

# Selected Resources on Contaminated Sediments in the Great Lakes

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Prepared by the Statewide Public Advisory Council for Michigan's Areas of Concern Program

Updated November 2002

An In Situ Laser-Induced Fluorescence (LIF) System for Polycyclic Aromatic Hydrocarbon-Contaminated Sediments describes the results of a field-scale demonstration of an innovative sediment assessment technology that quantitatively measures polyaromatic hydrocarbons (PAHs) in-place. The method uses real-time laser-induced fluorescence. This real-time measurement method allows much faster and efficient sampling for PAHs compared to the usual method of first collecting a sample of sediment and then analyzing it in the laboratory. The report documents excellent results of this system in quantifying the vertical and horizontal extent of PAH contamination at a site in the Milwaukee Area of Concern. Contact: Demaree Collier, U.S. EPA - GLNPO (312) 886-0214

Screening Level Risk Assessment for the Ottawa River, Ohio: Ecological and Human Health summarizes the results of a screening-level risk assessment for the lower portion (8.8 miles) of the Ottawa River, Ohio (near Toledo). The assessment used all of the existing data and some supplemental data collected specially for this study. The report evaluates the ecological and human health risks posed by the contaminants in Ottawa River biota, sediments, and water to provide a basis for prioritizing areas for remediation. Contact: Demaree Collier, U.S. EPA - GLNPO (312) 886-0214

June 2000 Survey of Sediment Contamination on the Manitowoc River, Manitowoc, Wisconsin documents the results of sediment chemistry and whole-sediment toxicity testing conducted by GLNPO and the U.S. Army Corps of Engineers in the lower Manitowoc River near Manitowoc, Wisconsin. Results indicate extremely elevated concentrations of polycyclic aromatic hydrocarbons (>4,000 ppm) and Oil & Grease (>15,000 ppm) in an area of the river near a former manufactured-gas plant. The report has been provided to the Wisconsin Department of Natural Resources and a consultant working for the current owner of the property who is planning further investigations later this fall. Contact: Scott Cieniawski, U.S. EPA - GLNPO (312) 353-9184

## Agency Links and General Resources

### ***Great Lakes Contaminated Sediments Program, U.S. EPA, Great Lakes National Program Office***

Homepage for the Great Lake contaminated sediments program managed by U.S. EPA, Great Lakes National Program Office (GLNPO). The site includes program reports on sediment activities funded by GLNPO, an overview of key sediment problem areas in the Great Lakes basin, and links to case studies and other resources, including the Assessment and Remediation of Contaminated Sediments (ARCS) Program. [www.epa.gov/glnpo/sediments.html](http://www.epa.gov/glnpo/sediments.html).

### ***U.S. Army Corps of Engineers, Great Lakes Region***

This site provides information about Corps' activities and projects within the Great Lakes Region and links to further information. This includes overviews of Corps authorities in the following areas: Restoration of Environmental Quality; Aquatic Ecosystem Restoration; Beneficial Use of Dredged Material; Great Lakes Remedial Action Plans and Sediment Remediation; Environmental Dredging; Planning Assistance to States; and Flood Mitigation and Riverine Restoration. [www.lrd.usace.army.mil/gl/gl.htm](http://www.lrd.usace.army.mil/gl/gl.htm)

### ***The U.S. Army Corps of Engineers Center for Contaminated Sediments***

The Corps' Center for Contaminated Sediments consolidates research expertise to deal with the problem of contaminated sediments. The Center coordinates and facilitates contaminated sediment activities among Corps organizations, the Department of Defense, other federal and state agencies, academia, and the private sector. Research and development activities support the Corps of Engineers navigation mission as well as work related to military cleanup activities; the Environmental Protection Agency's Superfund and Assessment and Remediation of Contaminated Sediments Programs; and the National Oceanic and Atmospheric Administration's Natural Resource Trustee Program. [www.wes.army.mil/el/dots/ccs/index.html](http://www.wes.army.mil/el/dots/ccs/index.html)

***U.S. Environmental Protection Agency, Region 5 Superfund Division***

U.S. EPA Region 5 administers the federal Superfund program for the states of Michigan, Minnesota, Wisconsin, Illinois, Indiana and Ohio. [www.epa.gov/region5superfund/index.html](http://www.epa.gov/region5superfund/index.html)

***Michigan Department of Environmental Quality, Environmental Response Division***

The Environmental Response Division administers Part 201 (Environmental Remediation) of Michigan's Natural Resources and Environmental Protection Act and portions of the federal Superfund program. These programs guide the division's efforts in the cleanup and redevelopment of contaminated sites throughout Michigan. [www.deq.state.mi.us/erd/](http://www.deq.state.mi.us/erd/)

***Michigan Department of Environmental Quality, Surface Water Quality Division***

The Surface Water Quality Division administers a number of programs that range from preventive to remedial and from voluntary to regulatory. These include the Biosolids Program, Enforcement Program, Environmental Assessment Program, Great Lakes Program (related to Remedial Action Plans for Great Lakes Areas of Concern and Lakewide Management Plans), Industrial Pretreatment Program, Nonpoint Source Control Program, NPDES Permit and NPDES Permit Compliance Programs, Part 41 Program (permits for new or expanded wastewater treatment facilities), Restoration and Protection Program, Septage Program, Storm Water Program, Water Quality Standards Program and Water Quality Trading Program. The division's web site will soon include an overview of sediment sites being addressed with funding from the Clean Michigan Initiative. [www.deq.state.mi.us/swq/](http://www.deq.state.mi.us/swq/)

***International Joint Commission***

The International Joint Commission (IJC) was established under the 1909 U.S.-Canada Boundary Waters Treaty to prevent and resolve disputes related to water bodies shared between the two countries, and to manage and protect those waters. The IJC monitors and assesses progress under the Great Lakes Water Quality Agreement (GLWQA) and advises the U.S. and Canadian governments on matters related to the quality of the boundary waters of the Great Lakes system. The GLWQA also calls upon the IJC to assist the governments with joint programs under the agreement and provides for two binational boards—the Great Lakes Water Quality Board and the Great Lakes Science Advisory Board—to advise the IJC. In its *Tenth Biennial Report on Great Lakes Water Quality* (July 2000), the IJC noted that less than 2.4 percent of known contaminated sediment by volume in U.S. Areas of Concern had been remediated and only 0.2 percent in Canadian Areas of Concern. (<http://www.ijc.org/comm/10br/en/indexen.html>). The IJC has made contaminated sediments a priority for the Great Lakes Water Quality Board, which formed the Sediment Priority Action Committee (SedPAC) to review and advise on the problem. <http://www.ijc.org/>

***Great Lakes Dredging Team***

The Great Lakes Dredging Team web site is a regional Internet resource for information on Great Lakes Dredging issues. The Great Lakes Dredging Team is a partnership of federal and state agencies created to assure that the dredging of U.S. harbors and channels throughout the Great Lakes, Connecting Channels and tributaries is conducted in a timely and cost-effective manner while meeting environmental protection, restoration and enhancement goals. [www.glc.org/projects/dredging/index.html](http://www.glc.org/projects/dredging/index.html)

***Sediment Management for Ecosystem Recovery***

Sediment Priority Action Committee, Great Lakes Water Quality Board, International Joint Commission, August 1999. This fact sheet identifies the contaminated sediment problem, emphasizes the need for a better understanding of the relationships between contaminated sediment and beneficial use impairments, and states the importance of monitoring the ecological effectiveness of contaminated sediment remediation after cleanup has taken place. [www.ijc.org/boards/wqb/sedpacbroc/index.html](http://www.ijc.org/boards/wqb/sedpacbroc/index.html)

***Overcoming Obstacles to Sediment Remediation in the Great Lakes Basin***

White Paper by the Sediment Priority Action Committee, Great Lakes Water Quality Board, International Joint Commission, 1997. This white paper summarizes the contaminated sediment problem, specifies key obstacles, and identifies options to address these obstacles. The white paper served as the basis for a 1997 workshop sponsored by the Sediment Priority Action Committee. [www.ijc.org/boards/wqb/sedrem.html](http://www.ijc.org/boards/wqb/sedrem.html)

***Identifying and Assessing the Economic Benefits of Contaminated Aquatic Sediment Cleanup***

International Joint Commission, Sediment Priority Action Committee, Great Lakes Water Quality Board, 2000. This report highlights the potential economic benefits associated with aquatic sediment cleanup. It identifies the types of potential economic benefits that may result from aquatic sediment remediation, which may also be seen as the economic costs of inaction; assesses the potential economic valuation tools to identify those that may be better suited to the sediment remediation issue; highlights methodological challenges; and identifies areas for further

action. [www.ijc.org/boards/wqb/econsed/index.html](http://www.ijc.org/boards/wqb/econsed/index.html)

***Ecological Benefits of Contaminated Sediment Remediation in The Great Lakes Basin***

International Joint Commission, Sediment Priority Action Committee, Great Lakes Water Quality Board, August 1999. This interim report of the Sediment Priority Action Committee reviews what is known about contaminated sediment, sediment contamination and remediation in the Great Lakes, measurements of ecological benefits, and also presents advice to managers and researchers on future evaluation of ecological effectiveness of sediment remediation. [www.ijc.org/boards/wqb/ecolsed/index.html](http://www.ijc.org/boards/wqb/ecolsed/index.html)

***Deciding When to Intervene: Data Interpretation Tools for Making Sediment Management Decisions Beyond Source Control***

International Joint Commission, Sediment Priority Action Committee, Great Lakes Water Quality Board, 1999. In December 1998, sediment management experts from throughout the Great Lakes Basin and beyond met to exchange and examine tools used as a means for arriving at a decision regarding whether or not to take action beyond source control. This report synthesizes the scientific methodologies and management experiences brought together by the participants. The intent is to provide RAP decision-makers with advice on methods for resolving those considerations, in order to finalize site-specific sediment management strategies. [www.ijc.org/boards/wqb/sedwkshp/index.html](http://www.ijc.org/boards/wqb/sedwkshp/index.html)

***A Risk-Management Strategy for PCB-Contaminated Sediments***

National Research Council, Board on Environmental Studies and Toxicology, Committee on Remediation of PCB-Contaminated Sediments, 2001. This book provides a risk-based framework for developing and implementing strategies to manage PCB-contaminated sediments at sites around the country. The framework has seven stages, beginning with problem definition, continuing through assessment of risks and management options, and ending with an evaluation of the success of the management strategy. At the center of the framework is continuous and active involvement of all affected parties-particularly communities-in the development, implementation, and evaluation of the management strategy. The book emphasizes the need to consider all risks at a contaminated site, not just human health and ecological effects, but also the social, cultural, and economic impacts. The book provides a consistent, yet flexible, approach for dealing with the many issues associated with assessing and managing the risks at Superfund and other contaminated sites. The book is available from the National Academies Press for \$36; order online at [www.nap.edu/catalog/10041.html](http://www.nap.edu/catalog/10041.html).

***Great Lakes Dredged Material Testing & Evaluation Manual***

The Environmental Protection Agency and Army Corps of Engineers have developed a regional testing manual for evaluating potential impacts of contaminants from dredged material proposed for discharge to the Great Lakes, connecting channels and tributaries. This manual is intended to be used as a decision making tool for dredge and fill permits issued by the Army Corps of Engineers, or States or Tribes where delegated, under Section 404 of the Clean Water Act. [www.epa.gov/glnpo/sediment/gltem/index.html](http://www.epa.gov/glnpo/sediment/gltem/index.html)

***Guide to GLNPO Assessment and Remediation of Contaminated Sediments (ARCS) Program***

U.S. Environmental Protection Agency (EPA), Great Lakes National Program Office (GLNPO). The 1987 amendments to the Clean Water Act authorized the U.S. Environmental Protection Agency's Great Lakes National Program Office (GLNPO) to coordinate and conduct a five-year study and demonstration project relating to the appropriate treatment of toxic pollutants in bottom sediments. Five areas were specified as requiring priority consideration in conducting demonstration projects: Saginaw Bay, Michigan; Sheboygan Harbor, Wisconsin; Grand Calumet River, Indiana; Ashtabula River, Ohio; and Buffalo River, New York. To fulfill the requirements of the Act, GLNPO initiated the Assessment and Remediation of Contaminated Sediments (ARCS) Program. This document provides the final summary report for the ARCS program as well as background information. [www.epa.gov/grtlakes/arcs/EPA-905-S94-001/EPA-905-S94-001-TOC.html](http://www.epa.gov/grtlakes/arcs/EPA-905-S94-001/EPA-905-S94-001-TOC.html)

***Guide to GLNPO Assessment and Remediation of Contaminated Sediments (ARCS) Reports***

This site provides links to technical reports with results of assessments and other studies of contaminated sediments conducted by the U.S. EPA, Great Lakes National Program Office between 1988 and 1994 under the Assessment and Remediation of Contaminated Sediments (ARCS) Program. [www.epa.gov/glnpo/arcs/arcsguide.html](http://www.epa.gov/glnpo/arcs/arcsguide.html)

***Contaminated Sediments and the Great Lakes***

University of Wisconsin Sea Grant. This fact sheet explains how contaminants build up in sediment, how they affect the food chain and why the Great Lakes are susceptible. <http://h2o.seagrant.wisc.edu/Communications/Publications/One-pagers/contamsed.html#ordering>

***Framework Report: Costs and Benefits of Cleaning Up Contaminated Sediments in Great Lakes Areas of Concern***

P. Kellor et al. (eds.), University of Wisconsin Sea Grant. Publication anticipated in late 2000. Contact Phil Keillor, University of Wisconsin Sea Grant Advisory Services, 1975 Willow Dr., Madison, WI, 53706-1177, jkeillor@seagrant.wisc.edu.

***Contaminated Sediments in Ports and Waterways: Cleanup Strategies and Technologies***

Committee on Contaminated Marine Sediments, National Research Council, 1997. This book examines management and technology issues and provides guidance that will help officials make timely decisions and use technologies effectively. It includes recommendations with a view toward improving decision making, developing cost-effective technologies, and promoting the successful completion of cleanup projects. The volume assesses the state of practice and research and development status of both short-term and longer-term remediation methods. The committee provides a conceptual overview for risk-based contaminated sediment management that can be used to develop plans that address complex technological, political, and legal issues and the interests of various stakeholders. The book emphasizes the need for proper assessment of conditions at sediment sites and adequate control of contamination sources. Available for purchase online at [www.nap.edu/catalog/5292.html](http://www.nap.edu/catalog/5292.html).

***Sediments Research Web***

An online community designed to promote improvements in the management and remediation of contaminated sediments. The site is sponsored by the South and Southwest Hazardous Substance Research Centers, a five-center consortium established and supported by the U.S. Environmental Protection Agency. [www.sediments.org/](http://www.sediments.org/)

Technical Reports

***Natural Attenuation for Groundwater Remediation***

Committee on Intrinsic Remediation, National Research Council, 292 pages, 2000. This book presents the consensus of a diverse committee, informed by the views of researchers, regulators, and community activists. The committee reviews the likely effectiveness of natural attenuation with different classes of contaminants and describes how to evaluate the "footprints" of natural attenuation at a site to determine whether natural processes will provide adequate clean-up. Included are recommendations for regulatory change. The committee emphasizes the importance of the public's belief and attitudes toward remediation and provides guidance on involving community stakeholders throughout the clean-up process. The book explores how contamination occurs, explaining concepts and terms, and includes case studies from the Hanford nuclear site, military bases, as well as other sites. It provides historical background and important data on clean-up processes and goes on to offer critical reviews of 14 published protocols for evaluating natural attenuation. Available for review and purchase online at <http://books.nap.edu/catalog/9792.html>.

***Guidance for In-Situ Subaqueous Capping of Contaminated Sediments***

This document provides technical guidance for subaqueous, in-situ capping as a remediation option for contaminated sediments. The document provides descriptions of the processes involved with in-situ capping, identification of the design requirements of an in-situ capping project, and a recommended sequence for design. Guidance is also provided on sediment characterization, cap design, equipment and placement techniques, and monitoring and management considerations. [www.epa.gov/glnpo/sediment/iscmain/index.html](http://www.epa.gov/glnpo/sediment/iscmain/index.html)

***Detection of Genotoxins in Contaminated Sediments: an Evaluation of a New Test for Complex Environmental Mixtures***

Assessment Document Great Lakes Program Office U.S. Environmental Protection Agency, 1995. This document reviews a new approach to detect genotoxins in contaminated freshwater sediments and summarizes lessons learned from this investigation of the Great Lakes Basin. This study was conducted as part of the U.S. EPA, Great Lakes National Program Office, Assessment and Remediation of Contaminated Sediment (ARCS) Program in cooperation with the National Biological Survey Contaminant Research Center. The objective was to detect genotoxic chemical contamination in Great Lakes Basin sediments. [www.epa.gov/glnpo/arcs/genotox/genotox.html](http://www.epa.gov/glnpo/arcs/genotox/genotox.html)

***Biological Remediation of Contaminated Sediments, with Special Emphasis on the Great Lakes***

These proceedings describe a workshop held July 17-19, 1990 in Manitowoc, WI, at which biological remediation of contaminated sediments was discussed. For the purpose of the workshop, contaminated sediments of primary interest were those within six of the Areas of Concern (AOC) identified by the U.S./Canada International Joint Commission's Great Lakes Water Quality Board; five of which are priority concerns of the U.S. Environmental Protection Agency's Assessment and Remediation of Contaminated Sediments (ARCS) program. The workshop was organized around four topic areas: (1) Overview of the Areas of Concern; (2) Biological degradation of PCBs; (3) Biological

degradation of PAHs; and (4) Biological treatment of metal species.  
[www.epa.gov/glnpo/arcs/EPA-600-991-001/EPA-600-991-001.html](http://www.epa.gov/glnpo/arcs/EPA-600-991-001/EPA-600-991-001.html)

***Chemical Contamination and Physical Characteristics of Sediments in The Upper Great Lakes Connecting Channels***

U.S. Environmental Protection Agency, Great Lakes National Program Office, 1985. In 1985, Canada and the United States initiated an Upper Great Lakes Connecting Channels Study that included several studies of pollution in the connecting channels. As part of this program, surficial sediments were surveyed in the connecting channels from the head of the St. Marys River to the mouth of the Detroit River to determine the extent of sediment contamination.  
[www.epa.gov/glnpo/arcs/EPA-905-991-018/991-018.html](http://www.epa.gov/glnpo/arcs/EPA-905-991-018/991-018.html)

***The Use of Sediment/Contaminant Geochemical Fingerprinting to Frame Management Questions: A Case Study Marine Environmental Update.*** Volume FY00, Number 1, Winter 1999. Marine Environmental Support Office, United States Navy. By Sabine E. Apitz, Ernest Arias, Bryan Ayers, Sheri A. Clawson and Victoria J. Kirtay. This article demonstrates some of the applications of sediment/contaminant geochemical fingerprinting, with results from Seaplane Lagoon, Naval Air Station Alameda, as a demonstration site.  
[http://kairos.spawar.navy.mil/Programs/MESO/Newsltr/fy00\\_no1.html#sediment](http://kairos.spawar.navy.mil/Programs/MESO/Newsltr/fy00_no1.html#sediment)

***Hazard Ranking of Contaminated Sediments Based on Chemical Analysis, Laboratory Toxicity Tests, and Benthic Community Structure: Method of Prioritizing Sites for Remedial Action***

M. L. Wildhaber and C. J. Schmitt, National Biological Survey, Midwest Science Center, September 1994.  
[www.epa.gov/grtlakes/sediment/docs/r94024.html](http://www.epa.gov/grtlakes/sediment/docs/r94024.html)

Case Studies

***Realizing Remediation: Progress in the Remediation of Contaminated Sediments in the Great Lakes***

U.S. EPA's Great Lakes National Program Office has released this comprehensive report documenting past and current sediment remediation activities in the Great Lakes Basin. The report provides a synopsis of each sediment remediation project that has taken place in the U.S. Waters of the Great Lakes region and lists an additional 15 sites where remediation projects are planned in the near future. [www.epa.gov/glnpo/sediment/realizing/realcover.html](http://www.epa.gov/glnpo/sediment/realizing/realcover.html)

***Moving Mud: Remediating Great Lakes Contaminated Sediments***

U.S. EPA, Great Lakes National Program Office, April 1997. This document is a synopsis of GLNPO's sediment grants program. The focus is on the 34 projects that have been initiated since fiscal year 1993. Included is a tabulation of grant recipients and monetary distribution, a summary of each of the projects, and a look ahead to the future of sediment assessment and remediation in the Great Lakes. [www.epa.gov/glnpo/sediment/movemud/](http://www.epa.gov/glnpo/sediment/movemud/)

***Sediment Remediation Case Studies***

Sediment Priority Action Committee, Great Lakes Water Quality Board, International Joint Commission. This document provides the following three case studies on environmental benefits of sediment remediation: PAH Contaminated Sediment Remediation in the Main Stem, Black River; Collingwood Harbour Sediment Removal Demonstration Project; and PCB Contaminated Sediment in Waukegan Harbor.  
[www.ijc.org/boards/wqb/cases/studies.html](http://www.ijc.org/boards/wqb/cases/studies.html)

***Health of Bullhead in an Urban Fishery After Remedial Dredging***

Final Report - January 31, 2000The Black River near its mouth at Lorain, Ohio has a history of contaminant loading, particularly PAH from a coking facility and associated steel complex several miles upstream. Surveys in the early 1980s documented PAHs in sediment at concentrations of hundreds of ppm for individual compounds. The brown bullhead population during this period had a liver cancer prevalence of over 30% for mature fish (age 3 and older), and a total liver neoplasm frequency of 60%. [www.epa.gov/glnpo/sediment/Bullhead/index.html](http://www.epa.gov/glnpo/sediment/Bullhead/index.html)

***Assessment of Sediment Quality in the Black River Watershed***

The Black River Remedial Action Plan (RAP) Strategy Plan (1997 - 2001) and 1997 Draft Annual Plan state that contaminated sediments and related toxicity are a significant issue in the system, yet no studies have been developed for assessing sediment toxicity. The Black River's infamous history of severe sediment contamination from polycyclic aromatic hydrocarbon (PAH) below USS/Kobe Steel and associated impacts on the fish community, the land use and hydrologic characteristics which result in extensive sediment loading and deposition, and past and present pollution sources clearly suggest sediments may, in fact, be the dominant stressor in the system. [www.epa.gov/glnpo/sediment/BlackRiver/Index.htm](http://www.epa.gov/glnpo/sediment/BlackRiver/Index.htm)

### ***Remediation of Contaminated Sediment at the Unnamed Tributary to the Ottawa River***

This document summarizes the successful sediment investigation and remediation recently completed at the Unnamed Tributary to the Ottawa River located in Toledo, Ohio. As a result of several factors, including a cooperative partnership between government representatives and private industry, this site was successfully remediated in record time, culminating in the removal of more than 56,000 pounds of PCBs. [www.epa.gov/glnpo/sediment/OttawaRiver/index.html](http://www.epa.gov/glnpo/sediment/OttawaRiver/index.html)

### ***Investigation of Sediment Contamination in the Lower Grand River***

A preliminary investigation of the nature and extent of sediment contamination in the lower Grand River was performed. Three areas in the lower Grand River exceeded sediment quality guidelines for heavy metals and selected organic chemicals. The Grand River watershed contains the longest river in the State of Michigan and comprises 13% of the entire Lake Michigan drainage basin. Two thirds of this 3.6 million acre watershed is designated as agricultural with 22% of the total pesticide usage in the Lake Michigan basin concentrated within its boundaries. [www.epa.gov/glnpo/sediment/GrandRiver/index.html](http://www.epa.gov/glnpo/sediment/GrandRiver/index.html)

### ***Contaminants in Sediment Samples from Waukegan Harbor, Illinois***

Waukegan Harbor in Illinois was designated as a Great Lakes Area of Concern due to high sediment concentrations of polychlorinated biphenyls (PCBs). The objective of this study was to evaluate sediment toxicity of 20 samples collected after remediation (primarily dredging) of Waukegan Harbor for PCBs. A 42-d whole-sediment toxicity test with the amphipod *Hyaella azteca* (28-d sediment exposure followed by a 14-d water-only exposure), a 28-d whole-sediment bioaccumulation test with the oligochaete *Lumbriculus variegatus*, and sediment-toxicity tests with Microtox® were conducted to evaluate sediments from Waukegan Harbor. [www.epa.gov/glnpo/sediment/waukegan/index.html](http://www.epa.gov/glnpo/sediment/waukegan/index.html)

### ***Assessment of Contaminated Sediments in Slip C, Duluth Harbor, Minnesota***

A sediment remediation scoping project was conducted in a contaminated boat slip in the Duluth, MN Harbor. Previous sediment investigations of this boat slip, Slip C, showed elevated levels of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), DDT metabolites, toxaphene, mercury, cadmium, copper, lead, and zinc. A sediment survey was conducted in June 1997 to collect additional sediment samples to further delineate the spatial extent of PAH, PCB, lead, and mercury contamination, as well as the distribution of total organic carbon (TOC) and particle size classes. [www.epa.gov/glnpo/sediment/slipc/index.html](http://www.epa.gov/glnpo/sediment/slipc/index.html)

### ***Preliminary Investigation Of The Extent And Effects Of Sediment Contamination In White Lake, MI***

White Lake is a 2,571 acre, drowned-rivermouth lake located on the eastern shore of Lake Michigan in Muskegon County. Recent and historical studies have indicated extensive contamination of sediments in White Lake. This investigation was conducted to define the ecological effects of the heavy metal contamination in Tannery Bay and to assess heavy metal contamination in eastern White Lake. [www.epa.gov/glnpo/sediment/whitelake/index.html](http://www.epa.gov/glnpo/sediment/whitelake/index.html)

### ***Restoration and Compensation Determination Plan for the Lower Fox River/Green Bay***

U.S. Department of the Interior, Fish and Wildlife Service, and other co-trustees of the Natural Resources Damage Assessment of the Lower Fox River/Green Bay, October 2000. [www.fws.gov/r3pao/nrda/RCDP-1.pdf](http://www.fws.gov/r3pao/nrda/RCDP-1.pdf)

### ***PCB Pathway Determination for the Lower Fox River/Green Bay Natural Resource Damage Assessment, Final Report***

U.S. Fish and Wildlife Service, U.S. Department of the Interior and the U.S. Department of Justice, August 1999. <http://www.fws.gov/r3pao/nrda/pathways.pdf>

### ***Evaluation of the Effectiveness of Remediation Dredging: The Fox River Deposit N Demonstration Project, November 1998 - January 1999***

Fox River Remediation Advisory Team, Madison, Wisconsin, June 2000. Water Resources Institute Special Report WRI SR00-01, Water Resources Institute, University of Wisconsin-Madison, 1975 Willow Dr., Madison, Wisconsin. As a result of a cooperative agreement between the State of Wisconsin and the Fox River Group (a coalition of seven former and present paper companies-Appleton Papers, Ft. James, P.H. Glatfelter Co., NCR Corp., Riverside Paper Corp., U.S. Paper Mills Corp. and Wisconsin Tissue Mills, Inc.) a demonstration project was developed to assess the effectiveness of dredging as a remediation option for PCB-contaminated sediments in the Lower Fox River. The results presented here focus on Phase I of the remediation, which encompasses pre-dredge periods, dredging (16 Nov.–29 Dec. 1998) and post-dredge coring (Jan. 1999). Activities occurring at Deposit N after Phase I are not considered in this report because the monitoring needed for complete mass balances was not in place. Post-Phase I activities, however, are briefly discussed in the Appendices.

***Natural Resource Damage Assessments***

U.S. Fish and Wildlife Service. This site provides links to information and reports on the Natural Resource Damage Assessment process underway in the Fox River/Green Bay, Wisconsin; Grand Calumet River, Indiana; Kalamazoo River, Michigan; and Saginaw River and Bay, Michigan. [Http://midwest.fws.gov/nrda/nrda.html](http://midwest.fws.gov/nrda/nrda.html).