	+	NA	*CNS*	1.42E-01	=	1.89E-03	+	NA	+	1.40E-01
Vanadium	NA	=	NA	+	NA	+	NA	*Skin*	3.86E-03	=	3.86E-03	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	2.20E-02	=	1.76E-02	+	4.41E-03	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	4.08E-01	=	3.42E-01	+	6.60E-02	+	NA
Acenaphthene	NA	=	NA	+	NA	+	NA	*Systemic*	6.90E-04	=	5.52E-04	+	1.38E-04	+	NA
Acenaphthylene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)anthracene	1.91E-06	=	1.52E-06	+	3.82E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	1.37E-05	=	1.10E-05	+	2.75E-06	+	3.51E-08		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	8.33E-07	=	6.66E-07	+	1.67E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	1.03E-07	=	8.25E-08	+	2.07E-08	+	NA		NA	=	NA	+	NA	+	NA
Chrysene	1.71E-08	=	1.36E-08	+	3.42E-09	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	2.05E-06	=	1.64E-06	+	4.11E-07	+	NA		NA	=	NA	+	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	+	NA	*Systemic*	5.30E-02	=	4.24E-02	+	1.06E-02	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	*Systemic, Circulatory*	7.57E-04	=	6.05E-04	+	1.52E-04	+	NA
Fluorene	NA	=	NA	+	NA	+	NA	*Circulatory*	7.71E-04	=	6.16E-04	+	1.55E-04	+	NA
Indeno(1,2,3-cd)pyrene	7.51E-07	=	6.01E-07	+	1.51E-07	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	*Respiratory, Systemic*	2.32E+01	=	5.00E-02	+	1.26E-02	+	2.32E+01
Pyrene	NA	=	NA	+	NA	+	NA	*Systemic*	1.41E-03	=	1.13E-03	+	2.83E-04	+	NA
VOCs															
1,2,3-Trimethylbenzene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
1,2,4-Trichlorobenzene	NA	=	NA	+	NA	+	NA	*Systemic, Adrenal*	8.13E-01	=	2.27E-02	+	NA	+	7.90E-01
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	2.20E-01	=	7.22E-05	+	NA	+	2.20E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	1.25E-01	=	3.37E-05	+	NA	+	1.25E-01
Benzene	9.10E-07	=	1.02E-08	+	NA	+	9.00E-07	*Circulatory*	2.73E-01	=	3.24E-03	+	NA	+	2.69E-01
Ethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, Teratology*	2.13E-02	=	3.93E-04	+	NA	+	2.09E-02
n-Butyl benzene	NA	=	NA	+	NA	+	NA	*Systemic*	1.27E-03	=	1.27E-03	+	NA	+	NA
p-Isopropyltoluene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
sec-Butyl benzene	NA	=	NA	+	NA	+	NA	*Systemic*	1.08E-03	=	1.08E-03	+	NA	+	NA
Toluene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	1.83E-02	=	1.44E-05	+	NA	+	1.83E-02
Xylenes (total)	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	9.05E-01	=	5.64E-04	+	NA	+	9.05E-01
Soil CR	**2E-05**	=	2E-05	+	4E-06	+	9E-07	**Soil HI**	**26**	=	1	+	0.1	+	26

Target Organ HI

Respiratory	2E+01
Circulatory	3E-01
Systemic	2E+01
Adrenal	8E-01
CNS	1E+00
Teratology	2E-02
Skin	4E-03

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index
CNS – Central Nervous System

Table 39
Industrial Worker Indoor Air Risk Summary
Central Tendency Evaluation

	Carcinogenic Risk unitless		Noncarcinogenic Hazard unitless
1,2,4-Trimethylbenzene	NA		8.55E-01
1,3,5-Trimethylbenzene	NA		2.06E-01
1,4-Dichlorobenzene	NA		1.58E-01
Benzene	6.76E-06		1.69E-01
Carbon tetrachloride	3.63E-06		NA
Methylene chloride	5.18E-08		2.14E-04
Trichloroethylene	8.17E-06		1.05E-02
Air CR	**2E-05**	**Air HI**	**1**

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Table 40
Subsistence Fisher Risk Summary
Central Tendency Exposure

	Risk	Hazard
Shorthead Redhorse & Walleye		
1-Methylnaphthalene	NA	3.40E-04
Smelt		
Benzo(a)anthracene	1.64E-07	NA
Benzo(a)pyrene	1.92E-06	NA
Benzo(b)fluoranthene	2.48E-07	NA
Benzo(e)pyrene	NA	NA
Dibenzo(a,h)anthracene	5.75E-07	NA
Indeno(1,2,3-cd)pyrene	1.68E-07	NA
Total CR	3E-06	***HI*** 3E-04

Notes:

NA – Not Applicable
CR – Cancer Risk
HI – Hazard Index

Table 41
Residential Risk Summary (0-10 feet)
Excluding VOC Concentrations Exceeding Csat Values
Reasonable Maximum Exposure

	Total Carcinogenic Risk								Total Noncarcinogenic Risk						
Chemical	Total Risk	=	Ingestion	+	Dermal Contact	+	Inhalation	Target Organs	Total Hazard	=	Ingestion	+	Dermal Contact	+	Inhalation
Inorganics															
Arsenic	1.31E-05	=	1.19E-05	+	1.18E-06	+	1.72E-09	*Skin, Circulatory*	2.35E-01	=	2.16E-01	+	1.91E-02	+	NA
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Thallium	NA	=	NA	+	NA	+	NA	*Systemic*	1.31E-02	=	1.31E-02	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	3.74E-02	=	2.74E-02	+	9.98E-03	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	5.89E-01	=	4.60E-01	+	1.29E-01	+	NA
Acenaphthene	NA	=	NA	+	NA	+	NA	*Systemic*	1.06E-03	=	7.76E-04	+	2.82E-04	+	NA
Benzo(a)anthracene	3.96E-05	=	2.81E-05	+	1.15E-05	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	3.14E-04	=	2.23E-04	+	9.14E-05	+	1.36E-09		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	3.43E-05	=	2.43E-05	+	9.97E-06	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	1.63E-06	=	1.16E-06	+	4.74E-07	+	NA		NA	=	NA	+	NA	+	NA
Chrysene	3.77E-07	=	2.67E-07	+	1.10E-07	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	5.02E-05	=	3.56E-05	+	1.46E-05	+	NA		NA	=	NA	+	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	+	NA	*Systemic*	8.66E-02	=	6.35E-02	+	2.31E-02	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	*Systemic, Circulatory*	2.77E-03	=	2.03E-03	+	7.40E-04	+	NA
Fluorene	NA	=	NA	+	NA	+	NA	*Circulatory*	2.00E-03	=	1.47E-03	+	5.34E-04	+	NA
Indeno(1,2,3-cd)pyrene	8.61E-06	=	6.11E-06	+	2.50E-06	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	*Systemic, Respiratory*	1.10E+01	=	1.19E-01	+	4.33E-02	+	1.08E+01
Phenanthrene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Pyrene	NA	=	NA	+	NA	+	NA	*Kidney*	4.98E-03	=	3.65E-03	+	1.33E-03	+	NA
VOCs															
1,2,4-Trichlorobenzene	NA	=	NA	+	NA	+	NA	*Systemic, Adrenal*	2.97E-01	=	3.79E-02	+	NA	+	2.59E-01
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	9.26E-01	=	1.55E-03	+	NA	+	9.24E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	4.12E-02	=	5.66E-05	+	NA	+	4.12E-02
Benzene	1.92E-05	=	1.22E-08	+	NA	+	1.80E-05	*Circulatory*	7.83E-01	=	4.52E-02	+	NA	+	7.38E-01
Xylenes (total	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	1.47E-01	=	4.67E-04	+	NA	+	1.47E-01
Soil CR	*5E-04*	=	*3E-04*	+	*1E-04*	+	*2E-05*	**Soil HI**	*14*	=	*1.0*	+	*0.2*	+	*13*

Notes

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Target Organ HI	
Respiratory	1E+01
Systemic	1E+01
Circulatory	1E+00
Adrenal	3E-01
CNS	1E+00
Skin	2E-01

Table 42
Construction Worker Risk Summary
Excluding VOC Concentrations Exceeding Csat Values
Reasonable Maximum Exposure

	Carcinogenic Risk							Noncarcinogenic Hazard						
Equation	CR	=	Ingestion	+	Dermal	+	Inhalation	Target Organ	HQ	=	Ingestion	+	Dermal	+	Inhalation
Units	unitless		unitless		unitless		unitless		unitless		unitless		unitless		unitless
Inorganics															
Arsenic	3.67E-07	=	3.39E-07	+	1.88E-08	+	9.02E-09	*Skin* *Circulatory*	5.56E-02	=	5.27E-02	+	2.92E-03	+	NA
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	7.44E-02	=	6.06E-02	+	1.38E-02	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	1.34E+00	=	1.14E+00	+	2.00E-01	+	NA
Acenaphthene	NA	=	NA	+	NA	+	NA	*Systemic*	2.91E-03	=	2.37E-03	+	5.41E-04	+	NA
Benzo(a)anthracene	8.16E-06	=	6.64E-06	+	1.52E-06	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	7.15E-05	=	5.82E-05	+	1.33E-05	+	6.52E-08		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	4.22E-06	=	3.43E-06	+	7.83E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	4.91E-07	=	4.00E-07	+	9.11E-08	+	NA		NA	=	NA	+	NA	+	NA
Chyrsene	7.50E-08	=	6.11E-08	+	1.39E-08	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	1.08E-05	=	8.82E-06	+	2.01E-06	+	NA		NA	=	NA	+	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	+	NA	*Systemic*	1.77E-01	=	1.44E-01	+	3.29E-02	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	*Systemic, Circulatory*	3.26E-03	=	2.66E-03	+	6.06E-04	+	NA
Fluorene	NA	=	NA	+	NA	+	NA	*Circulatory*	2.80E-03	=	2.28E-03	+	5.20E-04	+	NA
Indeno(1,2,3-cd)pyrene	3.86E-06	=	3.15E-06	+	7.18E-07	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	*Respiratory, Systemic*	3.09E+01	=	1.89E-01	+	4.32E-02	+	3.06E+01
Pyrene	NA	=	NA	+	NA	+	NA	*Systemic*	6.41E-03	=	5.22E-03	+	1.19E-03	+	NA
VOCs															
1,2,4-Trichlorobenzene	NA	=	NA	+	NA	+	NA	*Systemic, Adrenal*	7.18E-02	=	5.45E-03	+	NA	+	6.64E-02
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	2.45E-01	=	2.30E-04	+	NA	+	2.45E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	1.20E-02	=	9.28E-06	+	NA	+	1.20E-02
Benzene	1.15E-06	=	3.61E-08	+	NA	+	1.12E-06	*Circulatory*	3.46E-01	=	1.15E-02	+	NA	+	3.34E-01

Soil CR	*1E-04*	=	8E-05	+	2E-05	+	1E-06	**Soil HI**	33	=	2	+	0.3	+	31

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Target Organ HI	
Respiratory	3E+01
Systemic	3E+01
Circulatory	4E-01
Adrenal	7E-02
CNS	3E-01
Skin	6E-02

Table 43
Residential Risk Summary (0-10 feet)
Excluding VOC Concentrations Exceeding Csat Values
Central Tendency Evaluation

Chemical	Total Carcinogenic Risk							Target Organs	Total Noncarcinogenic Risk						
	Total Risk	=	Ingestion		Dermal Contact	+	Inhalation		Total Hazard	=	Ingestion		Dermal Contact	+	Inhalation
Inorganics															
Arsenic	4E-06	=	4E-06	+	1E-07	+	NA	*Skin* *Circulatory*	9E-02	=	9.16E-02	+	3.24E-03	+	3.40E-07
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Thallium	NA	=	NA	+	NA	+	NA	*Systemic*	8E-02	=	6.26E-02	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	8E-03	=	6.88E-03	+	1.00E-03	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	1E-01	=	1.29E-01	+	1.44E-02	+	NA
Acenaphthene	NA	=	NA	+	NA	+	NA	*Systemic*	3E-03	=	2.32E-03	+	3.38E-04	+	NA
Benzo(a)anthracene	8E-06	=	7E-06	+	1E-06	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	7E-05	=	6E-05	+	8E-06	+	4E-10		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	7E-06	=	6E-06	+	9E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	3E-07	=	3E-07	+	4E-08	+	NA		NA	=	NA	+	NA	+	NA
Chrysene	7E-08	=	7E-08	+	8E-09	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	1E-05	=	9E-06	+	1E-06	+	NA		NA	=	NA	+	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	+	NA	*Systemic*	2E-02	=	1.49E-02	+	2.17E-03	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	*Systemic, Circulatory*	7E-03	=	5.87E-03	+	8.55E-04	+	NA
Fluorene	NA	=	NA	+	NA	+	NA	*Circulatory*	5E-03	=	4.05E-03	+	5.90E-04	+	NA
Indeno(1,2,3-cd)pyrene	2E-06	=	2E-06	+	2E-07	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	*Respiratory, Systemic*	3E+00	=	1.55E-02	+	2.26E-03	+	2.74E+00
Phenanthrene	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
Pyrene	NA	=	NA	+	NA	+	NA	*Systemic*	1E-03	=	1.05E-03	+	1.53E-04	+	NA
VOCs															
1,2,4-Trichlorobenzene	NA	=	NA	+	NA	+	NA	*Systemic, Adrenal*	4E-01	=	9.87E-03	+	NA	+	3.42E-01
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	3E-01	=	4.82E-04	+	NA	+	2.64E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	1E-01	=	1.87E-04	+	NA	+	1.19E-01
Benzene	3E-07	=	3E-07	+	NA	+	1E-15	*Circulatory*	3E-01	=	1.34E-02	+	NA	+	2.56E-01
Xylenes (total)	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	3E-02	=	4.70E-04	+	NA	+	3.38E-02
Soil CR	1E-04	=	9E-05	+	1E-05	+	4E-10	**Soil HI**	4	=	0.4	+	0.03	+	4

Target Organ HI

Respiratory	3E+00
Systemic	4E+00
Circulatory	4E-01
Adrenal	4E-01
CNS	4E-01
Skin	9E-02

Notes

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

Table 44
Construction Worker Risk Summary
Excluding VOC Concentrations Exceeding Csat Values
Central Tendency Evaluation

	Carcinogenic Risk							Target Organs	Noncarcinogenic Hazard						
Equation	CR	=	Ingestion	+	Dermal	+	Inhalation		HQ	=	Ingestion	+	Dermal	+	Inhalation
Units	unitless		unitless		unitless		unitless		unitless		unitless		unitless		unitless
Inorganics															
Arsenic	8.82E-08	=	7.76E-08	+	4.73E-09	+	5.91E-09	*Skin Circulatory*	1.28E-02	=	1.21E-02	+	7.35E-04	+	NA
Lead	NA	=	NA	+	NA	+	NA		NA	=	NA	+	NA	+	NA
SVOCs															
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	1.38E-02	=	1.10E-02	+	2.76E-03	+	NA
2-Methylnaphthalene	NA	=	NA	+	NA	+	NA	*Respiratory*	2.47E-01	=	2.07E-01	+	3.99E-02	+	NA
Acenaphthene	NA	=	NA	+	NA	+	NA	*Systemic*	5.67E-04	=	4.53E-04	+	1.14E-04	+	NA
Benzo(a)anthracene	1.64E-06	=	1.31E-06	+	3.28E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	1.42E-05	=	1.13E-05	+	2.84E-06	+	3.63E-08		NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	8.59E-07	=	6.86E-07	+	1.72E-07	+	NA		NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	9.75E-08	=	7.79E-08	+	1.96E-08	+	NA		NA	=	NA	+	NA	+	NA
Chrysene	1.51E-08	=	1.20E-08	+	3.02E-09	+	NA		NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	2.17E-06	=	1.74E-06	+	4.36E-07	+	NA		NA	=	NA	+	NA	+	NA
Dibenzofuran	NA	=	NA	+	NA	+	NA	*Systemic*	3.38E-02	=	2.70E-02	+	6.78E-03	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	*Systemic, Circulatory*	6.57E-04	=	5.26E-04	+	1.32E-04	+	NA
Fluorene	NA	=	NA	+	NA	+	NA	*Circulatory*	5.54E-04	=	4.43E-04	+	1.11E-04	+	NA
Indeno(1,2,3-cd)pyrene	7.65E-07	=	6.12E-07	+	1.53E-07	+	NA		NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	*Respiratory, Systemic*	8.08E+00	=	3.43E-02	+	8.61E-03	+	8.04E+00
Pyrene	NA	=	NA	+	NA	+	NA	*Systemic*	1.29E-03	=	1.03E-03	+	2.58E-04	+	NA
VOCs															
1,2,4-Trichlorobenzene	NA	=	NA	+	NA	+	NA	*Systemic, Adrenal*	1.67E-02	=	7.88E-04	+	NA	+	1.59E-02
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	5.91E-02	=	3.83E-05	+	NA	+	5.90E-02
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	*Systemic, CNS*	3.13E-03	=	1.67E-06	+	NA	+	3.13E-03
Benzene	2.44E-07	=	5.33E-09	+	NA	+	2.39E-07	*Circulatory*	7.31E-02	=	1.70E-03	+	NA	+	7.15E-02
Soil CR	**2E-05**	=	2E-05	+	4E-06	+	3E-07	**Soil HI**	9	=	0.3	+	0.06	+	8

Target Organ HI

Respiratory	8E+00
Systemic	6E-04
Circulatory	9E-02
Adrenal	2E-02
CNS	6E-02
Skin	1E-02

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

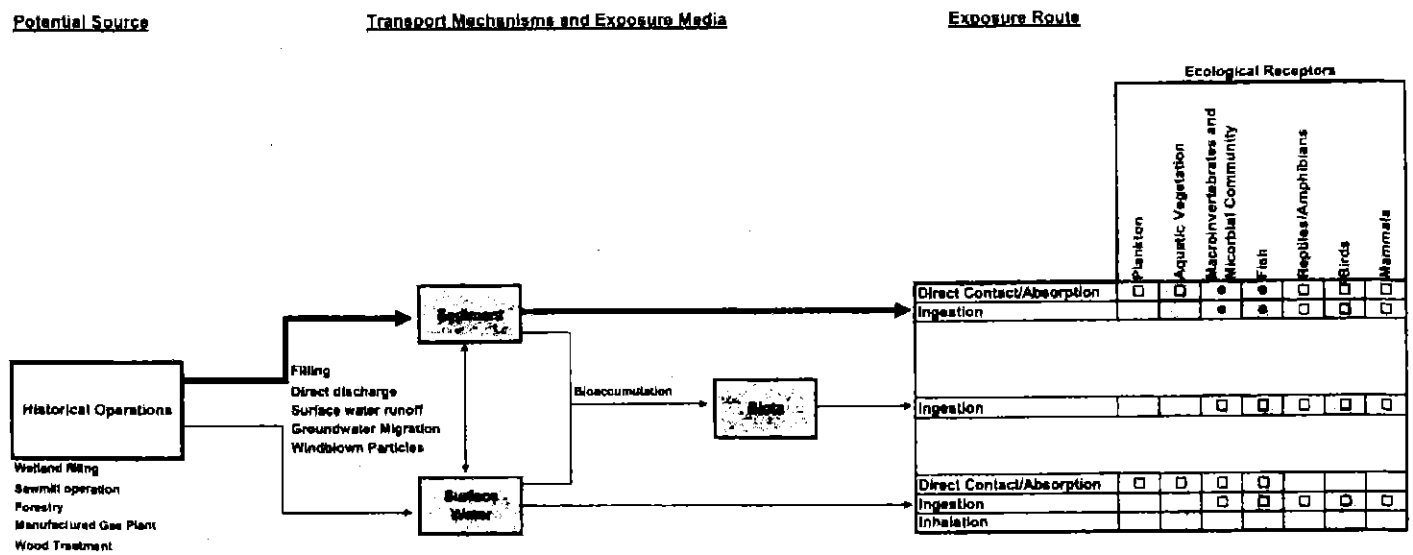
Table 45
Residential Risk Summary (0-3 feet)
Excluding VOCs Exceeding Csat Values
Reasonable Maximum Exposure

Chemical	Total Carcinogenic Risk: Total Risk	=	Ingestion	+	Dermal Contact	+	Inhalation	Total Noncarcinogenic Risk: Total Hazard	=	Ingestion	+	Dermal Contact	+	Inhalation
Inorganics														
Arsenic	9.65E-06	=	8.78E-06	+	8.74E-07	+	1.27E-09	1.73E-01	=	1.59E-01	+	1.41E-02	+	NA
Lead	NA	=	NA	+	NA	+	NA	NA	=	NA	+	NA	+	NA
SVOCs														
1-Methylnaphthalene	NA	=	NA	+	NA	+	NA	4.14E-03	=	3.03E-03	+	1.10E-03	+	NA
Benzo(a)anthracene	2.19E-05	=	1.55E-05	+	6.36E-06	+	NA	NA	=	NA	+	NA	+	NA
Benzo(a)pyrene	2.60E-04	=	1.84E-04	+	7.55E-05	+	1.12E-09	NA	=	NA	+	NA	+	NA
Benzo(b)fluoranthene	2.17E-05	=	1.54E-05	+	6.31E-06	+	NA	NA	=	NA	+	NA	+	NA
Benzo(k)fluoranthene	6.81E-07	=	4.83E-07	+	1.98E-07	+	NA	NA	=	NA	+	NA	+	NA
Dibenzo(a,h)anthracene	1.23E-05	=	8.70E-06	+	3.57E-06	+	NA	NA	=	NA	+	NA	+	NA
Fluoranthene	NA	=	NA	+	NA	+	NA	1.15E-03	=	8.46E-04	+	3.08E-04	+	NA
Indeno(1,2,3-cd)pyrene	5.47E-06	=	3.88E-06	+	1.59E-06	+	NA	NA	=	NA	+	NA	+	NA
Naphthalene	NA	=	NA	+	NA	+	NA	3.80E-01	=	4.13E-03	+	1.50E-03	+	3.75E-01
Pyrene	NA	=	NA	+	NA	+	NA	2.73E-03	=	2.00E-03	+	7.29E-04	+	NA
VOCs														
1,2,4-Trimethylbenzene	NA	=	NA	+	NA	+	NA	2.02E-01	=	3.38E-04	+	NA	+	2.02E-01
1,3,5-Trimethylbenzene	NA	=	NA	+	NA	+	NA	9.04E-03	=	1.24E-05	+	NA	+	9.02E-03
Benzene	2.64E-06	=	1.67E-07	+	NA	+	2.47E-06	1.05E-01	=	6.22E-03	+	NA	+	1.02E-01
Soil CR	3E-04	=	2E-04	+	9E-05	+	2E-06	**Soil HI** 0.9	=	0.2	+	0.02	+	0.7

Notes:

NA – Not Applicable
CR – Cancer Risk
HQ – Hazard Quotient
HI – Hazard Index

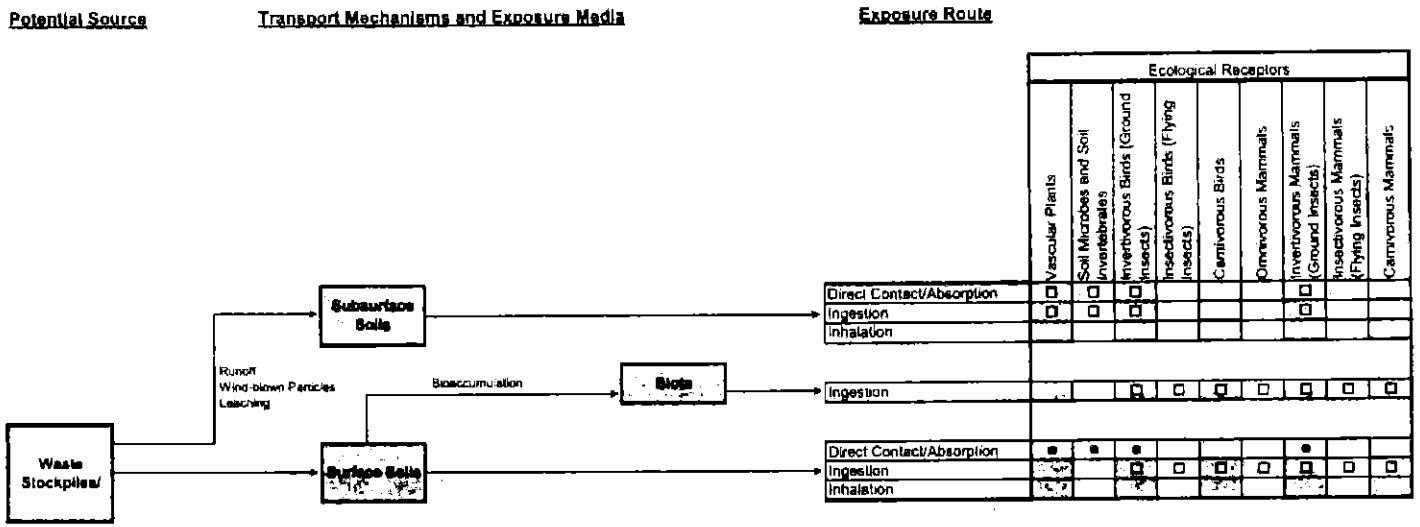
APPENDIX J
BERA Potential Exposure Pathways



NOTE:
● = Potentially Important Exposure Pathway
□ = Minor Exposure Pathway
Blank = Incomplete Exposure Pathway

FIGURE 3-1

CONCEPTUAL SITE MODEL
AQUATIC EXPOSURE PATHWAYS
Ashland Lakefront Site
Ashland, Wisconsin



NOTE:

NOTE:

● = Potentially Important Exposure Pathway

□ = Minor Exposure Pathway

Blank = Incomplete Exposure Pathway

FIGURE 3-2
SITE CONCEPTUAL MODEL
TERRESTRIAL PATHWAYS
Ashland Lakefront Superfund Site
Ashland, Wisconsin

APPENDIX K
BERA Assessment Endpoints and Risk Questions

Table ES-2. Endpoints and Risk Questions.		
Assessment Endpoint	**Risk Question**	**Measurement Endpoint(s) (Exposure and Effects)**
Benthic macroinvertebrate community	Are concentrations of contaminants in the sediments at the Site sufficiently elevated that they cause adverse alterations to the functioning of the benthic macroinvertebrate community?	• Determine the concentrations of Site-related contaminants in Site sediment. • Determine the levels of soot, coal, coke and slag, which may moderate the bioavailability of PAHs in the sediment. • Determine the levels of acid volatile sulfides (AVS) and simultaneously extractable divalent metals (SEM) in the sediment. • Compare concentrations of metals measured in Site sediment to WDNR (2003) sediment quality guidelines for threshold and probable effects. • Evaluate, quantitatively or qualitatively the bioavailability of sediment associated COPCs using SEM:AVS or Equilibrium Partitioning approach. • Compare concentrations of PAHs that accumulated in worm tissues in the bioaccumulation bioassay to the No Effects Body Residue (NEBR) that is associated with narcosis caused by PAHs and volatile organic compounds (VOCs). Use this as a model for predicting risk at the Site. • Using sediment toxicity bioassays, determine which sediments at the Site have elevated toxicity to surrogates for resident macroinvertebrate species compared to sediments in reference areas. • Determine on the basis of benthic macroinvertebrate sampling and analysis where benthic communities inhabiting sediments in waterbodies in and adjacent to the Site are impaired when compared to benthic communities inhabiting reference area sediment.

Table ES-2. Endpoints and Risk Questions.		
Assessment Endpoint	**Risk Question**	**Measurement Endpoint(s) (Exposure and Effects)**
Fish community	Are concentrations of contaminants in sediments and surface waters at the Site sufficiently elevated that they cause adverse alterations to the functioning of the fish community?	• Determine the concentrations of Site-related contaminants in Site surface water. • Determine the concentrations of Site-related contaminants in tissue from fish caught in and adjacent to the Site. • Compare tissue levels of PAHs and estimated VOCs in wild fish caught at the Site to the NEBR. • Using sediment bioassays, determine whether areas on and adjacent to the Site have elevated toxicity compared to sediment from reference areas to surrogates for juvenile resident fish species. • Compare the concentrations of Site-related contaminants in tissue from fish caught in and adjacent to the Site to levels in fish from reference areas. (This assessment endpoint will be used only qualitatively as an indicator of exposure).
Omnivorous aquatic bird community	Are dietary exposure levels of Site-related contaminants sufficiently elevated to cause adverse alterations to the omnivorous aquatic avian community?	• Determine the concentrations of Site-related contaminants in Site sediment. • Through food chain models for the black duck using sediment to benthic invertebrate bioaccumulation factors, estimate the ingestion of Site-related contaminants and compare it to toxicity reference values (TRVs) associated with adverse effects, including reproductive impairment.
Omnivorous birds	Are dietary exposure levels of site-related contaminants sufficient to cause adverse alterations to the omnivorous avian community?	• Determine the concentrations of Site-related contaminants in Site soils. • Through food chain models for the red-winged blackbird using soil to vegetation and soil to invertebrate bioaccumulation factors, estimate the ingestion of Site-related contaminants and compare it to TRVs associated with adverse effects, including

Table ES-2. Endpoints and Risk Questions.		
Assessment Endpoint	**Risk Question**	**Measurement Endpoint(s) (Exposure and Effects)**
		reproductive impairment.
Insectivorous birds	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to the insectivorous avian community?	• Determine the concentrations of Site-related contaminants in Site sediments. • Through food chain models for the tree swallow using sediment to emergent insect bioaccumulation factors, estimate the ingestion of Site-related contaminants and compare it to TRVs associated with adverse effects, including reproductive impairment.
Piscivorous birds	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to individual ospreys or to the piscivorous avian community?	• Determine the concentrations of Site-related contaminants in Site sediments. • Determine the concentrations of Site-related contaminants in fish caught in and adjacent to the Site. • Through food chain models for the double-crested cormorant and the osprey using actual levels of Site-related contaminants measured in fish in and adjacent to the Site, estimate the ingestion of Site-related contaminants and compare it to TRVs associated with adverse effects, including reproductive impairment.
Omnivorous mammals	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to the omnivorous mammal community?	• Determine the concentrations of Site-related contaminants in Site soils. • Through food chain models for the white-footed mouse using soil to plant and soil to invertebrate bioaccumulation factors, estimate the ingestion of Site-related contaminants and compare it to TRVs associated with adverse effects, including reproductive impairment.

Table ES-2. Endpoints and Risk Questions.		
Assessment Endpoint	**Risk Question**	**Measurement Endpoint(s) (Exposure and Effects)**
Insectivorous mammals	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to the insectivorous mammal community?	• Determine the concentrations of Site-related contaminants in Site sediments. • Through food chain models for the big brown bat using sediment to emergent insect bioaccumulation factors, estimate the ingestion of Site-related contaminants and compare it to TRVs associated with adverse effects, including reproductive impairment.
Piscivorous mammals	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to the piscivorous mammal community?	• Determine the concentrations of Site-related contaminants in fish caught in the Site area. • Through food chain models using actual levels of Site-related contaminants measured in fish, estimate the ingestion of Site-related contaminants and compare it to TRVs associated with adverse effects.

APPENDIX L
Conclusions of the BERA

Table 7-1. Conclusions of the Baseline Ecological Risk Assessment.

Assessment Endpoint	Risk Question	Conclusion of BERA
Benthic macroinvertebrate community	Are concentrations of contaminants in the sediments at the Site sufficiently elevated that they cause adverse alterations to the functioning of the benthic macroinvertebrate community?	Based upon two lines of evidence, there are potentially unacceptable impacts to the benthic macroinvertebrate community in aquatic portions of the Site although effects observed from field surveys of the existing benthic community indicated effects that were less dramatic than those demonstrated in the laboratory toxicity studies. However, the presence of contaminants in Site sediment that are sporadically released to the aquatic environment where the benthic macroinvertebrate community is exposed to them should be addressed in the Feasibility Study.
Fish community	Are concentrations of contaminants at the Site sufficiently elevated that they cause adverse alterations to the functioning of the fish community?	There is no unacceptable risk to the fish community utilizing the Site. However, the presence of contaminants in Site sediment that are sporadically released to the aquatic environment where the fish community is exposed to them should be addressed in the Feasibility Study.
Omnivorous aquatic bird community	Are dietary exposure levels of Site-related contaminants sufficiently elevated to cause adverse alterations to the omnivorous aquatic avian community?	There is no unacceptable risk to the omnivorous aquatic bird community utilizing the Site. However, the presence of contaminants in Site sediment that are sporadically released to the aquatic environment where the omnivorous aquatic bird community is exposed to them should be addressed in the Feasibility Study.
Omnivorous birds	Are dietary exposure levels of site-related contaminants sufficient to cause adverse alterations to the omnivorous avian community?	There is no unacceptable risk to omnivorous birds utilizing the Site. This exposure pathway does not require consideration in the Feasibility Study.
Insectivorous birds	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to the	There is no unacceptable risk to insectivorous birds utilizing the Site. This exposure pathway does not require consideration in the Feasibility Study.

Table 7-1. Conclusions of the Baseline Ecological Risk Assessment.

Assessment Endpoint	Risk Question	Conclusion of BERA
	insectivorous avian community?	
Piscivorous birds	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to individual ospreys or to the piscivorous avian community?	There is no unacceptable risk to piscivorous birds utilizing the Site. This exposure pathway does not require consideration in the Feasibility Study.
Omnivorous mammals	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to the omnivorous mammal community?	There is no unacceptable risk to omnivorous mammals utilizing the Site. This exposure pathway does not require consideration in the Feasibility Study.
Insectivorous mammals	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to the insectivorous mammal community?	There is no unacceptable risk to insectivorous mammals utilizing the Site. This exposure pathway does not require consideration in the Feasibility Study.
Piscivorous mammals	Are dietary exposure levels of Site-related contaminants sufficient to cause adverse alterations to the piscivorous mammal community?	There is no unacceptable risk to piscivorous mammals utilizing the Site. This exposure pathway does not require consideration in the Feasibility Study.

APPENDIX M
PRGs

APPENDIX M-1
Development of Sediment PRG

Technical Memorandum on the Derivation of Sediment Preliminary Remediation Goal (PRG) for the Ashland Lakefront Site

INTRODUCTION

The United States Environmental Agency (USEPA) and State of Wisconsin, Department of Natural Resources (DNR) have received and reviewed the second revised Remedial Investigation Report (RI Report) for the Ashland/Northern States Power Lakefront Superfund Site (Site) submitted by Northern States Power Company, a Wisconsin Corporation, a wholly owned subsidiary of Xcel Energy, Inc. (NSPW), pursuant to the Administrative Order of Consent (AOC) (V-W-04-C-764); between NSPW and the USEPA. The RI Report included a Baseline Ecological Risk Assessment (BERA) Report and a Remedial Action Objectives (RAO) Technical Memorandum, which proposes a sediment preliminary remediation goal (PRG) based on the conclusions of the BERA. For the reasons discussed in this Technical Memorandum and pursuant to Section X, (EPA Approval of Plans and Other Submissions), Subparagraph 21(c), of the AOC, USEPA hereby is modifying the RAO Technical Memorandum by incorporating the PRG contained herein. NSPW has 21 days to incorporate the PRG contained herein and resubmit the RAO Technical Memorandum based on EPA's modifications.

Previous BERAs were prepared for the Site by SEH under contract with DNR. SEH completed a BERA of the contaminated sediments adjacent to Kreher Park in 1998 (SEH, 1998). A supplemental BERA was performed in 2001 (SEH 2002), during which additional sediment toxicity testing was conducted to provide information describing the likelihood, nature, and severity of adverse effects to ecological receptors resulting from their exposure to contaminants at the Site. The NSPW iteration of the BERA was conducted to fill data gaps delineated through a data gap analysis of the earlier BERAs as requested by Xcel, and supplements the two other BERAs that have been conducted for this Site. The lack of data (i.e., data gap) in the 3 mg/kg to 300 mg/kg total polycyclic aromatic hydrocarbon (PAH) range of concentrations was to be filled during the NSPW iteration. After reviewing the NSPW BERA (revision 02), the USEPA has concluded that much of the past data collected during the 1998 and 2002 iterations of the BERA were not used to derive the conclusions presented in the NSPW BERA, which was required by the AOC.

This Technical Memorandum looks at the all of the data collected over the three iterations of sediment investigations, and following the sediment quality "triad" approach derives a range of concentrations of PAHs that would be expected to affect the benthic macroinvertebrate community. In addition, this Technical Memorandum draws upon the considerable body of information on PAH toxicity to benthic organisms to supplement the site data. From this range of contaminant concentrations and the expected effects to the benthic communities, USEPA proposes a preliminary remediation goal (PRG) for the sediment portion of the site that will be included in the RAO Technical Memorandum.

This Technical Memorandum does not constitute WDNR's and USEPA's complete comments to the submitted BERA (revision 02), but rather a streamlined approach to arriving at a PRG in order to keep the RI/FS process moving forward. The USEPA's comments to the BERA will be forwarded in a separate letter. These comments will be based on the NSPW's approved Work Plan and the USEPA letter dated September 1, 2006, commenting on the first BERA submittal, as well as subsequent meetings and response letter.

Following the sediment quality triad approach, the subsequent subsections describe the three measures of exposure used to evaluate sediment toxicity:

1) Evaluation of sediment chemistry;
2) Evaluation of site-specific toxicity tests; and
3) Evaluation of site-specific community studies.

Next, a range of PRGs is evaluated with the overall goal being protection of the survival, growth, and reproduction of benthic invertebrate communities. The PRGs produced in this document were derived from data collected through all iterations of sediment investigation at the Site and is based on USEPA review of all data collected. From these PRGs, a single PRG is proposed which will be used by NSPW to complete the Feasibility Study pursuant to the AOC.

1. Sediment Contaminant Chemistry

The sediment investigation conducted at the Site in 1996, and several subsequent investigations, identified the presence of extensive contamination, extending out to 700 feet offshore. Contaminants identified in the sediments include non-aqueous phase tars and oils, PAHs, petroleum volatile organic compounds, heterocyclic aromatic hydrocarbons, phenolic compounds and heavy metals.

The Supplemental BERA report (SEH, 2002) provided a summary of the various contaminants identified and a range of responses associated with the various levels of contamination. Ecological impacts were identified as likely being associated with a variety of the contaminants present. However, the BERA focused on PAHs since they appear to be present in the highest concentrations, are co-located with other contaminants, and appear to demonstrate a response effect.

The 2005 study conducted by URS on behalf of NSPW was intended to supplement the SEH 2002 study by addressing uncertainties related to the range of total PAH (TPAH) concentrations. Sediment Quality Triad (SQT) stations were to be distributed across TPAH concentrations from approximately 2,000 ug/kg to 300,000 ug/kg TPAH (dry weight, dwt), to represent a range of concentrations that encompasses those concentrations where potential ecological effects were likely to be found. At each SQT location, chemical analysis appears to have been conducted for a composite grab sample; each of five replicate samples used for the benthic community study; and a laboratory

homogenized sample utilized for bioassay toxicity tests. Particle size analysis was also conducted for the replicate samples.

Attachment 1 provides a summary of the TPAH, total organic carbon (TOC), and particle size data reported for the 2005 samples. The new data does supplement the 2002 BERA study in that it provides data on the variation at replicates sampling locations. Additionally, the supplemental data for new reference sites provides further information related to background levels.

At many of the sampling sites, calculation of the mean, median, and standard deviation reveals large variation among TPAH concentration in the replicates. At SQT1, SQT7, and SQT8, the standard deviation exceeded the mean and the median. It is apparent the TPAH concentration data are widely dispersed at these locations and that the mean is a poor representation of the data set. For example, at SQT1 the TPAH concentrations among replicates varied over two orders of magnitude, ranging from 12,994 mg/kg to 1,162,300 mg/kg. This variation in data reinforces the need to apply a conservative approach in the interpretation of sediment chemistry results to minimize the potential for underestimating effects at each SQT location.

Background reference site locations are useful for establishing a potential lower boundary for the sediment PRGs, as it is not typically reasonable to set cleanup objectives lower than background concentrations. As shown on Attachment 1, the TPAH concentrations at the reference sand (composite grab samples, homogenized samples and replicate results) were very similar to the 1998 reference sand site location, where the TPAH concentration was 500 ug/kg dwt @ 0.46% OC).

2. Site-Specific Sediment Toxicity Bioassays

Sediment toxicity bioassays conducted in 1998 and 2001 were summarized in the SEH (2002) BERA Supplement. Toxicity tests were conducted for a wide range of TPAH exposures ranging from 424 ug/kg to 836,300 ug/kg TPAH (dwt). Results of the tests indicated that acute (lethal) impacts were always demonstrated above the WDNR draft TPAH probable effect concentration (PEC) of 22,800 ug/kg (at 1% TOC). At concentrations below the WDNR draft TPAH threshold effect concentration (TEC) of 1,610 ug/kg (at 1% TOC), acute impacts were demonstrated only when toxicity tests were conducted with UV exposures. At concentrations between the TEC and PEC, a variety of lethal and sublethal impacts were observed.

The 2005 bioassay study conducted by URS was intended to supplement the SEH studies by addressing uncertainties related to the range of TPAH contaminant concentrations and by including several toxicity tests for both sand and wood substrates.

Attachment 2 includes a "stoplight diagram" that summarize the 1998, 2002, and recent URS study results for the sediment bioassay toxicity tests for sandy sediments. The diagram does not include the results of bioassays conducted with woody sediment, elutriate or UV light exposures. Discussions with Xcel/URS have indicated their interest

in establishing RAOs based on dry weight normalized PAH concentrations in sandy sediments and applying that same value as the RAO for woody sediments.

USEPA evaluation of the toxicity tests conducted with UV light exposures are provided in Attachment 3. The evaluation provides an analysis of expected photo-activated lethal effects expected to be associated with various TPAH concentrations (normalized to 0.41 % OC in sand) and UV exposures related to variable depths within the water column. The evaluation presents survival response curves illustrating sediment toxicity with and without UV exposures. A survival response curve integrating both the URS 2006 results and SEH 2001 results illustrates that a close relationship exists between the test results.

3. Site-Specific Sediment Macroinvertebrate Surveys

The benthic macroinvertebrate community investigation presented in the 1998 BERA (SEH, 1998) indicated that community degradation correlated to sediment TPAH contamination. Subsequent statistical evaluations of the 1998 data by both the WDNR and Dames & Moore in 1999 (excerpts included in Attachment 4 indicated strong correlation between sediment TPAH concentrations and several benthic community metrics, although it was acknowledged the data set was small and the range of contaminant concentrations was limited. The 2005 study conducted by URS was intended, in part, to supplement the 1998 study to address uncertainties related to sample size and range of contaminant concentrations.

According to the EPA's *Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems – Volume III – Interpretation of the Results of Sediment Quality Investigations* (EPA-905-BO2-001C, December 2002), "the information on benthic community structure can not be used alone to evaluate the cause of any impacts observed. While such communities certainly respond to chemical contamination in the sediment they are also affected by a wide range of physical factors that are not directly related to sediment quality (e.g., low dissolved oxygen levels, grain size differences, nutritional quality of substrates and water depth). In addition, benthic community composition exhibits significant spatial, short term temporal, and seasonal variability." Thus, if a study encounters a large degree of variability such that discriminatory power is greatly decreased, then the strength of the benthic community study as a line of evidence is decreased commensurately. It appears that there was tremendous variability and resultant uncertainty associated with both the site samples and reference samples collected in the URS 2005 benthic macroinvertebrate community investigation.

Issues associated with the variability and the uncertainty of the 2005 sampling sites used in the statistical evaluation of benthic community impacts include but are not limited to:

- The range of TPAH concentrations for SQT1 replicate samples overlapped the range of TPAH concentrations of most other SQT replicate samples;

- The standard deviation of the dataset exceeds the mean values for TPAH concentrations for replicate samples SQT1, SQT7, SQT8 and reference wood site SQT11;

- The standard deviation of the dataset exceeds the mean value for TOC concentration for reference wood site SQT9;

- The percentage of fine sands is higher in 80% of the reference samples than in 100% of site samples;

- The percentage of fines + fine sands is higher in 80% of the reference samples than in 75% of the site samples;

- The reference sand sites SQT10 and SQT12 exhibited "a strong odor of decaying organic matter" and "elevated levels of ammonia";

- The reference sand sites SQT10 and SQT12 exhibited <50% survival for *Hyalella azteca* 28 day sediment exposure toxicity test;

- The reference wood site SQT11 had no survival in several replicates of the *Lumbriculus* bioaccumulation study;

- The reference sand sites SQT13 and SQT 14 were collected in Fall 2005 versus Spring 2005, more than 3 months after the initial sample collection. Use of this data is questionable for comparison of population metrics due to expected seasonal variation in larval and emergent species; and

- Only three site locations appear to be "sand" sites, and none of the reference sand sites appear to be appropriate. Thus, the sample size for sand sediments does not appear meet the power requirements outlined in the RI/FS workplan.

The statistical analysis presented in the BERA appears to have included benthic community data without "clear and transparent" discussion of how the aforementioned issues were addressed. Input of questionable information into a statistical model produces questionable results and yields low power. If the benthic community study has low power, then it is prone to underestimating effects and is in fact a weak line of evidence rather than a strong one.

It is also noted that the 2005 study neglected to evaluate metrics that appeared to have statistical significance in the 1998 study including midge/oligochaete ratios and midge taxa richness (although this metric was listed in the RI/FS workplan).

Unfortunately, the 2005 benthic community study analysis, as presented in the BERA documentation, provides little value in supplementing the 1998 study and it does not lend value to the current discussion of PRGs.

4. Sediment Quality Triad Integration to Develop a Preliminary Remediation Goal

The accumulated data for sediment chemistry, bioassay toxicity tests, and benthic macroinvertebrate community surveys at this site continue to indicate that it is reasonable to conclude ecological impact is highly likely and contaminant-induced degradation of sediment-dwelling organisms is evident. Several approaches have been evaluated to calculate a site-specific PRG for the sediment TPAH concentrations. The alternate PRGs are presented below in order of ascending concentrations.

1) The 2002 Supplemental ERA calculated a PRG of **274 ug TPAH/kg dwt** for sandy sediments based on the mean of the no observed effect concentration (NOEC) and the lowest observed effect concentration (LOEC) related to the sediment elutriate dilution series for fathead minnows. USEPA is uncertain if the sediment elutriate dilution series may have overestimated aquatic exposures and effects.

2) The toxicity test conducted in 1998 with the contaminated sand sample (616 ug TPAH/g OC or 1,539 ug TPAH/kg dry weight (dwt) @ 0.25% TOC) resulted in sublethal effects for the midge toxicity test. Lethal effects were also documented with this sample with fathead sediment elutriate exposures, lethal effects with *Daphnia magna* sediment elutriate exposures (coupled with UV), and lethal effects associated with the *Lumbriculus variegates* sediment exposures (coupled with UV). Using the 1998 contaminated sand sample as the "low observed effects" sample and 1998 reference sand sample (109 ug TPAH/g OC or 500 ug/kg @ 0.46% TOC) as the "no observed effects" sample yields a mean value of **362 ug TPAH/g OC** (1,020 ug/kg @ 0.36% TOC).

3) Attachment 5 includes a discussion by David Mount (USEPA) related to PAH toxicity thresholds for the site sediments. The document discusses the various impacts that may be associated with a range of sediment TPAH concentrations. The lowest value discussed is **1,340 ug TPAH/g OC** (5,570 ug TPAH/kg dwt @ 0.415% TOC). The discussion of UV toxicity included in Attachment 3 appears to indicate this value would also provide protection from photoactivated toxicity effects for 80% of *Hyallela azteca* in water depths ranging from 2 to 8 feet (with no debris cover) It is noted that this concentration may not address potential sublethal effects.

4) The discussion by Dave Mount (Attachment 5) also indicates that the remediation goal of **5,310 ug TPAH/g OC** (22,000 ug TPAH/kg dwt @ 0.415% TOC) recommended by URS in the 2007 BERA is likely to result in substantial acute toxicity to *Hyalella*, *Lumbriculus*, and *Chironomus* species.

5) Based on a variety of data sources, the EC20 for midge is expected to lie within a range of 1340 to 3930 ug PAH/g OC (Attachment 5). At an OC of 0.415%, this corresponds to 5.6 to 16.3 ug PAH/g dwt. Use of the EC20 is consistent with the

data quality objective (DQO) for sediment bioassays which states: "If control survival is = 80%, and the difference between Site survival or growth and reference station survival or growth is = 20% (statistically significant difference at a= 0.1) it is indicative of unacceptable risks" (25 January 2005 BERA, Appendix G, Table 4. Data Quality Objectives for 28 day *Hyalella azteca* (Amphipod) with and without UV Light and 20-day *Chironomus dilutus* (formerly *C. tentans) (Midge) Sediment* Bioassay). The proposed PRG for sediment is 2.295 ug PAH/g OC (9.5 ug PAH/g dwt at 0.415% OC), which is the geometric mean of the above range.

SUMMARY AND CONCLUSIONS

The sediment chemistry and toxicity data presented in the NSPW BERA support the 1998 and 2002 SEH BERA data. The "high weight of evidence" that NSPW attempts to place on the benthic macroinvertebrate community study is not supported by USEPA guidance or the community study data and has little support from the 1998 BERA study. With the variability and uncertainty outlined above, the statistical analysis of the community data is questionable; as such, it was not used to derive the proposed PRG.

The NSPW sediment chemistry data supports earlier chemistry data. The NSPW toxicity testing supports the 1998 and 2001 SEH data sets and supports the PRGs previously proposed in these documents. The UV results from the 2005 study also support the earlier work. In addition, the bioassay data is in agreement with the body of data available in the literature on concentrations of TPAHs that produce toxic effects on benthic communities. Thus, both the chemistry data and the toxicity data are used to support the determination of a PRG for the Site.

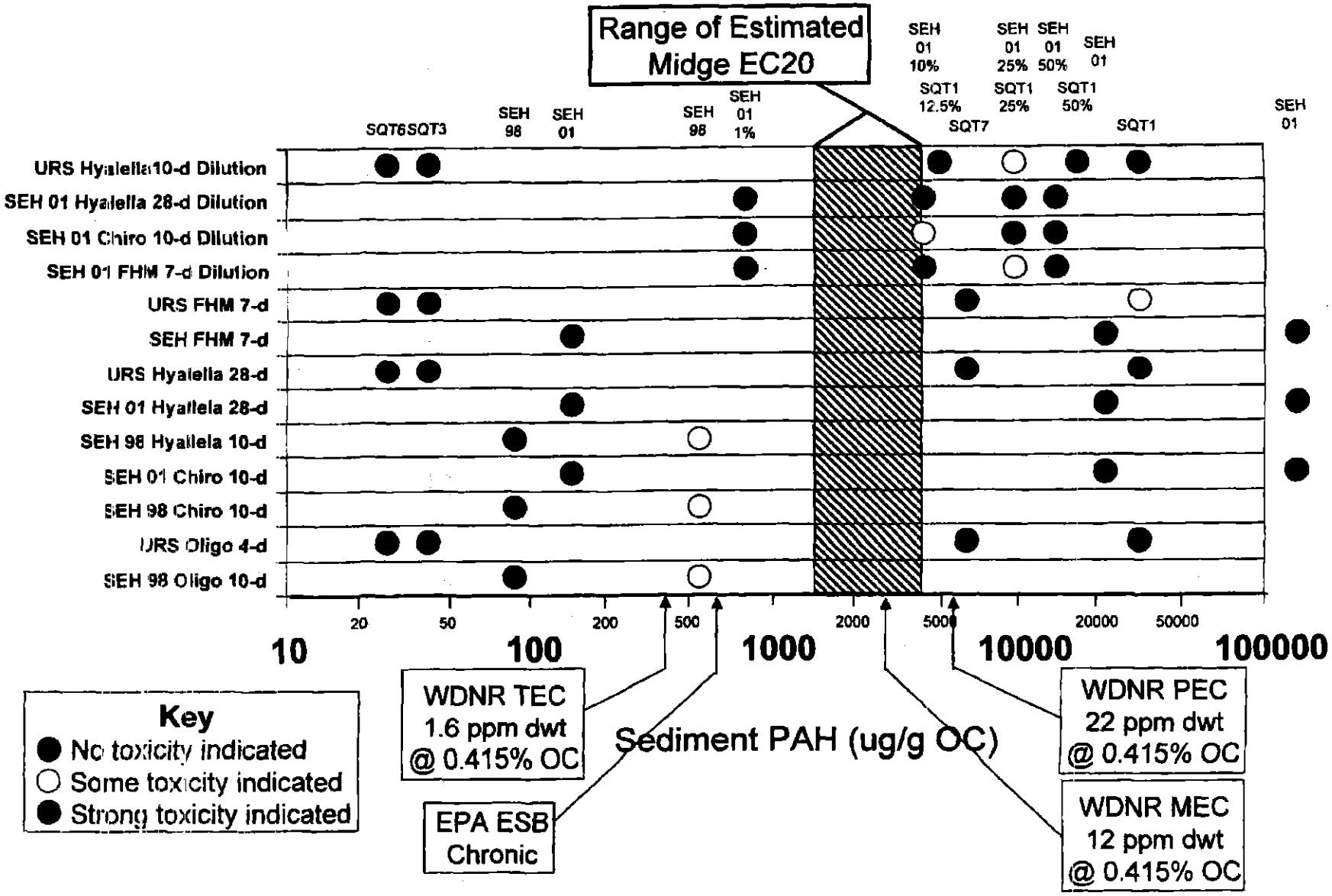
In conclusion, the proposed PRG **[2,295 ug PAH/g OC (9.5 ug PAH/g dwt at 0.415% OC)]** is based on a best professional evaluation of sediment chemistry, bioassay, and benthic community study data collected by SEH and NSPW and conclusions reached by NSPW. This PRG does not include the added effects of UV and is based on a water depth of 6 feet or more. If the final depth of sediments will be less than 6 feet, the PRG for any active remedial intervention will be adjusted downward as based upon UV extinction coefficients measured in Site waters. The adjusted PRGs (assuming no debris cover) are provided in Table 1 of Attachment 3.

Since the RI/FS Work Plan was approved by USEPA, a number of correspondence and meetings have taken place in an attempt to come to a mutually agreed upon PRG for sediment contamination at the Site. A number of differences in application of the data have continued to interfere with this pursuit. In order to keep on schedule for completion of the Feasibility Study, the USEPA has produced this Technical Memorandum. Pursuant to the AOC, NSPW will complete the ordered Feasibility Study using the PRG contained in this Technical Memorandum.

List of Attachments

1 Sediment Chemistry Data from URS 2005 BERA
2a Summary of Results for Sandy Sediments
2b Summary of Results for Woody Sediments
3 20 January 2007 Memorandum on "Analysis of Photoactivation Issue Relative to Ashland BERA"
4 Excerpts from WDNR and Dames & Moore (1999)
5 March 26, 2007 Memorandum on "Discussion of PAH Toxicity Thresholds for Ashland Site Sediments"

Figure 1 -- Summary of Toxicity Data for Sandy Sediments



Attachment 1
Sediment Chemistry Data from URS 2005 BERA

Sample ID#, Date of Collection	TPAH (dw ug/kg)	TOC (dw mg/kg)	TOC (%)	TPAH NOC (ug/g OC)	PARTICLE SIZE ANALYSIS OF SEDIMENTS							
					% Solids	Non-Soil Mass %	Gravel Size %	Coarse Sand Size %	Medium Sand Size %	Fine Sand Size %	Silt & Clay Fines % Size (<P200)	% S&C Fines and Fine Sand
SQT 9, Reference woody site, June 2005												
SQT 9 Mean of Replicates	426	20,808	2.1%	35	55	11	0.0	0.3	21	75	4	80
Standard Deviation +/-	-	23,103	2.3%	17	9	6	0.0	0.2	3	7	4	4
Median	426	10,500	1.1%	41	58	7	0.0	0.3	21	73	4	80
SQT 9 Composite Grab	334	32,000	3.2%	10								
SQT Tox Test Homogenized Sample	83	58,000	5.8%	1								
SQT 10, Reference sandy site, June 2005												
SQT 10 Mean of Replicates	428	4,320	0.4%	140	74	1	0.0	0.2	10	87	3	90
Standard Deviation +/-	-	3,905	0.4%	58	3	1	0.0	0.1	4	4	3	4
Median	428	2,600	0.3%	164	72	1	0.0	0.2	9	89	2	91
SQT 10 Composite Grab (TPAH avg with Dup)	230	860	0.1%	268								
SQT Tox Test Homogenized Sample	26	1,300	0.1%	20								
SQT 11, Reference woody site, June 2005												
SQT 11 Mean of Replicates	9,856	502,600	50.3%	20	29	131	0.0	0.0	25	48	29	76
Standard Deviation +/-	12,611	80,996	8.1%	25	4	50	0.0	0.0	7	23	19	8
Median	4,260	499,000	49.9%	10	29	129	0.0	0.0	22	37	31	78
SQT 11 Composite Grab	740	78,000	7.8%	9								
SQT Tox Test Homogenized Sample	3,798	280,000	28.0%	14								
SQT 12, Reference sandy site, June 2005												
SQT 12 Mean of Replicates	1,106	869	0.1%	1,264	74	0	0.2	0.0	1.3	96	3	99
Standard Deviation +/-	570	55	0.0%	605	1	0	0.2	0.0	0.3	2	1	0
Median	852	872	0.1%	990	74	-	0.0	0.0	1.2	96	3	99
SQT 12 Composite Grab (TPAH avg with dup)	435	407	0.0%	1,069								
SQT Tox Test Homogenized Sample	8	320	0.0%	26								
SQT 13, Reference sandy site, September 2005												
SQT 13 Mean of Replicates	426	2,742	0.3%	157	69	-	0.0	0.0	0.8	94	5	99
Standard Deviation +/-	-	268	0.0%	15	1	-	0.0	0.0	0.1	1	1	0
Median	426	2,750	0.3%	155	70		0.0	0.0	0.8	94	5	99
SQT 13 Composite Grab (TPAH avg with dup)	224	2,460	0.2%	91								
SQT Tox Test Homogenized Sample	NO DATA PROVIDED											
SQT 14, Reference sandy site, September 2005												
SQT 14 Mean of Replicates	426	3,865	0.4%	113	73	-	0.6	0.4	12	80	7	87
Standard Deviation +/-	-	665	0.1%	16	3	-	0.5	0.1	2	2	1	2
Median	426	3,820	0.4%	120	74		0.4	0.5	13	80	7	87
SQT 14 Composite Grab (TPAH avg with dup)	67	2,800	0.3%	24								
SQT Tox Test Homogenized Sample	NO DATA PROVIDED											

Attachment 1
Sediment Chemistry Data from URS 2005 BERA

Sample ID#, Date of Collection	TPAH (dw ug/kg)	TOC (dw mg/kg)	TOC (%)	TPAH NOC (ug/g OC)	PARTICLE SIZE ANALYSIS OF SEDIMENTS							
					% Solids	Non-Soil Mass %	Gravel Size %	Coarse Sand Size %	Medium Sand Size %	Fine Sand Size %	Silt & Clay Fines % Size (<P200)	% S&C Fines and Fine Sand
SQT 1, sandy site, June 2005												
SQT1 Mean of Replicates	442,595	6,196	0.6%	57,118	79	2	0.0	0.5	32	60	8	68
Standard Deviation +/-	*487,715*	*3,524*	*0.4%*	*42,721*	*2*	*4*	*0.1*	*0.3*	*4*	*5*	*5*	*3*
Median	*260,275*	*4,950*	*0.5%*	*70,155*	*79*	*1*	*0.0*	*0.6*	*32*	*60*	*9*	*68*
SQT 1 Composite Grab (TPAH avg with dup)	376,815	3,175	0.3%	118,682								
SQT Tox Test Homogenized Sample	168,940	4,600	0.5%	36,291								
SQT 2, woody site, June 2005												
SQT 2 Mean of Replicates	3,545	427,400	42.7%	9	37	82	0.0	0.0	32	45	24	69
Standard Deviation +/-	*1,314*	*139,292*	*13.9%*	*3*	*5*	*30*	*0.0*	*0.1*	*13*	*12*	*22*	*11*
Median	*3,283*	*385,000*	*38.5%*	*8*	*37*	*79*	*0.0*	*0.0*	*33*	*48*	*19*	*67*
SQT 2 Composite Grab	4,815	100,000	10.0%	48								
SQT Tox Test Homogenized Sample	3,195	420,000	42.0%	8								
SQT 3, woody site, June 2005												
SQT 3 Mean of Replicates	21,989	294,400	29.4%	68	35	52	0.0	0.0	9	53	38	91
Standard Deviation +/-	*14,228*	*140,190*	*14.0%*	*19*	*10*	*32*	*0.0*	*0.0*	*4*	*16*	*17*	*4*
Median	*25,235*	*364,000*	*36.4%*	*69*	*34*	*41*	*0.0*	*0.0*	*8*	*47*	*48*	*92*
SQT 3 Composite Grab (TPAH avg with dup)	*21,270*	*136,500*	*13.7%*	*156*								
SQT Tox Test Homogenized Sample	*17,060*	*400,000*	*40.0%*	*43*								
SQT 4, woody site, June 2005												
SQT 4 Mean of Replicates	20,302	420,201	42.0%	56	29	161	0.0	0.0	22	50	28	78
Standard Deviation +/-	*6,214*	*120,013*	*12.0%*	*36*	*2*	*58*	*0.0*	*0.0*	*8*	*13*	*18*	*8*
Median	*19,390*	*461,000*	*46.1%*	*42*	*30*	*146*	*0.0*	*0.0*	*24*	*52*	*24*	*76*
SQT 4 Composite Grab	26,942	160,000	16.0%	168								
SQT Tox Test Homogenized Sample	14,098	420,000	42.0%	34								
SQT 5, woody site, June 2005												
SQT 5 Mean of Replicates	57,482	348,600	34.9%	172	31	75	0.0	0.0	23	46	31	77
Standard Deviation +/-	*17,101*	*135,253*	*13.5%*	*34*	*3*	*12*	*0.0*	*0.0*	*8*	*5*	*13*	*8*
Median	*54,500*	*363,000*	*36.3%*	*157*	*31*	*74*	*0.0*	*0.0*	*23*	*46*	*35*	*77*
SQT 5 Composite Grab (TPAH avg with dup)	84,003	285,500	28.6%	316								
SQT Tox Test Homogenized Sample	31,250	250,000	25.0%	125								
SQT 6, sandy site, June 2005												
SQT 6 Mean of Replicates	4,155	79,060	7.9%	52	38	8	0.0	0.0	4	22	74	96
Standard Deviation +/-	*1,879*	*15,550*	*1.6%*	*15*	*2*	*5*	*0.0*	*0.0*	*1*	*6*	*6*	*1*
Median	*3,505*	*82,900*	*8.3%*	*49*	*38*	*7*	*0.0*	*0.0*	*4*	*20*	*76*	*96*
SQT 6 Composite Grab	9,036	14,000	1.4%	646								
SQT Tox Test Homogenized Sample	2,297	95,000	9.5%	24								
SQT 7, sandy site, June 2005												
SQT 7 Mean of Replicates	21,209	2,352	0.2%	16,148	78	2	0.2	0.7	36	59	4	63
Standard Deviation +/-	*25,828*	*1,078*	*0.1%*	*26,426*	*3*	*2*	*0.4*	*0.4*	*1*	*2*	*2*	*1*
Median	*13,720*	*2,190*	*0.2%*	*4,314*	*78*	*1*	*0.0*	*0.6*	*36*	*59*	*4*	*63*
SQT 7 Composite Grab (TPAH avg with dup)	14,058	3,100	0.3%	4,535								
SQT Tox Test Homog Sample (avg TPAH with dup)	23,086	3,500	0.4%	6,599								
SQT 8, woody site, June 2005												
SQT 8 Mean of Replicates	116,331	290,840	29.1%	288	36	70	14.4	0.3	24	48	14	62
Standard Deviation +/-	*161,989*	*179,095*	*17.9%*	*344*	*12*	*71*	*13.3*	*0.5*	*7*	*6*	*11*	*14*
Median	*86,630*	*309,000*	*30.9%*	*182*	*33*	*52*	*21.9*	*0.2*	*23*	*51*	*16*	*63*
SQT 8 Composite Grab	124,238	42,000	4.2%	2,958								
SQT Tox Test Homog Sample (TPAH Avg with Dup)	59,137	385,000	38.5%	154								

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
RESEARCH AND DEVELOPMENT

April 5, 2007

SUBJECT: Analysis of photoactivation issue relative to Ashland BERA

FROM: David R. Mount, Research Aquatic Biologist

TO: Scott Hansen, RPM Ashland Superfund Site

The following text describes my assessment of the predicted effects of combined UV and PAH exposure at the Ashland site based on the available experimental data. A draft of this memo was reviewed by Dr. Russell Erickson; his comments were incorporated and he is in agreement with the analysis.

For short term exposure, response to UV/PAH exposure has been shown to be proportional to the product of the PAH exposure (often expressed in terms of body burden) and the UV exposure. In the case of sediment exposure without measured body burdens, the sediment PAH concentration (OC normalized) should be a reasonable surrogate for PAH dose if one assumes that the organisms came to a steady state body burden relatively quickly. The uncertainty here is on the side of leniency (i.e. the opposite of environmentally conservative) as it would underestimate effects if steady state was not achieved. Under the steady state assumption, the expression of exposure as a product of sediment PAH concentration and UV exposure should be an appropriate way to compare results among experiments.

Figures 1 and 2 show the exposure-response relationships for the URS (2006) and SEH (2001) exposures of *Hyalella* to dilutions of a sandy PAH contaminated sediment from the site, with and without UV light. The PAH concentration for the 50% dilution in the SEH study has been adjusted as suggested previously by URS. These experiments show that the addition of UV light to sediment exposure consistently increases toxicity. In the URS study, the increase in toxicity from a 24-hour average UV of 28.3 $\mu W/cm^2$ (a 16-h photoperiod averaged over 24 hours) was about 2.1 fold, with the LC50 decreasing from 12750 µg PAH/g OC to 6050 µg PAH/g OC. In the SEH test, the average UV exposure was slightly higher (24-h average of 34.5 $\mu W/cm^2$) and the increase in toxicity was about 2.7 fold, with the LC50 decreasing from 14418 to 5351 µg PAH/g OC. Taking into account the slightly higher UV in the SEH tests, these results are remarkably close.

One difference between the URS and SEH tests is test duration – the URS test was a 10-d test, while the SEH test was a 28-d test. Because the UV dose is cumulative and therefore increases with time of exposure, one might expect that a longer exposure would show comparable effects

at a lower PAH concentration. However, despite the difference in duration, the LC50 values expressed on the basis of sediment PAHs were remarkably close. One explanation for this similarity might be that the duration of the SEH exposure was long enough for damage repair rates to become significant. The concept that the potency of UV/PAH exposure is a linear function of PAH * UV * time assumes that accumulated damage from UV/PAH exposure is repaired at a negligible rate, which appears to be true for shorter term exposures. However, it is reasonable to expect that for less severe exposures, which create damage at a slower rate over longer periods, repair rates will become significant. Thus, it may be that LC50 concentrations become asymptotic at longer exposure periods such as 10-28 days.

A second explanation is that the PAH exposure in the URS and SEH tests differed in a way not reflected by the reported PAH concentrations in the sediment. The evidence for this explanation is that the SEH 28-d *Hyalella* test without supplemental UV showed lower sensitivity to PAHs (28-d LC50 14400 µg PAH/g OC) than did the 10-d test without UV conducted by URS (10-d LC50 12700 µg PAH/g OC). Based on literature data (e.g., Schuler et al. 2004; ES&T 38:6247), one would expect the 28-d LC50 in the absence of UV light to be about half of the 10-d LC50.

For purposes of this analysis the former explanation, that damage repair becomes significant in longer term exposures, was used. While a more lenient (as opposed to environmentally conservative) assumption, it is not excessively so, and is very consistent with what one would expect from the underlying biology. Under this assumption, one can compare the two test responses by plotting them on the same axis using average daily UV/PAH exposure ([µW-h UV/cm^2] * [µg PAH/g OC]). Doing so is strongly suggestive of a single exposure response curve with an LC50 of 4.2 [W-h UV/cm^2] * [µg PAH/g OC] and an LC20 of 2.947 [µW-h UV/cm^2] * [µg PAH/g OC] (Figure 5).

The two UV experiments discussed above were both conducted to simulate UV intensity at moderate depth, circa 8 feet. However, UV penetration is highly depth dependent, so much greater UV intensity can be expected at shallower depths. EPA suggested to URS/Xcel on multiple occasions that additional UV exposures should be conducted at higher UV intensities in order to quantify the expected response at shallower depths. However, URS/Xcel declined to follow EPA's suggestion, so the BERA is left to extrapolate results representing moderate depths to responses that would be expected at shallower depths.

To do this, the extinction curve determined from UV measurements at the site was used to estimate the degree of light penetration at various. The extinction equation was:

% of surface UV at x cm depth = 10^(-0.0064*x+1.9769)

Based on previous calculations, the 24-h average UVA irradiance at the water's surface in June was estimated at 977 µW/cm^2. The expected 24-h dose expected at any depth equals the percentage UV penetration to that depth multiplied by the surface UVA multiplied by 24 hours. This can be divided by 10^6 to convert µW to W. If one divides the LC20 (from the PAH/UV response regression described above) by the depth-specific 24-h UV dose just described, the

result is the sediment PAH concentration expected to result in 20% lethality to *Hyalella* at that depth. Table 1 shows the results of these calculations.

A final issue relates to the degree to which overlying debris might provide partial shading to benthic organisms living at the site. All of the exposures discussed thus far have had no shading provided aside from the test sediment itself. To explore the shading issue, URS conducted an additional series of treatments in which leaf plugs were added to the test chambers to provide shade like might be expected from a sediment surface with overlying debris. The results of this exposure series, compared to the response obtained without UV, and with UV but without shading, is shown in Figure 6. These data indicate an intermediate response by organisms exposed in the presence of leaf plugs. The presumption is that the decreased sensitivity of *Hyalella* to UV/PAH in the presence of leaf plugs is associated with decreased UV exposure, although no measurements were made to determine if the presence of leaf plugs might have decreased bioavailability and/or accumulation of sediment PAHs. Previous analyses conducted by Dr. Russell Erickson of EPA/ORD-Duluth (provided to Xcel as part of initial EPA comments on the draft BERA) empirically estimated the amount of shading provided by the presence of leaf plugs, based on the differential responses among treatments with no UV, and UV with and without leaf plugs. The estimate was that the presence of overlying debris (leaf plugs) reduced UV exposure by 40%. This value can be used to estimate the expected response of *Hyalella* in the presence of overlying debris, by recalculating the depth-specific PAH LC20 concentrations assuming 40% less UV exposure. These "with debris" values are shown along with the "no debris" LC20 values in Table 1. Selection of thresholds to apply at the site depends on the degree to which overlying debris is expected (before or after remedial action) and how the shading effect of the debris layer would relate to that used in the laboratory experiments. in this range would depend on the degree to which overlying debris is available at the site, both before and after any remedial action. Table 1 also shows these LC20 values adjusted to a dry weight basis, assuming an organic carbon content of 0.415%, the average of the OC content in SQT1 and SQT7.

The extrapolation to UV exposures expected in areas shallower than 8 ft presumes that the increase in UV exposure of benthic organisms will be proportional to the increase in incident UV at the sediment surface, and that the UV alone will not cause adverse effects. Because Xcel/URS declined to conduct testing at UV intensities higher than those expected in roughly 8 feet of water, any non-linearities that might occur in the real world cannot be estimated, and direct proportionality is the only reasonable assumption (i.e., if one doubles the UV, the PAH concentration corresponding to the LC20 will be cut in half). There has been some preliminary experimental work conducted at EPA's Duluth laboratory using PAH-spiked sediments and simultaneous UV exposure. This work is neither complete nor published. However, it suggests that *Hyalella* can withstand continuous UVA exposure to at least 290 $\mu W/cm^2$ (highest exposure tested) in the presence of West Bearskin sediment (no overlying debris) without apparent adverse effect, and *Chironomus dilutus* and *Lumbriculus variegatus* withstood continuous UVA exposure of about 770 $\mu W/cm^2$ (highest exposure tested) in sediment without overlying debris. While these are preliminary data, they suggest that UVA exposure alone would not prevent colonization of sediments with higher UVA exposure, although whether there is an upper limit was not determined in these experiments.

The discussion above relied exclusively on data from UV/PAH exposures with *Hyalella azteca* as the basis for estimating effect thresholds. However, several other experiments involving UV/PAH exposure were conducted during the course of site investigations. The relationship between these other studies and the analysis above is discussed in the following paragraphs.

URS (2006) also conducted exposures of larval fathead minnows to both site sediments and simultaneous UV exposure. UV exposures used in these experiments were higher than those in the *Hyalella* exposures, intended to represent UV intensity in about 4 feet of water rather than the 8 feet assumed for the *Hyalella* exposures. In terms of sediment PAH concentration associated with effects, the fathead minnows appeared comparably sensitive as *Hyalella*. Survival in SQT7 was 38% percent, with a PAH concentration of 6084 ug/g OC. This 38% survival is about half that observed in the reference treatments, so one can view 6084 as an approximate LC50 for fathead minnows at the associated UV exposure. As described above, the LC50s for *Hyallela* were 6050 and 5351 ug/g OC. In absolute terms, this implies that fathead minnows were less sensitive than *Hyalella* to UV/PAH exposure because UV exposure was higher in the fathead minnow test. Regardless, the comparison of the fathead minnow and *Hyalella* tests suggest that fathead minnows would likely be protected by thresholds calculated based on the whole sediment exposures with *Hyalella* as shown in Table 1.

Additional experiments (SEH 1998) were conducted using organisms that were exposed UV light in clean water, after exposure to contaminated sediments without simultaneous UV. These exposures were relatively short (hours) and involved relatively high UV irradiance (circa 500 $\mu W/cm^2$). While these experiments definitely demonstrate that organisms accumulated contaminants from the sediments that could be photo-activated by UV exposure, the intense UV exposure and the absence of the shading effect of sediment (as would be available in nature) make it difficult to interpret these exposures relative to the effects one would expect under field conditions.

Finally, some UV/PAH experiments were conducted using sediment elutriates. Elutriate experiments can be challenging to interpret if actual exposures are not measured. Because experimental data are available for organisms simultaneously exposed to UV and PAH in bedded sediments, it does not appear necessary to apply data from elutriate experiments to risks associated with organisms exposed to bedded sediments. Elutriate experiments may have greater applicability to a resuspension event, though the absence of measured PAH concentrations in the elutriates make it difficult to directly relate the PAH exposure occurring in the elutriate experiments to concentrations of PAHs that might occur in the water column at the site during a resuspension event. In addition, hydrodynamic events of sufficient magnitude to resuspend substantial amounts of sediment would likely also affect UV penetration into the water column. Additional analysis and/or data collection would be necessary to comprehensively evaluate the potential for photo-activated toxicity under a resuspension scenario.

Table 1. Sediment PAH concentrations estimated to cause 20% lethality of *Hyalella azteca* in 10 days of exposure with and without overlying debris.

Water Depth (cm)	% of Surface Irradiance at Depth	24-h Average Irradiance ($\mu W/cm^2$)	PAH at LC20 (ug/g OC)		PAH at LC20 (ug/g dwt @ 0.415% OC))	
			No Debris	With Debris	No Debris	With Debris
5	88.1	860.6	143	238	0.59	0.99
10	81.8	799.5	154	256	0.64	1.06
25	65.6	640.9	192	319	0.80	1.33
50	45.4	443.4	277	462	1.15	1.92
100	21.7	212.2	579	964	2.40	4.00
150	10.4	101.6	1210	2020	5.02	8.36
200	4.98	48.6	2530	4210	10.5	17.5
232	3.11	30.3	4050	6750	16.8	28.0
250	2.38	23.3	5280	8800	21.9	36.5
300	1.14	11.1	11000	18400	45.8	76.3

Figure 1 URS 2006 Sandy Dilution

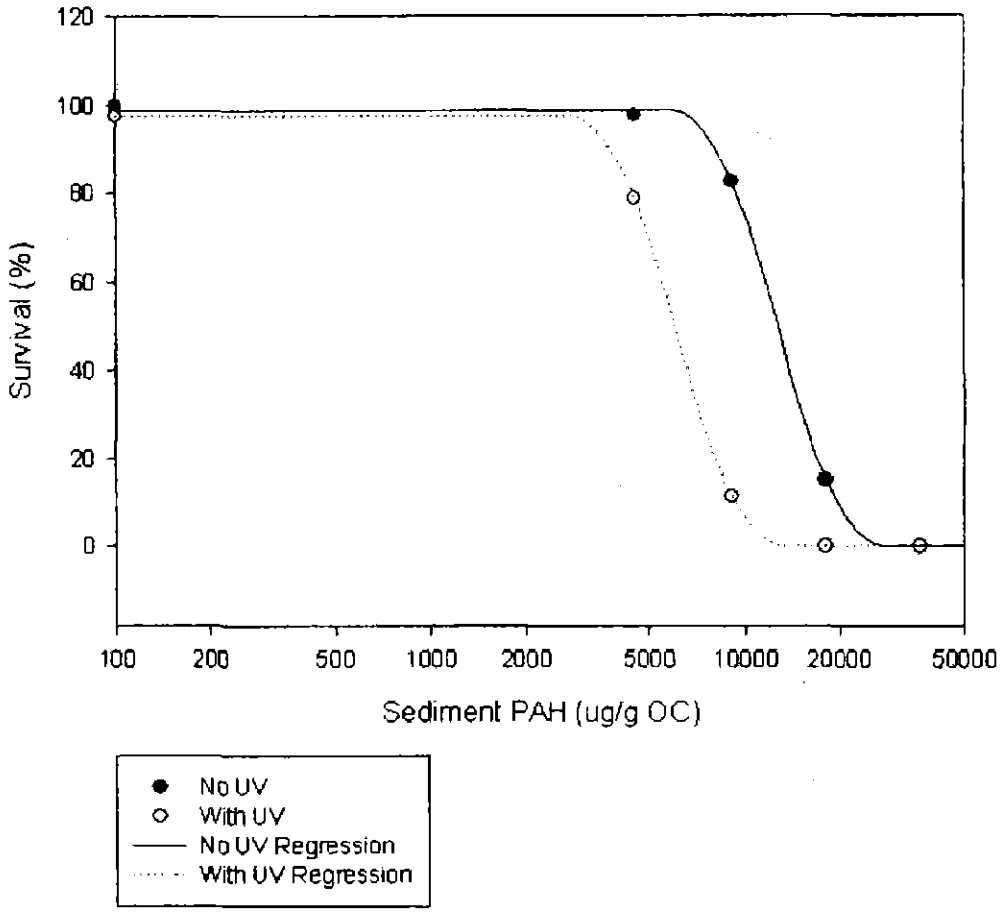


Figure 2 SEH 2001 Sandy Dilution

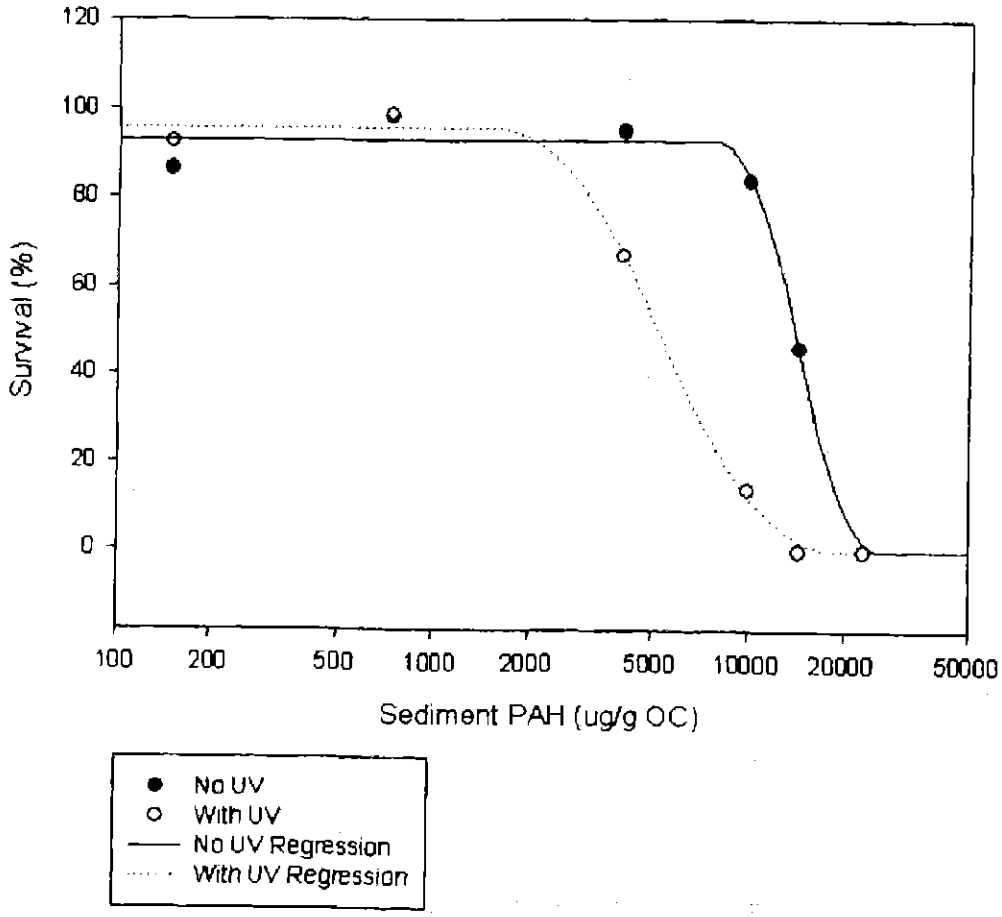


Figure 3 URS 2006 Sandy Dilution with UV

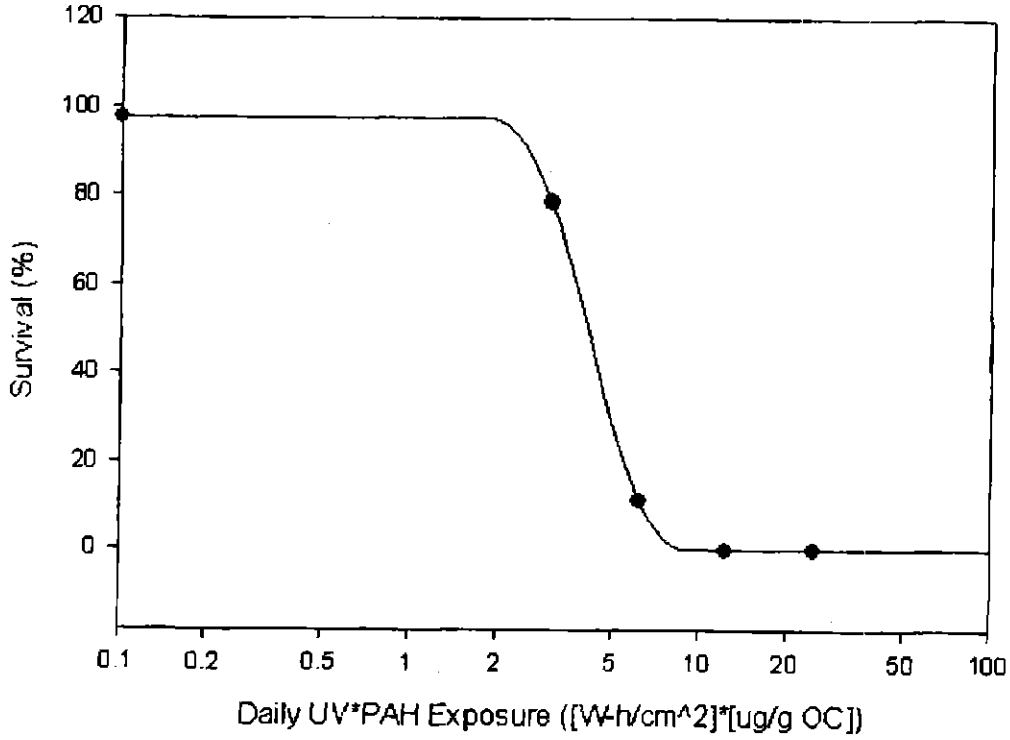


Figure 4 SEH 2001 Sandy Dilution with UV

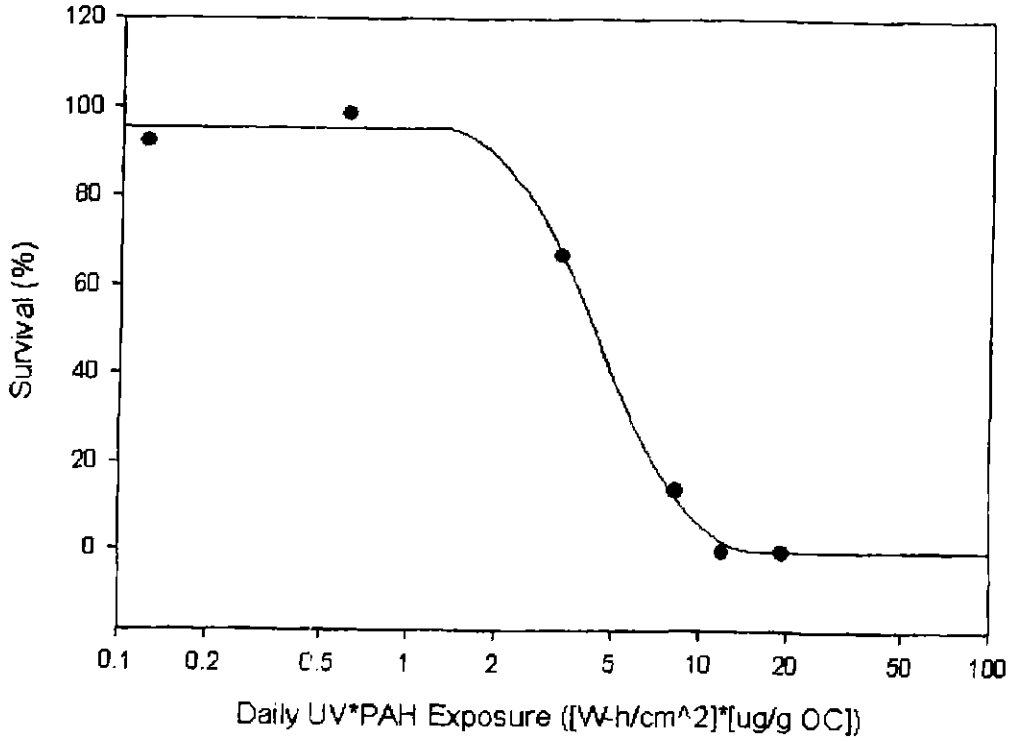


Figure 5 Combined Sandy Dilution with UV

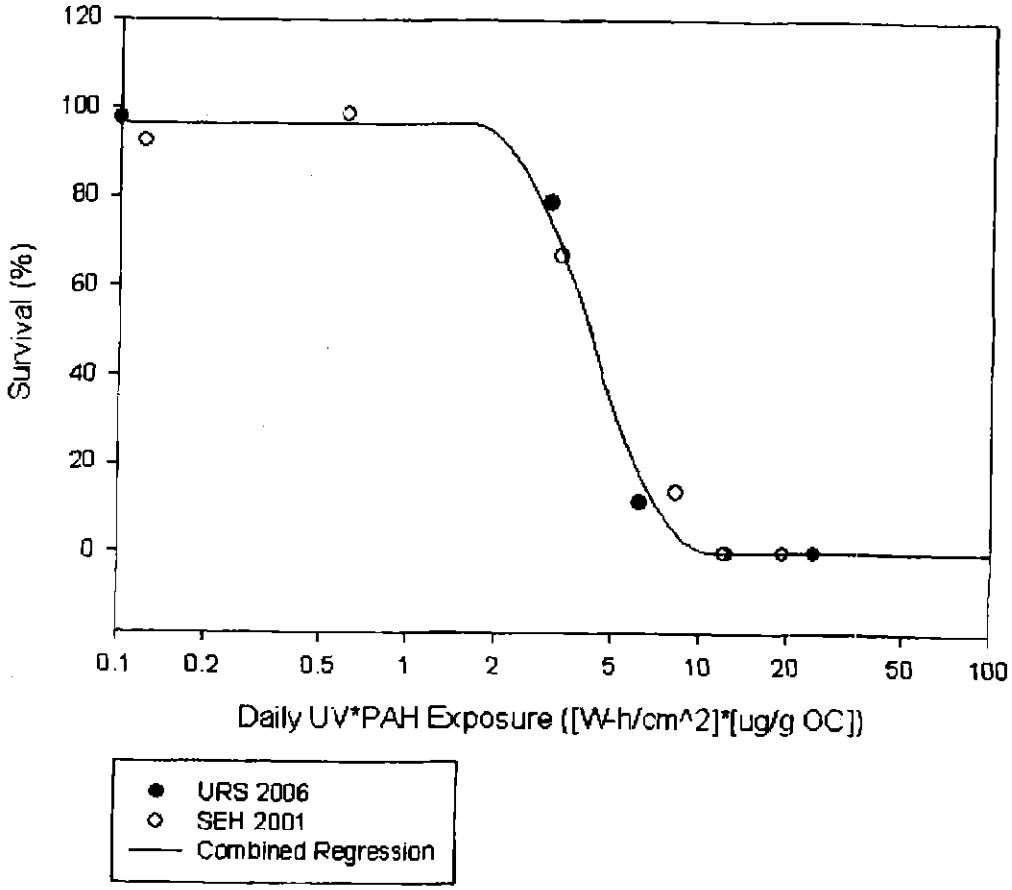
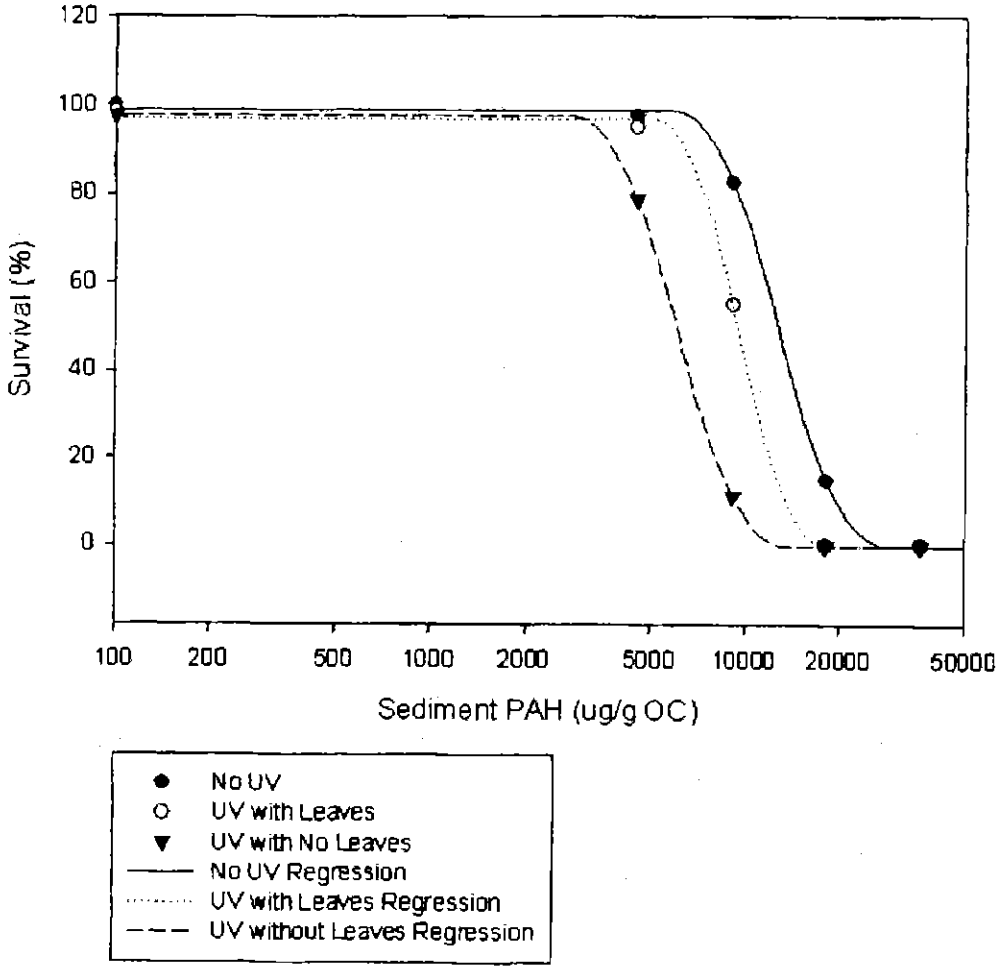


Figure 6 URS 2006 Sandy Dilution



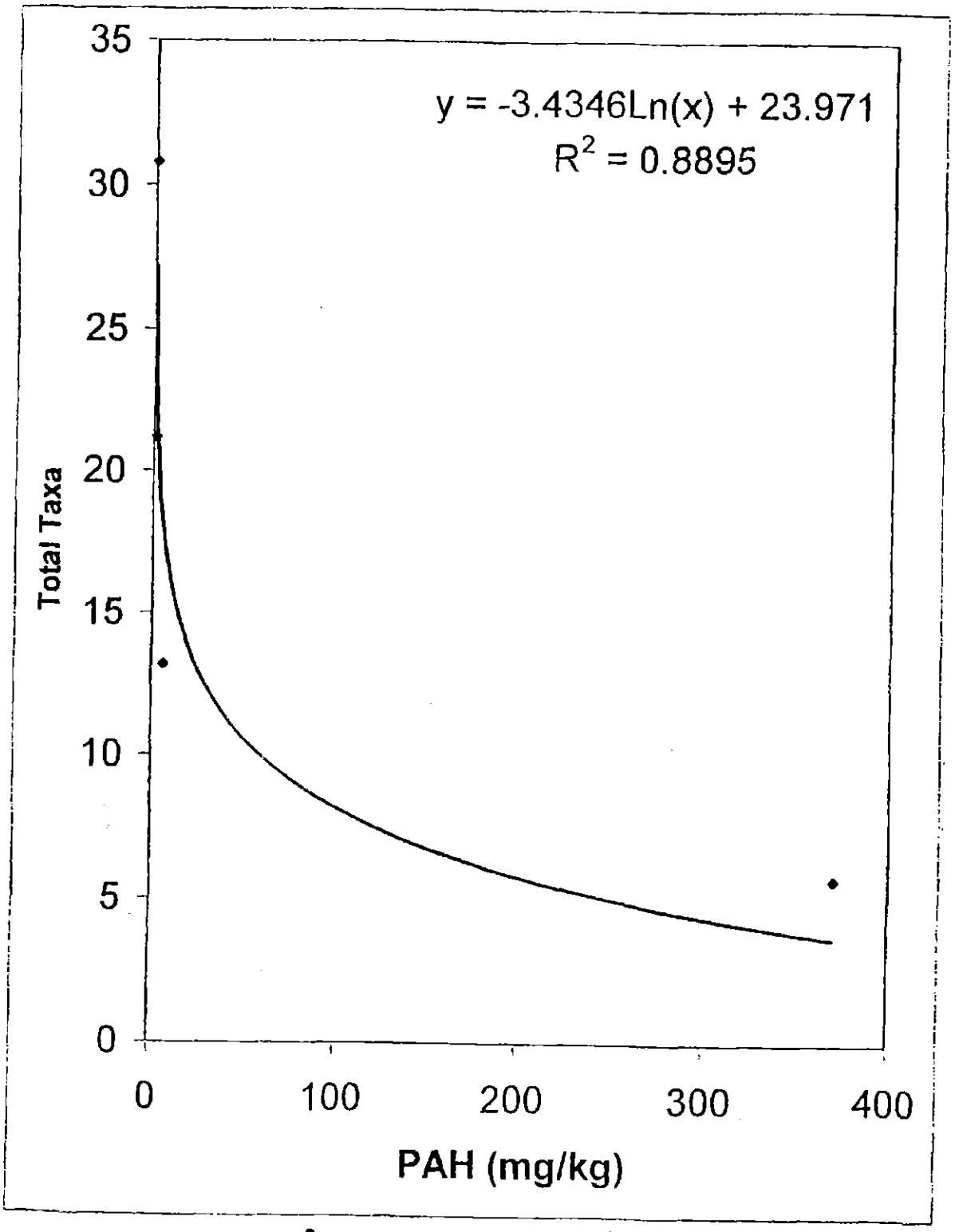
A statistical analyses was done on the paired sampling results from each substrate to determine if the results were significantly different. Separate t-tests (alpha less than or equal to 0.05) were run to compare the raw data from the two sand sites and the two wood sites. Data were transformed when necessary to achieve normality and equal variance by using natural log or natural log (x + 1) (if zero values were present in the data). Normality was tested using the Kolmogorov-Smirnov Test (with Lilliefors' correction), while equal variance was tested using the Levene Medial Test. If normality or equal variance could not be achieved, a Mann-Whitney Rank Sum Test was used. All tests were done using SigmaStat (Jandel Scientific, San Rafael, CA.). The paired results that were shown to be statistically different and the level of significance are shown in the table below. The eight indices that are significantly different in the table below are the same eight identified in the table above through qualitative means that were related to probable impacts from the coal tar contamination.. The statistical analyses confirms the conclusions reached through the qualitative evaluation of the data. *

Indices	Comparison of RW:CW Index Means Level of Significance		Comparison of RS:CS Index Means Level of Significance	
Total Taxa Richness	Significant	p = 0.019	Significant	p = 0.004
Midge Taxa Richness	Significant	p = 0.002	Significant	p = 0.007
Total Abundance (m2)	Not significantly different	p = 0.838	Significant	p < 0.001
Midge Abundance (m2)	Significant	p = 0.002	Significant	p < 0.001
Oligochaete Abundance (m2)	Not significantly different due to high variability at contaminated site	p = 0.294	Significant	p < 0.001

The end results of the above comparisons is the identification of four additional indices from the four identified by D & M which show probable impacts when the reference site results are compared to the contaminated site results on a qualitative and quantitative statistical basis.. The above results also generally coincide with the SEH ERA qualitative analysis of the macroinvertebrate data as shown in Table 15 of the ERA. *

SOURCE: WDNR (TOM JANISCH) 1999 COMMENTS TO D&M 1999 ERA

FIGURE 10



Source D&M March 1, 1999 ERA

FIGURE 11

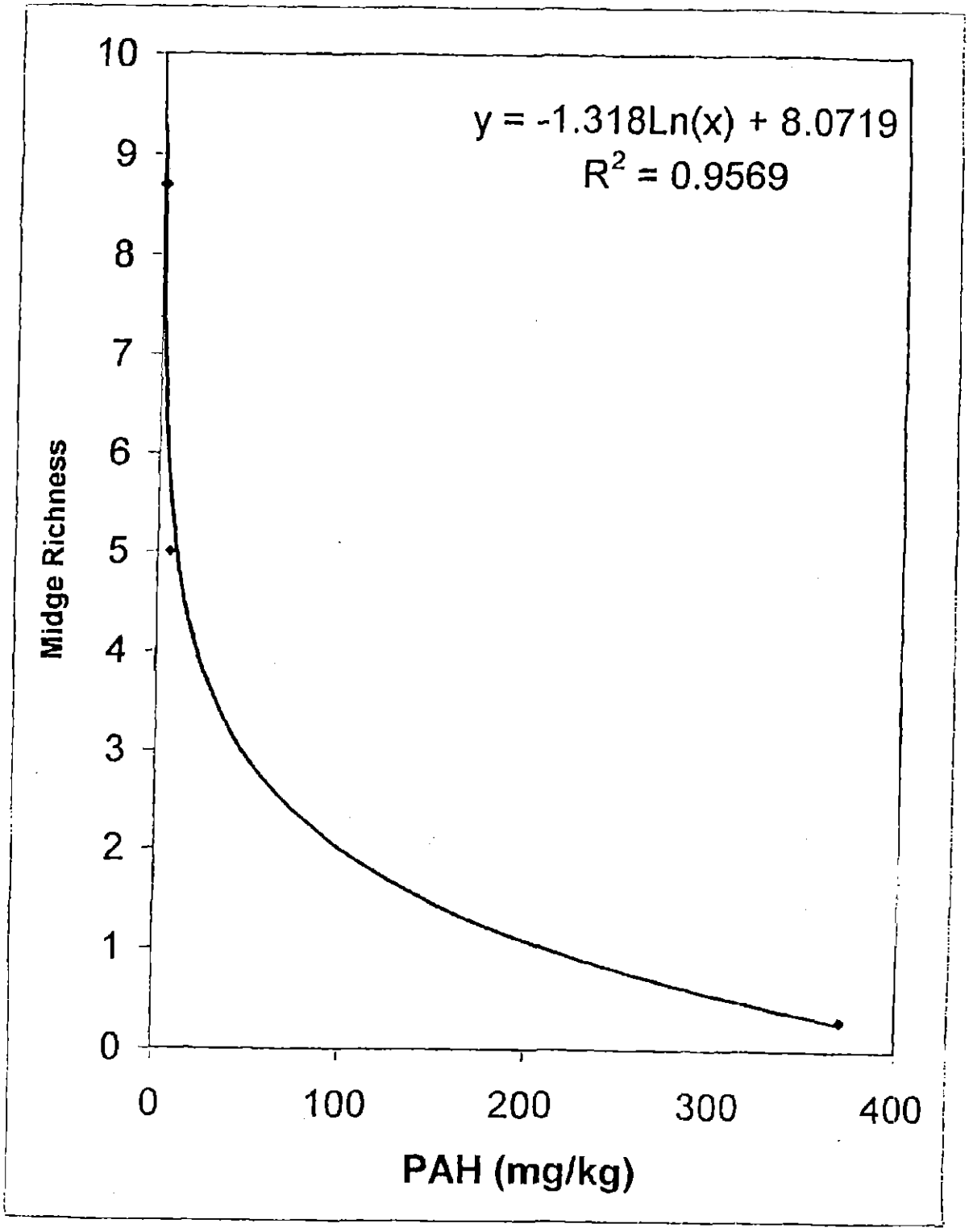

y = -1.318Ln(x) + 8.0719
R² = 0.9569
Midge Richness
10
9
8
7
6
5
4
3
2
1
0
0
100
200
300
400
PAH (mg/kg)

FIGURE 15

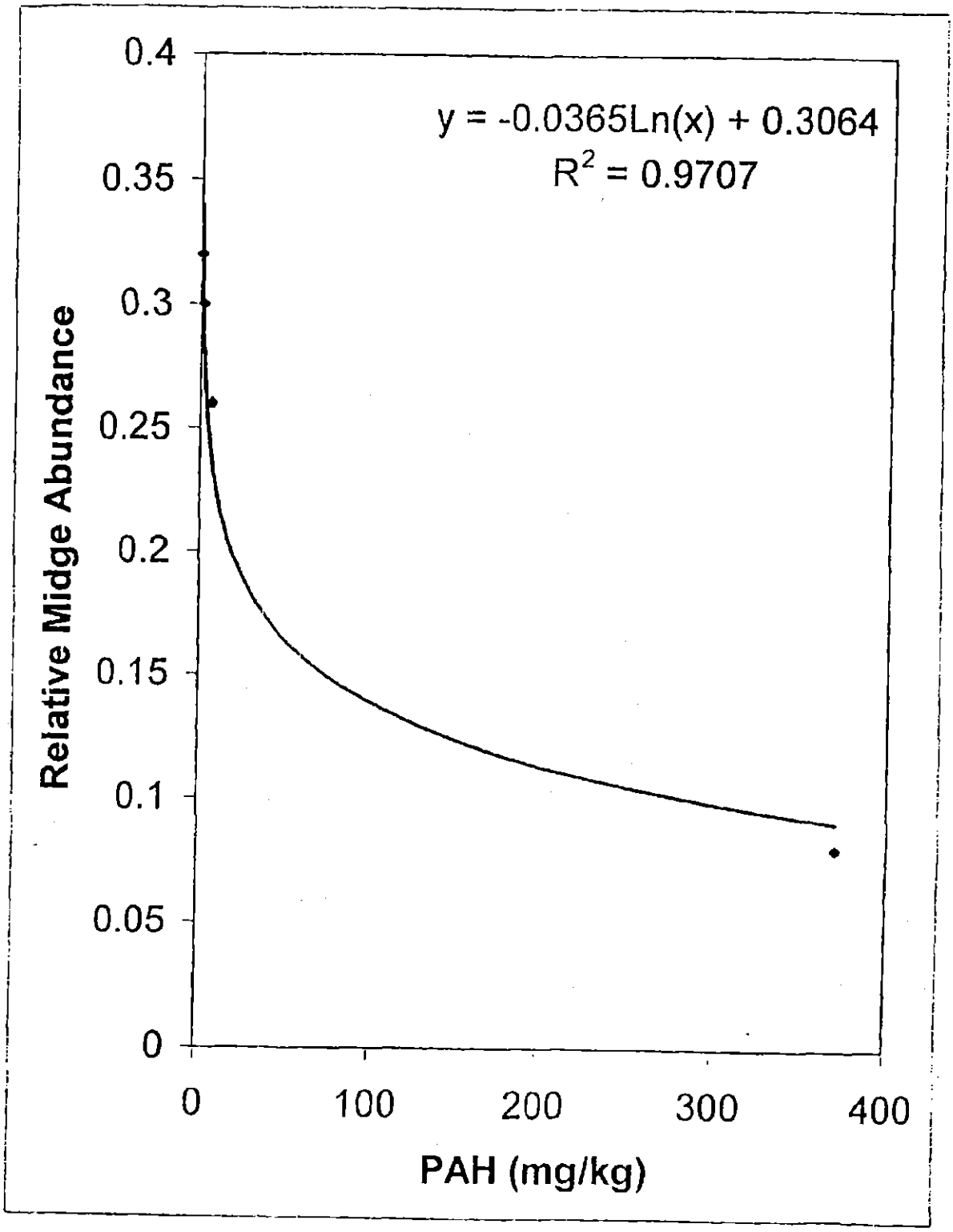
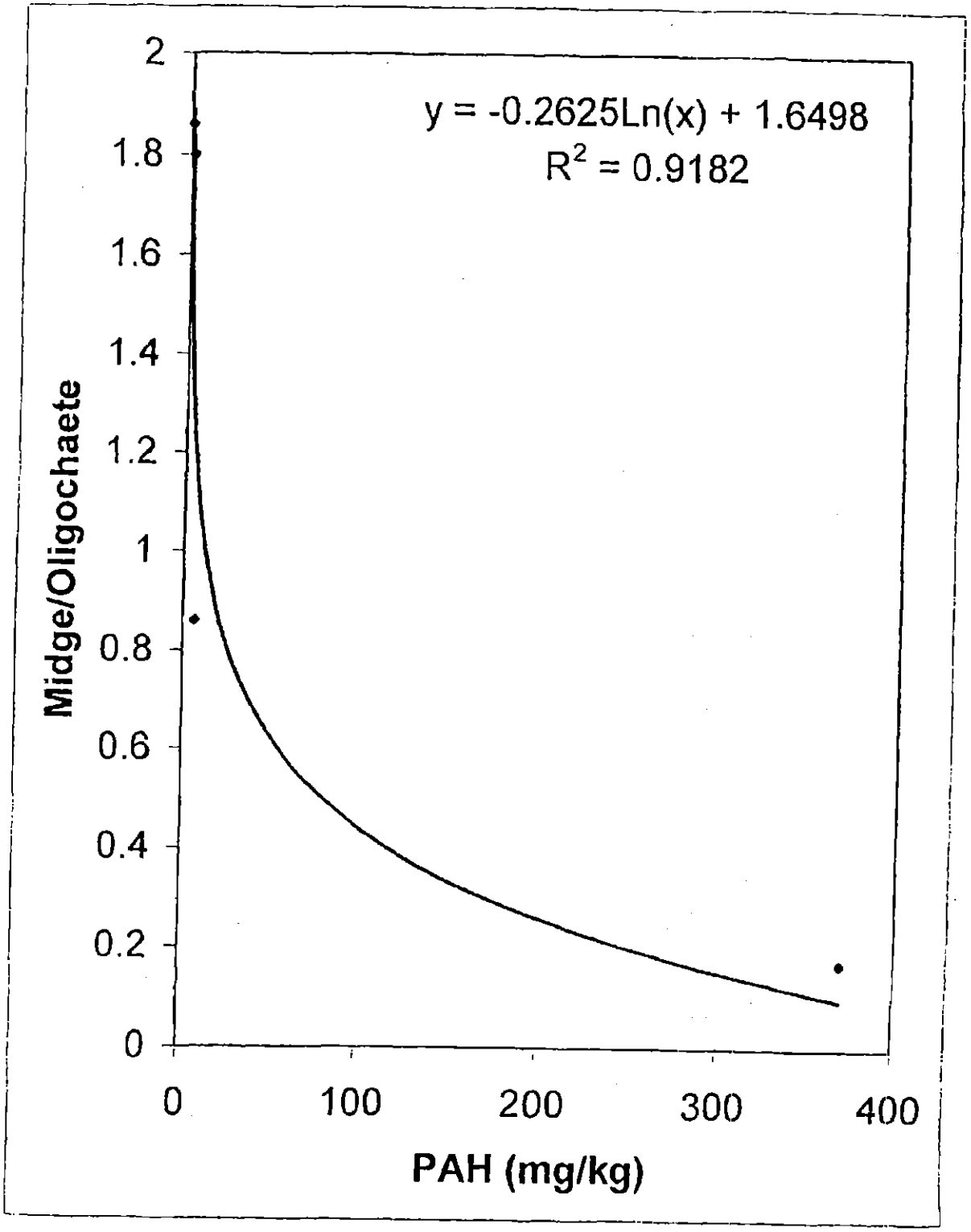

y = -0.0365Ln(x) + 0.3064
R² = 0.9707
Relative Midge Abundance
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
100
200
300
400
PAH (mg/kg)

FIGURE 16


y = -0.2625Ln(x) + 1.6498
R2 = 0.9182
Midge/Oligochaete
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
PAH (mg/kg)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL HEALTH & ENVIRONMENTAL EFFECTS
RESEARCH LABORATORY
MID-CONTINENT ECOLOGY DIVISION
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OFFICE OF
RESEARCH AND DEVELOPMENT

March 26, 2007

SUBJECT: Discussion of PAH toxicity thresholds for Ashland site sediments

FROM: David R. Mount, Research Aquatic Biologist

TO: Scott Hansen, RPM Ashland Superfund Site

I am writing to summarize my thoughts on establishing effect thresholds for PAH toxicity to benthic organisms from bedded sediments at the Ashland site. As you are aware from the recent string of written and telephone communications, the nature of the available data do not allow establishment of an effects threshold that is without uncertainty. Three major factors are responsible for this:

1) Not all studies targeting similar responses find the exact same exposure response profile;

2) Not all species tested have the same sensitivity;

3) While several studies have been completed, there remains a substantial gap in the toxicological information for a critical range of PAH concentrations, primarily 600 to 6000 µg/g organic carbon.

Xcel/URS have proposed a concentration of 53 ug total PAH/g[1] dwt as delineating sediments that have sufficient potential for adverse effect to require active remediation. From conversations with you, you have indicated that the remedial action objective (RAO) relative to protection of the benthic community should be a concentration expected to protect not just a single benthic organism, but the suite of benthic organisms evaluated. This is, of course, completely consistent with other regulatory approaches taken by the Agency; ecological protection is generally based on protecting most, if not all species, not just one. With this in mind, the RAO proposed by Xcel/URS fall short of your stated goals in two broad ways:

1) **An analysis of the available toxicity data, along with literature data, makes clear that toxicity due to the mixture of site PAHs can be expected well below 5300 µg/g OC, the value from which the RAO of 53 µg/g was derived.**

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[1]Unless otherwise noted, the term "total PAH" in this document refers to the sum of the PAH structures measured by URS in their analyses supporting the BERA. Note that a true measured of "total PAH" would include additional structures not quantified by URS in routine analyses.

2) **The 1% organic carbon content used by Xcel/URS to convert the purported effect "threshold" of 5300 µg/g OC to the RAO of 53 µg/g dwt is not reflective of the organic carbon content in the sediments which were the primary determinants of that threshold (0.37% and 0.46%). This has the effect of raising the proposed RAO (expressed on a dry weight basis) by a factor of 2.4-fold above the exposures actually shown to cause the effects Xcel/URS concedes are unacceptable.**

In the paragraphs that follow, I will discuss in detail why these two issues are critical, and how they can be more appropriately addressed. I will deal with the second issue first, as it is somewhat less complicated.

Translation Between Organic Carbon and Dry Weight Normalized Concentrations

The overwhelming evidence from the scientific literature shows clearly that partitioning to organic carbon (OC) controls the bioavailability, and therefore toxicity, of non-polar organic chemicals such as PAHs. For this reason, concentrations of PAHs in sediment are generally normalized on the basis of organic carbon for purposes of ecological risk assessment, as they are in the draft BERA. For this reasons, two sediments with the same dry weight (dwt) normalized PAH concentration may have pose greatly different ecological risks if their OC contents differ. However, there is often a preference on the part of remedial engineers and others to express remedial goals on a dwt basis rather than an OC basis. While this is contrary to toxicological theory, it is a practical reality, so a conversion is necessary.

This is a particularly important issue for the Ashland site, because the organic carbon contents of site sediments vary by more than a factor of 100-fold, from less that 0.4% to over 40%. This is further complicated by the belief that in sediments with relatively higher OC content, the OC is dominated by comparatively undegraded woody material, which can be suspected to have a lower affinity (i.e., lower partition coefficient) for PAHs than the more typical diagenic organic carbon likely to comprise the OC fraction in sandy, low OC sediments. If the partition coefficient for woody debris is in fact lower than that for diagenic carbon (and there is some evidence for this in the URS bioaccumulation studies and the SEH toxicity studies), then a different exposure/response relationship would be needed to determine the RAO for woody sediments. In discussions with Xcel/URS, it was proposed by Xcel/URS that a single, dwt-based RAO be developed based on responses in sandy sediment, and the same value would then be used for both sandy and woody sediments. Based on my review of the available data, I believe that establishing the RAO based on dwt-normalized concentrations in sandy sediments would in fact be protective of organisms in woody sediments if the same dwt-based RAO was applied.

Xcel/URS proposed an RAO of 53 µg total PAH/g dwt (total PAH being defined as the total of the PAH structures URS measured in their investigations), which was derived from a value of 5300 µg/g OC converted to a dwt basis assuming a OC content of 1%. The problem with this conversion is that the sediments that were primary drivers for the establishment of this threshold (SQT1 and SQT7) had organic carbon content well below 1% (0.46% and 0.37%, respectively). In fact, sediment SQT7, which was egregiously toxic to both *Hyalella* and *Lumbriculus*, had a dwt normalized PAH concentration of only 22.5 µg/g dwt. According to the RAO proposed by

Xcel/URS (53 µg/g dwt), SQT7 would not warrant active remediation, being less than half the RAO concentration, even though it was highly toxic to all species tested. Clearly, this is not consistent with a goal of protecting the suite of organisms evaluated in the BERA.

Because of this problem, the conversion of an OC-normalized threshold to a dwt-normalized RAO must consider the likely OC content to which the RAO will apply, not just a generic conversion assuming 1% organic carbon. Sampling by URS of sandy sediments both on and off site clearly indicate OC contents well below 1%. Later in this memo I will provide recommendations for dwt-normalized thresholds. For this purpose, I will use the mean of the OC measured in SQT1 and SQT7, which is 0.415%. Whether this is the exact value that should be used probably warrants further evaluation, though it is clear that something lower than 1% is necessary to accurately reflect the toxicity of sandy site sediments.

Summary: To protect benthos in sediment with the organic carbon content found in sandy site sediments collected and studied by Xcel/URS, conversion of OC-normalized PAH concentrations to dwt-normalized concentrations will require a conversion factor much lower than 1% organic carbon. This factor alone will result in an RAO much lower than the 53 µg/g dwt proposed by Xcel/URS.

Protectiveness of a sediment PAH concentration of 5300 µg/g OC

A variety of studies were conducted in support of the Ashland BERA to assess the likely effects of different PAH concentrations in site sediments. The majority of this evidence stems from laboratory exposures of organisms to site sediments. Xcel/URS evaluated these data and proposed a value of 5300 µg PAH/g OC as delineating PAH concentrations with do or don't pose unacceptable risk to benthos. This value seems to be derived through a geometric mean of purported NOEC and LOEC values from a mixture of sediment toxicity studies with *Hyalella azteca*.

There are several aspects of the available data that argue that this value does not have the characteristics of an effect/no effect threshold for benthos. Of the sandy site sediments tested, the sediment with the closest PAH concentration to this proposed RAO is SQT7, with a PAH concentration of 6084 µg total PAH/g OC[2]. This sediment caused >80% mortality of *Hyalella* in a 28-d exposure, and complete mortality of *Lumbriculus variegatus* in a 4-day exposure. Suggesting an RAO that is only 13% lower than a concentration causing egregious toxicity to every benthic organism tested is not consistent with a conceptual goal of little or no toxicity to benthos. URS has suggested that toxicity observed in simultaneous reference sediments reduces confidence in the finding of toxicity to *Hyalella* in SQT7, but the finding of toxicity to *Hyalella* at this PAH concentration is consistent with literature data (discussed further below).

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[2]After the analysis supporting this memo was completed, I was informed by URS that there had been an error in calculating the total PAH values for the SQT samples reported in the URS BERA. Because this error was reported so late, a decision was made to complete this memo using the PAH values previously reported by URS. Although specific values reported in this document would be affected by this error, the overall conclusions would not be greatly affected, hence the decision to proceed based on the values originally reported.

Furthermore, this contention is irrelevant with regard to *Lumbriculus*, to which SQT 7 was highly toxic, as results from the URS bioaccumulation experiment did not indicate that there was extraneous toxicity to *Lumbriculus* in the sandy reference stations.

Equally, or perhaps more significant, is that the Xcel/URS proposed RAO does not provide protection for the midge, *Chironomus dilutus*, for which sediment toxicity data were also available. URS did not succeed in completing toxicity tests on SQT7 or other sediments with midge. However, tests of diluted site sediments conducted by SEH 2001 indicated a EC20 for midge of 4100 µg/g OC. This value is not only lower than the proposed RAO, but was obtained using a dilution series that showed substantially lower toxicity to *Hyalella* than was found by URS in SQT7 and dilutions of SQT1, suggesting that toxicity of those sediments to midge would likely have occurred at even lower concentrations. This suggests strongly that 5310 µg/g OC is not a concentration that would protect against toxicity to *Chironomus dilutus*.

Summary: The site-specific toxicity data, including those collected by Xcel/URS, indicate strongly that an RAO of 5300 µg/g OC would allow for substantial sediment toxicity to all three benthic species tested in this investigation. This does not meet your definition of an appropriately protective value.

Relationship of Site Toxicity Data to Other Information on PAH Toxicity to Benthos

Among other issues, the approach taken by Xcel/URS in the draft BERA was highly empirical and did little to incorporate the larger body of knowledge of PAH effects on benthos. This is a particularly critical issue, because the available data suggest that the threshold for toxicity to benthos likes somewhere in the range of 600 to 6000 µg/g OC, but there are very, very few site-specific data for this concentration range. Thus, it is logical to relate the site specific responses observed in site sediments other information. If there is concordance, then these other sources of information can be used to supplement the site-specific information and, in doing so, provide a stronger basis for deriving an appropriately protective threshold.

Equilibrium partitioning (EqP), as described in the EPA ESB document for PAH mixtures, provides a mechanistic for understanding and predicting the toxicity of PAHs in sediments to benthic organisms. To apply this approach, one must assume or derive an organic carbon partition coefficient (Koc) to describe the distribution of PAH between the solid phase and interstitial water. Because it describes the relative chemical activity of PAHs in the solid phase and interstitial water, Koc is also used to quantify the bioavailability of PAHs in sediments. Although EqP can be applied regardless of the site-specific Koc value, the default approach is to assume that Koc is similar to Kow (log Koc = 0.983*Kow + 0.00028). Because Koc and Kow are nearly equal in value in the default case, it also follows that at steady state, an organism that does not metabolize PAHs will have a body burden (normalized to body lipid) that is roughly equivalent to the OC-normalized PAH concentration in sediment. Thus, the ratio of concentration in organism lipid to concentration in sediment OC (called the Biota Sediment Accumulation Factor or BSAF) is expected to be approximately one if Koc and Kow are similar, thus indicating the default EqP scenario is applicable. This same approach was used in a different context by Xcel/URS in their draft BERA.

The BSAFs for Ashland site sediments can be calculated from the bioaccumulation experiments conducted by URS using *Lumbriculus variegatus*. BSAFs calculated based on total PAH are in the range of 3 to 5 for most stations, indicating that PAH bioavailability in these sediments was, if anything, slightly higher than would be expected if Kow≈Koc. One site, SQT3 showed a much higher BSAF (10) and one site showed a much lower value (0.15). Values much higher than 1 indicate higher than expected bioavailability, which is not inconsistent with the presence of relatively undegraded wood debris, which is common at the site and is consistent with the relatively high OC content of these sediments. A value much lower than 1 indicates a higher Koc value as might result from the presence of large amounts of coal or soot. No values were obtained for SQT1 or SQT7 because these sediments were directly toxic to *Lumbriculus*. However, taken as a whole these BSAF data indicate that the assumption that Kow≈Koc is not unreasonable and is, if anything, perhaps somewhat lenient (i.e., the opposite of environmentally conservative).

The other assumption that is necessary to apply EqP theory to PAH toxicity at the Ashland site is the ratio between the concentration of all PAHs present (hundreds of structures), and those that were actually quantified for the BERA (26 structures). In the EPA ESB document, there is a recommendation that a set of 34 PAHs and PAH homolog series be considered as representing the total PAH concentration for purposes of the ESB. Data relevant to this ratio was collected in the so-called, "forensic study," which included both the 26 structures measured in the URS SQT studies, and the 34 groups in the EPA ESB recommendation. While this should lend itself to a straightforward calculation, there are irregularities in those data that reduce confidence in the calculations. For example, the sum of the two individually-measured methylnaphthalene compounds are significantly greater than the concentration reported for C1-naphthalenes; these concentrations should be equal. As a result, the correction factor for unmeasured PAHs in the BERA has some uncertainty about it which is beyond the scope of this document to fully discuss. For current purposes, a value of 1.2 was chosen, even though higher ratios were observed for other site stations, making this a lenient (as opposed to environmentally conservative) assumption. This was done because SQT1 and SQT7: 1) represent comparatively unweathered material ; 2) appear to be free of woody debris and the uncertainties associated with that material (e.g., retenes); and 3) are the sites whose toxicity was central to the derivation of the RAO based on data for SQT1 and SQT7, the two most toxic samples among the SQT stations, and therefore the samples among the SQT stations that have greatest influence on the RAO. Nonetheless, this value of 1.2 is toward the low end of values reported in the literature for coal tar sites (see Hawthorne et al. 2006) and may be an assumption worthy of further evaluation.

Accepting the assumption that Kow≈Koc, and a total PAH adjustment factor of 1.2, one can use water only toxicity data for PAHs to estimate the concentrations in sediment that would be toxic to *Hyalella azteca* and *Chironomus dilutus*. Schuler et al (2004; ES&T 38:6247) published water only toxicity data for fluoranthene, reporting a water only LC50 for *Hyalella* of 110 µg/l and 59 µg/L for 10-d and 28-d of exposure, respectively, and the 10-d LC50 for *Chironomus dilutus* of 36 µg/L. Assuming a middle-range Koc (5.00) and MW (202) as is represented by fluoranthene, and 1.2 as the adjustment factor for unmeasured PAHs, one would predict that the corresponding LC50's in Ashland sediments would be 10035 µg/g OC for 10-d *Hyalella*, 5383 µg/g OC for 28-d *Hyalella*. These values agree very well with measured responses by Hyalella to SQT1 (10-d LC50 of 12,700 µg/g OC) and SQT7 (28-d mortality of greater than 80% at 6084 µg/g OC),

which indicates that the assumptions of the EqP approach are appropriate for these sediments. The calculated 10-d LC50 for midge, 3284 µg/g OC, is a little more than half of the EC50 of 6220 µg/g OC observed in the 10-d sandy sediment dilution study with midge (SEH 2001), and the 28-d *Hyalella* LC50 from the same study (14400 µg/g OC) was also higher than would be predicted. However, as Xcel/URS has argued consistently, there are some irregularities in the reported organic carbon concentrations from the SEH (2001) studies which may influence this comparison.

Summary: The available data support the applicability of EqP and the EPA ESB assessment approach for predicting the toxicity of PAHs in Ashland site sediments.

Calculation of a Threshold Using the EPA ESB

The EPA ESB document contains procedures for estimating a concentration of PAHs in sediment that would protect roughly 95% of all species[3] from chronic toxicity of PAHs. In the ESB calculation, the overall potency of a PAH mixture depends on the distribution of compounds present. To estimate an ESB for the Ashland site, I calculated a concentration-weighted value based on the PAH composition in SQT7 (from the forensic report) with the rationale that this site was closest to the threshold. The molar concentration of each PAH in the "EMAP34" series of PAHs, and it was multiplied by the chemical specific guideline value from the ESB document. The sum of these products was then divided by the sum of all the molar concentrations to derive an overall ESB of 668 µg/g OC (this was the mean of two replicates, 670.5 and 666.0).

To relate this value to the BERA, one has to further correct for the ratio of the PAHs measured by Xcel/URS to the "EMAP34" on which the ESB is based. As described above, the ratio I have been using is 1.2, which makes the final value 557 µg/g OC, or 2.3 µg/g dwt at 0.415% OC.

Summary: The EPA ESB procedure suggests a value of 557 µg PAH/g OC as protecting roughly 95% of species from chronic toxicity.

Calculation of Thresholds for Benthic Species Tested for Ashland BERA

From the available data, it appears that of the three benthic species used in sediment toxicity tests, the midge *Chironomus dilutus* (formerly *tentans*) is the most sensitive. This is supported by both the comparative toxicity in sediment dilution series tested by SEH (2001) and by the literature data for water-only toxicity of fluoranthene reported by Schuler et al (2004). Therefore, if the goal is to derive an RAO that will protect these three species, then it is the toxicity threshold for midge that will set the threshold.

The first issue is to define what the threshold will be. Statistical significance is sometimes used to define toxicity thresholds, but this can be problematic because it is defined in large part by the concentrations tested and subtleties in data variability, neither of which is relevant to the

[3]The ESB is based on protecting the 95% percentile of species for which there are toxicity data; it is assumed that this is roughly equivalent to 95% of all species.

expected biological effect of exposure. In recent years, greater emphasis has been placed on estimating specific levels of effect using various regression techniques. For this purpose, a 20 percent effect threshold (EC20) is often chosen. While it is difficult to establish whether this is a true "threshold" for adverse effect (i.e., all concentrations below this are "safe"), it becomes difficult to reliably estimate levels of effect lower than this. It also corresponds to a level of effect that is commonly found to be significant in toxicological testing. In selecting the EC20, it is recognized that this does not guarantee the absence of biological effect at this concentration; however, it will be presumed that levels of effect lower than this will be adequately addressed through natural attenuation of residual effects.

Within the toxicity tests conducted for the Ashland BERA, there is only one test that directly determines an EC20 for midge; that was the sandy sediment dilution test by SEH (2001). While this is in some ways to most direct method for estimating this value, this study has been criticized repeatedly by Xcel/URS because of anomalies in the analytical data that make the reported exposure concentrations somewhat uncertain. As a cross check on this value, one can use the larger body of available data, to make estimates of the midge EC20 using responses in other tests and relationships among endpoints. The details of this analysis are described in detail in Attachment A, and are summarized in Table 1 below. Estimates of the midge EC20 range from 1340 to 3930 µg PAH/g OC; converting to a dwt basis assuming a sediment OC of 0.415%, this corresponds 5.57 to 16.3 µg PAH/g dwt. Because of the uncertainties involved, it may be most appropriate to think of the midge EC20 as a range rather than a single value.

Table 1 – Summary of Midge EC20 Estimates

Concentration (µg PAH/g OC)	µg PAH/g dwt. @ 0.415% OC	Summary of Derivation
1340	5.57	Treat SQT7 as *Hyalella* 28-d LC80; adjust from *Hyalella* 28-d LC80 to midge LC20 based on SEH (2001) dilution studies
1770	7.35	Treat SQT7 as *Hyalella* 28-d LC80; adjust from *Hyalella* 28-d LC80 to *Hyalella* 28-d LC50 based on URS (2006) and SEH (2001) dilution studies; adjust to midge LC50 based on Schuler (2004); adjust from midge LC50 to midge LC20 based on SEH (2001) dilution studies.
2020	8.38	Midge LC50 predicted from Schuler (2004); adjustment from LC50 to LC20 based on SEH (2001) dilution study
2560	10.6	*Hyalella* 10-d LC50 from URS (2006) dilution study; adjust from *Hyalella* 10-d LC50 to midge LC50 based on Schuler (2004); adjust midge LC50 to midge LC20 based on SEH (2001) dilution studies.
3930	16.3	Average of LC20 and EC20 from SEH (2001) test with dilutions of contaminated sandy sediment.

Note that these values are still not as low as the calculated EPA ESB concentration of 557 µg PAH/g OC (2.31 µg PAH/g dwt at 0.415% OC). Among the reasons for this is that the EC20 midge is the lowest value from among three species, and would not necessarily protect even more sensitive species. Basing an RAO on the midge EC20 should be done in recognition that effects to highly sensitive organisms are possible, and may require additional attenuation of exposure over time to meet a more stringent definition of "threshold."

Summary: Based on a variety of data sources, the EC20 for midge is expected to lie within a range of 1340 to 3930 µg PAH/g OC. At an OC of 0.415%, this corresponds to 5.6 to 16.3 µg PAH/g dwt.

Coherence of Midge EC20 Range with Aggregate Toxicity Data

Figure 1 shows a summary of all available toxicity data for solid-phase toxicity testing of sandy sediments from the Ashland site (in the absence of UV light), combining data from SEH (1998), SEH (2001), and URS (2006). Also shown are WDNR TEC, MEC, and PEC effect endpoints, the EPA ESB value, and the range of midge EC20 estimates listed in Table 1. As can be seen, the midge EC20 range lies in an area that is consistent with the distribution of toxic and non-toxic samples; that is, most of the toxic samples lie to the right of this range, and most of the non-toxic samples lie to the left. Also obvious is the very limited about of data in the 600 to 6000 µg/g range discussed earlier in the document. Finally, the midge EC20 range is consistent with midrange of the WDNR guidance values.

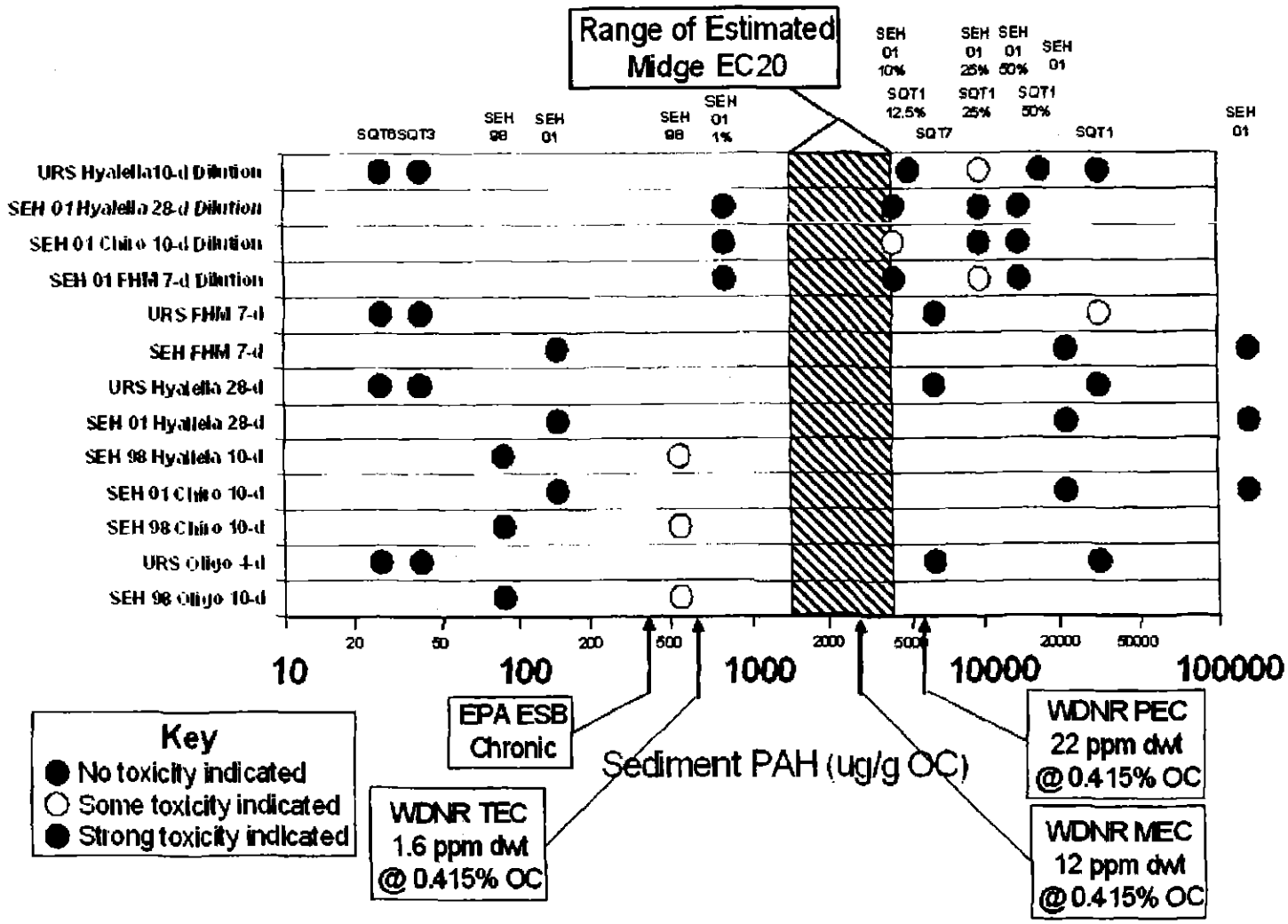
Summary: The range of estimated midge EC20 values is consistent with the distribution of site data and external chemical benchmarks.

Influence of UV Light on PAH Toxicity

The discussion above focuses solely on the effects of site PAHs in the absence of UV. As demonstrated experimentally in studies supporting the BERA, additional toxicity of PAHs can occur when UV light is present. Quantification of these effects, and adjustments to the RAO that may be needed for sediments in shallow water are discussed in a separate memo I forwarded to you previously.

Summary: Effect thresholds discussed in this memo do not include consideration of UV-induced effects, which are discussed in a separate document.

Figure 1 – Summary of Toxicity Data for Sandy Sediments



ATTACHMENT A

ESTIMATION OF MIDGE EC20 VALUES

Because Xcel/URS were unsuccessful at completing toxicity tests with *Chironomus* during the most recent investigations, the only site-specific testing with *Chironomus* across a concentration gradient in sandy sediments was the SEH(2001) dilution study. Regression analysis of these data yielded an EC20 of 4100 µg/g OC. Because of subtle differences in the slopes of the regression line, the estimated LC20 for this study was actually slightly lower, 3760 µg PAH/g OC. Because of this, the mean of these two, 3930 µg PAH/g OC is proposed as the 20% effect level for this study. An uncertainty with this value lies with the analytical characterization which contains some irregularities as pointed out previously by Xcel/URS.

As described in the main body of this document, the water-only fluoranthene data of Schuler et al. (2004) can also be used to estimate sediment effect concentrations. The reported water-only 10-d LC50 for *Chironomus* was 36 µg/L which, give the Kow and molecular weight of fluoranthene, corresponds to a predicted sediment LC50 of 3280 µg PAH/g OC. However, this value needs to be corrected from an LC50 to a 20% effect level. An estimate of this correction is available from the exposure response curve from the SEH(2001) sandy sediment dilution study, in which the ratio of the LC50 to the LC20, which is 6090/3760 or 1.62. Because the LC20 and EC20 were so close in this study, the lethality data were not adjusted downward further for sublethal effects. The results in an estimated LC20 based on the Schuler study of 2020 µg PAH/g OC.

Another point of reference is the toxicity of SQT7 to *Hyalella azteca*; this sediment caused about 80% mortality of *Hyalella* at 6080 µg PAH/g OC. Toxicity testing of this sediment with *Chironomus* was unsuccessful. However, assuming this concentration in this sediment represents an LC80 exposure for *Hyalella*, other data can be used to estimate a response that might be expected from *Chironomus*. One way is to look at the ratio of the *Hyalella* LC80 in the SEH (2001) sandy sediment dilution test to the *Chironomus* effect threshold mentioned above. This would be a ratio of 17800/3930 or 4.53. Dividing the PAH concentration in SQT7 by this value yields 6080/4.53 or 1342 µg PAH/g OC. Another way would be to adjust from a *Hyalella* LC80 to a *Hyallela* LC50 using the ratios of those values from the SEH (1.24) and URS (1.34; geo mean = 1.29), adjust to a *Chironomus* LC50 based on the ratio from Schuler (59/36 = 1.64) and to a *Chironomus* LC20 based on SEH(2001) as above (1.62). This gives an estimated *Chironomus* LC20 of 6080/(1.29*1.64*1.62) = 1770 µg PAH/g OC.

A final method would be to estimate the *Chironomus* LC20 based on the URS(2006) sandy sediment dilution test with *Hyalella*, which gave a 10-d LC50 of 12700 µg PAH/g OC. This can be adjusted to an estimated *Chironomus* 10-d LC50 using the Schuler data (110/36 = 3.06) and to an LC20 based on SEH (2001;1.62). This yields an estimated *Chironomus* 10-d LC20 of 12700/(3.06*1.62) = 2560 µg PAH/g OC.

APPENDIX M-2
PRGs for Soil, Surface Water and Groundwater

Soil Preliminary Remediation Goals for Construction Workers (mg/kg)					
Chemical	Carcinogenic Effects			Noncarcinogenic Effects	
	CR = 10^{-6}	CR = 10^{-5}	CR = 10^{-4}	HI = 0.1	HI = 1.0
SVOCs					
2-Methylnaphthalene	NA	NA	NA	1.13E + 02	1.13E + 03
Benzo(a)anthracene	2.01E + 00	2.01E + 01	2.01E + 02	1.06E + 04	1.06E + 05
Benzo(a)pyrene	2.01E - 01	2.01E + 00	2.01E + 01	NA	NA
Benzo(b)fluoranthene	2.01E + 00	2.01E + 01	2.01E + 02	NA	NA
Dibenzo(a,h)anthracene	2.01E - 01	2.01E + 00	2.01E + 01	NA	NA
Indeno(1,2,2-cd)pyrene	2.01E + 00	2.01E + 01	2.01E + 02	7.06E + 03	7.06E + 04
Naphthalene	NA	NA	NA	3.81E + 00	3.81E + 01
VOCs					
Benzene	1.4E + 00	1.4E + 01	1.4E + 02	4.11E + 00	4.11E + 01

Soil Preliminary Remediation Goals for Residents (mg/kg)				
Chemical	Carcinogenic Effects		Noncarcinogenic Effects	
	CR = 10^{-5}	CR = 10^{-4}	HI = 0.1	HI = 1.0
SVOCs				
Benzo(a)anthrancene	6.21E + 00	6.21E + 01	NA	NA
Benzo(a)pyrene	6.21E - 01	6.21E + 00	NA	NA
Benzo(b)fluoranthene	6.21E + 00	6.21E + 01	NA	NA
Dibenzo(a,h)anthracene	6.21E - 01	6.21E + 00	NA	NA
Naphthalene	NA	NA	1.70E + 00	1.70E + 01
VOCs				
Benzene	7.37E + 00	7.37E + 01	1.80E + 00	1.80E + 01

Surface Water Preliminary Remediation Goals for Swimmers (mg/L)					
Chemical	Carcinogenic Effects			Noncarcinogenic Effects	
	CR = 10^{-6}	CR = 10^{-5}	CR = 10^{-4}	HI = 0.1	HI = 1.0
SVOCs					
Benzo(a)anthrancene	2.04E - 04	2.04E - 03	2.04E - 02	NA	NA
Benzo(a)pyrene	1.17E - 05	1.17E -04	1.17E - 03	NA	NA
Benzo(b)fluoranthene	1.19E - 04	1.19E - 03	1.19E - 02	NA	NA
Dibenzo(a,h)anthracene	7.72E - 06	7.72E - 05	7.72E - 04	NA	NA
Indeno(1,2,2-cd)pyrene	1.17E - 04	1.17E - 03	1.17E - 02	NA	NA

Preliminary Remediation Goals (µg/l) for Organic COPCs in Groundwater (WAC Chapter NR 140 Enforcement Standard)			
COPC – VOCs	**ES**	**COPC – SVOCs***	**ES**
Benzene	5	Anthracene (LMW)	3,000
Ethylbenzene	700	Benzo(a)Pyrene (HMW)	0.2
Styrene	100	Benzo(b)Fluoranthene (HMW)	0.2
Toluene	1,000	Chrysene (HMW)	0.2
1,2,4-Trimethylbenzene	480**	Fluoranthene (HMW)	400
1,3,5-Trimethylbenzene		Fluorene (LMW)	400
Total Xylenes	10,000	Naphthalene (LMW)	40
		Pentachlorophenol	1
		Pyrene (HMW)	250
		Phenol	6,000

* (HMW) – Heavy molecular weight PAHs; (LMW) – Low molecular weight PAHs

** Trimethylbenzene (TMB) in groundwater will be presented as the sum of 1,2,4- and 1,3,5- TMB per the WAC ch. NR 140 standard.

Preliminary Remediation Goals (µg/l) for Inorganic COPCs in Groundwater			
Inorganics	**ES**	**Background Concentrations for Miller Creek (Well MW-11)**	**Background Concentrations for Copper Falls (Well MW-6A)**
Arsenic	6	0 – 3.2	0 – 4.4
Antimony	10	0 – 4.3	0 – 4.1
Barium	2,000	130 – 260	640 – 710
Beryllium	4	ND	ND
Cadmium	5	0 – 0.2	ND
Chromium (+3) Chromium (+6)	100*	ND	0.87 – 2.1
Cobalt	40	0 – 16	0 – 1.1
Copper	1,300	2 – 35	2.4 – 6.1
Cyanide	200	0 – 17	0 – 4
Iron	300	7.1 – 19,000	0 – 0.0046
Lead	15	0 – 3.3	0.485 – 2.6
Manganese	50	13 – 760	30 – 410
Mercury	2	ND	ND
Nickel	100	0.95 – 24	1.6 – 4.7
Selenium	50	0 – 3.3	0 – 2.8
Silver	50	0 – 1.65	0 – 0.8
Thallium	2	ND	ND
Vanadium	30	2.1 – 38	9 – 10
Zinc	5,000	0 - 59	0 – 17

* Chromium in groundwater will be presented as total chromium per the WI ch. NR 140 standard

APPENDIX N
Remedial Alternatives and Scenarios

APPENDIX N
Remedial Alternatives and Scenarios

APPENDIX N-1
Summary Table of Remedial Alternatives by Area of Concern

Table 1 - Summary of Remedial Alternatives by Areas of Concern

Area of Concern	FS Designation	Description
Filled Ravine	S-1/GW-1	No Action
	S-2	Containment Using Surface Barriers
	S-3A	Limited Removal and Off-site Disposal
	S-3B	Unlimited Removal and Off-site Disposal
	S-4A	Limited Removal and On-site Disposal at Kreher Park
	S-4B	Unlimited Removal and On-site Disposal at Kreher Park
	S-5A	Ex-situ Thermal Desorption - On-site treatment (limited removal)
	S-5B	Ex-situ Incineration - Off-site treatment (limited removal)
	S-6	On-site Soil Washing (limited removal)
	GW-2A	Containment Using Vertical Barriers
	GW-3	Ozone Sparge
	GW-6	In-site Chemical Oxidation
	GW-7	Electrical Resistance Heating
	GW-8	Steam Injection – Contained Recovery of Oily Water (CROW)
	GW-9A	Groundwater Extraction with EW-4
Copper Falls Aquifer	GW-1	No Action
	GW-3	Ozone Sparge
	GW-4	Dual Phase / Surfactant Injection
	GW-6	In-situ Chemical Oxidation
	GW-7	Electrical Resistance Heating
	GW-8	Steam Injection via Dynamic Underground Stripping (DUS)
	GW-9A	Groundwater Extraction with existing system
	GW-9B	Groundwater Extraction with enhanced groundwater extraction system
Kreher Park	S-1/GW-1	No Action
	S-2	Containment Using Surface Barriers
	S-3A	Limited Removal and Off-site Disposal
	S-3B	Unlimited Removal and Off-site Disposal
	S-5A	Ex-situ Thermal Desorption - On-site treatment (limited removal)
	S-5B	Ex-situ Incineration - Off-site treatment (limited removal)
	S-6	On-site Soil Washing (limited removal)
	GW-2A	Containment using vertical barriers (with hydraulic control of contained area)
	GW-2B	Containment using vertical barriers (with hydraulic control of contained area)
	GW-3	Ozone Sparge
	GW-5	Containment Using Vertical Barriers and Permeable Reactive Barrier Wall
	GW-6	In-site Chemical Oxidation
	GW-7	Electrical Resistance Heating
	GW-8	Steam Injection via Dynamic Underground Stripping (DUS)
	GW-9B	Groundwater Extraction with enhanced groundwater extraction system
Offshore	SED-1	No Action

Table 1 - Summary of Remedial Alternatives by Areas of Concern

Area of Concern	FS Designation	Description
	SED-2	Confined Disposal facility (CDF)
	SED-3A	Dredge and Subaqueous Cap with Mechanical Dredge (No treatment prior to off-
	SED-3B	Dredge and Subaqueous Cap with Mechanical Dredge (Thermal Treatment prior to off-site disposal)
	SED-3C	Dredge and Subaqueous Cap with Hydraulic Dredge (No treatment prior to off-site disposal)
	SED-3D	Dredge and Subaqueous Cap with Hydraulic Dredge (Thermal Treatment prior to off-site disposal)
	SED-4A	Dredge all with Mechanical Dredge (No treatment prior to off-site disposal)
	SED-4B	Dredge all with Mechanical Dredge (Thermal Treatment prior to off-site disposal)
	SED-4C	Dredge all with Hydraulic Dredge (No treatment prior to off-site disposal)
	SED-4D	Dredge all with Hydraulic Dredge (Thermal Treatment prior to off-site disposal)
	SED-5A	Dry Excavation
	SED-5B	Dry Excavation (Thermal Treatment prior to off-site disposal)
	SED-6A	Combination Dry Excavation Near shore/Mechanical Dredging Offshore (No treatment prior to off-site disposal)
	SED-6B	Combination Dry Excavation Near shore/Mechanical Dredging Offshore (Thermal Treatment prior to off-site disposal)
	SED-6C	Combination Dry Excavation Near shore/Hydraulic Dredging Offshore (No treatment prior to off-site disposal)
	SED-6D	Combination Dry Excavation Near shore/Hydraulic Dredging Offshore (Thermal Treatment prior to off-site disposal)

APPENDIX N-2
Detailed Description of Alternatives by Media

Appendix N-2
Detailed Description of Alternatives by Media

REMEDIAL ALTERNATIVES FOR SOIL

Alternative S-1 – No Action

The National Contingency Plan (NCP) at Title 40 Code of Federal Regulations (40 CFR §300.430(e)(6)) provides that the no-action alternative should be considered at every site. Implementation of no further action consists of leaving contaminated soil in place; no engineering, maintenance, or monitoring will be required. The "no action" alternative for soil was retained as required by the NCP as a basis for comparing the other alternatives.

Alternative S-2 – Containment Using Engineered Surface Barriers

Surface barriers that would prevent direct contact with subsurface soil contamination include the following:

- Asphalt cap;
- Clay cap;
- Multi-layer cap with a minimum two-foot thick clay barrier, drainage layer, soil and vegetated top soil cover; and,
- Multi-layer cap with geomembrane or equivalent (geocomposite fabric layer or GCL).

Key elements of the conceptual design for the use of these engineered surface barriers are as follows:

1. In the upland area the existing building and asphalt pavement will be repaired, upgraded or replaced to improve the integrity of the barriers on the south side of St. Claire Street.
2. New asphalt pavement on the north side of St. Claire Street (NSPW storage yard) and at Kreher Park (marina parking lot) could be installed as surface barriers for these areas to replace existing gravel surfaces.
3. A RCRA class D (i.e., ch. NR 500, WAC) cap will be placed over the former coal tar dump area. This will be an extension of the fine grained low permeability soil cap installed in the adjacent former seep area (following the removal of contaminated soil) as an interim response in 2002.
4. Existing fill soils covering the remainder of Kreher Park are currently preventing direct contact with subsurface contamination. With respect to soil contamination, capping the remainder of Kreher Park will be unnecessary to prevent direct contact with contaminated soil because no VOC or SVOC contaminants exceed RAOs in fill soils. However, partial and complete capping options for Kreher Park were evaluated as potential groundwater containment remedial responses. The former waste water treatment plant is preventing direct contact with the

subsurface contamination in that area. In the event that the building is removed, the area will be covered with a clay cap or asphalt pavement to prevent direct contact with subsurface contamination.

5. Surface barriers will be periodically inspected and repaired or replaced as needed to ensure they are performing as designed.

Surface barriers would not reduce contaminant mass or toxicity of contaminants remaining in place, but they would prevent direct contact with contaminated soil and groundwater. Surface barriers would also reduce infiltration minimizing the potential migration of contaminants from the unsaturated zone to the saturated zone where contaminated soil is present. Consequently, surface barriers were evaluated in combination with remedial responses for soil (described below). Because surface barriers can also be used to reduce groundwater recharge from infiltration, surface barriers as caps were also evaluated in combination with groundwater remedial alternatives.

Alternative S-3 – Removal and Off-site Disposal

Removal consists of the excavation of contaminated soil with conventional earth moving equipment. Off-site disposal consists of the transportation of excavated material to an off-site landfill for disposal. Off-site disposal may include the selection of one or more existing landfill facilities for disposal, or alternatively siting and constructing a landfill in the Ashland area in accordance with ch. NR 500, WAC specifically for the disposal of material removed from the Site. Removed material will include contaminated soil from the filled ravine at the upper bluff area, contaminated soil from Kreher Park, and sediment dredged from the offshore inlet area adjacent to the Park. A cost benefit analysis will be needed to evaluate the use of existing landfills, or the construction of a landfill specifically for material removed from the site. Off site disposal facilities will be evaluated in the design phase, and will depend on the cumulative disposal volume of all material from the Site. Both limited and unlimited removal alternatives for contaminated soil from the filled ravine and at Kreher Park were retained for evaluation as potential remedial alternatives.

Significant contaminant mass can be removed by excavation. However, site conditions may prevent the removal of all contamination exceeding RAOs by excavation. Residual soil and groundwater contamination may remain following excavation activities. If residual contamination remains above the RAOs, institutional controls and/or natural attenuation and/or other remedial action may be needed to achieve compliance with RAOs. Direct contact with residual soil and groundwater contamination can be prevented with asphalt pavement or clay caps as surface barriers; using asphalt pavements as a surface barrier was also included to restore site use to pre-remediation conditions.

Alternative S-3A - Limited Removal and Off-site Disposal

Limited removal involves the excavation of material from areas with the highest levels of contamination. At the upper bluff area, this will require the removal of material from the

two areas in the filled ravine. The first and largest area is the former gas holder area on the south side of St. Claire Street where NAPL has been encountered. The second and smaller area is at the base of the filled ravine on the north side of St. Claire Street; NAPL was encountered at the base of the ravine at this location in and around a former clay pipe encountered during a 2001 site investigation. If residual contamination remains above the RAOs, institutional controls and/or natural attenuation and/or other remedial actions may be needed to achieve compliance with RAOs. Key elements of the conceptual design for limited removal at the upper bluff area are as follows:

1. Demolition of the center section of the NSPW service center for excavation south of St. Claire Street will be required to access contaminated soil beneath the building at the upper bluff area.
2. Removal of existing asphalt pavement in the alley and courtyard area will also be required.
3. All shallow water table wells screened in the fill soil unit will be abandoned prior to excavation. Piezometers screened in the underlying Copper Falls aquifer will be protected during excavation and backfilling activities and remain in place for future use.
4. Removal will be limited to the excavation of soil containing NAPL, and the removal of all buried structures (i.e. former gas holders south of St. Claire Street and the clay tile north of St. Claire Street) at the upper bluff area.
5. Removal south of St. Claire Street will include the excavation of unsaturated and saturated zone soils to a depth between 12 and 15 feet for an area approximately 130 feet by 130 feet, yielding between 7,600 to 9,400 cubic yards.
6. Removal north of St. Claire Street will include the excavation of saturated zone soil from the bottom five feet of the filled ravine where the clay tile and NAPL were encountered. At the surface, this excavation area will be approximately 30 feet by 75 feet wide. An estimated 75 to 150 cubic yards of NAPL contaminated soil will be removed from the base of the filled ravine.
7. Deep excavations, or excavations completed near facility buildings may require shoring to support sidewalls.
8. Groundwater seeping into the excavation will be collected, temporarily placed in storage tanks, and treated by the existing on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit. .
9. Excavated material will be transported off site for disposal at an existing commercial licensed landfill facility. As an alternative to using existing commercial off-site landfills, a NR500 WAC landfill may be sited on property owned or purchased by NSPW for the disposal of all material removed from the Site.

Site restoration will include backfilling excavated areas with clean fill material and installation of new asphalt pavement as a surface barrier over the excavated area south of St. Claire Street. These surface barriers and existing facility buildings will prevent direct contact and may achieve compliance with RAOs if residual soil contamination remains

above the RAOs. On the north side of St. Claire Street. fill soil (overlying NAPL contaminated soil) will be returned to the excavation, and clean soil will be used as to backfill the excavation to grade. Asphalt pavement will be then be placed over the entire gravel covered storage yard as a surface barrier to prevent exposure to fill material left in place on this side of the street. The existing street will be upgraded as needed to provide a surface barrier for this portion of the filled ravine.

At Kreher Park, limited removal will require the excavation of approximately 4,800 cubic yards of contaminated soil overlying the saturated wood waste layer at the former coal tar dump area. If residual contamination remains above the RAOs, institutional controls and/or natural attenuation and/or other remedial actions may be needed to achieve compliance with RAOs. Key elements of the conceptual design for limited removal at Kreher Park are as follows:

1. Site preparation will include clearing and grubbing of small trees and bushes near the south side of the former coal tar dump area.
2. Clean fill soil overlying contaminated soil at the former coal tar area will be removed and used as backfill material following the removal of contaminated soil above the saturated wood waste layer.
3. Removal will include the excavation of unsaturated and saturated zone soils approximately 5 feet thick for an area approximately 260 feet by 100 feet, yielding approximately 4,800 cubic yards.
4. Groundwater seeping into the excavation will be collected, temporarily placed in storage tanks, and treated by the on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
5. Excavated material will be transported off site for disposal at an existing licensed landfill facility, or as an alternative to using an existing off-site landfill, a ch. NR500 landfill may be sited on property owned or purchased by NSPW for the disposal of all material removed from the Site.
6. Site restoration will include backfilling with clean fill material, and installation of a new RCRA Subtitle C or D (NR 500) cap over the excavated area.

With the exception of the former coal tar dump area no RAOs were exceeded in unsaturated zone soil at Kreher Park. Existing fill soils covering the remainder of Kreher Park are currently preventing direct contact with LNAPL contamination in the underlying saturated wood waste layer. The former waste water treatment plant also prevents direct contact with subsurface materials. In the event that the building is removed, the area will be covered with a clay cap or asphalt pavement to prevent direct contact. Using surface barriers as caps that prevent infiltration and direct contact are evaluated as potential groundwater remedial alternatives.

Alternative S-3B - Unlimited Removal and Off-site Disposal

Unlimited removal will consist of the removal of all fill material and contaminated soil above RAOs. At the upper bluff area, this will require the excavation of all fill material from the filled ravine north from the alley between Lake Shore Drive and St. Claire Street. Key elements of the conceptual design for unlimited removal at the upper bluff area are as follows:

1. Demolition of the center section of the NSPW service center for excavation south of St. Claire Street will be required to access contaminated soil beneath the building at the upper bluff area.
2. Removal of existing asphalt pavement in the alley and courtyard area will also be required.
3. Removal and replacement of the section of St. Claire Street overlying the filled ravine (including underground utility realignment) will also be required.
4. Removal will include the excavation of soil containing NAPL, and the removal of all underground structures (i.e. former gas holders) at the upper bluff area. Unlimited removal will include the entire filled ravine north of the alley located between Lake Shore Drive and St. Claire Street to the bluff face. This will include the excavation of approximately 35,000 cubic yards of unsaturated and saturated zone fill material from the filled ravine. This volume includes an estimated 15,000 cubic yards of fly ash material from the area on the north side of St. Claire Street.
5. Deep excavations, or excavations completed near facility buildings may require shoring to support sidewalls.
6. Groundwater seeping into the excavation will be collected, temporarily placed in holding tanks, and treated by the on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
7. Excavated material will be transported off site for disposal at an existing licensed landfill facility, or as an alternative to using an existing off-site landfill, a ch. NR500 landfill may be sited on property owned or purchased by NSPW for the disposal of all material removed from the Site. (Fly ash material may be transported to NSPW's existing fly-ash landfill for disposal.)
8. As an alternative, depending on the available existing landfill capacity, an NR500 landfill may be sited on property owned or purchased by NSPW.
9. Site restoration will include backfilling with clean fill material, replacement of St. Claire Street and utilities, and the installation of new asphalt pavement over excavated areas on the north and south sides of St. Claire Street as a surface barrier for any residual soil contamination remaining above the RAOs.

At Kreher Park, this will require the removal of the wood waste layer and overlying fill soil between Prentice and Ellis Avenues. Key elements of the conceptual design for unlimited removal at Kreher Park are as follows:

1. Site preparation will include clearing and grubbing small trees and bushes near the south side of the former coal tar dump area, and demolition of the former WWTP facility.
2. Clean fill soil overlying the wood waste layer will be removed, salvaged and used to backfill the excavated former ravine at the upper bluff area, or returned to Kreher Park for use as fill material.
3. Removal will include the excavation of the wood waste layer and the overlying fill soil. The estimated volume of fill soil and wood waste material is approximately 223,000 cubic yards.
4. Because the excavation will be completed below lake level, a temporary sheet pile wall will be constructed on the north, east, and west sides of the construction area to separate the excavation area from the lake. Approximately 2,000 feet of sheet pile would be installed to a minimum depth of 16 feet below ground surface.
5. Groundwater removed from the saturated portion of the excavation and any seepage into the excavation will be collected and treated by an on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
6. Excavated material will be transported off site for disposal at an existing licensed landfill facility, or as an alternative to using an existing off-site landfill, a ch. NR500 landfill may be sited on property owned or purchased by NSPW for the disposal of all material removed from the Site. If possible, wood suitable for fuel at the Bayfront power plant will be salvaged and used for power generation.

Unlimited removal will result in significant site disturbance, which may result in temporary or permanent loss of the current use of Kreher Park. Kreher Park could be restored to pre-filling conditions (i.e. wetland area or shallow lakebed), or backfilled with clean fill to restore it to present elevations. Our estimated cost assumes site restoration to pre-filling conditions, which would allow removal of the sheet pile wall. If the excavated area is backfilled to existing grade, the sheet pile wall will remain in place until filled to present grade.

Alternative S-4 – Removal and On-site Disposal

Removal will consist of the excavation of contaminated soil with conventional earth moving equipment. On-site disposal consists of the transportation of excavated material to an on-site landfill for disposal. Following the removal of contaminated soil, residual soil and groundwater contamination may remain above RAOs, which may require natural attenuation and/or institutional controls and/or other remedial actions for the excavated area. Inadequate space is available for on-site disposal at the upper bluff area, but adequate space is available at Kreher Park for the construction of an on-site disposal cell. The on-site disposal cell at Kreher Park could accommodate all or a portion of the material removed from the filled ravine at the upper bluff area previously described for Alternatives S-3A (limited removal) and S-3B (unlimited removal). It could also accommodate the limited removal of contaminated soil from the former coal tar dump area. Additionally, on-site disposal could accommodate the disposal of dredged sediment

from the inlet area. On-site disposal would need to be completed in combination with containment alternatives for shallow groundwater at Kreher Park and/or in conjunction with sediment containment alternatives described below. Key elements of the conceptual design for limited and unlimited removal of material from the filled ravine at the upper bluff and limited removal of contaminated soil from the former coal tar dump area are described above.

Alternative S-4A includes limited removal and on-site disposal of material from the upper bluff and the former coal tar dump area. Between seven and nine feet of contaminated soil could be placed in a one acre disposal cell constructed at Kreher Park between Prentice Avenue and the former coal tar dump area. Alternative S-4B includes a larger disposal cell required for unlimited removal material at the upper bluff area. This would require placement of approximately six feet of contaminated soil in a disposal cell four acres in size. The conceptual design for the construction of an on-site disposal facility at Kreher Park follows:

1. Site preparation will include clearing and grubbing of small trees and bushes near the south side of the former coal tar dump area.
2. A disposal cell for material excavated from the upper bluff area will be constructed at Kreher Park. Contaminated soil from the former coal tar dump area will also be placed in this disposal cell.
3. The disposal cell will include a liner and a cap The size and location of the disposal cell will depend on the volume of material removed from the filled ravine
4. Clean fill soil overlying the wood waste layer at Kreher Park will be removed for the construction of the disposal cell and used to backfill excavated areas. Fill soil outside the foot print of this area will be left in place.
5. Any groundwater seeping into the disposal cell during construction will be collected, temporarily placed in holding tanks, and treated by an on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
6. Site restoration at the upper bluff will include backfilling with salvaged clean fill material and installation of a RCRA cap or new asphalt pavement over the excavated area south of St. Claire Street, the existing street, and the gravel covered courtyard area on the north side of the street. A RCRA Subtitle D (ch. NR 500) cap will then be placed over the backfilled former coal tar dump area.
7. Long-term operation and maintenance for the disposal cell will include the groundwater monitoring and periodic inspection and repair of all asphalt and soil caps.

This soil remedial alternative could be combined with containment alternatives evaluated for groundwater and sediment. If excavated soil and sediment are mixed, a larger disposal cell will be required. The design of the liner and cap should be compatible with the groundwater remedial response selected for shallow groundwater at Kreher Park. The

thickness of the disposal cell liner could be reduced if containment is selected as the final remedial response.

Alternative S-5 – Ex-situ Thermal Treatment

Thermal treatment physically separates volatile and some semi-volatile contaminants from excavated soil or sediment by using ambient air, heat, and/or mechanical agitation to volatilize contaminants from soil into a gas stream for further treatment. Thermal treatment is achieved by either low temperature thermal desorption (LTTD), high temperature thermal desorption (HTTD), or incineration. The type of thermal treatment selected will be based on RAOs for VOCs and PAHs in treated soil. Another consideration is the suitability of treated soil as backfill material; soil treated by LTTD will retain pre-treatment physical properties (i.e. organic content) whereas soil treated by HTTD and incineration will not. Soils thermally treated on site can be returned to the excavation as backfill. Clean fill will be needed to replace soils transported off site for treatment and disposal.

LTTD is highly effective for VOCs; PAH compounds can also be treated, but at a reduced effectiveness. HTTD is effective for PAH compounds, but is not as cost effective as LTTD for VOCs. Incineration is effective for both VOCs and PAH compounds, but treating contaminated soil at high temperatures (1,400 to 2,200 °F) to volatilize and combust organic compounds would require significantly more effort than LTTD or HTTD. An on-site mobile incinerator would operate in a similar fashion as HTTD except the kiln would be direct-fired and would cause some COCs to be destroyed before the vapors reach the secondary combustion chamber. In addition, the gas flow rates are higher in an incinerator since the fuel and air combustion gases are included in the gases sent from the kiln to the secondary combustion chamber. Additional soil tests such as sieve analysis, soil fusion temperature, and soil heating value are generally needed to achieve proper incineration. Although mobile incinerators are available, most incineration is achieved at off-site facilities due to the substantial amount of equipment involved. Transportation costs, energy costs to sustain high temperatures, and regulatory compliance for incineration would be significantly higher than LTTD and HTTD costs. For this analysis we have assumed that on-site treatment will be completed by LTTD or HTTD, and that incineration will be completed at an off-site facility.

Alternative S-5A - Limited Removal and On-site Thermal Treatment

On-site thermal treatment will require excavation of contaminated material at the upper bluff area as previously described for the limited removal alternatives described above (Alternatives S-3A and S-4A). Excavated soil could be transported off site, but most likely would be treated on site by a mobile unit. Debris must be separated by size from material suitable for thermal treatment and transported off site for disposal. Consequently, wood waste at Kreher Park and fly-ash and cinders in the filled ravine at the upper bluff area must be separated from NAPL contaminated material encountered in these areas. Thermal treatment by LTTD or HTTD will be completed for suitable NAPL contaminated fill material, and contaminated material not suitable for thermal treatment

will be transported off site for disposal. Fill material including fly ash and cinders that is not contaminated with VOC and PAH compounds will be returned to the excavation. If residual soil and groundwater contamination remains above RAOs, institutional controls and/or natural attenuation and/or other remedial actions may be needed to achieve compliance with RAOs.

Thermal treatment will be performed on suitable fill material from areas with the highest levels of contamination. This includes the former gas holder area at the upper bluff, the NAPL in the ravine and contaminated soil encountered above the wood waste layer at Kreher Park; the underlying wood waste layer would not be suitable for thermal treatment. Key elements of the conceptual design for ex-situ thermal treatment of material removed from these areas follows:

1. A mobile unit and ancillary equipment will be set up at Kreher Park because inadequate space is available at the upper bluff area.
2. Demolition of the center section of the NSPW service center for excavation south of St. Claire Street will be required to access contaminated soil beneath this building at the upper bluff area.
3. Removal of existing asphalt pavement in the alley and courtyard area will also be required.
4. All shallow water table wells screened in the fill soil unit will be abandoned prior to excavation. Piezometers screened in the underlying Copper Falls aquifer will be protected during excavation and backfilling activities and remain in place for future use.
5. Removal will include the excavation of soil containing NAPL, and the removal of buried structures (i.e. former gas holders) at the upper bluff area south of St. Claire Street. This area includes the excavation of unsaturated and saturated zone soils to a depth between 12 and 15 feet for an area approximately 130 feet by 130 feet, yielding between 7,600 and 9,400 cubic yards. Also included for removal will be soil containing NAPL in the ravine on the north side of St. Claire Street. This will include the excavation of saturated zone soil from the bottom five feet of the filled ravine where the clay tile and NAPL were encountered. At the surface, this excavation area will be approximately 30 by 75 feet wide. An estimated 75 to 150 cubic yards of NAPL contaminated soil will be removed from the base of the filled ravine.
6. Removal will also include the excavation of unsaturated and saturated zone soils at the former coal tar dump area. This includes approximately 5 feet of contaminated soil in an area approximately 260 feet by 100 feet, yielding approximately 4,800 cubic yards.
7. Deep excavations, or excavations completed near facility buildings may require shoring to support sidewalls.
8. Groundwater seeping into the excavation will be collected, temporarily placed in holding tanks, and treated by the on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.

9. Saturated and unsaturated zone material will be thermally treated to reduce contaminant mass and toxicity and returned to the excavation as back fill. Material unsuitable for thermal treatment will be transported off site for landfill disposal. Fill material not contaminated with VOC and PAH compounds will be returned to the excavation as backfill.
10. Site restoration at the upper bluff area will include the installation of new asphalt pavement as a surface barrier over the excavated area on both sides of St. Claire Street, and new asphalt pavement at the gravel covered courtyard area on the north side of the street. The existing street (inspected for water tightness and sealed or replaced as needed) and new asphalt pavement on the NSPW property will prevent exposure to fill material beneath St. Claire Street and the NSPW storage yard.
11. Site restoration at Kreher Park will include backfilling excavated areas with clean fill material and installation of a new RCRA Subtitle D (ch. NR 500) cap over the excavated area.
12. Long-term operation and maintenance of backfilled areas will include groundwater monitoring, cap maintenance including the periodic inspection and repair of all asphalt and soil caps.

Alternative S-5B - Limited Removal and Off-site Incineration

Incineration will require excavation of contaminated material at the upper bluff area and the former coal tar dump area at Kreher Park as previously described for the other limited removal alternatives (Alternatives S-3A, S-4A, and S-5A). Contaminated soil suitable for incineration would be transported off site to a licensed facility for treatment and disposal. Wood waste at Kreher Park and fly-ash and cinders in the filled ravine at the upper bluff area must be separated from contaminated soil selected for incineration. Debris will be separated by size from material suitable for incineration and transported off site for disposal, and fill material not contaminated with VOCs and PAHs will be returned to the excavation as backfill.

As with thermal treatment, incineration will be performed on suitable fill material from areas with the highest levels of contamination. This includes the former gas holder area at the upper bluff, the NAPL in the ravine and contaminated soil encountered above the wood waste layer at Kreher Park. Key elements of the conceptual design for ex-situ thermal treatment of material removed from these areas follows:

1. All contaminated material will be separated from debris and transported off site for incineration and/or off-site disposal. Ancillary equipment needed to separate material suitable for incineration will be set up at Kreher Park because inadequate space is available at the upper bluff area.
2. Demolition of the center section of the NSPW service center for excavation south of St. Claire Street will be required to access contaminated soil beneath the building at the upper bluff area.
3. Removal of existing asphalt pavement in the alley and courtyard area will also be required.

4. All shallow water table wells screened in the fill soil unit will be abandoned prior to excavation. Piezometers screened in the underlying Copper Falls aquifer will be protected during excavation and backfilling activities and remain in place for future use.
5. Removal will include the excavation of soil containing NAPL, and the removal of buried structures (i.e. former gas holders) at the upper bluff area south of St. Claire Street. This area includes the excavation of unsaturated and saturated zone soils to a depth between 12 and 15 feet for an area approximately 130 feet by 130 feet, yielding between 7,600 and 9,400 cubic yards. Also included for removal will be soil containing NAPL in the ravine on the north side of St. Claire Street. This will include the excavation of saturated zone soil from the bottom five feet of the filled ravine where the clay tile and NAPL were encountered. At the surface, this excavation area will be approximately 30 feet by 75 feet wide. An estimated 75 to 150 cubic yards of NAPL contaminated soil will be removed from the base of the filled ravine.
6. Removal will also include the excavation of unsaturated and saturated zone soils at the former coal tar dump area. This includes approximately 5 feet of contaminated soil in an area approximately 260 feet by 100 feet, yielding approximately 4,800 cubic yards.
7. Deep excavations, or excavations completed near facility buildings may require shoring to support sidewalls.
8. Groundwater seeping into the excavation will be collected, temporarily placed in holding tanks, and treated by the existing on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
9. Saturated and unsaturated zone material will be transported off site for incineration and subsequent off-site disposal. Material unsuitable for incineration will be transported off site for landfill disposal. Fill material not contaminated with VOC and PAH compounds will be returned to the excavation as backfill.
10. Site restoration will include backfilling the excavation with clean fill material and installation of new asphalt pavement as a surface barrier over the excavated area south of St. Claire Street to prevent direct contact with residual soil contamination. On the north side of St. Claire Street, fill soil (overlying NAPL contaminated soil) will be returned to the excavation, and clean soil will be used as to backfill the excavation to grade. Asphalt pavement will be then be placed over the entire gravel covered storage yard as a surface barrier to prevent exposure to fill material left in place on this side of the street. The existing street will be upgraded, as needed, to provide a surface barrier for this portion of the filled ravine.
11. Long-term operation and maintenance of backfilled areas will include groundwater monitoring, cap maintenance including the periodic inspection and repair of all asphalt caps.

Alternative S-6 – Limited Removal and On-site Soil Washing

Soil washing is a water-based process for mechanically scrubbing excavated soil to remove contaminants by dissolving or suspending them in the wash solution. Contaminated soil from the saturated and unsaturated zones will be treated by soil washing following removal by excavation. Contaminants are either removed by dissolving or suspending them in a wash solution, or reducing concentrations in smaller volumes of soil by gravity separation. Wastewater used for soil washing is treated on site prior to discharge. A bio-slurry reactor is a hybrid soil washing technique that is used to treat a slurry of wastewater and contaminated soil. An aqueous slurry is created by combining soil, sediment, or sludge with water and other additives. The slurry is mixed to keep solids suspended and microorganisms in contact with the soil contaminants. Upon completion of the process, the slurry is dewatered and the treated soil is disposed or returned to the excavation. Material processing equipment (mixing unit and batch tanks) and water treatment equipment will require room for setup near one of the excavation areas. A mobile unit will be used to treat (wash) soil on site. Treated soil will be returned to the excavation as backfill material. Wastewater will be treated on-site and discharged to a sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit. Semi-volatile organics and hydrophobic contaminants may require the addition of a surfactant or organic solvent. A bench or pilot-scale treatability test may be needed to determine the best operating conditions and wash fluid compositions for soil washing and or bio-slurry treatment.

On-site soil washing can also be applied to contaminated material in the upper bluff area, and limited areas at Kreher Park, as described for the limited removal alternatives previously described (Alternatives S-3A, S-4A, S-5A, and S-5B). Man-made fill material (i.e. ashes, cinders, bricks, concrete, wood debris, and glass) is not suitable for soil washing and will require separation and off-site disposal. The presence of wood waste at Kreher Park and fly-ash and cinders in the filled ravine (on the north side of St. Claire Street in the upper bluff area) will preclude the use of soil washing of debris from these areas. Consequently, soil washing will be used for contaminated fill soil removed from areas with high concentrations of VOCs and PAH compounds at Kreher Park and the upper bluff area. If residual soil and groundwater contamination remains above RAOs, natural attenuation and/or institutional controls and/or additional remedial actions will be required to achieve compliance with RAOs.

Limited removal and on-site soil washing will be limited to areas with the highest levels of contamination. This includes the former gas holder at the upper bluff area where NAPL has been encountered, and the former coal tar dump area at Kreher Park. Key elements of the conceptual design for limited removal and ex-situ soil washing in the upper bluff area and Kreher Park are as follows:

1. Soil washing and ancillary equipment will be set up at Kreher Park because inadequate space is available at the upper bluff area.

2. Demolition of the center section of the NSPW service center for excavation south of St. Claire Street will be required to access contaminated soil beneath the building at the upper bluff area.
3. Removal of existing asphalt pavement from the alley and courtyard area will also be required.
4. All shallow water table wells screened in the fill soil unit will be abandoned prior to excavation. Piezometers screened in the underlying Copper Falls aquifer will be protected during excavation and backfilling activities and remain in place for future use.
5. Removal will include the excavation of soil containing NAPL, and the removal of buried structures (i.e. former gas holders) at the upper bluff area south of St. Claire Street. This area includes the excavation of unsaturated and saturated zone soils to a depth between 12 and 15 feet for an area approximately 130 feet by 130 feet, yielding between 7,600 and 9,400 cubic yards. Also included for removal will be soil containing NAPL in the ravine on the north side of St. Claire Street. This will include the excavation of saturated zone soil from the bottom five feet of the filled ravine where the clay tile and NAPL were encountered. At the surface, this excavation area will be approximately 30 feet by 75 wide. An estimated 75 to 150 cubic yards of NAPL contaminated soil will be removed from the base of the filled ravine.
6. Removal will also include the excavation of unsaturated and saturated zone soils at the former coal tar dump area. This includes approximately 5 feet of contaminated soil in an area approximately 260 feet by 100 feet, yielding approximately 4,800 cubic yards.
7. Deep excavations, or excavations completed near facility buildings may require shoring to support sidewalls.
8. Groundwater seeping into the excavation will be collected, temporarily placed in holding tanks, and treated by the on-site treatment system prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
9. Saturated and unsaturated zone material will be treated by soil washing to reduce contaminant mass and toxicity, and returned to the excavation as back fill. Material unsuitable for soil washing will be transported off site for landfill disposal.
10. Site restoration will include the installation of new asphalt pavement as a surface barrier over the excavated area south of St. Claire Street, and new asphalt pavement at the gravel covered courtyard area on the north side of the street. The existing street (inspected for water tightness and sealed or replaced as needed) and new asphalt pavement on the NSPW property will prevent exposure to fill material beneath St. Claire Street and the NSPW storage yard.
11. Site restoration at Kreher Park will include backfilling with clean fill material, and installation of a new RCRA Class C or D cap or asphalt road or parking lot over the Kreher Park area.
12. Long-term operation and maintenance for the site will include groundwater monitoring and periodic inspection and repair of all asphalt caps.

REMEDIAL ALTERNATIVES FOR GROUNDWATER

Alternative GW-1 – No Action

The "no action" alternative for groundwater was retained as required by the NCP as a basis for comparing the other alternatives. The NCP at Title 40 Code of Federal Regulations (40 CFR §300.430(e)(6)) provides that the no-action alternative should be considered at every site. Implementation of no further action consists of leaving contaminated groundwater in place; no engineering, maintenance, or monitoring will be required.

Alternative GW-2 – Containment Using Engineered Surface and Vertical Barriers

Containment for groundwater contamination consists of the utilization of natural or man-made barriers to prevent potential exposure to or migration of contaminants with subsurface contamination. Containment alternatives retained for screening and evaluated in this report include engineered surface barriers, vertical barrier walls installed in the aquifer, and extraction wells (hydraulic barrier wells). Surface barriers eliminate the direct contact exposure pathway. They also can reduce contaminant leaching from the unsaturated zone, by restricting infiltrating water from contacting contaminated soil at areas where contaminated soil is present. Vertical barrier walls and barrier wells prevent the off-site migration of contaminants with groundwater. Engineered surface barriers, vertical barrier walls, and barrier wells are described below.

Engineered Surface Barrier

Engineered surface barriers are considered passive containment alternatives because the contaminated zone is not disturbed, and only minimal maintenance is required following implementation. Surface barriers include the following:

- Asphalt cap;
- Low permeability soil cap (i.e. 2 feet of clay with hydraulic conductivity of less than 10^{-7} cm/sec);
- Multi-layer cap with a minimum two-foot thick clay barrier, drainage layer, soil and vegetated top soil cover; and,
- Multi-layer cap with geomembrane (a minimum two-foot thick clay barrier, geomembrane, drainage layer, soil and vegetated top soil cover.

At the upper bluff area, asphalt caps over the filled ravine as surface barriers will be compatible with existing and future site use. At Kreher Park, a low permeability soil cap could be placed over the entire 11.6 acre parcel, but installation of a clay cap over the entire park will require the removal of the existing marina parking lot, Marina Drive, and the former WWTP. New asphalt roads, parking lots, and/or slab on grade buildings could be then constructed on top of a larger cap, or installed at select areas in place of a cap for the entire park. These smaller surface barriers will be designed to be compatible with existing and future site use, and include asphalt pavement for the marina parking lot and a

low permeability cap for the former coal tar dump. Asphalt pavement over the gravel covered marina parking lot will reduce infiltration at this area. A surface barrier over the former coal tar dump area will reduce contaminant leaching from the unsaturated zone if contaminated soil remains in place. If the WWTP is removed, a clay cap or asphalt pavement could be installed at this area.

Multi-layer caps will be compatible with on-site and off-site disposal options for soil and the CDF for sediment. A multi-layer cap will also be compatible at areas of unexcavated soil, especially at Kreher Park. Single layer asphalt and low permeability caps will meet 40 CFR Subtitle D requirements, and multi-layer caps will meet 40 CFR Subtitle C requirements. As with potential soil remedial alternatives, surface barriers will be included as key elements of the potential groundwater and sediment remedial alternatives.

Barrier Wells

Barrier wells are considered active hydraulic containment alternatives. Long-term operation (groundwater extraction), maintenance, and monitoring will be required. Down gradient barrier wells were retained for groundwater at the upper bluff and for the saturated fill unit at Kreher Park. These wells will prevent contaminants from migrating off site with groundwater. However, down gradient barrier wells were not considered for the Copper Falls aquifer. Available information for the regional groundwater flow conditions in the Copper Falls indicate that a potential stagnation zone beneath the center of Kreher Park has prevented the dissolved phase plume from migrating beyond the shoreline. Additional hydrogeologic and groundwater quality data will be required to ensure that contaminants are not migrating beyond the Kreher Park shoreline.

Well EW-4 was installed at the mouth of the filled ravine to prevent water discharging to the seep area at Kreher Park; it has been in operation since 2002. A final remedy for shallow groundwater in the ravine could include continued operation of EW-4, installation of additional extraction wells, or future operation of EW-4 along with a vertical barrier wall installed down gradient from the extraction well (use of EW-4 will reduce the hydraulic head behind the vertical barrier). An evaluation of the volume of groundwater discharging from the filled ravine and a capture zone analysis for EW-4 will be necessary to evaluate which alternative will be more effective. Continued use of EW-4 as a barrier well for the upper bluff, and barrier wells for shallow groundwater at Kreher Park are evaluated with Alternative GW-9 (removal using groundwater extraction).

Vertical Barrier Walls

Vertical barrier walls consist of a slurry wall or sheet piling installed around the perimeter of the contaminated groundwater zone. A slurry wall is a low permeability barrier constructed by placing a low permeability material (slurry) in a trench around the perimeter of the contaminated groundwater mass. Sheet piling will consist of inter-locking sheets of steel pilings that form a continuous wall installed around the perimeter

of the contaminated groundwater mass. Vertical barrier walls are also considered active containment alternatives because contaminated material may be disturbed during construction, and/or long-term maintenance such as groundwater extraction from the contained area may be required.

Engineered vertical barrier walls were retained for further evaluation as potential containment alternatives for shallow contaminated groundwater encountered in the ravine fill at the upper bluff and at Kreher Park. However, vertical barrier walls would not be feasible for the underlying Copper Falls aquifer because this deep aquifer is confined by the Miller Creek Formation. Installation of a barrier wall for contaminants in the Copper Falls aquifer will require penetration of the Miller Creek Formation which will likely compromise the long-term integrity of this confining unit.

For shallow groundwater, both types of vertical barriers could be anchored into the underlying low permeability Miller Creek Formation to create a barrier that will prevent contaminants in the shallow fill units from migrating off site with groundwater. However, because groundwater in the filled ravine discharges to Kreher Park, vertical barriers will be used to funnel groundwater from the filled ravine to Kreher Park, which will be enclosed by vertical barrier walls. Engineered surface barriers will be used with vertical barriers to minimize groundwater recharge to contained areas from infiltration. At Kreher Park, vertical barriers may be also used in combination with containment or dredging alternatives evaluated for near shore sediment described in Section 8.0. The location of the vertical barrier wall at Kreher Park is shown on Figure 7-1. Key elements for the conceptual design of a sheet pile vertical barrier wall around the perimeter of Kreher Park follows:

1. Site preparation will include clearing and grubbing of small trees and bushes along the bluff and near the former seep area as needed.
2. Although the former wastewater treatment plant will be located within the contained area, demolition of this dormant facility may be required.
3. A vertical barrier wall will be placed around the perimeter of Kreher Park. This vertical barrier will consist of a sheet pile wall anchored into the underlying Miller Creek Formation.
4. The sheet pile wall along the shoreline will be installed at an approximate depth of 25 feet below existing grade to allow the off-shore removal of sediment to a depth of ten feet adjacent to the sheet pile wall. The sheet pile wall on the south, east, and west sides of Kreher Park will be installed at an approximate depth of 16 feet below existing grade.
5. Surface barriers will be installed over the filled ravine to minimize groundwater recharge from infiltration, and the sheet pile wall on the south side of Kreher Park will terminate on the east and west flanks of the filled ravine to create a "funnel" for shallow groundwater discharge into Kreher Park.
6. A groundwater diversion trench will be installed between the remainder of the south wall and the upper bluff area to divert groundwater that currently seeps from the upper bluff area into the Kreher Park fill unit.

7. At Kreher Park, site restoration will include installation of new asphalt pavement over the marina parking lot to minimize infiltration in this area. Additionally, a low permeability soil cap will be placed over the former coal tar dump area, and if applicable, a soil cap over the disposal cell.
8. Regrading and a storm-water basin will be constructed within the confined area to manage storm-water and restrict infiltration. The storm water basin will be lined to minimize seepage.
9. Long-term operation and maintenance of the facility will include the removal of contaminated groundwater, and annual inspection of surface barriers. A minimum of 15 groundwater extraction wells will be installed to remove groundwater and reduce the hydraulic head within the confined area. Contaminated groundwater will be conveyed to a treatment system constructed on-site prior to discharge to a sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
10. The treatment system will include an oil water separator, transfer pumps, and air stripper. This remediation equipment will be housed in a small on-site treatment building.

Institutional controls (i.e. deed restrictions) will likely be implemented as part of this remedial response to prevent exposure to groundwater contamination remaining within the contained area. Long-term operation and maintenance will include groundwater monitoring to confirm contaminants are not migrating from the contained area. This will include fluid level monitoring and groundwater extraction to ensure the hydraulic head within the confined area remains at or below lake level.

Although a cap for the entire Kreher Park area will result in significant site disturbance and additional implementation cost, long-term operation, maintenance, and monitoring (OM&M) costs may be lower if it can significantly reduce the volume of groundwater extraction and treatment that is required. To evaluate implementation and OM&M costs, annual groundwater recharge at Kreher Park from infiltration was evaluated for existing conditions, for partial caps (asphalt pavement for marina parking lot and clay cap for former coal tar dump area) with vertical barriers, and for a low permeability cap and vertical barriers for the entire park. Calculation and assumption are described in detail in Appendix D2 of the FS, and results (the nearest 100 gallons) are summarized below.

Existing Conditions	3,685,000 (gallons)
Partial Cap	2,245,400
Entire Cap	892,900

As shown above, partial caps will reduce annual groundwater recharge from 3,685,000 gallons to 2,245,374, and a complete area cap will reduce annual recharge to 898,900 gallons. Partial caps will result in a 39-percent reduction in recharge, and capping all of Kreher Park will result in a 75 or 76-percent reduction in recharge. Estimated costs for partial caps are included as Alternative GW-2A, and estimated costs for capping all of

Kreher Park and to further reduce the volume of groundwater extraction required is included as Alternative GW-2B.

Alternative GW-3 – In-situ Treatment using Ozone Sparge

Ozone sparging is an in-situ chemical oxidation technology that can be used to oxidize and degrade contaminants in groundwater. Because ozone is a gas, it can be injected into the saturated zone as a gas via sparging. Sparging consists of injecting air or oxygen rich ozone into an aquifer as a gas through small diameter sparge wells. Commercially, ozone is generated by a high voltage discharge through air or oxygen in an ozone generator. Generally, yields are on the order of 1 to 3-percent ozone by volume in air and 2 to 6-percent ozone by volume in oxygen. In water, ozone decomposes to form free radicals. These free radicals are strong oxidizers and react with contaminants in water to form carbon dioxide and water. As an additional benefit, ozone treatment increases the dissolved oxygen level in the water when any un-reacted free radicals combine to form water and oxygen; the dissolved oxygen content in groundwater promotes biodegradation of contaminants.

Ozone sparging is typically used for dissolved phase contamination, but is typically not used in areas where NAPL is present. If used for NAPL contamination, groundwater extraction will likely be needed because ozone/air injection may displace NAPL and/or cause a chemical reaction increasing the mobility of NAPL. This mobilized material is then recovered via extraction wells. Air/ozone sparging was retained for further evaluation as a potential in-situ treatment alternative for contaminated shallow groundwater encountered at the upper bluff and at Kreher Park, and in the underlying Copper Falls aquifer. Key elements for the conceptual design of an ozone sparging system for shallow groundwater at the upper bluff area and at Kreher Park, and for the Copper Falls aquifer follows:

1. All sparge wells will be installed in soil borings advanced with a hollow stem auger by a rotary drill rig.
2. Sparge wells will be installed on approximate 50-foot diameter centers, and one control panel will inject ozone into a cluster of 12 sparge wells.
3. One control panel will be needed for shallow groundwater in the filled ravine.
4. Eight control panels will be needed for shallow groundwater at Kreher Park.
5. Six control panels will be needed for groundwater in the underlying Copper Falls aquifer.
6. All air lines between the sparge wells and control panels will be buried in shallow trenches.
7. For the Copper Falls aquifer, the existing groundwater extraction system will be operated concurrent with the ozone sparge system to recover NAPL; treatment of contaminated groundwater and NAPL recovery is evaluated further with Alternative GW-9.

Although this technology can also be used for contaminated shallow groundwater in the ravine fill and at Kreher Park, buried structures (the former gas holders) and debris (wood

waste, bricks, cinders, etc.) will interfere with installation and optimum delivery. Additionally, injecting into fill soil, which exhibits a wide range of physical characteristics (permeability in particular), may limit the effectiveness of this in-situ technology (experience with the SITE demonstration during 2006-2007 confirms these site conditions.

The ozone sparge system may need to be operated for several years, and long-term groundwater monitoring will be required to evaluate the effectiveness of the sparging and subsequent natural attenuation. Institutional controls will also be utilized for this option.

Alternative GW-4 – In-situ Treatment using Surfactant Injection and Dual Phase Recovery

Physical/chemical treatment includes the use of surfactants to enhance the removal of NAPL. Surfactant injection is an in-situ injection technology. Surfactants are "surface active agents" that reduce the interfacial tension between NAPL and water by adsorbing at the liquid-liquid interface, which can result in an increase in the mobility of NAPL. Injection can also displace oil trapped within the aquifer media. Groundwater remediation using surfactant is a two phase approach involving injection of surfactant and recovery of fluids. Surfactant is injected to displace or mobilize NAPL, which is then recovered slowly by groundwater extraction or rapidly by vacuum enhancement. Vacuum enhancement is also referred to as dual phase or multiphase extraction because an induced vacuum is used to remove air, water, and NAPL simultaneously.

Although this technology can also be applied to contaminated groundwater in the ravine fill and at Kreher Park, site conditions may prevent implementation and limit effectiveness. Buried structures (the former gas holders) and man made debris (wood waste, bricks, cinders, etc.) may prevent proper installation of injection/extraction wells. Additionally, fill soil, which exhibits a wide range of physical characteristics (permeability in particular), may limit the effectiveness of this in-situ technology. Consequently, it was not retained for screening as a shallow groundwater remedial response. For the Copper Fall aquifer, dual phase recovery was retained for screening. Key elements for the conceptual design of surfactant injection and dual phase recovery system the Copper Falls aquifer follows:

1. A minimum of 30 small diameter injection/extraction wells will be installed in borings advanced below the Miller Creek / Copper Falls interface where NAPL has been identified. (Existing piezometers in this area will also be utilized).
2. Each well will be constructed with 2-inch diameter SCH 80 PVC well casing and screen. A sand pack will be placed around a well screen five feet in length.
3. Surfactant will be injected into wells where NAPL has been encountered to lower the interfacial tension that restricts the movement of non-mobile NAPL in the aquifer
4. After allowing the surfactant to penetrate the formation for 24 to 48 hours, NAPL and groundwater is then removed by an induced vacuum and treated on site.

Fluids will be removed from the injection/extraction wells by vacuum enhancement.

5. Multiple applications will be needed to remove NAPL to the extent practicable; for this evaluation it is assumed that a minimum of five applications of surfactant will be needed. Fluid levels will be checked one month after treatment, and the next application will be completed if NAPL remains. To remove a significant mass of mobile NAPL, it is assumed that fluids will be removed monthly for six months following the fifth application.
6. Recovered fluids will be treated on site prior to discharge to a sanitary or storm sewer. This will require upgrades to the existing treatment system (i.e. new oil water separator, and air stripper for increased volume). Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
7. A pilot test using existing piezometers MW-2AR, MW-4A, MW-10B, MW-13A, MW-15A, MW-19A, MW-21A, and MW-22A screened at the Miller Creek / Copper Falls interface should be completed prior to full scale remediation to determine if a mobile vacuum truck or fixed based system is needed for dual phase recovery. The pilot test will also be used to evaluate the mobile mass of NAPL that can be removed, the number of applications needed and the most efficient frequency of fluid removal between injections.

Surfactant injection and dual phase recovery can likely be completed within one year, but the existing groundwater remediation system will be operated for several more years. Treatment of contaminated groundwater and NAPL recovery is evaluated further with Alternative GW-9. Long-term groundwater monitoring will be required to evaluate natural attenuation and institutional controls will be implemented as part of this option.

Alternative GW-5 – In-situ Treatment using Permeable Reactive Barrier Walls

Physical/chemical treatment also includes the use permeable reactive barrier (PRB) walls to treat contaminated groundwater migrating from source areas. PRB walls are limited to subsurface conditions where contaminants are found above a continuous aquitard at a depth within the vertical limits of trenching equipment. PRB walls are installed across the flow path of a contaminant plume, allowing the plume to passively move through the wall. There are two types of barriers, 1) permeable reactive barriers and 2) in-place bioreactors. Both allow the passage of water while restricting, via reaction with barrier materials, the movement of contaminants. Contaminants are degraded, adsorbed, or retained in/ by the barrier material.

PRB walls were not retained for the underlying Copper Falls aquifer; construction of the PRB would require penetration of the overlying Miller Creek Formation. The Miller Creek forms a confining unit for the Copper Falls aquifer, and construction will compromise the integrity of the confining unit. However, a PRB could be used as a remedial alternative for shallow groundwater. Instead of installing PRB walls in source areas, they are typically installed at down gradient locations to treat contaminated groundwater before it migrates off site. PRB systems are typically constructed as "gate"

and "funnel" systems. A funnel and gate system is a passive remediation method which utilizes cutoff walls (the funnel) to modify flow patterns so that ground water flows primarily through high conductivity gaps (the gates). The non-permeable funnel serves to lead the contaminated groundwater to the highly permeable gate which contains a reactive agent.

Because Kreher Park is filled lakebed, the lake is in hydraulic connection with shallow groundwater at Kreher Park. Vertical barriers can be used to prevent flow between Kreher Park and the lake. However, groundwater within the contained area may still be recharged by infiltration. Rather than extracting contaminated groundwater, shallow groundwater will be allowed to discharge from Kreher Park through the PRB wall. PRB walls are passive systems designed for long-term operation to control/ treat contaminants in-situ with normal groundwater migration. A sheet pile or slurry wall (vertical barrier) will be installed around the east, north, and south sides of Kreher Park to form the gate, and a down gradient PRB wall will be installed along the west side as the funnel. Rather than install another PRB wall for the filled ravine, a single PRB wall at the northwest perimeter of the park will treat shallow groundwater discharging from the entire site. Key elements for the conceptual design of a PRB wall for shallow groundwater at the site follow:

1. Site preparation will include clearing and grubbing of small trees and bushes along the bluff and near the former seep area as needed.
2. Although the former wastewater treatment plant will be located within the contained area, demolition of this dormant facility may still be required as part of the overall remediation to accommodate future site use.
3. Hydrogeologic modeling may be necessary to determine width of the hydraulic capture zone and residence time during design of the PRB.
4. A vertical barrier wall will be placed on the north, east, and south sides of Kreher Park. This vertical barrier will consist of a sheet pile wall anchored into the underlying Miller Creek Formation.
5. The sheet pile wall along the shoreline will be keyed into the Miller Creek Formation, at an approximate depth of 25 feet below existing grade to allow the off-shore removal of sediment to a depth of ten feet. The sheet pile wall on the south, east, and west sides of the Kreher Park will be installed at an approximate depth of 16 feet below existing grade.
6. A trench will be excavated on the west side of the Kreher Park for the PRB wall. The wall will be constructed with a porous layer of granular activated carbon to remove dissolved phase organic compounds prior to discharge.
7. The base of the PRB wall would be placed several feet below lake level, and the top of the PRB wall would be placed several feet above lake level. This will allow groundwater within the confined area to discharge as groundwater elevations in the contained area and lake levels fluctuate.
8. Monitoring wells will be installed on both side of the PRB wall, and water levels will be monitored to confirm that groundwater is flowing through the PRB wall.
9. Surface barriers will be installed over the filled ravine to minimize infiltration, and the sheet pile wall on the south side of Kreher Park will terminate on the east

and west flanks of the filled ravine to create a "funnel" for shallow groundwater discharge into Kreher Park.

10. A groundwater diversion trench will be installed between the remainder of the south wall and the upper bluff area to divert groundwater seepage into the Kreher Park fill unit.
11. Site restoration will include installation of new asphalt pavement over the marina parking lot. A low permeability soil cap will be placed over the former coal tar dump area to minimize potential exposure to subsurface contamination and minimize leaching of contaminants from the unsaturated zone. Regrading will be performed and a storm-water basin constructed within the confined area to manage storm-water and restrict infiltration.

The length and thickness of the PRB wall must be designed to allow adequate flow and treatment of contaminated groundwater discharging from the contained area. The thickness of the PRB wall increases retention time and treatment of contaminated groundwater. However, increasing the thickness of the PRB wall may reduce the volume of water that can pass through each linear foot of the wall. The length of the PRB wall can be increased to allow for increased flow through the wall. but increasing the length will increase the cost. Therefore an accurate estimate of the volume of water that will pass through the PRB wall is critical to the design. Discharge through the PRB wall will be influenced by 1) fluctuating lake levels, and 2) groundwater recharge from infiltration within the contained area. The PRB could function with or without impermeable surface barriers. However, because the length on the east side of the park is limited, surface barriers will likely be used to restrict groundwater recharge from infiltration, which will reduce the volume of groundwater passing through the PRB wall. A numerical flow model evaluating surface infiltration coupled with fluctuating lake levels may be needed to determine the length of PRB wall required.

Long-term operation and maintenance of the PRB wall will be minimal. Groundwater monitoring will be needed to evaluate the effectiveness of the PRB wall. The reactive material used to construct the PRB may need to be replaced if NAPL migrates from the source area and permeates the PRB, or the reactive material is becomes saturated with contaminants removed from groundwater passing through the wall. Fluid levels will also be monitored to ensure the hydraulic head within the confined area remains at or slightly above lake level. Institutional controls will likely be implemented to prevent direct contact with subsurface contaminants within contained areas as part of this remedial option.

Alternative GW-6 – Treatment using Chemical Oxidation

Chemical oxidation introduces strong oxidizing chemicals such as permanganate and peroxide into the subsurface to degrade VOCs and PAH compounds to CO_2 and H_2O end products. Permanganate or peroxide could be injected as liquid reagents through boreholes, wells, or mixed with a backhoe in shallow trenches. Chemical oxidation has an added benefit of enhancing biodegradation by increasing oxygen concentrations in the

subsurface. Chemical oxidation could be performed on saturated and unsaturated zone soils by injecting chemicals into the subsurface via borings or wells.

In-situ chemical oxidation could be used for unsaturated and saturated zone contamination at the upper bluff. However, existing conditions at the upper bluff area (the NSPW facility building and buried gas holders) and at Kreher Park (wood waste layer) may limit implementability. Mixing reagent in shallow trenches would be the most effective treatment method at Kreher Park because contamination is present at shallow depths at the former coal tar dump area, and would be easily accessible. Because in-situ chemical oxidation reactions can result in the generation of off-gases, primarily CO_2, passive venting or an active SVE system may be required to capture off-gases. The presence of NAPL may require multiple applications to lower contaminant concentrations to acceptable levels. Key elements for the conceptual design for in-situ chemical oxidation for shallow soil and groundwater at the site follow:

1. Demolition of the center section of the NSPW service center south of St. Claire Street will be required to access contaminated soil beneath the building at the upper bluff area.
2. Between 200 and 300 injection borings will be advanced in the filled ravine using a direct push drill rig.
3. For this evaluation it is assumed that approximately 1,500 gallons of reagent will be injected into each boring.
4. Injections will be completed in a controlled manner and monitored to ensure that reaction off-gases do not create unsafe conditions (i.e. explosive conditions). A minimum of 10 passive vent wells will be installed in the filled ravine to allow off-gases to escape, which will minimize the subsurface migration of gases. Each vent well will be installed to an approximate depth of 20 feet with well screens 10 feet in length. Because the water table will intersect the well screen, these wells may also be used to recover fluids that rise to the surface in response to chemical reactions taking place in the subsurface. Recovered fluids will be placed in a holding tank and discharged to the on-site treatment system.
5. Site restoration at the upper bluff area will include replacement of existing asphalt pavement and new pavement over the footprint of the demolished building south of St. Claire Street. New pavement on the north of St. Claire Street will also be installed to prevent infiltration into this section of the filled ravine.
6. At Kreher Park, site preparation will include clearing and grubbing small trees and bushes along the bluff and near the former seep area as needed.
7. Chemical oxidation at Kreher Park will be completed above and in the wood waste layer where DNAPL is encountered and at the former coal tar dump area by mixing reagent in a shallow excavation.
8. Additionally, between 100 and 150 injection borings will be advanced at the former seep area and near TW-11 where DNAPL has been encountered. A direct push drill rig will be used to advance these borings, and approximately 1,500 gallons of reagent will be injected into each boring. Existing wells MW-7 and TW-11 will be used as passive vent wells in these areas.

9. Site restoration will include installation of new asphalt pavement over the marina parking lot and a low permeability soil cap over the former coal tar dump area to minimize potential exposure to subsurface contamination and minimize infiltration.
10. Regrading and a storm-water basin will be constructed within the confined area to manage storm-water and restrict infiltration.
11. Multiple applications may be needed to reduce contaminant levels to the extent practicable. The estimated remedial costs included in this report assume two applications. The first application will be completed in a regular grid pattern over the treatment area, but additional applications will be completed within the treatment area as needed.

Implementation for the underlying Copper Falls would be more extensive; it may require groundwater extraction rather than soil vapor extraction. EPA's SITE program recently completed a demonstration pilot test to fully evaluate the implementability of this alternative at the Site. Additional data will be available in the near future following compilation of pilot test data. Chemical oxidation may also increase the mobility of NAPL recovered by extraction wells resulting in the removal of significant contaminant mass in a short time frame. Preliminary results from the recent SITE program pilot test indicate that injection into areas with NAPL contaminants resulted in an initial vigorous reaction followed by an increase in the mobility and recovery of NAPL. Additional data is currently being collected and will be available in the near future to evaluate NAPL recovery and improvements to groundwater quality. Key elements for the conceptual design for in-situ chemical oxidation for the Copper Falls aquifer follow:

1. Between 250 and 500 injection borings will be advanced in the Copper Falls aquifer using a direct push drill rig.
2. For this evaluation it is assumed that approximately 1,500 gallons of reagent will be injected into each boring.
3. Existing extraction wells EW-1, EW-2, and EW-3 will continue to operate during and after reagent injection.
4. A minimum of 7 additional extraction wells will be installed in the Copper Falls aquifer in borings advanced with hollow stem auger using a rotary drill rig.
5. Recovered fluids will be treated on site prior to discharge to the sanitary or storm sewer. This will require upgrades to the existing treatment system. Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
6. Multiple applications may be needed to reduce contaminant levels to the extent practicable. The estimated remedial costs included in this report assume two applications. The first application will be completed in a regular grid pattern over the treatment area, but additional applications will be completed within the treatment area as needed.

Although chemical oxidation applications can be completed within a short period of time, the groundwater extraction system may be operated for several years; treatment of contaminated groundwater and NAPL recovery is evaluated further with Alternative

GW-9. Long-term groundwater monitoring to evaluate natural attenuation and institutional controls will be included with this remedial response.

Alternative GW-7 – In-situ Treatment using Electrical Resistance Heating

Electrical resistance heating (ERH) technology uses electricity applied into the ground through electrodes to heat the formation. This mobilizes contaminants by heating contaminants and groundwater to boiling point, the steam and contaminants are then recovered with a SVE, groundwater extraction, or dual phase system. The ERH electrodes can be installed either vertically to about 100 feet; or horizontally, or vertically beneath buildings. ERH heats the contaminants up to 100 ^{0}C, which raises the vapor pressure of volatile and semi-volatile organic compounds in the soil. For soil and shallow groundwater, this enhances the recovery of volatilized contaminants by SVE. At these high temperatures (100 ^{0}C), ERH can also be used to dry soil, which can create fractures that increase soil permeability resulting in improved recovery of contaminants by SVE. At high temperatures, saturated zone soils can also be heated to high temperatures to create steam that strips contaminants from soil. Treatment of effluent vapors and dissolved phase groundwater contamination will be required before discharge of air and/or water.

Implementation of this technology for shallow soil and groundwater contamination could be completed simultaneously; soil venting and groundwater extraction will likely be required. Existing site buildings and buried structures at the upper bluff and the wood waste layer at Kreher Park will likely limit implementation of this alternative for soil and shallow groundwater. Building demolition and removal of the buried structures at the upper bluff area would enhance the implementability of ERH for the underlying Copper Falls aquifer. For shallow soil and groundwater at the upper bluff area and at Kreher Park, and for the underlying Copper Falls aquifer, ERH could be utilized with groundwater extraction to remove DNAPL. Rather than heat soils to create steam, the saturated zone will be heated to between 30°C and 40°C to decrease the viscosity and increase the mobility of NAPL, which is then removed via extraction wells or by a dual phase recovery system.

Key elements for the conceptual design for ERH for shallow soil and groundwater at the site follow:

1. Demolition of the center section of the NSPW service center south of St. Claire Street will be required to access contaminated soil beneath the building in the upper bluff area.
2. Removal of the buried gas holders will improve the implementability of ERH for shallow soil and groundwater; cost is not included with this alternative.
3. Installation of a minimum of 200 electrodes at the filled ravine to heat the subsurface to 30° or 40° C to enhance DNAPL recovery.
4. A minimum of 10 active/passive vent wells will be installed at the filled ravine to allow vapors to escape, and a minimum of four extraction wells will be installed to recover fluids.

5. Treatment of effluent vapors and dissolved phase groundwater contamination will be required before discharge of air and/or water. Vapor-phase carbon adsorption will be used to treat vapors prior to discharge to the atmosphere. Water will be treated by the on-site treatment system prior to discharge to the sanitary or storm sewer; this will require upgrades to the existing treatment system (i.e. new oil water separator, and air stripper for increased volume). Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.
6. Site restoration will include replacement of existing asphalt pavement south of St. Claire Street and new pavement north of St. Claire Street to prevent infiltration into the underlying filled ravine.
7. At Kreher Park, site preparation will include clearing and grubbing of small trees and bushes along the bluff and near the former seep area as needed.
8. Installation of a minimum of 150 electrodes at the former seep, former coal tar dump, and TW-11 areas to heat the subsurface to 30° or 40° C to enhance DNAPL recovery.
9. A minimum of 10 active/passive vent wells and a minimum of four extraction wells will also be installed at the former coal tar dump area; the vent wells will allow vapors to escape and the extraction wells will be used to recover fluids.
10. Site restoration will include installation of new asphalt pavement over the marina parking lot and a low permeability soil cap over the disposal cell and former coal tar dump area to minimize potential exposure to subsurface contamination and minimize infiltration.
11. Regrading and a storm-water basin will be constructed within the confined area to manage storm-water and restrict infiltration.

If a containment alternative is implemented for Kreher Park, treatment of shallow soil and groundwater will not be required. If removal of buried structures is required, ERH may not be as feasible for soil and shallow groundwater as are removal and ex-situ treatment alternatives.

Key elements for the conceptual design for ERH for shallow the Copper Falls aquifer follow.

1. Demolition of the center section of the NSPW service center will likely be required for shallow soil and groundwater remediation. Demolition of the center and west sections of the NSPW service center will be required to access the underlying Copper Falls aquifer.
2. Removal of the buried gas holders will improve the implementability of ERH for the underlying Copper Falls aquifer.
3. Installation of a minimum of 200 electrodes in the underlying Copper Falls aquifer to heat the subsurface.
4. A minimum of 12 additional extraction wells will be installed, and the three existing groundwater extraction wells would be used to remove contaminated groundwater.

5. Treatment of effluent vapors and dissolved phase groundwater contamination will be required before discharge of air and/or water. Vapor-phase carbon adsorption will be used to treat vapors prior to discharge to the atmosphere. Water will be treated by the on-site treatment system prior to discharge to the sanitary sewer; this will require upgrades to the existing treatment system (i.e. new oil water separator and air stripper for increased volume). Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.

For the purpose of evaluating ERH in the FS Report, it was assumed that groundwater will be extracted for six to 12 months while the ERH system is in operation. It was assumed groundwater extraction rates of 5 to 10 gallons per minute (gpm) for shallow groundwater in the filled ravine, 10 to 20 gpm for shallow groundwater at Kreher Park, and 15 to 20 gpm for the Copper Falls aquifer. This increased flow rate will require upgrades to the existing NAPL treatment system, but long term operation of the treatment system will not be required. ERH can be completed within a short period of time (i.e. several months); therefore we have assumed that continued operation of the groundwater extraction system will not be required. Long-term groundwater monitoring to evaluate natural attenuation and institutional controls will be included with this remedial response.

Alternative GW-8 – In-situ Treatment using Steam Injection (Including Contained Recovery of Oily Wastes (CROW) and Dynamic Underground Stripping (DUS) Processes)

Steam injection physically separates volatile and semi-volatile organic constituents from soil by thermal or mechanical energies. A passive or active SVE and/or groundwater extraction system will be needed to recover volatilized contaminants. Implementation for soil and shallow groundwater remediation can be completed simultaneously. Key elements for the conceptual design for steam injection for shallow groundwater follow.

1. Demolition of the center section of the NSPW service center south of St. Claire Street will be required to access contaminated soil beneath the building in the upper bluff area.
2. Replacement of existing asphalt pavement south of St. Claire Street and new pavement north of St. Claire Street will be required.
3. Installation of a boiler for generation of steam for injection.
4. A minimum of nine steam injection wells and four steam recovery wells will be installed at each area (the filled ravine and the former coal tar dump area).
5. Treatment of effluent vapors and/or dissolved phase groundwater contamination will be required before discharge of air and/or water. Vapor phase carbon may be used to treat vapors prior to discharge to the atmosphere. Water will be treated by the on-site treatment system prior to discharge to the sanitary or storm sewer; this may require upgrades to the existing treatment system (i.e. new oil water separator, and air stripper for increased volume). Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.

The Contained Recovery of Oily Wastes (CROW) process is a patented hybrid thermal flushing process that uses steam injection. For the CROW process, hot water is injected with steam to mobilize NAPL toward recovery wells, which then convey the mixture to separators along with an on-site treatment system. This innovative technology has been successfully used at coal tar sites as full-scale remedial applications. Limitations to the technology include groundwater injection and recharge, groundwater chemistry, site accessibility, and utility access. Potential steam injection and recovery wells for shallow soil and groundwater using the CROW method will be similar to the steam injection layout.

As shown during the SITE demonstration, injection into the confined Copper Falls aquifer will require high pressures. This will reduce the effectiveness of steam and hot water injection for the deep groundwater. High pressures could hydraulically fracture the Copper Falls and Miller Creek formations. Alternatively, a patented hybrid steam injection process called Dynamic Underground Stripping (DUS) could be applied for the underlying Copper Falls aquifer. This technology involves groundwater extraction and treatment of contaminated fluids mobilized by heating via a combination of technologies. This process will consist of steam injection; electrical heating; underground imaging; and collection and treatment of effluent vapors, NAPL, and contaminated groundwater. These technologies are utilized as follows:

- Steam injection at the periphery of the contaminated area heating permeable zone soils, which then vaporizes volatile compounds bound to the soil causing contaminant migration to centrally located vapor/groundwater extraction wells;
- Electrical heating of less permeable clays and fine-grained sediments vaporizing contaminants causing migration into the steam zone;
- Underground imaging, primarily Electrical Resistance Tomography (ERT) and temperature monitoring, which delineates the heated area and tracks the steam fronts daily to monitor cleanup, and
- Treating effluent vapors, NAPL, and impacted groundwater as needed before discharge.

Hydrous Pyrolysis/Oxidation (HPO) is a process sometimes completed after contaminants are removed during the DUS phase. HPO consists of steam and air injection, which creates a heated, oxygenated zone in the subsurface. After the injection is terminated the steam condenses causing contaminated groundwater to migrate to the heated zone where it mixes with the condensed steam and oxygen. Although this may destroy some microorganisms impeding natural biodegradation, HPO enhances biodegradation of residual contaminants by stimulating other microorganisms (called thermophiles) that thrive at high temperatures. A pilot test will be needed to evaluate the effectiveness of HPO after DUS.

Key elements for the conceptual design for DUS for the Copper Falls aquifer follow.

1. Demolition of the center section of the NSPW service center south of St. Claire Street will be required to access the underlying Copper Falls aquifer at the upper bluff area.
2. A minimum of 12 steam injection wells will be installed in the Copper Falls aquifer at the upper bluff area.
3. A minimum of 9 recovery wells will be installed in the Copper Falls aquifer at the upper bluff area.
4. Recovered fluids will be treated on site prior to discharge to the sanitary or storm sewer. This will require upgrades to the existing treatment system (i.e. new oil water separator, and air stripper for increased volume). Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit.

For the purpose of evaluating steam injection technologies in the FS Report, it was assumed that the groundwater will be extracted for three to six months with steam injection is performed. It was assumed groundwater extraction rates of 5 to 10 gallons per minute (gpm) for shallow groundwater in the filled ravine, 10 to 20 gpm for shallow groundwater at Kreher Park, and 15 to 20 gpm for the Copper Falls. This increased flow rate will require upgrades to the existing NAPL treatment system, but long term operation of the treatment system will not be required. Although steam injection or DUS can be completed within a short period of time, long-term groundwater monitoring will be required to evaluate natural attenuation and institutional controls as final remedial responses.

A pilot test will likely be necessary prior to a full application of DUS at the Site. Information developed for the 2006-2007 SITE ISCO demonstration (injection rates, aquifer chemistry where applicable) will be utilized in the full analyses of this option in the design phase.

Alternative GW-9 – NAPL Removal using Groundwater Extraction Wells

Groundwater extraction uses water as a carrier to remove both NAPL and dissolved phase contamination. Groundwater extraction can be implemented for shallow groundwater contamination encountered at the upper bluff area and Kreher Park as well as the underlying Copper Falls aquifer. The existing interim groundwater extraction interim system currently extracts groundwater from one well installed at the mouth of the filled ravine, and groundwater and DNAPL from three low flow wells installed in the underlying Copper Falls aquifer. Continued operation of this system was evaluated as Alternative GW-9A, and enhanced groundwater extraction was evaluated as Alternative GW-9B. Enhanced removal at the upper bluff area will include installation of additional low flow extraction wells in the Copper Falls aquifer to increase DNAPL removal rates, and continued operation of existing wells EW-1, EW-2, and EW-3. This will also include continued operation of EW-4. However, an evaluation of the volume of groundwater discharged from the filled ravine along with a capture zone analysis for this

well will also be required to evaluate utilization of EW-4 for shallow groundwater containment (i.e. barrier wells). Key elements for enhanced groundwater and NAPL extraction in the upper bluff area follow.

1. A minimum of 12 extraction wells will be installed in the Copper Falls aquifer.
2. Installation of lateral piping between each extraction well and the existing treatment building.
3. Replacement of existing asphalt pavement south of St. Claire Street and new pavement north of St. Claire Street will be installed to reduce infiltration into the ravine fill.
4. Recovered fluids will be treated on site prior to discharge to the sanitary or storm sewer. Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit. This will require upgrades to the existing treatment system (i.e. new oil water separator, and air stripper for increased volume).

The groundwater extraction system at the upper bluff area may be operated for an extended period of time. Long-term groundwater monitoring will be required to evaluate natural attenuation and institutional controls will also be implemented as part of this option. Continued operation of the existing groundwater extraction system (Alternatives GW-9A) was also evaluated with Alternatives GW-3 (ozone sparge) and GW-4 (dual phase recovery and surfactant injection). Based on the historical operation of the existing system, a combined groundwater extraction rate of two to three gallons per minute (gpm) was used to evaluate long term operation and maintenance costs. The addition of seven additional extraction wells was evaluated as Alternative GW-6 (chemical oxidation), and Alternative GW-9B included the addition of 12 extraction wells. Additional wells would result in an increase of the combined flow rate to 10 to 15 gpm, which will require an upgrade to the existing treatment system.

Horizontal extraction wells will be used at Kreher Park because shallow groundwater is encountered in a widespread thin fill unit, and fill material has variable permeability in this area. Key elements for the conceptual design for shallow groundwater extraction at Kreher Park follow.

1. Horizontal wells consisting of perforated pipe will be installed in trenches penetrating the saturated fill unit.
2. One trench will transcend the length of the Kreher Park. Lateral trenches will be installed to dissect the former coal tar dump area and the former open sewer area.
3. Recovered fluids will be treated on site prior to discharge to the sanitary or storm sewer. This will require installation of a treatment system at Kreher Park (i.e. new oil water separator, and air stripper for increased volume). Discharge to the sanitary sewer system will require approval from the City wastewater treatment plant, and discharge to a storm sewer will require a WPDES permit,
4. Site restoration will include installation of new asphalt pavement over the marina parking lot and a low permeability soil cap over the former coal tar dump area to prevent potential exposure to subsurface contamination and minimize infiltration.

Groundwater extraction at Kreher Park will require installation of an on-site treatment system that will require operation for an extended period of time. Long-term groundwater monitoring will be required to evaluate natural attenuation and institutional controls will also be implemented as part of this option. For the purpose of evaluating groundwater extraction at Kreher Park, a pumping rate of 50 gallons per minute was used. This flow rate will exceed the estimated annual recharge rate and induce an inward hydraulic gradient at Kreher Park.

REMEDIAL ALTERNATIVES FOR SEDIMENT

Alternative SED-1 – No Action

The no-action alternative was retained as a baseline against which other technologies are compared. The no-action alternative assumes no cleanup or long-term monitoring, and is not expected to meet the RAOs. No action requires no planning, maintenance, or monitoring. Under this alternative, it is anticipated that natural mechanisms, such as dispersion, biodegradation, etc., would eventually reduce concentrations of VOC and PAH and NAPL; however, no monitoring would be performed to determine if these mechanisms are indeed taking place, nor would any method of evaluating potential risk to human health and the environment be enacted.

Alternative SED-2 – Sediment Containment within a Confined Disposal Facility

Alternative SED-2 would consist of sediment removal followed by disposal and containment within a CDF combined with institutional controls and monitored natural recovery. This alternative consists of the following components:

1) Determine the area of sediment containing significant wood debris and NAPL material to be covered by and contained within a CDF (currently this is estimated to be about seven acres of lake bed);
2) Construct CDF around pre-determined sediment area as well as upland portions of the Site that are impacted by wood material mixed with coal tar wastes;
3) Remove sediment containing concentrations of PAH greater than 9.5 ug tPAH/g dwt at 0.415% OC located outside the CDF footprint and place within CDF area;
4) Place any other impacted soils from upland areas into CDF; and
5) Monitor sediment areas outside of CDF where concentrations of PAH greater than 5.6 μg tPAH/g dwt at 0.415% OC have been observed.

Equipment that may be used for implementation of this alternative includes:

- Dredging equipment – for removing sediment from the lakebed
  - Hydraulic
  - Mechanical
- Excavation/construction equipment – for construction of portions of the CDF and dewatering basins

    - Traditional
    - Long-stick
    - Barge equipped with crane, pile driving hammer
    - Barge equipped with crane and carriage lift for placement of stone and barges loaded with blasted rock/cut limestone
- Transportation equipment – for moving sediment from the dredge to the CDF
    - Barge
    - Piping
- Water treatment equipment
    - Piping to lake or WWTP for treatment of water and collected fluids,
    - Water treatment system
        - Oil/water separator
        - Sand filtration
        - Activated carbon adsorption
- Monitoring equipment – to evaluate effectiveness of remedy
    - Groundwater monitoring wells
    - Piezometers for water level measurements
    - Sediment sampling devices
    - Surface water sampling devices

This alternative was described in detail in the Comparative Analysis of Alternatives Technical Memorandum which is attached to this FS as Appendix A2. Some of that information is summarized again in the following sections.

Concept

The CDF would be designed to cover most the areas of the offshore sediment that are impacted by NAPL as well as areas with the most wood debris. Sediment with unacceptably elevated levels of SVOCs and VOCs, including NAPL, as well as areas in Kreher Park that are impacted by wood material mixed with coal tar wastes, would remain in place and be incorporated into the CDF.

The CDF would be constructed over approximately seven acres of lake bed and 13 acres of upland. The elevation at the lake boundary will be approximately 609' NGVD in order to prevent wave overtopping. This elevation was estimated using wave height analysis based upon a 100 year return wave height and period, using 100 year still water level and water depth and bottom slope. This elevation will be confirmed during Remedial design. The top of the CDF would be fairly level, although there would be a provision for drainage and "blending" with upland topography.

Site Specific Elements of A CDF Design

There are several site-specific factors that will be considered during Remedial Design. These include the physical characteristics of the Site as well as the results of the Treatability Studies that were conducted in support of the FS.

Site Characteristics

Based upon core logs the stratigraphy of the offshore area that will be the focus of remedial efforts consists of:

1. contaminated wood layer
2. sand layer: Miller Creek beach deposit
3. silt layer: Miller Creek silt deposit
4. clay layer: Miller Creek clay deposit
5. sand layer: Copper Falls formation.

The wood layer is generally thicker near shore and therefore would be confined within the CDF footprint. Covering areas of the sediment where there is the most wood debris significantly reduces the amount of wood debris that will require removal, handling and disposing. Although the wood and sediment that would be underlying the CDF have different consolidation properties, based upon the Multiphase Testing, this characteristic would not materially affect long term consolidation behavior of the CDF cap.

Since NAPL was observed in the wood layer and in the Miller Creek sand and silt layers, the potential for NAPL mobility within the CDF will be considered in Remedial Design using the results from the Multiphase Testing. In addition, collection and removal of NAPL during placement of dredge materials into the CDF will be addressed during Remedial Design.

The potential for transport of NAPL due to ebullition also will be evaluated during Remedial Design. Both the Cap Flux Test and the Multiphase Testing provided information on this transport mechanism.

The geotechnical capacity of Miller Creek clay layer also will have to be addressed during Remedial Design since it is anticipated that sheet piling will be keyed into this layer. More core sampling and analysis along the proposed wall location likely will be needed to support Remedial Design.

In addition, since several of these sediment layers potentially have elevated levels of VOCs, including benzene, naphthalene and methylnaphthalene, control of emissions from these sediments also will be evaluated during Remedial Design.

The CDF cap and sheet pile enclosure of the CDF also will include the area in Kreher Park. As a result groundwater flow characteristics up gradient of the CDF as well as the thickness of the Miller Creek clay formation will need to be considered in the design and placement of hydraulic controls and the sheet pile or slurry wall.

Implementation of Remedy

Mobilization/Demobilization

This includes mobilization and demobilization of all the equipment and facilities needed to implement this alternative. This is estimated to be 5% of the remedial costs.

Construction of CDF

As previously discussed the CDF would be constructed over approximately seven acres of lake bed and 13 acres of upland. The elevation of the CDF at the lake boundary will be approximately 609' NGVD in order to prevent wave overtopping. Sealed sheet piling will be used to enclose the CDF and prevent contaminant migration. The method of sealing will be evaluated for water-side and soils areas during Remedial Design and it will be determined whether maintaining a lower gradient inside the containment areas is needed. It is expected that sheet piling will be utilized around the entire site although it is possible a slurry wall will be used in some upland areas, particularly where overburden is thin at the base of the bluff. A barge mounted pile driver will be used to drive pilings in the water. The CDF is intended to contain all of the sediment and groundwater in an essentially watertight enclosure. On the lake side of the wall a protective stone dike will be constructed against the sheet piling as a barrier to storms and ice movement. The extent of this armored dike will be determined in Remedial Design. Other considerations included in the construction cost estimate are placement and disposal of the hydrocarbon booms to collect NAPL that may be released during dredging and placement activities. This might include booms around the dredge where NAPL potentially may be released during dredging. Booms also will be deployed in CDF water areas until final capping activities are started.

Sediment Removal

Sediment removal under this alternative is less complex because a design objective for the CDF is that it will cover most of the areas that contain the majority of the wood debris and NAPL. This will avoid the need for substantial debris removal and with it the potential for release of VOCs and NAPL. Removal of sediment outside of the footprint of the CDF under this alternative likely will be accomplished with a hydraulic dredge. Although this will result in a need to treat more dredge water, hydraulic dredging will minimize volatilization and resuspension. Some modern hydraulic dredges should be able to achieve 20% solids content (v/v) with careful control when dredging in areas that are relatively debris-free.

Under this alternative, volatilization associated with dredging and dredge material dewatering may be an issue, but it is expected to be less than for Alternatives SED-3, SED-4 and SED-5 since the areas that will be dredged have relatively low levels of contaminants.

Areas outside of the footprint of the CDF with concentrations of total PAHs greater than the sediment PRG of 9.5 µg tPAH/g dwt at 0.415% OC will be dredged and pumped directly to the CDF. Under this scenario approximately 74,000 CY of sediment exceeding the PRG would be dredged from the approximately nine acre area outside of the CDF and disposed in the CDF. After dredging is completed, six inches of clean sediment would be placed on areas that are dredged. This would help in covering any dredging residuals as well as providing a better habitat for recruitment of benthic macroinvertebrates and for spawning of fish.

Performance Objectives for Dredging Residuals and Dredging-Related Resuspension

During Remedial Design dredging performance objectives will be developed for allowable rates of sediment resuspension during dredging based upon water quality standards that are protective of ecological receptors. These will be used for operational control of dredging. Typically, performance objectives for resuspension are two or three-tiered and specify how dredging operations need to be modified if the action levels are exceeded.

Dredging performance objectives also will specify goals for residual concentrations of contaminants in surface sediments for areas that have been dredged below the sediment PRG of 9.5 µg tPAH/g dwt at 0.415% OC. These performance objectives would specify whether re-dredging is necessary.

Volatilization and Odor Control

While volatilization is expected to be considerably less than for full scale dredging (Alternative SED-4), dry excavation (Alternative SED-5) or even Alternative SED-3, if volatiles are released, they may disperse beyond the immediate vicinity of dredging operations, within the CDF water areas and onshore treatment operations, depending upon ambient weather conditions. With the proximity of a relatively large population in Ashland, this presents the real possibility of unacceptable exposure unless engineering controls are designed.

Controls for minimization of volatile releases are available for onshore operations; however, volatilization control for operations on the water would have to be investigated further during a pilot scale project, since tenting over working dredges on the water is difficult and would add complexity to maintaining efficient dredge production rates. Engineering controls for volatilization are discussed at greater length under the Alternative SED-4 described below.

Silt Curtains and Hydrocarbon Booms

Engineering controls for minimizing release and dispersal of dissolved or free phase contaminants to water beyond the Site while dredging are well developed and would likely consist of redundant turbidity barriers and booms. These turbidity barriers may be surrounded by modular wave dampening barriers if necessary. Temporary sheet piling

will also be considered if redundant turbidity barriers and booms are not effective. This aspect of a dredging remedy can also be evaluated and optimized though a pilot scale project.

Again, this alternative will minimize the release and dispersal of dissolved or free phase contaminants to water beyond the Site since the CDF will cover the areas that have the highest levels of VOCs and NAPL.

Containment Structures

All alternatives assume that a barrier will be installed between the upland areas in Kreher Park and the bay to prevent any recontamination of bay sediments. The need for a barrier wall in the bay to prevent dispersion of resuspended sediments and dissolved contaminants from beyond the immediate site of dredging or excavation will be evaluated during pre-design pilot testing.

Sediment Dewatering

Prior to dewatering, the dredge material will be processed to separate wood from sediment. This can be achieved through processes that separate sediment by screening, gravity settling, and floatation. Screening would likely take place on the dredge if the material is mechanically dredged and hydraulically transported to the CDF. No other dewatering will be needed except for dredge dewatering of the debris stockpile in the barge before placing debris in the dumpster for disposal. Dredging of the area outside the CDF will allow the sequential filling of several cells within the CDF while allowing the other cells to settle the suspended solids. From this settling area, the excess water will be drawn off for treatment and discharge back to the lake. Any NAPL that floats in the cells will be skimmed from the surface, run through an oil/water separator and contained for off-site disposal. Evaluation of these operations will be further detailed in Remedial Design and may require additional treatability testing.

Wastewater Treatment

Water treatment potentially would include addition of polymers and alum to help settle fine particles in the CDF. Testing will be needed to determine solids settling rates, and if necessary, the effects chemical aides have on consolidation. Water would be pumped off at a rate approximately equal to the sediment placement into the CDF within certain design limits for head differential across the sheet pile wall. The system would include pumping the clear water near the surface of the CDF to a bag or sand filter or other cartridge filters, an oil/water separator and through an activated carbon filter bed. The treated water meeting the substantive requirements of an NPDES permit would be discharged to Lake Superior or to the WWTP. The cost for water treatment also includes operating a skimmer in the CDF to control any floating NAPL.

As an alternative to direct placement of sediments in the CDF using hydraulic dredging, hydraulic transportation from mechanically dredged sediments also may be considered.

This would include a screen on a hopper at the dredge that would discharge to a high solids slurry pump. Make-up water that is pumped from CDF after settling would be mixed with the sediments to a 15%-20% solids level and hydraulically conveyed in a pipe through a discharge nozzle into the CDF. This nozzle could be a tremy type design to minimize velocity at the discharge and also minimize suspension of fines in the CDF water. Use of a tremy also would allow more controlled placement and help reduce water settlement treatment in the CDF and may also help with preventing segregation of the dredged sediment placement and thus facilitate consistent consolidation. A cumulative estimated flow of about 40 million gallons will be re-circulated to the dredge using only settlement and polymer treatment in the CDF prior to pumping back to the dredge. A total of approximately 17 million gallons of wastewater resulting from sediment dewatering and the recirculation system will get fully treated and discharged to the lake or WWTP. The treated water will meet the substantive requirements of an NPDES permit.

Ancillary Solid Wastes

Waste such as personal protective equipment (PPE), construction debris and other types of solid wastes generated during the conduct of remedial activities can be disposed at a local solid waste landfill. The quantity generated will depend on the remedial alternative. PPE will be evaluated and handled in accordance with EPA guidance document to handle investigation derived waste (EPA 2007).

CDF Closure

Closure of the CDF after all dredging is complete will include construction of a CDF cap over the entire contained area. The CDF cap will meet Chapter NR 504.07, WAC design and construction specifications. Cap construction will include placing a one to two-foot sand cap on the dredged sediments to begin the consolidation process as well as provide a support layer over the water area. According to the Multiphase Testing results, this consolidation will allow the release of the pore water and gas from ebullition to rise to the surface without any significant transport of the contaminants. Multiphase Testing predicts that should NAPL be present, it will not be mobilized.

The cap will be placed in one-half to one foot lifts to facilitate even consolidation. After sufficient consolidation, additional sand will be placed in areas that are lower due to differential settlement. Settlement characteristics will be further evaluated during Remedial Design and placement techniques, such as the use of a tremy, will be considered to optimize even settlement. A sand drainage layer is part of the initial sand support layer, followed by a two foot compacted clay layer underlying a 40 mil HDPE liner. Drainage wells or wicks will be used to facilitate removal of water produced from additional consolidation in the drainage layer below the HDPE liner. This lower drainage layer will be sloped to allow removal of any gas accumulation and vented at the drainage wells and will be further evaluated in design. Another geotextile drainage layer or 1×10^{-3} cm/sec hydraulic conductivity sandy soil will be added above the HDPE liner to collect the storm water seepage. A two and one half-foot compacted layer additional foot of fill

(sand) of local soils for a drainage and plant rooting will be placed on top of the HDPE liner with an overlying layer 0.5 ft top soil that will be seeded for grass or planted with shrubs.

Long term performance and consolidation of the cap has been evaluated in the DECON Modeling and bench testing conducted during the Multiphase Testing and these results will be considered during Remedial Design. Drainage wells will be used to monitor moisture levels and used for removal of any additional water infiltration should this occur above acceptable levels over the long term. Since consolidation times of the sediments in the CDF are predicted to be rapid by the DELCON model, consolidation pore water infiltration should be minimal within the CDF.

On the land side of this cap in Kreher Park, the cap will be designed to meet the same requirements of Chapter NR 504.07, WAC and will be vegetated or paved on top. Up gradient groundwater will be passively diverted around the CDF through use of drainage tiles and/or the use of the existing hydraulic control system for the Filled Ravine. A means to discharge water to storm drainage systems would be a part of the hydraulic control plan for the CDF. The CDF cap will also include plantings to enhance evapotranspiration and absorb drainage from the hillside and a drainage layer. This should minimize the volume of run-off water that needs to be collected.

Any plantings on the cap will comply with the revegetation requirements specified in the Chapter NR 504.07, WAC criteria unless otherwise approved by WDNR.

Monitoring

The magnitude and nature of monitoring will include the following:

- baseline monitoring;
- implementation monitoring;
- verification monitoring;
- operation and maintenance monitoring; and
- long-term monitoring to verify achievement of PRGs.

As part of the Remedial Action Plan, the following monitoring programs would be developed.

Baseline Monitoring

The database of information from all Site studies will be reviewed to ascertain whether an adequate statistical database is available to provide the basis for determining whether performance criteria are achieved. Based upon this review additional baseline sampling may be necessary.

Implementation Monitoring

Monitoring during implementation of the remedy will be conducted to ensure that remediation is being conducted in accordance with the Remedial Action Plan and that all project design specifications including performance of the contractor and environmental controls are met.

Verification Monitoring

Of particular importance to removal alternatives, verification monitoring determines whether performance criteria established for environmental media cleanup levels are met. This will be especially important for those areas outside the dredge perimeter which will be monitored to evaluate natural recovery.

Operations and Maintenance Monitoring

An operations and maintenance monitoring plan will be developed as part of the Long Term Monitoring Plan and will include several aspects of CDF performance including:

a. Contaminant transport from the CDF;
b. Verification of hydraulic control; and
c. Physical integrity of CDF.

Long-term Monitoring

Long-term monitoring is primarily focused on verifying the continuing achievement of PRGs. It is of particular importance if any PRG is to be met through natural recovery mechanisms. Contingency plans will be implemented in instances where expected results of remediation, PRGs, are not met.

Alternative SED-3 – Subaqueous Capping

Alternative SED-3 would consist of sediment and wood debris removal, subaqueous capping, dewatering, consolidation, and off-site disposal with or without on-site treatment, combined with MNR. The shallow nature of near shore portions of the Site requires that some dredging be completed prior to capping so that the cap remains subaqueous and doesn't interfere with navigation or recreational boating. In addition, because of the location, the cap would have to be armored to resist erosion from waves or ice damage. A four foot depth was selected as a conceptual basis for costing because the requirements of cap design, i.e., prevention of contaminant transport and armouring to prevent ice damage, would likely require a cap of four feet thickness. The actual cap depth will be evaluated during Remedial Design and the dredge depth adjusted accordingly.

Alternative SED-3A: Mechanical Dredging and Capping, No Decontamination of Sediment
Alternative SED-3B: Mechanical Dredging and Capping, Thermal Treatment of Sediment
Alternative SED-3C: Hydraulic Dredging and Capping, No Decontamination of Sediment
Alternative SED-3D: Hydraulic Dredging and Capping, Thermal Treatment of Sediment

This alternative consists of the following components:

1) Determine the area of sediment containing significant wood debris and free-phase material with concentrations of PAH greater than 9.5 ug tPAH/g dwt at 0.415% OC;
2) Remove all wood debris, free product and approximately the top four feet of sediment in these areas using one or more of the following means from barge-based or land-based platforms:
    a. hydraulic dredging;
    b. mechanical dredging; and/or
    c. excavation.
3) In areas where PAH levels do not exceed 9.5 ug tPAH/g dwt at 0.415% OC at depths greater than approximately six feet, all sediment exceeding 9.5 ug tPAH/g dwt at 0.415% OC will be removed.
4) Dewater dredged sediment on site using a settling pond and mechanical separation followed by on-site treatment of sediment and liquid or off-site disposal of untreated sediment;
    a. If sediment is treated using thermal desorption or incineration it would be sent for off-site disposal at a solid waste or other landfill after treatment;
    b. If sediment is not treated on site but only stabilized, it would be sent to a NR 500 permitted landfill for off-site disposal;
    c. Wastewater would be treated using flocculation, clarification, sand filtering, and carbon filtering and discharged to the Ashland WWTP. Alternatively it could be discharged directly to Lake Superior if it met DNR surface water criteria;
5) Construct subaqueous armored cap over dredged area; and
6) Monitor sediment areas outside of cap where concentrations of PAH greater than 5.6 µg tPAH/g dwt at 0.415% OC have been observed.

Subaqueous capping would make use of a variety of materials, including some that would be reactive with site contaminants to contain contaminants in situ, e.g. organo-clays or activated carbon. A properly designed cap would significantly decrease contaminant mobility and isolate the contaminants from the overlying water column, thus preventing exposure to ecological receptors or humans by covering the sediment.

Equipment that may be used for implementation of this alternative includes:

- Dredging equipment – for removing sediment from the lakebed
    - Hydraulic

    - Mechanical
    - Excavation equipment (long stick excavators)
- Excavation equipment – for construction of dewatering basins
    - Traditional
- Transportation equipment – for dredging and moving sediment from the dredge to the dewatering basins
    - Barge
    - Piping
- Dewatering equipment – for removing water from sediment prior to treatment or disposal
    - Settling ponds
    - Mechanical dewatering equipment
- Treatment equipment
    - LTTD
    - HTTD
    - Incinerator
    - Water treatment system
        - Flocculation
        - Clarification
        - Sand filtration
        - Carbon filtration
        - Oil/water separator
    - Solidification
- Disposal equipment
    - Piping to lake or WWTP for treated water
    - Transport to disposal location
        - Rail
        - Truck
        - Barge
- Monitoring equipment – to evaluate effectiveness of remedy
    - Groundwater monitoring wells
    - Piezometers for water level measurements
    - Sediment sampling equipment
    - Surface water sampling equipment

Concept

The subaqueous capping alternative was selected for consideration because implementation of this alternative would meet the RAOs through capping of sediment that poses potential risk to human health and the environment. The cap would be designed to prevent access to impacted sediment with concentrations greater than 9.5 ug tPAH/g dwt at 0.415% OC, as well as minimize migration of VOCs, SVOCs and NAPL from within the sediment to surface water and unimpacted areas.

As previously stated, approximately four feet of wood debris and sediment would be removed from the cap area prior to constructing the cap in order that the finished project

depths approximate existing bathymetry. Sediment removal under this alternative would be conducted with excavators, mechanical dredges and/or hydraulic dredges. In some near shore areas, caissons could be constructed to enable dewatering near shore areas, which would allow use of shore-based excavators to remove sediment. The efficacy of this latter approach could be determined during a pilot scale project.

Engineering controls would need to be implemented to minimize volatilization of VOCs during dredging. This can best be evaluated during a pilot scale project. During dredging operations, turbidity curtains and floating hydrocarbon booms or sheet piling, if necessary, would be deployed to minimize dispersal of suspended sediments, dissolved constituents in water or floating free phase.

The subaqueous cap would be constructed over approximately seven and one-half acres of lake bed. Following construction, there would be no restrictions on usage of the capped area. Areas outside the cap area that are dredged would be covered with six inches of clean sediment to encourage recruitment of benthic organisms.

Site-specific Elements of a Subaqueous Cap Design

There are several site-specific factors that will be considered during Remedial Design. These include the physical characteristics of the Site as well as the results of the Treatability Studies that were conducted in support of the FS.

Site Characteristics

The site sediment characteristics were described in the Cap Flux Testing report in the FS. The substrate in the Site area includes layers of contaminated wood, sand and silt. The wood layer that is generally located near the sediment surface would be a large percentage of the top four feet of dredged material in this area. The wood layer is thicker near shore and thinner further offshore. Sand and silt layers would comprise the sediment types below and mixed with this wood layer.

Since NAPL was observed in the wood layer and in the Miller Creek sand and silt layers, the potential for NAPL mobility within the subaqueous cap will be considered in design using the results from the Multiphase Testing. In addition, collection and removal of NAPL during placement of dredge materials into the dewatering system will be addressed during Remedial Design.

The potential for transport of NAPL due to ebullition also will be evaluated during Remedial Design. Both the Cap Flux Test and the Multiphase Testing provided information on this transport mechanism.

In addition, since the several layers of sediment potentially have elevated levels of VOCs, including benzene, naphthalene and methylnaphthalene, control of emissions from these sediments also will be evaluated during Remedial Design.

Implementation of Remedy

Mobilization/Demobilization

This includes mobilization and demobilization of all the equipment and facilities needed to implement this alternative. This is estimated to be 5% of the remedial costs.

Containment Structures

All alternatives assume that a barrier will be installed between the upland areas in Kreher Park and the bay to prevent any recontamination of bay sediments. The need for a barrier wall in the bay to prevent dispersion of resuspended sediments and dissolved contaminants from beyond the immediate site of dredging or excavation will be evaluated during pre-design pilot testing.

Sediment Removal

Under this alternative, sediment overlying areas with large quantities of wood debris and areas containing NAPL would be dredged to a depth of approximately four feet. In some areas dredging will go deeper if it is judged more cost efficacious to dredge the extra depth rather than cap. This will be determined as part of Remedial Design based upon verification sampling.

Sediment removal under this alternative would be conducted with excavators, mechanical dredges and hydraulic dredges. Excavators and/or mechanical dredges would be used to remove debris from the targeted areas. In some places near shore caissons could be constructed to enable dewatering, which would allow use of shore-based excavators to remove sediment. The efficacy of this latter approach will be determined during a pilot scale project.

After removal of debris, hydraulic dredges would be employed to dredge sediments above the PRG. The dredge slurry will be pumped to an onshore dewatering and treatment facility. Engineering controls likely will need to be implemented to minimize volatilization of VOCs during dredging. Engineering controls for dredging are discussed at greater length in Sections below. The potential for volatilization can best be evaluated during a pilot scale project.

Performance objectives for dredge residuals and resuspension and control of volatilization and odor would be as discussed for Alternative SED-2.

Sediment Dewatering

Dewatering includes screening operations to remove large wood debris and operation of the plate and frame filter presses for dewatering (in the case of hydraulic dredging) prior to final sediment treatment. Also included in this alternative is about a four acre pond system and stockpile area built at Kreher Park area with a lined earthen dike. Volumes of dredged sediment slurries are estimated to be 13,000,000 gallons for mechanical dredging

and 70,000,000 gallons for hydraulic dredging. No VOC controls were included in costs in the FS. However, based upon the results of the treatability studies they may be needed due to the naphthalene and benzene emissions.

Wastewater Treatment

Water treatment includes sand filtration, oil/water separators, carbon filtration and related testing for discharge. Discharge will be to the Lake Superior or City of Ashland WWTP. Quantities range from about 7,790,000 gallons under mechanical dredging options to 70,000,000 gallons for hydraulic dredging. Costs for this are included in the sediment treatment category discussed in the next section. Most of the systems are closed and should have minimal impact on air emissions or have emission controls.

Sediment Treatment

Sediment treatment includes either stabilization for direct disposal at a ch. NR 500 permitted landfill, or alternatively thermal treatment to destroy the organics before landfilling. Both processes have the potential to create some emissions. However, this potential is much lower during dewatering operations unless there is an upset in the operations. The sediment treatment volumes are the same for all mechanical and hydraulic dredging options since they would all achieve the same dewatered feed volume of approximately 38,000 cy. The volume and weight after treatment is higher for stabilization since the process would add 10% more weight. Weight is estimated at 58,000 tons. On the other hand, thermal treatment would reduce the water weight and not require stabilization. This process would generate approximately 37,000 tons for disposal, including 5% moisture added to control dust and facilitate handling. HTTD was assumed to be the most cost effective thermal method and is the basis for the cost estimates. However additional design testing would be needed to evaluate this choice.

The major differences in cost are due to water treatment costs for hydraulic dredging and difference in stabilization versus thermal treatment costs.

Sediment Disposal

The disposal process will include the loading of sediment following drying and treatment/stabilization at the Site, and transportation to a commercial/industrial landfill or NR 500 permitted landfill. Several scenarios were evaluated for this option, assuming a sediment quantity of 78,000 cy based upon the sediment PRG. These scenarios were discussed in the CAATM. For purposes of cost estimation it is assumed one cubic yard of sediment will weigh 1.5 tons.

Other Disposal Alternatives

As previously discussed, NSPW also may initiate siting of a ch. NR 500, WAC landfill in the Ashland area for solid materials removed from the Lakefront Site. This disposal

option is dependent on the material volume. An analysis of siting a landfill in accordance with ch. NR 500 WAC in the Ashland area is discussed in Appendix H of the FS.

Wood Waste

There is the potential for generating a substantial quantity of wood waste if sediments are removed. The wood waste ranges in size from sawdust and chips to timber. Potentially, the larger debris could be burned as fuel at the NSP Bayfield Power Plant located in Ashland. Some additional maintenance at the plant would be required to accommodate the wood debris but this is considered a viable option at this time and will evaluated further during Remedial Design.

Ancillary Solid Wastes

Waste such as PPE, construction debris and other types of solid wastes generated during the conduct of remedial activities can be disposed of at a local municipal landfill. This management method will be used in all remedial alternatives. The quantity generated will depend on the remedial alternative. PPE will be evaluated and handled in accordance with EPA guidance document to handle investigation derived waste (EPA 2007).

Construction of Subaqueous Cap

A subaqueous cap will be designed for placement over the area that has been dredged to four feet but still has sediments beneath this depth exceeding the sediment PRG. Dredging to four feet will provide sufficient depth for placement of an armored cap while not decreasing the lake bottom depth. Cap material considered in this application would be natural sand, organoclays and/or carbon or other amendments to adsorb contaminants, as well as armoring to resist erosion.

As presently conceived, the cap will consist of first installing organ clay blankets over the area to be capped. As an alternative, a geotexile with activated carbon or bentonite sandwiched between a needle point punched mat may be installed. This will require first placing a 6-9 inch sand layer for protection from debris and leveling the surface. After installing the organoclay blanket, a two and one-half foot sand cover then would be placed over the area to be capped using a spreader barge, clam shell dredge or excavator on a barge. The sand cover would be added in 6-12" lifts to allow for consolidation of the underlying sediments to account for differential settlement. The sand cap would provide containment and allow the sediments to gain strength and stability with the consolidation from the cap load. In areas where the water is less than six feet deep armoring using gravel, cobble or stone rip rap would be added for wave and ice protection depending upon the water depth and anticipated erosion forces. A post capping bathymetric survey would be conducted to assure proper coverage and as a baseline for future measurements.

Monitoring

Monitoring options for this alternative would be the same as those described above, with the exception that the monitoring plan would be geared toward monitoring the effectiveness of a subaqueous cap rather than a CDF.

Alternative SED- 4: Removal (Dredging)

Alternative SED-4 would consist of removal, dewatering, consolidation, and off-site disposal with or without on-site treatment, combined with MNR. Under this alternative, the greatest amount of sediment would be removed, treated and disposed.

Alternative SED-4A: Mechanical Dredging, No Decontamination of Sediment
Alternative SED-4B: Mechanical Dredging, Thermal Treatment of Sediment
Alternative SED-4C: Hydraulic Dredging, No Decontamination of Sediment
Alternative SED-4D: Hydraulic Dredging, Thermal Treatment of Sediment

This alternative consists of the following components:

1) Determine sediment with concentrations of PAH greater than 9.5 ug tPAH/g dwt at 0.415% OC;
2) Remove these sediments using one or more of the following means from barge-based or land-based platforms:
    a. hydraulic dredging;
    b. mechanical dredging; and/or
    c. excavation.
3) Dewater dredged sediment on site using a settling pond and mechanical separation followed by on-site treatment of sediment and liquid and/or off-site disposal of untreated sediment;
    a. If sediment is treated using thermal desorption or incineration it would be sent for off-site disposal at a solid waste or other landfill after treatment;
    b. If sediment is not treated on site but only stabilized, it would be sent to a NR 500 permitted landfill for off-site disposal;
    c. Wastewater will be treated using flocculation, clarification, sand filtering, and carbon filtering and discharged to the Ashland WWTP. Alternatively it could be discharged directly to Lake Superior if it met DNR surface water criteria;
4) Monitor sediment areas outside of cap where concentrations of PAH greater than 5.6 µg tPAH/g dwt at 0.415% OC have been observed.

Equipment that may be used for implementation of this alternative includes:

- Dredging equipment – for removing sediment from the lakebed
    - Hydraulic
    - Mechanical
    - Excavation equipment (long stick excavators)

- Excavation equipment – for construction of dewatering basins
    - Traditional
- Transportation equipment – for dredging and moving sediment from the dredge to the dewatering basins
    - Barge
    - Piping
- Dewatering equipment – for removing water from sediment prior to treatment or disposal
    - Settling ponds
    - Mechanical dewatering equipment
- Treatment equipment
    - LTTD
    - HTTD
    - Incinerator
    - Water treatment system
        - Flocculation
        - Clarification
        - Sand filtration
        - Carbon filtration
        - Oil/water separator
    - Solidification
- Disposal equipment
    - Piping to lake or WWTP for treated water
    - Transport to disposal location
        - Rail
        - Truck
        - Barge
- Monitoring equipment – to evaluate effectiveness of remedy
    - Groundwater monitoring wells
    - Piezometers for water level measurements
    - Sediment sampling equipment
    - Surface water sampling equipment

Concept

Under this alternative, sediments greater than 9.5 ug tPAH/g dwt at 0.415% OC would be removed regardless of depth. In some areas, sediments as deep as ten feet would be removed. Sediment removal under this alternative would be conducted with excavators, mechanical dredges and hydraulic dredges. In some near shore areas, caissons could be constructed to enable dewatering near shore areas, which would allow use of shore-based excavators to remove sediment. The efficacy of this latter approach could be determined during a pilot scale project.

Engineering controls would need to be implemented to minimize volatilization of VOCs during dredging. This can best be evaluated during a pilot scale project. During dredging operations, turbidity curtains and floating hydrocarbon booms or sheet piling, if

necessary based on the results of a potential pilot study that would be conducted during pre-design phase, would be deployed to minimize dispersal of suspended sediments or floating free phase. Site restoration would include placing six inches of clean sediment on areas that have been dredged.

Removal is technically feasible for the Site, although several issues would have to be addressed in the design of a dredging alternative, including control of the release of free-phase product and dispersal and volatilization of VOCs during dredging activities, as well as management of dredging residuals and handling of a substantial amount of wood debris. Some aspects of the Site are more disposed to the use of mechanical dredges or excavators (e.g., debris removal), while other aspects favor hydraulic dredges, (e.g., capture of free phase and minimization of volatilization).

Implementation of Remedy

Mobilization/Demobilization

This includes mobilization and demobilization of all the equipment and facilities needed to implement this alternative. This is estimated to be 5% of the remedial costs.

Containment Structures

All alternatives assume that a barrier will be installed between the upland areas in Kreher Park and the bay to prevent any recontamination of bay sediments. The need for a barrier wall in the bay to prevent dispersion of resuspended sediments and dissolved contaminants from beyond the immediate site of dredging or excavation will be evaluated during pre-design pilot testing.

Sediment Removal

Under this alternative, sediments greater than 9.5 ug tPAH/g dwt at 0.415% OC would be removed regardless of depth. In some areas, sediments as deep as ten feet would be removed. The removal alternative would likely feature all three removal technologies, use of mechanical dredging and/or excavation to remove debris and hydraulic dredging once a sufficient amount of debris is removed. Debris close to shore might also be removed by long-armed excavators operating from shore or even from temporary piers made from modularized barges. To minimize volatilization of VOCs and SVOCs and dispersion of free phase, the dredging operation would likely employ modular pontoon barges or scows that are configured in such a manner that turbidity "skirts" can be placed around them. Debris removal and dredging will take place in the "hole" made by the arrangement of pontoons or scows. Various equipment including boom cranes, ladder cranes, hydraulic heads or excavators would operate off of these platforms depending upon their effectiveness. In areas where the presence of debris doesn't interfere with hydraulic dredging, hydraulic pumps on excavators might be used. The scows or pontoon barges would be moved around using either a tug or wires connected to the

shore. Anchor spuds could not be used in the free phase areas as they may disturb the sediments and release free phase and buried contaminants.

Once dredged or excavated, debris and the sediment/debris mixture can be passed through "grizzlies" to separate out large wood into hoppers or scows with mud locks. Water can be added to the sediment and moved hydraulically to dewatering and treatment areas.

Under this alternative, engineering controls would need to be implemented to minimize volatilization of VOCs during dredging. Approaches to control volatilization are discussed further below. The need for and design of engineering controls for volatilization would need to be evaluated during a pilot scale project. During dredging operations, turbidity curtains and floating hydrocarbon booms would be deployed to minimize dispersal of suspended sediments or floating free phase. If necessary, based on the results of a potential pilot study during pre-design, sheet piling would be deployed to control dispersal of suspended sediments, dissolved constituents or floating free phase. However, the water within the containment wall will not be released into the outer bay until the testing of water within the containment wall shows that the water is safe to be released into the rest of the bay. Therefore, the engineered barriers containing water will have to be maintained during the period the water does not meet the release criteria. This may result in significant delay for removal of the barrier wall and completion of the remedy.

Performance objectives for dredge residuals and resuspension and control of volatilization and odor would be as discussed for Alternative SED-2. The potential for unacceptable volatilization is substantially greater for this alternative since more areas where levels of NAPL and volatile VOCs are greater would be dredged. Based upon the results of the Air Emissions Treatability Study volatiles are expected to disperse beyond the immediate vicinity of dredging operations and onshore treatment operations, depending upon ambient weather conditions. With the proximity of a relatively large population in Ashland, this presents the real possibility of unacceptable exposure unless volatiles can be controlled. Controls for minimization of volatile releases are available for onshore operations; however, volatilization control for operations on the water would likely have to be investigated further during a pilot scale project during pre-design, since tenting over working dredges on the water is difficult and would add complexity to maintaining efficient dredge production rates. Beyond controls that can be employed by the dredge operator to minimize exposure of sediment to air there is little precedent for implementing engineering controls for volatilization at the dredge platform. Dredging areas with a high potential for release of volatiles during cooler periods of the year or when winds are predominantly offshore also may help minimize transport of volatiles to residential areas. However, it is likely that dredging will be shut down in the colder months of the year and wind directions in the Ashland area are variable and sometimes unpredictable.

After dredging is completed, six inches of clean sediment would be placed on areas that are dredged. This would help in covering any dredging residuals as well as providing

stabilization of the lakebed, a better habitat for recruitment of benthic macroinvertebrates, and for spawning of fish. In addition, because this alternative would result in substantial changes to the bathymetry of the near shore waters at the Site, approximately 30,000 cy of clean fill will have to be placed in the near shore areas to partially restore pre-dredge bathymetry.

Sediment Dewatering

Dewatering is similar to Alternative SED-3 and includes screening to remove large wood debris and operation of plate and frame filter presses for dewatering (if hydraulic dredging is used) prior to final sediment treatment. Also included is about a four acre pond system and stockpile area built on the Kreher Park area built with a lined earthen dike. Volumes of dredged sediment slurries are estimated at 21,900,000 gallons for mechanical dredging and 131,700,000 gallons for hydraulic dredging. No VOC controls were included in costs in the FS. However, they may be needed due to naphthalene and benzene emissions. Since the dredging and dewatering are greater volumes than in Alternative SED-3, the emissions will also last longer.

Wastewater Treatment

Water treatment is also similar to Alternative SED-3 and includes sand filtration, oil/water separators, carbon filtration and related testing for O&M and discharge. Discharge will be to the City of Ashland WWTP or to Lake Superior if it meets WDNR water quality criteria. Estimated treatment quantities range 13,400,000 gallons for mechanical dredging to 121,000,000 gallons for hydraulic dredging. Most of the systems are closed and should have minimal impact on air emissions.

Sediment Treatment

Sediment treatment is the same as for Alternative SED-3, however the volumes are larger. Sediment treatment includes either stabilization for disposal in a NR 500 permitted landfill or alternatively, thermal treatment before land filling in a solid waste landfill. Both processes have the potential to create some emissions in handling the dewatered sediment feed to the stabilization or thermal treatment systems. However, there is likely much lower emissions associated with sediment treatment than with the dewatering operations unless there is an upset in the operations. The sediment treatment volumes are the same for all mechanical and hydraulic dredging options since they would all achieve the same dewatered feed volume of approximately 64,000 cy. The volume and weight after treatment is higher for stabilization (99,000 tons) since it would add 10% more weight. Thermal treatment would reduce the water weight and with no added material would result in approximately 58,500 tons for disposal. HTTD is again assumed to be the most cost effective thermal method and is the basis for cost estimates for thermal treatment at this time. However additional design testing would be needed to evaluate this choice.

Major cost differences are due to water treatment costs for hydraulic dredging and difference in stabilization versus thermal treatment costs.

Sediment Disposal

The disposal options under this alternative are the same as for Alternative SED-3. There is just more sediment to dispose.

Other Disposal Alternatives

As previously discussed, NSPW also may initiate siting of a NR 500 permitted landfill in the Ashland area for solid materials removed from the Lakefront Site. This disposal option is dependent on the material volume. An analysis of siting an upland NR 500 permitted landfill in Ashland is presented in Appendix H of the FS.

Wood Waste

Under this alternative there is the potential for generating a substantial quantity of wood waste. The wood waste ranges in size from sawdust and chips to timber. Potentially, the larger debris could be burned as fuel at the NSP Bayfield Power Plant located in Ashland. Some additional maintenance at the plant would be required to accommodate the wood debris but this is considered a viable option at this time and will evaluated further during remedial design.

Ancillary Solid Wastes

Waste such as personal protective equipment (PPE), construction debris and other types of solid wastes generated during the conduct of remedial activities can be disposed of at a local municipal landfill. The quantity generated will depend on the remedial alternative. Personal protective equipment (PPE) will be evaluated and handled in accordance with EPA guidance document to handle investigation derived waste (EPA 2007).

Monitoring

Monitoring options for this alternative would be the same as those listed for Alternative SED-2 with the exception of those elements relating to CDF or cap performance.

Alternative SED-5 – Dry Excavation

Alternative SED-5 would consist of diverting water away from the targeted sediment area by construction of a barrier around the area to be remediated, removing standing water from the isolated area, continually pumping seepage from lake and groundwater to maintain conditions as dry as possible; and removing sediment using conventional earth moving technology. The remaining elements of this alternative are the same as in Alternative SED-4 and include, dewatering and consolidation of sediment and off-site

disposal with or without on-site treatment. Under this alternative, the same amount of sediment as in Alternative SED-4 would be removed, treated and disposed.

This alternative consists of the following components:

1) Determine sediment with concentrations of PAH greater than 9.5 ug tPAH/g dwt at 0.415% OC and areas where significant wood debris has been deposited;
2) A wave attenuation flotation device and sheet piling (alternatively a stone breakwater) would be constructed in the bay along the proposed alignment at 3,000N (approximate location);
3) Steel sheet pile containment wall would be constructed along 2,900N, approximate alignment.
4) Lake water within the containment will be removed with 2- 500 gpm, stand-alone pumps. Lake water pumped from within the containment will be managed/treated by an adsorbent liquid phase activated carbon system sized to adequately remove contaminants of concern. The untreated lake water will be tested to provide contaminant mass loading data and the carbon will be changed out and regenerated based upon the contaminant load. The treated effluent will be discharged directly to Lake Superior following laboratory testing that shows compliance with WDNR water quality criteria and meets substantive requirements of the NPDES permit.
5) Variable rate discharge pumps will be used to assist with dewatering sediments. Wastewater obtained from sediment dewatering will be managed/treated with filtration of the solids followed by contaminant adsorption with liquid phase activated carbon filters. The wastewater will flow through bag or sand filters and will then flow into a liquid phase activated carbon system sized to remove contaminants of concern from the water. The wastewater will be tested to estimate the contaminant mass loading on the carbon, and the carbon will be changed out and regenerated on an as needed basis. In addition, the effluent will be tested to show compliance with WDNR water quality criteria, and discharged to the lake. Alternatively, if surface water criteria are not initially met, the water will be contained and re-treated, and the system will be adjusted to fully treat the water.
6) Wood debris and sediment will be prepared for loading and disposal by one of the following methods: Stabilizing wet, fine grained (silt and clay) sediments with reagents such as Type C fly ash and/or Portland cement and excavation of wood debris and granular (sand and gravel) sediments on an asphalt pad to allow drainage of fluids by gravity flow.
7) Sediment excavation/stabilization/dewatered will be performed with heavy equipment such as a crane with drag-line and/or tracked excavator and/or wheeled conveyor and displacement with a bull dozer. It is anticipated that all of the sediment volume will be disposed off-site or thermally treated.
8) Monitor sediment areas outside of cap where concentrations of PAH greater than 5.6 µg tPAH/g dwt at 0.415% OC have been observed.
9) Groundwater removed from the trench system that parallels the sheet pile wall on the land side will be treated with filtration, oil/water separation followed by treatment with liquid phase activated carbon. As with the other water

that will enter the activated carbon system, water will be treated to comply with WDNR water quality criteria.

Equipment that may be used for implementation of this alternative includes:

- Construction of wave attenuation floatation device or breakwater and lakeside containment wall
    - Barge equipped with crane, pile driving hammer and steel sheet piles with interlock seal
    - Barge equipped with crane and carriage lift for placement of stone and barges loaded with blasted rock/cut limestone, or barges equipped with crane for placement of wave attenuation device and dead-man
    - Hydrocarbon collection booms
- Construction of landside containment wall
    - Crane, pile driving hammer and sheet piles with interlock seal
    - Hydrocarbon collection booms
- Dewatering equipment – for removing water from bay, groundwater collection trench and sediment
    - Trailer mounted 500 gpm pumps
    - Variable rate (10-100 gpm) sump pumps
    - Sump pump for collection of drained sediment fluids from asphalt drainage pad
    - Mechanical dewatering equipment
- Water treatment equipment
    - Piping to lake or WWTP for treatment of water and collected fluids
    - Water treatment system
        - Oil/water separator
        - Bag filtration
        - Activated carbon adsorption
- Sediment excavation equipment
    - Bulldozers
    - Excavators
    - Crane equipped with drag–line to move sediment into position for handling and stabilization
    - Wheel mounted conveyors
- Sediment stabilization/drainage equipment
    - Backhoes
    - Compressors
    - Tanker trucks containing reagent
    - Asphalt drainage pad and sump
- Disposal equipment
    - Transport to disposal location
        - Truck
- Monitoring equipment – to evaluate effectiveness of remedy
    - Groundwater monitoring wells
    - Piezometers for water level measurements

- Sediment sampling equipment
- Surface water sampling equipment

Concept

The concept behind dry excavation is simple: remove the water that covers the sediment and use traditional excavation equipment to remove it. Advantages to this removal technology include being able to directly "observe" what is being removed, thus making sure all targeted sediment is removed and residuals are significantly low. Critical issues to overcome include maintenance of a dewatered condition, especially along the coast of a Great Lake and, and the need to use Low Ground Pressure (LGP) excavation equipment because of the low bearing capacity of the dewatered sediment. The dry excavation method will also increase the potential for volatilization when sediments are exposed to the air. Alternatives for reducing the dynamic forces from lake waves include a wave dampening system and sheet pile containment wall. Alternatives include a stone breakwater or a parallel sheet pile wall system or coffer dams. Worker safety is of paramount concern in selecting the appropriate system.

Implementation of Remedy

Mobilization/Demobilization

This includes mobilization and demobilization of all the equipment and facilities needed to implement this alternative. This is estimated to be 5% of the remedial costs.

Construction of Temporary Wave Attenuation Device or Stone Breakwater

Wave dampening will be required to minimize dynamic forces on the containment wall. Two forms of wave dampening can be utilized, a temporary floating wave attenuation device or a permanent structure. Both forms of dampening are discussed below with the final selection to be determined at the Remedial Design stage.

Temporary Wave Attenuation Device

The partially assembled wave attenuator will be shipped to the site on flat bed trailers. The device will be unloaded and placed onto a work barge for assembly along the proposed alignment. Installation along the alignment will occur by placing concrete dead-men along the alignment. The exposed rebar extending from the dead-men would be connected to metal shackles that are connected to a metal cable which connects to the metal rods on the wave attenuator. Adjustment of the cables length would be performed to maximize wave attenuation.

During winter the wave attenuator could remain in-place or be pulled below the surface of the water to a depth that would be below the bottom of the ice that customarily forms in the bay. After ice out in the spring, the attenuator could be retuned to its initial

position by adjusting the cable attached to the dead-men. At the completion of the project the attenuator could be anchored to the bottom or cleaned and sold.

Stone Breakwater

Alternatively, a stone breakwater could be constructed. All of the breakwater construction activities will be performed from barges. The stone will be placed by cranes positioned on barges. Additional barges loaded with stone will be mobilized to the breakwater construction area. The bottom of the breakwater will consist of 6 to 12-in-diameter crushed rock base on which large 1 to 2 ton shot rock will be placed. The rock on the perimeter faces of the breakwater will be large stone, several feet in all dimensions and weigh several tons. The side slopes of the breakwater will be 3H:1V, with the breakwaters crest extending above the top of the water a minimum of 5 feet.

Containment Wall Installation

Landside containment wall construction will be performed by driving steel sheet piling that utilizes an interlock sealant to minimize seepage. The lake and landside sheet piling will be driven into the underlying Miller Creek formation approximately 20 feet and 5 feet, respectively. Prior to driving the sheet piling, an exploratory trench will be excavated along the land wall alignment to a depth of approximately 10 feet below ground surface to remove obstacles or debris that would prevent the sheeting from being installed.

The lakeside containment wall will be constructed from a barge by driving steel sheeting or Pipe/AZ sheeting combined wall system. Preliminary structural analysis of the Pipe/AZ wall system without the use of a stone breakwater indicates similar deflections to other systems with the stone breakwater in-place. This pipe pile/sheet pile wall system also minimizes the number of interlocks, which help in minimizing the volume of seepage through the wall as compared to other containment systems that were evaluated. The final design of the lakeside containment wall will be determined at the Remedial Design stage after geotechnical data is collected along the alignment.

Following completion of the containment wall system, the water within the containment will be removed using trailer mounted 500 gpm pumps. The discharged water from initial pumping within the containment wall will be transported to the WWTP and processed with minimal treatment. Variable rate discharge pumps will be deployed to reduce the water content of the sediments within the containment. This water will also be piped to the WWTP and processed using additional treatment.

Excavation/stabilization/disposal of sediments

The excavation of the wood debris will be performed with tracked mounted excavators and a crane equipped with a dragline and bucket. The excavated wood debris and some of the sediments that underlie the debris will be placed on the asphalt drying pad to allowing additional drainage of trapped fluids. The drained wood debris will be loaded

into trucks for transport to the disposal facility or to the NSP Bayfield Power Plant for burning. All precautions will be taken to contain the drainage of residual fluid from wood during loading, transportation and unloading. The trucks will be completely covered during transportation. Fluids collected at the drainage pad will be transferred to the WWTP for additional treatment before being discharged.

The silty/clayey sediments underlying the wood deposits will be stabilized with reagents prior to being loaded onto trucks for disposal. The reagent(s) will be of a type that will help to absorb the majority of the remaining fluids within the silty/clayey sediments. Concrete Jersey barriers will be used to separate the stabilization activity from other activities. Stabilization of the sediments will be performed by using a compressor to transfer the reagent provided in tanker trucks to the stabilization area. Mixing of the reagent with the sediments will be performed using an excavator bucket and/or bulldozers. The stabilized sediments will be loaded by excavator into trucks for transport to the disposal facility.

The underlying sandy granular sediments will be removed and placed on an asphalt drainage pad to allow additional drainage of fluids. The sandy material will be moved to the drainage pad using wheel mounted conveyors and/or tracked excavators and bull dozers. Drained sandy sediments will be loaded onto trucks for transport to a disposal facility. Fluids collected at the drainage pad will be transferred to the WWTP for additional treatment before being discharged.

The potential for unacceptable volatilization is substantially greater for this alternative since areas would be exposed to the air. Although a dry excavation scenario was not explicitly modeled in the Air Emissions Treatability Study, volatiles are expected to disperse beyond the immediate vicinity of excavation and onshore treatment operations, depending upon ambient weather conditions. With the proximity of a relatively large population in Ashland, this presents the possibility of unacceptable exposure unless volatiles can be controlled.

As with other sediment alternatives, controls for minimization of volatile releases are available for onshore operations; however, volatilization control for near shore dry excavation would likely have to be investigated further during a pilot scale project during pre-design, since tenting over working excavators is difficult and would add complexity to maintaining efficient excavation/stabilization/disposal rates. Volatilization controls for dry excavation would be similar to those discussed for SED-4 with the exception of those controls that take place under water. On the other hand, surrounding excavation areas with "tenting" may be more practical than surrounding dredging areas with "tenting". Since the project duration is anticipated to be twice that of the other sediment alternatives the potential for volatilization is greater. In addition, it would preclude use of the Kreher Park for approximately two years longer than the other sediment alternatives.

After dredging is completed, six inches of clean sediment would be placed on areas that are dredged. This would help in covering any dredging residuals as well as providing stabilization of the lakebed, a better habitat for recruitment of benthic macroinvertebrates,

and for spawning of fish. In addition, because this alternative would result in substantial changes to the bathymetry of the near shore waters at the Site, approximately 30,000 cy of clean fill will have to be placed in the near shore areas to partially restore pre-dredge bathymetry.

Sediment Dewatering

Dewatering of the sediment will be performed using variable rate discharge pumps that are placed in sumps pits located within the containment area and adjacent to the outermost containment wall. Additional drainage of wood debris and sandy granular sediments will be provided by placing these materials on the asphalt drainage pad built at the Kreher Park area. Sediment dewatering and seepage through the containment wall are estimated at 7,000 gal/day. No emission controls were included in costs in the FS. However, they may be needed due to VOC emissions. The emissions will last longer due to the large exposed area.

Wastewater Treatment

Water treatment is similar to Alternative SED-3 and SED-4 and includes bag/sand filtration, oil/water separation, adsorption with activated carbon filter and related testing for O&M and discharge. Most of the systems are closed and should have minimal impact on air emissions. Discharge will be to the City of Ashland WWTP or to Lake Superior if it meets WDNR water quality criteria and substantive requirement of NPDES permit. Estimated total treatment quantity for the dredge in the dry option is 180,000,000 gallons. The total treatment volume is based on a project duration of 3.8 years.

Sediment Treatment

Sediment treatment includes stabilization and/or gravity drainage of excess fluids followed by disposal in a solid waste landfill.

Sediment Disposal

The disposal options under this alternative are the same as for Alternative SED-3. There is just more sediment to dispose.

Other Disposal Alternatives

As previously discussed, NSPW also may initiate siting of landfill per ch. NR 500 requirements in the Ashland area for solid materials removed from the Lakefront Site. This disposal option is dependent on the material volume. An analysis of siting an landfill per ch. NR 500 requirements in the Ashland area is presented in Appendix H of the FS.

Ancillary Solid Wastes

Waste such as PPE, construction debris and other types of solid wastes generated during the conduct of remedial activities can be disposed of at a local municipal landfill. The quantity generated will depend on the remedial alternative. PPE will be evaluated and handled in accordance with EPA guidance document to handle investigation derived waste (EPA 2007).

Wood Waste

Under this alternative there is the potential for generating a substantial quantity of wood waste. The wood waste ranges in size from sawdust and chips to timber. Potentially, the larger debris could be burned as fuel at the NSP Bayfield Power Plant located in Ashland. Some additional maintenance at the plant would be required to accommodate the wood debris but this is considered a viable option at this time and will evaluated further during remedial design.

Monitoring

Monitoring options for this alternative would be the same as those listed for Alternative SED-2 with the exception of those elements relating to CDF or cap performance.

Alternative SED-6 – Hybrid Remedy (Dry Excavation Near shore/Dredging Offshore)

Alternative SED-6 would consist of a combination of features discussed in Alternatives SED-4 and SED-5. The NAPL-contaminated sediment with the greatest amount of debris near shore would be excavated in the dry using shore-based excavation techniques and equipment. The less contaminated sediment further from shore would be removed using conventional mechanical or hydraulic dredging technology.

Under this alternative the same amount of sediment would be removed and managed as under Alternatives SED-4 and SED-5.

Alternative SED-6A: Combination Dry Excavation/Mechanical Dredging, No Decontamination of Sediment
Alternative SED-6B: Combination Dry Excavation/Mechanical Dredging, Thermal Treatment of Sediment
Alternative SED-6C: Combination Dry Excavation/Hydraulic Dredging, No Decontamination of Sediment
Alternative SED-6D: Combination Dry Excavation/Hydraulic Dredging, Thermal Treatment of Sediment

This alternative consists of the following components:

1) Determine sediment with concentrations of PAH greater than 9.5 ug tPAH/g dwt at 0.415% OC.
2) Delineation of near shore areas that contain NAPL-impacted sediments and substantial wood debris will be done during pre-design testing and may be refined during Remedial Action. This will become the boundary of the near shore dry excavation area and the offshore dredging area. For purposes of this conceptual plan the boundary is assumed to be approximately 200 feet from the shoreline.
3) A wave attenuation flotation device will be installed at the outer boundary of the area to remediate (north of 2900N). Sheet piling would be constructed along the boundary between the near shore area and the offshore dredging area.
4) Lake water within the sheet pile containment would be removed with 2- 500 gpm, stand-alone pumps. Lake water pumped from within the containment will be managed/treated by an adsorbent liquid phase activated carbon system sized to adequately remove contaminants of concern. The untreated lake water will be tested to provide contaminant mass loading data and the carbon will be changed out and regenerated based upon the contaminant load and testing for contaminants. The treated effluent will be discharged directly to Lake Superior following laboratory testing that shows compliance with WDNR water quality criteria and meet the substantive requirements for NPDES permit.
5) Variable rate discharge pumps will be used to assist with dewatering sediments. Wastewater obtained from sediment dewatering will be managed/treated with filtration of the solids followed by contaminant adsorption with liquid phase activated carbon filters. The wastewater will flow through bag or sand filters and will then flow into a liquid phase activated carbon system sized to remove contaminants of concern from the water. The wastewater will be tested to estimate the contaminant mass loading on the carbon, and the carbon will be changed out and regenerated on an as needed basis based on testing for contaminants. In addition, the effluent will be tested to show compliance with WDNR water quality criteria, and discharged to the lake. Alternatively, if surface water criteria are not initially met, the water will be contained and re-treated, and the system will be adjusted to treat the water fully.
6) Within these containment, wood debris and sediment will be prepared for loading and disposal by one of the following methods: Stabilizing wet, fine grained (silt and clay) sediments with reagents such as Type C fly ash and/or Portland cement and excavation of wood debris and granular (sand and gravel) sediments on an impermeable asphalt pad to allow drainage of fluids by gravity flow.
7) Sediment excavation/stabilization/dewatering will be performed with heavy equipment such as a crane with drag-line and/or tracked excavator and/or wheeled conveyor and displacement with a bull dozer. It is anticipated that all of the sediment volume will be disposed off site or thermally treated.
8) Imported clean sand will be used as backfill in the area where removal of sediment and wood debris is performed in the dry. Heavy equipment will be used to place the sand. Techniques for placement of the sand may include: pushing the sand into excavation from created by removal of the sediment and wood debris and/or placing sand from long-stick excavators positioned adjacent to the sheet piling or the shoreline. Temporary sand berms may be constructed to support

equipment used for excavation. Material from these berms may later be used for backfill (Figure 8-19).

9) Sediment outside the near shore containment will be removed using barge-based hydraulic or mechanical dredging. Dredge material will be conveyed to shore-based dewatering facility.
10) Excavated and dredged sediment will be dewatered on site using a settling pond and mechanical separation followed by on-site treatment of sediment and liquid and/or off-site disposal of untreated sediment;
11) If sediment is treated using thermal desorption or incineration it would be sent for off-site disposal at a solid waste or other landfill after treatment;
12) If sediment is not treated on site but only stabilized, it would be sent to a NR 500 permitted landfill for off-site disposal;
13) Wastewater will be treated using flocculation, clarification, sand filtering, and carbon filtering and discharged to the Ashland WWTP. Alternatively it could be discharged directly to Lake Superior if it met DNR surface water criteria and the substantive requirements of an NPDES permit;
14) Groundwater removed from a trench system that parallels the sheet pile wall on the land side will be treated with filtration, oil/water separation followed by treatment with liquid phase activated carbon. As with the other water that will enter the activated carbon system, water will be treated to comply with WDNR water quality criteria and discharged into the lake.
15) Sediment areas outside of dredge area where concentrations of PAH greater than 5.6 µg tPAH/g dwt at 0.415% OC will be monitored.

Equipment that may be used for implementation of this alternative includes:

- Construction of wave attenuation floatation device on lakeside of containment wall
    - Barge equipped with crane, pile driving hammer and steel sheet piles with interlock seal
    - Barge equipped with crane and carriage lift for placement of stone and barges loaded with blasted rock/cut limestone, or barges equipped with crane for placement of wave attenuation device and dead-man
    - Hydrocarbon collection booms
- Construction of landside containment wall
    - Crane, pile driving hammer and sheet piles with interlock seal
    - Hydrocarbon collection booms
- Dewatering equipment – for removing water from bay, groundwater collection trench and sediment
    - Trailer mounted 500 gpm pumps
    - Variable rate (10-100 gpm) sump pumps
    - Sump pump for collection of drained sediment fluids from asphalt drainage pad
    - Mechanical dewatering equipment
- Water treatment equipment
    - Piping to lake or WWTP for treatment of water and collected fluids

    - Water treatment system
        - Oil/water separator
        - Bag filtration
        - Activated carbon adsorption
        - Sand Filtration
- Sediment excavation equipment
    - Modular barges of equivalent to provide access throughout containment areas, if necessary
    - Geotechnical mats (e.g., Durabase) may be needed on crest of sand berms to provide support to heavy equipment
    - Bulldozers
    - Excavators
    - Crane equipped with drag–line to move sediment into position for handling and stabilization
    - Wheel mounted conveyors
- Sediment dredging equipment
    - Hydraulic
    - Mechanical
- Sediment stabilization/drainage equipment
    - Backhoes
    - Compressors
    - Tanker trucks containing reagent
    - Asphalt drainage pad and sump
- Disposal equipment
    - Transport to disposal location
        - Truck
- Monitoring equipment – to evaluate effectiveness of remedy
    - Groundwater monitoring wells
    - Piezometers for water level measurements
    - Sediment sampling equipment
    - Surface water sampling equipment

Concept

This Alternative incorporates features of both Alternatives SED-4 and SED-5. Using conventional dredging technology, the potential for resuspension and dispersal of NAPL or impacted sediment beyond the Site area would be greatest when removing wood debris from the more heavily contaminated sediment near shore area. Excavation in the dry or in the wet within an enclosed containment area would eliminate this potential. The less contaminated sediments offshore would be removed using conventional dredging technology. Areas dredged would be backfilled with six inches of clean sand to help with lakebed stability.

Implementation of Remedy

Mobilization/Demobilization

This includes mobilization and demobilization of all the equipment and facilities needed to implement this alternative. This is estimated to be 5% of the remedial costs.

Construction of Temporary Wave Attenuation Device

Wave dampening will be required to minimize dynamic forces on the containment wall that will enclose the near shore area. A partially assembled wave attenuator will be shipped to the site on flat bed trailers. The device will be unloaded and placed onto a work barge for assembly along the proposed alignment. Installation along the alignment will occur by placing concrete dead-men along the alignment. The exposed rebar extending from the dead-men would be connected to metal shackles that are connected to a metal cable which connects to the metal rods on the wave attenuator. Adjustment of the cables length would be performed to maximize wave attenuation.

During winter the wave attenuator could remain in-place or be pulled below the surface of the water to a depth that would be below the bottom of the ice that customarily forms in the bay. After ice out in the spring, the attenuator could be retuned to its initial position by adjusting the cable attached to the dead-men. At the completion of the project the attenuator could be anchored to the bottom or cleaned and sold.

Containment Wall Installation

Landside containment wall construction will be performed by driving steel sheet piling that utilizes an interlock sealant to minimize seepage. The lake and landside sheet piling will be driven into the underlying Miller Creek formation approximately 20 feet and 5 feet, respectively. Prior to driving the sheet piling, an exploratory trench will be excavated along the land wall alignment to a depth of approximately 10 feet below ground surface to remove obstacles or debris that would prevent the sheeting from being installed.

The lakeside containment wall will be constructed from a barge by driving PZ-35 steel sheeting. Preliminary structural analysis of the PZ-35 wall system without the use of a breakwater indicates excessive deflections (around 12 to 14 inches of deflection at the top of the wall) when lateral forces from the lake waves are applied to the sheeting. Use of a wave attenuator or stone breakwater decreases the wall deflection to a more desired defection of approximately 6 inches or less. Decreasing wall deflection will also help reduce the volume of seepage through the wall located in the bay. The final design of the lakeside containment wall will be determined at the Remedial Design stage after geotechnical data is collected along the alignment.

Following completion of the containment wall system, the water within the containment will be removed using trailer mounted 500 gpm pumps. The discharged water from initial pumping within the containment wall will be transported via pipeline to the WWTP and processed with minimal treatment. Variable rate discharge pumps will be deployed to reduce the water content of the sediments within the containment. This water will also be piped to the WWTP and treated before discharge. Details of treatment will be developed during Remedial Design.

Excavation/stabilization/disposal of near shore sediments

The excavation of the wood debris in the near shore area will be performed with tracked mounted excavators and a crane equipped with a dragline and bucket. The excavated wood debris and some of the sediments that underlie the debris will be placed on the impermeable asphalt drying pad to allowing additional drainage of trapped fluids. The drained wood debris will be loaded into trucks for transport to the disposal facility or to the NSP Bayfront Power Plant for burning. Fluids collected at the drainage pad will be transferred to the WWTP and treated before being discharged.

The silty/clayey sediments underlying the wood deposits will be stabilized with reagents prior to being loaded onto trucks for disposal. The reagent(s) will be of a type that will help to absorb the majority of the remaining fluids within the silty/clayey sediments. Concrete Jersey barriers will be used to separate the stabilization activity from other activities. Stabilization of the sediments will be performed by using a compressor to transfer the reagent provided in tanker trucks to the stabilization area. Mixing of the reagent with the sediments will be performed using an excavator bucket and/or bulldozers. The stabilized sediments will be loaded by excavator into trucks for transport to the disposal facility.

The underlying sandy granular sediments will be removed and placed on an asphalt drainage pad to allow additional drainage of fluids. The sandy material will be moved to the drainage pad using wheel mounted conveyors and/or tracked excavators and bull dozers. Drained sandy sediments will be loaded onto trucks for transported in closed watertight containers to a disposal facility. Fluids collected at the drainage pad will be transferred to the WWTP and treated before being discharged.

The potential for unacceptable volatilization is substantially greater for this alternative since areas would be exposed to the air. Although a dry excavation scenario was not explicitly modeled in the Air Emissions Treatability Study, volatiles are expected to disperse beyond the immediate vicinity of excavation and onshore treatment operations, depending upon ambient weather conditions. With the proximity of a relatively large population in Ashland, this presents the possibility of unacceptable exposure unless volatiles can be controlled. An alternative to excavating the near shore sediments in the dry is to excavate them in the wet within a containment area. This is anticipated to result in less volatilization and will be further evaluated during pre-designs studies

As with other sediment alternatives, controls for minimization of volatile releases are available for onshore operations; however, volatilization control for near shore dry excavation would have to be investigated further during pre-design studies, since tenting over working excavators is difficult and would add complexity to maintaining efficient excavation/stabilization/disposal rates. Volatilization controls for dry excavation would be similar to those discussed for SED-4 with the exception of those controls that take place under water. On the other hand, surrounding excavation areas with "tenting" may be more practical than surrounding dredging areas with "tenting".

Depending upon the ultimate near shore bathymetry to be proposed by the City of Ashland in its Waterfront Development Plan, approximately 30,000 cy of clean fill may have to be placed in the near shore areas to partially restore pre-dredge bathymetry.

Dredging of Offshore Sediments

Sediments outside of near shore excavation area will be dredged using conventional dredging technology. Because sediments in this area are less contaminated and have less debris, it is anticipated that there will be less potential for dispersal of contaminated sediment or volatilization of VOCs. It is likely, therefore, that dredging in this area can be accomplished without permanent turbidity barriers. This will be verified during a pre-design evaluation. Performance objectives for resuspension and control of volatilization and odor would be as discussed for Alternative SED-2.

Dredge material will be conveyed hydraulically or by barge to dewatering areas onshore.

After dredging is completed, six inches of clean sediment would be placed on areas that are dredged. This would help in covering any dredging residuals as well as provide lakebed stabilization, a better habitat for recruitment of benthic macroinvertebrates and for spawning of fish.

Sediment Dewatering

Dewatering of the sediment will be performed using variable rate discharge pumps that are placed in sumps pits located within the containment area and adjacent to the outermost containment wall. Additional drainage of wood debris and sandy granular sediments will be provided by placing these materials on the asphalt drainage pad built at the Kreher Park area. Sediment dewatering and seepage through the containment wall are estimated at 7,000 gal/day. No emission controls were included in costs in the FS. However, they may be needed due to VOC emissions. The emissions will last longer due to the large exposed area.

Wastewater Treatment

Water treatment is similar to Alternative SED-4 and includes bag/sand filtration, oil/water separation, adsorption with activated carbon filter and related testing for O&M and discharge. Most of the systems are closed and should have minimal impact on air

emissions. Discharge will be to the City of Ashland WWTP or to Lake Superior if it meets WDNR water quality criteria. Estimated total treatment quantity for the dredge in the dry option is 60,000,000 gallons. The total treatment volume is based on a project duration of 2 years.

Sediment Treatment

Sediment treatment includes stabilization and/or gravity drainage of excess fluids followed by disposal in a solid waste landfill.

Sediment Disposal

The disposal options under this alternative are the same as for Alternative SED-3. There is just more sediment to dispose.

Other Disposal Alternatives

As previously discussed, NSPW also may initiate siting of landfill per ch. NR 500 requirements in the Ashland area for solid materials removed from the Lakefront Site. This disposal option is dependent on the material volume. An analysis of siting a landfill per ch. NR 500 requirements in the Ashland area is presented in Appendix H of the FS.

Ancillary Solid Wastes

Waste such as PPE, construction debris and other types of solid wastes generated during the conduct of remedial activities can be disposed of at a local municipal landfill. The quantity generated will depend on the remedial alternative. PPE will be evaluated and handled in accordance with EPA guidance document to handle investigation derived waste (EPA 2007).

Wood Waste

Under this alternative there is the potential for generating a substantial quantity of wood waste. The wood waste ranges in size from sawdust and chips to timber. Potentially, the larger debris could be burned as fuel at the NSP Bayfront Power Plant located in Ashland. Some additional maintenance at the plant would be required to accommodate the wood debris but this is considered a viable option at this time and will evaluated further during remedial design.

Monitoring

Monitoring options for this alternative would be the same as those listed for Alternative SED-3 with the exception of those elements relating to CDF or cap performance.

APPENDIX N-3
Summary Table of Integrated Remedial Scenarios

Table 9-2 Summary of Integrated Remedial Scenarios

Remedial Scenario	I	II	III	IV	V	VI	VII	VIII	IX	X
Sediment	Not Applicable	Dredge sediment up to four feet and cap remaining sediment in place (**SED-3**).	Dredge (hydraulic or mechanical) all sediment exceeding 9.5 ppm (**SED-4**).	Dredge (hydraulic or mechanical) all sediment exceeding 9.5 ppm (**SED-4**).	Confined Disposal Facility (CDF) for near shore sediment and material dredged outside of CDF footprint (**SED-2**).	Dry excavation of all sediment exceeding 9.5 ppm (**SED-5**).	Dry excavation of all sediment exceeding 9.5 ppm (**SED-5**).	Dredge (hydraulic or mechanical) all sediment exceeding 9.5 ppm (**SED-4**).	Dry excavation of all sediment exceeding 9.5 ppm (**SED-5**).	Removal of all sediment exceeding 9.5 ppm. Dry excavation nearshore/ mechanical dredging offshore (**SED-6**)
Kreher Park	Not Applicable	Surface barriers to prevent direct contact and limit leaching from unsaturated zone (**S-2**).	Limited soil / source removal via off site disposal (**S-3A**), ex-situ thermal desorption (**S-5A**), offsite incineration (**S-5B**, or soil washing (**S-6**), and groundwater remediation via enhanced groundwater extraction for hydraulic control (**GW-9B**). -	Limited soil / source removal via offsite disposal (**S-3A**), ex-situ thermal desorption (**S-5A**), offsite incineration (**S-5B**), or soil washing (**S-6**), and groundwater remediation via engineered surface and vertical barriers with partial caps and hydraulic control (**GW-2A**), or with PRB wall	CDF at Kreher Park combined with engineered surface and vertical barriers for soil and groundwater contaminatio n at Kreher Park (**GW-2B**).	Limited soil / source removal via offsite disposal (**S-3A**), ex-situ thermal desorption (**S-5A**), offsite incineration (**S-5B**), or soil washing (**S-6**), and groundwater remediation via engineered surface and vertical barriers with hydraulic control via groundwater extraction using, partial	Limited soil / source removal via offsite disposal (**S-3A**), ex-situ thermal desorption (**S-5A**), offsite incineration (**S-5B**), soil washing (**S-6**), in-situ chemical oxidation (**GW-6**), ERH (**GW-7**), or steam injection (**GW-8**), and groundwater remediation via ozone sparge (**GW-**	Limited soil / source removal via offsite disposal (**S-3A**), ex-situ thermal desorption (**S-5A**), offsite incineration (**S-5B**), soil washing (**S-6**), in-situ chemical oxidation (**GW-6**), ERH (**GW-7**), or steam injection (**GW-8**), and groundwater remediation via engineered surface and	Unlimited removal of unsaturated and saturated and off-site disposal (**S-3B**).	Limited soil / source removal via offsite disposal (**S-3A**), ex-situ thermal desorption (**S-5A**), offsite incineration (**S-5B**), or soil washing (**S-6**), and groundwater remediation via engineered surface and vertical barriers with partial caps and hydraulic control (**GW-2A**), or with PRB wall

Table 9-2 Summary of Integrated Remedial Scenarios

Remedial Scenario	I	II	III	IV	V	VI	VII	VIII	IX	X
				(GW-5).		caps for the park (GW-2A), a cap for entire park (GW-2B), or with a PRB wall (GW-5) at Kreher Park.	3) or enhanced groundwater extraction (GW-9B).	vertical barriers with hydraulic control via groundwater extraction and using a cap for the entire park (GW-2B), or with a PRB wall (GW-5) at Kreher Park.		(GW-5).
Filled Ravine	Not Applicable	Surface barriers to prevent direct contact and limit leaching from unsaturated zone (S-2).	Limited soil / source removal via offsite disposal (S-3A), ex-situ thermal desorption (S-5A), offsite incineration (S-5B), or soil washing (S-6), and groundwater extraction using the existing system (GW-9A).	Limited soil / source removal via offsite disposal (S-3A), ex-situ thermal desorption (S-5A), offsite incineration (S-5B), or soil washing (S-6), and groundwater remediation via engineered surface and vertical barriers with partial caps and hydraulic	Soil remediation via limited soil / source removal and onsite disposal (S-4A), and groundwater remediation using existing groundwater extraction system (GW-9A), or soil and groundwater remediation via unlimited removal and onsite	Limited soil / source removal via offsite disposal (S-3A), ex-situ thermal desorption (S-5A), offsite incineration (S-5B), or soil washing (S-6), and groundwater remediation via engineered surface and vertical barriers with hydraulic control via	Limited soil / source removal via offsite disposal (S-3A), ex-situ thermal desorption (S-5A), offsite incineration (S-5B), soil washing (S-6), in-situ chemical oxidation (GW-6), ERH (GW-7), or steam injection (GW-8), and	Limited soil / source removal via offsite disposal (S-3A), ex-situ thermal desorption (S-5A), offsite incineration (S-5B), soil washing (S-6), in-situ chemical oxidation (GW-6), ERH (GW-7), or steam injection (GW-8), and	Unlimited removal of unsaturated and saturated and off-site disposal (S-3B).	Limited soil / source removal via offsite disposal (S-3A), ex-situ thermal desorption (S-5A), offsite incineration (S-5B), or soil washing (S-6), and groundwater remediation via engineered surface and vertical barriers with partial caps and hydraulic

Table 9-2 Summary of Integrated Remedial Scenarios

Remedial Scenario	I	II	III	IV	V	VI	VII	VIII	IX	X
				control (**GW-2A**), or with PRB wall (**GW-5**) at Kreher Park.	disposal (**S-4A**).	groundwater extraction, and partial caps and (**GW-2A**), or with PRB wall (**GW-5**) at Kreher Park.	groundwater remediation via ozone sparge (**GW-3**) or groundwater extraction from EW-4 with existing system (**GW-9A**).	groundwater remediation via engineered surface and vertical barriers with hydraulic control via groundwater extraction (at Kreher Park) and, and partial caps and (**GW-2A**), or with PRB wall (**GW-5**) at Kreher Park.		control (**GW-2A**), or with PRB wall (**GW-5**) at Kreher Park.
Copper Falls	Not Applicable	Groundwater / NAPL extraction using the existing system (**GW-9A**)	Groundwater and NAPL remediation via ozone sparge (**GW-3**) or surfactant injection /dual phase recovery (**GW-4**), and groundwater / NAPL extraction using the existing	Groundwater remediation via ozone sparge (**GW-3**), surfactant injection /dual phase recovery (**GW-4**), and groundwater extraction with the existing system (**GW-9A**), or in-situ chemical	Groundwater remediation via ozone sparge (**GW-3**), surfactant injection /dual phase recovery (**GW-4**), and groundwater extraction with the existing system (**GW-9A**), or in-situ chemical	Groundwater remediation via ozone sparge (**GW-3**), surfactant injection /dual phase recovery (**GW-4**), and groundwater extraction with the existing system (**GW-9A**), or in-situ chemical	Groundwater remediation via enhanced groundwater extraction (**GW-9B**).	Groundwater remediation via ozone sparge (**GW-3**), surfactant injection /dual phase recovery (**GW-4**), and groundwater extraction with the existing system (**GW-9A**), or in-situ chemical	Groundwater remediation via enhanced groundwater extraction (**GW-9B**).	Groundwater remediation via ozone sparge (**GW-3**), surfactant injection /dual phase recovery (**GW-4**), and groundwater extraction with the existing system (**GW-9A**), or in-situ chemical

Table 9-2 Summary of Integrated Remedial Scenarios

Remedial Scenario	I	II	III	IV	V	VI	VII	VIII	IX	X
			system (**GW-9A**), or in-situ chemical oxidation (**GW-6**), ERH (**GW-7**), steam injection (**GW-8**), or enhanced groundwater extraction (**GW-9B**).	oxidation (**GW-6**), ERH (**GW-7**), steam injection (**GW-8**), or enhanced groundwater extraction (**GW-9B**).	oxidation (**GW-6**), ERH (**GW-7**), steam injection (**GW-8**), or enhanced groundwater extraction (**GW-9B**).	oxidation (**GW-6**), ERH (**GW-7**), or steam injection (**GW-8**).		oxidation (**GW-6**), ERH (**GW-7**), steam injection (**GW-8**), or enhanced groundwater extraction (**GW-9B**).		oxidation (**GW-6**), ERH (**GW-7**), steam injection (**GW-8**), or enhanced groundwater extraction (**GW-9B**).

APPENDIX O
Estimated Costs of each Remedial Alternative

Table F1-1
Cost Summary of Soil Remedial Alternatives

Alternative	General Response Action	Technology	Soil Volume	Capital Costs	Mob/Demob	Engineering	Construction Oversight	Contingency	Post Construction Maintenance	Total
			cy							
S1	No Action	No Action	na	$0	$0	$0	$0		$0	$0
S2	Containment - Eng. Surface Barriers	Upper Bluff Area	na	$105,556	$5,278	$15,833	$15,833	$21,111	$0	$163,611
		Kreher Park	na	$1,118,563	$55,928	$167,784	$167,784	$223,713	$21,716	$1,755,488
		Total		$1,224,118	$61,206	$183,618	$183,618	$244,824	$21,716	$1,919,099
S3A	Removal - limited removal & offsite disposal	Upper Bluff Area	9,550	$2,203,435	$110,172	$330,515	$330,515	$440,687	$0	$3,415,324
		Kreher Park	4,800	$973,848	$48,692	$146,077	$146,077	$194,770	$0	$1,509,464
		Total	14,350	$3,177,283	$158,864	$476,592	$476,592	$635,457	$0	$4,924,788
S3B	Removal - unlimited removal & offsite disposal	Upper Bluff Area	35,000	$5,103,860	$255,193	$765,579	$765,579	$1,020,772	$0	$7,910,983
		Kreher Park	225,000	$22,591,722	$1,129,586	$3,388,758	$3,388,758	$4,518,344	$0	$35,017,169
		Total	260,000	$27,695,582	$1,384,779	$4,154,337	$4,154,337	$5,539,116	$0	$42,928,152
S4A	Removal - limited removal & onsite disposal (one acre disposal cell)	Upper Bluff Area	9,550	$1,451,850	$72,593	$217,778	$217,778	$290,370	$0	$2,250,368
		Kreher Park	4,800	$1,054,203	$52,710	$158,130	$158,130	$210,841	$0	$1,634,014
		Total	14,350	$2,506,053	$125,303	$375,908	$375,908	$501,211	$0	$3,884,382
S4B	Removal - unlimited limited removal & onsite disposal (four acre disposal cell)	Upper Bluff Area	35,000	$1,788,580	$89,429	$268,287	$268,287	$357,716	$0	$2,772,299
		Kreher Park	4,800	$2,364,788	$118,239	$354,718	$354,718	$472,958	$0	$3,665,421
		Total	39,800	$4,153,368	$207,668	$623,005	$623,005	$830,674	$0	$6,437,720
S5A	Ex-situ Thermal Treatment (Onsite thermal desorption)	Upper Bluff Area	9,550	$3,036,291	$151,815	$455,444	$455,444	$607,258	$0	$4,706,250
		Kreher Park	4,800	$1,392,456	$69,623	$208,868	$208,868	$278,491	$0	$2,158,306
		Total	14,350	$4,428,746	$221,437	$664,312	$664,312	$885,749	$0	$6,864,557
S5B	Ex-situ Thermal Treatment (Offsite incineration)	Upper Bluff Area	9,550	$5,228,016	$261,401	$784,202	$784,202	$1,045,603	$0	$8,103,424
		Kreher Park	4,800	$2,436,468	$121,823	$365,470	$365,470	$487,294	$0	$3,776,525
		Total	14,350	$7,664,483	$383,224	$1,149,672	$1,149,672	$1,532,897	$0	$11,879,949
S6	Ex-situ Physical/Biological Treatment (onsite soil washing)	Upper Bluff Area	9,550	$3,671,748	$183,587	$550,762	$550,762	$734,350	$0	$5,691,209
		Kreher Park	4,800	$1,711,848	$85,592	$256,777	$256,777	$342,370	$0	$2,653,364
		Total	14,350	$5,383,595	$269,180	$807,539	$807,539	$1,076,719	$0	$8,344,573

Table F2-1
Cost Summary of Groundwater Remedial Alternatives

Alternative	General Response Action	Technology	Capital Costs	Mob/Demob	Engineering	Construction Oversight	Contingency	Post Construction OM&M	Total
GW1	No Action	No Action	$0	$0	$0	$0	$0	$0	$0
GW2A	Containment	Engineered Surface & Vertical Barriers							
		Copper Falls Aquifer	$0	$0	$0	$0	$0	$0	$0
		Shallow Groundwater - Filled Ravine	$105,556	$5,278	$15,833	$15,833	$21,111	$0	$163,611
		Shallow Groundwater - Kreher Park (partial cap)	$4,237,768	$211,888	$635,665	$635,665	$847,554	$2,504,757	$9,073,298
		Total	*$4,343,324*	*$217,166*	*$651,499*	*$651,499*	*$868,665*	*$2,504,757*	*$9,236,909*
GW2B	Containment	Engineered Surface & Vertical Barriers							
		Copper Falls Aquifer	$0	$0	$0	$0	$0	$0	$0
		Shallow Groundwater - Filled Ravine	$105,556	$5,278	$15,833	$15,833	$21,111	$0	$163,611
		Shallow Groundwater - Kreher Park (cap entire Park)	$6,030,852	$301,543	$904,628	$904,628	$1,206,170	$1,469,226	$10,817,047
		Total	*$6,136,408*	*$306,820*	*$920,461*	*$920,461*	*$1,227,282*	*$1,469,226*	*$10,980,658*
GW3	In-situ Treatment	Ozone sparge							
		Copper Falls Aquifer	$763,000	$38,150	$114,450	$114,450	$152,600	$694,704	$1,877,354
		Shallow Groundwater - Filled Ravine	$133,000	$6,650	$19,950	$19,950	$26,600	$63,550	$269,700
		Shallow Groundwater - Kreher Park	$1,009,000	$50,450	$151,350	$151,350	$201,800	$84,050	$1,648,000
		Total	*$1,905,000*	*$95,250*	*$285,750*	*$285,750*	*$381,000*	*$842,304*	*$3,795,054*
GW4	In-situ Treatment	Surfactant Injection/Dual Phase Recovery							
		Copper Falls Aquifer	$479,800	$23,990	$71,970	$71,970	$95,960	$682,404	$1,426,094
		Shallow Groundwater - Filled Ravine	$0	$0	$0	$0	$0	$0	$0
		Shallow Groundwater - Kreher Park	$0	$0	$0	$0	$0	$0	$0
		Total	*$479,800*	*$23,990*	*$71,970*	*$71,970*	*$95,960*	*$682,404*	*$1,426,094*
GW5	In-situ Treatment	Permeable Reactive Barrier Well							
		Copper Falls Aquifer	$0	$0	$0	$0	$0	$0	$0
		Shallow Groundwater - Filled Ravine	$105,556	$5,278	$15,833	$15,833	$21,111	$0	$163,611
		Shallow Groundwater - Kreher Park	$3,650,174	$182,509	$547,526	$547,526	$730,035	$397,088	$6,054,858
		Total	*$3,755,730*	*$187,786*	*$563,359*	*$563,359*	*$751,146*	*$397,088*	*$6,218,469*
GW6	In-situ Treatment	Chemical Oxidation							
		Copper Falls Aquifer	$2,017,500	$100,875	$302,625	$302,625	$403,500	$2,596,420	$5,723,545
		Shallow Groundwater - Filled Ravine	$1,333,333	$66,667	$200,000	$200,000	$266,667	$67,363	$2,134,029
		Shallow Groundwater - Kreher Park	$1,352,389	$67,619	$202,858	$202,858	$270,478	$94,308	$2,190,510
		Total	*$4,703,222*	*$235,161*	*$705,483*	*$705,483*	*$940,644*	*$2,758,090*	*$10,048,085*
GW7	In-situ Treatment	Electrical Resistance Heating							
		Copper Falls Aquifer	$4,439,200	$221,960	$665,880	$665,880	$887,840	$123,000	$7,003,760
		Shallow Groundwater - Filled Ravine	$2,852,533	$142,632	$427,895	$427,895	$570,527	$51,250	$4,472,832
		Shallow Groundwater - Kreher Park	$2,949,628	$147,481	$442,444	$442,444	$589,926	$71,750	$4,643,673
		Total	*$10,241,461*	*$512,073*	*$1,536,219*	*$1,536,219*	*$2,048,292*	*$246,000*	*$16,120,265*
GW8	In-situ Treatment	Dynamic Underground Stripping / CROW							
		Copper Falls Aquifer (DUS)	$4,637,200	$231,860	$695,580	$695,580	$927,440	$123,000	$7,310,660
		Shallow Groundwater - Filled Ravine (CROW)	$1,698,333	$84,917	$254,750	$254,750	$339,667	$51,250	$2,683,667
		Shallow Groundwater - Kreher Park (CROW)	$1,581,111	$79,056	$237,167	$237,167	$316,222	$71,750	$2,522,472
		Total	*$7,916,644*	*$395,832*	*$1,187,497*	*$1,187,497*	*$1,583,329*	*$246,000*	*$12,516,799*
GW9A	Removal	Groundwater Extraction - Existing System							
		Copper Falls Aquifer	$0	$0	$0	$0	$0	$2,220,466	$2,220,466
		Shallow Groundwater - Filled Ravine	$105,556	$5,278	$15,833	$15,833	$21,111	$0	$163,611
		Shallow Groundwater - Kreher Park	$0	$0	$0	$0	$0	$0	$0
		Total	*$105,556*	*$5,278*	*$15,833*	*$15,833*	*$21,111*	*$2,220,466*	*$2,384,078*
GW9B	Removal	Groundwater Extraction - Enhanced System							
		Copper Falls Aquifer	$284,500	$14,225	$42,675	$42,675	$56,900	$5,978,656	$6,419,631
		Shallow Groundwater - Filled Ravine	$105,556	$5,278	$15,833	$15,833	$21,111	$0	$163,611
		Shallow Groundwater - Kreher Park	$966,278	$48,314	$144,942	$144,942	$193,256	$17,392,454	$18,890,185
		Total	*$1,356,333*	*$67,817*	*$203,450*	*$203,450*	*$271,267*	*$23,371,111*	*$25,473,427*

Table F3-1 Cost Summary for [illegible]ent Remedial Alternatives.

Alternative	Dredge Volume (cy)[1]	Sediment Weight (t)	Water Volume (Mgal)	Mob/Demob	Sediment Removal (Mechanical)	Sediment Removal (Hydraulic)	Sediment Transport & Disposal	Thermal Treatment	Subaqueous Cap	CDF	Water Collection & Treatment	Misc (H&S; Mitigation)	Post Construction[2]	Planning & Engineering @ 15%	Oversight @ 15%	Contingency @ 20%[4]	Total
SED-2	70,963	38,589	7	$1,101,155	$5,096,964					$14,696,082	$1,805,801	$324,260	$1,142,000	$3,468,640	$3,468,640	$4,624,853	$35,828,395
SED-3A	77,822	33,899	8	$1,058,324	$14,013,073		$2,752,164		$2,413,900		$1,713,075	$324,260	$1,078,000	$3,333,719	$3,333,718	$4,444,959	$34,415,193
SED-3B	77,822	33,899	8	$1,197,640	$12,520,529		$1,750,243	$5,230,796	$2,413,900		$1,713,075	$324,260	$1,078,000	$3,772,566	$3,772,566	$5,030,088	$38,803,663
SED-3C	77,822	33,899	70	$1,250,032		$13,425,886	$2,692,814		$2,560,515		$6,197,188	$324,260	$1,078,000	$3,969,101	$3,969,101	$5,292,135	$40,769,012
SED-3D	77,822	33,899	70	$1,426,457		$12,520,529	$1,750,243	$5,230,796	$2,506,115		$6,197,188	$324,260	$1,078,000	$4,483,338	$4,483,338	$5,980,865	$46,011,381
SED-4A	133,706	58,503	13	$1,416,825	$20,767,047		$4,634,149				$2,296,786	$638,520	$715,090	$4,462,999	$4,462,999	$5,950,665	$45,345,081
SED-4B	133,706	58,503	13	$1,857,313	$18,197,528		$3,011,561	$9,001,843			$2,296,786	$638,520	$715,090	$5,220,536	$5,220,536	$6,960,714	$52,920,446
SED-4C	133,706	58,503	121	$1,731,393		$19,485,725	$4,436,108				$10,067,515	$638,520	$715,090	$5,453,889	$5,453,889	$7,271,852	$55,253,983
SED-4D	133,706	58,503	121	$2,032,047		$17,927,528	$3,011,561	$9,001,792			$10,067,515	$638,520	$715,090	$6,401,882	$6,401,882	$8,535,856	$64,734,014
SED-5A[5]	133,706	58,503	114	$2,249,265	$27,970,833		$4,984,160				$11,308,406	$721,800	$715,090	$7,085,185	$7,085,185	$11,808,641	$73,928,664
SED-5B[5]	133,706	58,503	114	$2,692,502	$29,456,767		$3,361,280	$9,001,808			$11,308,406	$721,800	$715,090	$8,481,382	$8,481,382	$14,135,637	$88,356,041
SED-6A[6]	133,706	58,503	55	$1,771,872	$28,120,164		$5,209,183				$6,145,864	$456,315	$715,090	$6,255,510	$6,255,510	$8,340,680	$63,270,186
SED-6B[6]	133,706	58,503	55	$2,276,626	$26,166,815		$3,328,584	$8,984,978			$5,880,729	$456,315	$715,090	$7,064,107	$7,064,107	$9,418,809	$71,356,160
SED-6C[6]	133,706	58,503	59	$2,168,403		$24,120,164	$5,209,183				$8,582,400	$456,315	$715,090	$6,830,470	$6,830,470	$9,107,293	$69,019,788
SED-6D[6]	133,706	58,503	59	$2,475,855		$24,166,815	$3,328,584	$8,984,978			$8,582,400	$456,315	$715,090	$7,641,757	$7,641,757	$10,189,009	$77,132,661

1 Includes Wood
2 Without Wood
3 Present Value at 7% Discount Rate
4 A 25% contingency was applied to Alternatives 5A and 5B.

APPENDIX P
Cost Breakdown for Scenario 10

F3-14. SED-4B Near Shore Dry Excavation and Bay Mechanical Dredging -Thermal Treatment.

Total Area	698,860 sq ft	Based upon GIS calculations
Total In-Place Sediment Volume	133,908 cy	Includes volume of water in sediments
Sediment Volume to be Dredged in-the-Dry	76,492 cy	Includes volume of water in sediments, Assuming an average excavation depth of 6 - 7 ft
Sediment Volume to be Mechanically Dredged	57,414 cy	Includes volume of water in sediments; Assuming an average excavation depth of 3 - 4 ft
Total Volume of Large Wood/Debris Waste	26,781 cy	Assumed to be 20% of total sediment volume.
Sediment Volume to be Dry Dredged that is not Large Wood/Debris	49,711 cy	All large wood/debris assumed to be in the Dry Dredge area; Small wood debris will be removed with sediments that are mechanically dredged and is include in the volume to be dredged
Total Volume of Water to be treated by WWTP	55 Mgal	6 Mgal from mechanical dredging; 60 Mgal from dry dredging (including lake and ground water removal); 10 Mgal of which is lake water that is assumed not to need treatment

Mobilization/Demobilization

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Mob/Demob	ls	1	$2,276,626	$2,276,626	Estimate at 5% of total costs except without engineering, contingency and LT monitoring

Sediment Removal and Treatment

Pre-Construction Activities

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Perimeter Fence	ft	1680	$20	$33,600	Fence along land side where there is no sheet pile wall (with 20 ft overlap), back to the railroad tracks
2	Bathymetric Survey	ea	3	$37,500	$112,500	Pre-investigation and Pre- and Post Dredge - Bathymetric Survey
3	Pretrenching along Proposed Landward Sheet Pile Alignment	day	11	$1,800	$19,800	2105 ln ft at apprx 200 ln ft per day
4	Removal of Existing Site Features	ls	1	$500,000	$500,000	
5	Move/Abandon Existing Utilities	ls	1	$100,000	$100,000	Includes installation of electric upon completion ($40k) & move/abandon existing utilities ($60k)
				Subtotal	$765,900	

Containment with Sheet Pile Wall approximately 110 feet from shoreline and Wave Attenuator

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	1380 linear feet of WhispirWave® Floating Wave Attenuator	ft	1380	2288	$3,155,150	Purchase, ship, and install wave attenuator device
2	Install HC Boom in Lake	ft	1920	$4	$7,680	Install HC Boom on one side of piling and extend to shorelines, assume same length as sheetpiling in lake
3	North Sheetpiling (in Lake)	sf	96000	$62	$5,952,000	Includes $56 sq/ft for PZ35 piling (35lbs/sq ft @ $0.80/lb + $28 for installation), $6 sq/ft for seal, depth piling 50 ft Length,ft: 1920
4	West Sheetpiling	sf	17680	$62	$1,096,160	Includes $56 sq/ft for PZ35 piling (35lbs/sq ft @ $0.80/lb + $28 for installation), $6 sq/ft for seal, depth piling 52 ft Length,ft: 340
5	East Sheetpiling	sf	19800	$62	$1,227,600	Includes $56 sq/ft for PZ35 piling (35lbs/sq ft @ $0.80/lb + $28 for installation), $6 sq/ft for seal, depth piling 33 ft Length,ft: 600
6	South Sheetpiling	sf	31455	$62	$1,950,210	Includes $56 sq/ft for PZ35 piling (35lbs/sq ft @ $0.80/lb + $28 for installation), $6 sq/ft for seal, depth piling 27 ft Length,ft: 1165
7	Remove HC Boom from Lake	ft	1920	$4	$7,680	Remove HC Boom on one side of piling and extend to shorelines
8	Dispose HC Boom	ea	3	$600	$1,800	Dispose of HC Boom in 20 cy, roll off boxes
9	Silt Fence	ft	1640	$20	$32,800	Along south, east, and west sides of Kreiser Park, back to the railroad track, beyond the sheetpile wall
				Subtotal	$13,431,000	

Sediment Drainage Pad

Item No.	Item	Unit	Quantity	Unit Costs	Total	Notes
1	Asphalt Drainage Pad Construction	sq yd	4170	$45	$187,650	150 ft x 250 ft = 37,500 sq ft = 4,170 sq yd
2	Pumping excess/drained water to WWTP	day	240	$300	$72,000	
				Subtotal	$259,650	

Dry Dredging Sediment Removal

Item No.	Item	Unit	Quantity	Unit Costs	Total	Notes
1	Cutoff and Remove Old Pilings	ea	40	$500	$20,000	
2	Remove Existing Shoreline Riprap	ton	7580	$20	$150,000	Appr. 320 cu yds per day
3	Excavate, Load, Haul, and Dump Sediments	cy	76492	$24	$1,835,808	Excavate and load sediments into trucks, dump sediments in asphalt drainage pad area
4	Confirmation Samples	ea	200	$200	$40,000	
5	Temporary Barriers	ea	30	$1,500	$45,000	Jersey barriers to provide separation of areas
				Subtotal	$2,090,808	

Mechanical Dredging Sediment Removal

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Install silt curtain outside dredge area	sq ft	16560	$10	$165,600	Install silt curtain; assume 12 ft depth and same linear footage as wave attenuation device
2	Install HC Boom	ft	1680	$4	$6,400	Install HC Boom on lake side of shit pile wall
3	HC Boom Removal	ft	1600	$4	$6,400	Removal of HC Boom into roll off box
4	Dispose of Boom	ea	2	$1,500	$3,000	Dispose of HC Boom in two 20 cy. roll off boxes
5	Mechanically Dredge Sediment	cy	57414	$30	$1,722,420	Mechanically dredge sediments to depth of 3 ft. (Includes transport to land cost). Assume 200 cy/day of affected sediment
6	Air Emissions Monitoring	weeks	60	$8,725	$523,500	Monitor air quality during construction and dredging based on 5 stations 3 times/week using NIOSH methods
7	Water Quality Monitoring	weeks	60	$9,000	$540,000	Daily Water Quality Monitoring through dredging process
				Subtotal	$2,967,320	

Waste Separation

Item No.	Item	Unit	Quantity	Unit Costs	Total	Notes
1	Remove Large Wood/Debris Waste	day	240	$1,800	$432,000	Load at $1800/day for period of ~240 days of sediment processing
2	Screening	day	240	$2,500	$600,000	Screening system to separate wood from sediments
3	Dispose Large Wood/Debris Waste at 20 cu yd per roll-off box	ea	1340	$1,500	$2,010,000	Dispose of large debris as special waste in a 20 cy. roll off box. Assume 33% is large waste.
4	Waste Sampling for Landfilling	ea	10	$400	$4,000	
5	Filterpress Dewatering of Mechanically Dredged Sediments	cy	57414	$35	$2,009,490	Total dredged rate based on bids, Assumes all large wood/debris is in dry dredged area
6	Excavator	day	240	$1,800	$432,000	$1800 per day for an excavator and truck to transport sediments to the thermal treatment area
				Subtotal	$5,487,490	

Clean Sand Capping and Shoreline Restoration

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Clean Sand Fill and Install	cy	30000	$25	$750,000	Place 30,000 cu yds of sand in the dry dredge area
2	Clean Sand Fill and Install	cy	12907	$25	$322,667	Apply 0.5 ft of sand over the entire area
3	Install Rip-Rap Shore Protection	ton	1360	$40	$54,400	~2600 lf of shoreline inside 2900N, 8ft wide, 1 ft thick rip-rap = 20,800 cu ft of rip-rap = 1360 tons @ 130 pcf
4	Survey	ea	1	$37,500	$37,500	Post-capping bathymetric survey
				Subtotal	$1,164,567	

Total Sediment Removal and Treatment $26,166,815

Sediment Transport and Disposal

Item No.	Item	Unit	Quantity	Unit Cost	Total	
1	Load Mechanically Dredged Sediments	day	43	$1,440	$62,082	40 trucks/day X 20 tons/truck = 800 tons/day; $1.80 per ton
2	Haul Mechanically Dredged Sediments to Landfill	ton	34490	$27	$931,230	Assumes initial wet sediments weight of 46.3% solids by wt; dry wt x 1.1 = thermal treated sediment wt
3	Disposal of Mechanically Dredged Sediments	ton	34490	$18	$620,820	Tipping Fee
4	Load Dry Dredged Sediments	day	38	$1,440	$54,702	40 trucks/day X 20 tons/truck = 800 tons/day; $1.80 per ton
5	Haul Dry Dredged Sediments to Landfill	ton	30390	$27	$820,530	Assumes initial wet sediments weight of 1.2 tons/cu yd & 46.3% solids by wt, dry wt x 1.1 = thermal treated sediment wt
6	Disposal of Dry Dredged Sediments	ton	30390	$18	$547,020	Tipping Fee
7	Disposal of NAPL offsite	gal	5000	$8	$40,000	Same units used in 1998 cost
8	Cut Permeator Sheet Pile Wall and Dispose of Piling	sf	8420	$25	$210,500	Three sides of site, 4 ft x total East, West, and South piling lengths
9	Remove Piling in Bay	sf	95000	$0	$0	Cost included in installation price
10	Remove Asphalt Drainage Pad and Dispose	sq yd	4170	$10	$41,700	
				Subtotal	$3,328,584	

Total Sediment Transport and Disposal $3,328,584

Thermal Treatment

Item No.	Item	Unit	Quantity	Unit Cost	Total	
1	Thermal Treatment of Mechanically Dredged Sediments	ton	48420	$100	$4,841,978	See Sediment vol/wt calc sht for tonnage calc
2	Thermal Treatment of Dry Dredged Sediments	ton	41430	$100	$4,143,000	Dry dredged non-large wood/debris mat'l, assumes initial wet sed. wt of 1.2 tons/cu yd & 46.3% solids by wt, dry wt x 1.5 = maxi. dewatered sed. wt
				Subtotal	$8,984,978	

Total Thermal Treatment $8,984,978

Water Collection and Treatment

Ground Water Capture System Upgradient of Containment Wall

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Trench Excavation	lf	1165	$50	$58,250	18 ft deep by 3 ft wide
2	Contaminated Soil Disposal	tons	3495	$60	$209,700	Dispose as special waste at $60/ton, Assumes 1.5 tons/cu yd
3	Trench Filter Fabric	sf	48930	$1	$48,930	Fabric along both sides and the bottom of the trench, and between the gravel backfill and the overlying soil backfill material
4	Gravel Backfill	tons	2718	$20	$54,367	From 4 ft to ~18 ft bgs, 3 ft wide, 1.5 tons/cu yd
5	Collection Pipe 4-in HDPE Perforated	lf	1245	$30	$37,350	1165 ft of pipe in trench, 4 - 20 ft segments from the sumps to the header
6	Trenching, Backfill, and Compaction	cy	518	$20	$10,356	Soil material above the gravel in the trench; from 0 to 4 ft bgs; 1.5 tons/cu yd
7	Discharge Piping, 6-in HDPE	lf	1335	$38	$50,730	1165 ft of header pipe placed on ground surface, 170 ft from header pipe to WWTP
8	Connection to Sanitary Pump Station	ea	1	$2,000	$2,000	
9	Water Samples	ea	100	$200	$20,000	
10	Collection Sump	ea	4	$2,000	$8,000	
11	Sump Pump	ea	4	$4,500	$18,000	
12	Sump Level Controls	ea	4	$2,500	$10,000	
13	Electrical Conduit	lf	1245	$10	$12,450	1065 ft of conduit pipe placed on ground surface, and 4 - 20 ft segments from the sumps to the header
14	Misc. Electrical	ls	1	$10,000	$10,000	
15	Grout Ground Water Treatment System Trench at end of Project	cy	820	$25	$20,500	18 ft deep, 3 ft wide 1165 lf, assumes 35% void space
				Subtotal	$570,632	

Lake Water Removal System Inside of Containment

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	2 Pumps at 500 gpm w/ Operator to Initially Drain Bay	day	12	$7,840	$94,080	[$85/hr x 8 hrs = 127.50/hr x 16 hr + $1200/day pump] x 2. ~12million gal in side SPW; 2 - 500gpm pumps = 1,440,000 gpd; added ~2 add'l days for rain, gw, and lake water infiltration
2	Sump pumps variable discharge 10 to 100 gpm	ea	8	$4,500	$36,000	Dewater sediments
3	Collection/discharge piping, 12-in HDPE	lf	3280	$5.50	$18,040	Two collection pipes runs on land along Bay from the NW and NE corners of the Bay until reaching WWTP; Discharge pipe runs to the east to Lake Superior (east of the containment area)
4	Connection to WWTP	ea	3	$2,000	$6,000	Two intake connections from each side of the Bay (West and East), one outgoing connection for treated water going to Lake Superior
5	Start-up Samples	ea	200	$200	$40,000	
6	Electrical Conduit	lf	1450	$10	$14,500	Runs on land along Bay to the west and east, connects up with the Ground Water Capture System conduit to the south
7	Connection to City Power Supply	ls	1	$20,000	$20,000	Connection and transformer
8	1 500 gpm Pump w/ Operator to Drain Bay in the Spring	day	7	$3,920	$27,440	
				Subtotal	$254,060	

Ground/Lake Water Treatment System

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
	Year 1 Set-up					
1	Oil Water Separator and associated system (200 gpm) (purchase)	ea	1	$30,000	$30,000	
2	Fuel and energy surcharge (estimated [illegible] .35%)	ea	2	$1,298	$2,595	
3	Connecting piping, pumps, accessories	ea	1	$20,000	$20,000	
	Year 1 and 2 Operation					
	Carbon Adsorber System (1500 gpm					Assumes activated carbon of lake water sufficient to discharge water back into Lake Superior
1	*Rental Installation, mobilization, set up, carbon*	ea	2	$49,335	$98,670	For use at the beginning of each work season
2	*Rental**	months	6	$5,000	$30,000	*There is a three month minimum rental for each of the units
3	*Rental Termination, carbon removal, demobilization*	ea	2	$41,935	$83,870	
	Carbon Adsorption System and Bag System for Filtration (200 gpm)					*Assumes activated carbon of lake water sufficient to discharge water back into Lake Superior*
1	*Rental Installation, mobilization, set up, carbon*	ea	1	$28,675	$28,675	For use after returning the 1500 gpm units
2	*Rental**	months	5	$1,500	$7,500	
3	*Rental Termination carbon removal, system disassembly, demob*	ea	1	$39,350	$39,350	
4	*Carbon Sand Filtration*	kgal	55	$67,000	$3,685,000	Stryker Bay Cost Estimates
5	*Water Quality Testing*	kgal	55	$2,400	$132,000	Stryker Bay Cost Estimates
6	*BF400 Four Bag Filter Site*	months	11	$4,000	$44,000	
7	*Filter Bags (5 micron rating) - Bag [illegible] 50*	cases	12	$600	$7,200	
8	Fuel and energy surcharge (estimated [illegible] .35%)	ea	1	$358,142	$358,142	
9	Dispose soil in filter bags (special wash)	tons	27	$60	$1,620	All filter bags will fill with fines and have to be disposed as special waste. Assumed average cost is $60/ton.
10	Oil Disposal	gallons	350	$3	$1,050	Oil from oil/water separator will be collected in a 55 gallon drum and disposed as necessary.
11	Operation and Maintenance (labor)	hours	6000	$100	$600,000	Two employees for 50 hours per week for operations and maintenance.
12	Oil Water Separator O&M	kgal	55	$2,700	$148,500	Stryker Bay Cost Estimates
	Subtotal					
				Subtotal	$5,054,837	
				Total Water Collection and Treatment	$6,890,729	

Miscellaneous

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Develop HASP	ls	1	$10,000	$10,000	$100/hr X 40 hr/wk X 2.5 weeks
2	Health & Safety Personnel	day	76	$1,440	$109,440	Once a week, for 2 years (38 weeks/yr)
3	24 hr Security of Site	weeks	125	$2,695	$336,875	$15/hr X 24 hr X 7 days + $25/day (expenses), 30 weeks of work
				Subtotal	$456,315	
				Total Miscellaneous	$456,315	

Subtotal	$47,094,047
Engineering @ 15%	$7,064,107
Oversight @ 15%	$7,064,107
Subtotal	$61,222,261
Contingency @ 20%	$9,418,809 Only taken on Capital Costs not Engineering
TOTAL:	**$70,641,070**

Post-Construction:

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Monitoring	yr	30	$40,000.00	$1,200,000	
2	Reporting	yr	30	$12,000.00	$360,000	Post-Closure Reporting
3	O&M	yr	30	$10,000.00	$300,000	
				Subtotal	$1,860,000	
	Present worth @ 7% discount factor				$715,980	

GRAND TOTAL: $71,356,160

Table F1-8
Alternate S5A: Limited Removal and On-site Thermal Treatment

Containment:

		Volume to Remove	
Excavation - Limited Removal			
Remove NAPL contaminated soil	1.7 ton/cubic yard	9,400 cy	NSPW Property South of St. Claire Street
		150 cy	NSPW Property North of St. Claire Street
		4,800 cy	Former Coal Tar Dump Area
		Total Area:	
Surface Barriers			
Asphalt Pavement -		26,000 sq ft	NSPW Property South of St. Claire Street
Includes 6 inches stone, 3 inches binder, 2 inches surface.		22,000 sq ft	NSPW Property North of St. Claire Street
		98,000 sq ft	Marina Parking Lot Area
Low Permeability Cap -			
Includes 3 feet of clay.		42,500 sq ft	Former Coal Tar Dump Area

Upper Bluff Area

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Building Demolition	Est.	1	$50,000	$50,000	Center section of NSPW building overlying filled ravine.
2	Gas Holder Removal	Est.	1	$30,000	$30,000	Removal/demolition of buried gas holders.
3	Excavation	cy	9,550	$5	$47,750	
4	Transportation for off-site landfill	ton	1,624	$25	$40,588	Assumes 10% of fill not suitable for thermal treatment
5	Sorting and Disposal (unsuitable material)	ton	1,624	$18	$29,223	
6	Thermal Treatment	ton	14,612	$100	$1,461,150	Thermal desorption and on-site placement of treated soil.
7	Backfill	cy	9,550	$12	$114,600	
8	Excavation de-watering equipment	Est.	1	$25,000	$25,000	Pumps and holding tanks
9	Waste water treatment	Gallon	144,000	$0.05	$7,200	Existing treatment system (5 gpm for 20 days)
10	Installation of new asphalt pavement	sq. yd.	48,000	$25	$1,200,000	NSPW Property North of St. Claire Street (includes grading)
11	Move Abandon Existing Utilities	ls	1	$10,000	$10,000	Includes move/abandon existing buried sanitary and gas utilities
12	24 hr. Security of Site	weekly	4	$2,695	$10,780	$15/hr X 24 hr X 7 days + $25/day (expenses)
13	Perimeter Fence	ln ft	500	$20	$10,000	Fence around excavation area
				Subtotal	$3,036,291	
	Mobilization/Demobilization @	5%	of	$3,036,291	$151,815	
	Engineering @	15%	of	$3,036,291	$455,444	
	Construction Oversight @	15%	of	$3,036,291	$455,444	
				Subtotal	$4,098,992	
	Contingency @	20%	of	$3,036,291	$607,258	
				Total	$4,706,250	

Table F1-8
Alternate S5A: Limited Removal and On-site Thermal Treatment

Kreher Park

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Clear & Grub	est.	1	$10,000	$10,000	
2	Excavation	cy	4,800	$5	$24,000	Former coal tar dump area to 5 feet.
3	Transportation	ton	816	$25	$20,400	
4	Sorting and Disposal (unsuitable material)	ton	816	$18	$14,688	Assumes 10% of fill not suitable for thermal treatment
5	Thermal Treatment	ton	7,344	$100	$734,400	
6	Backfill	cy	4,800	$12	$57,600	
7	Excavation de-watering equipment	Est.	1	$25,000	$25,000	Pumps and holding tanks
8	Waste water treatment	Gallon	144,000	$0.05	$7,200	Existing treatment system (5 gpm for 20 days)
9	Installation of low permeability cap	cy	4,722	$25	$118,056	3 ft. of clay over former coal tar dump area
10	Top Soil	sq. yd.	4,722	$18	$85,000	0.5 ft. topsoil cover over clay cap
11	Vegetation	acre	1	$3,500	$3,500	Seeding
12	Installation of new asphalt pavement	sq. yd.	10,889	$25	$272,222	Marina Parking Lot Area
13	24 hr. Security of Site	weekly	2	$2,695	$5,390	$15/hr X 24 hr X 7 days + $25/day (expenses)
14	Perimeter Fence	ln ft	750	$20	$15,000	Fence around excavation area
	subtotal			Subtotal	$1,392,456	
	Mobilization/Demobilization @	5%	of	$1,392,456	$69,623	
	Engineering @	15%	of	$1,392,456	$208,868	
	Construction Oversight @	15%	of	$1,392,456	$208,868	
				Subtotal	$1,879,815	
	Contingency @	20%	of	$1,392,456	$278,491	
				Total	$2,158,306	

GRAND TOTAL $6,864,557

Summary

	Capital Costs	Mod / Demob	Engineering	Construction Oversight	Contingency	Estimated Cost
Limited removal and off-site disposal - upper bluff area	$3,036,291	$151,815	$455,444	$455,444	$607,258	$4,706,250
Limited removal and off-site disposal - Kreher Park	$1,392,456	$69,623	$208,868	$208,868	$278,491	$2,158,306
Total Estimated Cost	$4,428,746	$221,437	$664,312	$664,312	$885,749	$6,864,557

Long term groundwater monitoring costs are included with groundwater remedial alternatives.

Table F2-3
Alternate GW2A: Containment Using Engineered Surface and Vertical Barriers (Partial Cap for Kreher Park)

Containment: Surface Barriers

	Total Area:	
1 ***Asphalt Pavement -*** Includes 6 inches stone, 3 inches binder, 2 inches surface.	16,000 sq ft	NSPW Property South of St. Claire Street
	22,000 sq ft	NSPW Property North of St. Claire Street
	98,000 sq ft	Marina Parking Lot Area
2 ***Low Permeability Cap -*** Includes 3 feet of clay.	42,500 sq ft	Former Coal Tar Dump Area
	5,000 sq ft	TW-11 Area
	72,000 sq ft	WWTP Area

Upland Area ***Shallow Groundwater - Filled Ravine***

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Installation of new asphalt pavement	sq. yd.	1,778	$25	$44,444	NSPW Property South of St. Claire Street (includes grading)
2	Installation of new asphalt pavement	sq. yd.	2,444	$25	$61,111	NSPW Property North of St. Claire Street (includes grading)
				Subtotal	**$105,556**	
	Mobilization/Demobilization @	5%	of	$105,556	$5,278	
	Engineering @	15%	of	$105,556	$15,833	
	Construction Oversight @	15%	of	$105,556	$15,833	
				Subtotal	**$142,500**	
	Contingency @	20%	of	$105,556	$21,111	
				Total	**$163,611**	

Kreher Park ***Shallow Groundwater - Kreher Park Former Coal Tar Dump and TW-11 Areas***

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Clear and Grub	est.	1	$10,000	$10,000	
2	Installation of new asphalt pavement	sq. yd.	10,889	$25	$272,222	Marina Parking Lot Area
3	Installation of low permeability cap	cy	5,278	$25	$131,944	3 ft. of clay over former coal tar dump area
4	Top Soil	sq. yd.	5,278	$18	$95,000	0.5 ft. topsoil cover over clay cap
5	Vegetation	acre	1.1	$3,500	$3,817	Seeding
6	Storm water Drainage System	est.	1	$30,000	$30,000	For water runoff during storm post-remediation
7	Vertical barrier wall - along shoreline	sf	38,750	$35	$1,356,250	Sheet pile wall (1,550 linear feet and 25 feet deep).
8	Vertical barrier wall - perimeter	sf	32,000	$35	$1,120,000	Sheet pile wall (2,000 linear feet and 16 feet deep).
9	Groundwater Diversion Trench	ln ft	1,525	$50	$76,250	Divert groundwater from upper bluff area around Kreher Park
10	Groundwater Extraction Wells	each	15	$2,500	$37,500	
11	Well Pumps	each	15	$2,500	$37,500	
12	Extraction Well Lateral Piping	ln ft	2,500	$100	$250,000	
13	Discharge Lateral Piping	ln ft	1,500	$75	$112,500	
14	Treatment equipment	each	1	$30,000	$30,000	
15	Building	each	1	$25,000	$25,000	
16	UST/OWS System	Est.	1	$15,000	$15,000	
17	Institutional Control Implementation	est.	1	$5,000	$5,000	Groundwater use and deed restrictions.
	subtotal			**Subtotal**	**$3,607,983**	
	Mobilization/Demobilization @	5%	of	$3,607,983	$180,399	
	Engineering @	15%	of	$3,607,983	$541,197	Includes WPDES permit application.
	Construction Oversight @	15%	of	$3,607,983	$541,197	
				Subtotal	**$4,870,777**	
	Contingency @	20%	of	$3,607,983	$721,597	
				Total	**$5,592,374**	

Table F2-3
Alternate GW2A: Containment Using Engineered Surface and Vertical Barriers (Partial Cap for Kreher Park)

Shallow Groundwater - Kreher Park
WWTP Area

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	WWTP Building Demolition	est.	1	$250,000	$250,000	
2	Installation of low permeability cap	cy	8,000	$25	$200,000	3 ft. of clay at WWTP area (post demolition)
3	Top Soil	sq. yd.	8,000	$18	$144,000	0.5 ft. topsoil cover over clay cap
4	Vegetation	acre	1.7	$3,500	$5,785	Seeding
5	Storm water Drainage System	est.	1	$30,000	$30,000	For water runoff during storm post-remediation
				Subtotal	$629,785	
	Mobilization/Demobilization @	5%	of	$629,785	$31,489	
	Engineering @	15%	of	$629,785	$94,468	
	Construction Oversight @	15%	of	$629,785	$94,468	
				Subtotal	$850,210	
	Contingency @	20%	of	$629,785	$125,957	
				Total	$976,167	

Post Construction

Item No.	Item	Unit	Quantity	Unit Costs	Total	
1	Annual Inspections	yr	30	$250	$7,500	
2	Post-Closure Reporting/Record Keeping	yr	30	$500	$15,000	
3	Cap Maintenance	yr	30	$1,000	$30,000	
4	Groundwater Extraction System O & M	yr	30	$57,600	$1,728,000	$4,800 per month
5	Groundwater monitoring	yr	30	$25,000	$750,000	shallow groundwater monitoring
6	Annual cap inspection and reporting	yr	30	$5,000	$150,000	
7	Groundwater treatment & disposal	yr	30	$112,500	$3,375,000	*2,250,000 gallons per year (from infiltration)*
			Subtotal	$201,850	$6,065,500	
	Present worth @7% Discount				$2,504,757	

GRAND TOTAL $9,236,909

Summary

	Capital Costs	Mob / Demob	Engineering	Construction Oversight	Contingency	OM & M Costs	Estimated Cost
Installation of surface barrier - upper bluff area	$105,556	$5,278	$15,833	$15,833	$21,111	$0	$163,611
Installation of surface & vertical barrier - Kreher Park	$3,607,983	$180,399	$541,197	$541,197	$721,597	$0	$5,592,374
WWTP Demolition and clay cap	$629,785	$31,489	$94,468	$94,468	$125,957	$0	$976,167
Post construction maintenance and monitoring (30 years)	$0	$0	$0	$0		$2,504,757	$2,504,757
Total Estimated Cost	$4,343,324	$217,166	$651,499	$651,499	$868,665	$2,504,757	$9,236,909

Includes groundwater monitoring costs for shallow groundwater

Table F2-8
Alternate GW6: In-situ Chemical Oxidation

In-situ Treatment In-situ Chemical Oxidation

	Total Area:	
1 *Asphalt Pavement* -	26,000 sq ft	NSPW Property South of St. Claire Street
Includes 6 inches stone, 3 inches binder, 2 inches surface.	22,000 sq ft	NSPW Property North of St. Claire Street
	86,000 sq ft	Marina Parking Lot Area
2 *Low Permeability Cap* -		
Includes 3 feet of clay.	42,500 sq ft	Former Coal Tar Dump Area

Upland Area *Copper Falls Aquifer*

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Groundwater Extraction Wells	each	7	$5,000	$35,000	Additional extraction wells
2	Pumps	each	7	$2,500	$17,500	
3	Lateral piping	ln ft	1,000	$50	$50,000	
4	LSTO/NS System	Est.	1	$15,000	$15,000	Upgrade existing system
5	Wastewater treatment equipment	Est.	1	$25,000	$25,000	Upgrade existing system
6	Drilling	per gal	750,000	$2	$1,500,000	500 holes, 1,500 gallons per hole @ $2 per gallon
7	Reagent Injection	per week	50	$7,500	$375,000	3,000 gallons per day
				Subtotal	$2,017,500	
	Mobilization/Demobilization @	5%	of	$2,017,500	$100,875	
	Engineering @	15%	of	$2,017,500	$302,625	
	Construction Oversight @	15%	of	$2,017,500	$302,625	
				Subtotal	$2,723,625	
	Contingency @	20%	of	$2,017,500	$403,500	
				Total	$3,127,125	

Post Construction *Copper Falls Aquifer*

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Operation and Maintenance	year	7	$57,600	$403,200	Existing groundwater extraction system
2	Groundwater extraction (existing wells)	year	7	$394,200	$2,759,400	15 gpm @ $0.05
3	Groundwater Monitoring	year	7	$25,000	$175,000	
4	Annual report	year	7	$5,000	$35,000	
			Subtotal	$481,800	$3,372,600	
	Present worth @7% Discount				$2,598,420	
				Total	$5,723,545	

Shallow Groundwater - Filled Ravine

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Building Demolition	Est.	1	$50,000	$50,000	Center section of NSPW building overlying filled ravine.
2	Vent Well Installation	each	10	$2,500	$25,000	10 passive vent wells
3	Drilling	per gal	450,000	$2	$900,000	300 holes, 1,500 gallons per hole @ $2 per gallon
4	Reagent Injection	per week	30	$7,500	$225,000	3,000 gallons per day
5	Installation of new asphalt pavement	sq. yd.	2,889	$25	$72,222	NSPW Property South of St. Claire Street (includes grading)
6	Installation of new asphalt pavement	sq. yd.	2,444	$25	$61,111	NSPW Property North of St. Claire Street (includes grading)
				Subtotal	$1,333,333	
	Mobilization/Demobilization @	5%	of	$1,333,333	$66,667	
	Engineering @	15%	of	$1,333,333	$200,000	
	Construction Oversight @	15%	of	$1,333,333	$200,000	
				Subtotal	$1,800,000	
	Contingency @	20%	of	$1,333,333	$266,667	
				Total	$2,066,667	

Post Construction *Shallow Groundwater - Filled Ravine*

Item No.	Item					
1	Groundwater Monitoring	year	7	$10,000	$70,000	
2	Annual report	year	7	$2,500	$17,500	
			Subtotal	$12,500	$87,500	
	Present worth @7% Discount				$67,363	
				Total	$2,134,029	

Table F2-8
Alternate GW6: In-situ Chemical Oxidation

Kreher Park — *Shallow Groundwater - Kreher Park*

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Clear and Grub	est.	1	$10,000	$10,000	
2	Excavation	cy	3,935	$10	$39,352	
3	Bench scale test	est.	1	$5,000	$5,000	
4	Reagent Mixing	cy	3,935	$50	$196,759	
5	Drilling	per gal	225,000	$2	$450,000	150 holes. 1,500 gallons per hole @ $2 per gallon
6	Reagent Injection	per week	15	$7,500	$112,500	3,000 gallons per day
7	Installation of new asphalt pavement	sq. yd.	10,889	$25	$272,222	Marina Parking Lot Area
8	Installation of low permeability cap	cy	4,722	$25	$118,056	3 ft. of clay over former coal tar dump area
9	Top Soil	sq. yd.	4,722	$18	$85,000	0.5 ft. topsoil cover over clay cap
10	Vegetation	acre	1	$3,500	$3,500	Seeding
11	Storm water Drainage System	Basin	2	$30,000	$60,000	For water runoff during storm post-remediation
				Subtotal	$1,352,389	
	Mobilization/Demobilization @	5%	of	$1,352,389	$67,619	
	Engineering @	15%	of	$1,352,389	$202,858	
	Construction Oversight @	15%	of	$1,352,389	$202,858	
				Subtotal	$1,825,725	
	Contingency @	20%	of	$1,352,389	$270,478	
	Total			Total	$2,096,203	

Post Construction — *Shallow Groundwater - Kreher Park*

Item No.	Item					
1	Groundwater Monitoring	year	7	$15,000	$105,000	
2	Annual report	year	7	$2,500	$17,500	
	subtotal		Subtotal	$17,500	$122,500	
	Present worth @7% Discount				$94,308	
				Total	$2,190,510	

GRAND TOTAL $10,048,085

In-situ chemical oxidation

Summary	In-situ chemical oxidation	Capital Costs	Mob / Demob	Engineering	Construction Oversight	Contingency	OM & M Costs	Estimated Cost
	Copper Falls Aquifer	$2,017,500	$100,875	$302,625	$302,625	$403,500	$2,596,420	$5,723,545
	Shallow Groundwater - Filled Ravine	$1,333,333	$66,667	$200,000	$200,000	$266,667	$87,363	$2,134,029
	Shallow Groundwater - Kreher Park	$1,352,389	$67,619	$202,858	$202,858	$270,478	$94,308	$2,190,510
	GRAND TOTAL	$4,703,222	$235,161	$705,483	$705,483	$940,644	$2,758,090	$10,048,085

Table F2-12
Alternate GW9B: Enhanced Groundwater Extraction

Removal Groundwater Extraction and On-site Treatment

	Total Area:	
1 *Asphalt Pavement -*	16,000 sq ft	NSPW Property South of St. Claire Street
Includes 6 inches stone, 3 inches binder, 2 inches surface.	22,000 sq ft	NSPW Property North of St. Claire Street
	98,000 sq ft	Marina Parking Lot Area
2 *Low Permeability Cap -*	42,500 sq ft	Former Coal Tar Dump Area
Includes 3 feet of clay		

Upland Area *Copper Falls Aquifer*

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Extraction wells	each	12	$7,500	$90,000	
2	Pumps	per gal	12	$3,500	$42,000	
3	Lateral piping	ln ft	1,500	$75	$112,500	
4	USTOWS System	Est.	1	$15,000	$15,000	Upgrade existing system
5	Wastewater treatment equipment	Est.	1	$25,000	$25,000	Upgrade existing system
				Subtotal	$284,500	
	Mobilization/Demobilization @	5%	of	$284,500	$14,225	
	Engineering @	15%	of	$284,500	$42,675	
	Construction Oversight @	15%	of	$284,500	$42,675	
				Subtotal	$384,075	
	Contingency @	20%	of	$284,500	$56,900	
				Total	$440,975	

Post Construction *Copper Falls Aquifer*

Item No.	Item	Unit	Quantity	Unit Cost	Total	Notes
1	Operation and Maintenance	year	30	$57,600	$1,728,000	Existing groundwater extraction system
2	Groundwater extraction (existing wells)	year	30	$394,200	$11,826,000	15 gpm @ $0.05
3	Groundwater Monitoring	year	30	$25,000	$750,000	
4	Annual cap inspection and reporting	year	30	$5,000	$150,000	
			Subtotal	$481,800	$14,454,000	
	Present worth @7% Discount				$5,978,656	

Table F2-12
Alternate GW9B: Enhanced Groundwater Extraction

				Total	$6,419,631	
Upland Area	***Shallow Groundwater - Filled Ravine***					
Item No.	**Item**	**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Installation of new asphalt pavement	sq. yd.	1,778	$25	$44,444	NSPW Property South of St. Claire Street (includes grading)
2	Installation of new asphalt pavement	sq. yd.	2,444	$25	$61,111	NSPW Property North of St. Claire Street (includes grading)
				Subtotal	$105,556	
	Mobilization/Demobilization @	5%	of	$105,556	$5,278	
	Engineering @	15%	of	$105,556	$15,833	
	Construction Oversight @	15%	of	$105,556	$15,833	
				Subtotal	$142,500	
	Contingency @	20%	of	$105,556	$21,111	
				Total	$163,611	

Kreher Park	***Shallow Groundwater***					
Item No.	**Item**	**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Extraction trench	ln ft	1,500	$150	$225,000	
2	Sump and pump	each	1	$20,000	$20,000	
3	Lateral piping	ln ft	1,500	$75	$112,500	
4	Treatment equipment	each	1	$30,000	$30,000	
5	Building	each	1	$25,000	$25,000	
6	UST/OWS System	Est.	1	$15,000	$15,000	
7	Installation of new asphalt pavement	sq. yd.	10,889	$25	$272,222	Marina parking lot
8	Installation of low permeability cap	cy	4,722	$25	$118,056	3 ft. of clay over former coal tar dump area
9	Top Soil	sq. yd.	4,722	$18	$85,000	0.5 ft. topsoil cover over clay cap
10	Vegetation	acre	1	$3,500	$3,500	Seeding
11	Storm water Drainage System	Basin	2	$30,000	$60,000	For water runoff during storm post-remediation
				Subtotal	$966,278	
	Mobilization/Demobilization @	5%	of	$966,278	$48,314	
	Engineering @	15%	of	$966,278	$144,942	
	Construction Oversight @	15%	of	$966,278	$144,942	
				Subtotal	$1,304,475	
	Contingency @	20%	of	$966,278	$193,256	
				Total	$1,497,731	

Table F2-12
Alternate GW9B: Enhanced Groundwater Extraction

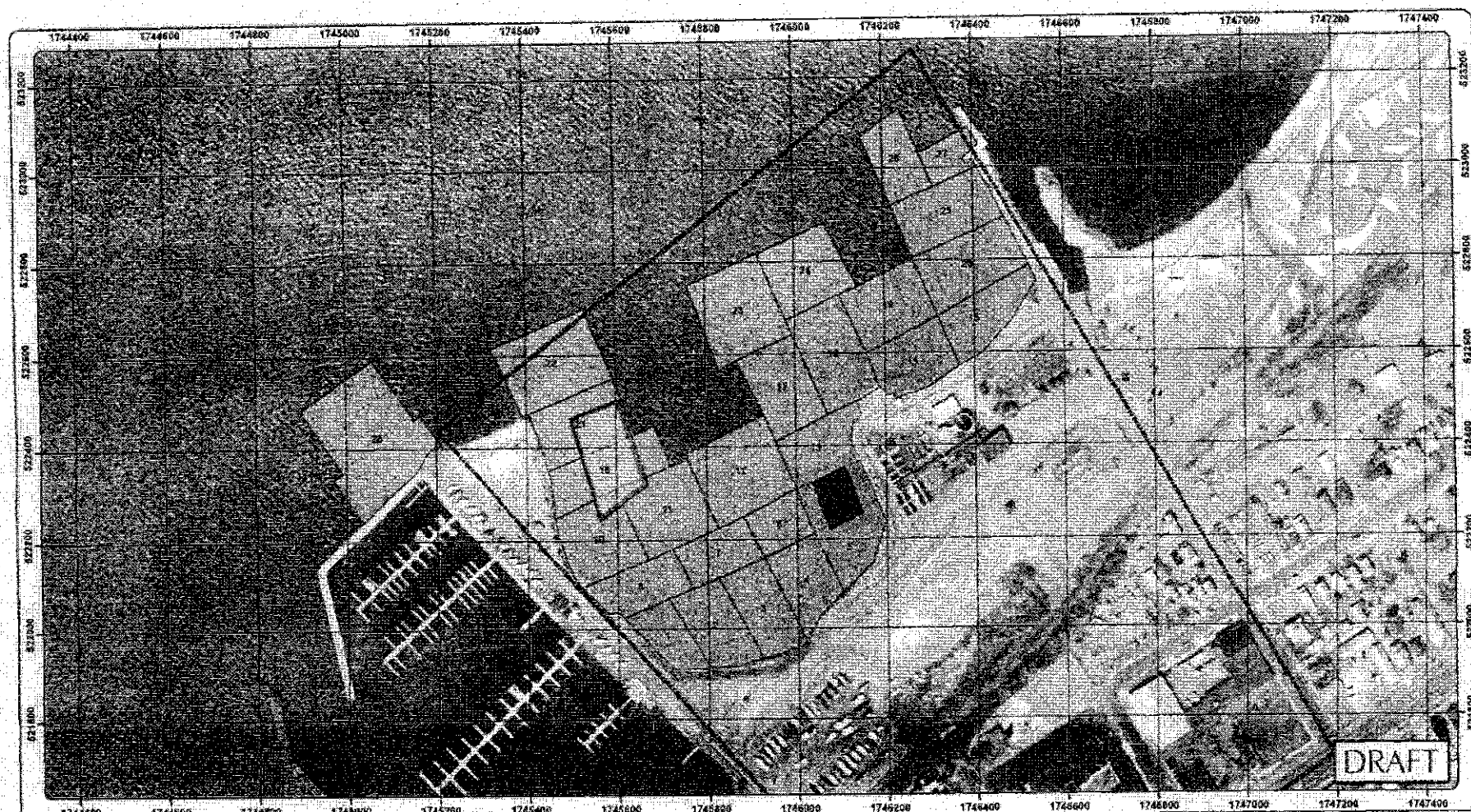
	Unit	Quantity	Unit Cost	Total	Notes
	year	30	$57,600	$1,728,000	
osal	year	30	$1,314,000	$39,420,000	50 gpm @ $0.05
	year	30	$25,000	$750,000	
orting	year	30	$5,000	$150,000	
subtotal			$1,401,600	$42,048,000	
Present worth @7% Discount				$17,392,454	
			Subtotal	$18,890,185	

GRAND TOTAL $25,415,372

	Capital Costs	Mob / Demob	Engineering	Construction Oversight	Contingency	OM & M Costs	Estimated Cost
	$284,500	$14,225	$42,675	$42,675	$56,900	$5,978,656	$6,419,631
Ravine	$105,556	$5,278	$15,833	$15,833	$21,111	$0	$163,611
Park	$966,278	$48,314	$144,942	$144,942	$193,256	$17,392,454	$18,890,185
GRAND TOTAL	$1,356,333	$67,817	$203,450	$203,450	$271,267	$23,371,111	$25,473,427

APPENDIX Q

Figures Showing Expected Implementation of Components of Remedy



Legend

- Preliminary Geologic Mapping Area of Units
- NAPL Target Area
- NAPL Side Slope Area
- Non-NAPL Target Area
- Non-NAPL Side Slope Area
- NPL Boundary

Notes
1. Coordinate grid grid system, NAD 1983, Wisconsin State Plane North (feet)

Source
2005 6-inch resolution orthophoto received from the Ashland County Land Information Office

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

N

XCEL ENERGY

PILOT STUDY LOCATION
NON-NAPL AND NAPL REGIONS
ASHLAND, WISCONSIN

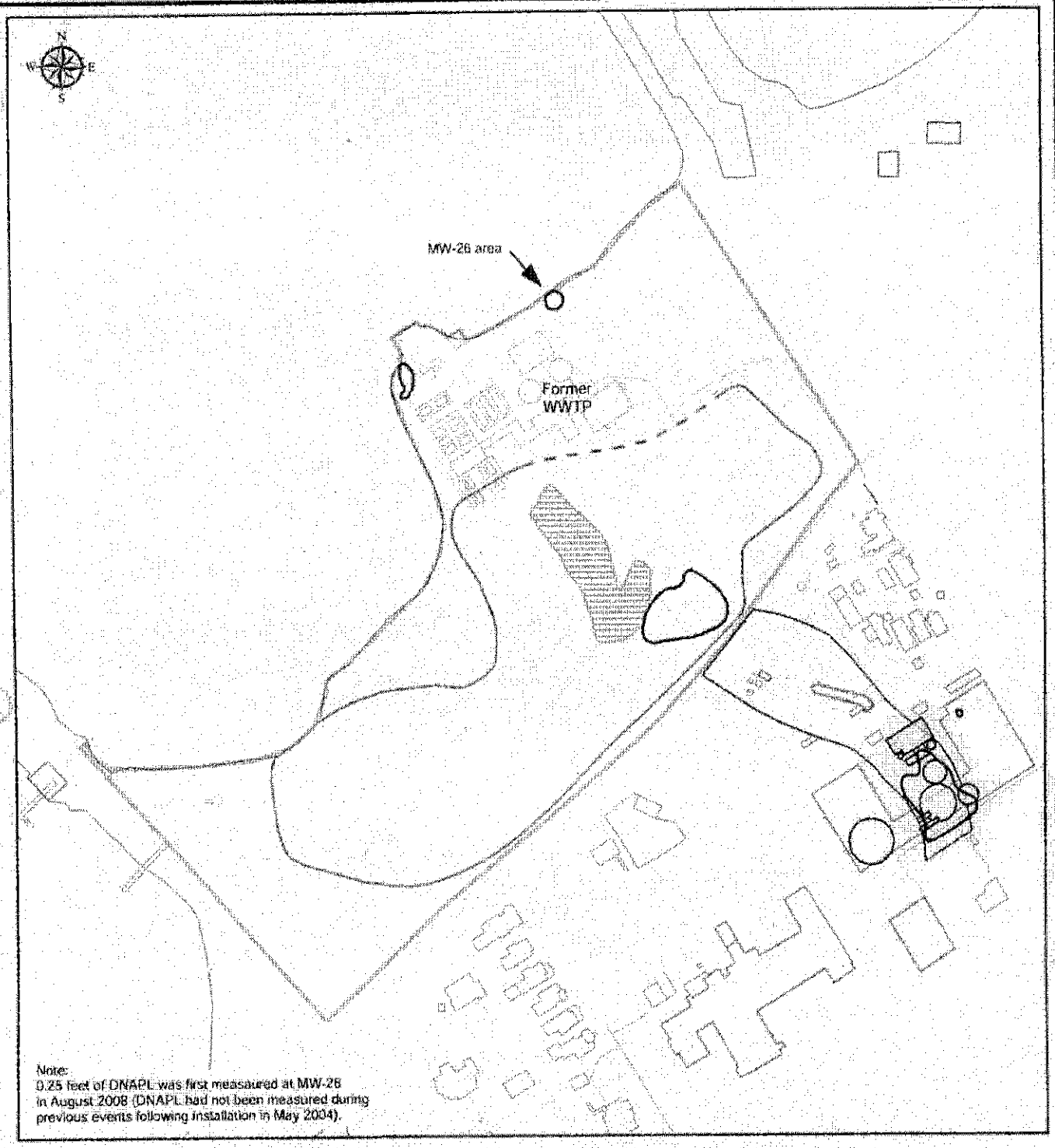
SCALE: 0 100 200 Feet

PROJECT ID: 09X001

DATE: 09/26/09
PREPARED BY: BAW
CHECKED BY: SGA

Foth Cedar

FIGURE NO. 1A



Note:
0.25 feet of DNAPL was first measured at MW-26 in August 2008 (DNAPL had not been measured during previous events following installation in May 2004).

Legend

- Clay Tile DNAPL Area
- DNAPL Extent
- LNAPL Extent (dashed where inferred)
- Former Coal Tar Dump Area
- Former MGP Tanks/holders
- Filled Ravine - Unlimited Removal Excavation Area
- Kreher Park - Unlimited Removal Excavation Area

0 50 100 150 200 Feet

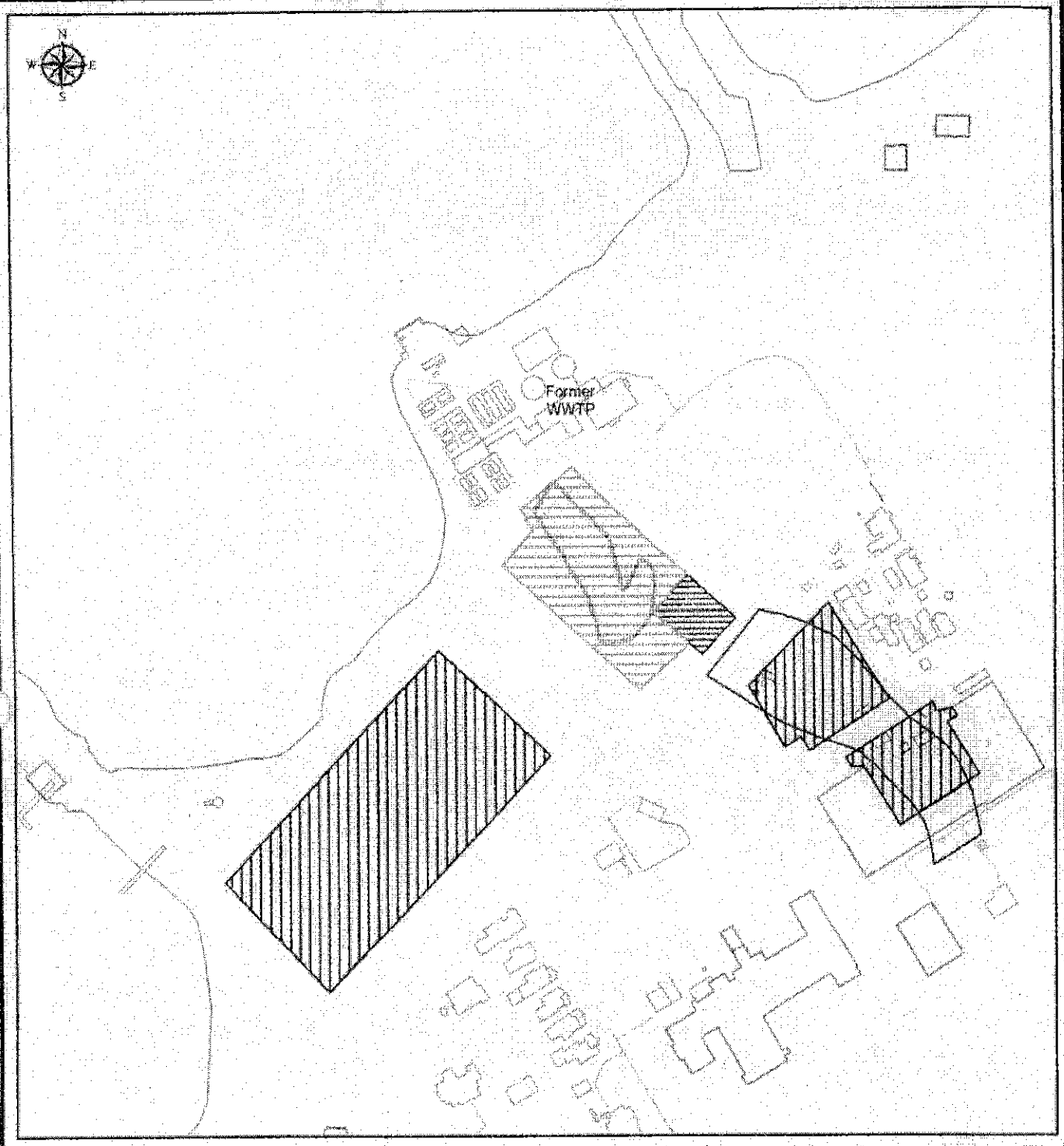
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 6-1
Existing Conditions at
Upper Bluff Area & Kreher Park

DRAWN BY: DDZ	SCALE: AS SHOWN	PROJECT: 25688375	
CHECKED BY: MSM	DATE: 24 OCT 2008	SHEET: 6-1	
APPROVED BY: DPT			

URS

8737 W. WASHINGTON ST. SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100



Legend

- Former Coal Tar Dump Area
- Filled Ravine
- Asphalt pavement (new)
- Low Permeability Clay Cap
- Existing Surface Barrier - Former Seep Area

0 75 150 225 300 Feet

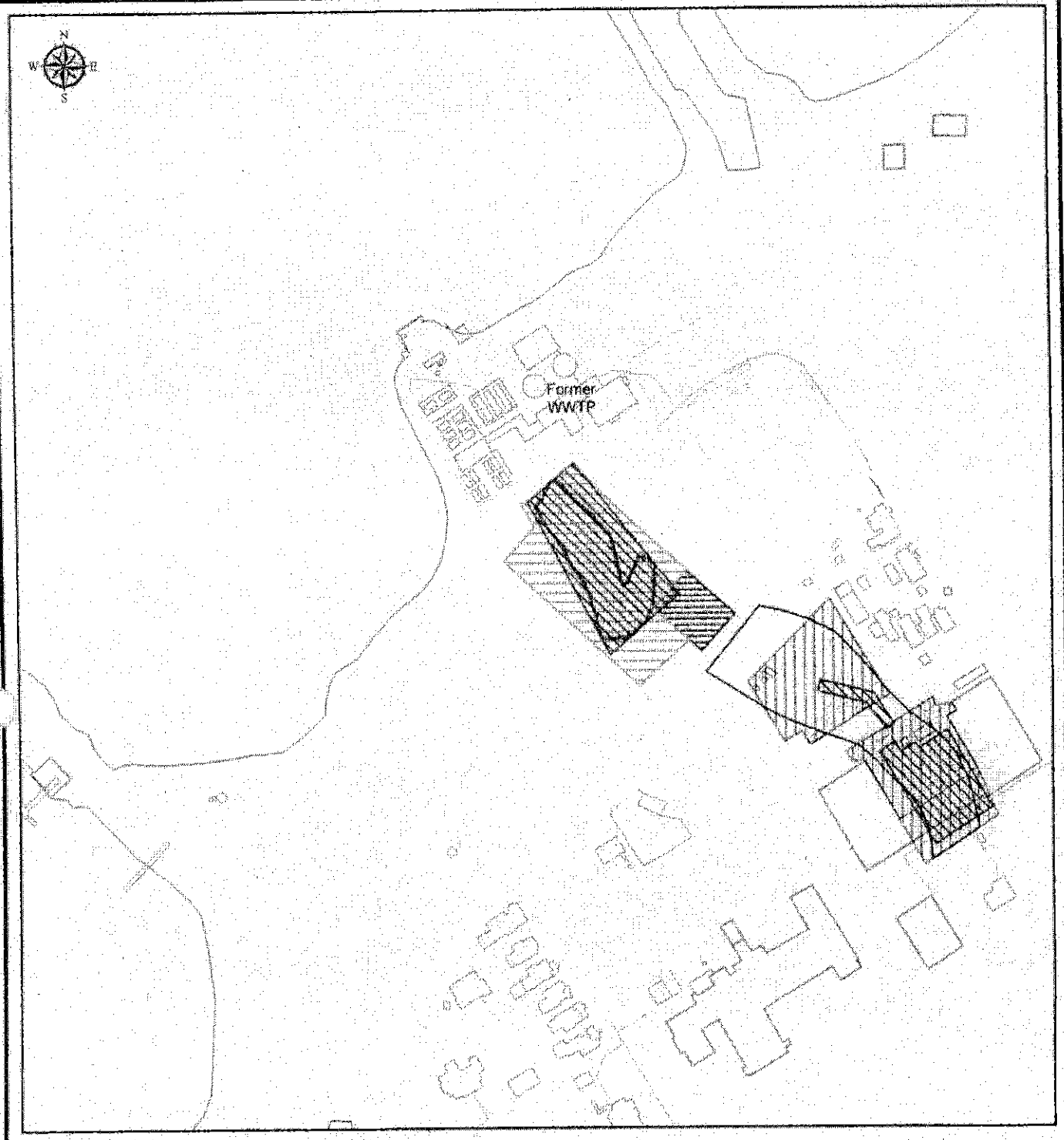
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 6-2
Engineered Surface Barriers
Upper Bluff Area & Kreher Park

DRAWN BY: DDZ	SCALE: AS SHOWN	PROJECT: 25688375	
CHECKED BY: MSM	DATE: 24 OCT 2008	SHEET: 6-2	
APPROVED BY: CPT			

URS

6727 W. WASHINGTON ST. SUITE 2260
MILWAUKEE, WISCONSIN 53214
414-831-4100



Legend

- Former Coal Tar Dump Area
- Filled Ravine
- Soil Excavation Area - Limited Removal Area
- Asphalt pavement (new)
- Low Permeability Clay Cap
- Existing Surface Barrier - Former Seep Area

0 75 150 225 300 Feet

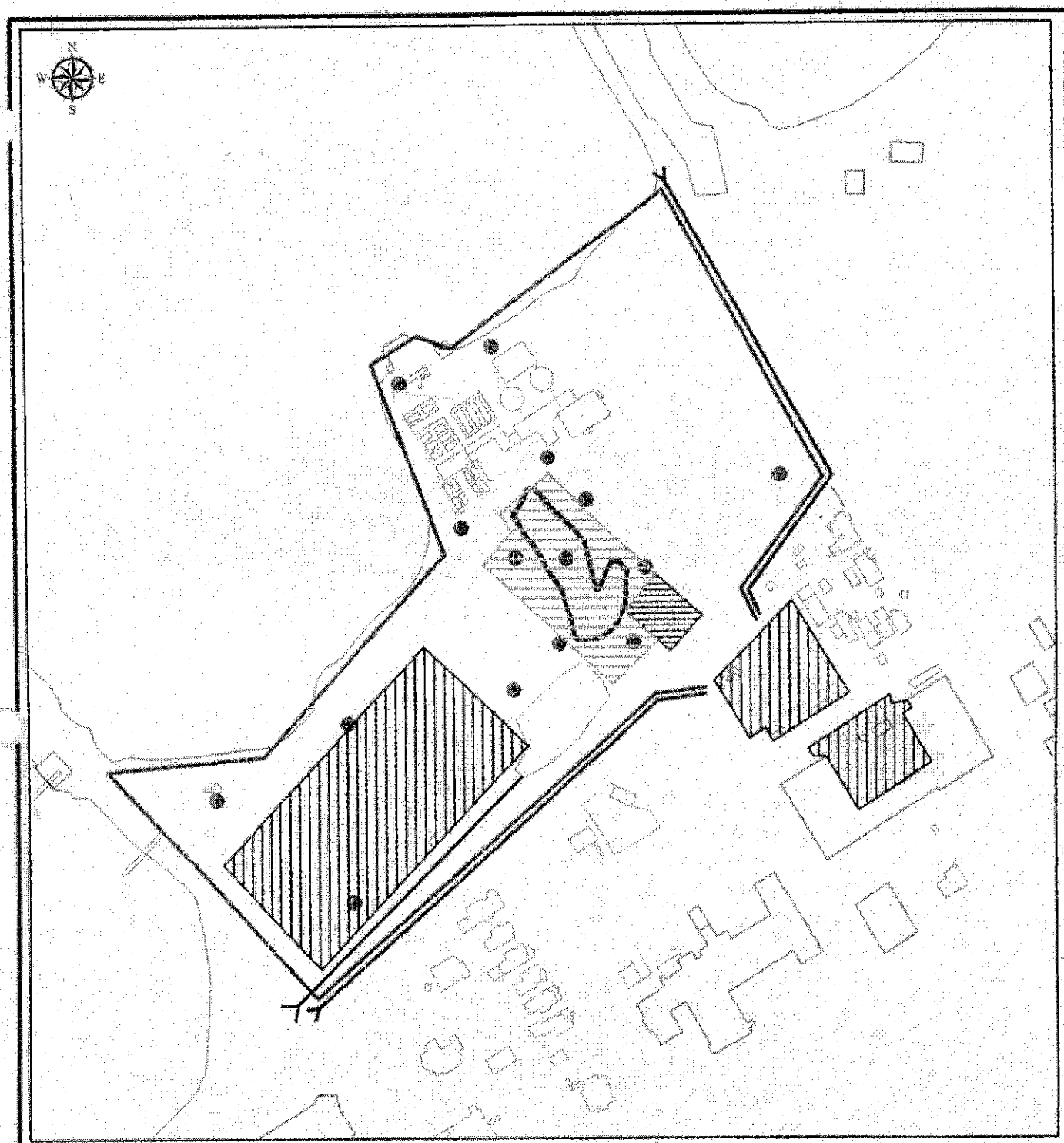
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 6-3A
Limited Removal & Off-site Disposal
Upper Bluff Area & Kreher Park

DRAWN BY: DDZ	SCALE: AS SHOWN	PROJECT: 25688375	
CHECKED BY: MSN	DATE: 24 OCT 2008	SHEET: 6-3A	
APPROVED BY: DPT			

URS

9757 W. WASHINGTON ST, SUITE 3265
MILWAUKEE, WISCONSIN 53214
414-831-8100



Legend

- Asphalt pavement (new)
- Low Permeability Clay Cap
- Existing Surface Barrier - Former Seep Area
- Vertical Barrier Wall
- Pressure Relief Wells
- Stormwater Outfall
- Stormwater Basin
- Stormwater Diversion Tile
- Former Coal Tar Dump Area

0 75 150 225 300 Feet

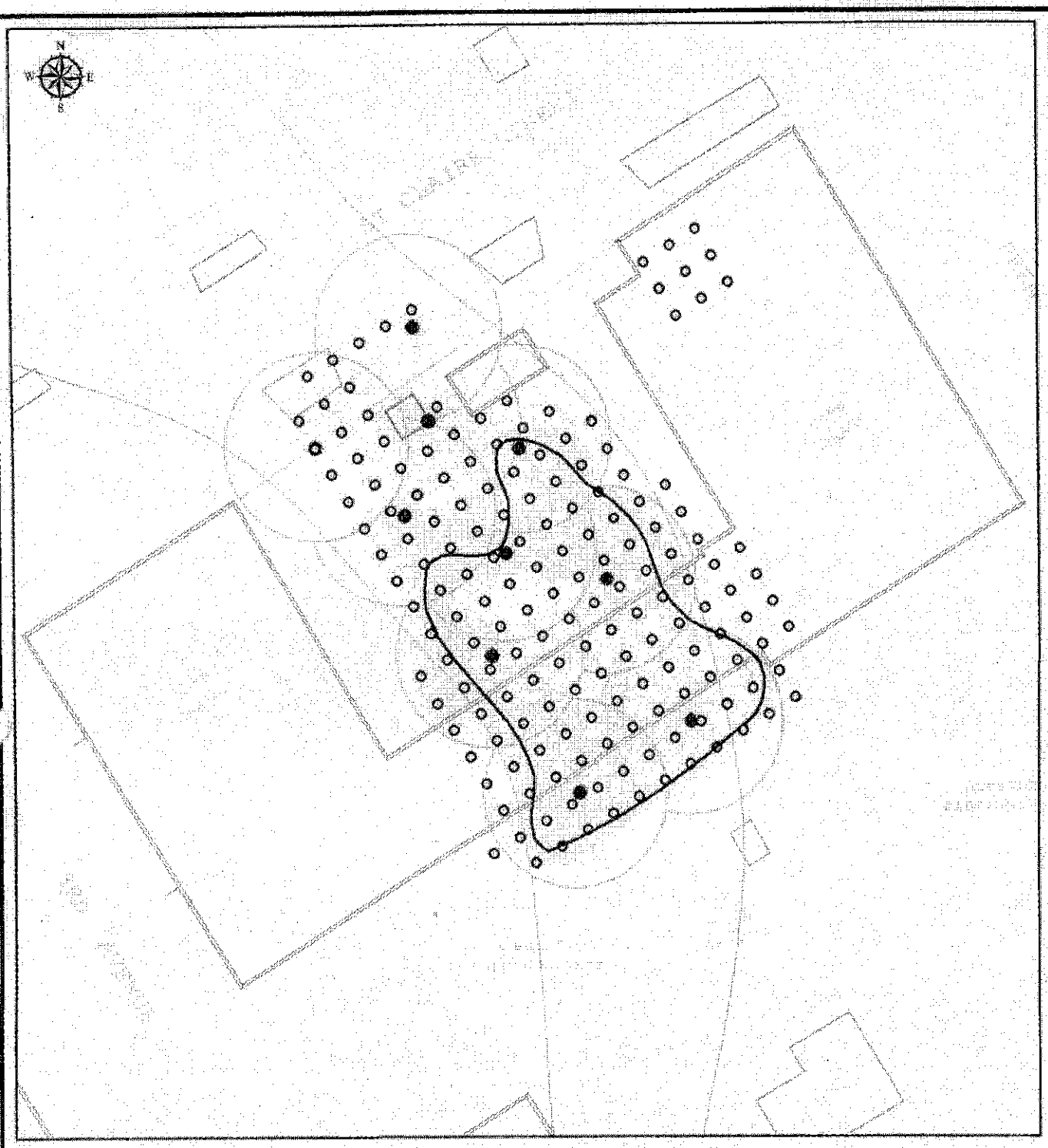
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 7-1
Containment Using Engineered Surface and Vertical Barriers

DRAWN BY:	DDZ	SCALE:	AS SHOWN	PROJECT:	25889375
CHECKED BY:	WSM	DATE:	24 OCT 2008	SHEET:	7-1
APPROVED BY:	DPT				

URS

6737 W. WASHINGTON ST. SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100



Legend

- DNAPL Extent
- Chemical Oxidation Injection Borings
- Passive Vent Wells
- Passive Vent Wells (Area of Influence)

0 25 50 75 100 Feet

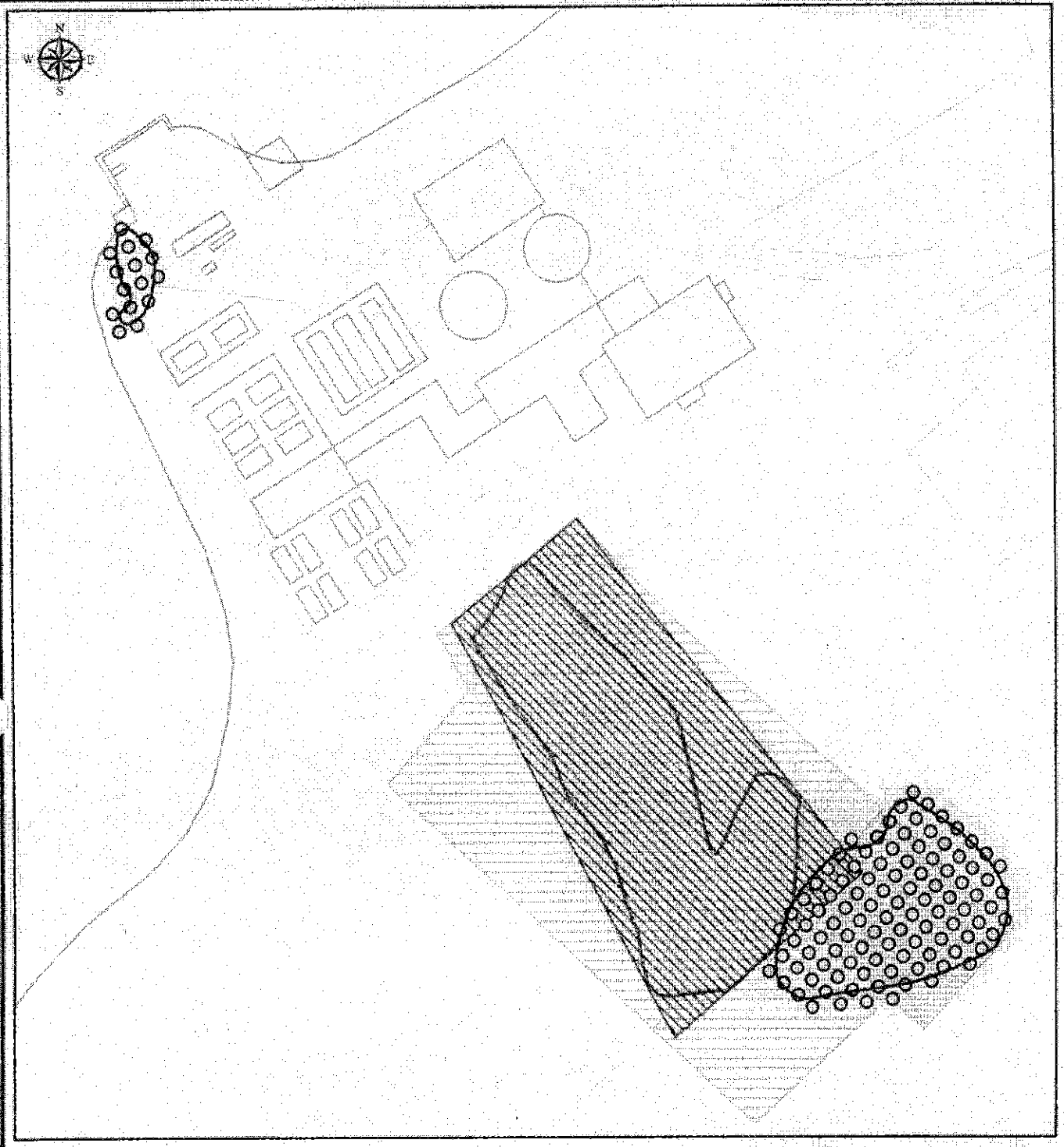
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 7-5A
In-Situ Chemical Oxidation -
Shallow Soil and Groundwater - Upper Bluff Area

DRAWN BY:	SDZ	SCALE:	AS SHOWN	PROJECT:	25888375
CHECKED BY:	MSM	DATE:	24 OCT.2008	SHEET:	7-5A
APPROVED BY:	DRT				

URS

6737 W. WASHINGTON ST, SUITE 2263
MILWAUKEE, WISCONSIN 53214
414-631-4100



Legend

- DNAPL extent - Kreher Park
- Chemical Oxidation Injection Borings
- In-situ Treatment Area - Trench Mixing
- Low Permeability Clay Cap
- Existing Surface Barrier - Former Seep Area
- Former Coal Tar Dump Area

0 25 50 75 100 Feet

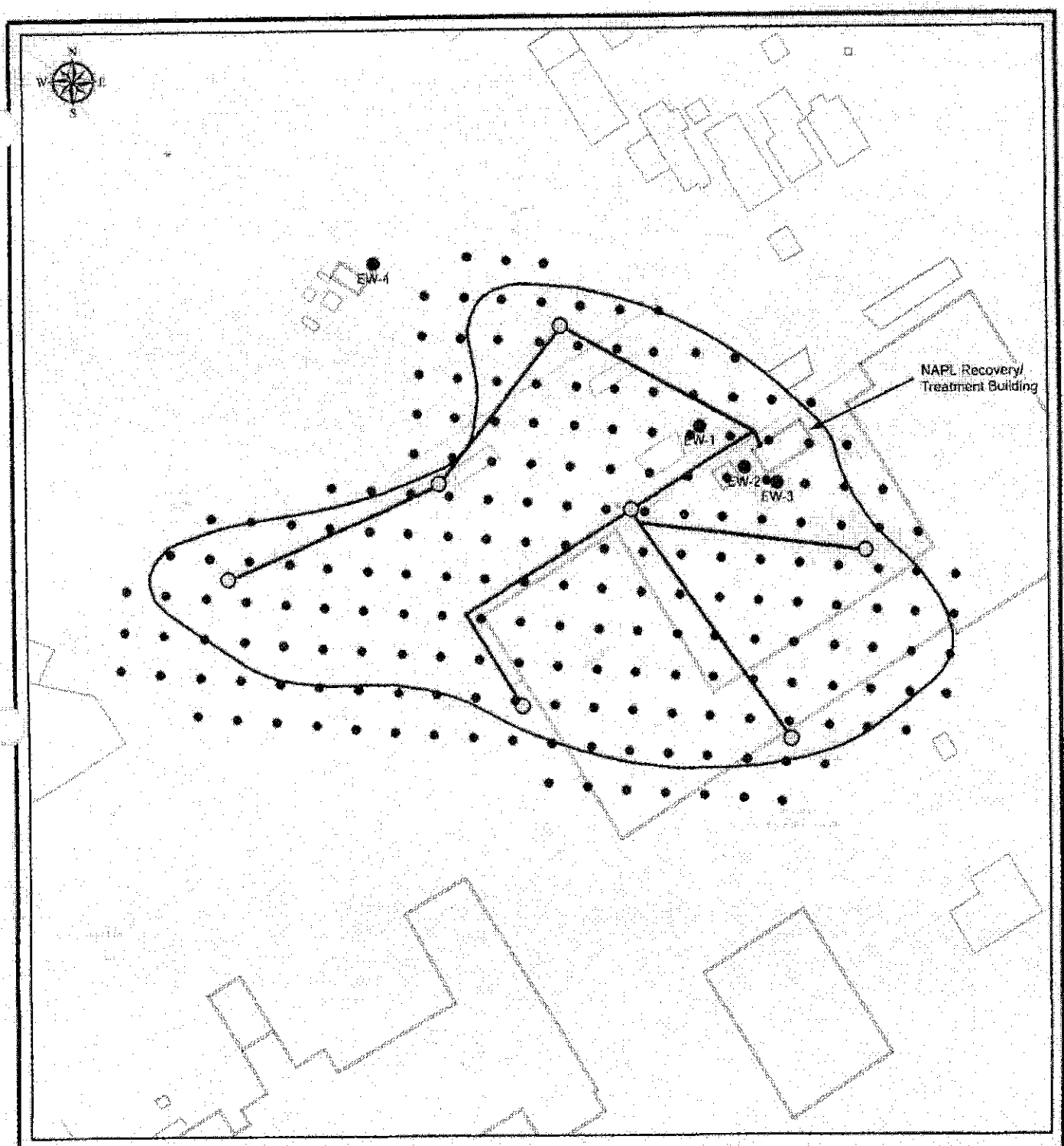
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 7-5B
In-Situ Chemical Oxidation -
Shallow Soil and Groundwater - Kreher Park

DRAWN BY: DDZ	SCALE: AS SHOWN	PROJECT: 29668375	
CHECKED BY: MSM	DATE: 24 OCT 2008	SHEET: 7-5B	
APPROVED BY: DPT			

URS

6737 W. WASHINGTON ST. SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100



Legend

- NAPL Extent - Copper Falls aquifer
- Existing Extraction Wells
- Copper Falls Chemical Oxidation Borings
- Copper Falls Recovery Wells
- Copper Falls Recovery Wells (Area of Influence)
- Lateral Piping

0 25 50 75 100 Feet

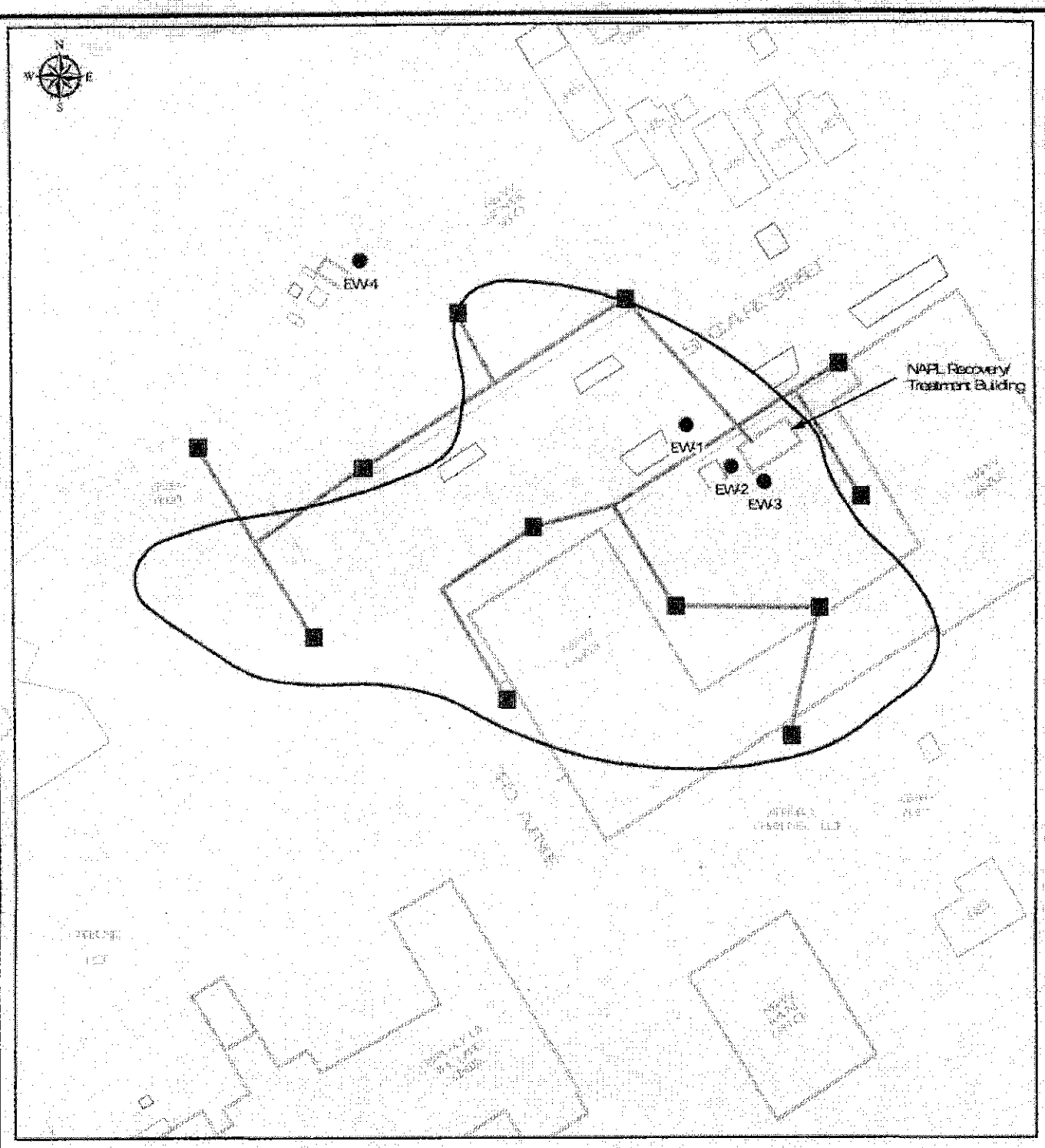
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: Figure 7-5C
In-Situ Chemical Oxidation -
Copper Falls Aquifer

DRAWN BY:	DDZ	SCALE:	AS SHOWN	PROJECT:	25688375
CHECKED BY:	MSM	DATE:	24 OCT 2008	SHEET:	7-5C
APPROVED BY:	DPI				

URS

6737 W. WASHINGTON ST, SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100



Legend

- NAPL Extent - Copper Falls aquifer
- Copper Falls GW Extraction Well
- Copper Falls GW Extraction Lateral Piping
- Existing Extraction Well

0 25 50 75 100 Feet

PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

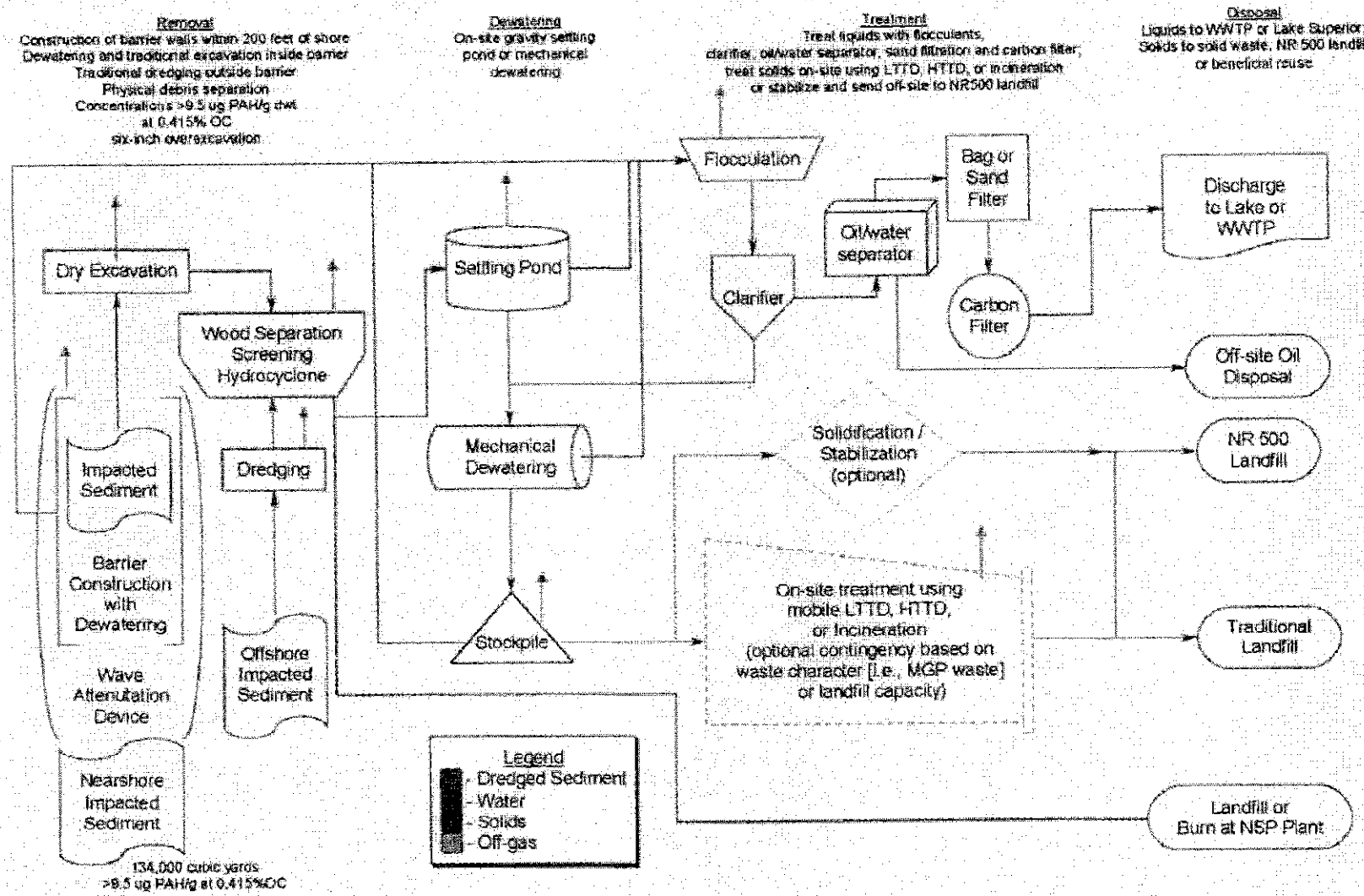
TITLE: Figure 7-8A
Removal Using Groundwater Extraction -
Copper Falls Aquifer & Ravine Fill

DRAWN BY: CDZ	SCALE: AS SHOWN	PROJECT: 25088375	
CHECKED BY: MSM	DATE: 24 OCT 2008	SHEET: 7-8A	
APPROVED BY: DPT			

URS

6737 W. WASHINGTON ST, SUITE 2265
MILWAUKEE, WISCONSIN 53214
414-831-4100

Alternative 6: Hybrid remedy - Remove sediment >9.5 ug PAH/g dwt at 0.415%OC; treat sediment on-site, dispose of sediment off-site; monitor sediment areas >5.6 ug PAH/g dwt at 0.415%OC

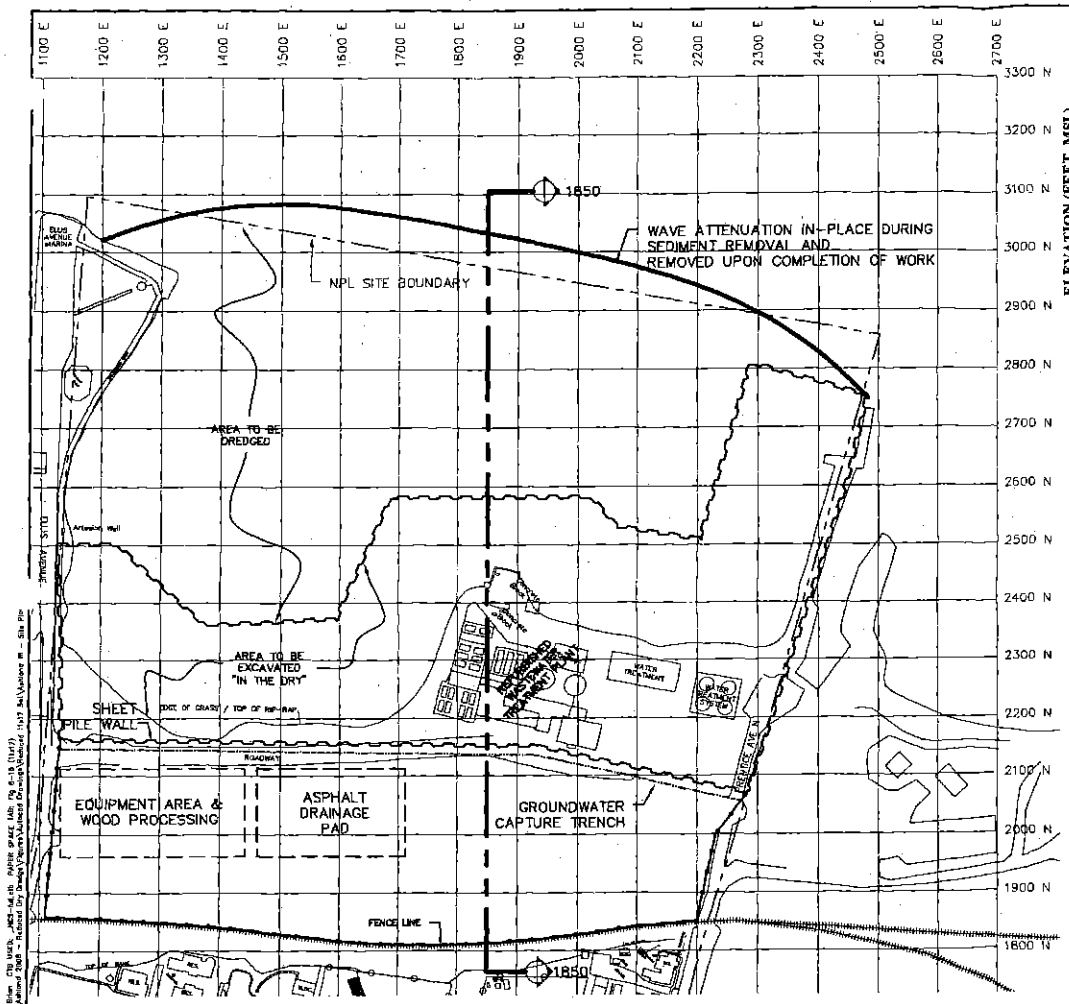


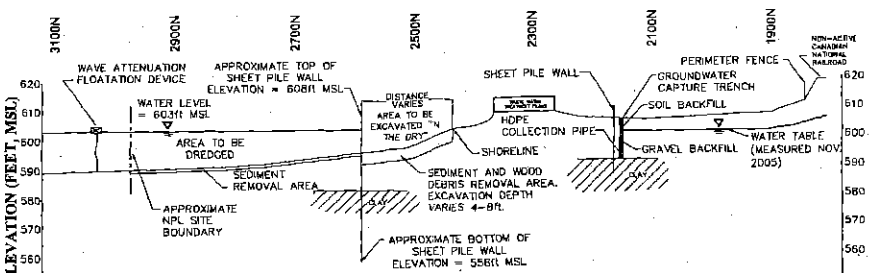
ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

ALTERNATIVE SED-6 – COMBINATION REMEDY, DRY EXCAVATION NEAR SHORE, DREDGING OFFSHORE, DISPOSE OF SEDIMENT OFFSITE

DRAWN BY: TH	SCALE: AS SHOWN	PROJECT: 25686375
CHECKED BY: WSB	DATE: 24.OCT.2008	SHEET: 8-17

URS 5757 W. WASHINGTON ST. SUITE 2285 MILWAUKEE, WISCONSIN 53214 414-831-4100





CROSS SECTION AT 1850 EAST

HORIZONTAL SCALE IN FEET

0 100 200 400

NORTH

SCALE IN FEET

0 100 200 400

LEGEND:

- = NPL SITE BOUNDARY
- = SHEET PILE WALL
- = GROUNDWATER CAPTURE TRENCH
- = FENCE LINE

NOTES:

1) SECTIONS OF THE WAVE ATTENUATION DEVICE WOULD BE DESIGNED TO ALLOW BARGE ACCESS FOR INSTALLATION OF THE CONTAINMENT WALL LOCATED WITHIN THE BAY.

2) THE EXACT LOCATION OF THE BARRIER WALL WILL BE DETERMINED DURING THE REMEDIAL DESIGN PHASE.

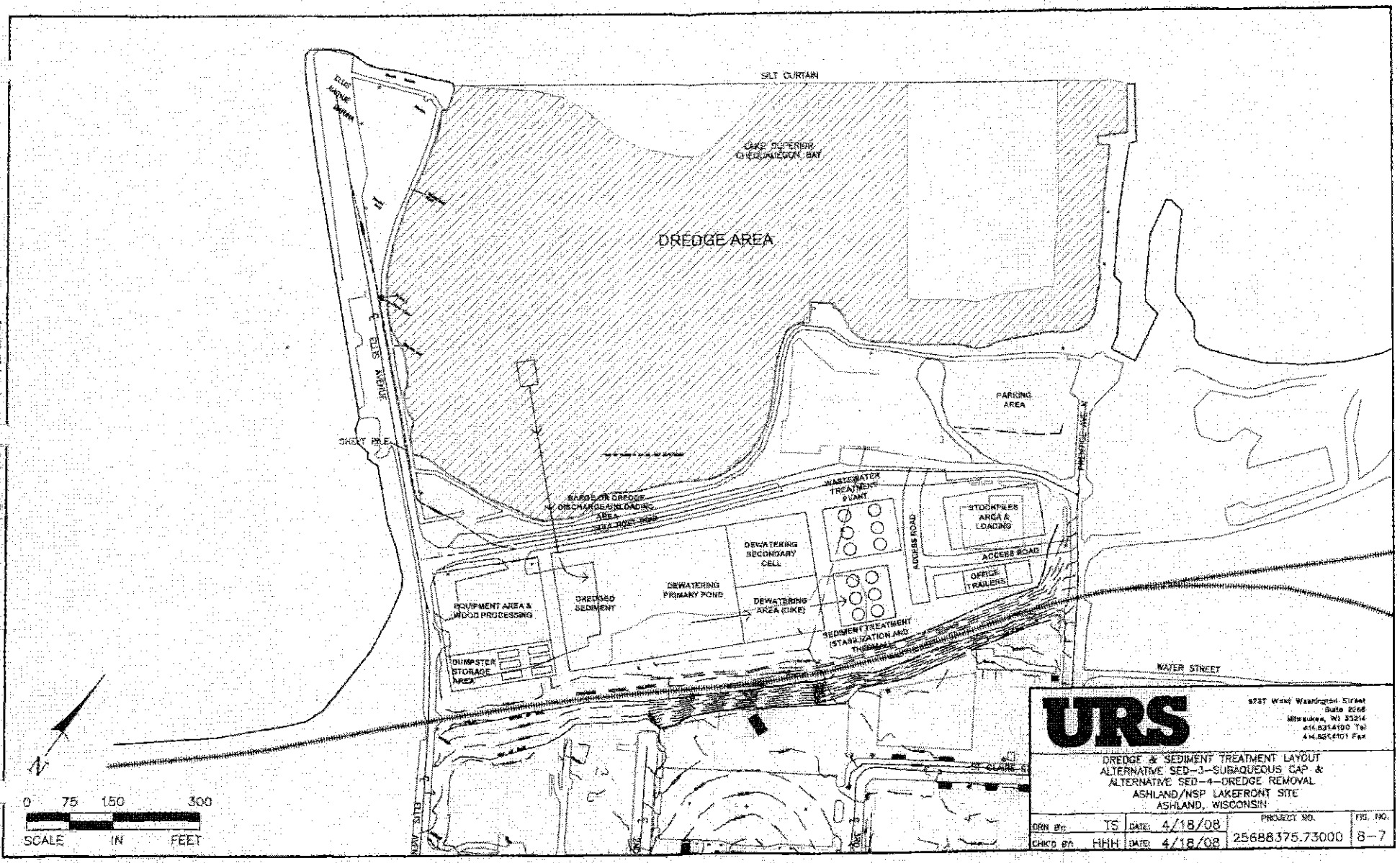
REVISIONS

NO.	NAME	DATE
#1	REDUCED DREDGE IN DRY BOUNDARY	08/18/08
#2	FIGURE NUMBER	10/21/08
#3	PAGE SIZE REDUCED	10/23/08
#4	BARRIER WALL NOTE	11/20/08

URS
100 S. WACKER DRIVE
SUITE 500
CHICAGO, ILLINOIS 60606
(312) 939-1000 Tel
(312) 939-4196 Fax

PROPOSED CONSTRUCTION ELEMENTS & CROSS SECTION
REDUCED DRY EXCAVATION ALTERNATIVE ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN

DRN BY:	BKR	DATE: 10/21/08	PROJECT NO.	FIG. NO.
CHK'D BY:	JVH	DATE: 10/21/08	25688375.76000	8-18


SILT CURTAIN
LAKE SUPERIOR
CHEQUAMEGON BAY
DREDGE AREA
ELLIS AVENUE
SHEET PILE
PARKING AREA
BARGE OR DREDGE DISCHARGE/UNLOADING AREA
WASTEWATER TREATMENT PLANT
DEWATERING SECONDARY CELL
DEWATERING PRIMARY POND
DEWATERING AREA (DIKE)
DREDGED SEDIMENT
EQUIPMENT AREA & WOOD PROCESSING
DUMPSTER STORAGE AREA
SEDIMENT TREATMENT (STABILIZATION AND THERMAL)
STOCKPILES AREA & LOADING
ACCESS ROAD
OFFICE TRAILERS
WATER STREET
ST CLAIRE ST
0 75 150 300
SCALE IN FEET
URS
DREDGE & SEDIMENT TREATMENT LAYOUT
ALTERNATIVE SED-3-SUBAQUEOUS CAP &
ALTERNATIVE SED-4-DREDGE REMOVAL
ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN
DRN BY: TS
DATE: 4/18/08
CHKD BY: HHH
DATE: 4/18/08
PROJECT NO. 25688375.73000
FIG. NO. 8-7

APPENDIX R
Administrative Record Index

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
ASHLAND/NORTHERN STATES POWER LAKEFRONT SUPERFUND SITE
ASHLAND, WISCONSIN

ORIGINAL
JUNE 12, 2009

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	08/00/94	Short Elliott Hendrickson, Inc.	WDNR	Remedial Investigation Interim Report for the Ashland Lakefront Property	
2	05/00/97	Short Elliott Hendrickson, Inc.	WDNR	Comprehensive Environmental Investigation Report for the Ashland Lakefront Property	
3	10/00/98	Short Elliott Hendrickson, Inc.	WDNR	Ecological Risk Assessment for the Coal-Tar Contaminated Sediments and Surface Waters Off the Ashland Lakefront Property in Ashland Harbor	
4	12/00/98	Short Elliott Hendrickson, Inc.	WDNR	Remedial Actions Options Feasibility Study for the Ashland Lakefront Property and Contaminated Sediments	
5	09/03/02	Ells, S., U.S. EPA/ CSTAG	Peterson, J., U.S. EPA	Memorandum re: CSTAG Recommendations on the Ashland/NSP Lakefront Site	
6	10/16/02	Dunn, J., WDNR	Peterson, J., U.S. EPA	Letter re: WDNR Comments on CSTAG Recommendations for the Ashland/NSP Lakefront Site	
7	10/22/02	Xcel Energy	U.S. EPA	U.S. EPA Responses to Selected CSTAG Recommendations on the Ashland/NSP Lakefront Site	
8	02/25/03	Short Elliott Hendrickson, Inc.	WDNR	Quality Assurance Project Plan Task Specific OU4 Winter 2003 Sediment Sampling **(SDMS ID: 278366)**	694
9	02/27/03	Trainor, D., URS	Dunn, J., WDNR	Letter re: Quality Assurance Project Plan Addendum Task Specific OU4 Winter Sediment Split Sample Collection **(SDMS ID: 278365)**	229

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
10	09/25/03	ATSDR	U.S. EPA	Public Health Assessment	
11	11/14/03	U.S. EPA	Respondent	Administrative Order on Consent for Remedial Investigation/Feasibility Study **(SDMS ID: 203048)**	34
12	07/26/04	Jaffess, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: U.S. EPA Comments on the February 18, 2004 Draft RI/FS Work Plan	
13	10/00/04	URS	U.S. EPA	Field Sampling Plan (Revision 1) **(SDMS ID: 278371)**	248
14	01/00/05	WDNR	U.S. EPA	Community Involvement Plan	
15	02/00/05	URS	U.S. EPA	Remedial Investigation/ Feasibility Study Work-Plan (Revision 2)	
16	02/22/06	Winslow, J., Xcel Energy	Hansen, S., U.S. EPA	Letter re: Revised Schedule and Proposed Table of Contents for the Remedial Investigation	
17	03/21/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Approval of Revised RI Submittal Schedule w/Attachment	
18	08/15/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments on the Draft Human Health Risk Assessment	
19	08/29/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments on the Draft Remedial Investigation	
20	09/01/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments on the Draft Baseline Ecological Risk Assessment	
21	09/12/06	Winslow, J., Xcel Energy	Hansen, S., U.S. EPA	Letter re: RI/FS Schedule Modification	
22	10/18/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Response to RI/FS Schedule Modifications Request	
23	10/25/06	Winslow, J., Xcel Energy	Hansen, S., U.S. EPA	Letter re: Response to October 18, 2006 Letter Regarding RI/FS Schedule Modification Request	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
24	10/27/06	Northern States Power Company	U.S. EPA	NSPW Responses to Agency Comments to the Baseline Ecological Risk Assessment Draft RI Report	
25	10/27/06	Northern States Power Company	U.S. EPA	NSPW Responses to Agency Comments On the Draft RI Report	
26	10/27/06	Northern States Power Company	U.S. EPA	NSPW Responses to Agency Comments to the Human Health Risk Assessment Draft RI Report	
27	10/30/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Additional Responses to the RI/FS Schedule Modifications Request	
28	12/22/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments on Xcel's Response to EPA's Comments on the Draft BERA	
29	12/22/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments on Xcel's Response to EPA's Draft RI Comments	
30	12/22/06	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments on Xcel's Response to EPA's Comments on the Draft HHRA	
31	03/15/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments to Alternatives Screening Technical Memorandum	
32	03/15/07	Northern States Power Company	U.S. EPA	NSPW Responses to Agency Comments Dated March 15, 2007 to the Draft Alternatives Screening Technical Memorandum	
33	04/05/07	U.S. EPA	File	Technical Memorandum on the Derivation of Sediment Preliminary Remediation Goal (PRG) for the Ashland Lakefront Site	
34	04/25/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions tO the Remedial Action Objectives w/ Attachment	
35	05/14/07	Hurst, P., URS Corp.	Nehls-Lowe, H., WI Dept. of Health & Family Services	Technical Memorandum: Comments on Human Health Risk Assessment	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
36	05/18/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions to the Revised Remedial Investigation Report w/Attached Report	
37	05/29/07	Hurst, P., URS Corp.	Nehls-Lowe, H., WI Dept. of Health & Family Services	Technical Memorandum: Comments on Human Health Risk Assessment	
38	06/06/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Remedial Action Objectives Technical Memorandum w/Attachment	
39	07/09/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions to the Revised Remedial Investigation w/Attached Report	
40	07/09/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions to Alternatives Screening Technical Memorandom w/Attachment	
41	07/10/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions to the Revised BERA w/Attached Report	
42	07/10/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions to the Revised HHRA w/Attached Report	
43	08/17/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions to the Revised Remedial Investigation w/Attached Report	
44	08/17/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Report: Final Revisions to Alternatives Screening Technical Memorandum w/ Attached Cover Letter	
45	08/23/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions to the HHRA w/Attached Report	
46	08/23/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions to the BERA w/Attached Report	
47	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 1 of 12 (Text, tables, Figures)	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
48	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 2 of 12 (Appendices A-D)	
49	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 3 of 12 (Appendix E)	
50	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 4 of 12 (Appendix E)	
51	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 5 of 12 (Appendix E)	
52	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 6 of 12 (Appendices E-F)	
53	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 7 of 12 (Appendix G)	
54	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 8 of 12 (Appendix G)	
55	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 9 of 12 (Appendix G)	
56	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 10 of 12 (Human Health Risk Assessment Part 1 of 2)	
57	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 11 of 12 (Human Health Risk Assessment Part 2 of 2)	
58	08/31/07	URS	Northern States Power Company	Final Report: Remedial Investigation Report Volume 12 of 12 (Baseline Ecological Risk)	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
59	09/26/07	Trainor, D., NewFields	Hansen, S., U.S. EPA	Letter re: Final Remedial Investigation Report	
60	09/07/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments/Suggested Changes to Draft Comparative Analysis of Alternatives Technical Memorandum	
61	09/19/07	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Additional Comments to Remedial Investigation and HHRA	
62	09/24/07	Winslow, J., Xcel Energy	Hansen, S., U.S. EPA	Letter re: Response to to U.S. EPA's Required Changes to the Baseline Ecological Risk Assessment	
63	09/26/07	Trainor, D., NewFields	Hansen, S., U.S. EPA	Letter re: Errata for Remedial Investigation Report - Final Human Health Risk Assessment	
64	10/00/07	U.S. EPA	Public	Fact Sheet: Cleanup Investigation Complete; Identifying Options is Next Step	
65	02/05/08	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Required Changes to the Baseline Ecological Risk Assessment	
66	02/05/08	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Approval of Remedial Investigation Report	
67	02/15/08	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments to the Draft Feasibility Study	
68	05/15/08	Northern States Power Company	U.S. EPA	NSPW Responses to Agency Comments Dated Feb. 15, 2008 on the FS Report Dated Oct. 29, 2007	
69	05/27/08	Trainor, D., NewFields	Hansen, S., U.S. EPA	Errata for the Revised Draft Feasibility Study Report	
70	05/15/08	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Revised Draft Report: Feasibility Study	
71	06/17/08	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Comments on the Groundwater Sampling Plan	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
72	07/03/08	Winslow, J., Xcel Energy	Hansen, S., U.S. EPA	Letter re: Response to Comments on Groundwater Sampling Plan w/Attachments	
73	07/31/08	URS	Northern States Power Company	Groundwater Sampling Plan	
74	08/01/08	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Approval of Groundwater Sampling Plan	
75	08/01/08	Winslow, J., Xcel Energy	Hansen, S., U.S. EPA	Letter re: Final Groundwater Sampling Plan	
76	09/25/08	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Final Revisions and Comments to the Revised Feasibility Study	
77	10/24/08	Northern States Power Company	U.S. EPA	NSPW Responses to Agency Comments Dated Sept. 25, 2008 on Revised Draft FS Report Dated May 15, 2008	
78	11/00/08	U.S. EPA	Public	Information Sheet: Review of Cleanup Options Done; Selection of Plan is Next Step	
79	11/21/08	Northern States Power Company	U.S. EPA	NSPW Responses to Agency Comments Dated Nov. 13, 2008 on the Revised Final Draft FS Dated Oct. 24, 2008	
80	12/04/08	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Approval of Final Feasibility Study	
81	12/05/08	URS	Northern States Power Company	Final Report: Feasibility Study Volume 1 of 2 (Text, Figures, Appendix A)	
82	12/05/08	URS	Northern States Power Company	Final Report: Feasibility Study Volume 2 of 2 (Appendices B-H)	
83	12/10/08	U.S. EPA	File	Presentation Slides: Ashland NSP Lakefront Superfund Site: Cleanup Options Information Meeting December 10, 2008	
84	06/01/09	U.S. EPA	Public	Fact Sheet: EPA Proposes Cleanup Plan	
85	06/01/09	U.S. EPA	Public	U.S. EPA Proposed Plan	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
86	06/04/09	U.S. EPA	Public	NPL Fact Sheet: Ashland/ Northern States Power Lakefront Site	
87	06/17/09	U.S. EPA	Public	Public Announcement for June 17, 2009 Information Session and June 29, 2009 Public Hearing	
			UPDATE #1 JANUARY 11, 2010		
1	00/00/02	Smith Group, JJR	City of Ashland	Waterfront Development Plan	2
2	10/00/08	Northern States Power Company	U.S. EPA/ NRRB	National Remedy Review Board Consideration for the Ashland/NSP Lakefront Superfund Site	100
3	05/21/09	Karl, R., U.S. EPA	Garrahan, K., U.S. EPA	Letter re: Region 5 Response to National Remedy Review Board Recommendations for Ashland/NSP Lakefront Site	7
4	06/29/09	Edwards Court Reporting	U.S. EPA	Transcript of the June 29, 2009 Proposed Plan Public Meeting for the Ashland/NSP Lakefront Site	60
5	07/09/09	Gurnoe-Soulier, R., Red Cliff Band of Lake Superior Chippewas	Krause, P., U.S. EPA	Letter re: Red Cliff Band Comments of the Proposed Cleanup Plan for the Ashland/NSP Lakefront Site	1
6	07/14/09	Warzecha, C., Wisconsin Department of Health Services	Hansen, S., U.S. EPA	Letter re: DHS Comments on the Proposed Plan for Remediation of the Ash-land/NSP Lakefront Site	1
7	08/11/09	Monroe, E. & R. Peterson, City of Ashland	Krause, P., U.S. EPA	Letter re: City of Ashland Comments on the Proposed Plan for the Ashland/NSP Lakefront Site	2
8	08/14/09	Giesfeldt, M., WDNR	Karl, R., U.S. EPA	Letter re: WDNR Concur-rence with the Proposed Plan for the Ashland/ NSP Lakefront Site	2

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
9	08/17/09	Burns & McDonnell, DCI Environmental and Sevenson Environmental	Northern States Power Wisconsin	Constructability Review re: EPA Proposed Plan (June 2009) for the Ashland/NSP Lakefront Site	82
10	08/17/09	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Performance Standards for Pilot Test at the Ashland/NSP Lakefront Site	2
11	08/17/09	Winslow, J., Xcel Energy	Krause, P., U.S. EPA	Letter re: Xcel Comments on the Proposed Plan for The Ashland/NSP Lakefront Site	152
12	08/18/09	Concerned Citizens	Krause, P., U.S. EPA	Comments from Concerned Citizens on the Proposed Cleanup Plan for the Ashland/NSP Lakefront Site Received June 29-August 18, 2009 **(PORTIONS OF THIS DOCUMENT HAVE BEEN REDACTED)**	17
13	10/21/09	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: Performance Standards for Wet Dredging Scenario for the Ashland/NSP Lakefront Site	6

UPDATE #2
SEPTEMBER 30, 2010

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	10/00/85	Long, E., U.S. NOAA and P. Chapman, EVS Consultants	File	Journal Article: "A Sediment Quality Triad: Measures of Sediment Contamination , Toxicity and Infaunal Community Composition in Puget Sound (Marine Pollution Bulletin Volume 16, Number 10)	11
2	00/00/90	U.S. NOAA	File	The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program (NOAA Technical Memorandum NOS OMA 52)	227
3	08/00/93	Environment Canada	File	Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (92-2309-067)	33

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
4	03/02/98	Trainor, D., Dames & Moore	Dunn, J., WDNR	Letter re: Coal Tar Production Calculations and Response to WDNR February 20, 1998 Letter and February 24 1998 Amendment	6
5	03/24/98	McColloch, M. & D. Trainor, Dames & Moore	Musso, J., Northern States Power Company	Letter re: Exploration Trench Activities and Findings for the Northern States Power Ashland Facility	23
6	12/04/98	Trainor, D., Dames & Moore	Crass, D., Michael Best & Friedrich	Letter re: Gas and Tar Production and Release Estimates at the Former MGP-NSP Ashland Facility	7
7	10/29/01	Ingraham, C., SHE	Dunn, J., WDNR	Investigation, Interim Remedial Action Options, and Design Report for the Ashland NSP Manufactured Gas Plant Seep Area	121
8	02/19/02	Trainor, D., URS	Winslow, J., Xcel Energy	Letter re: NSP Ashland Lakefront Sediment-Clay Tile Investigation Report	38
9	12/00/03	WDNR	File	Interim Guidance: Consensus-Based Sediment Quality Guidelines—Recommendations for Use & Application (WT-732 2003)	40
10	10/04/09	Nehls-Lowe, H., Wisconsin Department of Health Services	Hansen, S., U.S. EPA	Letter: DHS Comments on the NSPW Comments on EPA Proposed Remedial Action Plan for the Ashland/ NSP Lakefront Site	2
11	11/20/09	Weston Solutions, Inc.	U.S. EPA	Technical Memorandum: Conceptual Geotechnical Assessment for Sediment Removal for the Ashland/ Northern States Power Lakefront Site	151
12	04/20/10	Winslow, J., Xcel Engery	Krause, P., U.S. EPA	Letter re: Additional Comments of EPA's Proposed Plan for the Ashland Lakefront Site	9
13	09/14/10	Hansen, S., U.S. EPA	Winslow, J., Xcel Energy	Letter re: U.S. EPA Response to Additional Comments on EPA's Proposed Plan for the Ashland/NSP Lakefront Site	1

APPENDIX B to Consent Decree

STATEMENT OF WORK FOR
THE REMEDIAL DESIGN AND REMEDIAL ACTION
AT
Kreher Park, Copper Falls Aquifer and Upper Bluff/Filled Ravine Portions of
ASHLAND NORTHERN STATES POWER LAKEFRONT SITE
Ashland
Ashland County, Wisconsin

I. PURPOSE

The purpose of this Statement of Work (SOW) is to set forth requirements for implementation of the Phase 1 Remedial Design (RD), Phase 1 Remedial Action (RA) and Operation and Maintenance (O&M), as defined in the Consent Decree (CD), for the Kreher Park, Copper Falls Aquifer, and Upper Bluff/Filled Ravine (Phase 1 Project Area), which is a portion of the Ashland Northern States Power Lakefront Site (Site) as set forth in the Record of Decision (ROD), which was signed by the Director of the Superfund Division of the United States Environmental Protection Agency (EPA), Region 5, on September 30, 2010, and concurred in by Wisconsin Department of Natural Resources (WDNR).1 The Settling Defendant shall follow the CD, the ROD, the SOW, the approved Phase 1 Remedial Design Work Plan, the approved Phase 1 Remedial Action Work Plan, EPA Superfund Remedial Design and Remedial Action Guidance, and any additional guidance provided by EPA in submitting deliverables for designing and implementing the RA at the Phase 1 Project Area. In accordance with the ROD, the specific details of the remedial design and remedial action (RD/RA) will be determined during the Phase 1 Remedial Design. The RD/RA addressed in this SOW is for the Phase 1 Remedial Action for the Phase 1 Project Area as defined in the CD. This SOW does not address and is not intended to address the RD or RA for the sediment portion of the Site.

II. PERFORMANCE STANDARDS FOR THE REMEDIAL ACTION

Settling Defendant shall design, implement and maintain the remedy for the Phase 1 Project Area selected in the ROD to meet the Phase 1 Performance Standards as defined in the CD. The specific details of the Phase 1 Performance Standards will be developed during the Phase 1 Remedial Design in the Performance Standards Verification Plan.

This SOW encompasses all the RD and RA work for Kreher Park, Copper Falls Aquifer, and Upper Bluff/Filled Ravine described in the ROD. The sediment remedy prescribed in the ROD contemplates that sediments dredged from Chequamegon Bay will be dewatered and stabilized at Kreher Park. Accordingly, to minimize risk of recontamination the construction,

1 Unless otherwise expressly provided in this SOW, terms used in this SOW that are defined in the CD shall have the meaning assigned to them in the CD. Pursuant to the terms of the CD, terms used in this SOW that are defined in CERCLA or in regulations promulgated under CERCLA shall have the meaning assigned to them under CERCLA or in such regulations.

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implementation, operation and maintenance of the final Kreher Park cap will take place following the sediment related work set forth in the ROD. If Settling Defendant enters into a future agreement to perform the sediment-related work set forth in the ROD, Settling Defendant will implement the final Kreher Park cap as set forth in the CD. However, if such sediment work is performed by another entity, Settling Defendant will fund the implementation of the final cap as set forth in the CD. Settling Defendant may decide to install an interim cap in Kreher Park upon completion of the Phase 1 Remedial Action if needed to protect the Kreher Park remedy pending completion of the sediment remedy. If an interim cap is installed, the final cap will be designed as a further augmentation of that interim cap.

1. Site Security

During remedy implementation, the Settling Defendant shall maintain site security around the Phase 1 Project Area to prevent access and vandalism to the Phase 1 Project Area. When necessary, warning signs shall be posted to advise that the area is hazardous due to chemicals in the soils, sediments, and groundwater which pose a risk to public health through direct contact. The signs shall also provide a telephone number to call for further information.

2. Construction, Installation, and Operation of the Selected Remedy for Kreher Park, Copper Falls Aquifer and the Upper Bluff/Filled Ravine

The selected remedy for Kreher Park, Copper Falls Aquifer, and the Upper Bluff/Filled Ravine is Scenario 10 of the ROD and includes, but is not limited to, the components below.

- **Kreher Park:** Limited soil/source removal with ex-situ thermal treatment (Alternative S-5A) and containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control (Alternative GW-2A). Alternative GW-2A includes caps at Kreher Park to limit groundwater recharge. Shallow groundwater extracted from the contained area for hydraulic control will be treated on site and discharged to the lake or Publicly Owned Treatment Works (POTW). The remedy will serve to restore the shallow groundwater to its beneficial use by reducing contaminant levels in groundwater. In-situ chemical oxidation (GW-6) can be used to possibly enhance groundwater treatment.
- **Upper Bluff/Filled Ravine:** Limited soil removal with ex-situ thermal treatment (Alternative S-5A) and containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control (Alternative GW-2A). Alternative GW-2A includes caps to limit groundwater recharge. Shallow groundwater extracted from the contained area for hydraulic control will be treated on site and discharged to the lake or POTW. The remedy will serve to restore the shallow groundwater to its beneficial use by reducing contaminant levels in groundwater. In-situ chemical oxidation (GW-6) can also be used to possibly enhance groundwater treatment.
- **Copper Falls Aquifer:** Enhance existing groundwater extraction system (GW-9B). In-situ chemical oxidation (GW-6) or in-situ treatment via ozone sparge (GW-3) can be used to possibly enhance groundwater treatment. Enhancing the existing groundwater extraction and treatment system (and possibly using in-situ treatment) will hydraulically

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control the groundwater contamination and non-aqueous phase liquid (NAPL) in the aquifer. The remedy will also serve to make progress toward restoring groundwater to beneficial use.

- **Conduct O&M and Long-Term Monitoring:** Collect groundwater samples to ensure contaminants are not migrating off site or from the contained area with groundwater. Fluid levels within the contained area will also need to be monitored to ensure that groundwater remains at or below the design elevation. Complete annual inspections to ensure integrity of surface barriers and repair damage as needed.
- **Institutional controls:** Implement land use controls as part of remedial response at Upper Bluff/Filled Ravine and Kreher Park where contaminants remain in subsurface and for shallow groundwater in contained areas.

The remedy may include any equivalent and appropriate components that are established in the approved Phase 1 Remedial Design. Key technical components of a conceptual design for the selected remedy are described in greater detail below.

Kreher Park and Upper Bluff/Filled Ravine: For soils, Alternative S-5A includes limited soil/ source removal with ex-situ thermal treatment. For the Upper Bluff/Filled Ravine, Alternative S-5A may include the removal of soil and source materials to the vertical and horizontal extents required to meet applicable cleanup criteria for residential use. For example, surface and vertical barriers may not be necessary if the remedial action restores the Upper Bluff/Filled Ravine area (e.g., remediate to residential standards). For Kreher Park, Alternate S-5A includes limited removal of soil and source materials within the area identified in the ROD as the former coal tar dump area as defined in the Phase 1 Remedial Design Work Plan. Excavated soil will likely be treated on-site by a mobile unit. If on-site treatment is determined to be infeasible, then off-site treatment and/or disposal will be the alternate option. Debris must be separated by size from material suitable for thermal treatment and transported off-site for disposal. Consequently, wood waste at Kreher Park and fly-ash and cinders in the Filled Ravine at the Upper Bluff area must be separated from NAPL-contaminated material encountered in these areas. Thermal treatment will be completed for suitable NAPL-contaminated fill material and contaminated material not suitable for thermal treatment will be transported off-site for disposal. Fill material, including fly ash and cinders, may be returned to the excavation pursuant to the approved Phase 1 Remedial Design.

Thermal treatment will be performed on suitable fill material from areas with the highest levels of contamination. This includes the former gas holder area at the Upper Bluff, the NAPL in the Filled Ravine, and contaminated soil encountered above the wood waste layer at Kreher Park; the underlying wood waste layer would not be suitable for thermal treatment.

Long-term operation and maintenance of backfilled areas will include groundwater monitoring and cap maintenance, including the periodic inspection and repair of all asphalt and soil caps.

For groundwater, Alternative GW-2A includes containment using engineered surface and vertical barriers with groundwater extraction as hydraulic control. Under this alternative,

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containment may be installed around the entire perimeter of Kreher Park, limiting the migration of groundwater from the Upper Bluff/Filled Ravine in order to reduce the volume of groundwater entering the Kreher Park area. Containment for groundwater contamination may consist of engineered controls. Surface barriers eliminate the direct contact exposure pathway. They also can reduce contaminant leaching from the unsaturated zone, by restricting infiltrating water from contacting contaminated soil at areas where contaminated soil is present. Vertical barrier walls and barrier wells prevent the off-site migration of contaminants with groundwater. Institutional controls will be implemented as part of this remedial response to prevent exposure to groundwater contamination remaining within the contained area until such time as groundwater cleanup standards are achieved. Long-term operation and maintenance will include groundwater monitoring to confirm contaminants are not migrating from the contained area. This will include fluid level monitoring and groundwater extraction to ensure the hydraulic head within the confined area remains at or below lake level.

NAPL removal objectives shall be met through a combination of source removal in the former coal tar dump area, NAPL trenches and groundwater extraction.

Engineered surface barriers, vertical barrier walls, and barrier wells are described below.

Engineered Surface Barriers

Engineered surface barriers are considered passive containment alternatives because the contaminated zone is not disturbed, and only minimal maintenance is required following implementation.

At the Upper Bluff area, if needed, asphalt caps over the Filled Ravine as surface barriers will be compatible with existing and future site use. At Kreher Park, a low permeability soil cap could be placed over the entire park, but installation of a clay cap over the entire park will require the removal of the existing marina parking lot, Marina Drive, and the former WWTP. New asphalt roads, parking lots, and/or slab on grade buildings could be then constructed on top of a larger cap, or installed at select areas in place of a cap for the entire park. These smaller surface barriers will be designed to be compatible with existing and future site use and include asphalt pavement for the marina parking lot and a low permeability cap for the former coal tar dump. Asphalt pavement over the gravel covered marina parking lot will reduce infiltration at this area. A surface barrier over the former coal tar dump area will reduce contaminant leaching from the unsaturated zone if contaminated soil remains in place. Once the WWTP is removed, a clay cap or asphalt pavement could be installed at this area. The low permeability cap will be constructed following completion of all sediment-related work.

Multi-layer caps will need to be compatible with on-site areas of unexcavated soil, especially at Kreher Park. Single layer asphalt and low permeability caps will meet 40 CFR Subtitle D requirements, and multi-layer caps will meet 40 CFR Subtitle C requirements or their equivalent.

Permanent engineered surface barriers for Kreher Park will be installed following completion of

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Groundwater Extraction/Barrier Wells

Barrier wells are considered active hydraulic containment alternatives. Long-term operation (groundwater extraction), maintenance, and monitoring will be required. Down gradient barrier wells or other hydraulic control features approved by EPA will be used for groundwater at the Upper Bluff and for the saturated fill unit at Kreher Park. These wells will prevent contaminants from migrating off site with groundwater.

Vertical Barrier Walls

Vertical barrier walls consist of a slurry wall or sheet piling installed around the perimeter of the contaminated groundwater zone. A slurry wall is a low permeability barrier constructed by placing a low permeability material (slurry) in a trench around the perimeter of the contaminated groundwater mass. Sheet piling will consist of inter-locking sheets of steel pilings that form a continuous wall installed around the perimeter of the contaminated groundwater mass.

For shallow groundwater, both types of vertical barriers could be anchored into the underlying low permeability Miller Creek Formation to create a barrier that will prevent contaminants in the shallow fill units from migrating off site with groundwater. However, because groundwater in the Filled Ravine discharges to Kreher Park, vertical barriers will be used to funnel groundwater from the Filled Ravine to Kreher Park, which will be enclosed by vertical barrier walls. Engineered surface barriers will be used with vertical barriers to minimize groundwater recharge to contained areas from infiltration.

In-Situ Chemical Oxidation

In addition to the remedial components described above, in-situ chemical oxidation (GW-6) can be used to possibly enhance groundwater treatment. This may be concluded during the pre-design phase. Chemical oxidation introduces strong oxidizing chemicals such as permanganate and peroxide into the subsurface to degrade VOCs and PAH compounds to CO_2 and H_2O end products. Permanganate or peroxide could be injected as liquid reagents through boreholes, wells, or mixed with a backhoe in shallow trenches. Chemical oxidation has an added benefit of enhancing biodegradation by increasing oxygen concentrations in the subsurface. Chemical oxidation could be performed on saturated and unsaturated zone soils by injecting chemicals into the subsurface via borings or wells.

In-situ chemical oxidation could be used for unsaturated and saturated zone contamination at the Upper Bluff. However, existing conditions at the Upper Bluff area (the NSPW facility building and buried gas holders) and at Kreher Park (wood waste layer) may limit implementability.

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Mixing reagent in shallow trenches would be the most effective treatment method at Kreher Park because contamination is present at shallow depths at the former coal tar dump area, and would be easily accessible. Because in-situ chemical oxidation reactions can result in the generation of off-gases, primarily CO_2, passive venting or an active SVE system may be required to capture off-gases. The presence of NAPL may require multiple applications to lower contaminant concentrations to acceptable levels.

Although chemical oxidation applications can be completed within a short period of time, the groundwater extraction system may be operated for several years. Long-term groundwater monitoring to evaluate natural attenuation and institutional controls would be included with this remedial response.

Copper Falls Aquifer: Alternative GW-9B –NAPL Removal using Enhanced Groundwater Extraction System. Groundwater extraction uses water as a carrier to remove both NAPL and dissolved phase contamination. The existing interim groundwater extraction system currently extracts groundwater from one well installed at the mouth of the Filled Ravine, and groundwater and NAPL from three low-flow wells installed in the underlying Copper Falls aquifer. Enhanced removal at the Upper Bluff area will include installation of additional low-flow extraction wells in the Copper Falls aquifer to increase NAPL removal rates, and continued operation of existing wells EW-1, EW-2, and EW-3. This will also include continued operation of EW-4. Although the ROD states a minimum of 12 extraction wells will be installed in the Copper Falls aquifer to increase groundwater extraction rates to 10-15 gallons per minute, the final location and number of wells, and the resulting extraction rate, will be determined during the Phase 1 Remedial Design.

The groundwater extraction system at the Upper Bluff area may be operated for an extended period of time. Long-term groundwater monitoring will be required to evaluate natural attenuation and institutional controls will also be implemented as part of this option.

In addition, implementation of in-situ chemical oxidation (GW-6) for the underlying Copper Falls would be more extensive; it may require groundwater extraction rather than soil vapor extraction. EPA's SITE program completed a demonstration pilot test to fully evaluate the implementability of this alternative at the Phase 1 Project Area. Whether in-situ chemical oxidation will be pursued will be determined during the pre-design phase. Chemical oxidation may also increase the mobility of NAPL recovered by extraction wells resulting in the removal of significant contaminant mass in a short time frame. Preliminary results from the SITE program pilot test indicate that injection into areas with NAPL contaminants resulted in an initial vigorous reaction followed by an increase in the mobility and recovery of NAPL.

Although chemical oxidation applications can be completed within a short period of time, the groundwater extraction system may be operated for several years. Long-term groundwater monitoring to evaluate natural attenuation and institutional controls would be included with this remedial response.

Mixing reagent in shallow trenches would be the most effective treatment method at Kreher Park because contamination is present at shallow depths at the former coal tar dump area, and would be easily accessible. Because in-situ chemical oxidation reactions can result in the generation of off-gases, primarily CO_2, passive venting or an active SVE system may be required to capture off-gases. The presence of NAPL may require multiple applications to lower contaminant concentrations to acceptable levels.

Although chemical oxidation applications can be completed within a short period of time, the groundwater extraction system may be operated for several years. Long-term groundwater monitoring to evaluate natural attenuation and institutional controls would be included with this remedial response.

Copper Falls Aquifer: Alternative GW-9B –NAPL Removal using Enhanced Groundwater Extraction System. Groundwater extraction uses water as a carrier to remove both NAPL and dissolved phase contamination. The existing interim groundwater extraction system currently extracts groundwater from one well installed at the mouth of the Filled Ravine, and groundwater and NAPL from three low-flow wells installed in the underlying Copper Falls aquifer. Enhanced removal at the Upper Bluff area will include installation of additional low-flow extraction wells in the Copper Falls aquifer to increase NAPL removal rates, and continued operation of existing wells EW-1, EW-2, and EW-3. This will also include continued operation of EW-4. Although the ROD states a minimum of 12 extraction wells will be installed in the Copper Falls aquifer to increase groundwater extraction rates to 10-15 gallons per minute, the final location and number of wells, and the resulting extraction rate, will be determined during the Phase 1 Remedial Design.

The groundwater extraction system at the Upper Bluff area may be operated for an extended period of time. Long-term groundwater monitoring will be required to evaluate natural attenuation and institutional controls will also be implemented as part of this option.

In addition, implementation of in-situ chemical oxidation (GW-6) for the underlying Copper Falls would be more extensive; it may require groundwater extraction rather than soil vapor extraction. EPA's SITE program completed a demonstration pilot test to fully evaluate the implementability of this alternative at the Phase 1 Project Area. Whether in-situ chemical oxidation will be pursued will be determined during the pre-design phase. Chemical oxidation may also increase the mobility of NAPL recovered by extraction wells resulting in the removal of significant contaminant mass in a short time frame. Preliminary results from the SITE program pilot test indicate that injection into areas with NAPL contaminants resulted in an initial vigorous reaction followed by an increase in the mobility and recovery of NAPL.

Although chemical oxidation applications can be completed within a short period of time, the groundwater extraction system may be operated for several years. Long-term groundwater monitoring to evaluate natural attenuation and institutional controls would be included with this remedial response.

Ozone Sparging

Ozone sparging is an in-situ chemical oxidation technology that can be used to oxidize and degrade contaminants in groundwater. Because ozone is a gas, it can be injected into the saturated zone as a gas via sparging. Sparging consists of injecting air or oxygen rich ozone into an aquifer as a gas through small diameter sparge wells. Commercially, ozone is generated by a high voltage discharge through air or oxygen in an ozone generator. Generally, yields are on the order of 1 to 3-percent ozone by volume in air and 2 to 6-percent ozone by volume in oxygen. In water, ozone decomposes to form free radicals. These free radicals are strong oxidizers and react with contaminants in water to form carbon dioxide and water. As an additional benefit, ozone treatment increases the dissolved oxygen level in the water when any un-reacted free radicals combine to form water and oxygen; the dissolved oxygen content in groundwater promotes biodegradation of contaminants.

Ozone sparging is typically used for dissolved phase contamination, but is typically not used in areas where NAPL is present. If used for NAPL contamination, groundwater extraction will likely be needed because ozone/air injection may displace NAPL and/or cause a chemical reaction increasing the mobility of NAPL. This mobilized material is then recovered via extraction wells. It will be determined during pre-design whether ozone sparging will be used for the Copper Falls aquifer.

The ozone sparge system may need to be operated for several years. Long-term groundwater monitoring would be required to evaluate the effectiveness of the sparging and subsequent natural attenuation, and institutional controls would be included with this remedial response.

Conduct O&M and Long-Term Monitoring: Collect groundwater samples to ensure contaminants are not migrating off site or from the contained area with groundwater. Fluid levels within the contained area will also need to be monitored to ensure that groundwater remains at or below the design elevation. Complete annual inspections to ensure the integrity of surface barriers and repair damage as needed. The long-term monitoring will evaluate achievement of the specified action levels and will ascertain whether the remedial actions objectives were achieved. The sampling endpoints, monitoring frequency and criteria will be part of the approved O&M plan.

Institutional Controls: Implement land use controls as provided under Chapter 292 of the Wisconsin Statutes, as part of the remedial action to prohibit use of contaminated groundwater and restrict use of land at the Upper Bluff/Filled Ravine and Kreher Park to prevent exposure to contaminants that may remain in groundwater and soil after implementation of the remedial action. Institutional controls to prohibit use of groundwater will be required until groundwater cleanup goals are achieved.

Institutional Controls (ICs) are necessary to prevent interference with the remedy and to reduce human or ecological receptors' exposure to contaminants. ICs are defined as restrictions,

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limitations, or other conditions imposed on the property to ensure that the remedy remains protective of public health, safety and welfare, and the environment, such as administrative and legal controls, that help minimize potential for exposure to contamination and protect the integrity of the remedy. ICs are also required to assure long-term protectiveness for those areas that do not allow for unlimited use and unrestricted exposure. ICs are also required to maintain the integrity of the remedy. At this Phase 1 Project Area, ICs are required to protect the cap, and reduce potential exposure for all areas where residual contamination will remain. Also, interim ICs may be necessary to prevent exposure to contaminants which may be released during construction activities such as excavations, capping, and placing of covers. Long-term protectiveness requires compliance with effective ICs. Hence, effective ICs must be implemented, monitored, and maintained.

ICs will be identified as part of the remedial design process in a draft Institutional Control Implementation and Assurance Plan (ICIAP) for review and approval by EPA, in consultation with WDNR. A final ICIAP will be submitted to EPA for approval, in consultation with WDNR, prior to the pre-final construction inspection. The required ICs may include restrictions, limitations or other conditions on the property, governmental controls (including zoning ordinances and local permits), and informational devices (including signage and fish consumption advisories). The ICIAP shall identify parties responsible (*i.e.*, federal, State or local authorities, or private entities) for implementation, enforcement, and monitoring and long-term assurance of each institutional control including costs, both short-term and long-term, and methods to fund the costs and responsibilities for each step.

The ICIAP shall include maps, which shall describe coordinates of the restricted areas on paper and provide shape files in an acceptable GIS format (*i.e.*, NAD 83) depicting all areas that do not allow unlimited use/unrestricted exposure, where excavation or subsurface disturbance is not allowed, and areas where ICs have been implemented along with a schedule for updating them. The maps and information about the ICs shall be made available to the public in at least several ways, such as the WDNR Database that is easily accessible to the public and included in the information repositories. In addition the ICIAP shall identify reporting requirements associated with each institutional control which shall include at a minimum an annual certification to EPA regarding the status and effectiveness of the ICs. The ICIAP shall also provide additional information to the public to assure protectiveness of the remedy.

3. <u>Compliance with the Institutional Control Implementation and Assurance Plan</u>

In accordance with the plans and schedules set forth in the approved Phase 1 Remedial Design Work Plan, Settling Defendant shall submit to EPA for review and approval, in consultation with WDNR, an ICIAP that will require the implementation and maintenance of institutional controls to impose land and groundwater activity and use limitations over areas that do not support unlimited use/unrestricted exposure as set forth in the ROD. The final ICIAP shall be submitted to EPA and WDNR prior to the pre-final construction inspection. The ICIAP shall include the following minimum requirements:

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A. Areas That Cannot Safely Support Unlimited Use or Unrestricted Exposure ("Non-UU/UE Areas") – Activity and Use Limitations:

i. Containment Systems: Settling Defendant shall implement and maintain Institutional Controls to prohibit interference with the containment systems set forth in Section 2 of this SOW. Settling Defendant shall survey the area covered by the final containment systems and shall install "capped iron (set)" permanent markers placed at the boundaries of the containment systems. Settling Defendant shall implement Institutional Controls that are enforceable in the State of Wisconsin.

ii. Limited Groundwater Use: Settling Defendant shall implement and maintain Institutional Controls to prohibit construction of wells and to prohibit any activity that extracts, consumes, or otherwise uses any contaminated groundwater at the Phase 1 Project Area, except for the purposes of an EPA approved response activity.

iii. Monitoring Systems: Settling Defendant shall implement and maintain Institutional Controls to prohibit interference with the Monitoring Systems set forth in Section 3 of this SOW.

B. Demonstration that Institutional Controls Cover All Non-UU/UE Areas: The ICIAP shall demonstrate that ICs cover all physical areas including non- UU/UE areas based on current conditions for the entire Phase 1 Project Area. The ICIAP shall include a methodology for mapping of all non-UU/UE areas during and after completion of construction, including preparing final survey maps and legal descriptions of non-UU/UE areas.

C. Institutional Controls: For ICs, the ICIAP shall include:

i) a current title insurance commitment in the form of ALTA Commitment form - 1982 (as amended) from a title company, which shows title to the non-UU/UE areas to be free and clear of all prior liens and encumbrances. If Settling Defendant requests that EPA waive this requirement after employing best efforts pursuant to Paragraphs 26-28 of the CD, Settling Defendant must demonstrate and certify that such preexisting liens, encumbrances, or other property interests will not interfere with the remedy or cause undue exposure. Such a demonstration must include: a) copies of encumbrances referenced in the Title Commitment; b) identification of encumbrances that impact the non-UU/UE areas; c) copies of requests for subrogation agreements for such encumbrances; d) identification of the encumbrances on maps that depict parcel numbers and the area impacted by the encumbrance; and e) discussion of how use of existing encumbrances will impact the Phase 1 Project Area;

ii) arrangements for the execution and recording of notices with the Ashland County Register of Deeds in accordance with the CD.

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D. Long Term Stewardship: The ICIAP shall provide for long term maintenance and stewardship of the ICs. Settling Defendant shall maintain and ensure compliance with all ICs at the Phase 1 Project Area.

i. Inspections and Certification: The ICIAP shall require that Settling Defendant inspect the Phase 1 Project Area at least annually to evaluate compliance with the activity and use limitations set forth above in section II.5.A. In the annual report, Settling Defendant shall certify compliance with the activity and use restrictions set forth in section II.5.A;

ii. Groundwater IC requirements: The ICIAP shall require annual submittal to EPA of the following information regarding compliance with groundwater use limitations:

-a map showing the location of existing and any new wells located in and around the Phase 1 Project Area;

-discussion of whether the boundaries of restricted areas under the ICs are sufficient to prevent exposure to contaminated groundwater; and
-contingency plans if the ICs are not sufficient to prevent exposure to contaminated groundwater.

iii. Soil Management Plan Requirements: The ICIAP shall include a Soil Management Plan (SMP). The Settling Defendant shall develop the SMP and submit it to the EPA and WDNR for review. Once the EPA, after consultation with WDNR, approves the SMP, the Settling Defendant shall implement the plan in accordance with the approved Remedial Design Work Plan schedule. The SMP shall identify the process for ensuring that future land use at the Phase 1 Project Area, including utility installation and repair and foundation installation, is protective of human health and the environment. The SMP shall establish standardized procedures for any future construction at the Phase 1 Project Area. The SMP shall identify the volumes and locations of soil that require management and establish management procedures for handling (excavating, grading, etc) and disposing of impacted soil. The SMP would also control exposure to construction workers during future work that may involve handling impacted soil by establishing engineering controls and other health and safety procedures.

III. SCOPE OF REMEDIAL DESIGN AND REMEDIAL ACTION

The Remedial Design/Remedial Action shall consist of six tasks. All plans are subject to EPA review and approval. Unless otherwise specifically stated, WDNR's participation shall be in a consultation role.

Task 1: Phase 1 Remedial Design Work Plan

Task 2: Remedial Design Phases

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A. Preliminary Design
B. Prefinal Design/ Final Design

Task 3: Phase 1 Remedial Action Work Plan

Task 4: Remedial Action/Construction

A. Preconstruction Meeting
B. Prefinal Inspection
C. Final Inspection
D. Reports

1. Final Construction Report
2. Completion of Remedial Action Report

Task 5: Operation and Maintenance

Task 6: Performance Monitoring

Task 1: Phase 1 Remedial Design Work Plan

Settling Defendant has submitted a Phase 1 Remedial Design Work Plan that EPA has approved, after consultation with WDNR. The Phase 1 Remedial Design Work Plan documents the overall management strategy for performing the design, construction, operation, maintenance, and monitoring of Remedial Actions for EPA review and approval. It documents the responsibility and authority of all organizations and key personnel involved with the implementation and includes a description of qualifications of key personnel directing the RD, including contractor personnel. The Phase 1 Remedial Design Work Plan also contains a schedule of RD activities. It also describes certain pre-design studies, including the RD Quality Assurance Project Plan (QAPP) with appropriate detail for pre-design investigation, Health and Safety Plan, Field Sampling Plan and schedule. The pre-design studies may include further delineation of the extent of contamination in soils.

The Settling Defendant shall implement the pre-design work in accordance with the final RD Work Plan. The results of the pre-design studies shall be included with the 30% design submittal to the EPA and WDNR.

Task 2: Remedial Design Phases

Settling Defendant shall prepare construction plans and specifications to implement the RA at the Phase 1 Project Area as described in the ROD and this SOW. Plans and specifications shall be submitted in accordance with the schedule set forth in Section V below. Subject to approval by EPA, Settling Defendant may submit more than one set of

A. Preliminary Design
B. Prefinal Design/ Final Design

Task 3: Phase 1 Remedial Action Work Plan

Task 4: Remedial Action/Construction

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The Settling Defendant shall implement the pre-design work in accordance with the final RD Work Plan. The results of the pre-design studies shall be included with the 30% design submittal to the EPA and WDNR.

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design submittals reflecting different components of the RA. All plans and specifications shall be developed in accordance with EPA's Superfund Remedial Design and Remedial Action Guidance (OSWER Directive No. 9355.0-4A) and shall demonstrate that the RA shall meet all objectives of the ROD, the CD, and this SOW, including all Performance Standards. Settling Defendant shall meet regularly with EPA to discuss design issues.

A. Preliminary Design

Settling Defendant shall submit the Preliminary Design when the design effort is approximately 30 % complete. The Preliminary Design submittal shall include or discuss, at a minimum, the following:

- Preliminary plans, drawings, and sketches, including design calculations;
- Results of treatability studies and additional field sampling;
- Design assumptions and parameters, including design restrictions, and performance criteria;
- List of groundwater and soil analysis for performance monitoring;
- Proposed cleanup verification methods, including compliance with Applicable or Relevant and Appropriate Requirements (ARARs);
- Outline of required specifications;
- Proposed siting/locations of processes/construction activity;
- Expected long-term monitoring and operation requirements;
- Real estate, easement, and permit requirements; and
- Preliminary construction schedule, including contracting strategy.

B. Prefinal and Final Designs

Settling Defendant shall submit the Prefinal Design when the design effort is 95% complete and shall submit the Final Design when the design effort is 100% complete. The Prefinal Design shall fully address all comments made to the preceding design submittal. The Final Design shall fully address all comments made to the Prefinal Design and shall include reproducible drawings and specifications suitable for bid advertisement. The Prefinal Design shall serve as the Final Design if EPA, after consultation with WDNR, has no further comments and issues the notice to proceed.

The Prefinal submittal shall include those elements listed for the Preliminary Design, as

design submittals reflecting different components of the RA. All plans and specifications shall be developed in accordance with EPA's Superfund Remedial Design and Remedial Action Guidance (OSWER Directive No. 9355.0-4A) and shall demonstrate that the RA shall meet all objectives of the ROD, the CD, and this SOW, including all Performance Standards. Settling Defendant shall meet regularly with EPA to discuss design issues.

A. Preliminary Design

Settling Defendant shall submit the Preliminary Design when the design effort is approximately 30 % complete. The Preliminary Design submittal shall include or discuss, at a minimum, the following:

- Preliminary plans, drawings, and sketches, including design calculations;
- Results of treatability studies and additional field sampling;
- Design assumptions and parameters, including design restrictions, and performance criteria;
- List of groundwater and soil analysis for performance monitoring;
- Proposed cleanup verification methods, including compliance with Applicable or Relevant and Appropriate Requirements (ARARs);
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Settling Defendant shall submit the Prefinal Design when the design effort is 95% complete and shall submit the Final Design when the design effort is 100% complete. The Prefinal Design shall fully address all comments made to the preceding design submittal. The Final Design shall fully address all comments made to the Prefinal Design and shall include reproducible drawings and specifications suitable for bid advertisement. The Prefinal Design shall serve as the Final Design if EPA, after consultation with WDNR, has no further comments and issues the notice to proceed.

The Prefinal submittal shall include those elements listed for the Preliminary Design, as

well as the following:

- Draft Performance Standard Verification Plan; and
- Draft Construction Quality Assurance Plan (CQAP).

The Final Design submittal shall include those elements listed for the Preliminary Design, as well as the following:

- Final Performance Standard Verification Plan;
- Final CQAP;
- Final QAPP/Final H & S Plan/Final FSP/Final Contingency Plan;
- Draft Operation and Maintenance Plan;
- Draft Institutional Control Implementation and Assurance Plan (see Section III);
- Draft Soil Management Plan;
- Capital and Operation and Maintenance Cost Estimate. This cost estimate shall refine the FS cost estimate to reflect the detail presented in the Final Design; and
- Final Project Schedule for the construction and implementation of the Remedial Action which identifies timing for initiation and completion of all critical path tasks. The final project schedule submitted as part of the Final Design shall include specific dates for completion of the project and major milestones.

Task 3: Phase 1 Remedial Action Work Plan

The Settling Defendant shall submit a Phase 1 Remedial Action Work Plan which includes a detailed description of the remediation and construction activities. The Phase 1 Remedial Action Work Plan shall include a project schedule for each major activity and submission of deliverables generated during the RA. The Settling Defendant shall submit the RA Work Plan in accordance with Section VI, Paragraph 12 of the CD and Section V of this SOW.

Task 4: Remedial Action Construction

The Settling Defendant shall implement the RA as detailed in the approved Final Design. The following activities shall be completed in constructing the RA.

A. Preconstruction inspection and meeting

well as the following:

- Draft Performance Standard Verification Plan; and
- Draft Construction Quality Assurance Plan (CQAP).

The Final Design submittal shall include those elements listed for the Preliminary Design, as well as the following:

- Final Performance Standard Verification Plan;
- Final CQAP;
- Final QAPP/Final H & S Plan/Final FSP/Final Contingency Plan;
- Draft Operation and Maintenance Plan;
- Draft Institutional Control Implementation and Assurance Plan (see Section III);
- Draft Soil Management Plan;
- Capital and Operation and Maintenance Cost Estimate. This cost estimate shall refine the FS cost estimate to reflect the detail presented in the Final Design; and
- Final Project Schedule for the construction and implementation of the Remedial Action which identifies timing for initiation and completion of all critical path tasks. The final project schedule submitted as part of the Final Design shall include specific dates for completion of the project and major milestones.

Task 3: Phase 1 Remedial Action Work Plan

The Settling Defendant shall submit a Phase 1 Remedial Action Work Plan which includes a detailed description of the remediation and construction activities. The Phase 1 Remedial Action Work Plan shall include a project schedule for each major activity and submission of deliverables generated during the RA. The Settling Defendant shall submit the RA Work Plan in accordance with Section VI, Paragraph 12 of the CD and Section V of this SOW.

Task 4: Remedial Action Construction

The Settling Defendant shall implement the RA as detailed in the approved Final Design. The following activities shall be completed in constructing the RA.

A. Preconstruction inspection and meeting

The Settling Defendant shall participate with the EPA and WDNR in a preconstruction inspection and meeting to:

1. review methods for documenting and reporting inspection data;

2. review methods for distributing and storing documents and reports;

3. review work area security and safety protocol;

4. discuss any appropriate modifications of the construction quality assurance plan to ensure that site-specific considerations are addressed; and

5. conduct a Phase 1 Project Area walk-around to verify that the design criteria, plans, and specifications are understood and to review material and equipment storage locations.

The preconstruction inspection and meeting shall be documented by a designated person and minutes shall be transmitted to all parties present.

B. Prefinal Inspection

Within 15 days after Settling Defendant makes a preliminary determination that construction is complete, the Settling Defendant shall notify the EPA and WDNR for the purposes of conducting a prefinal inspection. The prefinal inspection shall consist of a walk-through inspection of the entire Phase 1 Project Area with EPA and WDNR. The inspection is to determine whether the project is complete and consistent with the contract documents and the RA. Any outstanding construction items discovered during the inspection shall be identified and noted. Additionally, treatment equipment shall be operationally tested by the Settling Defendant. The Settling Defendant shall certify that the equipment has performed to meet the purpose and intent of the specifications. Retesting shall be completed where deficiencies are revealed. The prefinal inspection report shall outline the outstanding construction items, actions required to resolve items, completion date for these items, and a proposed date for final inspection.

C. Final Inspection

Within 15 days after completion of any work identified in the prefinal inspection report, the Settling Defendant shall notify the EPA and WDNR for the purposes of conducting a final inspection. The final inspection shall consist of a walk-through inspection of the Phase 1 Project Area by EPA, WDNR, and the Settling Defendant. The prefinal inspection report shall be used as a checklist with the final inspection focusing on the outstanding construction items identified in the prefinal inspection. Confirmation shall be made that outstanding items have been resolved.

The Settling Defendant shall participate with the EPA and WDNR in a preconstruction inspection and meeting to:

1. review methods for documenting and reporting inspection data;

2. review methods for distributing and storing documents and reports;

3. review work area security and safety protocol;

4. discuss any appropriate modifications of the construction quality assurance plan to ensure that site-specific considerations are addressed; and

5. conduct a Phase 1 Project Area walk-around to verify that the design criteria, plans, and specifications are understood and to review material and equipment storage locations.

The preconstruction inspection and meeting shall be documented by a designated person and minutes shall be transmitted to all parties present.

B. Prefinal Inspection

Within 15 days after Settling Defendant makes a preliminary determination that construction is complete, the Settling Defendant shall notify the EPA and WDNR for the purposes of conducting a prefinal inspection. The prefinal inspection shall consist of a walk-through inspection of the entire Phase 1 Project Area with EPA and WDNR. The inspection is to determine whether the project is complete and consistent with the contract documents and the RA. Any outstanding construction items discovered during the inspection shall be identified and noted. Additionally, treatment equipment shall be operationally tested by the Settling Defendant. The Settling Defendant shall certify that the equipment has performed to meet the purpose and intent of the specifications. Retesting shall be completed where deficiencies are revealed. The prefinal inspection report shall outline the outstanding construction items, actions required to resolve items, completion date for these items, and a proposed date for final inspection.

C. Final Inspection

Within 15 days after completion of any work identified in the prefinal inspection report, the Settling Defendant shall notify the EPA and WDNR for the purposes of conducting a final inspection. The final inspection shall consist of a walk-through inspection of the Phase 1 Project Area by EPA, WDNR, and the Settling Defendant. The prefinal inspection report shall be used as a checklist with the final inspection focusing on the outstanding construction items identified in the prefinal inspection. Confirmation shall be made that outstanding items have been resolved.

D. Reports

1. Construction Completion Report

Within 90 days of a successful final inspection, Settling Defendant shall submit a Construction Completion Report. In the report, a registered professional engineer and the Settling Defendant's Project Coordinator shall state that the RA has been constructed in accordance with the design and specifications. The written report shall include as-built drawings signed and stamped by a professional engineer. The report shall contain the following statement, signed by a responsible corporate official of the Settling Defendant or the Settling Defendant's Project Coordinator:

"To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

2. Completion of Remedial Action Report

Within 30 days of a successful pre-certification inspection, Settling Defendant shall submit a Completion of Remedial Action Report pursuant to Paragraph 50, a. of the CD. In the report, a registered professional engineer and the Settling Defendant's Project Coordinator shall state the RA has been completed in full satisfaction of the requirements of the CD and that all performance standards have been achieved. The written report shall include as-built drawings signed and stamped by a professional engineer. The report shall demonstrate that all elements of the performance standard verification plan have been met, and that all performance standards have been achieved. The report shall contain the following statement, signed by a responsible corporate official of the Settling Defendant or the Settling Defendant's Project Coordinator:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Task 5: Operation and Maintenance

The Settling Defendant shall prepare an Operation and Maintenance (O&M) Plan to cover both implementation and long term maintenance of the RA. An initial Draft O&M Plan shall be submitted as a final Design Document submission. The final O&M Plan shall be submitted to EPA and WDNR prior to the pre-final construction inspection, in accordance with the approved construction schedule. The O&M Plan shall be composed

D. Reports

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Within 90 days of a successful final inspection, Settling Defendant shall submit a Construction Completion Report. In the report, a registered professional engineer and the Settling Defendant's Project Coordinator shall state that the RA has been constructed in accordance with the design and specifications. The written report shall include as-built drawings signed and stamped by a professional engineer. The report shall contain the following statement, signed by a responsible corporate official of the Settling Defendant or the Settling Defendant's Project Coordinator:

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Within 30 days of a successful pre-certification inspection, Settling Defendant shall submit a Completion of Remedial Action Report pursuant to Paragraph 50, a. of the CD. In the report, a registered professional engineer and the Settling Defendant's Project Coordinator shall state the RA has been completed in full satisfaction of the requirements of the CD and that all performance standards have been achieved. The written report shall include as-built drawings signed and stamped by a professional engineer. The report shall demonstrate that all elements of the performance standard verification plan have been met, and that all performance standards have been achieved. The report shall contain the following statement, signed by a responsible corporate official of the Settling Defendant or the Settling Defendant's Project Coordinator:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Task 5: Operation and Maintenance

The Settling Defendant shall prepare an Operation and Maintenance (O&M) Plan to cover both implementation and long term maintenance of the RA. An initial Draft O&M Plan shall be submitted as a final Design Document submission. The final O&M Plan shall be submitted to EPA and WDNR prior to the pre-final construction inspection, in accordance with the approved construction schedule. The O&M Plan shall be composed

of the following elements:

1. Description of normal operation and maintenance;

    a. Description of tasks for operation;
    b. Description of tasks for maintenance;
    c. Description of prescribed treatment or operation conditions; and
    d. Schedule showing frequency of each O&M task.

2. Description of potential operating problems;

    a. Description and analysis of potential maintenance problems;
    b. Sources of information regarding problems; and
    c. Common and/or anticipated remedies.

3. Description of routine monitoring and laboratory testing;

    a. Description of monitoring tasks;
    b. Description of required data collection, laboratory tests, and their interpretation;
    c. Required quality assurance, and quality control;
    d. Schedule of monitoring frequency and procedures for a petition to EPA to reduce the frequency of or discontinue monitoring; and
    e. Description of verification sampling procedures if Cleanup or Performance Standards are exceeded in routine monitoring.

4. Description of alternate O&M;

    a. Should systems fail, alternate procedures to prevent release or threatened releases of hazardous substances, pollutants, or contaminants which may endanger public health and the environment or exceed performance standards; and
    b. Analysis of vulnerability and additional resource requirement should a failure occur.

5. Corrective action;

    a. Description of corrective action to be implemented in the event that cleanup or performance standards are exceeded; and
    b. Schedule for implementing these corrective actions.

6. Safety plan;

    a. Description of precautions, of necessary equipment, etc., for Phase 1 Project Area personnel; and

of the following elements:

1. Description of normal operation and maintenance;

    a. Description of tasks for operation;
    b. Description of tasks for maintenance;
    c. Description of prescribed treatment or operation conditions; and
    d. Schedule showing frequency of each O&M task.

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    b. Schedule for implementing these corrective actions.

6. Safety plan;

    a. Description of precautions, of necessary equipment, etc., for Phase 1 Project Area personnel; and

b. Safety tasks required in event of systems failure.

7. Description of equipment;

a. Equipment identification;
b. Installation of monitoring components;
c. Maintenance of Phase 1 Project Area equipment; and
d. Replacement schedule for equipment and installed components.

8. Records and reporting mechanisms required; and

a. Laboratory records;
b. Records for operating costs;
c. Mechanism for reporting emergencies;
d. Personnel and maintenance records; and
e. Annual reports to State agencies.

9. Institutional Control Implementation and Assurance Plan – Long Term Stewardship (see Section IV).

Task 6: Performance Monitoring

Performance monitoring shall be conducted to ensure that all Performance Standards are met.

A. Performance Standard Verification Plan

The purpose of the Performance Standard Verification Plan is to provide a mechanism to ensure that both short-term and long-term Performance Standards for the RA are met. The Draft Performance Standards Verification Plan shall be submitted with the Preliminary Design. Once approved, the Performance Standards Verification Plan shall be implemented on the approved schedule. The Performance Standards Verification Plan shall include:

1. Quality Assurance Project Plan
2. Health and Safety Plan
3. Field Sampling Plan

The Remedial Investigation/Feasibility Study (RI/FS) approved QAPP may be modified to address the RD/RA activities. A new Health and Safety Plan will be required to address the RD/RA activities.

IV. CONTENT OF SUPPORTING PLANS

b. Safety tasks required in event of systems failure.

7. Description of equipment;

a. Equipment identification;
b. Installation of monitoring components;
c. Maintenance of Phase 1 Project Area equipment; and
d. Replacement schedule for equipment and installed components.

8. Records and reporting mechanisms required; and

a. Laboratory records;
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c. Mechanism for reporting emergencies;
d. Personnel and maintenance records; and
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The purpose of the Performance Standard Verification Plan is to provide a mechanism to ensure that both short-term and long-term Performance Standards for the RA are met. The Draft Performance Standards Verification Plan shall be submitted with the Preliminary Design. Once approved, the Performance Standards Verification Plan shall be implemented on the approved schedule. The Performance Standards Verification Plan shall include:

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The Remedial Investigation/Feasibility Study (RI/FS) approved QAPP may be modified to address the RD/RA activities. A new Health and Safety Plan will be required to address the RD/RA activities.

IV. CONTENT OF SUPPORTING PLANS

The documents listed in this section -- the QAPP, the Field Sampling Plan, the Health and Safety Plan, the Contingency Plan, and the CQAP -- are documents which must be prepared and submitted as outlined in Section III of this SOW. The following section describes the required contents of each of these supporting plans.

A. Quality Assurance Project Plan

Settling Defendant shall develop a Site-specific QAPP, covering sample analysis and data handling for samples collected in all phases of future Phase 1 Project Area work, based upon the CD and guidance provided by EPA (http://www.epa.gov/quality/qs-docs/g5-final.pdf). The QAPP shall be consistent with the requirements of the EPA Contract Lab Program (CLP) for laboratories proposed outside the CLP. The QAPP shall at a minimum include:

Project Description
* Facility Location History
* Past Data Collection Activity
* Project Scope
* Sample Network Design
* Parameters to be Tested and Frequency
* Project Schedule

Project Organization and Responsibility

Quality Assurance Objective for Measurement Data
* Level of Quality Control Effort
* Accuracy, Precision, and Sensitivity of Analysis
* Completeness, Representativeness, and Comparability

Sampling Procedures

Sample Custody
* Field Specific Custody Procedures
* Laboratory Chain of Custody Procedures

Calibration Procedures and Frequency
* Field Instruments/Equipment
* Laboratory Instruments

Analytical Procedures
* Non-Contract Laboratory Program Analytical Methods
* Field Screening and Analytical Protocol

The documents listed in this section -- the QAPP, the Field Sampling Plan, the Health and Safety Plan, the Contingency Plan, and the CQAP -- are documents which must be prepared and submitted as outlined in Section III of this SOW. The following section describes the required contents of each of these supporting plans.

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* Facility Location History
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* Project Scope
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* Project Schedule

Project Organization and Responsibility

Quality Assurance Objective for Measurement Data
* Level of Quality Control Effort
* Accuracy, Precision, and Sensitivity of Analysis
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Sampling Procedures

Sample Custody
* Field Specific Custody Procedures
* Laboratory Chain of Custody Procedures

Calibration Procedures and Frequency
* Field Instruments/Equipment
* Laboratory Instruments

Analytical Procedures
* Non-Contract Laboratory Program Analytical Methods
* Field Screening and Analytical Protocol

* Laboratory Procedures

Internal Quality Control Checks
* Field Measurements
* Laboratory Analysis

Data Reduction, Validation, and Reporting
* Data Reduction
* Data Validation
* Data Reporting

Performance and System Audits
* Internal Audits of Field Activity
* Internal Laboratory Audit
* External Field Audit
* External Laboratory Audit

Preventive Maintenance
* Routine Preventative Maintenance Procedures and Schedules
* Field Instruments/Equipment
* Laboratory Instruments

Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness
* Field Measurement Data
* Laboratory Data

Corrective Action
* Sample Collection/Field Measurement
* Laboratory Analysis

Quality Assurance Reports to Management

Settling Defendant shall attend a pre-QAPP meeting with EPA. The Settling Defendant shall submit a draft QAPP to EPA for review and approval, in consultation with WDNR.

B. Health and Safety Plan

The Settling Defendant shall develop a health and safety plan which is designed to protect on-site personnel and area residents from physical, chemical, and all other hazards posed by this remedial action. The safety plan shall develop the performance levels and criteria necessary to address the following areas.

Facility description

* Laboratory Procedures

Internal Quality Control Checks
* Field Measurements
* Laboratory Analysis

Data Reduction, Validation, and Reporting
* Data Reduction
* Data Validation
* Data Reporting

Performance and System Audits
* Internal Audits of Field Activity
* Internal Laboratory Audit
* External Field Audit
* External Laboratory Audit

Preventive Maintenance
* Routine Preventative Maintenance Procedures and Schedules
* Field Instruments/Equipment
* Laboratory Instruments

Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness
* Field Measurement Data
* Laboratory Data

Corrective Action
* Sample Collection/Field Measurement
* Laboratory Analysis

Quality Assurance Reports to Management

Settling Defendant shall attend a pre-QAPP meeting with EPA. The Settling Defendant shall submit a draft QAPP to EPA for review and approval, in consultation with WDNR.

B. Health and Safety Plan

The Settling Defendant shall develop a health and safety plan which is designed to protect on-site personnel and area residents from physical, chemical, and all other hazards posed by this remedial action. The safety plan shall develop the performance levels and criteria necessary to address the following areas.

Facility description

Personnel
Levels of protection
Safe work practices and safeguards
Medical surveillance
Personal and environmental air monitoring
Personal protective equipment
Personal hygiene
Decontamination - personal and equipment
Phase 1 Project Area work zones
Contaminant control
Contingency and emergency planning
Logs, reports, and recordkeeping

The Health and Safety Plan shall follow EPA guidance and all OSHA requirements as outlined in 29 CFR 1910 and 1926.

A Contingency Plan shall be included as part of the Health and Safety Plan.

Settling Defendant shall submit a Contingency Plan describing procedures to be used in the event of an accident or emergency at the Site related to the Phase 1 Remedial Action. The draft Contingency Plan shall be submitted with the prefinal design and the final Contingency Plan shall be submitted with the final design. The final Contingency Plan shall be submitted prior to the start of construction, in accordance with the approved construction schedule. The Contingency Plan shall include, at a minimum, the following:

1. Name of the person or entity responsible for responding in the event of an emergency incident.

2. Plan and date(s) for meeting(s) with the local community, including local, State, and Federal agencies involved in the cleanup, as well as local emergency squads and hospitals.

3. First aid medical information.

4. Air Monitoring Plan (if applicable).

5. Spill Prevention, Control, and Countermeasures (SPCC) Plan (if applicable), as specified in 40 CFR Part 109 describing measures to prevent and contingency plans for potential spills and discharges from materials handling and transportation.

C. Field Sampling Plan

The Settling Defendant shall develop a field sampling plan (as described in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,"

Personnel
Levels of protection
Safe work practices and safeguards
Medical surveillance
Personal and environmental air monitoring
Personal protective equipment
Personal hygiene
Decontamination - personal and equipment
Phase 1 Project Area work zones
Contaminant control
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C. Field Sampling Plan

The Settling Defendant shall develop a field sampling plan (as described in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,"

October 1988). The Field Sampling Plan should supplement the QAPP and address all sample collection activities.

D. Construction Quality Assurance Plan

Settling Defendant shall submit a CQAP which describes the Site-specific components of the quality assurance program which shall ensure that the completed project meets or exceeds all design criteria, plans, and specifications. The draft CQAP shall be submitted with the prefinal design and the final CQAP shall be submitted with the final design. The final CQAP shall be submitted prior to the start of construction in accordance with the approved construction schedule. The CQAP shall contain, at a minimum, the following elements:

1. Responsibilities and authorities of all organizations and key personnel involved in the design and construction of the RA.

2. Qualifications of the Quality Assurance Official to demonstrate he possesses the training and experience necessary to fulfill his identified responsibilities.

3. Protocols for sampling and testing used to monitor construction.

4. Identification of proposed quality assurance sampling activities including the sample size, locations, frequency of testing, acceptance and rejection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports, and final documentation. A description of the provisions for final storage of all records consistent with the requirements of the Consent Decree shall be included.

5. Reporting requirements for construction quality assurance activities shall be described in detail in the CQAP. This shall include such items as daily summary reports, inspection data sheets, problem identification and corrective measures reports, design acceptance reports, and final documentation. Provisions for the final storage of all records shall be presented in the CQAP.

V. SUMMARY OF MAJOR DELIVERABLES/SCHEDULE

A summary of the project schedule and reporting requirements contained in this SOW is presented below:

Submission	Due Date
1. Pre-Design Study Work Plans	Fifteen (15) days after EPA's approval of the Supervising Contractor
2. Preliminary Design (30%)	Thirty (30) days after completion of pre-

October 1988). The Field Sampling Plan should supplement the QAPP and address all sample collection activities.

D. Construction Quality Assurance Plan

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2. Qualifications of the Quality Assurance Official to demonstrate he possesses the training and experience necessary to fulfill his identified responsibilities.

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5. Reporting requirements for construction quality assurance activities shall be described in detail in the CQAP. This shall include such items as daily summary reports, inspection data sheets, problem identification and corrective measures reports, design acceptance reports, and final documentation. Provisions for the final storage of all records shall be presented in the CQAP.

V. SUMMARY OF MAJOR DELIVERABLES/SCHEDULE

A summary of the project schedule and reporting requirements contained in this SOW is presented below:

Submission	Due Date
1. Pre-Design Study Work Plans	Fifteen (15) days after EPA's approval of the Supervising Contractor
2. Preliminary Design (30%)	Thirty (30) days after completion of pre-

	design studies
3. Prefinal Design (95%)	Sixty (60) days after receipt of EPA's comments on the Preliminary Design (30%)
4. Draft ICIAP	Thirty (30) days after receipt of EPA's comments on the Prefinal Design
5. Draft O & M Plan	Thirty (30) days after receipt of EPA's comments on the Prefinal Design
6. Final Design (100%)	Sixty (60) days after receipt of EPA's comments on the Prefinal Design
7. Phase 1 RA Work Plan	Thirty (30) days after EPA's approval of Final Design.
8. Award RA Contract(s)	Six (6) days after receipt of EPA's Approval of the Phase 1 Remedial Action Work Plan
9. Pre-Construction Inspection and Meeting	One (1) day after Award of RA Contract(s)
10. Initiate Construction of RA	One(1) day after Pre-Construction Inspection and meeting
11. Completion of Construction	As approved by EPA in RA construction schedule
12. Prefinal Inspection	No later than fifteen (15) days after completion of construction
13. Final O&M Plan	No later than Prefinal Inspection
14. Final ICIAP Plan	No later than Prefinal Inspection
15. Prefinal Inspection Report prefinal inspection	Fifteen (15) days after completion of
16. Final Inspection	Fifteen (15) days after completion of work identified in prefinal inspection report
17. Construction Completion Report	Ninety (90) days after a successful final inspection pursuant to Task 4, D, 1. of this SOW

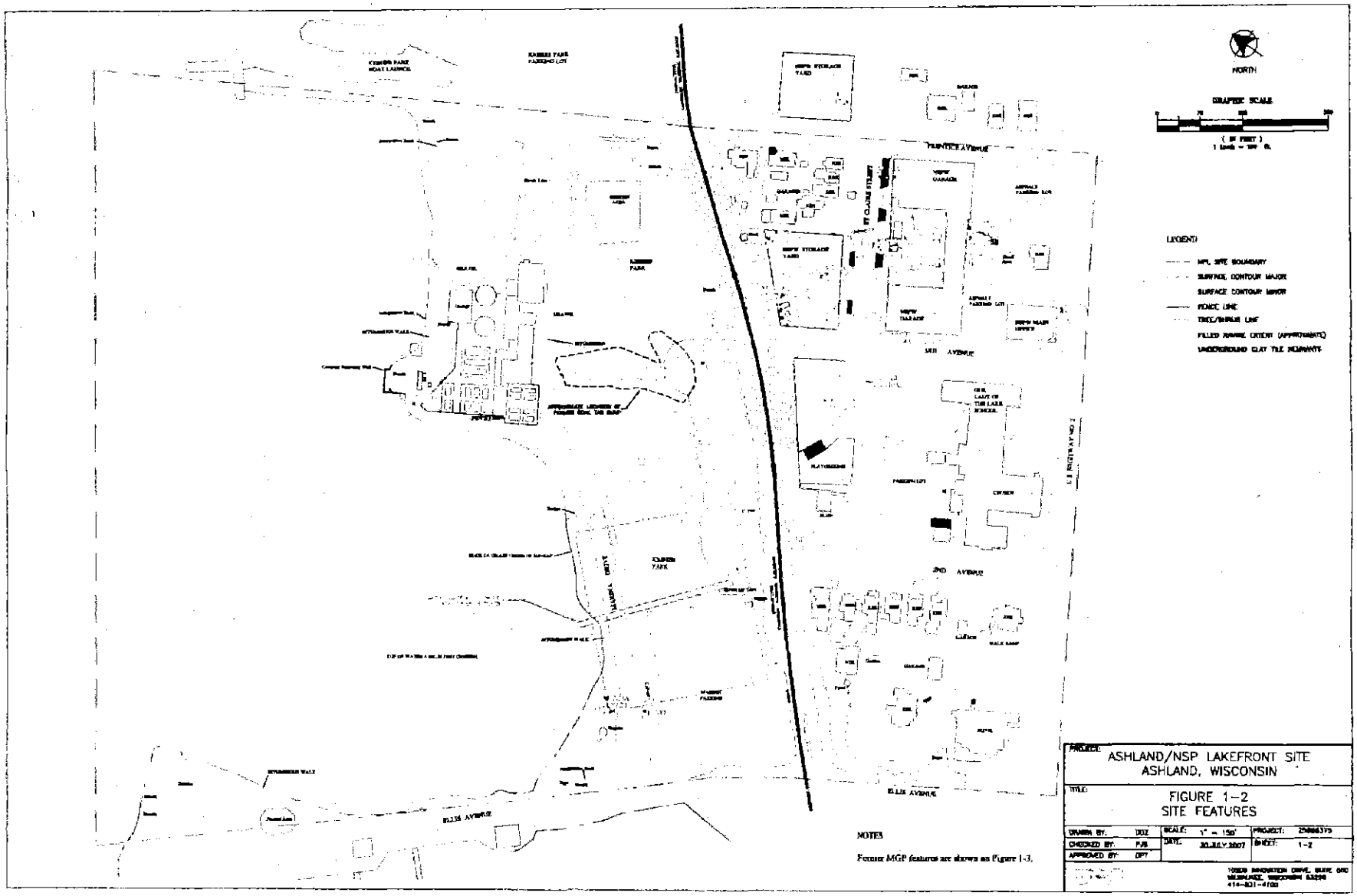
	design studies
3. Prefinal Design (95%)	Sixty (60) days after receipt of EPA's comments on the Preliminary Design (30%)
4. Draft ICIAP	Thirty (30) days after receipt of EPA's comments on the Prefinal Design
5. Draft O & M Plan	Thirty (30) days after receipt of EPA's comments on the Prefinal Design
6. Final Design (100%)	Sixty (60) days after receipt of EPA's comments on the Prefinal Design
7. Phase 1 RA Work Plan	Thirty (30) days after EPA's approval of Final Design.
8. Award RA Contract(s)	Six (6) days after receipt of EPA's Approval of the Phase 1 Remedial Action Work Plan
9. Pre-Construction Inspection and Meeting	One (1) day after Award of RA Contract(s)
10. Initiate Construction of RA	One(1) day after Pre-Construction Inspection and meeting
11. Completion of Construction	As approved by EPA in RA construction schedule
12. Prefinal Inspection	No later than fifteen (15) days after completion of construction
13. Final O&M Plan	No later than Prefinal Inspection
14. Final ICIAP Plan	No later than Prefinal Inspection
15. Prefinal Inspection Report prefinal inspection	Fifteen (15) days after completion of
16. Final Inspection	Fifteen (15) days after completion of work identified in prefinal inspection report
17. Construction Completion Report	Ninety (90) days after a successful final inspection pursuant to Task 4, D, 1. of this SOW

18. Completion of Remedial Action Report	Within thirty (30) days of the pre-certification inspection pursuant to Task 4, D, 2. of this SOW and Section XIV, Paragraph 50, a. of the CD

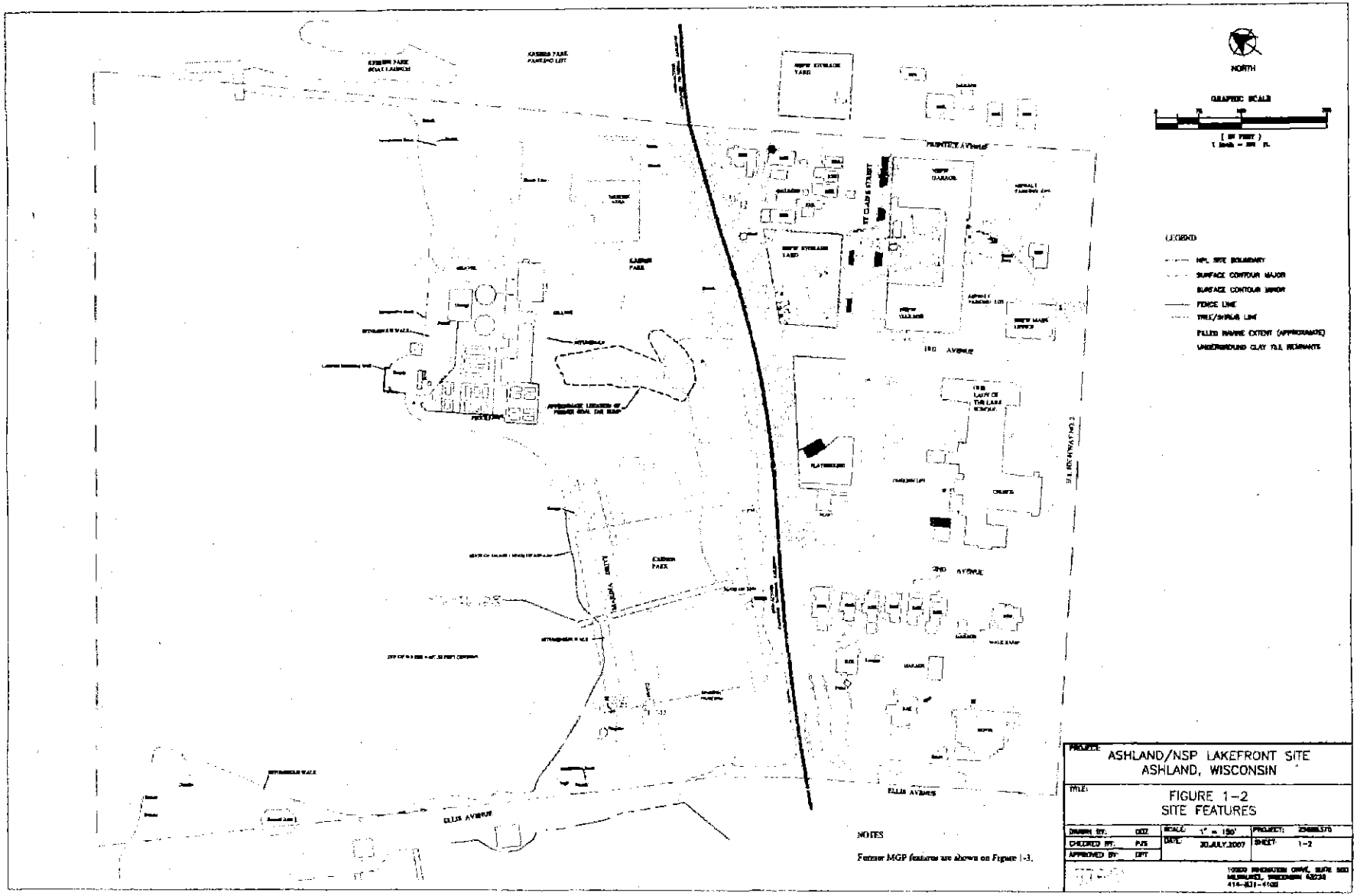
The project schedule may be accelerated, provided that any such changes are mutually agreed upon in writing by Settling Defendant and EPA, in consultation with WDNR.

18. Completion of Remedial Action Report	Within thirty (30) days of the pre-certification inspection pursuant to Task 4, D, 2. of this SOW and Section XIV, Paragraph 50, a. of the CD

The project schedule may be accelerated, provided that any such changes are mutually agreed upon in writing by Settling Defendant and EPA, in consultation with WDNR.


NORTH
GRAPHIC SCALE
LEGEND
PRENTICE AVENUE
ST CLAIR STREET
3RD AVENUE
2ND AVENUE
ELLIS AVENUE
NOTES
Former MGP features are shown on Figure 1-3.
PROJECT:
ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN
TITLE:
FIGURE 1-2
SITE FEATURES
DRAWN BY:
CHECKED BY:
APPROVED BY:
SCALE:
DATE:
PROJECT:
SHEET:
1-2

Appendix C


NORTH
GRAPHIC SCALE
LEGEND
NPL SITE BOUNDARY
SURFACE CONTOUR MAJOR
SURFACE CONTOUR MINOR
FENCE LINE
TREE/SHRUB LINE
FILLED MARINE EXTENT (APPROXIMATE)
UNDERGROUND CLAY TILE REMNANTS
PRENTICE AVENUE
1ST AVENUE
2ND AVENUE
ELLIS AVENUE
ELLIS AVENUE
NOTES
Former MGP features are shown on Figure 1-3.
PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN
TITLE: FIGURE 1-2
SITE FEATURES
DRAWN BY: DDZ
CHECKED BY: PJS
APPROVED BY: DPT
SCALE: 1" = 150'
DATE: 30 JULY 2007
PROJECT:
SHEET: 1-2

Appendix C

SPILL RESPONSE AGREEMENT

WHEREAS, the Department of Natural Resources ("DNR" or "the Department") has investigated contamination at the lakefront in the City of Ashland (in Kreher Park, on property owned by Wisconsin Central Limited Railroad ("WCL") and in certain sediments in Chequamegon Bay) and Northern States Power Company ("NSP") has investigated contamination on its property, the site of a former manufactured gas plant ("MGP"), located on St. Claire Street, between 3rd Avenue East and Prentice Avenue in the City of Ashland ("the NSP Property"), and has conducted investigations, at Kreher Park and on property owned by WCL;

WHEREAS, the Department has concluded, based on the results of the investigations conducted to date by the Department and by NSP, that contamination on and under the NSP Property was caused by discharges from the former MGP and that the primary source of contamination found in Kreher Park and in bay sediments is contamination that originated on, and migrated from, the NSP Property; and

WHEREAS, NSP disputes the Department's conclusion that discharges from the former MGP on the NSP Property are the primary source of contamination found in Kreher Park and in bay sediments.

NOW THEREFORE:

1. This Agreement is entered into pursuant to s. 292.11(7)(d), Wis. Stats., by the Department and NSP, without either party waiving any rights, enforcement authority, causes of action, legal or factual defenses, or admitting any responsibility or liability. This Agreement shall be enforceable under s. 292.11(7)(e), Wis. Stats. The parties hereby agree that NSP will conduct the activities listed below in compliance with the following schedule, except as provided in paragraph 3 of this Agreement:

No.	Activity	Compliance Date
a	Place and maintain Department-approved warning signs at intervals of no more than 100 feet on the lakefront at Kreher Park, adjacent to the contaminated sediment area.	Beginning 20 days after the receipt of approval necessary from the City of Ashland, or the entry of a court order obtained by DNR that authorizes placement of the warning signs, until remediation is completed.

b	Submit a plan for the installation of additional fencing to completely restrict access to the seep area and the surface water run-off area adjacent to the seep, which includes delineation of the surface water run-off area, for DNR approval.	Within 20 days after the effective date of this Agreement.
c	Install additional fencing, and maintain existing fencing, to completely restrict access to the seep area, as well as the surface water run-off area adjacent to the seep, and place and maintain Department-approved warning signs on or near the fencing.	Beginning 20 days after the receipt of approval from DNR of the plan submitted under Para. 1. b above and grants of access from WCL and the City of Ashland, or the entry of a court order obtained by DNR that authorizes the placement of the fencing until remediation is completed.
d	Maintain, and remove and replace in the Fall and Spring, the existing warning buoys in Chequamegon Bay, including placement of Department-approved markings and warning signs.	Buoys are to be removed not earlier than November 15 annually, and replaced within one week after "ice out" in the Bay each year until remediation is completed, in compliance with any required approval from the U.S. Coast Guard.
e	Submit to the Department all drawings of record ("as-built plans"), working drawings, operational drawings, photographs or any other documentation that NSP has knowledge of and access to, regarding the manufactured gas plant's operation, construction, or decommissioning; the plant's water supply system, waste treatment systems (including wastewater, MGP wastes, or other wastes generated from the MGP process), and all MGP waste disposal activities.	Within 14 days after the effective date of this agreement.

f	Submit, for DNR approval, a work plan for an investigation of the NSP Property (including sampling in the areas on the NSP Property where tar wells, gas holders, and gas condensate removal processes were located) that defines the degree and extent in the soil and groundwater of the "contaminants of concern" listed in Appendix A and complies with the requirements of ch. NR 716, Wis. Adm. Code.	Within 30 days after the effective date of this agreement.
g	Conduct an investigation of the NSP Property in compliance with the work plan that has been approved under Para. 1. f of this Agreement.	In compliance with the schedule specified in the DNR's approval or conditional approval of the investigation work plan. DNR's approval or conditional approval shall take into account the presence of existing buildings and other structures that may impede subsurface exploration, and shall not require unreasonable subsurface exploration beneath existing structures or buildings.
h	If NSP believes that the DNR's final feasibility study is not adequate, NSP shall submit, for DNR approval, a Supplemental Remedial Action Options Report that complies with the requirements of s. NR 722.13(2)(a) to (d), Wis. Adm. Code. for those contaminated portions of (a) Kreher Park, (b) sediments in Chequamegon Bay, and (c) Wisconsin Central Limited property that are addressed in the DNR's final feasibility study.	Within 60 days after NSP receives a copy of DNR's final feasibility study of remedial options for Kreher Park, Wisconsin Central Limited property, and the contaminated sediments in Chequamegon Bay.

i	Submit, for DNR approval, a Remedial Action Options Report for the NSP Property, including a revised Remedial Action Options Report for the Lower Copper Falls Formation Aquifer, that complies with the requirements of s. NR 722.13(2)(a) to (d), Wis. Adm. Code.	Within 60 days after the completion of the investigation that is required by Para. 1. f of this Agreement, or 30 days after the receipt of DNR's comments on NSP's initial Remedial Action Options Report for the Lower Copper Falls Formation Aquifer, whichever comes first.

2. NSP will not select a remedy in the Remedial Action Option Reports required under Para. 1. h and i of this Agreement, although remedial options may be recommended for selection. The Department will issue a record of decision, selecting a remedy for this site, after there has been an appropriate opportunity for public input.

3. NSP will perform all of the work required under this Agreement within the time limits set forth herein, unless the schedule is amended by mutual agreement of the parties or unless performance is delayed by events that constitute a "force majeure." For purposes of this Agreement, a "force majeure" is an event arising from causes beyond the control of NSP and any entity controlled by NSP which delays or prevents performance of any work required by this agreement. Increases in cost or changes in economic circumstances do not by themselves constitute a force majeure. However, an event that would otherwise constitute a force majeure shall be deemed a force majeure even though such an event also results in increased costs or changed economic circumstances. NSP shall notify the Department in writing no later than ten (10) business days after NSP becomes aware of any event that NSP contends is a force majeure. If the Department agrees that a delay is attributable to a force majeure, the time period for performance under this Agreement shall be extended by adding the time period attributable to the delay caused by the force majeure event to the deadlines specified in this Agreement.

4. Since this Agreement only covers one phase of a multiple-phase remedial action project, the Department reserves the right to take other appropriate enforcement action to supplement this Agreement. Similarly, NSP reserves the right to contest such enforcement action and to bring any claims on its own behalf.

5. This Agreement shall become effective on the date that it is signed by the Department.

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

By: _____ Date: 6/22/98
George E. Meyer
Secretary

NORTHERN STATES POWER COMPANY

By: _____ Date: 6/22/98
John D. Wilson
General Counsel

414 Nicollet Mall
Minneapolis, MN 55401

APPENDIX E to Consent Decree

_____, 2012

Richard Hackley
Regional Financial Management Officer
U.S. EPA Region 5
77 West Jackson Blvd.
Mail Code: MF-10J
Chicago, IL 60604-3507

Dear Mr. Hackley :

I am the chief financial officer of Northern States Power Company (a Wisconsin Corporation) (the "Company"). This letter is in support of the Company's use of a financial test to demonstrate financial assurance for the obligations of the Company under the Consent Decree (the "Consent Decree"), between the Company and United States Environmental Protection Agency ("EPA"), entered pursuant to the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, 42 U.S.C. § 9607 et seq. ("CERCLA"). This letter confirms the Company's satisfaction of certain financial criteria, as set forth more fully below, that makes the Company eligible to utilize the financial test as financial assurance under the Consent Decree.

1. The dollar amount of financial assurance required by Paragraph 44 of the Consent Decree and covered by the Company's use of the financial test: $40,000,000.

2. The Company is a signatory to the following CERCLA settlements (other than the Consent Decree) under which the Company is providing financial assurance to EPA through the use of a financial test. The total dollar amount of such financial assurance covered by a financial test is equal, in the aggregate, to $0, and is shown for each such settlement as follows: None.

3. The Company is the owner and/or operator of the following facilities for which the Company has demonstrated financial assurance through a financial test, including but not limited to hazardous waste Treatment, Storage, and Disposal ("TSD") facilities under 40 CFR parts 264 and 265, Municipal Solid Waste Landfill ("MSWLF") facilities under 40 CFR part 258, Underground Injection Control ("UIC") facilities under 40 CFR part 144, Underground Storage Tank ("UST") facilities under 40 CFR part 280, and Polychlorinated Biphenyl ("PCB") storage facilities under 40 CFR part 761. The total dollar amount of

such financial assurance covered by a financial test is equal, in the aggregate, to $3,483,520, and is shown for each such facility as follows: Woodfield Ash Landfill and Deer Creek Landfill.

4. The Company guarantees the CERCLA settlement obligations and/or the MSWLF, TSD, UIC, UST, PCB, and/or other facility obligations of the following guaranteed parties. The total dollar amount of such CERCLA settlement and regulated facility obligations so guaranteed is equal, in the aggregate, to $0, and is shown for each such settlement and/or facility as follows: None.

5. The Company is required to file a Form 10K with the Securities and Exchange Commission ("SEC") for the Company's latest fiscal year.

6. The Company's fiscal year ends on December 31. I hereby certify that the figures for the following items marked with an asterisk are derived from the Company's independently audited, year-end financial statements for its latest completed fiscal year, ended December 31, 2011, and further certify as follows:

A. The aggregate total of the dollar amounts shown in Paragraphs 1 through 4 above equals $43,483,520.

B. The current rating of the Company's most recent bond issuance of senior unsecured debt is (P) A3 as issued by Moody's Investor Services.

*C. Company's tangible net worth equals[1]: $521,146,808.

*D. Company's total assets in the U.S. equal (required only if less than 90% of Company's assets are located in the U.S.): N/A

E. Is line C at least 6 times line A? (Yes/No): Yes.

F. Is line C at least $10 million? (Yes/No): Yes.

G. Are at least 90% of Company's assets located in the U.S.? (Yes/No): Yes

[1] Note that we have subtracted out intangible assets and regulatory assets are not considered to be intangible assets.

I hereby certify that, the above responses were prepared under my general direction and supervision and that, to the best of my knowledge and belief, qualified personnel gathered the information and the information contained in this letter is true, accurate, and complete as of this date

_____ [Signature]
Teresa S. Madden
Senior Vice President, Chief Financial Officer and Director
_____, 2012

[Copies to U.S. and EPA per Paragraph 121 of CD]

STATE OF _____)
) ss
COUNTY OF _____)

On this ____ day of _____ 20___, before me, the subscriber, a Notary Public in and for said State and County, personally appeared _____, known or identified to me to be the person whose name is subscribed to the within instrument, and in due form of law acknowledged that he/she is authorized on behalf of said company to execute all documents pertaining hereto and acknowledged to me that he/she executed the same as his/her voluntary act and deed on behalf of said company.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my seal in said State and County on the day and year last above written.

(Notary Seal)

_____
Notary

My Commission Expires: _____

CERCLA Financial Assurance Financial Test:
Sample CPA Report (for Test Alternative 2)

[CPA Letterhead]

Independent Accountants' Report
on Applying Agreed-Upon Procedures

To the Board of Directors and Management of [_____]:

We have performed the procedures outlined below, which were agreed to by [PRP] (the "Company"), to assist the Company in confirming selected financial data contained in the attached letter from [_____], the Company's Chief Financial Officer, dated [_____], to the Regional Administrator, United States Environmental Protection Agency, Region [__] (the "CFO Letter"). We have been advised by the Company that the CFO Letter has been or will be submitted to the United States Environmental Protection Agency ("EPA") in support of the Company's use of a financial test to demonstrate financial assurance for the Company's obligations under that certain Consent Decree (the "Consent Decree"), dated _____ ___, _____, Docket No. [_____], between the Company and EPA. The procedures outlined below were performed solely to assist the Company in complying with the financial assurance requirements contained in the Consent Decree.

This agreed-upon procedures engagement was conducted in accordance with attestation standards established by the American Institute of Certified Public Accountants. The sufficiency of these procedures is solely the responsibility of those parties specified in this report. Consequently, we make no representation regarding the sufficiency of the procedures described below either for the purpose for which this report has been requested or for any other purpose.

The procedures we performed and our associated findings are as follows:

1. We confirm that we have audited the consolidated financial statements of the Company as of and for the fiscal year ended [December 31, 200_] in accordance with U.S. generally accepted accounting principles (such audited, consolidated financial statements, the "Audited Financials"). Our report dated [_____], with respect thereto, is included in the Company's [200_] Annual Report on Form 10-K.

2. Using data set forth in the Audited Financials, we calculated the amount of the Company's tangible net worth as of [December 31, 200_] as [$_____], by [subtracting the amount of net intangible assets of [$_____] from the amount of total stockholders' equity of [$_____]]. We compared the amount of the Company's tangible net worth as so calculated with the amount set forth in Line 6(C) of the CFO Letter ("Tangible Net Worth"), and found such amounts to be in agreement.

3. We compared the amount of the Company's total assets located in the United States as of [December 31, 200_] of [$_____] (as such amount was derived by the Company from its underlying accounting records that support the Audited Financials and notified to us in writing) with the amount set forth in Line 6(D) of the CFO Letter, and found such amounts to be in agreement. **OR** We calculated the percentage of Company assets located in the United States as of [December 31, 200_] by dividing the amount of the Company's total assets located in the United States of [$_____] (as such amount was derived by the Company from its underlying accounting records that support the Audited Financials and notified to us in writing) by the amount of the Company's total assets as defined and set forth in the Audited Financials, and found such percentage to be greater than 90%.

4. Our calculation of the amount of the Company's tangible net worth (as set forth in Line 2 above) is [greater to or equal than] [less than] $10 million.

5. The dollar amount identified in Line 6(A) of the CFO Letter is hereinafter referred to as the "Financial Assurance Amount." Our calculation of the amount of the Company's tangible net worth (as set forth in Line 2 above) is [greater to or equal than] [less than] an amount calculated as six times the Financial Assurance Amount.

6. [Complete Line 6 only if less than 90% of Company's assets are located in the United States] Our calculation of the amount of the Company's total assets located in the United States (as set forth in Line 3 above) is [greater to or equal than] [less than] an amount calculated as six times the Financial Assurance Amount.

The foregoing agreed-upon procedures do not constitute an audit of the Company's financial statements or any part thereof, the objective of which is the expression of opinion on the financial statements or a part thereof. Accordingly, we do not express such an opinion. Had be performed additional procedures, other matters might have come to our attention that would have been reported to you.

This report is intended solely for the information and use of the Board of Directors and Management of the Company and is not intended to be and should not be used by anyone other than these specified parties; provided, however, that we acknowledge and agree that the Company may provide this report to the United States Environmental Protection Agency in support of the Company's financial assurance demonstration under the Consent Decree.

_____ [Signature]

_____ [Name]

_____ [Date]

APPENDIX F

HIGH VOLTAGE ELECTRICAL UTILITY EASEMENT

Line: 3316 Parcel No. 68.5 Name: Bad River Reservation

The undersigned, hereinafter called "Grantor", is the owner of the following described property (the "Premises") situated in the County of Ashland, State of Wisconsin, to-wit:

Northwest ¼ - Northeast ¼, and the Northeast ¼ - Northeast ¼, Section 36, Township 47 North, Range 3 West, Ashland County, Wisconsin.

RETURN TO: Xcel Energy
Siting & Land Rights, Nancy Dotson
1414 W. Hamilton Ave., PO Box 8
Eau Claire WI 54702-0008

PIN: 022-01350-0000, 022-01349-0000

The Grantor, in consideration of the sum of One Dollar ($1.00) and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, does hereby grant unto Northern States Power Company, a Wisconsin corporation d/b/a Xcel Energy, hereinafter referred to as "Xcel Energy", duly authorized to transact business in the States of Wisconsin and Michigan, its successors and assigns, the perpetual right, privilege, and easement to survey, construct, install, mark, inspect, operate, maintain, repair, alter, rebuild, relocate (within the Easement Area), reconstruct, replace, and remove all towers, structures, poles, crossarms, cables, wires, guys, supports, fixtures, devices, and other facilities, including distribution facilities, and appurtenances (collectively referred to as "Facilities") necessary or desirable for the purposes of conducting electric energy, light, and communication impulses, subject to the limitations herein, through, over, and across the following described lands within the premises, hereinafter called "Easement Area", situated in the County of Ashland, State of Wisconsin, to-wit:

A strip of land 100 feet in width, lying 50 feet on each side of and adjacent to the following described centerline: Commencing at a point on the west line of the NW¼ of the NE¼, Section 36, which point is five-hundred sixty-seven (567) feet south of the northwest corner of said quarter-quarter section and the Point of Beginning; Thence continuing southeasterly across the NW¼ - NE¼ and the NE¼ of the NE¼ to a point on the east line of the NE¼ of the NE¼, said point being 1,027 feet south of the northeast corner of said NE¼ of the NE¼, and there terminating.

All Facilities shall be located and limited to the above described right of way.

The easement granted herein involves a strip of land approximately 4,026 feet in length along the above described centerline and is 100 feet in width.

Xcel Energy shall have the right to string, install, operate, maintain, and replace One (1) transmission circuit(s) consisting of a total of Three (3) wires and/or cables together with Two (2) shield wires on said Facility. The wires and cables shall carry a nominal voltage of 115,000 with a maximum voltage of 120,750. Said wires and cables shall be strung so as to have ground clearance of not less than that established by the National Electrical Safety Code in effect at the time of construction. Xcel Energy shall have the right to install additions to or replace these Facilities within the Easement Area for the distribution of energy, light, and communication impulses, subject to the limitations herein.

The number, maximum height, and type of all poles existing or to be erected on said lands shall be: Three (3), H-Frame (or poles that are otherwise reasonable and appropriate in scale, kind and number).

Together with the associated rights to: 1) erect reasonable signs for the purpose of monumenting the boundaries of the Easement Area; 2) trim, cut down and remove all brush, trees, and overhanging branches now or hereafter existing on said Easement Area that interfere with the purpose of the easement; and 3) trim, cut down and remove trees now or hereafter existing on the property of Grantor located outside of said Easement Area which by falling might interfere with or endanger the Facilities; and 4) install additional Facilities on the existing structures within the Easement Area for the distribution of energy, light, and communication impulses. If Grantor has indicated its consent on Exhibit A attached hereto, and subject to the limitations set forth in Exhibit A, Xcel Energy has the right to (1) use property of Grantor outside of and adjacent to the Easement Area, including the Premises, for ingress and egress of personnel, equipment and vehicles to and from said Easement Area; however, Xcel Energy

shall avoid crossings of rivers and streams for ingress and egress to the Easement Area where reasonably practicable and (2) apply herbicides for tree, weed and brush control in accordance with applicable laws, rules and regulations.

Grantor shall have the right to use the surface of the Easement Area for all lawful purposes consistent with the intended use of the Easement Area and the existence and use of the Facilities, and subject to Xcel Energy's rights set forth herein (including, without limitation, the right to trim, cut down and remove trees). However, until Grantor obtains written consent of Xcel Energy, Grantor shall not, within the Easement Area: 1) erect any buildings, structures, or other improvements, whether permanent or temporary; 2) place or store any flammable materials; 3) park or store any machinery or equipment capable of extending to a height of 12 feet or more above the surface of the ground; 4) plant trees; 5) perform any act which will interfere with or endanger said facilities, or 6) alter by more than one (1) foot the elevation of the existing ground surface.

Xcel Energy shall repair, replace in kind, or pay for all future damages to Natural Resources, as defined in 42 U.S.C. § 9601(16), property, crops (other than trees trimmed or cut down and removed), fences, livestock, road, and fields caused by the future maintenance or construction of any Facilities. Claims on account of such damages may be referred to the nearest Xcel Energy office.

Xcel Energy shall construct, install, operate, maintain, repair and replace all of its facilities in the Easement Area in a manner which complies with all applicable environmental laws and in a manner so as to prevent and avoid any threatened or actual release or disposal of any hazardous substance as identified in accordance with any applicable environmental laws. In the event any liability does arise under applicable environmental laws, as a result of Xcel Energy's violation of any applicable environmental law or to the extent that Xcel Energy brings onto and introduces hazardous substances to the Easement Area, Xcel Energy shall,to the extent permitted by law, indemnify Grantor for any clean up costs, investigation costs, response costs, natural resource damages, penalties, or any other reasonable costs for which Grantor is found liable, except in each case only to the extent directly caused by Xcel Energy's violation of applicable environmental law or introduction of hazardous substances to the Easement Area.

Attached hereto as Exhibit "A" are additional landowner rights regarding the use of the Easement Area by Xcel Energy.

All of the terms and conditions contained in this Agreement, including the benefits and burdens, shall run with the land and shall be binding upon, inure to the benefit of, and be enforceable by the parties hereto and their respective successors and assigns, and incorporates all agreements and stipulations between the parties, and no prior representations or statements, verbal or written, shall modify, add or change the terms hereof.

IN WITNESS WHEREOF, I/We have hereto set my/our hand(s) and seal this ____ day of _____, 2012.

Bad River Band of the Lake Superior Tribe of Chippewa Indians

_____

By:
Its: _____

_____

By:
Its: _____

STATE OF _____)

Line: 3316, Parcel: 68.5

rev. 3/26/01
TMB/Legal rev. 8/26/98

) ss.
COUNTY OF _____)

Personally came before me, this _____ day of _____, 2012, the above _____ and _____ to me known to be the _____ and _____ of said corporation and acknowledged that they executed the foregoing instrument as such officers as the deed of said corporation, by its authority.

_____
Notary Public, State of _____.
My Commission Expires: _____

This instrument drafted by: Nancy Dotson, an employee of Xcel Energy Inc.

Line: 3316, Parcel: 68.5

rev. 3/26/01
TMB/Legal rev. 8/26/98

EXHIBIT "A"
"Landowner Rights" under Sec. 182.017 Wis. Stats.
Line: 3316, Parcel #: 68.5

As used herein "Landowner" shall mean Grantor, its successors and assigns, and the "Utility" shall mean Xcel Energy, its successors and assigns.

1. In maintaining and constructing the high-voltage transmission line on the property covered by the easement to which this Exhibit "A" is attached, the Utility shall:

a. If excavation is necessary, ensure that the topsoil is stripped, piled and replaced upon completion of the operation.
b. Restore to its original condition any slope, terrace or waterway which is disturbed by the maintenance or construction.
c. Insofar as is practicable and when the Landowner requests, schedule any construction work in an area used for agricultural production at times when the ground is frozen in order to prevent or reduce soil compaction.
d. Clear all debris and remove all stones and rocks resulting from construction activity upon completion of said construction.
e. Satisfactorily repair to its original condition any fence damaged as a result of construction or maintenance operations If cutting a fence is necessary, a temporary gate shall be installed. Any such gate shall be left in place at the Landowner's request.
f. Repair any drainage tile line within the easement damaged by such maintenance or construction.
g. Pay for any crop damage caused by such maintenance or construction
h. Supply and install any necessary grounding of a Landowner's fences, machinery or buildings.

2. The Utility shall control weeds and brush around the transmission line facilities. If weed or brush control is undertaken by the Landowner under an agreement with the Utility, the Landowner shall receive from the Utility a reasonable amount for such services. No herbicidal chemicals may be used for weed or brush control without the express written consent of the landowner

_____Subject to the foregoing statement, the Landowner, by INITIALING IN THE SPACE AT LEFT, hereby grants written consent to the Utility to use HERBICIDAL chemicals for weed and brush control.

3. The Landowner shall be afforded a reasonable time prior to commencement of construction to harvest any trees located within the easement boundaries, and if the Landowner fails to do so, the Landowner shall nevertheless retain title to all trees cut by the Utility.

4. The Landowner shall not be responsible for any injury to persons or property caused by the maintenance, design, or construction or upkeep of the high-voltage transmission lines or towers.

5. The Utility shall employ all reasonable measures to ensure that the Landowner's television and radio reception is not adversely affected by the high-voltage transmission lines.

6. The Utility may not use any lands beyond the boundaries of the easement for any purpose, including ingress to and egress from the right-of-way, without the written consent of the Landowner.

_____ The foregoing statement notwithstanding, the Landowner, BY INITIALING IN THE SPACE AT LEFT, hereby grants its written consent for the Utility to use any land beyond the boundaries of the easement for ingress and egress for personnel, equipment and vehicles; however, Xcel Energy shall avoid non-road crossings of rivers and streams for ingress and egress to the Easement Area where reasonably practicable.

Executed this _____ day of _____, 2012.

In Presence Of	**Bad River** Band of the Lake Superior Tribe of Chippewa Indians
_____	_____
Name:	Name: Title:
_____	_____
Name:	Name: Title: