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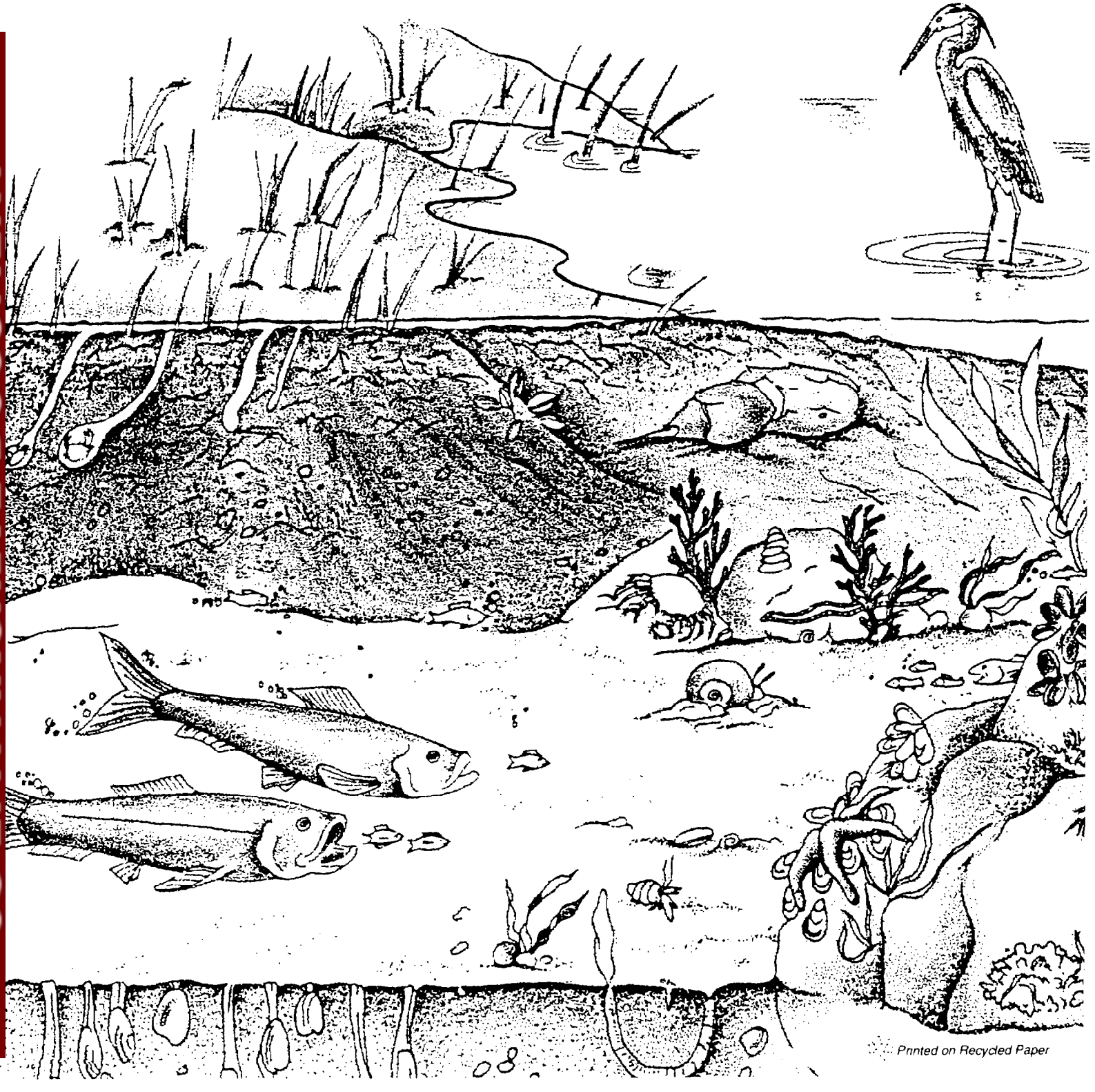
Proceedings of the EPA's Contaminated Sediment Management Strategy Forums



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PROCEEDINGS OF EPA'S CONTAMINATED SEDIMENT MANAGEMENT STRATEGY FORUMS

★ 1 9 9 2 ★
THE YEAR OF
CLEAN WATER
Celebration & Commitment

Office of Water
Office of Science and Technology
Standards and Applied Science Division
U.S. Environmental Protection Agency
Washington, DC 20460

September 1992

This document is based entirely on presentations at three public forums sponsored by the U.S. Environmental Protection Agency (EPA) to solicit input on its proposed Contaminated Sediment Management Strategy. The views expressed by individual presenters are their own and do not necessarily reflect those of EPA. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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EXECUTIVE SUMMARY

INTRODUCTION

On March 5, 1992, the U.S. Environmental Protection Agency (EPA) distributed a draft outline of EPA's Contaminated Sediment Management Strategy to government agencies, industry, consulting firms, law firms, environmental groups, and academia as a proposal for discussion. With the transmittal of the draft discussion document, EPA solicited written public comment and issued an invitation to attend three public forums to discuss the draft.

This document summarizes the proceedings of these EPA-sponsored forums. Each forum addressed a particular issue related to development of the Contaminated Sediment Management Strategy. The three forums were:

- The Extent and Severity of Contaminated Sediments, held April 21-22, 1992, in Chicago, IL
- Building Alliances Among Federal, State, and Local Agencies to Address the Problem of Contaminated Sediments, held May 27-28, 1992, in Washington, DC
- Outreach and Public Awareness, held June 16, 1992, in Washington, DC

FORUM 1: THE EXTENT AND SEVERITY OF CONTAMINATED SEDIMENTS

This forum consisted of panel discussions on three topics of concern: (1) the extent of sediment contamination, (2) the severity of contamination with respect to human health effects, and (3) the severity of contamination with respect to ecological effects. Forum participants concluded that (1) contaminated sediments are a national problem, and (2) human health problems and ecological harm have been documented at a number of contaminated sediment sites.

Extent of Sediment Contamination

Representatives of several federal agencies involved in tracking the condition of sediments in the United States presented evidence of sediment contamination in particular geographic regions. The presentations suggest that sediment contamination is a widespread problem with toxic hot spots occurring in many areas across the United States.

Thomas O'Connor, of the National Oceanographic and Atmospheric Administration (NOAA), summarized the results of sampling at 280 sites nationwide; these samples indicate that contamination is most severe near densely populated urban areas. Richard Latimer, of EPA's Monitoring and Assessment Program, reported elevated concentrations of metals and organic chemicals in several areas along the mid-Atlantic coast. In his presentation, Steve Garbaciak, of the Great Lakes National Program Office, described results of that office's research which identified 42 areas in the Great Lakes where sediments contain elevated levels of cadmium, copper, mercury, PAHs, and PCBs. Charles R. Lee reported findings of the U.S. Army Corps of Engineers (COE), estimating that 12 million of the 400 million cubic yards of sediments dredged each year from the

nation's waterways were contaminated. According to data presented by Frank Manheim, of the U.S. Geological Survey (USGS), 50 percent of 1,300 sediment samples drawn from Boston Harbor from 1962 to 1990 contained levels of copper, zinc, lead, chromium, nickel, and mercury above those commonly associated with adverse biological effects. In his presentation, Richard Cahill, of the Illinois State Geological Survey, explained how cesium-137 could be used to determine when sediment contamination has occurred.

Panelists agreed that existing data on the extent of sediment contamination are decentralized. They supported the development of a national inventory of contaminated sites based on site chemistry, health effects, and intended uses. For this purpose, existing data from diverse sources must be compiled and subjected to rigorous quality assurance procedures.

Severity of Contamination—Human Health Effects

Evidence presented by this panel suggests that direct or indirect exposure to contaminants in sediments can adversely affect human health. Since human exposure to sediment contamination is typically too low to result in acute or observable toxicity, the severity of human health effects is often expressed as estimates of increased cancer incidence, reproductive or developmental toxicity, or neurotoxicity.

The consumption of seafood contaminated through bioaccumulation from sediments is a major concern, but the effects of chronic exposure to contaminants from seafood have been poorly documented. Gerald Pollock, of the California EPA, reported that estimated excess lifetime cancer risks from consumption of seafood in areas of high contamination range from below 1 in 100,000 to as high as 2 to 5 per 1,000. Nancy Ridley, of the Massachusetts Department of Public Health, noted that the greatest human health risks come from consumption of large quantities of raw shellfish; consumption of typical amounts of seafood may not pose a significant threat to human health. Wayland Swain, of Eco Logic International, Inc., presented studies correlating consumption of contaminated seafood with higher body burdens of PCBs in both male and female adults and increased levels of PCBs in the whole serum and breast milk of highly exposed mothers. Mr. Swain also noted that infants born to highly exposed mothers have had lower birth weights, reduced gestational ages, and smaller head circumferences, and have exhibited neuro-motor effects.

Little research has been done on the health risks associated with dermal contact and incidental ingestion of contaminants from sediment. William Alsop, of ENSR Consulting and Engineering, presented case studies from seven Superfund sites which suggest that health risks from these forms of exposure are minimal compared to risks from consumption of contaminated seafood.

Severity of Contamination—Ecological Effects

Panelists presented studies associating elevated concentrations of metals and organic chemicals in sediment with elevated tissue burdens of these pollutants in aquatic organisms. Such burdens can produce a variety of effects.

Robert C. Hale, of the Virginia Institute of Marine Science, presented studies conducted in the Elizabeth River, a subestuary of the Chesapeake Bay, linking sediment contamination to increased frequency and intensity of neoplasms, cataracts, enzyme induction, "finrot", and other lesions in fish populations. According to Paul Baumann, of the U.S. Fish and Wildlife Service

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(FWS), over the last 15 years, concentrations of PAHs in sediments have correlated with elevated tumor frequencies in six species of fish at 16 locations across the country. Barry Vittor, of Vittor & Associates, Inc., reported documented decreases in the abundance and variety of benthic species as a result of sediment contamination and sedimentation in the Gulf of Mexico.

Assessing ecological effects is more difficult than delineating the extent of sediment contamination, because important effects manifest themselves in ways that are often difficult to detect. Peter Chapman, of EVS Environment Consultants, suggested that integrated assessments—encompassing toxicity tests, sediment chemical analyses, tissue chemical analyses, pathological studies, and community structure studies—are necessary to appraise an ecosystem's status.

FORUM 2: BUILDING ALLIANCES AMONG FEDERAL, STATE, AND LOCAL AGENCIES TO ADDRESS THE PROBLEM OF CONTAMINATED SEDIMENTS

This forum was conducted in three parts corresponding to three elements of the Contaminated Sediment Management Strategy: (1) assessment, (2) prevention, and (3) remediation. Forum participants concluded that (1) EPA should expedite implementation of the Strategy; (2) development of a contaminated sediment inventory is a high priority need for which all agencies want to provide data; (3) more attention should be paid to nonpoint sources in the Strategy; (4) the addition of sediment toxicity and bioaccumulation tests to chemical registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Toxic Substances Control Act (TSCA) is a high priority need to prevent point and nonpoint source contamination of sediments; and (5) consideration should be given to developing an integrated federal agency strategy on contaminated sediments.

Assessment

Panelists from several state and federal agencies involved in assessing sediment contamination described their activities and made recommendations for EPA's assessment strategy. In addition, an industry representative expressed a perspective from the private sector.

Betsy Southerland, of EPA, summarized the proposed assessment strategy, which calls for the development of a national inventory of contaminated sediment sites and sources, the use of consistent biological and chemical tests for evaluating sediments, and increased monitoring of sediment conditions. Gail Mallard outlined several USGS programs currently studying physical properties of sediments, fate and transport mechanisms, rates of sedimentation, sediment grain size, and fish uptake of sediment contaminants. She suggested that USGS and EPA coordinate their efforts to develop a national inventory of contaminated sites. Representatives of COE, David Moore and Joseph Wilson, described COE's dredging activities and recommended a biological effects-based, tiered testing approach to sediment assessment. Andrew Robertson, of NOAA, described his program's "mussel watch" and "benthic surveillance" assessment measures as well as historical core sampling assessment measures. Donald Steffeck described FWS's joint efforts with COE and EPA to manage contaminated sediments and FWS's new techniques for evaluating bioaccumulation. Fred Calder, of the Florida Department of Environmental Regulation, recommended Florida's "weight-of-evidence" approach to sediment assessment, involving a large data base of biological effects from 25 priority contaminants. In a formal public comment, Randall Ransom, of the Chemical Manufacturer's Association (CMA), expressed CMA's belief that

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sediment contamination is a local hot spot problem, not a national problem, and that contamination should be assessed in terms of human health risks, not numerical chemical criteria.

Panelists identified assessment of contaminated sites as an area in which EPA's Strategy needs clearer direction. The Strategy must define contaminated sediments more precisely, focus more attention on nonpoint source contamination, identify and promulgate consistent QA/QC protocols for sediment sampling and bioeffects testing, actively encourage coordination with state agencies, and propose mechanisms for effective use of assessment data to support sediment management programs. Panelists were divided on two issues: (1) whether the Strategy should encourage an effects-based assessment approach or the development of numerical sediment quality criteria, and (2) whether the Strategy should specify uniform effects-based testing methods or call for different but comparable effects-based testing methods.

Prevention

Representatives of several state and federal agencies responsible for the prevention of sediment contamination discussed their activities and made recommendations for EPA's prevention strategy.

Judith Nelson, Stuart Tuller, and James Pendergast outlined EPA's efforts to control point and nonpoint sources of sediment contamination. David Farrell, of the U.S. Department of Agriculture (USDA), described USDA's program to monitor the distribution, accumulation, and dissipation of agricultural chemicals over time. The Forest Service's attempts to minimize the impact of land management practices on water and sediment quality in the National Forests were described by Warren Harper, also of USDA. In his presentation, James Burgess described NOAA and EPA's Coastal Zone Management Program, the only program that has enforcement authority to control nonpoint source pollution. Duane Schuettpelz, of the Wisconsin Department of Natural Resources, presented Wisconsin's Sediment Assessment and Remediation Techniques program, which is currently conducting a statewide inventory of contaminated sediments. This program applies sediment quality criteria developed by the state to clean up some Superfund sites, and has an active pollution prevention component. Craig Wilson, of the California State Water Resources Control Board, pointed to similarities between California's Bay Protection and Toxic Cleanup Program and EPA's Strategy, and commended EPA for developing a strong, coherent approach to prevention of sediment contamination.

Echoing many of the concerns expressed by the panel on assessment, the panel on prevention urged EPA to clarify several aspects of the Strategy. Panelists called for the Strategy to state clearly how sediment quality criteria will be used, include stronger provisions for prevention of nonpoint source contamination, and identify ways to improve coordination between state and federal agencies. In addition, panelists urged EPA to avoid overreliance on models and recognize the value of case study approaches to understanding contaminated sediments. Some panelists pointed out that sediments may act as a natural sink for trapping contaminants and rendering them unavailable to other environmental media over time. However, recycling of contaminants from sediment biota, surface water, and ground water can occur at varying rates depending on chemical and biological processes.

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Remediation

Panelists representing several state and federal organizations currently managing contaminated sediments described their remediation activities and provided recommendations for EPA's remediation strategy.

Richard Nagle, Lawrence Zaragoza, Denise Keehner, and Tony Baney outlined EPA's authority to remediate contaminated sediments under the Clean Water Act; the Clean Air Act; the Comprehesive Environmental Response, Compensation, and Recovery Act; the Resource Conservation and Recovery Act; the Toxic Substances Control Act; the Rivers and Harbors Act; and the Oil Pollution Act. Bruce Kimmel spoke about the Department of Energy's (DOE's) "federal facility agreements" with several states and with EPA to coordinate remedial actions at DOE facilities nationwide. Joe Wilson and Norman Francingues outlined several COE research projects aimed at garnering a better understanding of dredging, disposal, and treatment technologies for contaminated sediments. The State of Washington's sediment management strategy, which has established narrative, chemical, and biological criteria for use in remedial actions, was described by Keith Phillips, Washington Department of Ecology. Ellen Fisher, of the Wisconsin Department of Transportation, indicated that sediment contamination currently threatens the viability of Wisconsin's harbors and that disposal capacity is dwindling.

Participants recommended that contaminated sediment remediation must be linked to human health protection and ecological risk reduction. Some cautioned, however, that risk assessment analyses that are too conservative can paralyze remedial actions programs, and lead to high costs with little marginal benefit. Therefore, the Strategy should support the use of more liberal risk assessments.

Panelists also pointed out that liability issues have prevented cleanup at a number of sites. The Strategy should address liability issues to facilitate more timely remedial actions. In addition, the Strategy should provide guidance on specific issues related to managing contaminated sediments. These include remediation of oil spills, disposal of contaminated dredged material, aquatic construction and maintenance activities, management of sediments contaminated by stormwater discharges and other nonpoint sources, and the use of natural recovery options.

FORUM 3: OUTREACH AND PUBLIC AWARENESS

This forum provided recommendations for effective public outreach from four perspectives: (1) state government, (2) the regulated community, (3) environmental advocacy groups, and (4) a public awareness group. There was a consensus among the groups participating in the forum that EPA should get the public involved as early as possible, clearly indicate how long cleanup will take, convey complete information without skimping on details, and communicate the health risks associated with sediment contamination in terms analogous to comparable risks that the public can understand. Whenever possible, EPA should link the contaminated sediment issue to visible effects, such as beach closings and seafood consumption advisories. Since cleanup will probably take a long time, EPA must articulate and remain accountable to short-term goals and celebrate interim successes while working toward long-term restoration. Above all, EPA must engage in active dialogue with the public and be responsive to public concerns.

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State Government

David O'Malley, of the Wisconsin Department of Natural Resources, outlined how Wisconsin's Remedial Action Plans (RAPs) successfully foster public involvement. Based on his experience with RAPs, Mr. O'Malley recommended that EPA utilize existing state networks for public involvement and information dissemination, and allow states flexibility in adapting the strategy to local situations.

The Regulated Community

Dick Schwer, of E.I. DuPont Company, and Donna Tomlinson, of Eastman Chemical Company, represented the Chemical Manufacturers Association (CMA) in this presentation. Ms. Tomlinson described CMA's Responsible Care Program, an industry outreach initiative to improve performance, health and safety, and environmental quality. Mr. Schwer reiterated CMA's belief that sediment contamination is a local hot spot problem, not a national problem. He critiqued the proposed Strategy, strongly urging EPA to subject all data and conclusions about sediment contamination to rigorous review and to define contaminated sediments with respect to human health and ecological risk, not numerical chemical criteria.

Environmental Advocacy Groups

Glenda Daniel, of the Lake Michigan Federation, suggested that current public outreach efforts are inadequate. Beth Milleman, of the Coast Alliance, indicated that the public lacks confidence that EPA has a rational, defensible program to manage contaminated sediments. Both panelists recommended that EPA take advantage of existing communication networks, such as conventions of environmental groups or labor unions, to present information on contaminated sediments; establish face-to-face contact whenever possible through meetings, workshops, or conferences; and develop more engaging written and graphic information, particularly when introducing the subject of contaminated sediments to nontechnical audiences.

Public Awareness Group

Frances Flanigan, of the Alliance for the Chesapeake Bay, described her organization's successful campaign to raise public consciousness of pollution in Chesapeake Bay. Based on this experience, Ms. Flanigan advised EPA to make sure outreach efforts address the specific needs of various target audiences, to design materials to foster participation in effective policy making, to build consensus among conflicting interests, and to develop a framework of institutions that will be self-sustaining and carry the work of sediment management into the future.

PROCEEDINGS FORMAT

This proceedings document summarizes the presentations at the three forums and captures the highlights of comments, questions, and input from the participants. Chapter One describes the development of EPA's Contaminated Sediment Management Strategy; Chapter Two summarizes Forum 1; Chapter Three summarizes Forum 2; and Chapter Four summarizes Forum 3. The document concludes with a series of appendices containing the draft outline of the Contaminated Sediment Management Strategy (Appendix A), Proposed Outreach Activities to Support Implementation of EPA's Contaminated Sediment Management Strategy (Appendix B), agendas

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of the three forums (Appendix C), and address lists for forum participants (Appendix D) and forum speakers (Appendix E).

As the written record of the public forums, this document will be reviewed extensively by EPA senior management during revision and implementation of the Contaminated Sediment Management Strategy.

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CHAPTER ONE

INTRODUCTION

1.1 SEDIMENT CONTAMINATION IN THE UNITED STATES

The contamination of sediments in water bodies of the United States has emerged in recent years as an ecological and human health issue of national proportions. In surveys performed in 1985 and 1987, the Office of Water (OW) of the U.S. Environmental Protection Agency (EPA) first began to document the extent and severity of sediment contamination in the United States (see Figures 1-1 through 1-4). In 1989, a study by the National Academy of Sciences, "Contaminated Marine Sediments—Assessment and Remediation," identified the potential for far-reaching health and ecological effects of contaminated sediments.

Sediments are often the depository for a myriad of chemicals and other pollutants discharged into surface waters from both point and nonpoint sources. These sources include industries, agricultural operations, publicly owned treatment works (POTWs), combined sewer overflows (CSOs), stormwater, hazardous waste disposal sites, and atmospheric deposition. Heavy metals, dioxins, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and other contaminants in sediment can harm aquatic environments and pose a significant threat to human health. Benthic organisms, fish, wildlife, and humans come into contact with sediment either directly or through the food chain and face the risk of exposure to elevated concentrations of harmful contaminants and their associated health impacts. In many cases, contaminated sediment has led to elevated tissue burdens of certain pollutants, "fin rot," reduced reproductive capacity, and decreased biodiversity and abundance in benthic communities. Elevated carcinogenic and other health risks have been predicted in affected human populations at many sites nationwide. To date, contamination has been identified in the sediments of water bodies at hundreds of locations at levels high enough to harm human health and wildlife.

1.2 DEVELOPMENT OF A STRATEGY FOR MANAGING CONTAMINATED SEDIMENTS

In 1989, EPA Administrator William Reilly formed an Agency-Wide Sediment Steering Committee to address the problem of contaminated sediments on a national scale. This committee, chaired by OW's Deputy Assistant Administrator, was composed of senior managers from all the major program offices in the Agency. In January 1990, the Steering Committee decided to prepare a Strategy for managing contaminated sediments with an aim to:

- Prevent ongoing contamination of sediments that may cause unacceptable risks to human health and the environment.
- Clean up existing sediment contamination where practical.
- Ensure that sediment dredging and disposal of dredged materials are managed in an environmentally sound manner.

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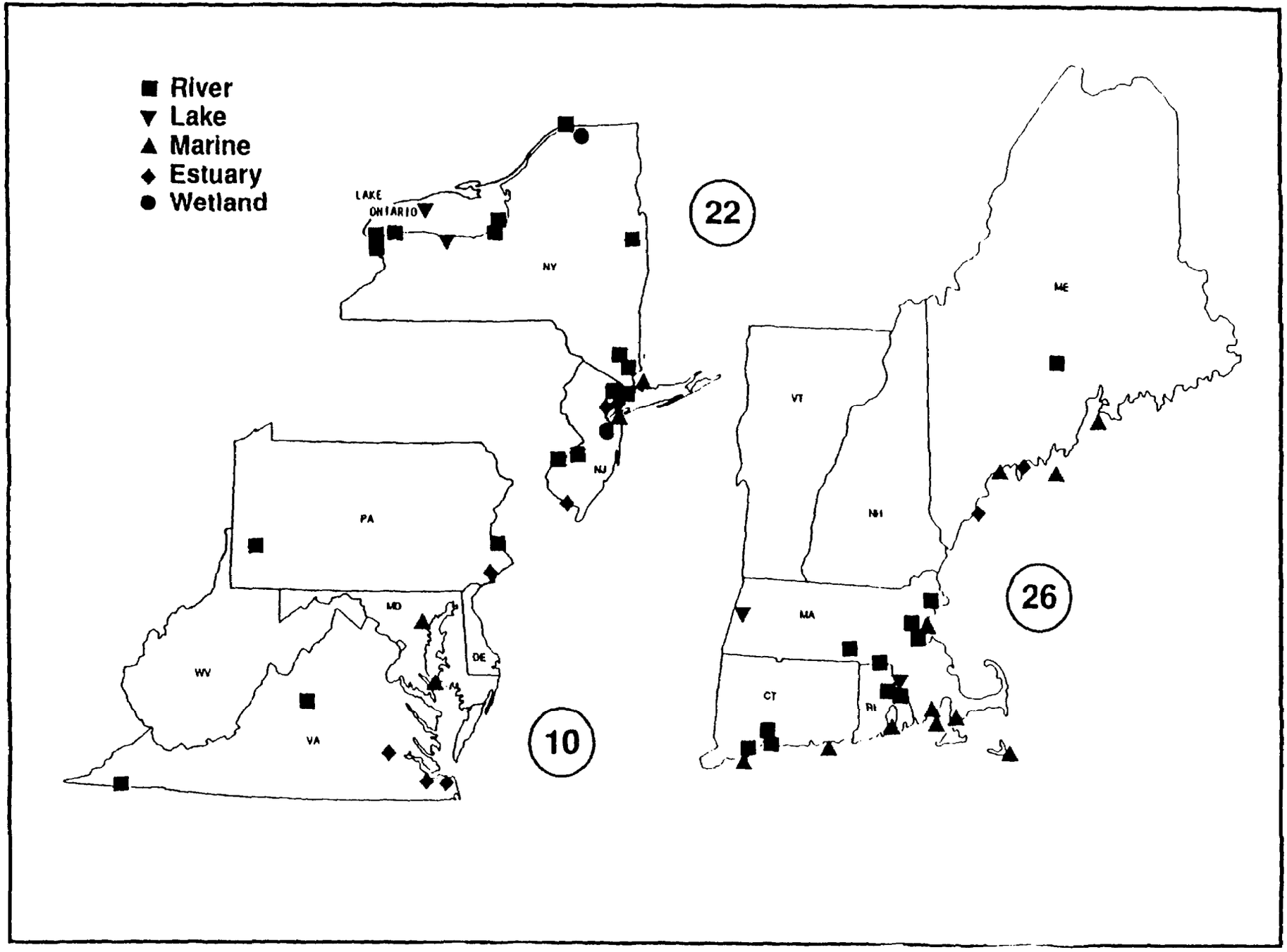

Figure 1-1. Documented contaminated sediment sites in U.S. EPA Regions I, II, and III (adapted from U.S. EPA, 1987).

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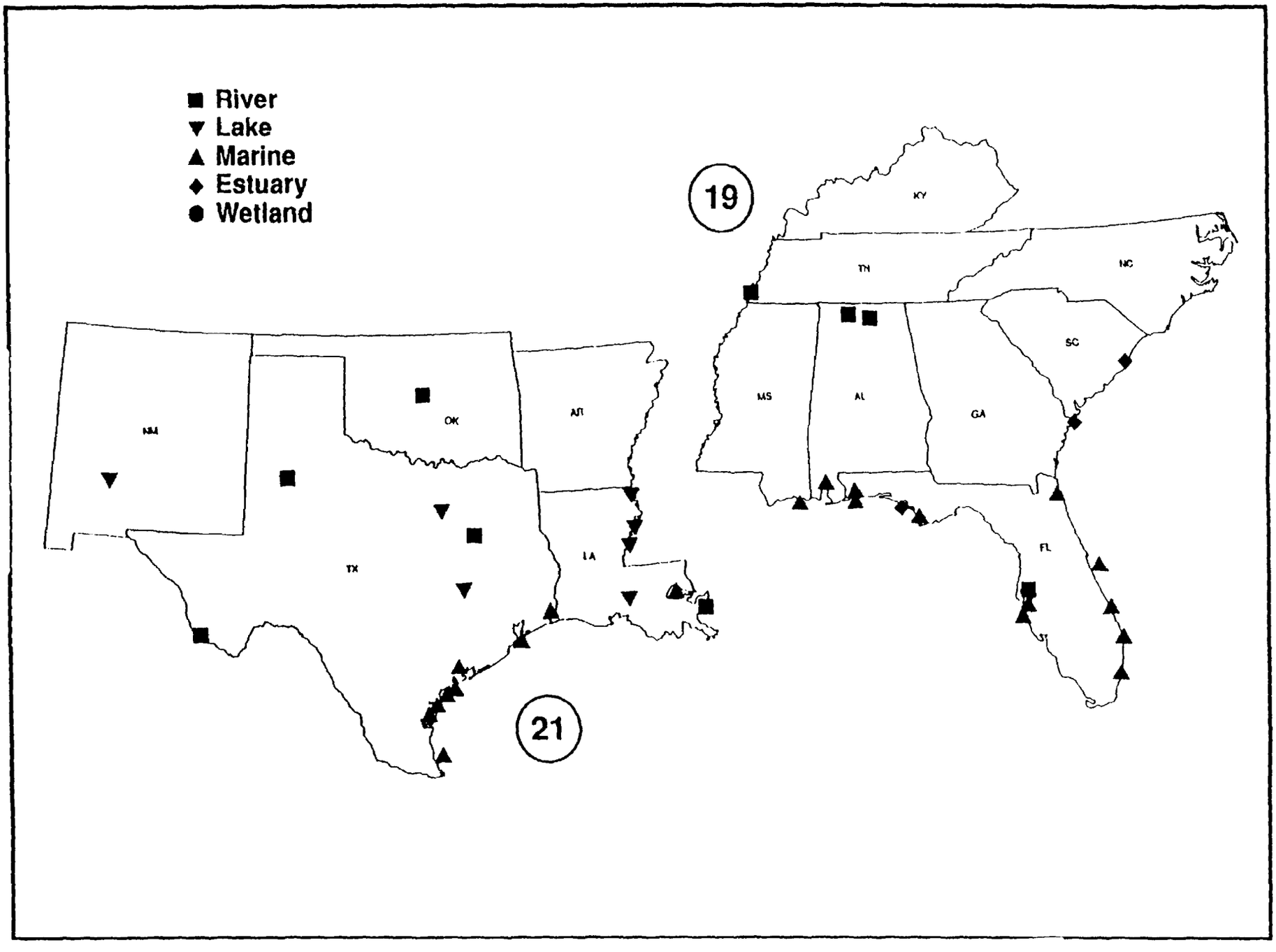

Figure 1-2. Documented contaminated sediment sites in U.S. EPA Regions IV and VI (adapted from U.S. EPA, 1987).

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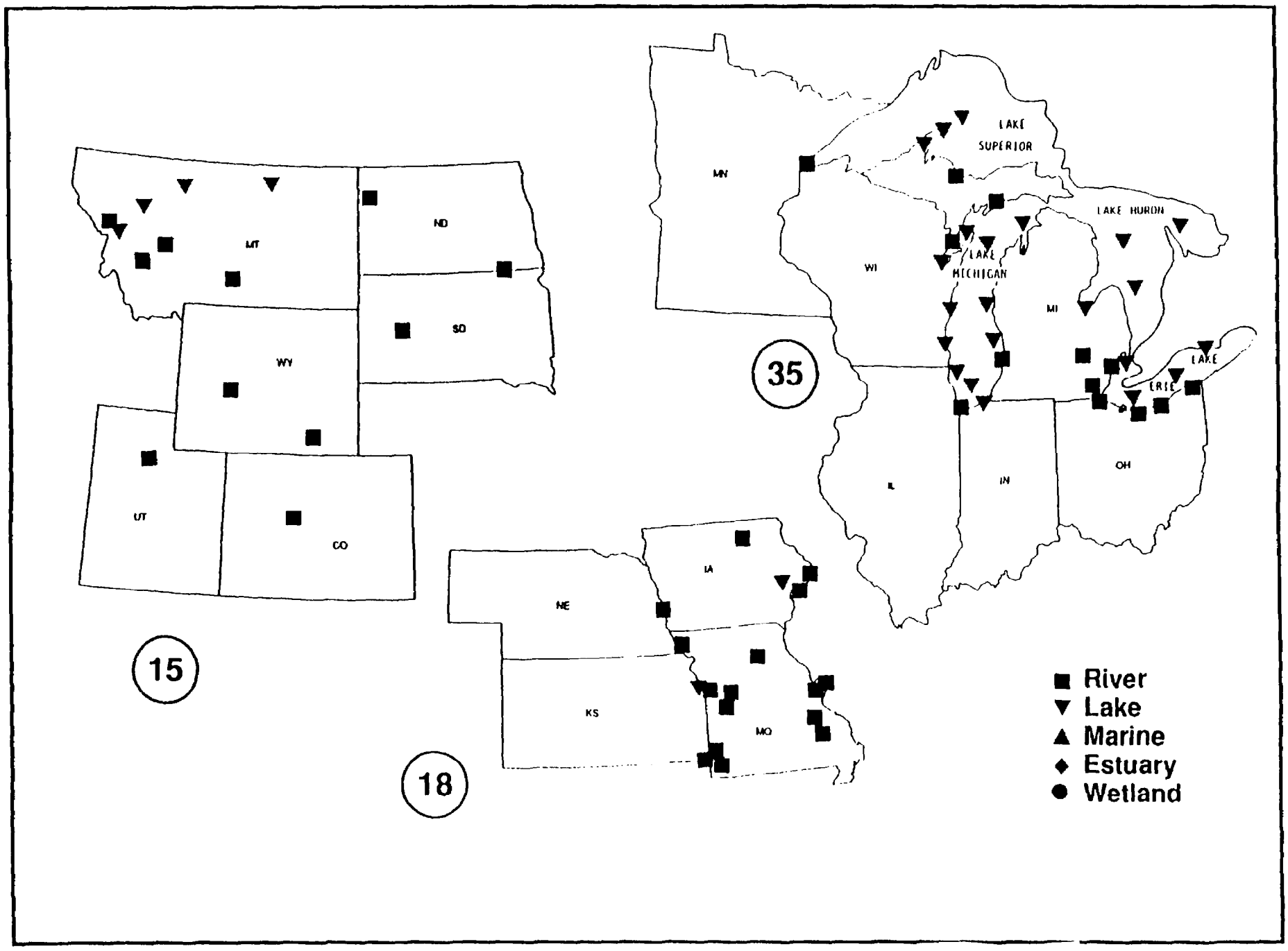

Figure 1-3. Documented contaminated sediment sites in U.S. EPA Regions V, VII, and VIII (adapted from U.S. EPA, 1987).

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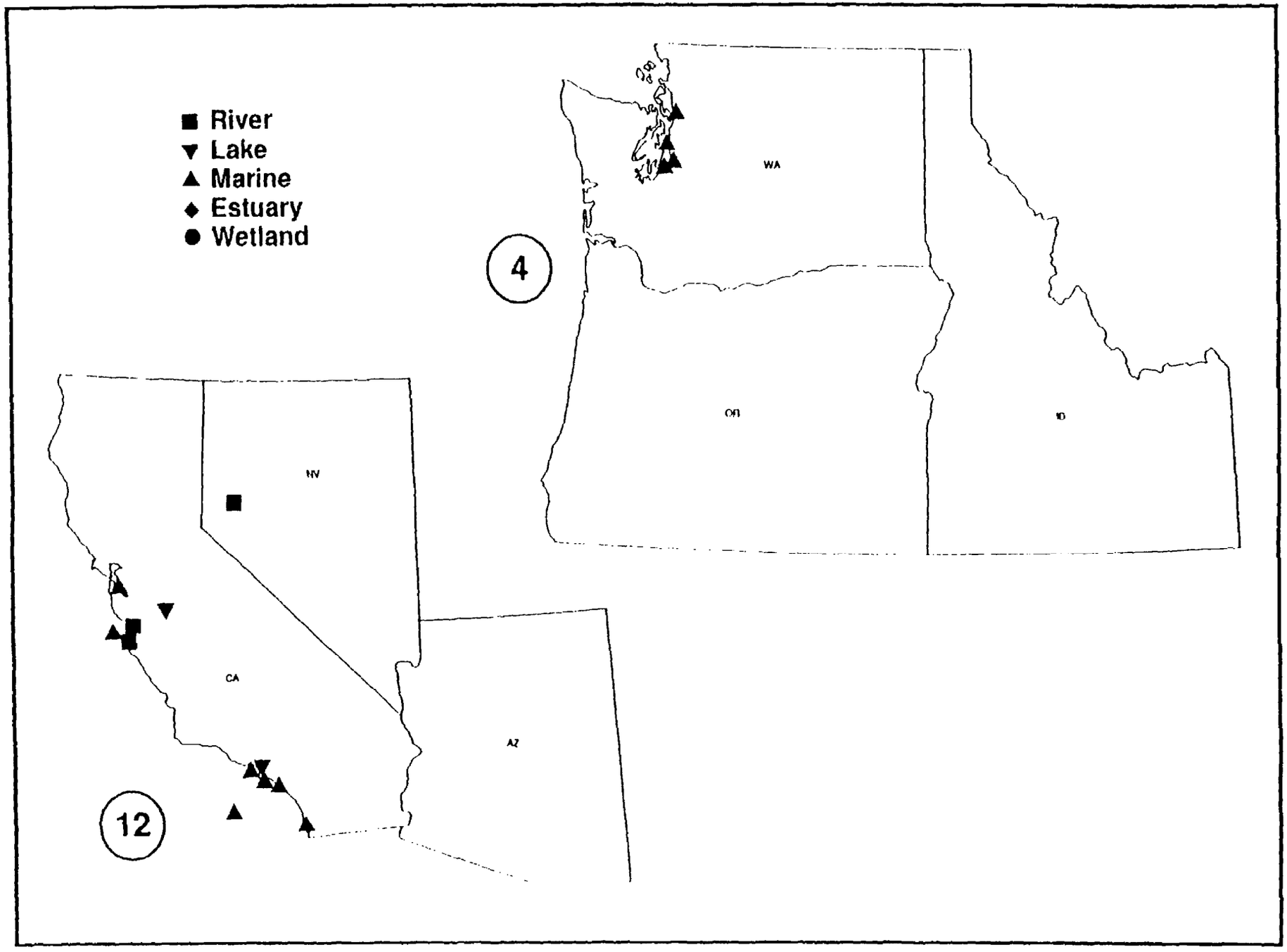

Figure 1-4. Documented contaminated sediment sites in U.S. EPA Regions IX and X (adapted from U.S. EPA, 1987).

EPA has authority to assess, remediate, and prevent sediment contamination under 10 different statutes, including the Clean Water Act (CWA); the Marine Protection, Research and Sanctuaries Act (MPRSA); the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); the Toxic Substances Control Act (TSCA); the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the Resource Conservation and Recovery Act (RCRA); the National Environmental Policy Act (NEPA); the Coastal Zone Management Act (CZMA); the Great Lakes Water Quality Agreement (GLWQA); and the Clean Air Act (CAA). No less than 16 EPA program offices and 10 EPA regional offices currently implement programs that, in some manner, manage contaminated sediment. The Contaminated Sediment Management Strategy would aid in the coordination of EPA program offices and regions, as well as other federal, state, and local entities to promote:

- Consistent consideration of sediment risks.
- Consistent decision-making at federal, state, and local levels in managing these risks.
- Wise use of scarce resources for research, technical, and field activities.
- Consistent sediment assessment practices.

In addition, the Strategy will facilitate EPA's response to legislative proposals currently being considered as part of CWA reauthorization, which might require development of a national inventory of sites with contaminated sediments, national sediment criteria and standards, accelerated point and nonpoint source control and cleanup in designated areas, and a consistent protocol for collecting and analyzing sediment samples.

EPA's Strategy represents a plan of action for assessing, preventing, and remediating sediment contamination and for managing disposal of dredged materials. The success of this Strategy, however, depends on the involvement and cooperation of a large number of federal agencies and other groups, including the regulated community, state and local governments, environmental groups, industry, scientists, and the general public.

1.3 PUBLIC REVIEW OF EPA'S CONTAMINATED SEDIMENT MANAGEMENT STRATEGY

In February 1992, Administrator Reilly met with the Sediment Steering Committee and recommended that EPA distribute the draft Strategy outline to the public to acquire a better understanding of the basic issues involved and to learn about alternative approaches. To further this effort, EPA's OW, Risk Assessment and Management Branch, sponsored a series of three public forums to present the Strategy and solicit feedback from the many audiences that will be affected by its implementation.

The first forum on the Extent and Severity of Sediment Contamination was held April 21 and 22, 1992, in Chicago, IL; the second on Building Alliances Among Federal, State, and Local Agencies was held May 27 and 28, 1992, in Washington, DC; and the third on Outreach and Public Awareness was held in Washington on June 16, 1992. The first two forums were attended by over 100 people each, and the third forum had approximately 35 attendees. Government agencies, industry, environmental consulting and law firms, environmental groups, and academia were all represented. The goal of all three forums was to allow key constituency groups to provide EPA

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with additional information about the sediment problem, and to provide feedback about their concerns and information needs, which could then be incorporated into the final Strategy.

To date, EPA has distributed at least 2,000 copies of the draft Strategy outline issued March 5, 1992. EPA accepted written comments on the draft outline through July 15, 1992, and now plans to revise the draft Strategy, taking into consideration comments and criticisms voiced during the three national forums as well as in the formal written comments. Following the intra-agency "red border" review process, EPA intends to send a proposed Strategy to the Office of Management and Budget (OMB) so that it can be published in the *Federal Register* during 1993.

1.4 REFERENCES

U.S. EPA. 1987. U.S. Environmental Protection Agency. An overview of sediment quality in the United States. EPA No. EPA-905/9-88-002. Fig. IV-2a—2h. pp. 25-39.

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CHAPTER TWO

THE EXTENT AND SEVERITY OF CONTAMINATED SEDIMENTS

2.1 INTRODUCTION

The forum on the extent and severity of contaminated sediments was the first in a series of three forums sponsored by EPA's Office of Water, Risk Assessment and Management Branch. This forum was held April 21 and 22, 1992. Section 2.2 of this report summarizes the key points in the forum presentations. Section 2.3 summarizes the key points from the open discussions and formal comments as well as subjects discussed during overall dialogue. Section 2.4 is a list of references used by the speakers in their presentations.

2.1.1 **Welcome**, presented by Tudor Davies, U.S. EPA, Office of Science and Technology

The Director of EPA's Office of Science and Technology, Tudor Davies, welcomed attendees and gave an overview of EPA's Contaminated Sediment Management Strategy. Dr. Davies noted that EPA regards sediment contamination as a serious national problem. He stated that, although progress has been made toward controlling sources of sediment contamination, some contaminants are persistent and bioaccumulative. These contaminants are recycling in the environment. Studies have identified sites with sediment contaminant levels that are harmful to aquatic life and pose a threat to people ingesting fish. Of the approximately 1,400 fish consumption advisories in the United States, 1,000 are in the Great Lakes region. Only six states do not have fishing bans or fishing advisories.

Approximately 10 statutes deal with the management of contaminated sediments. EPA believes that a comprehensive plan coordinating all federal activities to address sediment problems is necessary. In various provisions of the Clean Water Act reauthorization proposals and other legislative proposals, Congress has demonstrated an interest in addressing potential sediment contamination problems.

The purpose of EPA's Contaminated Sediment Management Strategy is to protect beneficial uses of surface water from the impacts of contaminated sediment. The Strategy proposes implementation of pollution prevention and source control measures and, where possible and appropriate, natural recovery processes to restore sediment quality. EPA must therefore improve the understanding of natural recovery processes for in-place contaminants. The Strategy calls for remediation only where there are potentially high human health or ecological risks and where the natural recovery process would be too lengthy and the short-term risks unacceptable.

EPA believes there is a need for a national inventory to assess the contaminated sediment problem. Pilot projects to inventory the sources of contaminants in sediment are currently being undertaken. EPA's Region IV (Southeastern United States) and V (Midwestern United States) have completed inventories of sediment contaminant sources and are now working to gather data needed for inventories of contaminated sediment sites.

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The Strategy also outlines a number of areas for further research. EPA needs to develop sediment criteria and common assessment methods for determining the ecological effects of sediment contaminants and for refining fate and transport assessment techniques. The costs and availability of technologies for sediment remediation need further investigation as well. EPA intends to manage the National Pollutant Discharge Elimination System (NPDES) permitting process and improve the pesticide registration and reregistration process to more effectively address sediment concerns. EPA will seek corporate agreements for contaminant source reduction and recycling. The Agency also will work with the U.S. Army Corps of Engineers (COE) to develop testing methodologies for ocean and freshwater disposal of dredged material. EPA supports applying COE's tiered testing approach, developed for ocean dumping, nationwide for freshwater.

Further research also is needed to assist EPA in understanding the risks associated with sediment contamination, and outreach is needed to communicate those risks to the public.

2.1.2 EPA's Understanding of the Extent and Severity of Contaminated Sediments, presented by Tim Kasten, U.S. EPA, Office of Water

Tim Kasten, of EPA's Contaminated Sediments Section, spoke about the Agency's understanding of the extent and severity of sediment contamination. In 1985, EPA examined data in the STORET data base to begin compiling data on a national scale regarding sediment. Since this data source was limited for sediment, EPA conducted a study in 1987 in which people in state and federal agencies and academia were interviewed and new surveys were conducted. From these studies, EPA concluded that potentially hundreds of sites in all types of water bodies were contaminated with pollutants such as polychlorinated biphenyls (PCBs), pesticides, polynuclear aromatic hydrocarbons (PAHs), and metals. In 1989, the National Academy of Sciences (NAS) conducted a study on contaminated marine sediments and reviewed EPA's studies. The NAS concurred with EPA's conclusion that the national extent of sediment contamination might be large and the effects severe. Sources of sediment contamination were found to be varied; some are historical, and some continue to contribute to the problem.

In a 1986 EPA study that ranked environmental problems, sediment contamination as a category of nonpoint source pollution was given a medium score for noncancer risks and a low score for cancer risk, but was ranked as the highest surface water risk for carcinogens. On a regionally comparative basis, in EPA Regions I, II, III, and V, sediment contamination was given a medium-high score for cancer risk. There have been numerous fishing bans in the United States due to sediment contamination, although in some areas of the country the problems have been resolved. Case studies of human health effects in Quincy Bay, Massachusetts; Puget Sound, Washington; Los Angeles, California; and Long Beach Harbor, California, showed moderate to high health risks to people who consume certain species of fish.

The 1986 EPA study ranked nonpoint sources of sediment and sediment contamination high as local and regional factors affecting ecological risks. EPA comparative risk studies in the Agency's regional offices produced a high score for contaminated sediment affecting ecosystems. Ecological effects case studies have documented effects in fish, birds, and mammals.

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2.2 PRESENTATION SUMMARIES

This forum on the extent and severity of contaminated sediments was structured around three panels: (1) extent of sediment contamination, (2) severity of contamination with respect to human health effects, and (3) severity of contamination with respect to ecological effects. For each of the three panels, a group of panelists presented study results. These presentations were followed by a formal public comment period and an open discussion period (facilitated by Charles Menzie of Menzie-Cura and Associates, Inc.).

This section summarizes the main points of the panelists' presentations as well as important issues or comments related directly to the presentations. This section also summarizes the presentation of any formal comments related to each panel topic.

2.2.1 Extent of Sediment Contamination

2.2.1.1 The Extent and Severity of Sediment Contamination in the Estuaries of the Mid-Atlantic Region, presented by Richard W. Latimer, EPA's Environmental Monitoring and Assessment Program (EMAP)

EPA's Office of Research and Development (ORD) initiated the Environmental Monitoring and Assessment Program (EMAP) to monitor status and trends in the condition of the nation's ecological resources. The near coastal component of EMAP consists of estuaries, coastal waters, and the Great Lakes. A demonstration project was conducted in 1990 in estuaries of the mid-Atlantic region called the Virginian Province (Cape Cod to Chesapeake Bay) (see Figure 2-1). The EMAP sampling design is probability based on a well-defined grid to provide unbiased estimates of resource condition. Indicators measured include habitat and exposure characteristics as well as biological responses. Of particular interest are organic and inorganic sediment contaminants, sediment toxicity, and macrobenthic community composition and abundance.

Results from the 1990 demonstration project (see Figures 2-2 through 2-8) suggest that about 11 percent of the region had elevated concentrations of metals in the sediments. About 12 percent of the region had elevated concentrations of organic chemicals in the sediments. A 10-day solid-phase toxicity test using indigenous biota was conducted to examine the condition of estuarine sediments. Nine percent of the sediments were toxic. Elevated concentrations above background were found in 12 percent of the areas for both PCBs and PAHs, and in 15 percent of the areas for pesticides. Small estuarine systems, including harbors and bays, had the highest proportion of toxic sediments and elevated metal and organic concentrations.

The biotic integrity of the estuaries was assessed by measuring the condition of bottom-dwelling animals. Twenty percent of the region had degraded benthic resources. The largest portion of the sites with degraded benthos also had low dissolved oxygen conditions. Other sites showing degradation had low dissolved oxygen, toxic sediments, or other stressors.

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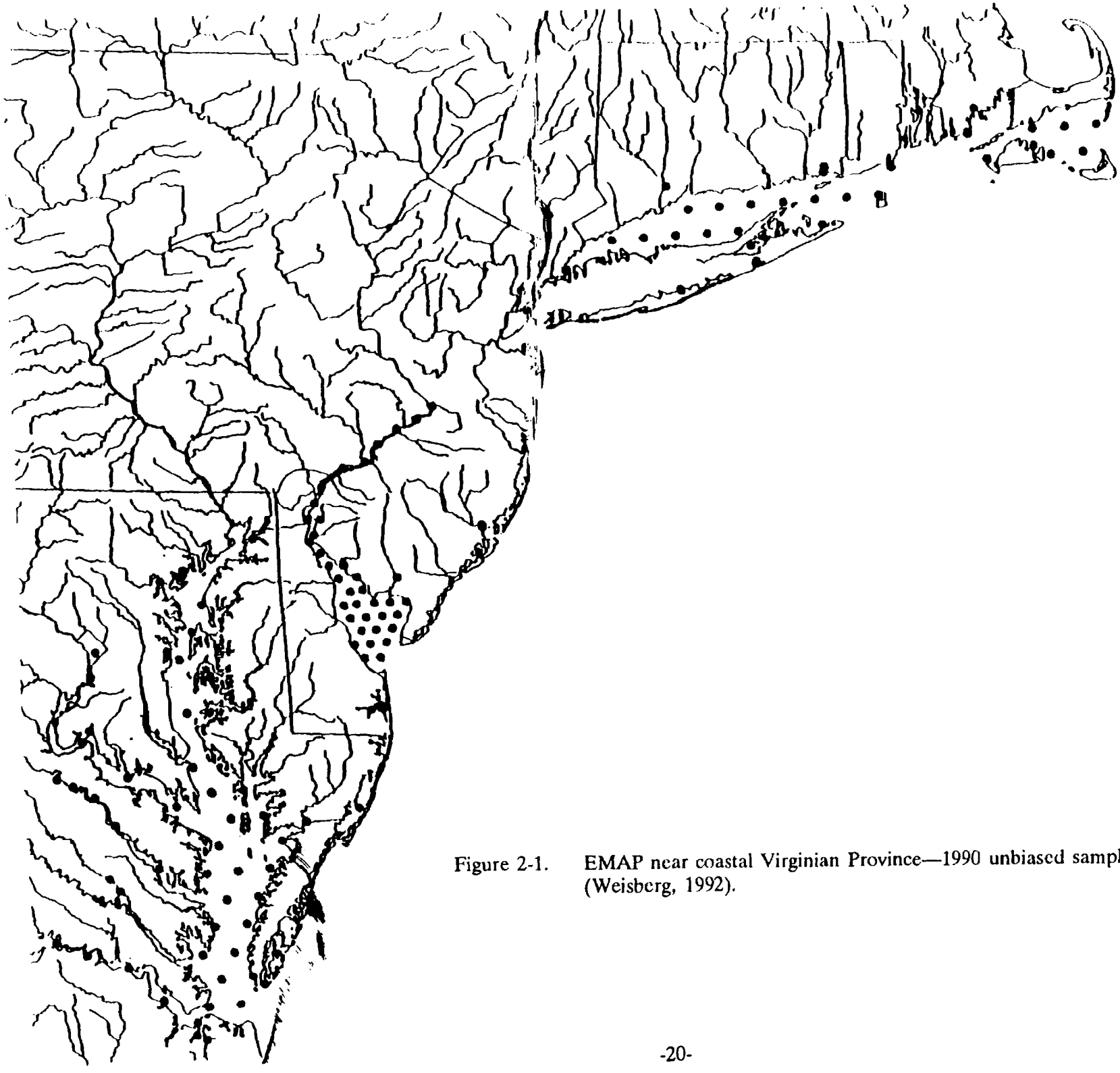

Figure 2-1. EMAP near coastal Virginian Province—1990 unbiased sampling stations (Weisberg, 1992).

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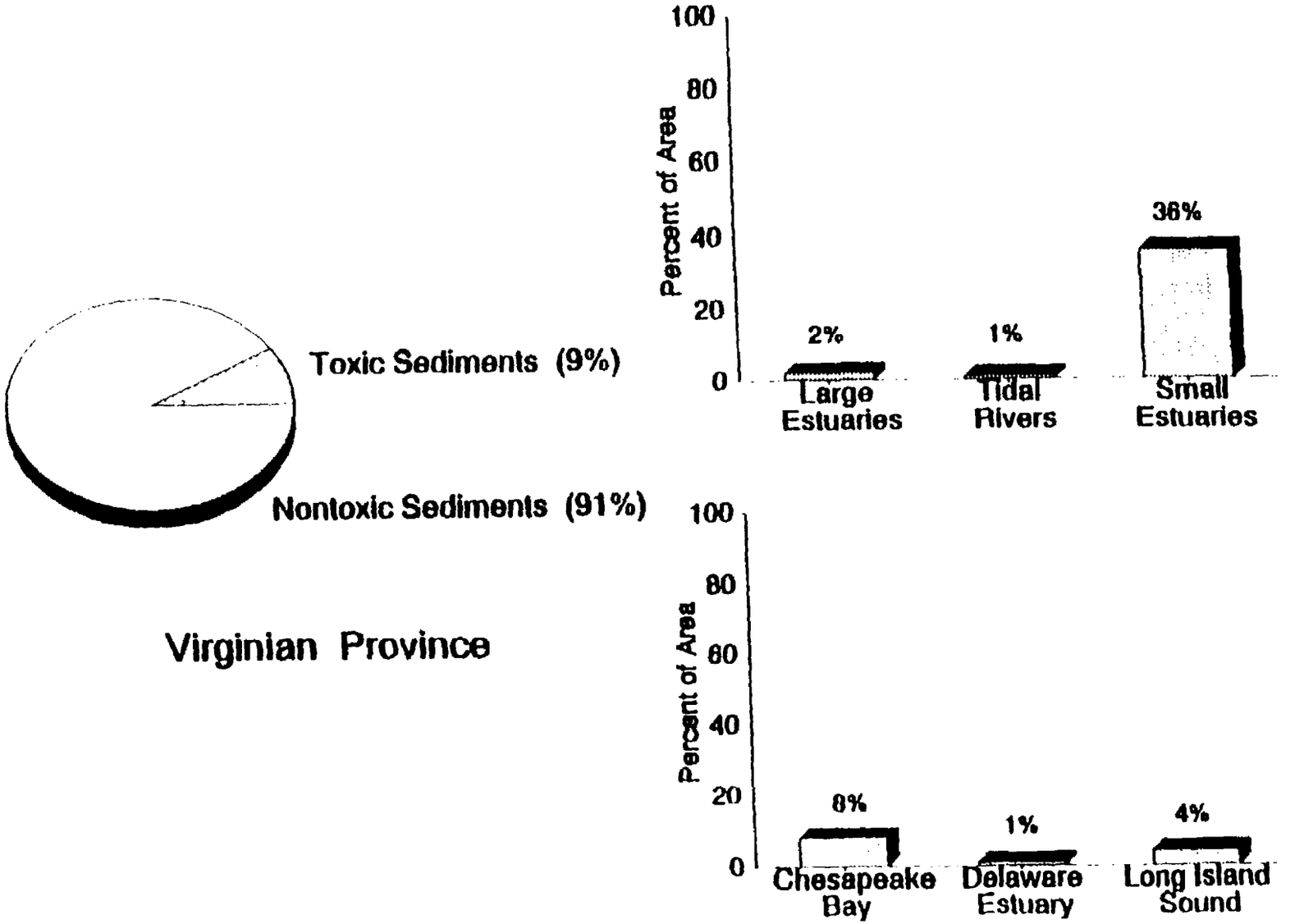

Figure 2-2. Percentage of area containing toxic sediment (from Weisberg, 1992).

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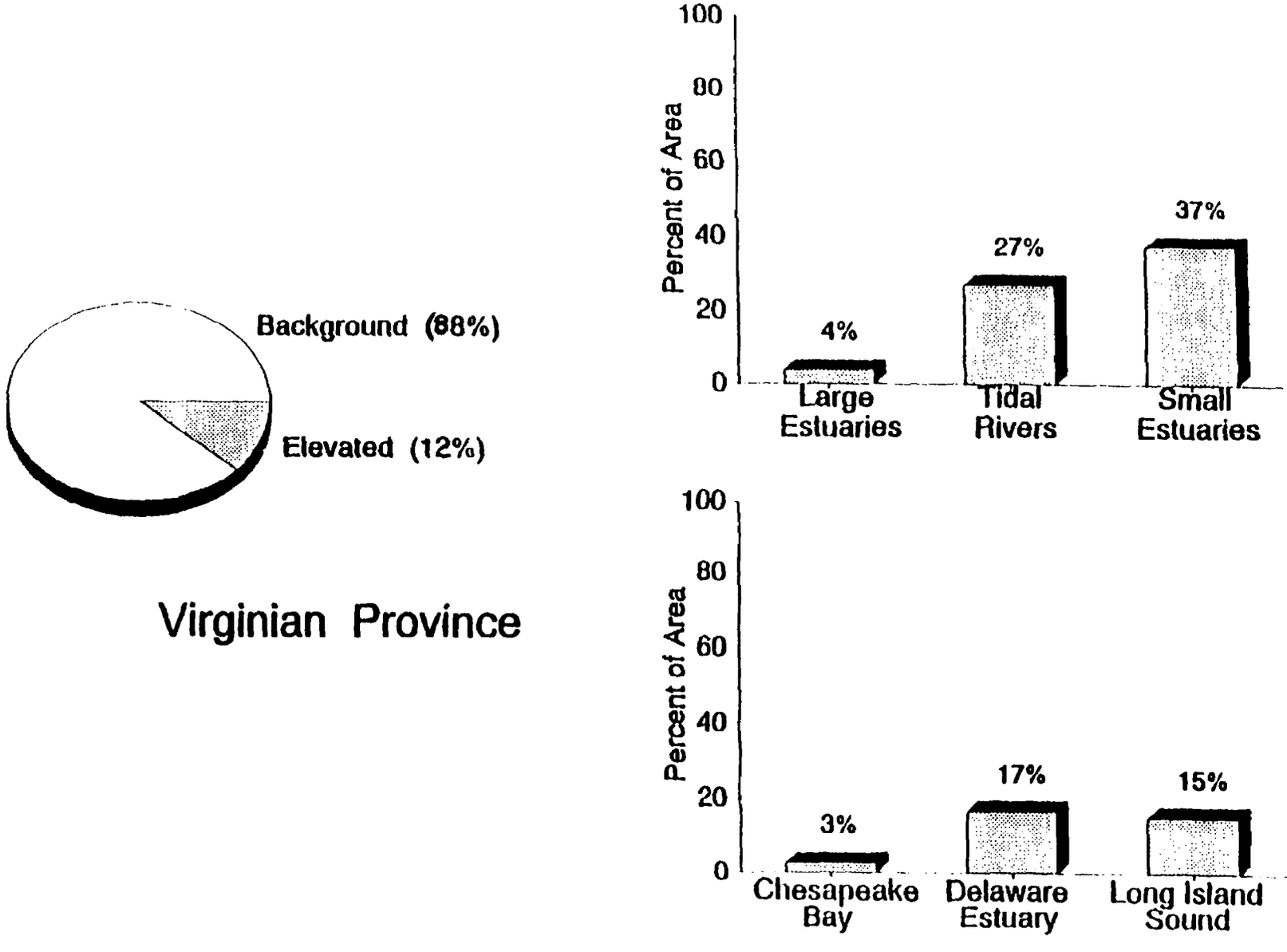

Figure 2-3. Percentage of area containing elevated concentrations of PCBs in sediment (from Weisberg, 1992).

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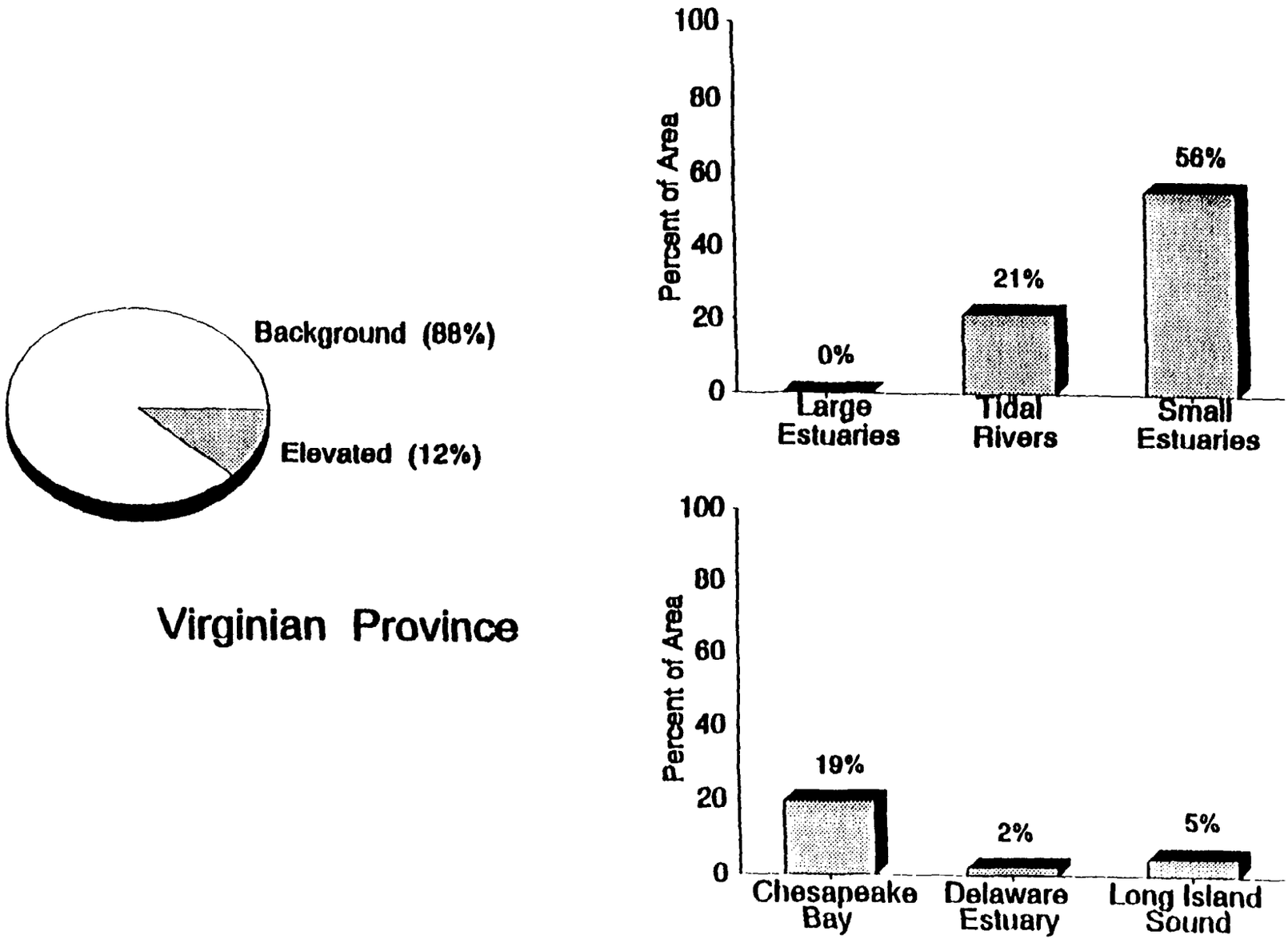

Figure 2-4. Percentage of area containing elevated concentrations of PAHs in sediment (from Weisberg, 1992).

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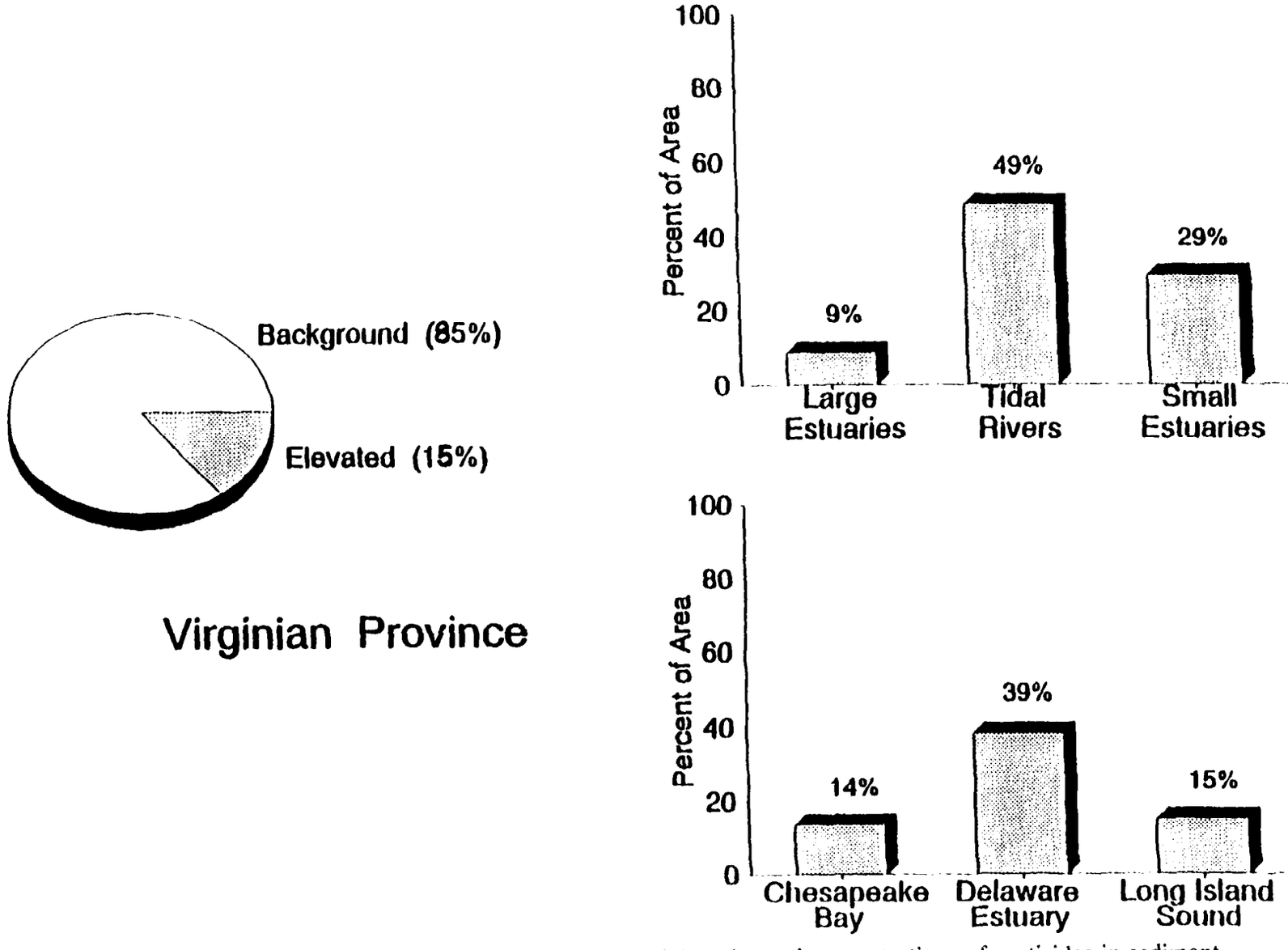

Figure 2-5. Percentage of area containing elevated concentrations of pesticides in sediment (from Weisberg, 1992).

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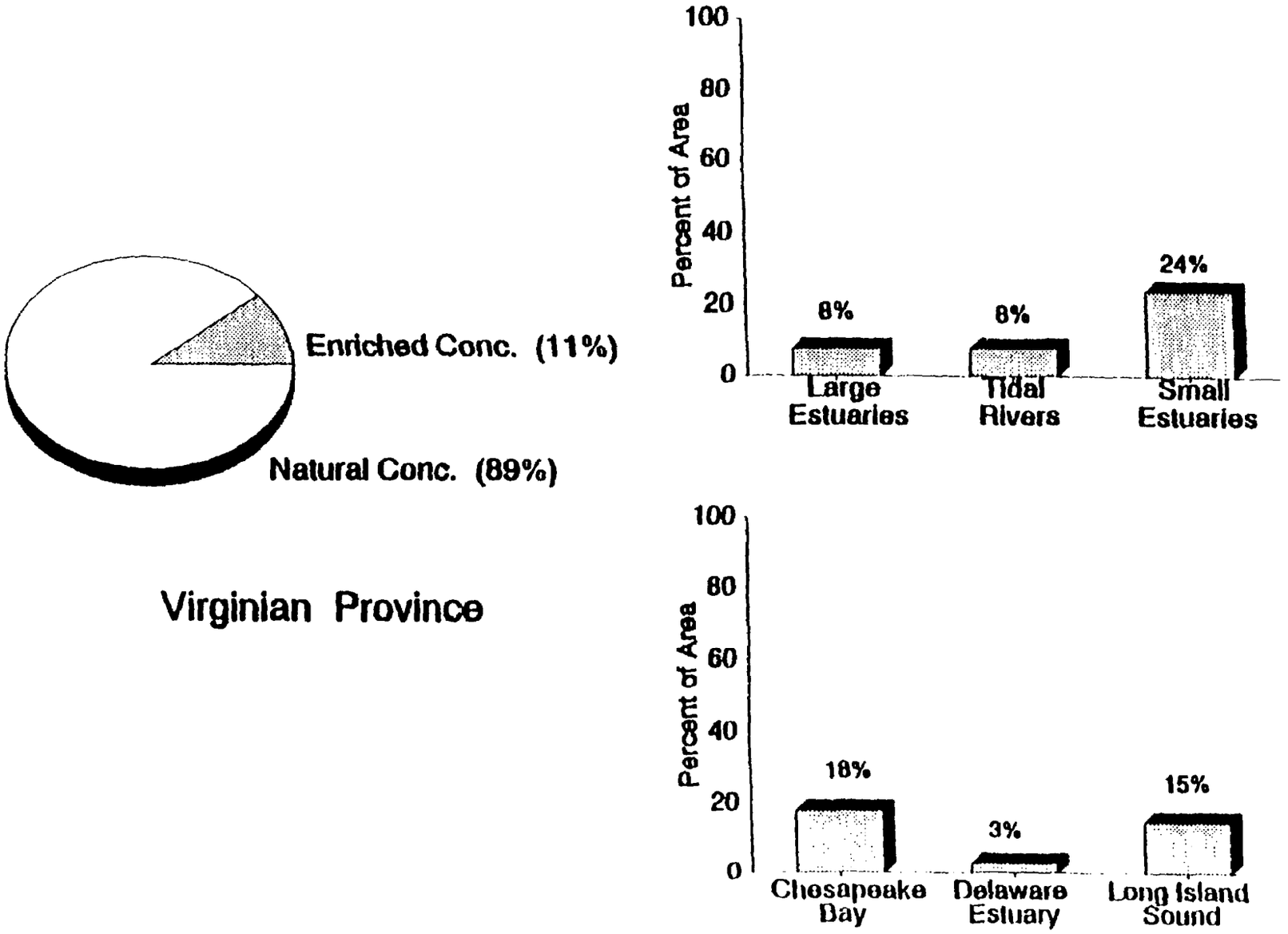

Figure 2-6. Percentage of area containing elevated concentrations of metals in sediment (from Weisberg, 1992).

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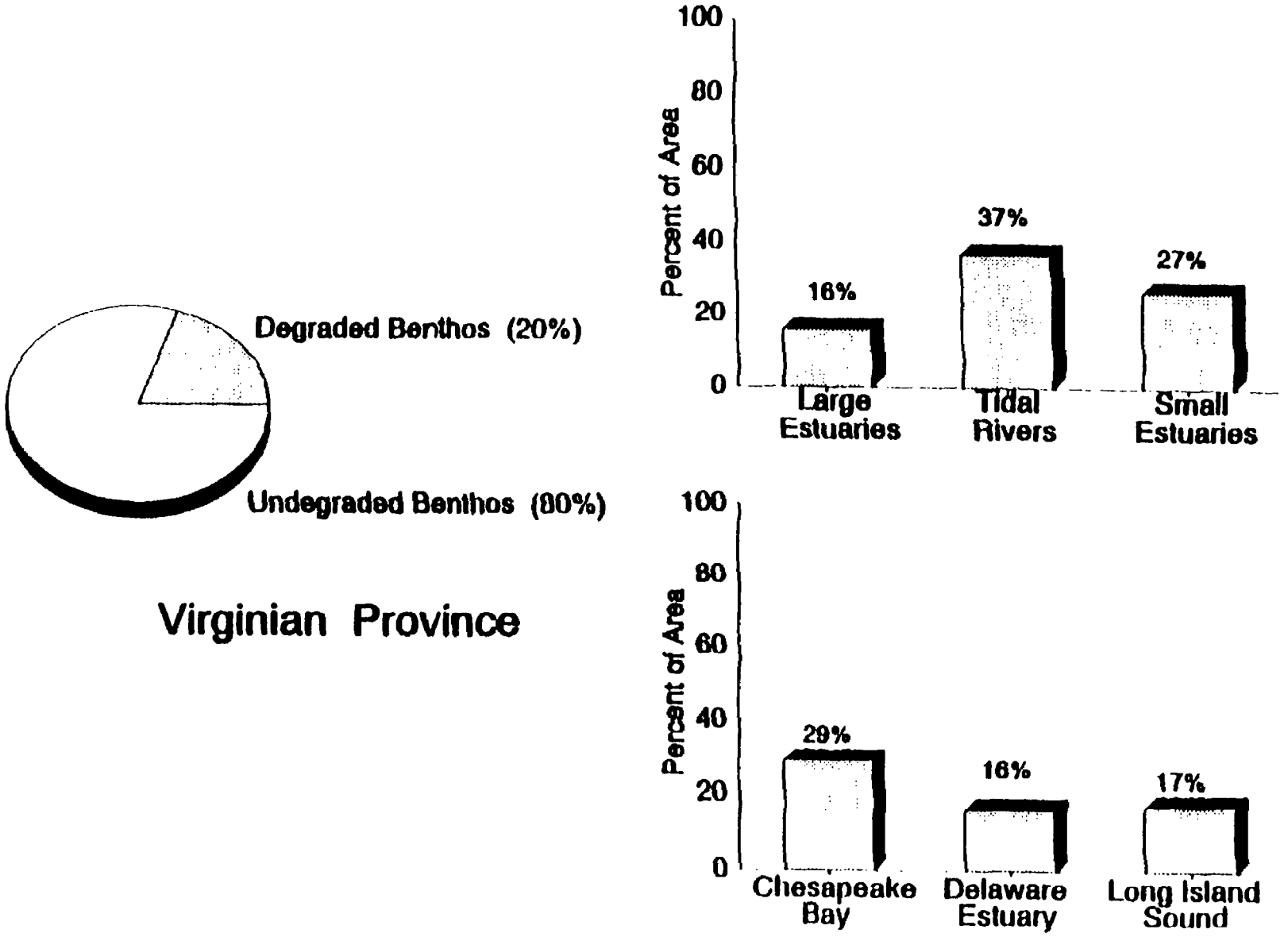

Figure 2-7. Percentage of area containing degraded benthos (from Weisberg, 1992).

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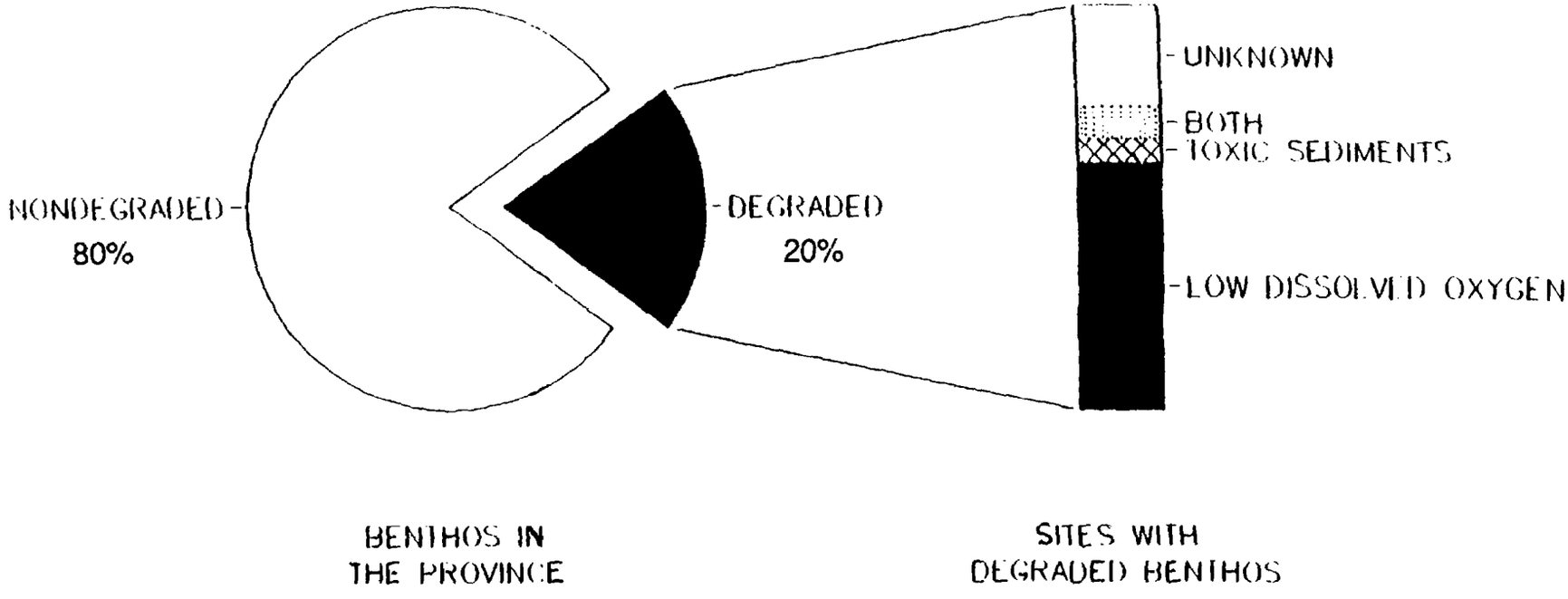

Figure 2-8. Exposure conditions at sites having degraded biological assemblages (Weisberg, 1992).

2.2.1.2 National Distribution of Sediment Contamination, presented by Thomas P. O'Connor, NOAA National Status and Trends Program (NS&T)

The NOAA National Status and Trends (NS&T) Program has determined concentrations of trace metals and organic compounds in sediment samples collected at about 280 sites around the coastal and estuarine United States. The intent has been to describe the national distribution of chemical contamination. To ensure that data would be representative of rather large areas, samples were not taken at "hot spots" (such as at the ends of discharge pipes or small poorly flushed industrial waterways).

The data reveal a general connection between chemical concentrations and numbers of people residing near sites, and the highest concentrations were found at sites in urban areas. Even the high concentrations, however, are usually below levels often associated with biological effects. Direct measures of biological effects are not made at all NS&T sites, but most toxicity tests of sediments from some of the more contaminated sites have been negative. Liver tumors among bottom-feeding fish, one effect of chemical contamination on indigenous organisms, are found infrequently, although such effects might not be evident if the fish sampled were not old enough to exhibit effects.

The NS&T results imply that sediments over a large portion of the estuarine and coastal United States do not generally carry chemical contaminants at high enough concentrations to harm marine life. As noted above, however, these data were taken from 280 sites, and do not reflect contaminant concentrations at hot spots. Extremely contaminated sediments do occur over spatial scales that are too small to be found by a national program sampling representative sites. The NOAA program now conducts bioeffects surveys that examine selected estuaries more intensively, with the express purpose of determining the spatial scales of sediments sufficiently contaminated to induce biological effects.

2.2.1.3 Compiling Sediment and Pollutant Data Bases from the Historical Record; Results of Pilot Studies from the Boston Harbor-Massachusetts Bay Program, presented by F. T. Manheim, J. C. Hathaway, and M. B. ten Brink, U.S. Geological Survey, Woods Hole, MA

The U.S. Geological Survey (USGS) is conducting multidisciplinary studies of the transport and accumulation of contaminated sediments in selected regions of the U.S. coastal and marine environment. These studies are designed to answer fundamental questions such as:

- How are water and material transported through the system?
- Where do sediments and associated contaminants accumulate and at what rate?
- What are present levels of contaminants in sediments and how will they change?

One component of these studies is the development of data bases for sediment texture and contaminants, both inorganic and organic. The cooperation and active participation of multiple agencies and organizations is an integral part of generating comprehensive data bases that will provide inventories of contaminants in sediments in U.S. waterways.

In the past, the scattered and heterogeneous nature of older data made compilation, quality control, and use difficult. Often, researchers launched new field surveys rather than attempt to use any but the most accessible older data. Over time, much of the "new" information also took its place among the little-used historical archives.

In late 1990, the USGS Office at Woods Hole, Massachusetts, began efforts to compile a detailed data base of chemical, geological, physical, and environmental parameters on estuarine and coastal sediments from all sources. The pilot study was undertaken in Boston Harbor and Massachusetts Bay.

USGS and EPA Region I (Boston) recovered data from about 1,300 sediment samples, taken and analyzed from 1962 to 1990 (see Figures 2-9 through 2-13). Utilizing new batch screening methods, the USGS achieved increased effectiveness in processing and validating data. Examples in Figure 2-11 show data before and after the "VALIDS" procedure. The validated set (b) also added data beyond the earlier set (a), which was limited to the "Boston Harbor Data Management File" (BHDMF). The augmented validated data set yielded a somewhat lower geometric mean (black dot) and median, but the general distribution and central tendency of values were confirmed. The large number of data points provides three-dimensional geographic distributions of key contaminant parameters, more robust dispersion estimates, and measures of changes in sediment composition with time. The amount of data also reduces the risk that a few erroneous or poorly located data points will adversely affect statistical or management evaluations.

Applying the effects-based toxicity screening guidelines of Long and Morgan (NOAA Tech. Mem. NOS OMA 51, 1990) to the Boston Harbor data, more than 50 percent of analyzed samples for each of at least six metals (copper, zinc, lead, chromium, nickel, and mercury) fell above the lowest screening threshold (ER-L or 10 percentile) among samples showing adverse biological effects (Figure 2-12, dotted vertical line). Some of these elements had not been previously cited as having significant toxic potential in the area.

Studies by the USGS and the Massachusetts Water Resources Authority found that metal and *Clostridium perfringens* (a bacterium spore used to trace sewage) concentrations are highest in "depositional" (rather than erosional or other) areas defined in bottom sediment maps. Bottom substrate mapping from more comprehensive data thus enhances the ability to extrapolate environmental conditions on the coastal sea floor and aids the design of scientific efforts toward answering critical management questions.

The USGS would be pleased to share data bases and techniques and work cooperatively with agencies and institutions toward a national contaminated sediments inventory for the marine environment.

2.2.1.4 U.S. Army Corps of Engineers National Dredging Program, presented by Charles R. Lee, Environmental Laboratory of the U.S. Army Engineer Waterways Experiment Station

The COE is mandated by Congress to maintain navigable waterways throughout the United States. This area includes roughly 400 harbors and 25,000 miles of waterways. Each year COE is responsible for dredging approximately 400 million cubic yards of material. Sixty million cubic yards are placed in the ocean under the Ocean Dumping Act, and the remaining 340 million cubic yards are regulated under Section 404 of the Clean Water Act (see Figure 2-14).

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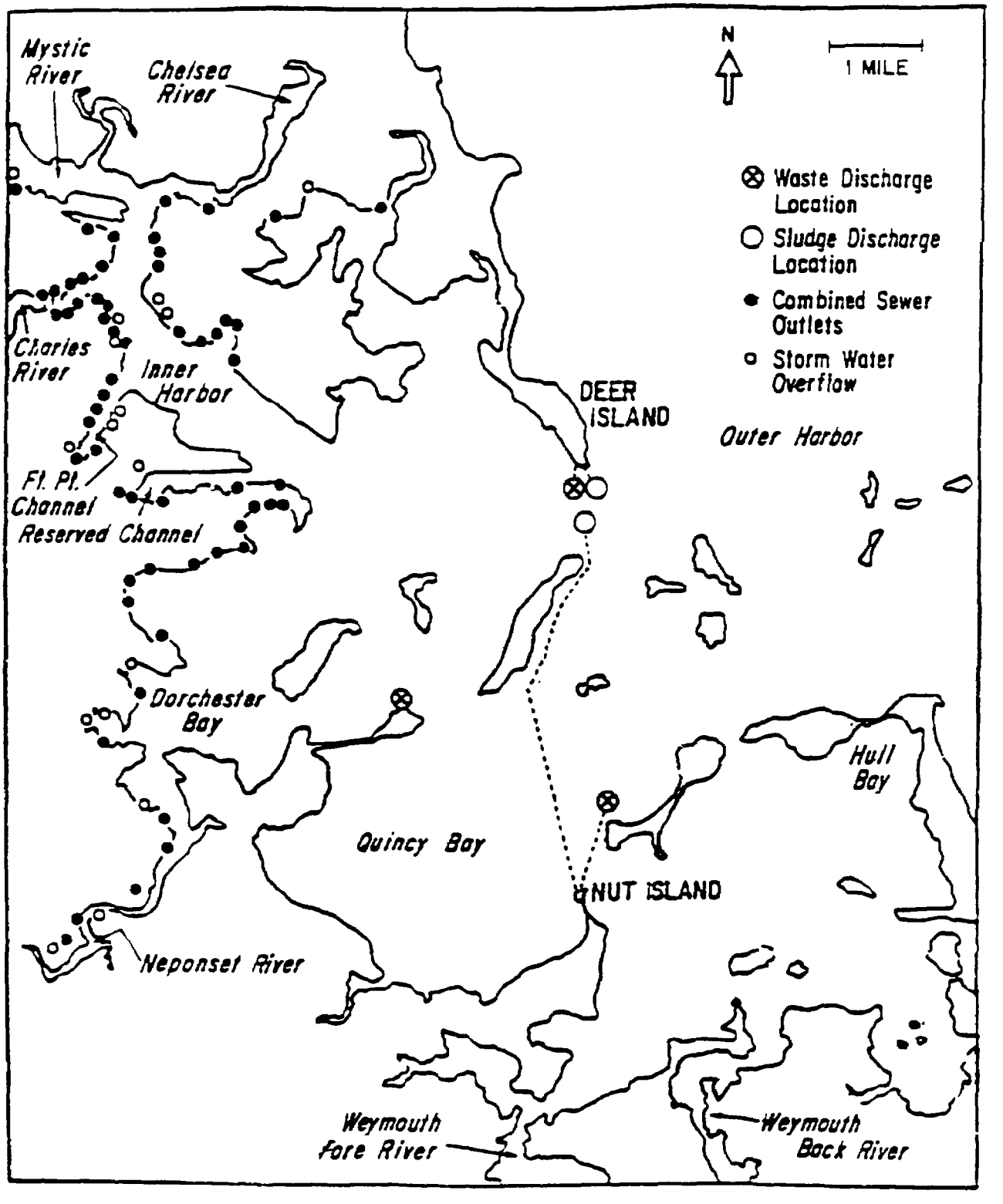

Figure 2-9. Location of waste discharge locations in Boston Harbor (from MWRA, 1990).

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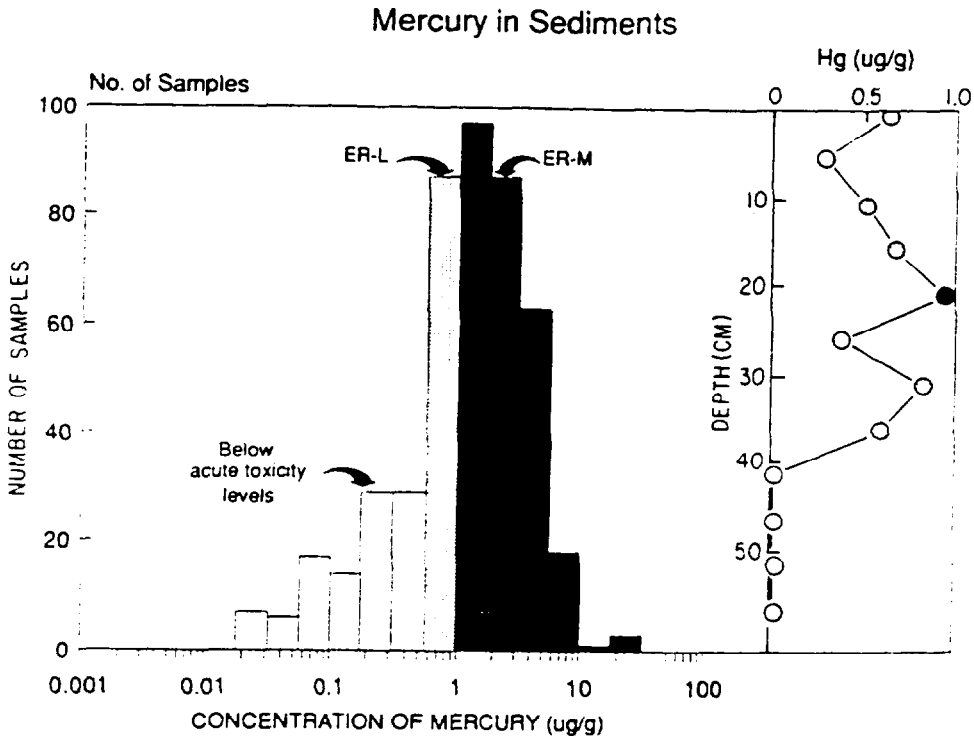
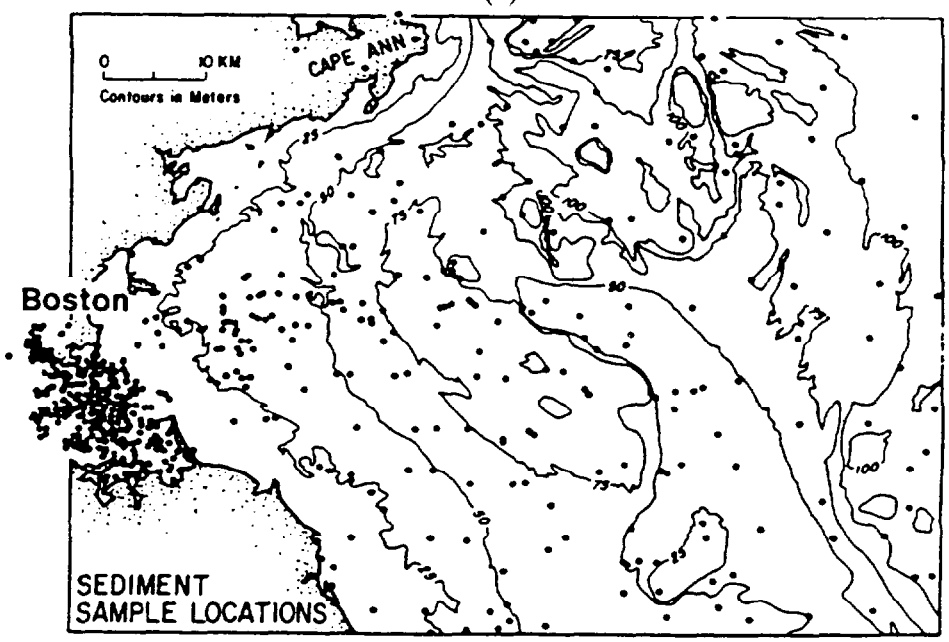


(a)



(b)

Figure 2-10. (a) Mercury in sediments from Boston Harbor and surrounding areas of Massachusetts Bay from the USGS (BHDMF) data base and EPA Region 1 sediment samples (Manheim et al., 1992). Black columns refer to samples having concentrations greater than ER-M or the 50 percentile of concentration levels in populations showing adverse biological and mortality behaviors according to the Long and Morgan review (1990). Shaded columns refer to ER-L or 10 percentile of the affected population range, whereas empty histograms refer to levels below acute toxicity levels. The same designations are applied to mercury values in the sediment core. Note the very low mercury values in presumed uncontaminated pre-anthropogenic sediment layers. (b) Distribution of USGS data base and EPA Region 1 sediment samples (Manheim et al., 1992).

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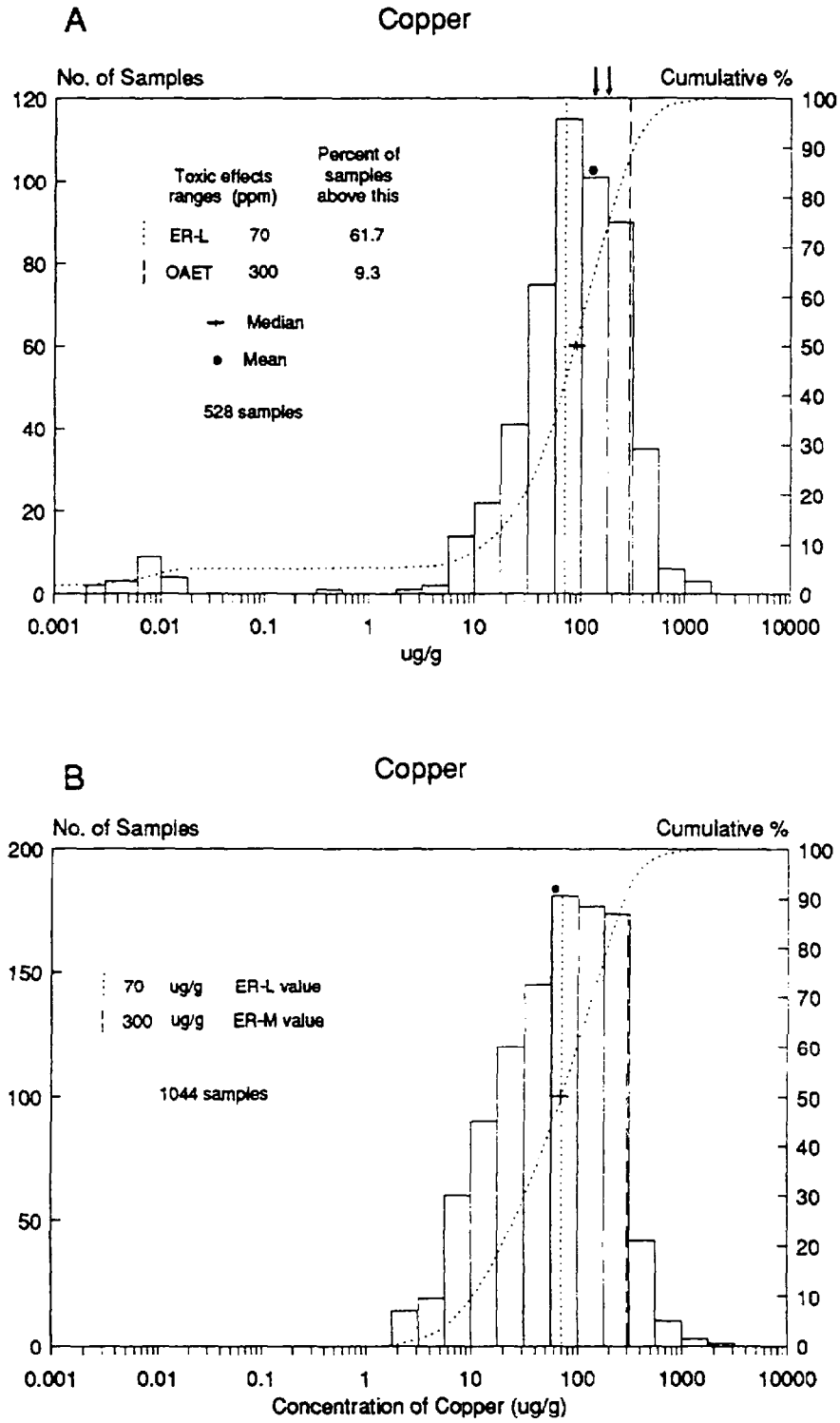

Figure 2-11. (a) Frequency plot for copper values in raw data from Boston Harbor sediments (all depths) before batch validation procedures (from Manheim and Hathaway, 1991). Note outlier at low and high concentration tails. N=528. (b) Frequency plot for copper values with additional data set (total N =1044) and after validation procedures (from Hathaway and Manheim, 1992). Low-concentration tail in (a) was found to represent mostly elutriation, interstitial water, and other values not properly attributable to bulk sediments. Some high values were likewise found to be due to errors in original sources. However, note similarity in the general distributions of values, which extend over more than three orders of magnitude in concentration.

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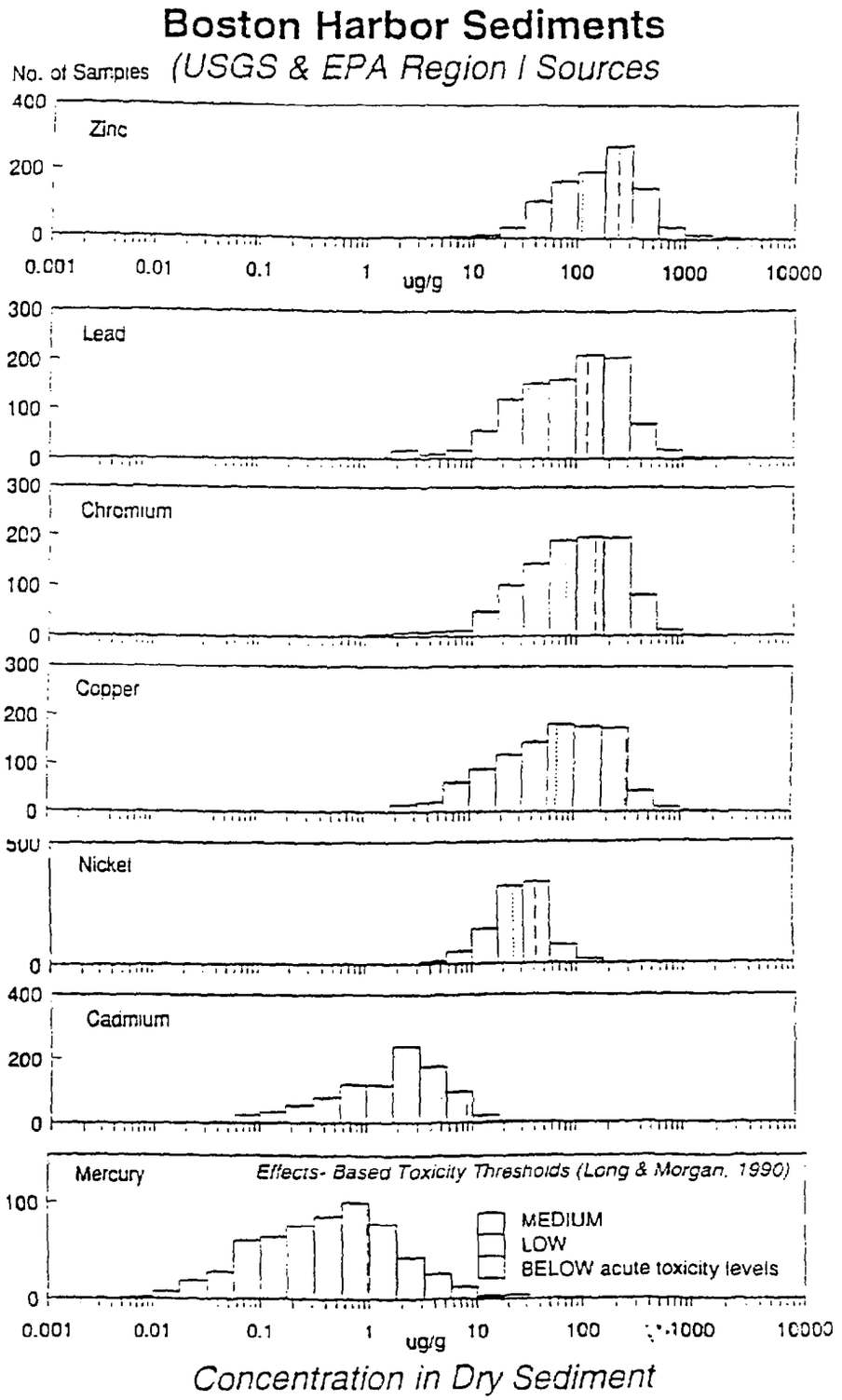

Figure 2-12. Metal distributions for seven elements from Greater Boston Harbor sediments (from Manheim et al., 1992). Dashed vertical line refers to ER-M apparent effects-based toxicity screening level (from Long and Morgan, 1990); dotted vertical line refers to ER-L toxicity screening level.

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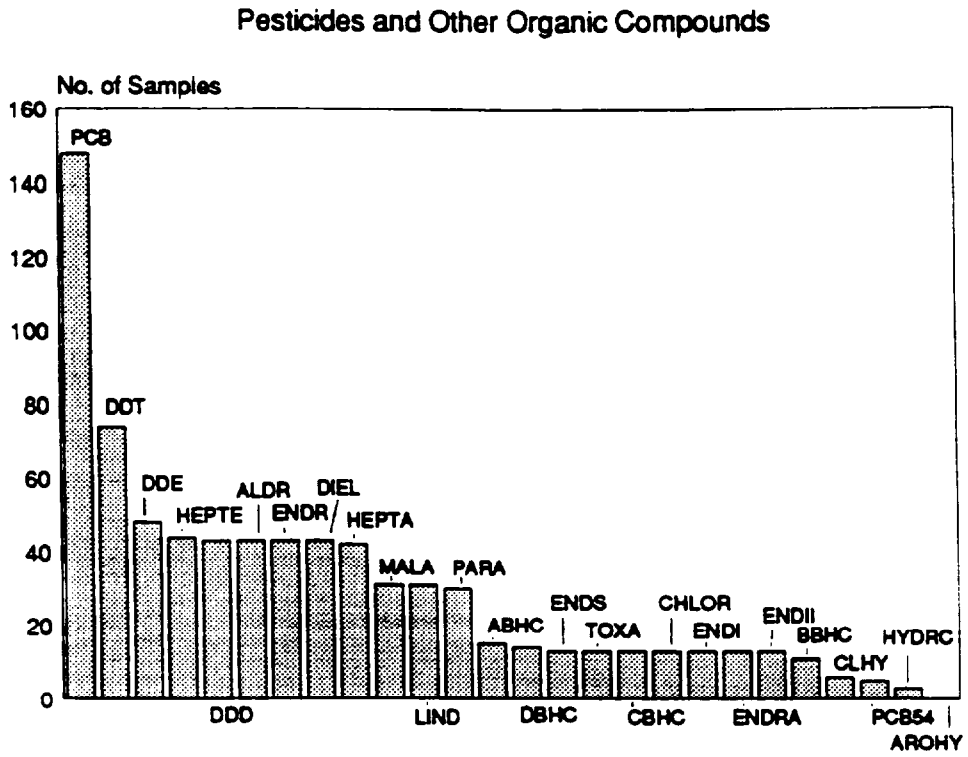

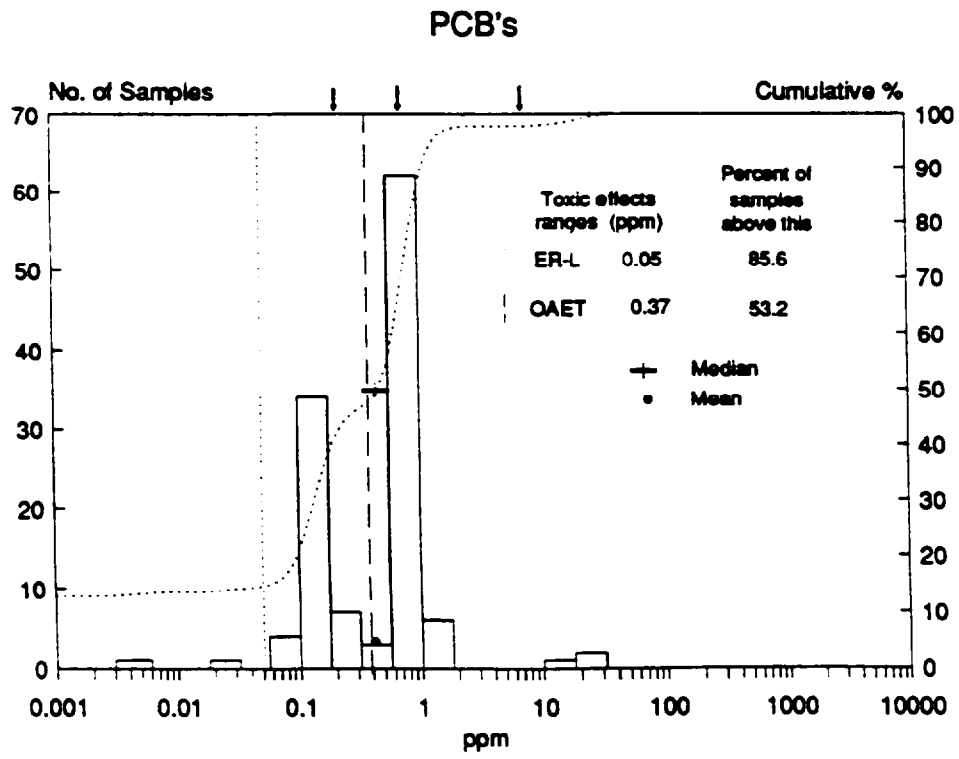

Figure 2-13. Distribution of pesticides and other organic compounds in the BHDMF data set, and frequency plot of PCB values (total) from the BHDMF set (from Manheim and Hathaway, 1991). Note the irregular distribution, unlike smooth lognormal distributions for metals.

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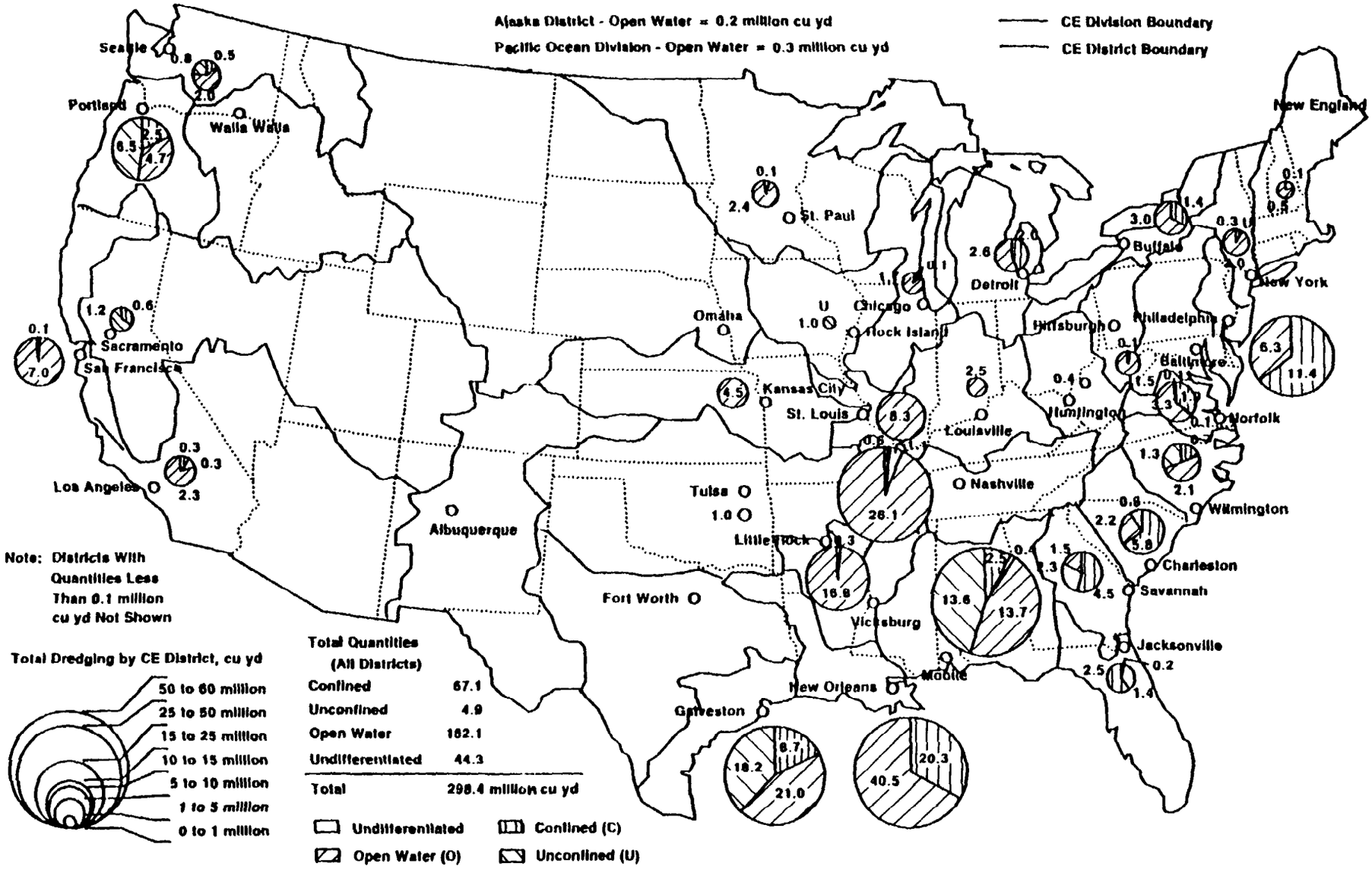

Figure 2-14. Average annual quantities (cubic yards) disposed by area by district (Boyd et al., 1992).

A small percentage of the dredged material, approximately 3 to 12 million cubic yards, is contaminated and requires special handling and/or treatment. COE established the Environmental Laboratory in 1972 to develop test procedures to predict potential impacts of COE activities in aquatic, wetland, and upland disposal environments. For the past 20 years, these test procedures have been developed and applied to numerous dredging projects and currently are incorporated in COE's nationwide management strategy for dredged material disposal (33 CFR Part 336, April 26, 1988). The COE process for managing dredged material involves a tiered approach that begins with an initial screening of the sediment to be dredged. If the initial screening indicates a cause for concern, a detailed assessment of the sediment is conducted. If the results of the assessment show evidence of a potential problem, the COE management strategy is applied, which includes evaluations and tests of the available disposal options (see Figure 2-15).

COE has worked closely with EPA in jointly preparing testing manuals and other guidance for the dredging and disposal of sediments from waterways. More recently, COE has assisted EPA in applying its expertise to the dredging and management of contaminated sediments at Superfund sites.

2.2.1.5 Sediment Contamination in the Great Lakes, presented by Steve Garbaciak, EPA's Great Lakes National Program Office

The United States and Canadian governments have identified 43 "toxic hot spots" in the Great Lakes and designated them as Areas of Concern (AOCs). Of these 43 areas, 42 have been identified as having contaminated sediments. EPA and local Remedial Action Plan (RAP) teams have cited contaminated sediments as a problem in all of the 31 U.S. and joint U.S./Canadian AOCs. In addition, the recently released National Water Quality Inventory cited contaminated sediments as a leading source of impairments in the Great Lakes. Half of the 4 million cubic yards of sediment dredged annually for navigation in the Great Lakes is contaminated.

A principal problem posed by contaminated sediments is that pollutants are consumed by bottom-dwelling organisms and are transferred up the food chain. Thus, sediments can act as a major source of contaminants to fish and wildlife and can subsequently pose a risk to human health. Contaminated sediments also have a significant economic impact associated with closed commercial fisheries, sport fish consumption advisories, and restrictions on navigational dredging.

Sediment contamination is widespread in the urban and industrialized harbors and rivers of the Great Lakes. Pollutants such as cadmium, copper, mercury, PAHs, and PCBs have been found at elevated levels. Whole sediment toxicity tests from Indiana Harbor have shown 100 percent mortality for some species. In 1988, the Assessment and Remediation of Contaminated Sediments (ARCS) Program was convened to focus on specific problem areas. In addition, an inventory of contaminated sediment sites in EPA's Region V is under way.

2.2.1.6 Advantages of Including Cesium-137 in Sediment Contamination Studies: Examples from Lake Michigan and the Grand Calumet River, presented by Richard A. Cahill, Illinois State Geological Survey

Programs were undertaken to sample sediment in Lake Michigan and in the Grand Calumet River. The Lake Michigan results, published in 1981, included the chemical analysis of 286 surficial

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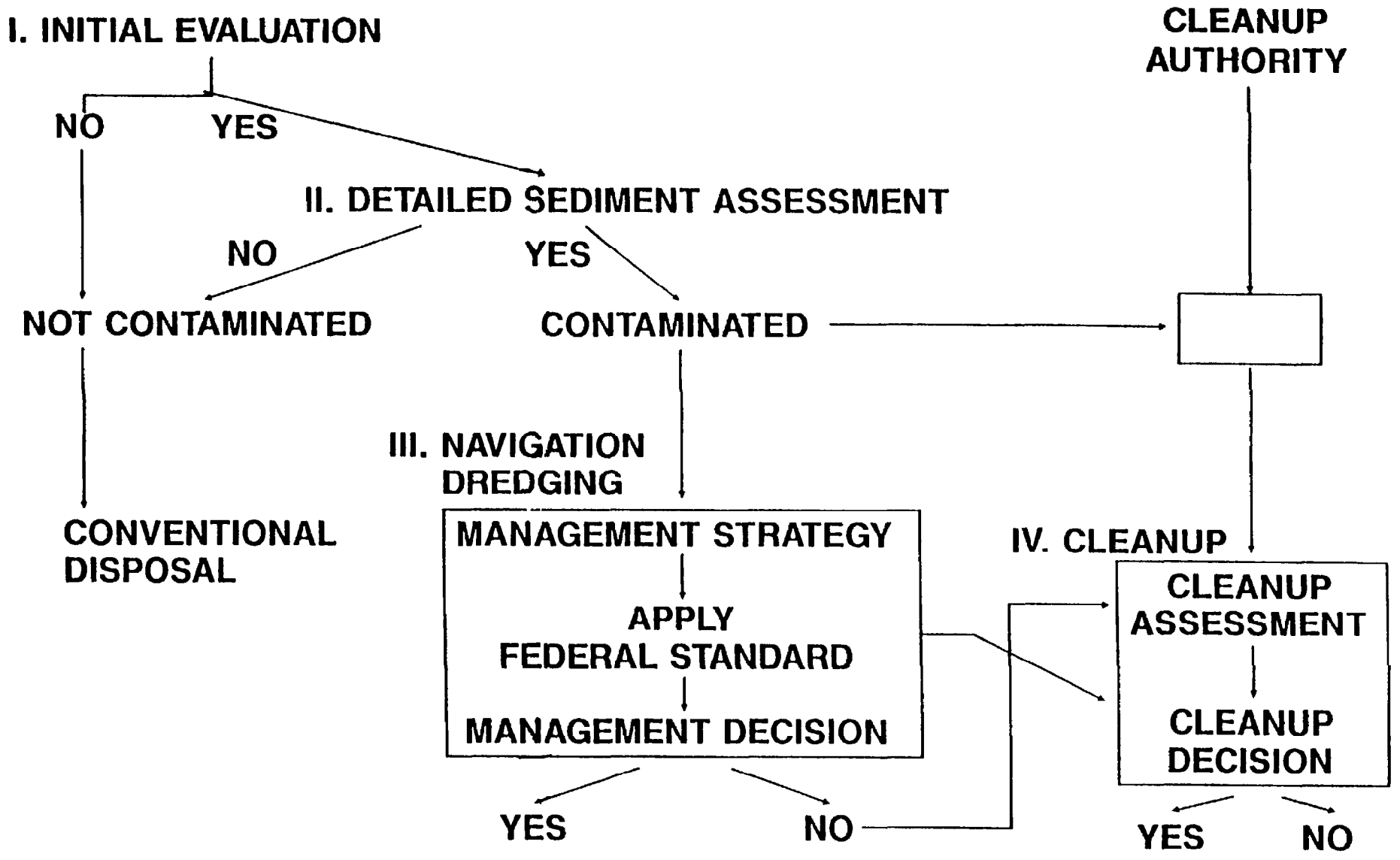

Figure 2-15. U.S. Army Corps of Engineers process for evaluation of the disposal of dredged material.

sediment samples, collected on a 12 x 12 km lake-wide grid (Figures 2-16 to 2-18). These samples reveal that arsenic and lead contamination is concentrated in fine grain deposits of deep basin areas. In these areas, arsenic concentrations typically range from 10 to 20 ppm, rising to 40 ppm in isolated hot spots. Lead concentrations are higher but similarly distributed, falling between 50 and 100 ppm in most areas, with some hot spots of over 100 ppm.

The inclusion of cesium-137 results (Figure 2-19) provides a better understanding of the deposition patterns of the sediment and clues as to the source of contamination. In Green Bay, for example, core samples reveal high concentrations of arsenic, but cesium-137 results indicate little recent deposition. These findings suggest that arsenic contamination in Green Bay is probably not anthropogenic. By contrast, cesium-137 results show recent deposition near the Menominee River, where arsenic contamination is known to have human sources.

Results also are shown for the west branch of the Grand Calumet River (Figure 2-20), where 10 cores were subsampled every 30 cm for chemical analysis (Figures 2-21 through 2-23). These samples indicate that zinc and organic carbon are most heavily concentrated in the upper sedimentary layers of the Grand Calumet River near the outfall of the Hammond Sanitary District. Cesium-137 profiles (Figure 2-24) combined with chemical analysis (Figure 2-25) provide information on when contaminants entered the sediment. This information allows researchers to construct what Mr. Cahill calls "the industrial history" of the region.

Mr. Cahill concluded by emphasizing the importance of four aspects of a sampling program to ensure the integrity of the analytical results:

- Use a well-designed sampling grid
- Use uniform sampling techniques
- Subsample cores in discrete intervals
- Include sedimentation rate estimates

Mr. Cahill indicated, during questions, that bioturbation can mix sediments and blur the record of sedimentation constructed from cesium-137. He added that cesium-137 and lead-210 provide complementary results on sedimentation rates, although cesium-137 is somewhat less expensive, and fewer samples are required for the cesium-137 determination.

2.2.2 Severity of Contaminated Sediments - Human Health Effects

2.2.2.1 Estimating the Severity of Human Health Effects Caused by Chemically Contaminated Sediments in California, presented by Gerald A. Pollock, Pesticide and Environmental Toxicology Section, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency

Intense concerns have been raised regarding human health effects caused by consumption of seafood contaminated via bioaccumulation from sediments. This situation has led to the issuance of health advisories for contaminated species and passage of legislation to address hot spots of contaminated sediments in the bays and estuaries of California.

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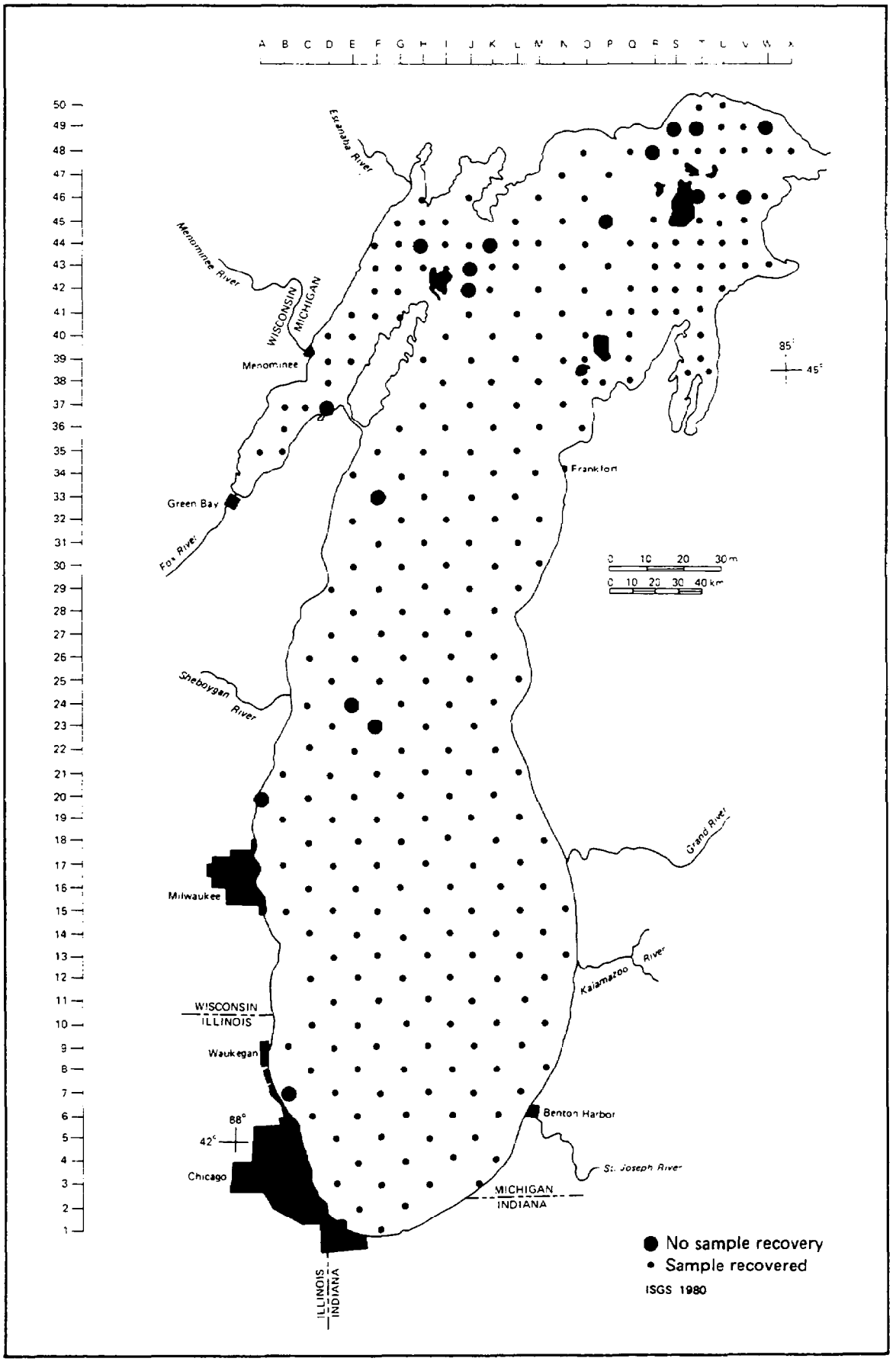

Figure 2-16. Sample location grid for the 1975 cruise of the CSS LIMNOS in Lake Michigan (Cahill, 1981).

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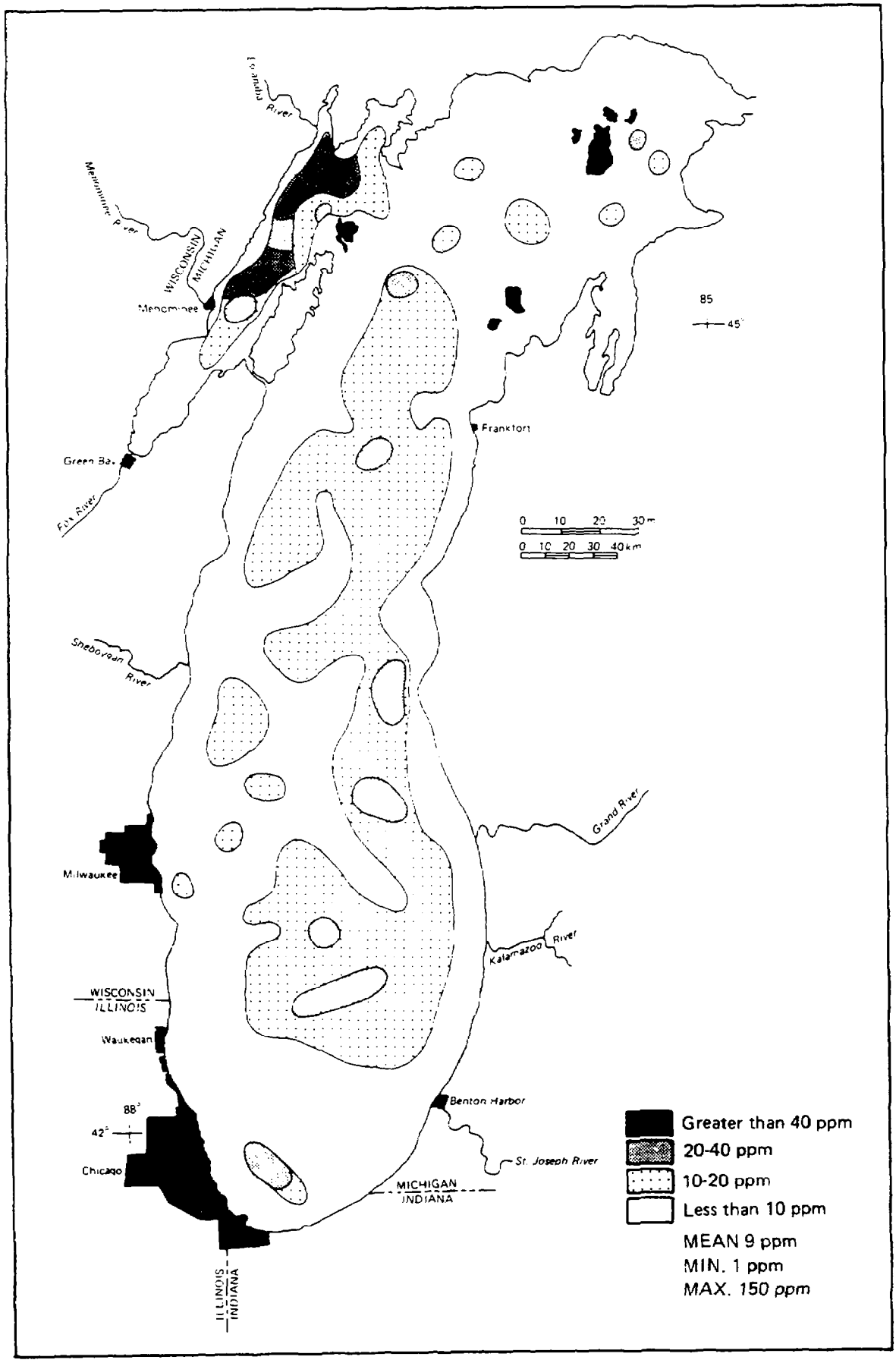

Figure 2-17. Arsenic distribution in the upper 3 cm of Lake Michigan sediments (Cahill, 1981).

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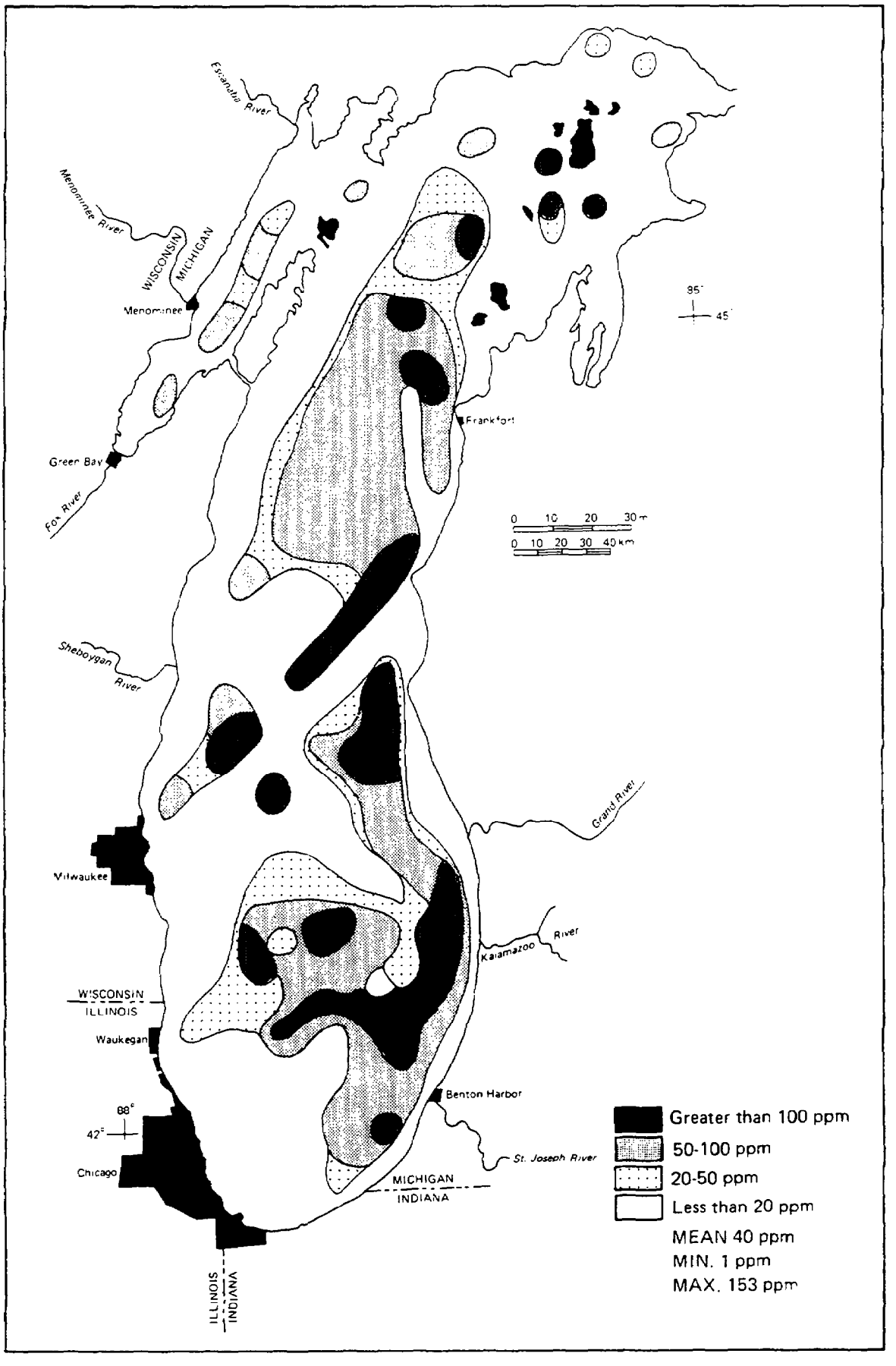

Figure 2-18. Lead distribution in the upper 3 cm of Lake Michigan sediments (Cahill, 1981).

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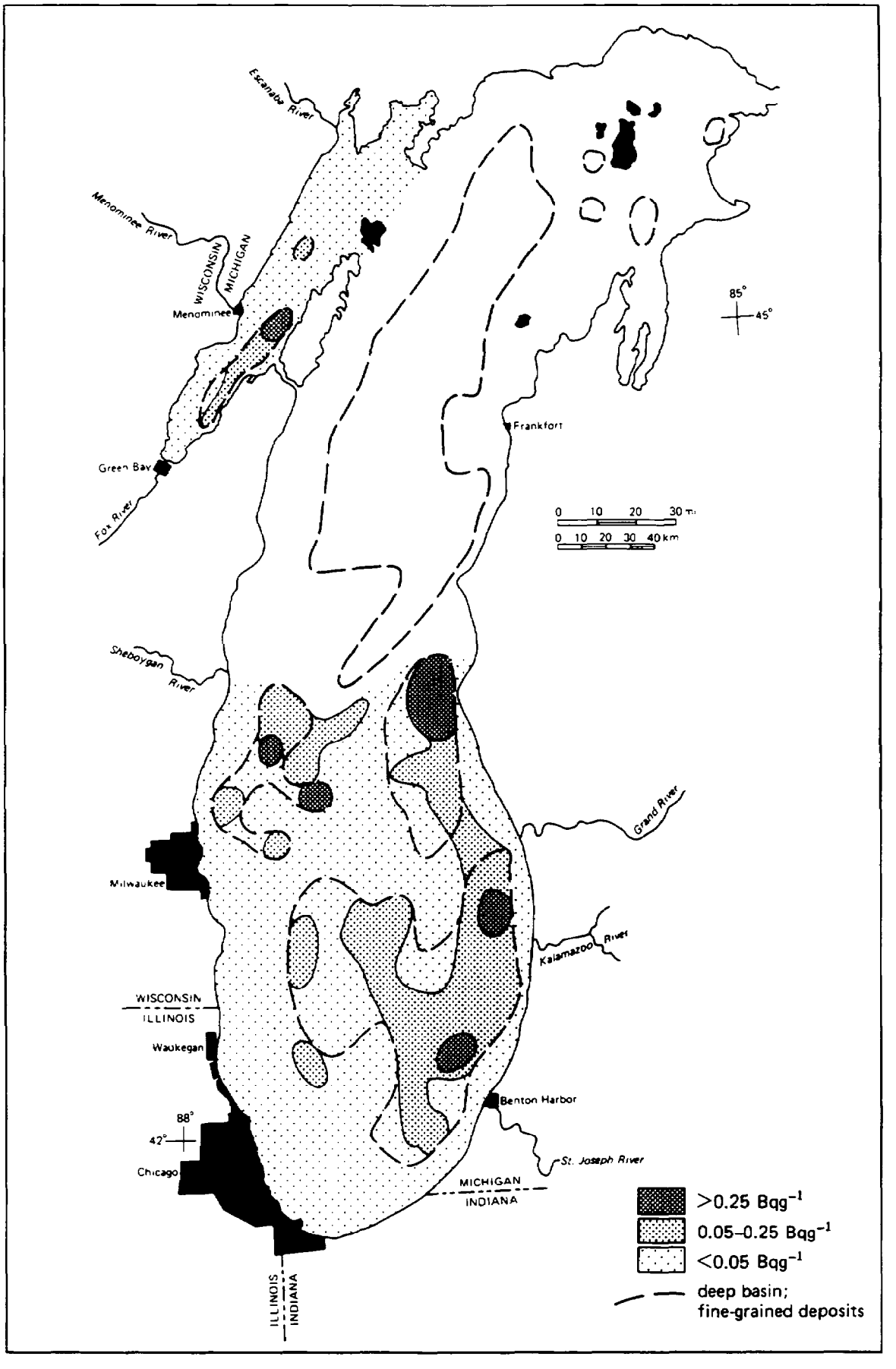

Figure 2-19. Cesium-137 distribution in the upper 3 cm of Lake Michigan (Cahill and Steele, 1986).

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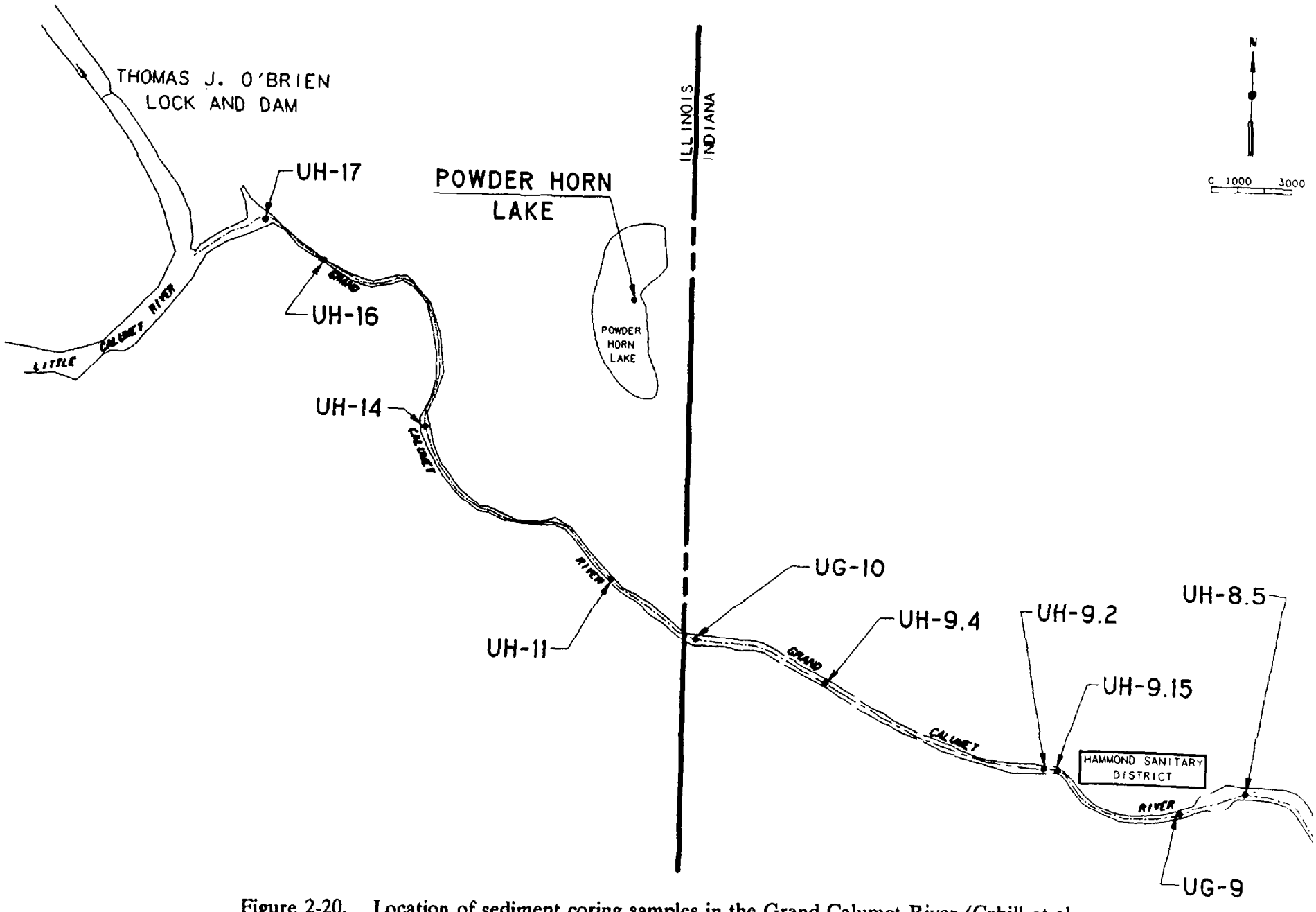

Figure 2-20. Location of sediment coring samples in the Grand Calumet River (Cahill et al., 1992).

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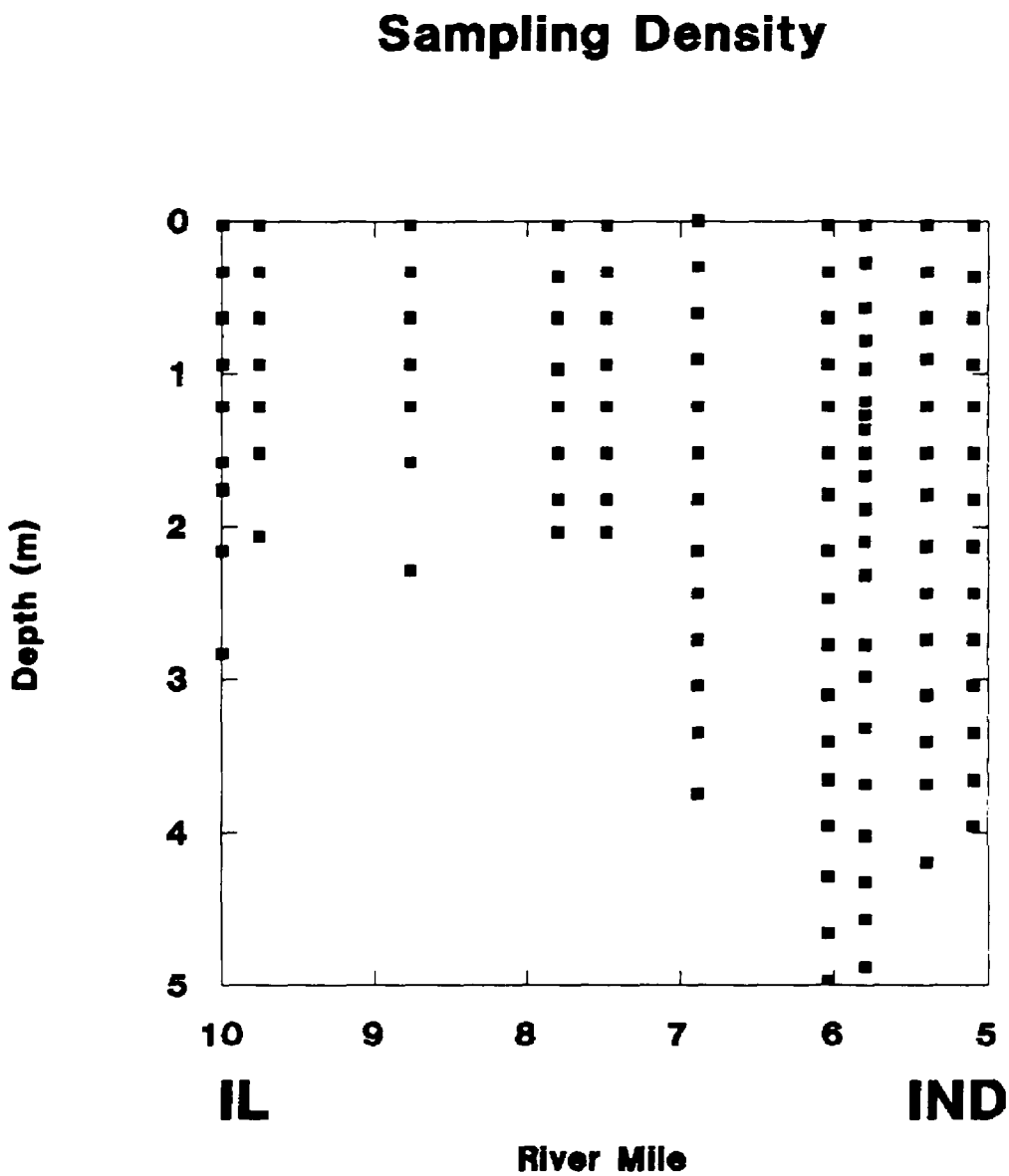

Figure 2-21. Sample density used in the Grand Calumet River (from Cahill et al., 1992).

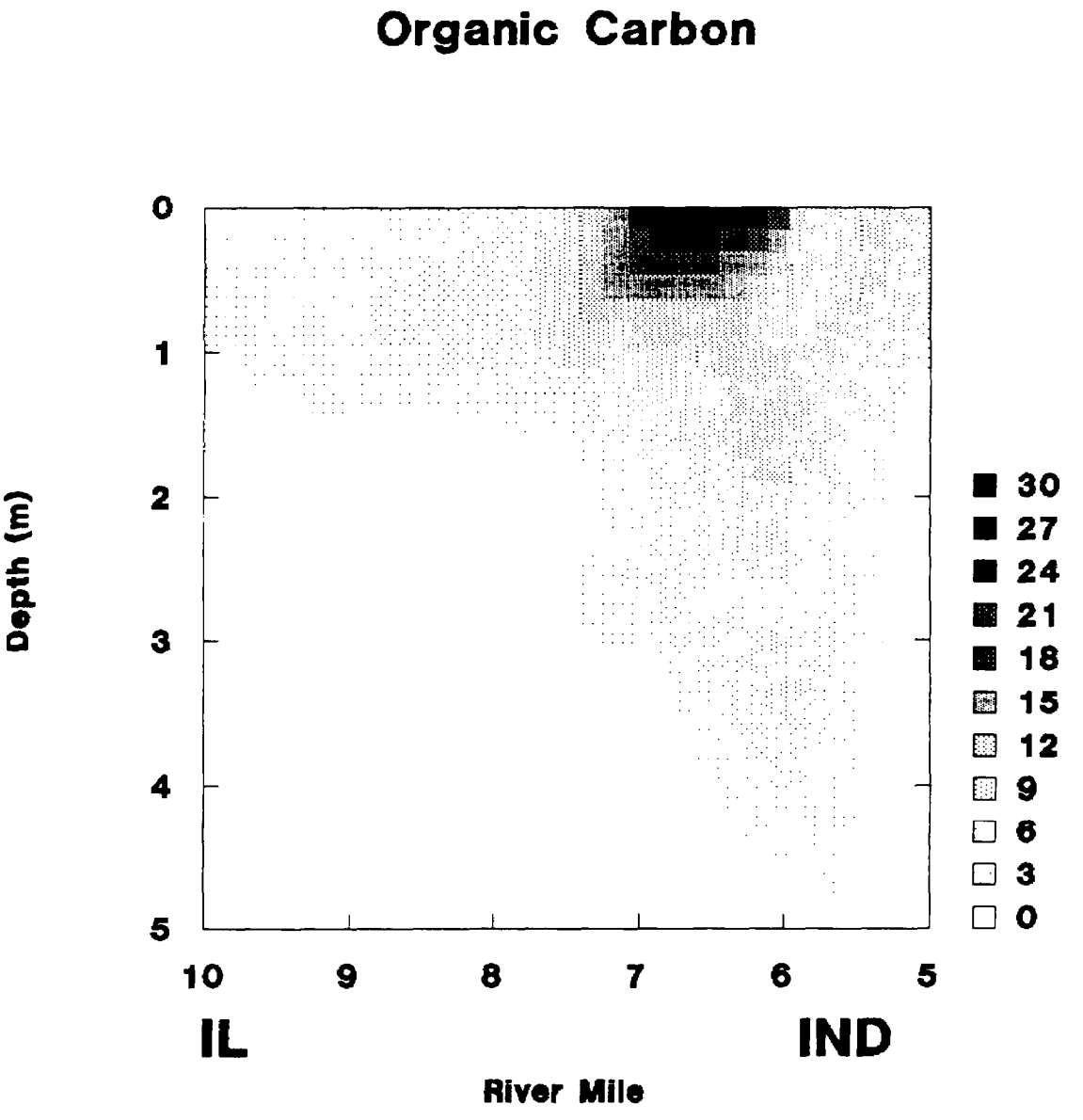

Figure 2-22. Organic carbon concentrations (percent) in sediments of the Grand Calumet River (from Cahill et al., 1992).

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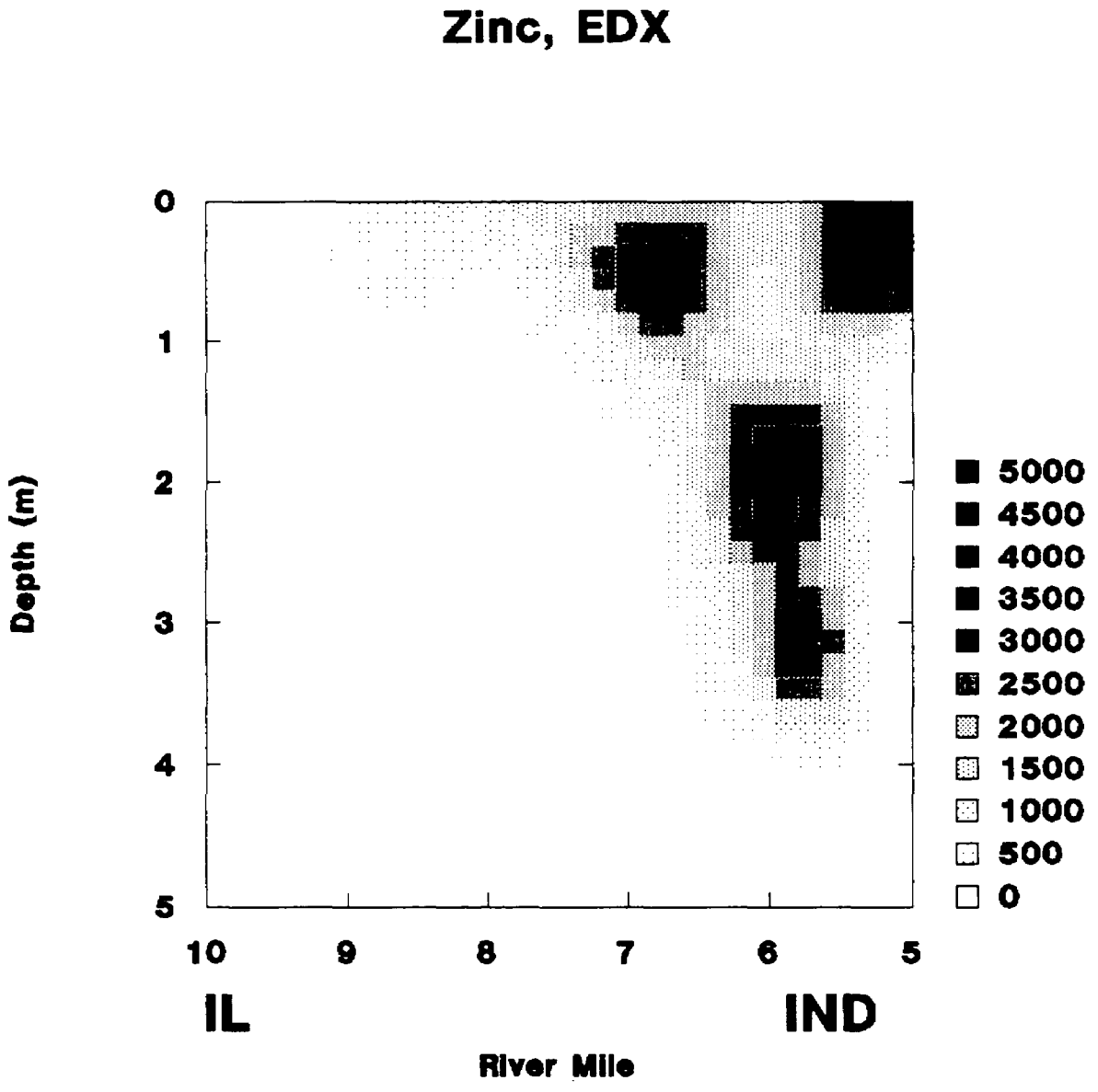

Figure 2-23. Zinc concentrations (ppm) in sediments of the Grand Calumet River (from Cahill et al., 1992).

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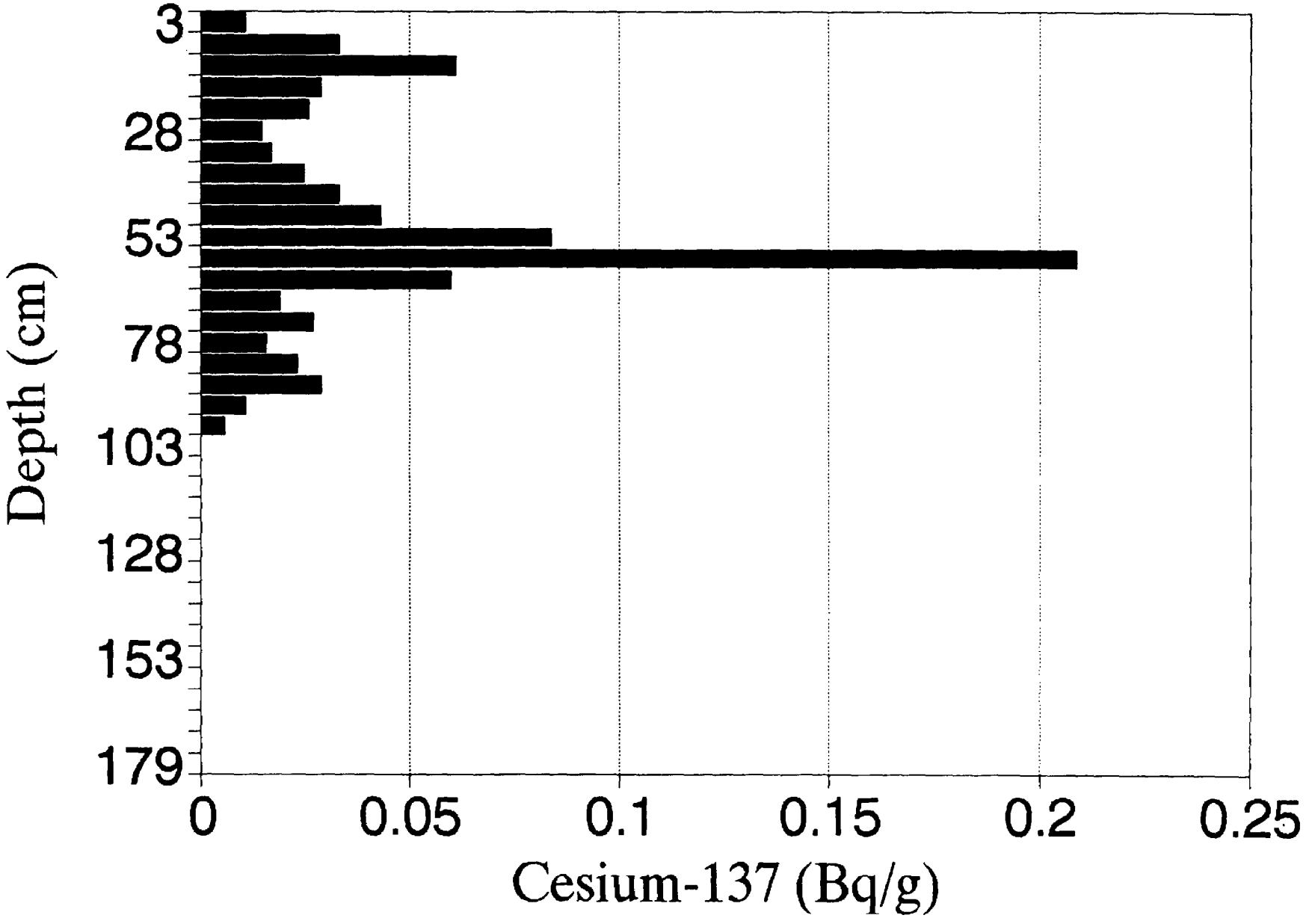

Figure 2-24. Cesium-137 profile in core UH-9.2 from Grand Calumet River (from Cahill et al., 1992).

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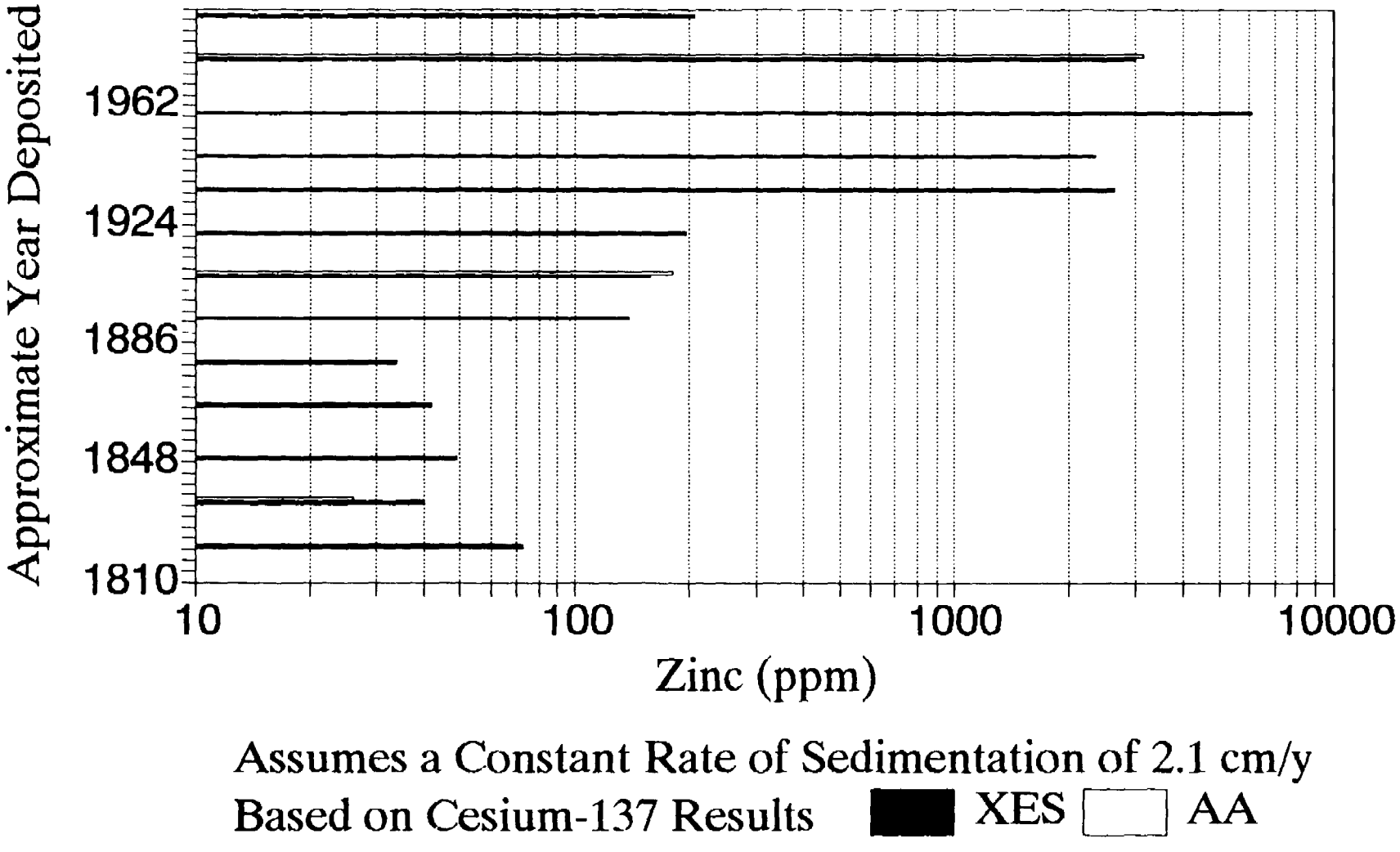

Figure 2-25. Zinc distribution in core UH-9.4 from the Grand Calumet River, including the approximate year deposited based on cesium-137 (from Cahill et al., 1992).

Public health attention has focused on local populations that might fish near contaminated sites. Highly contaminated sediments have been identified in San Diego Bay, Santa Monica Bay and the Los Angeles Bight, San Francisco Bay, and the Sacramento/San Joaquin River.

The severity of human effects usually is described based on estimates of excess cancer incidence or other toxicity (e.g., reproductive/developmental, neurotoxicity), since the exposures frequently are not high enough to result in acute or observable toxicity. Estimated excess lifetime cancer risks from consumption of seafood in areas of high contamination range from below 1 in 100,000 to as high as 2 to 5 per 1,000. Also, significant exposures for mercury levels in inland lakes have been calculated.

Better estimates of actual human health impacts are limited due to the uncertainty associated with the risk assessment process. Uncertainty in estimating the consumption rate of contaminated seafood and the lack of adequate epidemiological data pose problems in conducting human health risk assessments. Recent studies on populations exposed to PCBs, DDTs, and methyl mercury may greatly aid in our ability to evaluate the severity of human exposure to toxic chemicals due to contaminated sediments.

Fish samples were taken and chemical analyses were conducted at 25 sites in the vicinity of the sewage outfall in southern California. About 15 fish species were sampled, and 1,000 chemical analyses were conducted. The chemicals of most concern were the DDT-composites found at levels up to 3,000 ppb and PCBs found at levels up to several hundred ppb. Contamination was found to be highest around the sewage outfall. Species- and site-specific fishing advisories were issued.

A case study of the Upper Sacramento River in the vicinity of a pulp mill outfall showed elevated levels of dioxins and furans. A risk assessment found high health risks. Estimated maximum excess cancer risk from consumption of fish from the Sacramento River ranged from 2×10^{-3} to 5×10^{-3} (Pollock et al., 1989).

Dr. Pollock expressed concern over the uncertainties inherent in currently used risk assessment methodologies, and emphasized a need for further research to refine the assumptions and methodologies used. Assumed seafood consumption rates, projection of human health effects based on laboratory data on animals, and expansion of the list of the chemicals of concern are three of the areas needing further research.

2.2.2.2 The Impacts of Contaminated Sediments on Human Health: A Case Study from the Great Lakes, presented by Wayland R. Swain, Eco Logic International, Inc.

Residue-forming organic contaminants of anthropogenic origin have become ubiquitously distributed throughout the global environment. In large aquatic systems, the sediments serve as a sink for many of these compounds. Unfortunately, the sediments also serve as a large reservoir of these materials, which under conditions of resuspension, equilibrium partitioning, bioturbation, and advection can become a long-term source of toxic substances. Food chain transfer of these mobilized sedimentary contaminants frequently contributes to elevated concentrations of toxic organic substances in fish, exceeding recommended guidelines for human consumption.

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Although often surrounded by considerable controversy, the effects of acute human exposure to many toxic organic substances are reasonably well documented, chiefly as a result of occupational exposure or catastrophic accident. Less well understood are the human health effects of small, repeated, or chronic exposures to these materials, particularly with respect to the role of sediments in this process. Sources of PCBs in sediments of the Great Lakes, and their contribution through the biota can be linked to effects on human health. Human exposure to PCBs can be analyzed in the light of data from extensive epidemiological studies of two matched cohorts of exposed individuals consisting of (1) sports anglers and (2) mothers and their newborn infants. These groups were chronically exposed to significant quantities of PCBs from consumption of contaminated freshwater fish from Lake Michigan.

In 1974, a Lake Michigan angler study of 178 adults showed that the longer they had consumed fish, the higher their PCB body burden. Another study of 1,091 adults in 1982 showed that persons consuming fish from Lake Michigan had higher PCB body burdens compared to non-fish eating individuals (see Figures 2-26 through 2-28).

A study of mothers and their newborn infants showed that, as the period of time over which fish from the lake were consumed increased, so did the body burden of PCBs. In addition, the higher the PCB body burden, the more intense the effects exhibited by the infants. Exposed mothers were found to have increased levels of PCBs in whole serum and breast milk. Infants of highly exposed mothers were born at reduced birth weights and reduced gestational ages, had smaller head circumferences, and exhibited neuro-motor effects (see Figures 2-29 through 2-31). The effects of PCBs are subtle and become apparent in specific psychological tests. With low level chronic exposures to PCBs, a mother may exhibit no effects; however, her children may experience neurobehavioral deficits.

The exposure of fish to PCBs in Lake Michigan was probably the result of a single massive source at Waukegan Harbor (see Figures 2-32 through 2-36). Based on calculations, the majority of the PCB releases from the source to Lake Michigan probably occurred before 1970.

2.2.2.3 Risks Associated with Seafood Consumption: Perception vs. Reality - the Quincy Bay Case Study, presented by Nancy Ridley, Bureau of Environmental Monitoring, Massachusetts Department of Public Health

The problems of chemical and microbiological contamination of fish and shellfish have historically presented a challenge to public health, environmental, and natural resource officials at the federal, state, and local levels. While the vast majority of fishery products are wholesome and not likely to cause illness, there are areas of risk. According to the 1991 report on Seafood Safety from the National Academy of Sciences, the greatest risks are for consumers of raw shellfish. Next highest are the risks associated with naturally occurring toxins. Less well defined are the acute and chronic risks associated with chemical contaminants.

In June 1988, EPA released a report, completed at the request of Congress, entitled *Assessment of Quincy Bay Contamination*. The study investigated the types and concentrations of pollutants in Quincy Bay, Massachusetts, the incidence of abnormalities in marine life, and the potential public health implications of consumption of seafood exposed to contaminated sediments. Study results indicated that levels of PCBs and PAHs were elevated in sediments and in the marine species studied (see Tables 2-1 and 2-2). Elevated levels of trace metals such as copper, chromium,

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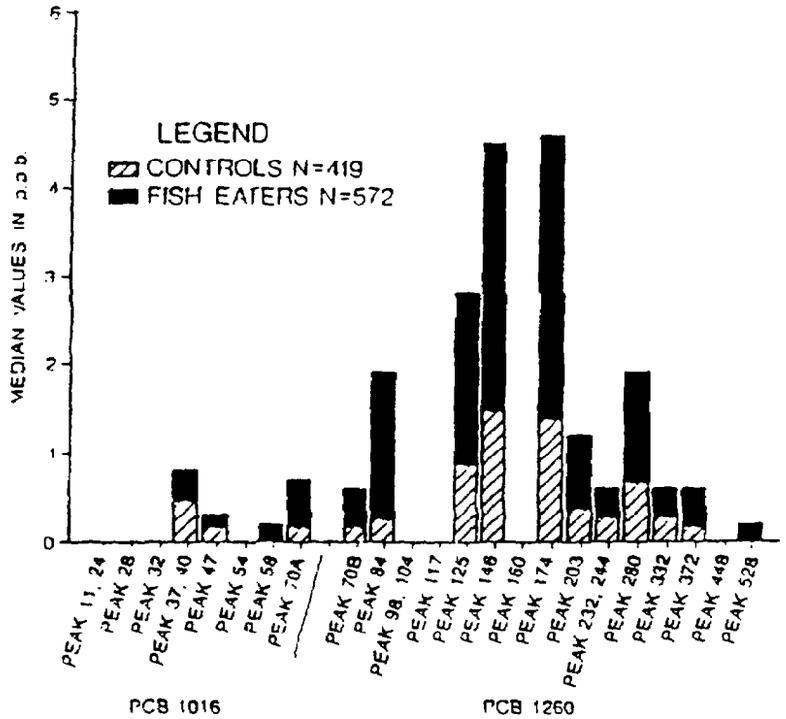

Figure 2-26. Median PCB levels for elution peaks found in human serum of fish eaters and nonfish eaters (from Humphrey, 1987).

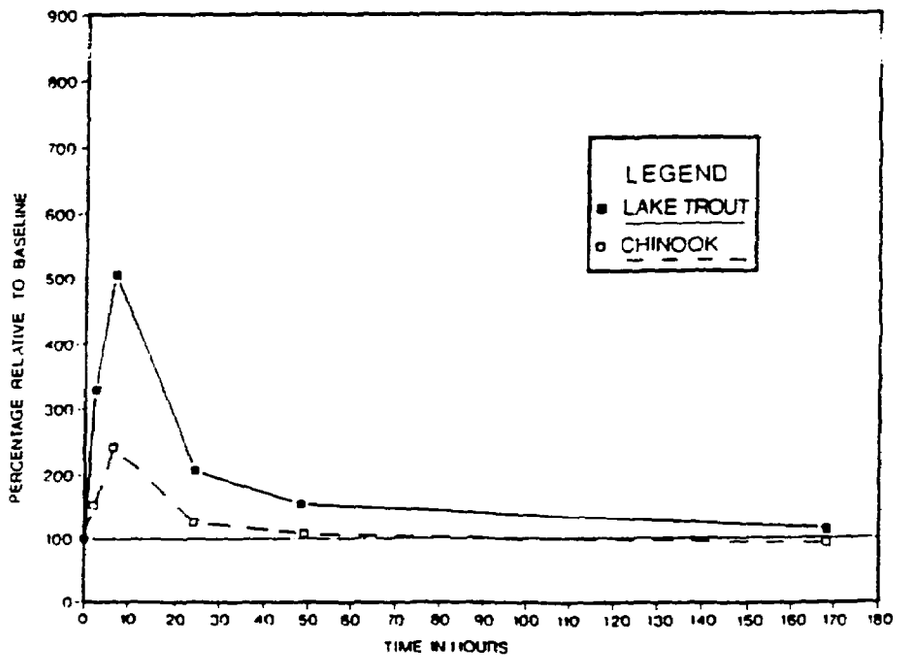

Figure 2-27. Percent change through time in baseline serum PCB levels following a meal of contaminated fish (from Humphrey, 1987).

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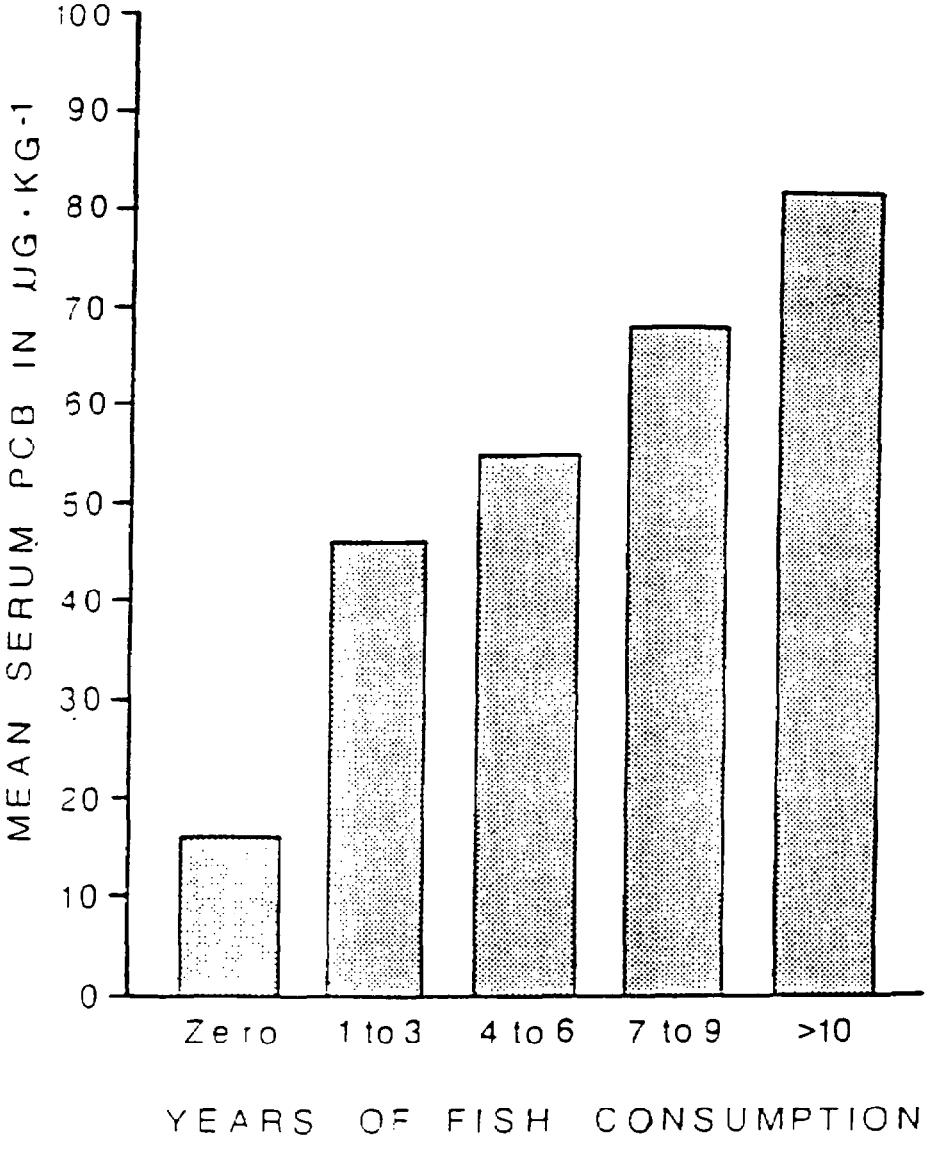

Figure 2-28. Relationship between fish consumption and PCB body burden (from Swain, 1988a).

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8482 women interviewed

4% ate sufficient quantities of contaminated

fish to qualify (1.2 – 41.7 kg/yr)

313 mothers and infants studied

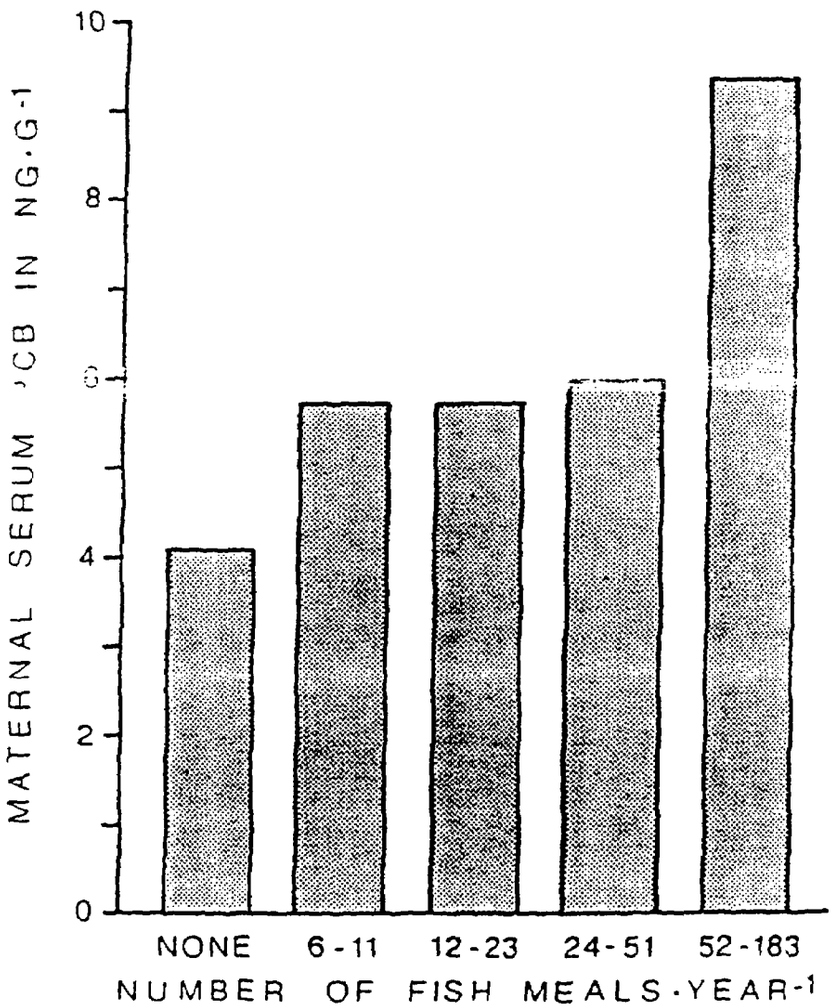

Figure 2-29. Relationship between number of fish meals per year and PCB concentrations in maternal serum (from Swain, 1988a).

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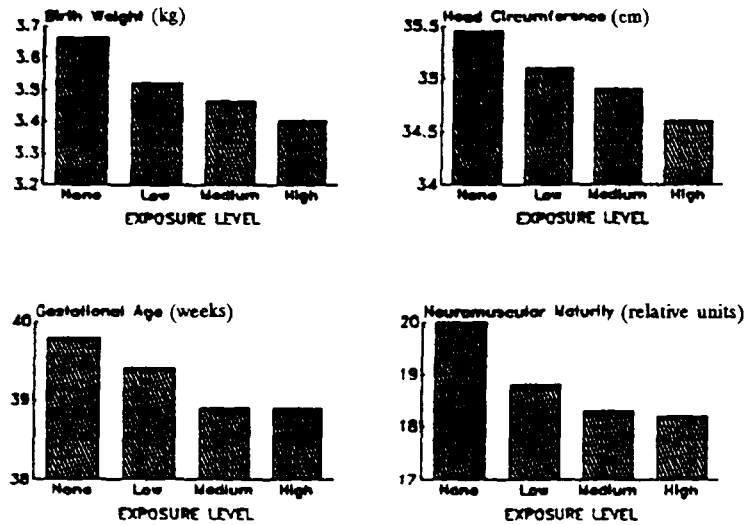

Figure 2-30. PCB dose-response relationships for birth weight, gestational age (Ballard Examination), head circumference, and neuromuscular activity by overall contaminated fish consumption (from Jacobsen et al., 1985; and Fein et al., 1984).

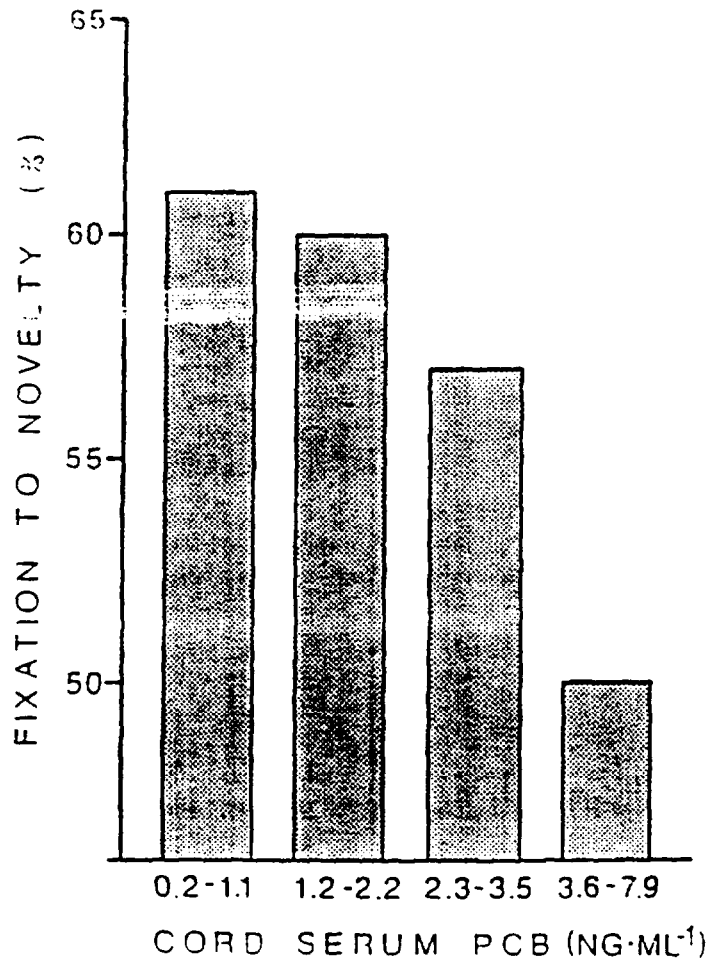

Figure 2-31 Visual recognition memory as a function of fixation to novelty compared with PCB level in umbilical cord serum (from Swain, 1988a).

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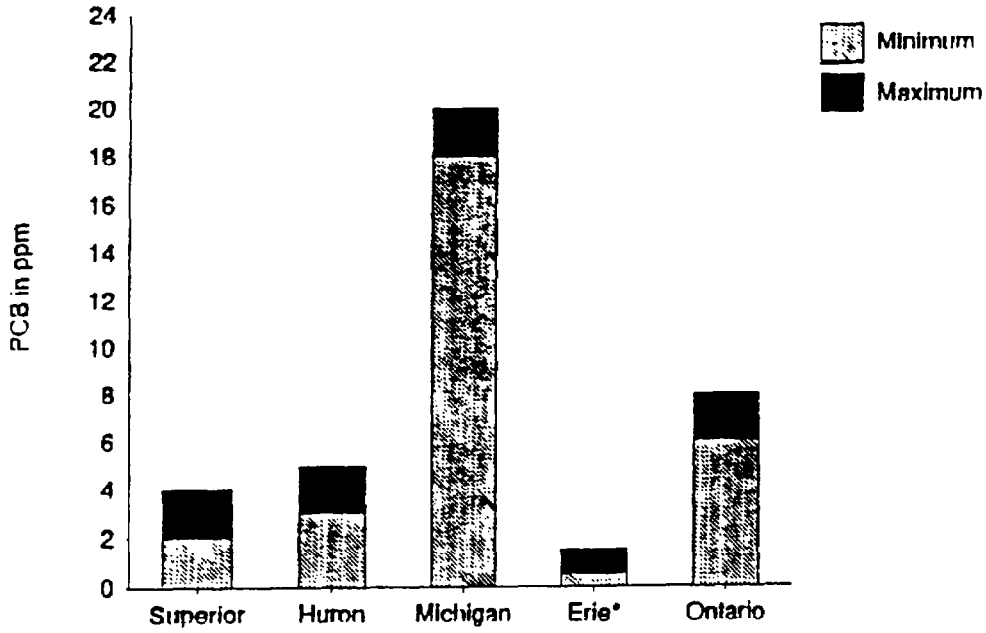

* Coho Salmon in Lake Erie; Lake Trout not present

Figure 2-32. Representative range of PCB levels in Great Lakes fish: mid-1970s (Swain, 1992).

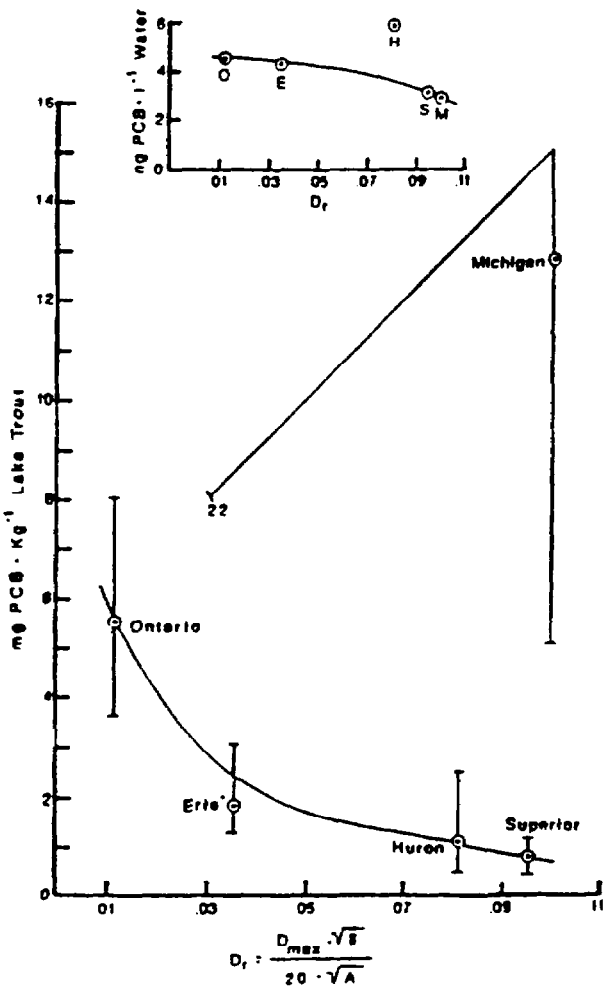

Figure 2-33. Range of reported values of PCB levels in lake trout (Salvelinus namaycush) in the North American Great Lakes, and their associated arithmetic means compared with the relative depth (D_r) of each lake. Relative depth is calculated as a function of the maximum depth (D_{max}) of a lake over the square root of its area (A) (Swain, 1988b).

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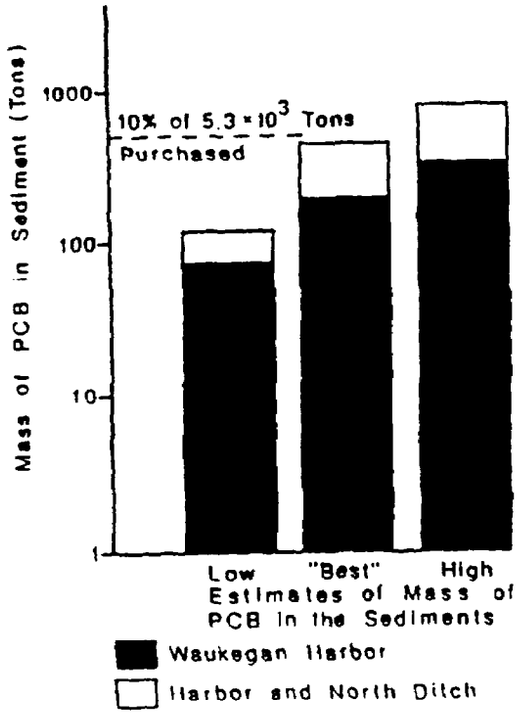

Figure 2-34. Estimates of total PCBs in the Waukegan Harbor-North Ditch complex relative to the 10 percent level of PCBs purchased by the manufacturer between 1955 and 1970 (from Swain, 1988b).

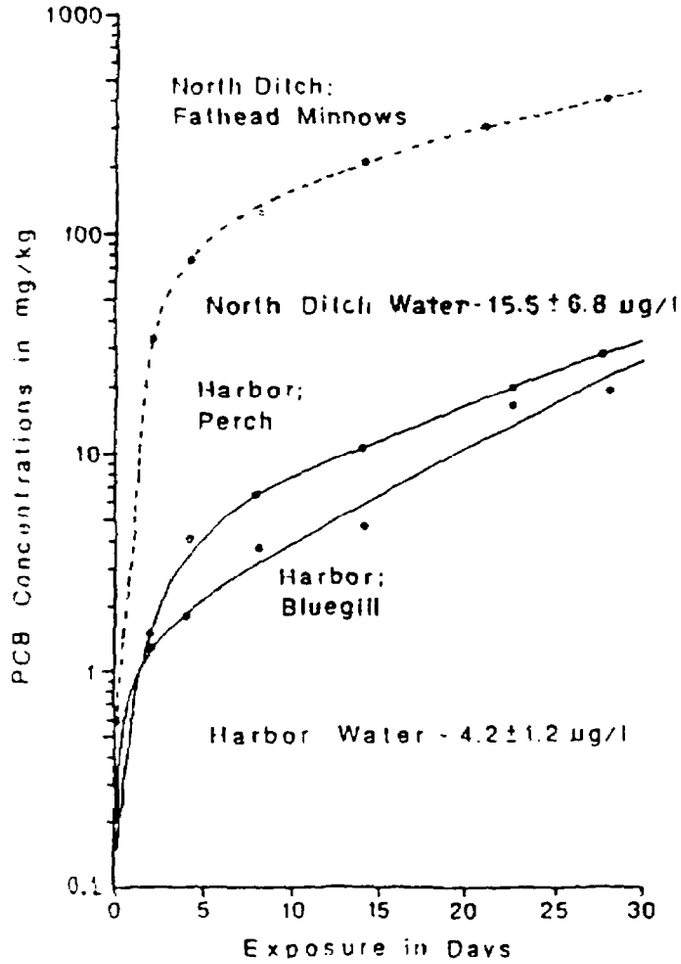

Figure 2-35. Effects of exposure to PCBs from Waukegan Harbor-North Ditch complex demonstrated by caged-fish study (Swain, 1988b).

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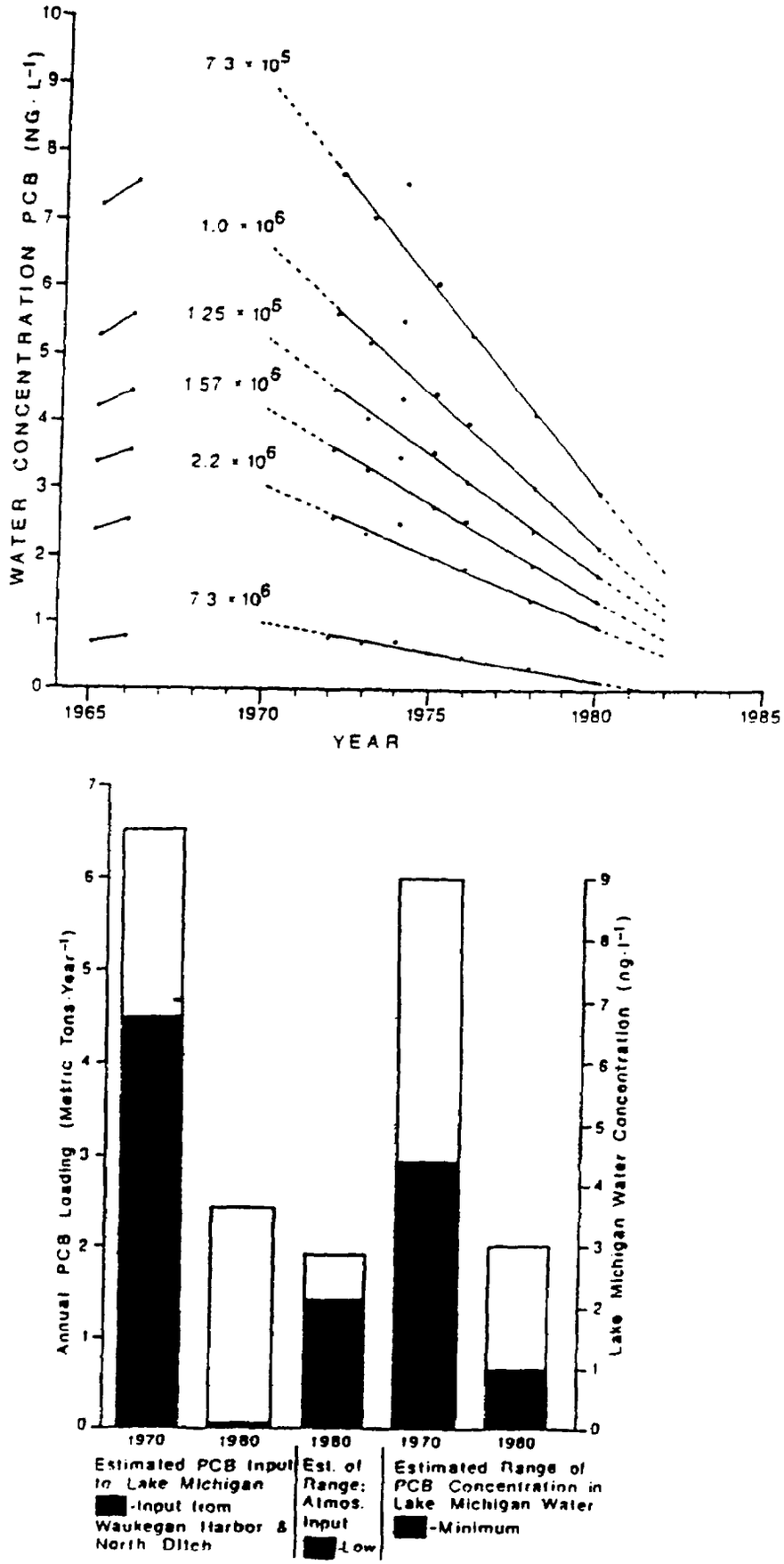

Figure 2-36. Comparison of estimated Lake Michigan PCB parameters for 1970 and 1980 (Swain, 1988b).

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TABLE 2-1

SUMMARY OF ASSUMED LIFETIME CONSUMPTION LEVELS[a]

	Maximally Exposed Individual		Typical Local Consumer	
	Mixed Diet	Flounder Only	Mixed Diet[c]	Mixed Diet[d]
Quincy Bay Clams	16 g/day (26 meals/yr)	--	--	--
Quincy Bay Flounder	113 g/day (about 182 meals/yr)	165 g/day (about 265 meals/yr)	1 g/day (1-2 meals/yr)	1 g/day (1-2 meals/yr)
Quincy Bay Lobster[b]				
Tissue	30 g/day (about 115 meals/yr)	--	2.1 g/day (6-7 meals/yr)	1.7 g/day (6-7 meals/yr)
Tomalley	6 g/day (about 115 meals/yr)	--	--	0.4 g/day (6-7 meals/yr)

[a]Assumes ½ lb. (227 g) serving per meal of clams or flounder and ¼ lb. (113.5 g) serving of edible parts per meal of lobster.
[b]Breakdown of tomalley versus other edible lobster tissue based on MDMF, unpublished data.
[c]Typical diet of flounder and lobster without tomalley.
[d]Typical diet of flounder and lobster with tomalley.

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TABLE 2-2

MAXIMUM UPPER BOUND ESTIMATED LIFETIME CANCER RISKS FROM CONSUMPTION OF QUINCY BAY SEAFOOD

	Maximally Exposed Individual		Typical Local Consumer	
	Mixed Diet	Flounder Only	Mixed Diet[a]	Mixed Diet[b]
Clams	2.1×10^{-4} (<1%)	--	--	--
Flounder	3.2×10^{-3} (13.9%)	4.7×10^{-3} (100%)	2.8×10^{-5} (33%)	2.8×10^{-5} (2.2%)
Lobster Meat	8.0×10^{-4} (3.5%)	--	5.6×10^{-5} (67%)	4.5×10^{-5} (3.5%)
Tomalley	1.9×10^{-2} (82.6%)	--	--	1.2×10^{-3} (92.3%)
TOTAL RISK	2.3×10^{-2}	4.7×10^{-3}	8.4×10^{-5}	1.3×10^{-3}

[a]Typical diet of flounder and lobster without tomalley.
[b]Typical diet of flounder and lobster with tomalley.
Note: Percentages may not add to 100% because of rounding and the need to display no more than two significant digits.

and lead also were found. Flounder and soft-shelled clams were found to exhibit an extremely high incidence of conditions believed to be associated with environmental stress and poor health. Significant histopathologic findings included cancerous lesions; liver, intestinal, and pancreatic pathology; and neoplasms.

The risk assessment concluded that the risks of regular consumption of lobster tomalley (hepatopancreas) from Quincy Bay lobsters were high and were comparable to those associated with advisories and/or fishery closures in Upper New York Harbor of Lake Michigan. Consumption of very large amounts (100 to 200 meals per year) of flounder and/or lobster muscle potentially posed risks higher than those for other generally accepted risks associated with eating, such as consumption of high cholesterol foods. Consumption of "typical" amounts of lobster (not tomalley) and/or flounder (less than 10 meals per year) posed risks similar to those of other eating or drinking activities.

The U.S. Food and Drug Administration (FDA) also conducted a risk assessment of Quincy Bay contamination and arrived at different findings. FDA concluded that PCBs were of little toxicological importance in Quincy Bay and that consumption of tomalley from lobsters taken from Quincy Bay posed a negligible threat to human health. Nancy Ridley stressed that these studies are indicative of the need for interagency coordination and consistency in approaches to conducting risk assessments.

2.2.2.4 Human Health Risks at Superfund Sites Associated with Dermal Contact and Incidental Ingestion of Contaminated Sediments, presented by William R. Alsop, ENSR Consulting and Engineering

Case studies of human health risk assessments performed at seven Superfund sites were used to illustrate the presence and severity of risks associated with contaminated sediments. The range of sediment concentrations were reported for each of the sites. Potential human health risks, both carcinogenic and noncarcinogenic, were derived for each of the sites based on observed sediment concentrations. Human health risks associated with dermal contact and incidental ingestion of contaminated sediments were compared with the overall risks calculated for each of the sites to determine the contribution of these pathways. The assumptions used to derive these risks include the amount of sediment in contact with skin, skin surface area exposed, sediment ingestion rate, body weight, and other parameters based on exposure frequency and duration. Preliminary results indicate that the carcinogenic and noncarcinogenic risks associated with exposure to contaminated sediments via dermal contact and incidental ingestion do not significantly contribute to the calculated total risk. Risks associated with fish consumption often constitute the greatest proportion of the total risk, and sometimes drive the human health risk assessment (see Figures 2-37 and 2-38). This information suggests that even when conservative assumptions about direct human exposure are used, risks associated with dermal contact and incidental ingestion of contaminated sediments are minimal, and contribute less to the calculation of total risk than other pathways, such as fish consumption.

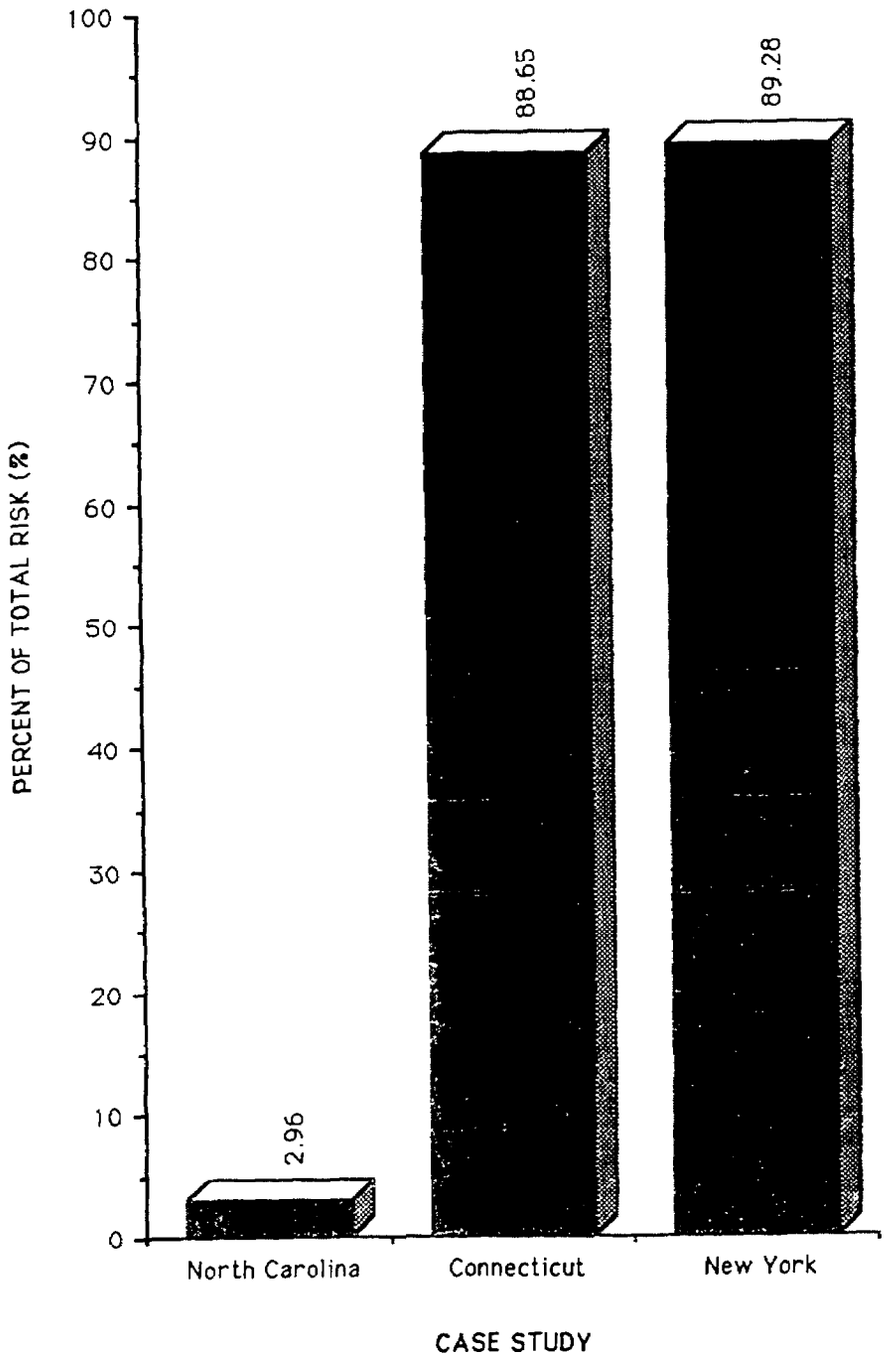

Figure 2-37. Percentage of total risk due to fish ingestion.

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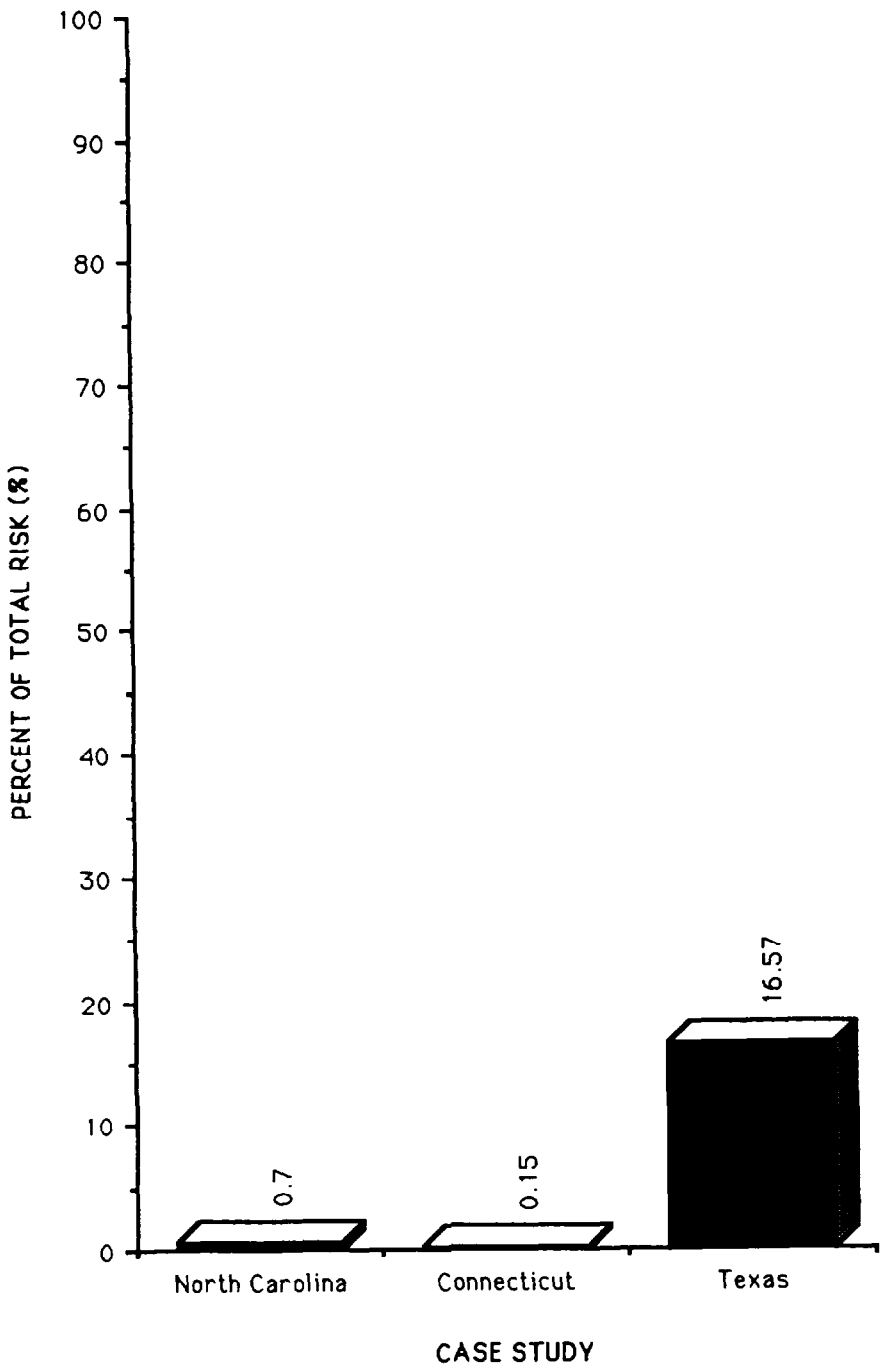

Figure 2-38. Percentage of total risk due to sediment exposure.

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2.2.3 Severity of Contaminated Sediments - Ecological Effects

2.2.3.1 PAHs in Sediment Cause of Liver Tumors and Reduced Lifespan in Brown Bullhead, presented by Paul C. Baumann, U.S. Fish and Wildlife Service

Over the last 15 years, concentrations of PAHs in sediment have been associated with elevated tumor frequencies in six species of fish at 16 locations (Harshbarger and Clark, 1990). One such location is the Black River in Ohio, where brown bullheads three years old or older were found to have a high incidence of liver tumors in a study done from 1980 to 1982 (see Figures 2-39 through 2-43 and Tables 2-3 through 2-6). These same fish had elevated PAH concentrations with a profile matching that found in sediment. There were three orders of magnitude difference between PAH levels in sediment in the Black River and sediment in reference sites. The Black River bullhead population in 1980 and 1981 had a truncated age structure with a lifespan about 70 percent that of bullhead from nearby Old Woman Creek (Baumann et al., 1990). The steel and coke industry underwent a decline in 1982. Residues of such PAHs as phenanthrene, fluoranthene, and the carcinogen benzo(a)pyrene were approximately 10 times higher in bullhead sampled in 1980 and 1981 than in those sampled in 1982. In October 1983, the USX coking plant ceased operation; it has not been reopened. The frequency of liver neoplasms in bullheads over the age of 3 (N=125) was 60 percent in 1982, and the frequency of advanced lesions (cancer) was 39 percent. By 1987 the neoplasm frequency for this same age group (N=80) had declined to almost one-half (32 percent), and the incidence of cancer had been reduced to about one-quarter of the 1982 level (10 percent). Using criteria established for human epidemiology studies, the evidence supports a cause-effect relationship for sediment PAH carcinogens and liver cancer in native fish populations.

2.2.3.2 Integrative Sediment Assessments, presented by Peter M. Chapman, EVS Environment Consultants

Integrative sediment assessments are defined as investigations involving attempts to integrate measures of environmental quality to make an overall assessment of the ecosystem's status. Such assessments include two or more of the following components: sediment toxicity tests, sediment chemical analyses, tissue chemical analyses, pathological studies, and community structure studies. As such, integrative assessments are more than the sum of their parts; the total amount of information about a system extracted by an integrative assessment (through a preponderance of evidence approach) is of much greater utility than the information provided by individual components. The following points were covered (see Tables 2-7 and 2-8):

- Pollution comprises contamination resulting in exposures that cause effects.
- Determining the presence and significance of pollution is not always easy.
- Targets and measures of the five individual assessment components were discussed (see Table 2-7).
- Information provided by each of the five assessment components presents a total picture of the situation. If used in isolation, individual components can be misleading (see Table 2-8).

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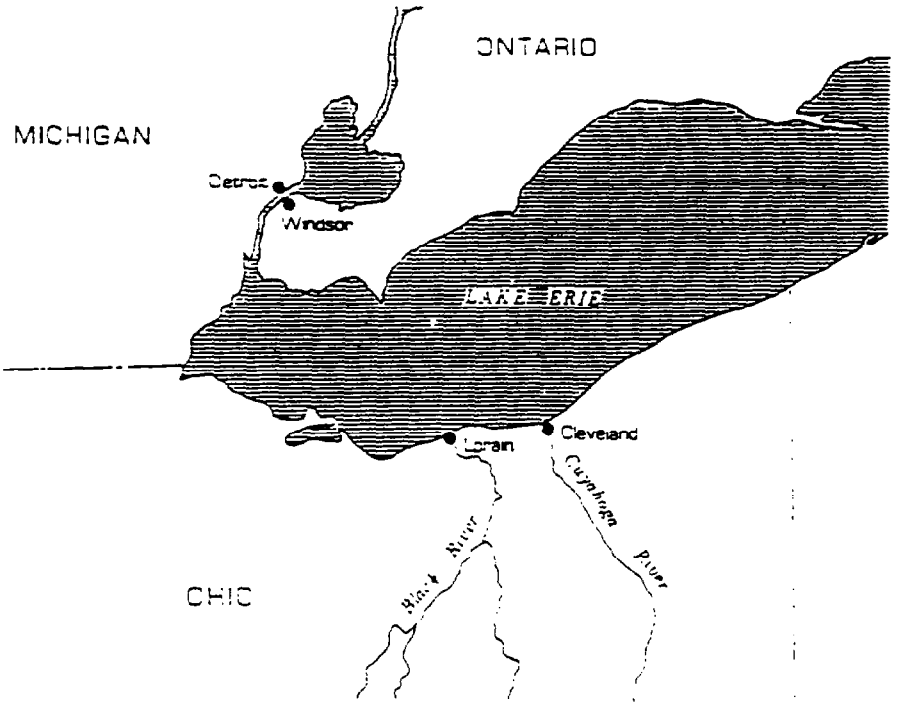

Figure 2-39. Map showing the location of the Black River (Johnston, 1989).

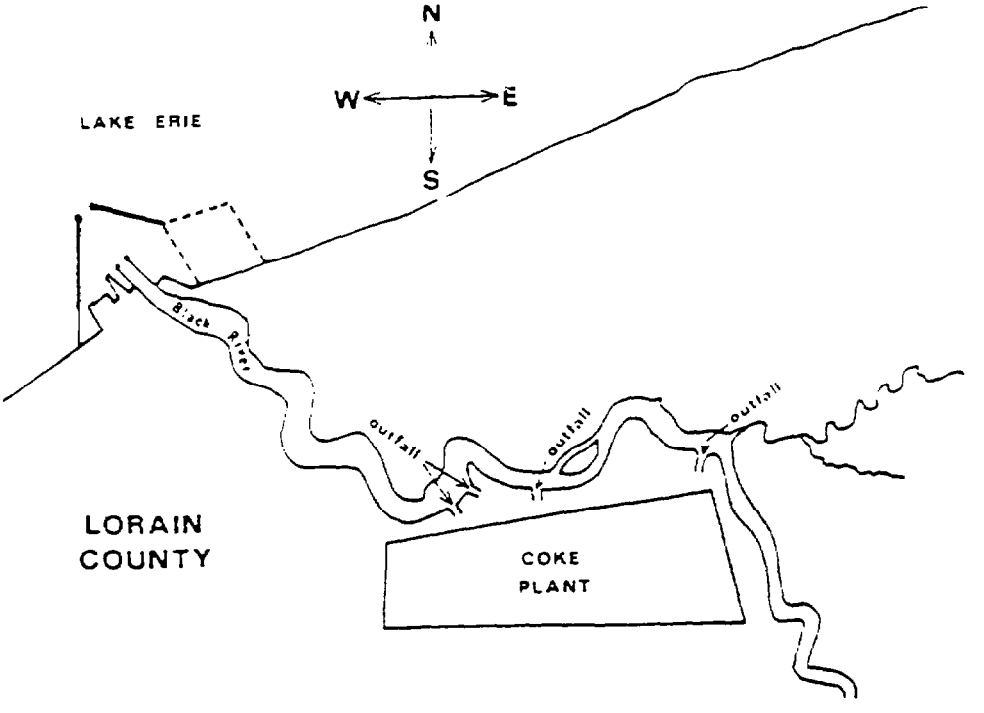

Figure 2-40. Map showing the location of the USX coke facility and outfall on the Black River (Baumann et al., 1987).

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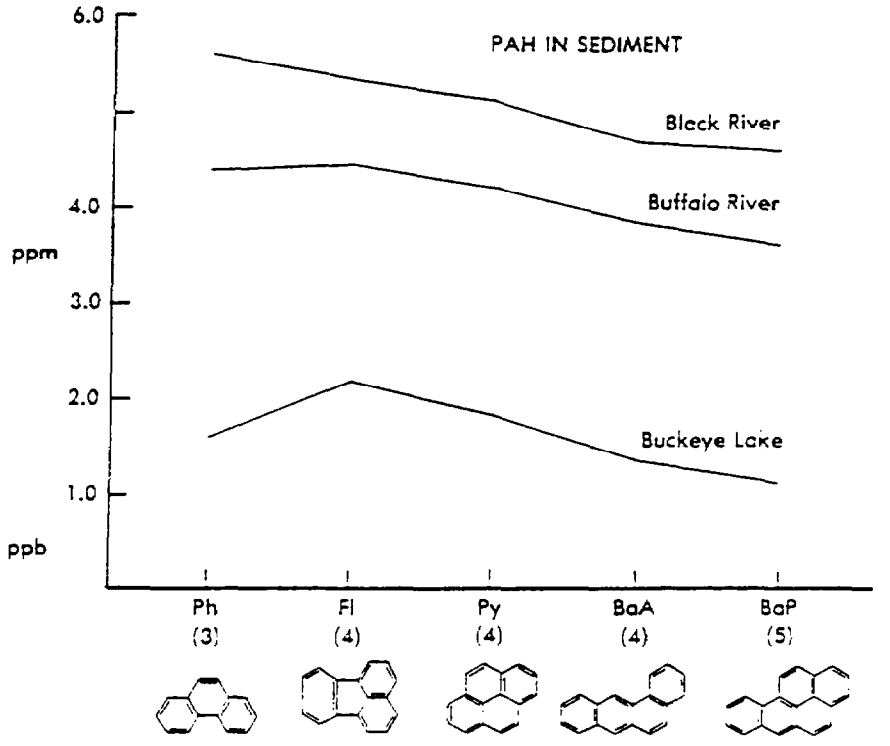

Figure 2-41. PAH residues in sediment of the Black River, Buffalo River, and Buckeye Lake.

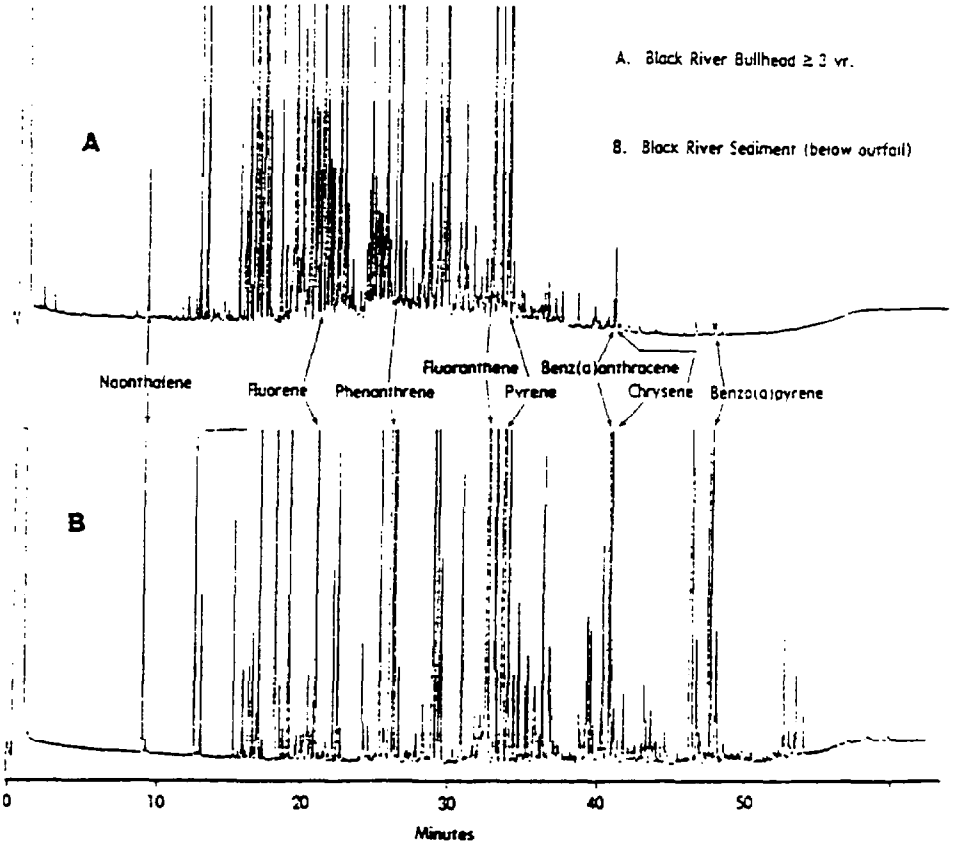

Figure 2-42. Correlation between PAH profile in tissue of brown bullheads and PAH profile in Black River sediment (Baumann, 1989).

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Grossly observable liver tumor frequencies
were very high in Black River bullhead
from 1980-1982 and increased
with increasing age.

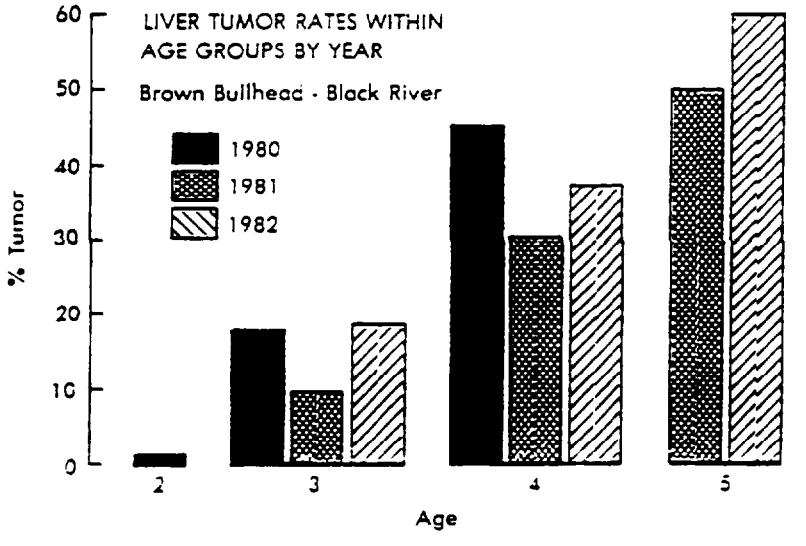

Figure 2-43. Grossly observable liver tumor frequencies in Black River bullhead from 1980 to 1982 and increase with increasing age (Baumann et al., 1987).

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TABLE 2-3

PAH RESIDUES IN AGE 3 BROWN BULLHEAD FROM THE BLACK RIVER

PAH	1980	1981	1982
Dibenzothiophene	509	832	45.8
Phenanthrene	3,930	7,570	161.0
Fluoranthene	1,260	4,040	129.0
Pyrene	756	1,570	83.9
Chrysene	60.5	42	13.2

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TABLE 2-4

DECLINE IN LIVER CANCER IN AGE 3 AND OLDER
BROWN BULLHEAD FROM THE BLACK RIVER

Liver Condition	Year Collected 1982 (N=124)	1987 (N=80)	Sig.
Normal	20.2%	42.5%	**
Cellular Alteration	19.4%	25.0%	
Noncancer Neoplasm	21.8%	22.5%	
Cancer	38.7%	10.0%	**

* $0.01 < p \leq .05$
** $p \leq 0.01$

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TABLE 2-5

DECLINE IN LIVER CANCER IN AGE 3 BROWN BULLHEAD FROM THE BLACK RIVER

Liver Condition	Year Collected 1982 (N=48)	1987 (N=42)	Sig.
Normal	22.9%	45.2%	*
Cellular Alteration	20.8%	33.3%	
Noncancer Neoplasm	25.0%	14.3%	
Cancer	31.2%	7.1%	**

* $0.01 < p \leq .05$
** $p \leq 0.01$

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TABLE 2-6

DECLINE IN LIVER CANCER IN AGE 4 BROWN BULLHEAD FROM THE BLACK RIVER

Liver Condition	Year Collected 1982 (N=73)	1987 (N=29)	Sig.
Normal	19.2%	41.1%	*
Cellular Alteration	19.2%	17.2%	
Noncancer Neoplasm	20.5%	34.5%	
Cancer	41.1%	6.5%	**

* $0.01 < p \leq .05$
** $p \leq 0.01$

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TABLE 2-7

TARGETS AND MEASURES OF INDIVIDUAL ASSESSMENT COMPONENTS

Component	Target(s)	Measure(s)
Sediment Toxicology	Benthos Indicator organisms Commercially and/or ecologically sensitive species	Survival Sublethal effects Chronic effects Mutagenic effects Cytotoxic effects Genotoxic effects
Sediment Chemistry	Sediments	Individual contaminants Sediment features (e.g., grain size) Ancillary analyses (e.g., AVS, TOC)
Tissue Chemistry	Bottom-fish Benthic epifauna Benthic infauna	Individual contaminants Ancillary analyses (e.g., size, weight, age)
Pathology	Bottom-fish	Individual pathological conditions Ancillary analyses (e.g., size, weight, age, lipid content)
Community Structure	Benthic infauna	Taxa presence/abundance Dominance Diversity

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TABLE 2-8

INFORMATION FROM INDIVIDUAL ASSESSMENT COMPONENTS

Component	Information	
	Provided	**Lacking**
Sediment Toxicity	Laboratory responses(s) by organisms to test conditions	Field responses Responses to test not conducted and organisms not exposed
Sediment Chemistry	Presence and levels of measured chemicals	(Bio)availability Presence and levels of chemicals not measured
Tissue Chemistry	Presence/levels of chemicals in organisms/tissues Bioavailability	Effects Presence of transformed chemicals Presence/levels of chemicals not measured
Pathology	Presence/levels of measured responses in organisms and tissues	Effects Presence/levels of responses not measured
Community Structure	Presence/numbers of taxa/individuals	Causality Ecosystem level relevance

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- Two case study examples (the Gulf of Mexico and the North Sea) showed that pollution was associated with populated areas, and hot spots were restricted rather than widespread.

- Use of a preponderance of evidence approach includes drawing conclusions from individual components considered relative to each other and considering different viewpoints when determining possible mechanisms.

- The objective of integrative assessments is to use the best professional judgment for decision-making based on data, facts, intuition, background knowledge, characteristics of the site, and experience.

2.2.3.3 Ecological Effects of Contaminated Sediments in the Elizabeth River, presented by Robert C. Hale, Division of Chemistry and Toxicology, Virginia Institute of Marine Science, College of William and Mary

Assessing ecological effects is a more difficult task than delineating the extent of sediment contamination. Important effects can be expressed in a number of ways, some of which are difficult to detect. To examine the relationship between ecological effects and sediment contamination, a severely polluted area has been chosen for study.

The Elizabeth River is a subestuary of the Chesapeake Bay and is heavily contaminated with a variety of pollutants, particularly aromatic hydrocarbons. Sediment gradients of these latter compounds have been established. Examination of benthic communities in the Elizabeth River suggests impacts from exposure to contaminated sediments. Uptake of organic compounds in fish has been observed by assaying bile from exposed fish. Bioaccumulation of aromatic hydrocarbons in commercially fished, resident crabs has also been documented. In addition, the frequency and intensity of neoplasms, cataracts, enzyme induction, finrot, and other lesions observed in fish populations is correlated with the extent of sediment contamination (see Figure 2-44). Laboratory studies have been conducted in an attempt to elucidate whether these sediments are responsible for the observed effects. Fish maintained in the laboratory in contact with sediments taken from the Elizabeth River exhibited several of the symptoms observed among fish populations in the field. Additional laboratory studies have implicated contaminants from sediments as causal agents for other effects, such as immune system dysfunction.

2.2.3.4 Case Studies of the Ecological Effects of Contaminated Sediments in the Northeastern Gulf of Mexico, presented by Barry A. Vittor, Barry A. Vittor & Associates, Inc.

Four case studies of typical northeastern Gulf of Mexico estuaries provide information on the ecological effects of contaminated sediments, through benthic macroinfauna, acute toxicity, and bioaccumulation investigations.

Upper Mobile Harbor (Alabama) sediments contain high concentrations of lead (64 to 477 mg/kg), copper (16 to 72 mg/kg), zinc (150 to 543 mg/kg), and PCBs (up to 1,267 ppb). No biological studies have been conducted in the most contaminated area (Industrial Canal), but benthic communities in the adjoining Mobile River contain less than half the number of species and individuals found in the upper estuary just outside the harbor.

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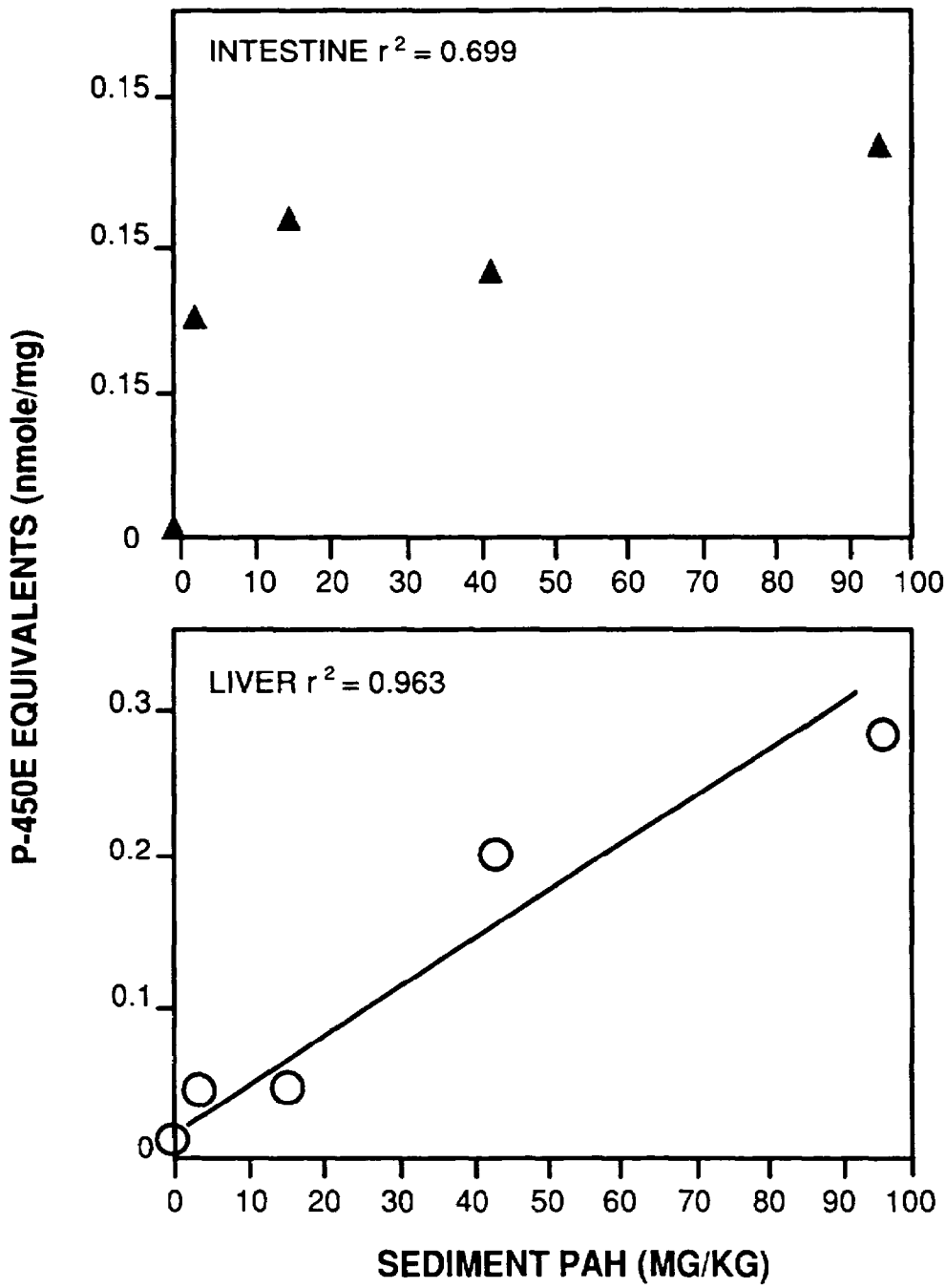

Figure 2-44. Sediment contamination and correlation with enzyme induction in spot (*Leiostomes xanthurus*) (Van Veld et al., 1990).

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Lower Mobile Bay and an area southwest of the bay entrance are known to be sinks for fine-grained sediments and contain unusually high levels of arsenic (up to 80.8 mg/kg), lead (160 mg/kg), nickel (34.6 mg/kg), and zinc (187 mg/kg). Benthic species abundances in the bay sink (20 taxa) and offshore sink (35 taxa) were lower than in other areas of the lower estuary. Individual abundances (990/m^2 in the bay and 2,667/m^2 offshore) were also lower than in uncontaminated areas. Bioassay results indicated no acute toxicity.

Expansion of Pensacola Harbor, Florida, involved disposal of 4.1 million cubic yards of sediment in an offshore disposal site. Sediments contained moderate quantities of chromium (up to 91.7 mg/kg) and total organic carbon (9.8 percent). Benthic communities in the disposal site exhibited a 24 percent decrease in species abundance and a 29 percent decrease in individual abundance. Acute toxicity bioassays showed no effects on test species, and no bioaccumulation was observed.

St. Andrew Bay, Florida, is a relatively deep estuary (up to 13 m) in which limited flushing has resulted in organic material accumulation mostly from paper mill and municipal waste treatment facilities, as well as from nonpoint sources. Volatile organics comprise up to 34.7 percent of sediments in areas deeper than 8 m. Other contaminants (metals, hydrocarbons) occur in only moderate to low concentrations. Benthic communities in the deep sink areas exhibit only 30 percent of the species and 42 percent of the individuals present in shallower, less-contaminated areas.

Acute toxicity and bioaccumulation testing of sediments from each of these four areas has not indicated ecological effects of contaminants, despite apparent and sometimes severe ecosystem impacts shown by benthic macroinfauna studies.

2.3 SUMMARY OF COMMENTS AND DISCUSSIONS

The comments and discussions centered on several topics, including the draft outline of EPA's Contaminated Sediment Management Strategy, the definition of contaminated sediment, the extent and severity of contamination in the nation's sediment, the need and uses for national sediment quality criteria, and future research needs. The following comments were made by various forum participants during the discussion.

2.3.1 Comments on Draft Outline of EPA's Contaminated Sediment Management Strategy

A representative from the U.S. Army Corps of Engineers suggested that the tiered approach used by COE to manage dredged material disposal could be applied by EPA to identify areas with contaminated sediment.

Donald Hughes, representing the Atlantic States Legal Foundation, presented formal comments on the draft outline of EPA's Contaminated Sediment Management Strategy. He stated the Foundation's concern over their interpretation that the Strategy would call for remediation of sites only where the cleanup is practical. Under some circumstances, sediments might pose significant risks and should be remediated regardless of practicality. The Foundation believes that sediment standards and pollution prevention requirements should be applied universally, not just in areas with identified problems. The Foundation is concerned about the plausibility of natural biodegradation improving sediment quality in a reasonable time frame and about the capacity in

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some geographical areas to accommodate enough natural deposition of clean sediment to adequately cover contaminated sediment. The Foundation recommended that EPA have numerical guidelines for all NPDES permits for protecting sediment and better controls for nonpoint sources. Hughes suggested that EPA develop a Technical Assistance Grant Program for addressing areas with contaminated sediment. Hughes applauded the inclusion of sediment considerations in the Superfund Hazard Ranking System and EPA's emphasis on pollution prevention as a means of reducing future contamination.

Richard Schwer, representing the Chemical Manufacturers Association (CMA), presented comments on the draft outline of EPA's Contaminated Sediment Management Strategy. The CMA generally supports an EPA assessment of the sediment contamination problem. The CMA does not, however, believe that EPA's existing data reveal a problem of national scope warranting a comprehensive management strategy. The CMA does not believe there is a correlation between sediment contamination and biological effects. The CMA believes that the study conducted by EPA in 1985, entitled National Perspective on Sediment Quality, showed only a small number of hot spots and that quality of the data in the study was unknown since detailed information on sample collection methods, sediment characteristics, and quality assurance/quality control procedures were not included in the data base. The CMA feels that only severely contaminated sites should be addressed by the Strategy. In addition, the Strategy calls for identifying a list of chemicals of concern for sediment. The CMA is concerned that the Strategy does not assure the list will be compiled in a way that will include only chemicals actually concentrating in sediment at levels adversely affecting human health and the environment.

Participants recommended that EPA add Federal Drug Administration, Centers for Disease Control, and Agency for Toxic Substances and Disease Registry to the list of cooperating agencies in the draft outline of the Strategy.

2.3.2 Definition of Contaminated Sediment

Discussions suggested that contamination could be defined as the presence of pollutants above levels expected in the absence of human influence. The EPA Contaminated Sediment Management Strategy has not defined contaminated sediment. There was a consensus that the Agency should focus its efforts on developing assessment methods that can identify areas where sediment contamination is a problem.

2.3.3 Extent of Contamination

National monitoring programs such as the Environmental Monitoring and Assessment Program and NOAA have collected data indicating that, although areas containing contaminated sediments may be numerous, the geographic extent of each individual contaminated area may be relatively small. Sediment contaminants are often found in areas subject to human influence. They are frequently near urban areas where contaminants are concentrated by hydrodynamic factors. In the United States, these contaminated areas are widespread and numerous.

The participants generally supported a national inventory of contaminated sediment sites, but noted that the primary purposes and benefits of mounting such an effort must be identified. A set of criteria for determining the sites to be included in the inventory must be developed and should probably be based on sediment chemistry, effects, and intended uses of the area. The

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participants seemed to agree that, in the absence of observed effects, a site should probably not be a candidate for the inventory. When conducting a national inventory, data on major point source locations and physical features of the receiving water bodies that influence hydrodynamics can assist in predicting where problem areas might occur.

Many sets of decentralized historical data are available; these sets have been compiled for various permit-related environmental reports or site studies. These data have generally been compiled for state and federal authorities, the majority by contractors. The COE regional offices also have considerable data related to the dredging program. The Federal Energy Regulatory Commission is probably another source of data on sediment near hydroelectric facilities. If existing data could be compiled and run through proper quality assurance/quality control procedures, it could be useful in providing information on the extent of contamination, particularly if mapping techniques were applied.

Consistency in testing methods is important in determining contaminant levels in sediment. Test results from different laboratories using different test methods, detection limits, and technicians with various levels of experience and qualifications can yield very different results on the same sample. Historical data were often generated using higher detection limits than used recently. Thus, historical data can lead to false impressions about the presence of a pollutant over time.

2.3.4 Severity of Contamination

Determining the severity of sediment contamination is a complex undertaking. Standardized approaches are needed to measure and assess effects of contamination. Interpretation of both technical results and societal values are components of the definition of severity. When determining the severity of contamination, the potentially exposed population and the current uses of contaminated areas should be considered. Hydrodynamic factors and residence time will influence the severity of contamination.

Criteria must be developed for determining when sediment contamination brings about effects and is therefore a problem that warrants remediation. The simple presence of elevated levels of metals, for instance, does not necessarily imply significant ecological effects. Sediment is a complex mixture, and site-specific factors influence the bioavailability and potential exposure of contaminants to aquatic life and humans. In addition to toxic chemical contamination, effects from microbial contamination should be considered. Other pollutants not currently being studied might be responsible for significant effects as well.

There is an urgent need for determining which effects are important and how to measure them (i.e., What bioassays are most appropriate? Are field studies most appropriate?). Laboratory tests might not reflect true field conditions. EPA should focus attention on how to interpret laboratory tests in terms of effects that can be expected in the field. It is difficult to standardize an approach to assessing effects, and a large amount of data is needed to complete a proper evaluation.

Best professional judgment (BPJ) should be used when making decisions regarding the severity of contamination at a particular site. BPJ should be based on data from an integrated assessment, coupled with information on the characteristics of a site and the decision-maker's experience.

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Although contaminated in-place sediment may not show effects, one has to assess the risk of exposure from future events, such as storms or future dredging activities, that can mobilize contaminants. Assurance that contaminants will remain immobile is needed if the management strategy for a particular site is to allow natural recovery to take place. Also, the risks of disturbing sediment for remediation purposes should be weighed against the risks of leaving it in place.

Site-specific evaluations are usually necessary in determining the need for fish advisories. Sports anglers usually have high fish consumption rates and may continue to consume fish taken from contaminated sites for lengthy periods of time. When considering fish advisories, the risks of consuming contaminated fish should be weighed against the benefits of consuming fish versus other sources of protein such as beef.

There are many uncertainties associated with the risk assessment process. Additional work must be completed to develop a better understanding of fish consumption rates, other exposure assumptions, and the potency factors. Potency factors express the degree to which specific chemicals have been linked to certain diseases, such as cancer. (Cancer potency factors are common measures of human health effects of chemical exposures.) Currently, human health risk assessments add cancer potency factors for individual chemicals present in sediment samples. This method does not account for the synergistic effects of complex mixtures of pollutants in sediment. Furthermore, for some compounds there may be endpoints other than cancer that should be investigated and considered in the risk assessment process. Refinement of risk assessment procedures will be needed to more accurately predict potential effects.

The specific PCB cogeners, types of PAH, or metal species must be measured to give a more accurate prediction of the possible effects from contamination.

2.3.5 Sediment Criteria

Concern was expressed over how sediment criteria will be used and what role they will play in managing contaminated sediment. Site-specific conditions of the sediment, such as the presence of iron sulfide or organic material, influence the bioavailability and toxicity of certain pollutants. Sediment criteria will be a useful screening tool in determining when and how contaminated sediment should be managed. Criteria may be modified by site-specific factors to be used effectively in decision-making processes.

2.3.6 Research Needs

More research is needed on the sediment conditions that affect the toxicity of pollutants such as PAHs. In addition, research is needed to determine how aquatic organisms metabolize PAHs and what the effects of the metabolites are.

Research is needed to develop mechanisms for quantitative ecological assessments of sediment contamination effects and to refine the human health risk assessment techniques currently used.

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CHAPTER THREE

BUILDING ALLIANCES AMONG FEDERAL, STATE, AND LOCAL AGENCIES TO ADDRESS THE NATIONAL PROBLEM OF CONTAMINATED SEDIMENTS

3.1 INTRODUCTION

As part of the development of the Agency-wide Contaminated Sediment Management Strategy, EPA's Office of Water (OW) sponsored the second of three forums to present and discuss federal, state, and local perspectives on contaminated sediment management. This forum took place in Washington, DC, on May 27 and 28, 1992, bringing together contaminated sediment management experts and policy makers from numerous EPA program offices and regions, the U.S. Army Corps of Engineers (COE), the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service (FWS), the U.S. Department of Agriculture (USDA), the U.S. Department of Energy (DOE), and the States of California, Florida, Washington, and Wisconsin. The forum commenced with opening remarks by Elizabeth Southerland, Chief of EPA's Risk Assessment and Management Branch, OW, who emphasized the importance of public participation and interagency coordination in the development of the Strategy.

The forum was conducted in three parts corresponding to the three principal elements of EPA's Contaminated Sediment Management Strategy: contaminated sediment assessment, prevention, and remediation. Each part of the forum consisted of presentations by representatives of federal and state agencies followed by a period of formal public comment and open discussion (facilitated by Virginia Tippie of the Council on Environmental Quality [CEQ]). EPA requested that forum participants representing each agency focus their presentations on four points:

- What the agency/organization is doing to assess, prevent, or remediate sediment contamination.
- How the agency/organization's contaminated sediment management program coincides with EPA activities outlined in the Strategy.
- How two or more agencies can work together to effectively manage contaminated sediments.
- The strengths and weaknesses of EPA's Strategy.

The following sections summarize EPA staff presentations describing the three principal parts of the Agency's Contaminated Sediment Management Strategy (Section 3.2 - assessment, Section 3.3 - prevention, and Section 3.4 - remediation). These sections also include remarks made by the various federal and state agencies regarding their contaminated sediment management efforts and the EPA Strategy. Each section includes summaries of panel presentations and questions

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addressed to the panels during open discussion. Section 3.5 summarizes EPA's response to recommendations made by forum participants.

3.2 ASSESSMENT

3.2.1 **EPA's Proposed Assessment Strategy**, presented by Elizabeth Southerland, Risk Assessment and Management Branch, Office of Water, U.S. EPA

The assessment component of EPA's Strategy calls for a national inventory of contaminated sediments and sources of contaminated sediments; the development of a consistent, minimum set of chemical and biological tests for evaluating sediments; and increased monitoring of sediment conditions. A national inventory of sites with contaminated sediments would allow EPA to complete the best possible near-term assessment of the national extent and severity of the contaminated sediment problem, identify areas that need further assessment, and target those areas and contaminants causing high human health and ecological risks for appropriate remedial actions. The national inventory would rely in part on existing data. Additional data would be needed, however, in areas where sediment quality data have not been collected; acute toxicity tests were used inappropriately; or crucial data characterizing sediment, such as grain size, organic content, or the presence of acid volatile sulfides, have not been documented. Pilot inventories using existing data are near completion in Regions IV, V, and VI.

EPA also will conduct a pilot inventory of sources of sediment contamination using Toxics Release Inventory (TRI) data, effluent guidelines data, and other sources of data. The inventory will be closely coordinated with the Office of Prevention, Pesticides, and Toxic Substances (OPPTS). It will be used to target pollution prevention and source control activities, including the selection of industries for the development of new or revised effluent guidelines, permitting, and enforcement actions.

EPA is committed to promulgating a minimum set of chemical criteria and biological tests for evaluating sediments and the risks they pose to aquatic and terrestrial environments. This effort includes the selection of acute and chronic toxicity bioassay techniques for use across all EPA programs, the development of sediment quality criteria based on the equilibrium partitioning method, and selection of bioaccumulation bioassays. An Agency-wide workgroup will recommend a minimum set of acute and chronic bioassay methods for review and approval by EPA's Sediment Steering Committee. Sediment quality criteria for nonpolar hydrophobic organic contaminants have undergone three reviews by EPA's Science Advisory Board (SAB). The SAB plans to issue its report in Fall of 1992. EPA hopes to publish the proposed criteria in the *Federal Register*, announce a formal public comment period, and finalize the criteria following public review. The biological test protocols will not go through such a lengthy regulatory approval process.

A key aspect of the assessment strategy involves improving the monitoring of sediment quality. Data from ongoing monitoring programs could enhance EPA's ability to predict the effectiveness of natural recovery processes and identify the contribution of particular sources of contaminants to ongoing sediment contamination. EPA's Office of Research and Development (ORD) will monitor sediment quality, water column quality, and fish tissue contaminant concentrations in its extensive Environmental Monitoring and Assessment Program (EMAP). In addition, EPA has joined forces with USGS to form the Water-Quality Monitoring

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Intergovernmental Task Force (ITF) with federal, state, and local representation. The task force will formulate national monitoring protocols, quality assurance/quality control (QA/QC) procedures, and data transfer systems. EPA's water quality data systems (STORET, BIOS, and ODES) are in the midst of a 7-year modernization effort that will include special provisions for archiving and accessing sediment quality data.

ORD's FY92 budget includes $2 million for researching acute and chronic bioassay techniques, sediment quality criteria, fate and transport modeling, and remediation technologies. Current EPA research activities also include field validation of bioassay and sediment quality criteria developed under laboratory conditions; the Assessment and Remediation of Contaminated Sediments (ARCS) demonstration program in the Great Lakes; and a technology transfer program for rapid dissemination of information on remedial technologies, monitoring and sampling techniques, and other data of interest in managing sediment contamination. EPA hopes to have a sediment management technology transfer center available within the next year.

3.2.2 Federal and State Agency Assessment Programs

3.2.2.1 Gail Mallard, Toxics Substances Hydrology Branch, Water Resources Division, U.S. Geological Survey (USGS)

USGS, along with a number of other federal agencies (COE, Bureau of Land Management [BLM], U.S. Forest Service, Tennessee Valley Authority [TVA], and USDA), plays an important role in the implementation of the Federal Interagency Sedimentation Project. Mandated by OMB, the Federal Interagency Sedimentation Project focuses on the study of physical properties of sediments, fate and transport mechanisms, rates of sedimentation, and sediment grain size. These physical characteristics and mechanisms often determine the degree to which existing sediments trap contaminants and the time period over which natural recovery will occur. Research is also conducted under the project to properly calibrate instruments to measure the movement of suspended sediment in rivers.

USGS cochairs the Interagency Task Force on Monitoring Water Quality (ITFM) with EPA. The task force was created to heighten information sharing among federal and state agencies and research issues of data comparability. The ITFM will recommend a list of "best" water and sediment quality indicators to be used in assessing regional water quality and sediment quality, and directing resources toward sites with the most severe levels of contamination.

Other important areas of USGS research include developing models of sediment transport, deposition, and resuspension; modeling fish uptake of sediment contaminants; and looking at issues of bioavailability of sediment contaminants. Because data on sediment texture (i.e., grain size) are readily available in most cases, USGS has studied the correlation between sediment texture and the potential for sediment contamination and bioavailability. Study results could be extremely useful to infer contaminant levels in areas where contaminant observations are sparse. As part of its research on Boston Harbor and Massachusetts Bay, USGS is developing techniques for archiving data, exercising quality control, and displaying historical data. The archived data will be available on CD-ROM for retrieval on PCs.

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In another major sediment research effort, USGS's National Water Quality Assessment Program will examine the occurrence of 45 trace metals and over 100 synthetic organics in the water column, sediment, and biota at some 60 sites nationwide. The 60 sites constitute more than 60 percent of the nation's public water use. This effort is coordinated with EPA, USDA, and FWS with the goal of measuring baseline conditions and also monitoring conditions over time to define trends. Each site will have an advisory board made up of representatives from these federal agencies as well as state and local agencies and organizations. The program plans to relate water and sediment contamination to human activities where appropriate. The effort began in 1991 and will continue over the next decade.

Dr. Mallard noted that USGS and EPA can coordinate efforts to develop information about contaminated sediments. The data available through the National Water Quality Assessment Program would certainly be of use in a national inventory. The greatest strength of the EPA assessment strategy, according to Dr. Mallard, is its emphasis on federal, state, and local agency cooperation and its coherent and integrated plan for bringing together the many program offices within EPA that currently address sediment assessment. Dr. Mallard looks forward to seeing the outline transformed to a complete document with greater detail. Conducting a national inventory may prove to be difficult and USGS would be happy to lend EPA its considerable expertise in that area.

3.2.2.2 David Moore and Joseph Wilson, U.S. Army Corps of Engineers (COE)

COE, in fulfilling its mission to maintain, improve, and extend the nation's waterways, is responsible for managing large volumes of dredged material each year. COE's Dredged Materials Research Program has been in place since 1973, and has collected a wealth of information pertinent to the assessment and modeling of sediment contamination, fate, transport, and disposal.

Dr. Moore and Mr. Wilson focused their presentation on the relative merits of what was termed effects-based testing versus chemical criteria derived by means of equilibrium partitioning (EP). COE employs a tiered testing approach to evaluate the potential toxicity of sediments and the effect of their disposal on benthic communities and water column concentrations. The tiered approach consists of four tiers of effects-based testing with each tier increasing in complexity, certainty of assessment, and cost. The first tier involves the evaluation of historical data, the second examines physical and chemical sampling to develop predictive models, and the third tier employs acute toxicity tests and evaluates bioaccumulation potential. The fourth tier requires advanced biological effects testing, possibly including chronic sublethal effects tests, field assessments, and environmental risk assessment.[1] COE may initiate sediment evaluation at any tier and proceeds through tiers only until sufficient information has been obtained to make an informed decision. COE maintains that this approach provides cost-effective sediment assessment that is sensitive to particular site conditions.

COE prefers the tiered testing approach to the use of numerical sediment quality criteria for a number of reasons. The tiered testing approach accounts for the complexity of the

[1]COE has yet to develop the sublethal, chronic effects-based test required in tier four. COE expects to have such a test within 2 to 3 years.

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relationship between sediment contamination and biological effects, and allows for site-specific evaluations of sediment toxicity that may not be incorporated in chemical-specific sediment criteria. COE fears that the chemical-specific criteria currently under development at EPA ignore complicated factors that determine the bioavailability of sediment contaminants, as well as the potential for interactive effects of multiple contaminants. COE also stated that tiered testing has been a regulatory requirement for more than 20 years and its application is agreed upon, whereas the applicability and regulatory status of chemical sediment criteria are not clear. Mr. Wilson stated that he believes there should be one regulatory system for assessing sediment contamination, and he warned against relying on theoretically derived chemical criteria that may "give easy answers to what are often viewed as complex questions." Dr. Southerland of EPA commented that EPA does not agree with the above criticisms of chemical sediment criteria.

Overall, COE wholeheartedly supports the EPA Strategy, and believes it will eventually help to reduce the cost of dredged material disposal by reducing the point and nonpoint sources of sediment contamination. COE applauds EPA's intention to develop a national inventory of sediment contamination sites and sources and EPA's continuing efforts in developing consistent effects-based testing protocols.

3.2.2.3 Andrew Robertson, Coastal Monitoring and Bioeffects Assessment Division, National Oceanic and Atmospheric Administration (NOAA)

NOAA's National Status and Trends (NS&T) program monitors long-term trends in environmental quality of U.S. coastal and estuarine waters. The "mussel watch" component of the program measures sediment contamination at 220 sites nationwide, and the "benthic surveillance" component measures sediment contamination at about 70 sites nationwide. Over 70 contaminants and other sediment characteristics are measured at these sites on a bi-annual basis. NOAA selects sampling sites that it believes to be representative of larger aquatic ecosystems. Hence, sampling does not generally take place near known sources of contamination since this might result in biased sampling data. Other components of the NS&T program include historical assessments of sediment contamination through core sampling and bioeffects studies in areas of elevated contamination using acute and chronic effects-based testing methods.[2]

Dr. Robertson noted that EPA has developed a coherent Contaminated Sediment Management Strategy and coordinated the sediment-related activities of the many program offices within EPA. He voiced several concerns with the Strategy, however. Dr. Robertson cautioned EPA that many federal and state agencies collect sediment quality data, and, to avoid duplication of effort, EPA should review these data closely prior to embarking on a major data-gathering effort for the national inventory of contaminated sediment sites. EMAP and NS&T data could provide the framework for a national inventory. In Dr. Robertson's opinion, NOAA and EPA should participate in cooperative QA/QC protocol development for data gathering, assuring compatible data management, and other areas of common interest.

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[2]NOAA is currently conducting bioeffects surveys in Boston Harbor, Long Island Sound, Hudson-Raritan Estuary, Southern California Bight, Chesapeake Bay, San Francisco Bay, the Savannah River, and Tampa Bay.

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Dr. Robertson also was concerned that the Strategy does not sufficiently address the study of contaminated sediments and bioeffects. In recent years, NOAA's program has turned toward the study of bioeffects, and Dr. Robertson suggested that the Strategy provide for further bioeffects assessments. He offered NOAA's assistance in developing a national inventory of contaminated sediment sites and sources of sediment contamination.

3.2.2.4 Donald Steffeck, Division of Environmental Contaminants, U.S. Fish and Wildlife Service (FWS)

Proposed for full implementation in 1996-97, FWS's Biomonitoring of Environmental Status and Trends (BEST) program will monitor trust resource health at selected sites nationwide. Resources to be monitored will include migratory birds, endangered species, certain anadromous fish and marine mammals, and the 91 million acres of National Wildlife Refuges. The program will identify environmental contaminants and sources on public trust lands, and develop methods for predicting the bioeffects of environmental contaminants. FWS will collect data on tissue burdens of contaminants and bioeffects, and conduct full community bioassessments. Part of the effort includes the development of a system of "biomarkers" or indicators of organism health, so that future evaluations will be able to identify signals of deteriorating ecological conditions. A strong component of the program involves developing consistent QA/QC protocols and cataloguing the data in a manner accessible to other agencies. Mr. Steffeck noted that these data would be useful in developing the national inventory of contaminated sediment sites.

FWS's special studies in its 50 operational field offices often address issues related to contaminated sediment management. FWS works with COE on dredging projects, assists USDA's Soil Conservation Service by providing technical assistance on stream alteration projects, and provides technical assistance to EPA in projects falling under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). Recently, FWS has developed new techniques for evaluating bioaccumulation and new acute and chronic bioassay methods.

Mr. Steffeck joined with other panelists in praising EPA's emphasis on intra- and interagency coordination in developing a national Contaminated Sediment Management Strategy, and looks forward to working with EPA in providing solutions for the contaminated sediments problem. Mr. Steffeck sees the development of a single national inventory as a crucial element of the assessment strategy. Mr. Steffeck also agreed with EPA's identification of air pollution as an important sediment contaminant source.

Mr. Steffeck was concerned, however, that the Strategy might force federal and state agencies to adopt a single set of bioeffects testing protocols. In Mr. Steffeck's opinion, EPA should work with other agencies in developing comparable methods for bioeffects assessment and should not demand conformity to a single bioeffects assessment method. The Strategy should recognize that individual assessment methods are designed to meet individual program needs. Mr. Steffeck believes that a single method would become obsolete over time, thus hampering future bioeffects studies.

In addition, Mr. Steffeck suggested that the inventory of contaminated sediment sources should evaluate nonpoint as well as point sources. Mr. Steffeck also recommended that the Strategy

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include a mechanism to ensure that assessment data are used efficiently in other components of the Strategy. Mr. Steffeck feels that all too often assessment data do not play a central role in decisions regarding the remediation of sediments.

3.2.2.5 Fred Calder, Florida Department of Environmental Regulation

A collaborative effort between the State of Florida and NOAA has resulted in a comprehensive survey of sediment and biological conditions along Florida's 11,000 miles of shoreline. The survey effort has sampled sediments for metals contamination at over 700 sites and organic contaminants at over 245 sites. The majority of these sites are located in estuaries adjacent to cities and industrial areas. Florida also has issued guidelines for interpreting sediment chemical data, and is in the process of developing preliminary sediment quality assessment guidelines for its coastal waters.

Florida's sediment quality guidelines follow NOAA's "weight-of-evidence" approach to deriving assessment guidelines, which is based on a variety of studies documenting biological effects associated with sediment contamination.[3] Florida used the NOAA approach and augmented NOAA's bioeffects data base with additional North American coastal biological effects data. Data derived from a wide variety of methods and approaches were assembled and evaluated to derive preliminary sediment quality guidelines for 25 priority contaminants in Florida coastal waters. The numerical sediment quality guidelines were used to define three ranges of concentrations for each of the 25 contaminants: a probable effects range, a possible effects range, and a no effects range. A subjective assessment of the credibility of these guidelines indicated that a high level of confidence could be placed on the guidelines derived for 11 substances and a moderate or low level of confidence could be placed on the guidelines for the remaining 14 substances. The preliminary guidelines will be fully evaluated and refined using the results of investigations conducted in Florida and elsewhere.

The strengths of Florida's approach, according to Mr. Calder, are (1) the large data base of biological effects from which the guidelines are derived and (2) the practicality of using guidelines that define ranges of contaminant concentrations for screening a large number of sites often having little biological data. The guidelines, however, are meant only as a measure of the *potential* for biological effects; *actual* biological effects should not be directly inferred from the comparison of site-specific sediment sampling data with the numerical criteria set forth in the guidelines. Similarly, EPA should, in Mr. Calder's opinion, avoid drawing strong conclusions regarding the bioeffects of contaminated sediment relying on chemical sediment criteria developed using the EP approach.

Mr. Calder agreed with EPA that developing a national inventory is a critical step in the overall Strategy but criticized EPA for not soliciting sufficient state input to the development of criteria by which inventory data might be assessed. Mr. Calder worries about the inventory's reliance on existing data. He asserts that existing data were collected for different reasons using

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[3]NOAA. 1990. National Oceanic and Atmospheric Administration. Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. Technical Memorandum NOS OMA 52. Seattle, WA: NOAA.

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different methods and that this discrepancy in data sources may compromise the degree to which sediment quality can be meaningfully compared between sites.

Mr. Calder also questioned the effectiveness of the Strategy in dealing with nonpoint sources. According to Mr. Calder, nonpoint sources tend to lead to chronic rather than acute bioeffects. Currently, science is ill-equipped to assess and predict the chronic bioeffects that might result from long-term nonpoint source contamination. Also, Mr. Calder feels that the Strategy should address the protection of areas with surface water resources that are fully viable today, but that over time may deteriorate due to the accumulation of contaminants from nonpoint sources. EPA may want to include in the Strategy a component emphasizing the importance of further research on the chronic effects of sediment contamination.

Mr. Calder stated that EPA should look toward Florida's collaboration with NOAA as a successful model of how state and federal agencies can work together in performing cost-effective sediment assessments.

3.2.3 Formal Public Comment: Randall Ransom, Chemical Manufacturers Association (CMA)

Randall Ransom, Chemical Manufacturers Association (CMA), expressed CMA's agreement with the following elements of the draft Strategy:

- Ranking contaminated sediment sites in priority so that scarce resources can be allocated to sites with the greatest potential to cause adverse effects.
- The commitment to improved human health and ecological risk assessment methodologies.
- The commitment to sound science and cost-effective assessment, prevention, and remediation methods.
- The preference for natural remediation where such an option is consistent with human health and environmental standards.

Mr. Ransom expressed CMA criticisms of the draft Strategy:

- EPA must develop a scientifically sound definition of contaminated sediment before finalizing the Strategy.
- The Strategy focuses on chemical criteria and inadequately addresses the relationship between sediment contamination and bioeffects. National standards must be able to account for site-specific conditions.
- The Strategy does not recognize the critical role of the states. Sediment contamination is a water quality issue, and states have traditionally taken a lead role in developing water quality related programs. CMA believes the Strategy should

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allow states to address sediment contamination issues as part of their normal waste load allocation process during watershed permitting.

- The Strategy must address nonpoint sources in addition to already regulated point sources.

- The development of a "hit list" of problem chemicals and sediment contamination sources is a source of concern. CMA believes each site should be evaluated separately, and not according to a predefined list of "problem" sources.

- CMA believes that sediment contamination is a local hot spot problem, not a national problem.

3.2.4 Open Discussion

3.2.4.1 Summary of Assessment Panel Concerns and Recommendation[4]

- EPA should clearly define what contaminated sediments are, prior to release of the Strategy.

- The Strategy should focus more attention on the problem of nonpoint source contamination.

- The Strategy should propose mechanisms for effective use of sediment assessment data.

- The EPA should actively solicit state input and encourage greater coordination with state agencies in Strategy development

- EPA should identify and promulgate consistent QA/QC protocols for sediment sampling and bioeffects testing as part of the Strategy.

- Panelists were divided on the issue of a whole sediment testing approach versus a numerical chemical criteria assessment approach.

- Panelists were also divided on the issue of whether the strategy should encourage the adoption of uniform effects-based testing methods, or allow the development of different but comparable effects-based testing methods.

[4]Not all panelists necessarily support the following concerns and recommendations.

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3.2.4.2 Questions Addressed to the Assessment Panel

Will other agencies be involved in developing standardized effects-based tests?

Dr. Southerland (U.S. EPA) responded that EPA will actively solicit federal and state agency input throughout the development of effects-based testing protocols and numerical sediment quality criteria. EPA has formed an Agency-wide workgroup to determine what types of effects-based tests should be adopted for Agency-wide use. EPA will hold national workshops in September 1992 and the first quarter of 1993 to discuss effects-based testing and the overall tiered testing structure. Once the Agency has determined the most appropriate effects-based test protocols, EPA's Science Advisory Board (SAB) will review the tests and make further recommendations. The SAB review meetings will be open to the public. Unlike the sediment quality criteria, the Agency does not need to publish its effects-based testing protocols in the *Federal Register* for formal public comment.

Are EP-based chemical criteria in fact effects based?

Dr. Southerland said that because the criteria are derived from ambient water quality criteria, they are, in essence, effects based. Ambient water quality criteria are based on acute and chronic toxicity data. The EP approach assumes that benthic organisms in sediments are exposed to contaminants via the interstitial water in sediments. The criteria EP methodology is used to calculate threshold concentrations of contaminants in sediments that lead to interstitial water contaminant concentrations equal to the ambient water quality criteria.

Can the EP-derived sediment quality criteria adjust to site-specific conditions?

Dr. Southerland answered that the EP approach incorporates site-specific data on crucial determinants of bioavailability, such as organic content for nonpolar hydrophobic organic contaminants and the presence of acid volatile sulfides for metals.

Is research being conducted on the effects of sediment contamination on larger organisms higher in the food chain?

Dr. Mallard (USGS) replied that COE, FWS, and USGS are currently conducting such research at a number of sites nationwide.

How will sediment quality criteria and effects-based test protocols be used in the Strategy?

Dr. Southerland noted first that the development and promulgation of criteria and biological test protocols are on separate paths. Numerical criteria go through a lengthy regulatory approval process; effects-based tests do not. Numerical criteria are developed under Section 304 of CWA and thus must receive OMB approval and be published in the *Federal Register* for formal public comment. Depending upon the EPA program, biological testing may not be subject to statutory provisions and hence may not need to go through a formal approval process. The test protocols

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developed pursuant to EPA's Sediment Strategy will not, in many cases, be legally binding. EPA hopes, however, to procure federal and state agency agreements to use these protocols and eliminate the current situation in which different EPA program offices and federal and state agencies use different organisms to test for acute and chronic effects and bioaccumulation.

The application of the sediment quality criteria will depend on the particular statute under which a given sediment contamination problem is being addressed (see response to similar question in Section 3.3). Dr. Southerland also pointed out that states could adopt different numerical criteria as long as they are "scientifically defensible."

3.3 PREVENTING SEDIMENT CONTAMINATION

3.3.1 EPA's Proposed Prevention Strategy

3.3.1.1 Judith A. Nelson, Office of Prevention, Pesticides, and Toxic Substances (OPPTS), U.S. EPA

OPPTS administers the Office of Pesticide Programs (OPP) and the Office of Pollution Prevention and Toxics (OPPT) which in turn administer the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Toxic Substances Control Act (TSCA). FIFRA and TSCA provide EPA with the authority to review new chemicals and regulate existing chemicals. Only recently has OPPTS begun to consider the potential for chemicals to accumulate and persist in sediments. OPP is currently developing a strategy for evaluating sediment toxicity and its potential ecological effects when processing pesticide registration, reregistration, and special reviews. If a pesticide has the potential to bioaccumulate or persist in sediments, OPP may require additional aquatic fate testing. OPP plans to revise pesticide test requirements in 40 CFR Part 158 and protocols in the Subdivisions of the Pesticide Assessment Guidelines. OPP will use the national inventory of sediment quality and incident reports to select certain pesticides, if warranted, for special review. In addition, OPP will continue work on reducing pesticide use in general by disseminating information on alternative pest management practices, providing technical support, and conducting pest management research.

In a few cases, OPPT, under the authority of TSCA, has required manufacturers to submit data on a chemical's propensity to accumulate and persist in sediment. A recent test rule for brominated fire retardants (June, 1991) included sediment toxicity testing. Like OPP, OPPT plans to use the national inventory as well as data from TRI to select chemicals for review. If OPPT determines that a particular chemical contributes to sediment contamination and poses unreasonable risks, OPPT can ban or regulate the use of that chemical. Through its New Chemicals Review Program, OPPT encourages manufacturers to design chemicals with molecular weights greater than 1,000 to prevent absorption through molecular membranes, and with K_{ow} values either greater than 8 for no effects at saturation or less than 3.5 to avoid partitioning to sediments. OPPT's exposure-based review (EBR) policy for the New Chemicals Review Program requires environmental effects and fate testing if certain criteria are met upon initial review.

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3.3.1.2 Stuart Tuller, Nonpoint Source Control Section, Office of Water, U.S. EPA

EPA's nonpoint source control program has five main elements: CWA Section 319 grants to states, the Clean Lakes Program, the Coastal Zone Act Reauthorization Amendments (CZARA), and an agricultural pollution prevention initiative. States with EPA-approved nonpoint source management programs can apply for Section 319 grants to fund implementation of projects designed to address nonpoint source contamination of sediments. Section 319 grants have totaled approximately $50 million in recent years, and EPA has set aside $800,000 in 1992 for nonpoint source programs that deal specifically with sediments. Through the Clean Lakes Program, Section 314 of CWA provides grants to states that could be used to develop methods for controlling nonpoint source contamination of sediments.

In 1990, EPA and NOAA issued proposed national guidance for nonpoint source controls under CZARA. Farmers, land owners, and manufacturers located within the coastal zone (as defined by CZARA) must implement best management practices (BMPs) to control nonpoint source contamination of sediments and other media. BMPs will be determined on a best available technology basis and are legally enforceable.

A memorandum of agreement signed in April 1992 between EPA and USDA commits the two agencies to work together to draft a strategy for reducing agricultural nonpoint source contamination. EPA and USDA will issue a detailed plan for program development and implementation by October 1, 1992. Key components of the program will include nutrient, animal waste, and pesticide management plans, and plans to protect critical habitats. The program will rely on voluntary, educational, incentive, and enforcement tools to implement the various program elements.

3.3.1.3 James Pendergast, Water Quality and Industrial Permits Branch, Office of Water, U.S. EPA

EPA's point source control program has issued effluent guidelines for almost 20 years. To date, effluent guidelines have not considered sediment quality, in part because of a lack of guidance on how to derive acceptable effluent concentrations based on sediment quality. For the same reasons, there are currently very few National Pollutant Discharge Elimination System (NPDES) permits that contain effluent limits specifically tailored to achieve a high level of sediment quality. With new guidance from EPA, states, and other federal agencies, the Office of Water hopes to begin issuing NPDES permits based on sediment quality where effluent contaminants are likely to accumulate and persist in sediments. EPA is developing guidance for relating effluent concentrations to sediment quality and applying this guidance to field studies in Louisiana and Lake Michigan. The Office of Water hopes to use the national inventory of contaminated sediment sites and other screening devices to determine which industrial sources to target for sediment quality-based NPDES permits. The Office of Water also is actively engaged in researching BMPs to reduce effluent discharges and control stormwater discharges.

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3.3.1.4 James Edward, Strategic Planning and Prevention, U.S. EPA

With the enactment of the Pollution Prevention Act of 1990, pollution prevention has become the apex of the environmental protection hierarchy. The act directs EPA to incorporate pollution prevention strategies in all of its regulatory programs. The Agency has identified 16 broad regulatory categories (pesticides formulation; pulp and paper; degreasing operations; paints, coating, and adhesives; rubber and chemicals; and others) in which to incorporate pollution prevention approaches over the next 5 to 6 years. The act also requires EPA to develop a federal government pollution prevention strategy for federal facilities. EPA's 33/50 program aims at achieving a 33 percent reduction in 17 high-priority toxic chemicals by the end of 1992 and a 50 percent reduction by 1995. Currently, 236 companies participate in the 33/50 program.

Two policies recently drafted by the Office of Enforcement allow settlements to include enforceable pollution prevention elements. Enforcement settlements will emphasize source reduction and recycling actions that enhance the prospect for long-term compliance with applicable regulations wherever possible. Over 100 settlements to date have included significant pollution prevention elements. EPA hopes that all of these efforts will reduce pollutant loadings that result in contaminated sediments.

3.3.2 Federal and State Agency Prevention Programs

3.3.2.1 David Farrell, Agricultural Research Service (ARS), U.S. Department of Agriculture (USDA)

The Agricultural Research Service (ARS) has actively conducted research in the areas of soil erosion control, pest control, and fate and transport of agricultural chemicals since 1953. More recently, ARS has modeled aquatic systems to monitor the distribution, accumulation, and dissipation of agricultural chemicals over time. During the 1980s, ARS worked with COE to assess the availability and plant uptake of heavy metals from contaminated dredged materials placed in flooded and upland environments. Also during the last decade, ARS undertook a number of research projects to evaluate approaches for reducing contaminants in industrial food processing effluents.

Research funded in fiscal year 1992 applicable to contaminated sediment prevention includes:

- Revision of the Universal Soil Loss Equation (USLE), the Water Erosion Prediction Project (WEPP), and the Wind Erosion Prediction System (WEPS) for predicting the effects of tillage and residue management practices on soil erosion by water and wind.
- Development and evaluation of techniques to control soil erosion.
- Development of livestock and crop management practices that reduce surface loadings of contaminants.
- Research on the fate and transport of agricultural chemicals.

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- Field evaluations of no-tillage and post-emergent herbicides which could reduce runoff of agricultural chemicals.

- Development of methods for evaluating sources and extent of ecosystem contamination.

- Evaluation of integrated pest management and biological pest controls as substitutes for more traditional pesticides, fungicides, and herbicides.

- Evaluation of the ion exchange potential of a variety of agricultural residues, and the utilization of hulls and hull components from oil seed and cereal crops to treat industrial wastewater.

ARS's current research program coincides with many elements of EPA's prevention strategy. In particular, ARS's emphasis on reducing the volume and mobility of agricultural chemicals in the environment is consistent with EPA's prevention strategy. The previously mentioned memorandum of agreement between USDA and EPA should facilitate interagency cooperation in preventing sediment contamination from point and nonpoint agricultural sources. Dr. Farrell nonetheless feels that a major weakness of the EPA Strategy is the absence of a well-defined plan for accommodating USDA research, education, and technical assistance. Those aspects of the Strategy that deal specifically with nonpoint source control could be strengthened by a closer working relationship with the agricultural sector.

According to Dr. Farrell, there are many ways in which agencies such as the Soil Conservation Extension Service, ARS, and EPA can work together on problems associated with sediment contamination. Dr. Farrell listed options including interagency task forces and work groups; collaborative research; and educational and technical assistance programs. ARS's strength and experience in all the major disciplines associated with the production and processing of agricultural products should be invaluable to EPA by ensuring that cost-effective alternatives to regulation are developed and made available to producers and processors. Many of the scientific questions raised by the Contaminated Sediment Management Strategy might be best answered by ARS, in Dr. Farrell's opinion, using long-term controlled experiments performed collaboratively with or under contract to EPA.

Dr. Farrell also emphasized that the EPA Strategy should not rely on simplistic analyses of agricultural chemicals (such as amount used and concentrations found in sediments) to target certain chemicals for regulation. Concentrations found to be harmful in some aquatic environments may be acceptable in others. EPA should consider the potential benefits sediments may provide in binding potentially harmful compounds until they degrade into harmless components. EPA also should not underestimate the potential for no-tillage and post-emergent herbicides to reduce nonpoint sources of sediment contamination. Dr. Farrell pointed out that a reduction in the total amount of pesticides used will not necessarily result in better protection for people and the environment since not all pesticides pose the same human health and environmental risks. Dr. Farrell stated that a better measure of risk might be the "toxic" load of a given pesticide as opposed to shear volume of active ingredient.

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3.3.2.2 Warren Harper, Watershed and Air Management, Forest Service, U.S. Department of Agriculture

The Forest Service regularly monitors sediments produced as a result of land management activities. It also devises prevention strategies for the National Forest on Forest Service lands. Recent research by this agency has focused on physical characteristics of stream systems. Understanding the relationship of geomorphology to stream flow and sediment loads may help in assessing the impact of sedimentation on the aquatic environment and the ecological impacts of anthropomorphic sediment contamination.

Mr. Harper warned against overreliance on modeling in the Contaminated Sediment Management Strategy because of the large modeling errors associated with predicting natural events and the spurious correlation errors that may result from a poor understanding of cause/effect relationships. Typically, the Forest Service has relied on a case study approach to assessing the impacts of land management practices (e.g., logging, grazing, mineral extraction, recreation, etc.) on water and sediment quality on National Forests. Mr. Harper suggested that the Strategy provide for this type of analysis as well.

According to Mr. Harper, nonpoint source pollution from land management activities may result in increased sediment loading to aquatic systems from the National Forests. Land management practices can be designed to reduce these sediment load increases to a level compatible with water quality requirements. Hence, the Forest Service's strategy has centered on prevention through use of BMPs. The agency's greatest difficulty has been in implementing proposed BMPs to achieve water and sediment quality objectives. Monitoring and subsequent feedback on BMP effectiveness is an essential component of successful BMP implementation. The Forest Service coordinates its efforts with individual states that have the responsibility for monitoring and adjusting defined BMPs. Mr. Harper believes that EPA's greatest challenge in managing sediments may be in devising effective monitoring programs and models capable of accurate predictions.

3.3.2.3 James Burgess, Office of Ocean and Coastal Resource Management, Coastal Programs Division, National Oceanic and Atmospheric Administration (NOAA)

NOAA and EPA's Coastal Zone Management (CZM) program authorized by the Coastal Zone Management Act is the only program that can legally enforce nonpoint source controls. The CZM program requires states to devise and implement BMPs to control nonpoint sources in coastal zones. Failure to implement these programs by the 1995 statutory deadline will result in financial penalties to violating states. NOAA and EPA will issue a guidance document on BMPs including specific recommendations for each state's coastal zones. The guidance will cover BMPs for agricultural, urban, hydromodification, and marina nonpoint sources. Preliminary guidance was issued in 1991.

Mr. Burgess stated that the CZM program has struggled with a number of important issues that might be pertinent to the nonpoint source prevention aspects of EPA's Contaminated Sediment Management Strategy:

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- The flexibility states should have in devising and implementing BMPs.
- The appropriate time frame for implementation.
- Enforcement of BMP implementation by the CZM program.
- The sources of pollutants BMPs should target.
- The appropriate boundary for a "coastal zone".

Mr. Burgess advised EPA to coordinate the Strategy with federal and state nonpoint source pollution programs, including the new coastal nonpoint pollution control program.

3.3.2.4 Duane Schuettpelz, Wisconsin Department of Natural Resources

Wisconsin's Sediment Assessment and Remediation Techniques (SMART) program parallels the EPA's Contaminated Sediment Management Strategy in many respects. The SMART program is presently conducting an inventory of contaminated sediment sites, uses sediment quality criteria at some Superfund sites, and has an active pollution prevention component. Wisconsin employs water quality standards, stormwater permitting, and hazardous air substances controls to aid in the prevention of sediment contamination. The state also issues grants to local organizations for devising innovative approaches to nonpoint source control.

Mr. Schuettpelz thinks the prevention component of EPA's Strategy is a strong proposal, and he particularly approves of the information transfer and education elements. Mr. Schuettpelz is encouraged that EPA plans to characterize the contribution of pesticides and other chemicals to nonpoint source sediment contamination. EPA should make certain the potential ecological and human health effects of these contaminants are characterized as well.

Mr. Schuettpelz had a number of suggestions for the EPA prevention strategy. Under the NPDES program, Mr. Schuettpelz recommended that EPA reevaluate the priority pollutant list with sediment contamination in mind. Mr. Schuettpelz claimed that EPA has been too restrictive in reviewing NPDES permits and that states need greater flexibility so that they can implement innovative solutions to water and sediment quality problems. CERCLA and RCRA remedial investigations should evaluate the effects of sediment contamination on entire aquatic ecosystems including terrestrial animals. Mr. Schuettpelz generally agrees with EPA's strategy for managing nonpoint sources, but he would like to see more attention paid to the impacts of atmospheric deposition on contaminated sediments and a more coherent results-oriented approach to stormwater management. Mr. Schuettpelz feels that the nonpoint source program needs to be better integrated with the stormwater program, and that the term stormwater needs to be more clearly defined. He questioned whether stormwater was a nonpoint source or strictly permittable point source.

Wisconsin supports EPA's prevention strategy. Mr. Schuettpelz stressed, however, that the Strategy should allow for quick and efficient solutions and accommodate "public policy risk taking." Sediment contamination threatens delicate ecosystems across the country that, in many cases, cannot wait for the completion of long and detailed studies. Mr. Schuettpelz strongly believes that

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the states are prepared to take the initiative with contaminated sediment management and should have an important role within the EPA Strategy.

3.3.2.5 Craig Wilson, Bay Protection and Toxic Cleanup Program (BPTCP), California State Water Resources Control Board

The Bay Protection and Toxic Cleanup Program (BPTCP) gave the State Water Resources Control Board (the Board) a mandate to develop a data base of all available information on sediment contamination in California. Recognizing the large number of sites in California, the BPTCP also directed the Board to develop qualitative and quantitative sediment quality criteria by which to rank sediment sites. The BPTCP will expand the Board's monitoring and surveillance program for sediments. The Board will integrate information from its inventory of contaminated sediment sites, sediment criteria development effort, and monitoring program to develop plans for establishing cleanup levels and remediating targeted sites, preventing further point and nonpoint contamination, and identifying responsible parties. Parties responsible for point and nonpoint sediment contamination will help pay for the BPTCP through a fee system.

Mr. Wilson believes that the BPTCP mirrors the EPA Strategy in many respects, and commended EPA for developing a strong, coherent approach to the sediment contamination problem. Mr. Wilson feels that the ideas expressed in the Strategy for incorporating pollution prevention into new chemical testing and enforcement are particularly commendable. The greatest weakness of the Strategy lies in its preoccupation with point sources. Mr. Wilson doubts that additional point source controls will make a large difference in the overall contaminated sediments problem without an aggressive program to reduce nonpoint source contaminants. EPA's nonpoint source control strategy should encourage implementation of BMPs though education, regulatory incentives, and command and control permitting. Mr. Wilson feels that although the Strategy advocates intra- and interagency coordination, it does not provide any guidance concerning this coordination. Finally, Mr. Wilson echoed earlier speakers in stating that the Strategy should clearly define the potential role of sediment quality criteria in managing contaminated sediments under different environmental statutes.

3.3.3 Open Discussion

3.3.3.1 Summary of Prevention Panel Concerns and Recommendations[5]

- EPA should not underestimate the ability of sediments to act as a natural mechanism for trapping contaminants and rendering them harmless to other environmental media over time.

- The Strategy should recognize the danger inherent in overreliance on models and recognize the value of case study approaches in understanding contaminated sediment problems.

[5]Not all panelists necessarily support the following concerns and recommendations.

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- The Strategy should include stronger provisions addressing nonpoint sources.

- The Strategy should state clearly how EPA intends to use sediment quality criteria in its programs.

- EPA should expedite approval and implementation of the Strategy and balance the need for further research with the need for quick policy actions.

- The Strategy should identify ways in which federal and state agencies can work together, avoid duplication of efforts, and provide prompt and efficient solutions to contaminated sediment problems.

3.3.3.2 Questions Addressed to the Prevention Panel

How will numerical sediment quality criteria affect current assessment, prevention, and remediation efforts?

Dr. Southerland (U.S. EPA) stated that the criteria will have different functions under different statutes. For example, CERCLA requires that remediation plans include all applicable rules and regulations (ARARs). Sediment quality criteria would become another ARAR governing sediment remediation. They would not, however, necessarily determine cleanup levels at a given site. Remediation plans under RCRA and CERCLA must incorporate cost, technical feasibility, and other considerations as well. Preventive actions taken under the CWA, however, cannot take into consideration economic factors. NPDES permits issued under the CWA must meet ambient water quality standards and other applicable criteria designed to protect human health and the environment. EPA's Strategy includes provisions to issue NPDES permits based on sediment quality criteria when necessary.

Mr. Wilson (State of California) pointed out that California has used its "narrative" and quantitative sediment quality criteria to prevent pollution. California also will have a separate ranking system that includes both sediment criteria and cleanup levels. Mr. Wilson felt that, while in some circumstances it is useful to have stringent numerical criteria, cost and feasibility issues also must play a role in determining prevention and remediation actions.

Dr. Farrell (USDA) reiterated that numerical criteria should account for site-specific conditions such as the potential bioavailability of contaminants, salinity, and other relevant ecosystem variables. Dr. Southerland responded that the criteria can be adjusted to account for organic content and the presence of acid volatile sulfides, and reiterated that sediment quality criteria alone will not always drive preventive and remedial actions at a given site.

Why doesn't the Strategy propose a more stringent regulatory approach for the control of nonpoint sources?

Mr. Tuller (U.S. EPA) remarked that EPA does not currently have the statutory authority (with the exception of the Coastal Zone Management Act [CZMA]) to regulate nonpoint sources. Given statutory limitations, EPA's nonpoint source control programs have relied on educational, voluntary, and economic incentives rather than on the more traditional "command and control"

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approach. Even with statutory authority, Mr. Tuller believes that the very nature of nonpoint sources makes the command and control approach difficult to implement. Mr. Tuller argues that one of the principal reasons why CWA reauthorization was initially vetoed in 1987 was controversy over nonpoint source control provisions. Mr. Tuller, however, is optimistic that Congress will adopt approaches to nonpoint source control like those in the CZMA during upcoming CWA reauthorization.

Mr. Schuettpelz (State of Wisconsin) commented that little actual improvement in sediment quality will be accomplished in issuing more restrictive NPDES permits for point sources. Mr. Schuettpelz thinks that given existing analytical technology, the current ambient water quality criteria are sufficiently stringent to protect sediments from further point source contamination. The greatest threat to sediment quality is from nonpoint sources; hence, the greatest gains in sediment quality could be made by implementing an aggressive nonpoint source control strategy. Dr. Southerland stated that although nonpoint source control will result in major improvements in sediment quality, significant improvements in sediment quality could be achieved by revising NPDES permits based on sediment quality criteria for some industries, stormwater sewers, and combined sewer overflows.

3.4 REMEDIATION OF CONTAMINATED SEDIMENTS

3.4.1 EPA's Proposed Remediation Strategy

3.4.1.1 Richard Nagle, U.S. EPA Region V

Mr. Nagle stressed that no single environmental statute was designed to address contaminated sediments in particular; thus, the EPA cannot rely on a single "silver bullet" to enforce remediation by responsible parties. Nonetheless CWA, CERCLA, RCRA, TSCA, the Rivers and Harbors Act, and the Oil Pollution Act all contain provisions that, under the appropriate circumstances, can compel responsible parties to contribute to the cleanup of contaminated sediments.

Because contaminated sediments occur in such diverse circumstances, enforcement agencies must have a detailed understanding of the many enforcement statutes at their disposal in order to recover all or part of the significant costs of remediation. The case of Sheboygan Harbor, for example, is relatively simple, with only a couple of potentially responsible parties (PRPs) and one or two major contaminants of concern. Indiana Harbor and Ship Canal, on the other hand, have a "veritable soup of contaminants" and hundreds of PRPs. Region V's enforcement strategy must be highly flexible and innovative to deal with such diverse circumstances. Region V recently instituted a Geographic Enforcement Initiative that targets large areas for remediation and prevention actions, prioritizes sites for remediation, and ensures timely solutions to contaminated sediment problems. In closing, Mr. Nagle asserted that any remediation and prevention effort must be backed up with a credible enforcement threat, regardless of the complexity of the site and cooperation of PRPs.

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3.4.1.2 Lawrence J. Zaragoza, Office of Emergency and Remedial Response, U.S. EPA

Because of the expense associated with contaminated sediment site cleanup, Dr. Zaragoza emphasized that most contaminated sediment cleanup will occur at sites that are on the National Priorities List (NPL). Once a site is placed on the NPL, it is eligible for remedial funding, which is typically associated with long-term cleanup.

Sites are typically placed on the NPL following an evaluation with the Hazard Ranking System (HRS), which assigns points to nominated sites based upon the severity of contamination. The revised HRS (promulgated in 1990) provides for explicit consideration of sediment contamination at sites. Dr. Zaragoza stated that an inventory of sites with contaminated sediments may be evaluated with the HRS to determine if these sites warrant placement on the NPL.

An Agency-wide workgroup is developing a consistent tiered testing method for the evaluation of contaminated sediments. Following completion of this methodology, the Superfund program will probably develop some additional guidance that would be applicable to Superfund sites. The Superfund process generally includes comparisons to background levels, human health risk ranges, and various ARARs (used as Maximum Contaminant Levels [MCLs]) to determine cleanup levels.

3.4.1.3 Denise Keehner, Office of Solid Waste, U.S. EPA

Ms. Keehner stated that while many are aware of EPA's Superfund program, few are aware of EPA's cleanup program under RCRA. Owners and operators of RCRA waste management treatment, storage, and disposal facilities are responsible for cleaning up current as well as historical contamination at their facilities. Once EPA conducts an initial investigation of a RCRA facility and determines that a release is occurring or has occurred at the site, the owner/operator of the site is responsible for conducting a more detailed investigation and taking necessary remedial actions. Of the 4,500 facilities covered by the RCRA program, EPA expects an estimated 3,600 will require some level of remediation at a cost of approximately $200 billion over the next several decades. Contaminated sediment is not uncommon at these RCRA sites and will no doubt account for a significant proportion of remedial costs. Ms. Keehner stated that the RCRA program intends to use the national inventory of sediment quality to help prioritize RCRA facilities for remedial actions.

Where appropriate, EPA currently requires owner/operator investigations to evaluate sediment quality. If tiered testing protocols are adopted by the Agency, the RCRA program would probably include them as guidance to owner/operators for evaluating the nature and extent of sediment contamination. The RCRA program also would consider adopting any numerical chemical criteria that the Agency proposes.

3.4.1.4 Tony Baney, Chemical Regulations Branch, U.S. EPA

The PCB Program under TSCA controls the manufacture, processing, distribution, use, and disposal of polychlorinated biphenyls (PCBs). This program administers the broadest control over a single contaminant exercised by any federal government agency. Although the PCB program has

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a great deal of authority to manage PCBs, a number of other statutes (CWA, CAA, RCRA, CERCLA, etc.) have authority to control the disposal of PCBs and remediate PCB contamination. Mr. Baney spends much of his time coordinating PCB regulatory efforts between TSCA and other statutes, including state statutes.

Formerly, under TSCA's PCB disposal rule, sediment was the only medium that could be remediated based on site-specific risks. Other PCB-contaminated media were subject to disposal criteria specific to the medium in which the contamination occurred, regardless of risks specific to the site. For example, PCB contamination of ground water would be subject to one set of criteria; soil contamination to another. Modifications to the PCB disposal rule will allow EPA to combine all media into one remediation category, so that management decisions can be made on a site-by-site basis.

The Agency hopes to propose a unified strategy for PCB management by the end of 1992. This strategy would contain provisions addressing PCB contamination of sediments. A recent investigation found that 244 of 1,218 Superfund sites have PCB contamination, much of which is found in sediments.

3.4.2 Federal and State Agency Remediation Programs

3.4.2.1 Bruce Kimmel, Oak Ridge National Laboratory, Department of Energy (DOE)

DOE has entered into "federal facility agreements" with several states and EPA to coordinate the implementation of remedial actions at DOE facilities nationwide. The overall goal of the DOE Environmental Restoration Program is protection of human health and ecological risk reduction. The DOE Oak Ridge Reservation in Tennessee has slated three large facilities (the Oak Ridge National Laboratory, Y-12 Plant [weapons manufacturing], and K-25 Plant [gaseous diffusion plant]) for remediation. Some contaminants have migrated from waste sites at these facilities and into stream, river, pond, and reservoir sediments both on and off site. The primary contaminants of concern are PCBs, metals, and radionuclides. The presence of radioactive and mixed wastes (hazardous and radioactive) poses a particular challenge at many DOE sites, including Oak Ridge.

In September 1990, an ongoing remedial investigation of the Clinch River revealed higher-than-expected levels of cesium-137 in the near-surface sediments of the White Oak Creek Embayment (WOCE) located on the DOE Oak Ridge Reservation. This discovery raised concern, because the WOCE surface sediments could be eroded and transported downstream into public waters. Therefore, the DOE initiated a "time-critical" CERCLA action to prevent further migration of these contaminated sediments. With the cooperation of the Tennessee Valley Authority (TVA), COE, EPA Region IV, and the State of Tennessee, a sediment-retention dam was constructed to gain control of these sediments. Dr. Kimmel touts this "time-critical" action as an excellent example of the benefits of interagency cooperation and a model of how agencies can work together to provide immediate solutions.

A second example of such cooperation involved the organization of an interagency working group for Watts Bar Reservoir, which has received some contaminants from Oak Ridge. When investigations determined that contaminants from the Oak Ridge Reservation were present in the Watts Bar sediments, DOE, COE, EPA, TVA, and the State of Tennessee formed a working group

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to screen permit applications for reservoir-use activities that had any potential for disturbing contaminated sediments. DOE has since worked closely with TVA in the remedial investigation of Watts Bar Reservoir to effectively utilize the expertise of the two agencies.

Dr. Kimmel was pleased to see an emphasis in the proposed Strategy on evaluation of risks and, in particular, the comparison of baseline risks to the risks associated with remediation. Dr. Kimmel feels that recognition of the importance of natural recovery processes and the inclusion of national sediment quality criteria are also strong points of the Strategy.

Dr. Kimmel made the following recommendations for the remediation strategy:

- Employ the best science possible with a solid measure of common sense and realism in developing solutions to contaminated sediment problems.

- Resolve the discrepancy between regulation-driven and risk-based remediation decision-making. Dr. Kimmel defined regulation-based decision-making as that which relies solely on statutory guidelines and criteria. Risk-based decision-making, on the other hand, uses the outcome of risk and cost-effectiveness analyses to make remedial decisions. Dr. Kimmel would like to see a greater emphasis on risk-based decision-making in the Strategy.

- Avoid the tendency to be overly conservative in conducting health and ecological risk analyses. Multiple layers of conservatism are inherent in the risk assessment assumptions and methodologies.

- Employ risk screening methods and the observational approach to focus investigations and expedite remediation processes.

3.4.2.2 Norman Francingues and Joe Wilson, U.S. Army Corps of Engineers (COE)

Mr. Francingues began his presentation by outlining COE's major research projects aimed at garnering a better understanding of dredging, disposal, and treatment technologies for contaminated sediments:

- The Great Lakes Confined Disposal Facility (CDF) program has constructed CDFs in the Great Lakes region.

- The Disposal Area Monitoring System (DAMOS) program in New England has examined the impacts of dredged material disposal in coastal waters. The program led to advances in capping technologies.

- The Puget Sound Dredged Disposal Analysis (PSDDA) program provides Puget Sound with a model for predicting impacts of unconfined dredged material disposal.

- COE assisted in developing the New York-New Jersey Comprehensive Dredged Material Management Plan, which provides alternatives to open ocean disposal.

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- The Field Verification Program (FVP) with EPA has produced invaluable information on the effectiveness of open water, upland confinement, and wetland creation disposal alternatives for highly contaminated sediments.

- The Dredged Material Research Program investigated numerous topics of interest to identify, assess, and manage contaminated sediments associated with navigation dredging projects. The program resulted in first-generation procedures for evaluating the physical, chemical, and biological impacts of a variety of disposal alternatives on water, land, and wetland areas. The program demonstrated the viability and limits of new disposal alternatives, including the use of dredged material as a natural resource.

- The Long-Term Effects of Dredging Operations (LEDO) program provides the state-of-the-art technology for predicting long-term environmental impacts of dredging and management of contaminated sediments and developing methods for minimizing impacts associated with dredging activities.

- The Improvement of Operations and Maintenance Techniques (IOMT) program has resulted in general guidance for selection of equipment and techniques for dredging contaminated sediments to achieve a high level of precision and minimal resuspension.

Mr. Francingues discussed COE's research at New Bedford Harbor and extensive involvement in the dredging and dredged material disposal pilot project there. Dredging and disposal of contaminated sediments had never been conducted on such a scale before, and Mr. Francingues called the pilot project "a pioneering effort." COE concluded from the pilot project that readily available dredging equipment and management techniques were sufficient to control resuspension of contaminated sediment during dredging and to isolate contaminated sediment in onsite disposal facilities. The New Bedford Harbor Superfund project was a venture between EPA Region I, the Commonwealth of Massachusetts, and COE. COE plans to remain highly involved in demonstration and full-scale remediation projects of this type.

Mr. Wilson began his part of the presentation by explaining that, until quite recently, COE did not have the authority to remediate contaminated sediments on its own initiative. Throughout the 1980s, however, COE was involved in many cleanup efforts under interagency agreement with EPA (New Bedford Harbor, Commencement Bay, Waukegan Harbor, Sheboygan Harbor, Marathon Battery Site, Upper Hudson River, and others). In 1987, Congress created the Assessment and Remediation of Contaminated Sediments (ARCS) program to assess the extent of sediment contamination in the Great Lakes and demonstrate bench-scale treatment technologies. COE has taken the lead in designing and implementing engineering and treatment technologies for the ARCS program.

The 1990 Water Resources Development Act (WRDA) expanded COE's authority to dredge and remediate contaminated sediments and directed COE to include environmental protection as a primary mission in planning, designing, constructing, operating, and maintaining water resource projects. WRDA also authorizes COE to actively contribute to the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters. COE can now initiate "clean up" dredging adjacent to and outside authorized federal navigation channels. Prior to 1990,

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COE could only initiate dredging activities within the bounds of a federal navigation channel. This restriction prevented COE from remediating contaminated sediments outside the navigation channel that acted as a continuing source of contamination to the channel. Mr. Wilson believes that this authorization will allow COE to implement more permanent and less piecemeal solutions to contaminated sediment problems in harbors and estuaries.

COE has had some difficulty in implementing this new authority because of questions of liability. COE does not want to dredge contaminated sediments outside of navigational boundaries without having identified responsible parties for cost recovery. Finding responsible parties can be extremely difficult at many sites. In Mr. Wilson's opinion, EPA should examine liability issues in sediment remediation so that COE and COE subcontractors can implement remedial actions outside of navigational channels without assuming total liability for the cleanup.

3.4.2.3 Keith Phillips, Sediment Management Unit, Washington Department of Ecology (Ecology)

In 1991, the Washington Department of Ecology (Ecology) adopted a sediment management strategy to deal with contaminated sediments in Puget Sound and other areas of Washington State. In addition to assessment and prevention provisions, the strategy promulgated sediment quality criteria known as Sediment Management Standards. The rule established narrative, chemical, and biological criteria for use in existing source control programs and remedial actions. Recognizing the need for regulatory flexibility in addressing contaminated sediment problems, Ecology proposed two sets of sediment quality standards: a "no effects" level and a "minor adverse effects" level. The former standard establishes a sediment quality goal below which contaminants in sediment should have no adverse effects on aquatic life and human health. The "minor adverse effects" level considers engineering feasibility and cost factors and acts as an upper bound for regulatory decisions. Ecology will mandate cleanup levels and source control actions that fall between these two standards based on net environmental effects and cost/feasibility tradeoffs.[6] Because the standards apply to discharges and dredged material disposal as well, Ecology has ensured that permitted discharges and dredged material disposal sites will not become cleanup sites in the future.

The Washington standard provides allowances for both ongoing contamination and natural recovery. For ongoing discharges, the state can authorize an area outside the discharge outfall known as a "sediment impact zone" within which the discharge can exceed the lower "no effects" standard but not the higher "minor adverse effects" standard. The standard also allows the state to use natural recovery as an acceptable remediation technique providing it reduces sediment contamination to below the "minor adverse effects" level within 10 years.

Ecology has yet to resolve some critical liability and nonpoint source issues. For example, should landowners be able to dictate the terms of discharge permits when such permits allow for continuing sediment contamination on their land? Landowner approval of discharge permits could result in the landowner holding the discharger hostage. Ecology also has not determined how to

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[6]Ecology also has established five standard biological "interpretive guides" which can either override or confirm the chemical criteria. Mr. Phillips stated that 3 times out of 10 chemical criteria predicted adverse effects when biological tests did not.

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establish sediment impact zones for nonpoint source runoff from cities and highways and how to assign liability for future cleanup of such areas. The issue of managing stormwater discharges and future cleanup of sediment impact zones also has not been resolved.

In commenting upon EPA's Contaminated Sediment Management Strategy, Mr. Phillips noted that the overall remediation strategy is quite strong, and he supported the emphasis on prevention, risk-based analysis, natural recovery, and cost and feasibility considerations. He feels, however, that the Strategy fails to address some critical issues, such as how to deal with oil spills, persistent ongoing discharges (e.g., stormwater), and lack of disposal capacity.[7] The Strategy also should address the impact of designating contaminated sediment sites for remediation on routine construction and maintenance activities at the site. Mr. Phillips believes that construction and maintenance of docks, piers, and other aquatic structures will be deterred at sites with contaminated sediments because of liability concerns. That is, landowners may resist making improvements to aquatic structures for fear of being assigned full or partial liability for sediment remediation costs.

Mr. Phillips also was concerned that remediation strategies employing natural recovery might be thwarted because of the natural resource damages provisions in various environmental statutes. Natural resource damages provisions often make immediate cleanup a more attractive alternative than natural remediation, since natural remediation in many cases may require several decades. This potentially lengthy process increases the number of years over which damage to natural resources can occur. Responsible parties may wish to solve the problem immediately rather than be liable for additional years of resource damages.

Finally, Mr. Phillips suggested that the Strategy explore the potential for state regulatory agencies to integrate authorities to achieve additional cleanup through state lease renewal actions for docks, piers, and other aquatic structures. Washington has been very successful in collecting additional cleanup resources during real estate transactions involving a site with contaminated sediments.

3.4.3 Formal Public Comment: Ellen Fisher, Wisconsin Department of Transportation

Wisconsin maintains 14 commercial harbors, which receive and discharge more than $7 billion in cargo each year. Dredging activities in these harbors have been paralyzed by "bureaucratic gridlock" over the management of contaminated sediments. An additional inch of sediment in shipping channels forces reduction of the average shipping load by approximately 200 tons. Ms. Fisher was pleased that EPA's Contaminated Sediment Management Strategy promises to encourage greater cooperation and integration of the many agencies that manage contaminated sediments, but she would like to see these promises acted upon. The key to finding suitable contaminated dredged material disposal sites in a timely manner is cooperation among the regulatory agencies and early and continuous involvement of the local project sponsor. This effort also requires a willingness of regulators to coordinate their efforts and to engage in a problem-solving partnership with the local project sponsor.

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[7]Mr. Phillips estimated that between 30 and 70 million cubic yards of sediment will require remediation. The State of Washington currently has about 2 to 3 million cubic yards of disposal capacity for contaminated sediments.

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Ms. Fisher stressed that sediment contamination threatens the viability of Wisconsin's harbors now, and these harbors are running out of disposal capacity. A partnership among Wisconsin, EPA, and local harbor authorities should be formed immediately to find suitable disposal sites.

Ms. Fisher stated that Wisconsin and the Port of Milwaukee would like to serve as a Great Lakes demonstration project to test the proposed Strategy. The International Joint Commission has designated Milwaukee's harbor as an area of concern. The city has engaged in the development of a remediation plan to identify disposal options for the harbor's contaminated sediments. The Port Authority of Milwaukee would welcome EPA's assistance in solving the contaminated sediment problem and fending off the disastrous consequences of port closure.

3.4.4 Open Discussion

3.4.4.1 Summary of Remediation Panel Concerns and Recommendations[8]

- The Strategy should clearly state that the bottom line of contaminated sediment remediation should be human health protection and ecological risk reduction.

- Risk assessment analyses that are too conservative can paralyze remediation actions and lead to high costs with little marginal benefit. The Strategy should condone the use of more liberal risk assessments.

- Liability issues have prevented cleanups at a number of sites. The Strategy should address liability issues and explore ways in which liability laws can be altered to facilitate more timely remedial actions.

- EPA should provide a more detailed account in the Strategy of how it plans to implement the remediation of contaminated sediment.

- The Strategy should address oil spills, contaminated dredged material disposal capacity, and liability issues regarding construction and maintenance of docks, piers, and other aquatic structures at contaminated sediment sites.

- The Strategy should include guidance on managing sediment contaminants in storm-water discharges and implementing cleanup of sediment contaminated by nonpoint source pollution.

- The Strategy should examine the effect of natural resource damage settlements on the natural recovery alternative.

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[8]Not all panelists necessarily support the following concerns and recommendations.

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3.4.4.2 Questions Addressed to the Remediation Panel

Who is responsible for planning for adequate contaminated sediment disposal capacity?

Dr. Zaragoza (U.S. EPA) responded that disposal capacity must be addressed by states. States are required to develop plans that show how the hazardous wastes generated within their borders can be managed. While capacity assurance plans only address hazardous wastes (all sediments are not expected to fall into this category), Dr. Zaragoza suggested that by examining the generation of waste and disposal capacity, states could better identify shortfalls in capacity for the treatment and disposal of contaminated sediments. Mr. Phillips (State of Washington) agreed with Dr. Zaragoza on this point, although he feels that there should be some level of federal cost sharing for disposal capacity planning. The State of Washington is currently examining the liability, contingency, and indemnification issues of contaminated sediment disposal. Mr. Wilson (COE) added that EPA's Strategy should call for more research on remediation alternatives that do not require confined disposal (i.e., capping, in situ chemical treatment, solidification, open disposal, etc.).

What elements of the Strategy provide for risk assessments that may be too conservative?

Dr. Kimmel (DOE) feels that the EPA risk assessment guidance requiring remediation to yield incremental cancer risks of 10^{-6} for the maximally exposed individual are too conservative. Dr. Kimmel stated that, in the case of radionuclides, natural background levels in most areas of the world yield incremental cancer risks in the 10^{-6} range. Investigators at Oak Ridge National Laboratory are using an approach similar to that of the State of Washington, in which lower-bound risk estimates using conservative assumptions and upper-bound estimates using more realistic assumptions are established. Dr. Kimmel understands that conservative risk assessments diminish the potential for underestimating risks due to uncertainties, but noted that the upper-bound risk estimates are both more realistic and appropriately conservative. Unfortunately, multiple layers of conservatism can paralyze efforts at efficient and timely remedial actions. Dr. Zaragoza commented that the Superfund target risk range of 10^{-6} to 10^{-4} is sufficiently flexible to provide for public health protection. He stated that higher risk levels may not be protective of public health.

3.5 EPA RESPONSE TO FORUM RECOMMENDATIONS

Dr. Southerland (U.S. EPA) reiterated EPA's intention to incorporate oral and written comments into the Strategy and offered the following responses to forum recommendations:

3.5.1 Assessment

- EPA fully intends to use all existing data on sediment contamination in developing the national inventory of contaminated sediment sites and sources.

- EPA recognizes the importance of identifying methods that the Agency will use in consistent tiered testing of contaminated sediments and sharing those methods and

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associated QA/QC data with other federal and state agencies. EPA will sponsor two workshops in the next 6 months on standardizing biological-effects testing methods.

3.5.2 Prevention

- EPA will ensure that Section 319 (nonpoint source program) grants to states will continue to promote nonpoint source controls for sediment contamination. EPA will specifically target $800,000 of the 319 grant funds in 1992 to states interested in developing BMPs that prevent nonpoint source contamination of sediments.

- EPA will address nonpoint source contamination of sediments through its agreement with USDA to implement an interagency agricultural pollution prevention strategy and through the regulatory provisions of the Coastal Zone Management Act.

3.5.3 Remediation

- EPA will carefully examine the risks of remediation versus the risks of natural recovery at all sites.

- EPA will look into solving liability issues that currently hamper remediation efforts at many sites nationwide.

- EPA will examine the disposal capacity issue and try to find innovative solutions to that problem.

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CHAPTER FOUR

OUTREACH AND PUBLIC AWARENESS

4.1 INTRODUCTION

The forum on outreach and public awareness was the third and final forum sponsored by EPA's Office of Water for the purpose of gathering information and soliciting feedback on the Agency's Contaminated Sediment Management Strategy. This forum was held June 16, 1992, in Washington, DC, and attendees included representatives from industry, states, municipalities, EPA program offices, environmental organizations, public interest groups, and consulting and legal firms.

Section 4.1 summarizes opening presentations that set forth the forum's goals and objectives, and provides an overview of EPA's proposed outreach and public awareness activities related to the Strategy. Section 4.2 presents summaries of presentations made by representatives of state government (4.2.1), the regulated community (4.2.2), environmental advocacy groups (4.2.3), and a public awareness group (4.2.4), and concludes with a presentation from a representative from EPA headquarters on the National Environmental Education Act (4.2.5). This section summarizes key points made by the presenters and in the question and answer sessions following each group. Section 4.3 concludes with broad impressions of the overall dialogue.

4.1.1 **Welcome**, presented by Elizabeth Southerland, Risk Assessment and Management Branch, Office of Water, U.S. EPA

Elizabeth Southerland, Chief of EPA's Risk Assessment and Management Branch, Office of Water (OW), began the forum with welcoming remarks and an overview of the Agency's Contaminated Sediment Management Strategy. She briefly described EPA's goals for and conclusions from the first two forums and expressed the Agency's pleasure at the attendance of approximately 120 people at each one. The two major conclusions from the first forum were (1) contaminated sediments are a national problem, and (2) case studies have documented harm to human health and the environment. Conclusions from the second forum included the following:

- EPA should expedite implementation of the Strategy.
- The development of a national inventory of contaminated sediment sites is a high priority, and a number of federal and state agencies have quality data to contribute.
- More attention should be paid to nonpoint sources; many participants felt the Strategy places too much emphasis on point sources.
- Sediment toxicity and bioaccumulation are high priorities to be addressed under the Toxic Substances Control Act (TSCA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

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- The Strategy should be integrated among all federal agencies, either through a federal task force or through memoranda of agreement or understanding.

Dr. Southerland also informed participants that the proceedings containing summaries of all three forums would be available in late Fall 1992. She emphasized that this report would serve as the public record for comments concerning the Strategy from these meetings.

4.1.2 **Forum Overview**, presented by Charles Menzie, Menzie-Cura & Associates

Charles Menzie, Menzie-Cura & Associates, served as the forum moderator, and opened by presenting the forum goals and introducing its key participants. Dr. Menzie commented on the diversity of the audience in attendance, which included members of the regulated community, states, municipalities, environmental groups, and the general public. He stressed that the forum's most important goal was hearing comments from the Strategy's key audiences on the information they would need to implement and comply with the Strategy. In addition to the speakers on the agenda, Dr. Menzie appealed to other members of the audience to comment on how EPA could assist them in communicating the Strategy's key messages to their constituents. He also emphasized that the Strategy does not exist in isolation and that one of the most important issues to consider is how to integrate the Strategy's components into a larger message on management of water bodies.

4.1.3 **EPA's Proposed Outreach Activities to Support Implementation of EPA's Contaminated Sediment Management Strategy**, presented by Tom Armitage, Risk Assessment and Management Branch, Office of Water, U.S. EPA

Tom Armitage, of EPA's Office of Water, presented an overview of EPA's proposed plan for the outreach component of the Strategy. (The proposed outreach activities are included in this document as Appendix B.) Dr. Armitage stressed that outreach is a critical component of the Strategy, because of the importance of public understanding and support in Strategy implementation. He reiterated EPA's desire to obtain feedback from all speakers and participants at this meeting, so that the Agency could craft an outreach plan that would be most useful to its audiences. He noted that in implementing the Contaminated Sediment Management Strategy, EPA intends to build on existing successful outreach programs in which the government has worked with public and private interests, such as the Chesapeake Bay Citizen's Advisory Committee (described in more detail in Frances Flanigan's presentation, Section 4.2.4.1), the National Estuary Program, EPA public-private partnership programs, and the RCRA public outreach program.

The primary goal of EPA's contaminated sediment outreach program is to educate key audiences about the risks, extent, and severity of contaminated sediments; the role of the Strategy in solving the contaminated sediments problem; and how stakeholders will be involved in Strategy implementation. The proposed outreach plan has four key elements: (1) defining key Strategy themes and messages; (2) identifying target audiences and needs; (3) developing appropriate materials such as guidance documents, brochures, and videos; and (4) providing channels to facilitate two-way communication on Strategy issues. Targeted audiences include environmental and public interest groups, the scientific community, congressional representatives and committees, federal agencies, states and municipalities, EPA program offices and regions, the regulated

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community, and the news media. Outreach materials will be developed for broad audiences and specific subgroups within those audiences.

Dr. Armitage outlined four messages for the outreach program to convey, which are closely linked to the goals of the Strategy itself:

- Sediment contamination poses threats to human health and the environment.
- Sediment contamination comes from many sources, both point and nonpoint.
- An effective program to address sediment contamination will focus upon assessment, prevention, and remediation activities.
- EPA's Strategy relies on intra-agency coordination to consistently and efficiently make decisions, characterize risks, and employ resources. It also will be necessary for EPA to work closely with other federal and state agencies.

Dr. Armitage mentioned that EPA is already working with other federal and state agencies, including the National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey (USGS) in monitoring efforts, and the United States Department of Agriculture (USDA), Department of Defense (DOD), and Department of Transportation (DOT) in promoting remediation and prevention activities consistent with the Strategy.

Dr. Armitage also presented some of the specific outreach activities, guidance, and publications being planned by EPA as part of the Contaminated Sediment Management Strategy. EPA is planning to form task forces and to develop guidance for regulatory actions, testing guidelines, informational publications, and multimedia materials. The Agency is particularly interested in the role task forces and advisory groups can play in informing key audiences about contaminated sediment issues and generating input to the Strategy. Currently, there are EPA work groups developing the national inventory of contaminated sediment sites and tiered testing methods for sediment, and an interagency work group on consistency in monitoring methods. Proposed legislation would establish a national task force on contaminated sediments in order to facilitate interagency cooperation. EPA is considering establishment of a Citizen's Advisory Council, similar to those supporting the National Estuary and Chesapeake Bay Programs, which would consist of representatives from all stakeholders in the Strategy including the regulated community. The committee would provide input to EPA in support of Strategy development and implementation.

4.1.4 Questions on EPA's Proposed Outreach Activities

Many stakeholders, such as farmers, municipalities, and public works departments, are missing from the forum audience. Why were they not included?

Dr. Armitage responded that EPA had invited a broad range of participants and would be interested in receiving written comments from groups that could not attend the forum. The end of the public comment period was July 15, 1992. Nicole Veilleux, Office of Wetlands, Oceans, and Watersheds (OWOW) emphasized that the news media is an important audience, which also must be kept informed and educated.

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How will the National Environmental Education Act (NEEA) be employed in the Strategy's outreach efforts?

Dr. Armitage replied that the NEEA targets students in earth science and environmental education classes. He added that Michael Baker of EPA's Office of Environmental Education would be speaking on the NEEA later in the program (see Section 4.2.5.1).

On what particular aspects of the outreach program would EPA most like feedback from forum attendees?

Dr. Armitage responded that he was most interested in hearing what types of technical guidance the regulated community needs, and what types of nontechnical guidance and outreach approaches would be most effective in reaching the public with critical information.

4.2 PRESENTATION SUMMARIES

4.2.1 State Government

4.2.1.1 David O'Malley, Planning Analyst, Wisconsin Department of Natural Resources

In Wisconsin, the public has reacted most strongly to water quality problems that result in visible effects, such as beach closings, restrictions on water consumption, contaminated fish and wildlife, and eutrophication. Mr. O'Malley felt that the public must be educated about the link between contaminated sediments and fish and wildlife advisories, which are in effect in many places in Wisconsin. Although fish advisories are probably the number one concern noted by local citizens, other issues often raised include the duration and costs of cleaning up contaminated sites, the equitable distribution of funds for remediation among different regions, and the level of commitment from the government to implement Remedial Action Plans (RAPs). Affected citizens need information on remedial technologies, especially innovative technologies such as bioremediation. They also need technical support for development of sediment cleanup guidelines for metals, PAHs, and PCBs. Information on increased funding to carry out remedial activities from sources outside the state government must also be made available. Mr. O'Malley also thought it would be useful to have more information available about the scope of sediment cleanup activities nationwide.

Mr. O'Malley focused on the RAP process as an example of successful public involvement in Wisconsin. RAPs stress a multimedia approach to addressing contamination that includes both point and nonpoint sources of pollution. In the Great Lakes Region, 42 of the 43 areas of concern (see Figure 4-1) have contaminated sediments as a common denominator. Five of these contaminated sediment areas are in Wisconsin. Mr. O'Malley outlined the three stages in the RAP development process: stage 1 describes the water quality problems and establishes goals; stage 2 develops a blueprint for action which describes what is going to be done by whom and in what time frame; and stage 3 involves surveillance and monitoring to confirm that the area is restored.

The Citizen's Advisory Committee is the backbone of the RAP process. The committee's representation is diverse, including industry, sporting clubs, and the general public. Mr. O'Malley stressed the importance of the committee's role in educating local decision-makers about the extent

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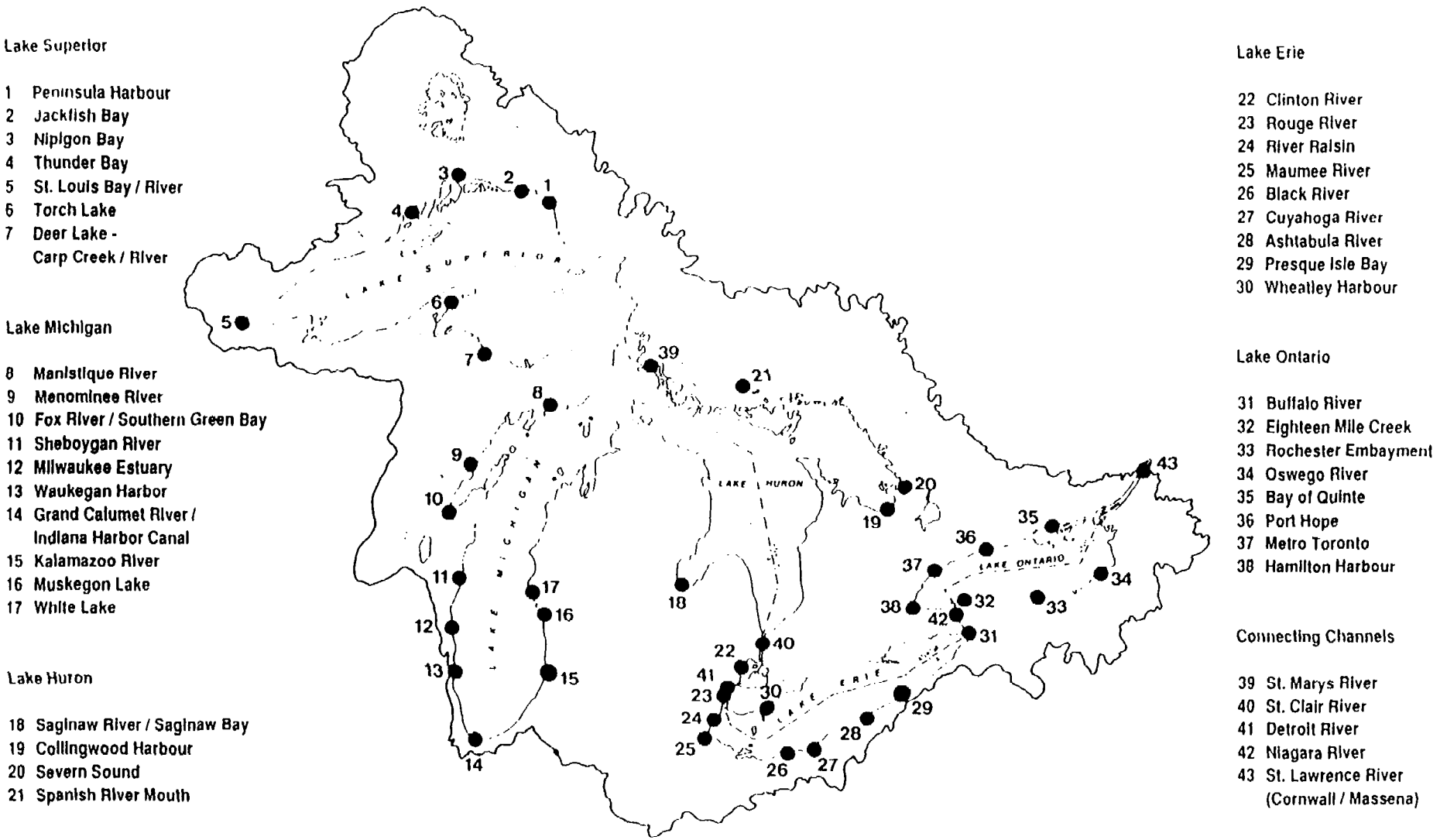

Figure 4-1. Forty-three areas of concern identified in the Great Lakes Basin.

of the problem and educating state agency personnel about the stakeholders' perceptions and concerns. He also emphasized that because RAPs can be years in completion, committee members can experience burnout and need to identify achievable short-term milestones, such as getting funding from a particular source, to instill a sense of accomplishment.

Specific outreach efforts in Wisconsin have included the development of a program to explain the fish consumption advisory to the Huomong population in Sheboygan. A specially designed advisory poster relies on symbols rather than words to convey fish consumption risks (see Figure 4-2). Wisconsin also developed a RAP newsletter and a magazine supplement stressing partnerships in RAP implementation by profiling local contributors such as sports fishers and local chambers of commerce. The supplement, which had a circulation of 80,000, was produced under a grant from the Coastal Zone Program.

Mr. O'Malley reminded EPA to be responsive to comments from advisory groups and members of target audiences when planning Agency outreach efforts. He also advised EPA to use existing state networks, such as the RAP process in Wisconsin, to implement the goals of the Contaminated Sediment Management Strategy, and to allow states flexibility in their own efforts. He thought it was important to emphasize from the outset of sediment management programs how long cleanup could be expected to take, and to inform the public about the risks and costs associated with different remedial options, including natural recovery. Fact sheets that summarize key information and describe specific technologies would be very useful in disseminating this type of information. Mr. O'Malley commended EPA for organizing the forum series as a way to get input, generate ideas, and establish a network for communicating with important audiences. He reinforced the idea of the Strategy as a partnership effort, expressing the view that the more the public and the regulated community were involved in decision-making, the more likely they were to support the Strategy's implementation.

4.2.1.2 Summary of State Government Recommendations

- EPA should involve people as early as possible in the Strategy planning process. The Agency should involve the private sector as well as the general public, and emphasize community participation.

- EPA should clearly state its expectations for sediment cleanup efforts at the outset. Issues such as costs, time frame for cleanup, and how the local situation compares to the sediment efforts nationwide all should be addressed in the initial planning stages of a cleanup effort.

- EPA should focus on keeping the momentum going with respect to citizen involvement. The Agency should create short-term goals and highlight accomplishments.

- Whenever possible, EPA should tie the issue of in-place sediments to tangible effects such as fish consumption advisories.

- EPA should demonstrate its commitment to sediment management efforts through consistent involvement and its accountability by providing status reports.

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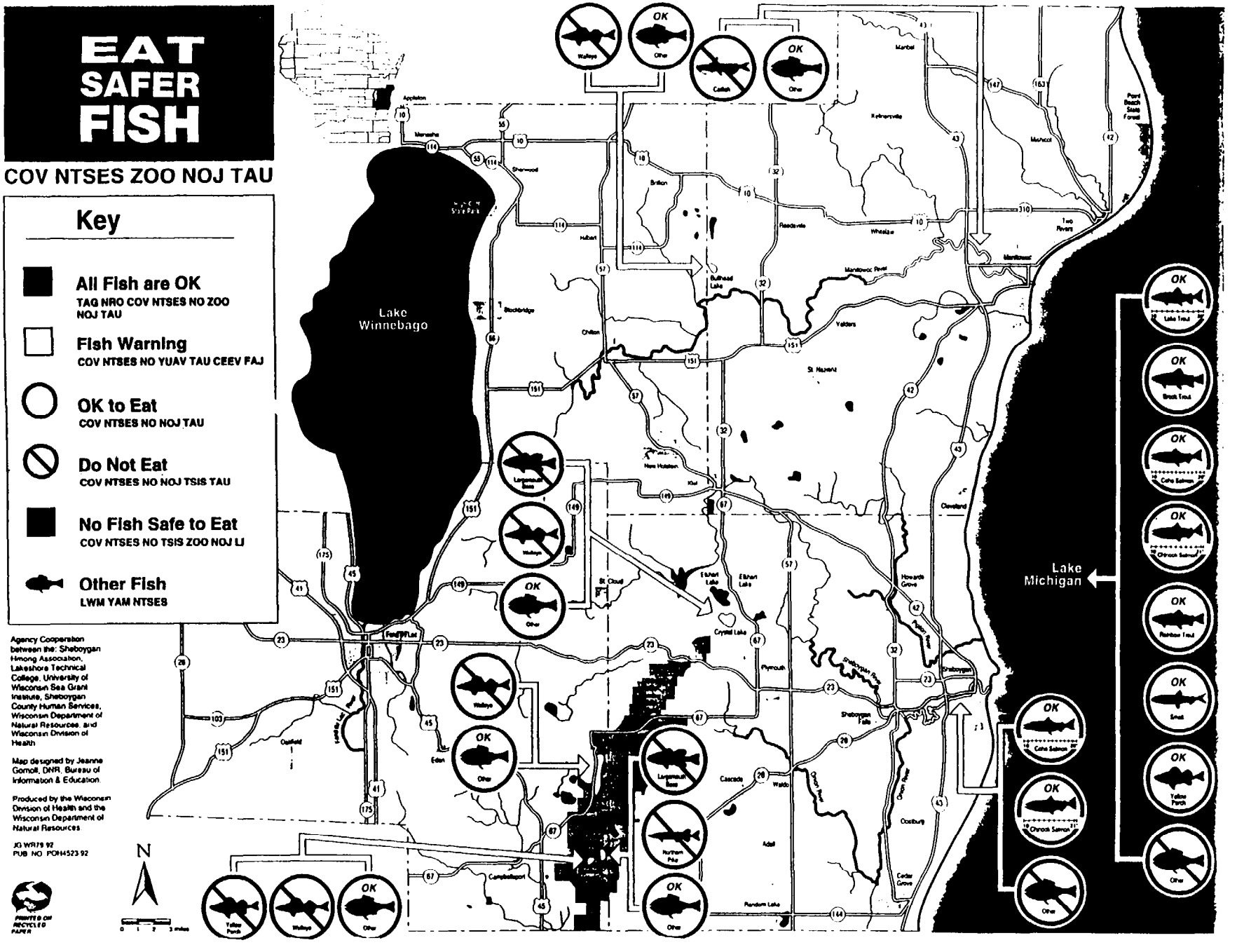

Figure 4-2. Fish consumption advisory for the Huomong population in Sheboygan.

- EPA should utilize existing state networks and mechanisms for public involvement and information dissemination.

- EPA should provide broad information and support, but allow the states flexibility in making decisions and adapting the Strategy to local situations.

- Fact sheets and clear, consistent guidance are useful methods for getting technical information across to the largest audience. Workshops and face-to-face contact, however, are important for demonstrating commitment and allowing a two-way flow of information.

4.2.1.3 Questions Addressed to the State Government Representative

How much do your Wisconsin constituents know about the link between fish advisories and contaminated sediments?

Mr. O'Malley replied that the RAP committee members understand this link, but that the general public must be educated further.

How did Wisconsin originally determine that sediment contamination was a problem in the five areas of concern?

Mr. O'Malley said state officials used EPA and U.S. Army Corps of Engineers (COE) guidelines for determining moderately and heavily polluted areas. Data from routine sampling and sampling for fish consumption advisories were also used. He further noted that sediment contamination was determined on the basis of concentrations rather than effects. Glenda Daniel, Lake Michigan Federation, added that caged fish studies had been used to determine concentrations in fish in the Detroit River. Mr. O'Malley said that Wisconsin was initiating this type of study and finding some chronic effects from bioassays.

What form of information would be most useful to your constituents?

Mr. O'Malley replied that short, abbreviated, and clearly summarized guidance was most important in getting across basic concepts. Workshops and forums such as this one are also very helpful in disseminating information and receiving input. One of the worst frustrations, he said, was being asked to comment on documents within a time frame that did not allow a thorough review.

What are the most useful ways to communicate with the public in terms of nontechnical guidance?

Mr. O'Malley emphasized the need for consistent guidance nationwide, and for information about a range of remedial options. He also stressed the importance of using programs that are already in place and communicating through existing state channels.

What methods does Wisconsin use to distribute guidance?

Mr. O'Malley replied that face-to-face contact has been most effective in the past, such as in RAP committee meetings and when local RAP coordinators and committee members appear in booths on local information days or distribute materials in a workshop setting. He also mentioned a Wisconsin group called the Green Bay Backers, who have sponsored citizen involvement activities in communities.

What roles do the private sector and the farming community play in RAP implementation?

Mr. O'Malley said that these groups were active in committee meetings and drafting recommendations, and often contributed money for the development and distribution of publications. He felt that members of industry and agriculture, in addition to carrying clout with the community, could share valuable technical knowledge not obtainable elsewhere.

What is the relationship between the state and municipal governments, where municipalities enact their own regulations?

Mr. O'Malley replied that county or city governments do not have to follow the recommendations of the RAP, because these documents do not have the force of law. Often, however, in light of community pressures and public opinion, municipalities enact even more stringent regulations than the state, for example, with regard to protective zoning for wetlands.

What are your techniques for dealing with minority opinion in the advisory groups, and how would you protect against a citizen's action suit?

Mr. O'Malley answered that, although it is not always possible to obtain a 100 percent consensus, minority opinion may be incorporated into the RAP as an alternative. Sometimes, however, the Department of Natural Resources (DNR) finds it necessary to make a decision that may not be popular with everyone on the committee. This is because the DNR is ultimately responsible for the RAP's implementation. There is always the possibility that a citizen may take legal action if he or she disagrees with the committee's decisions. The use of the natural recovery option for sediment remediation might be an issue associated with some controversy and disagreement. Mr. O'Malley said that even 1 percent of a group could force a legal decision on an issue over which there was 99 percent consensus.

4.2.2 Regulated Community

4.2.2.1 Richard Schwer, E.I. DuPont Company

As a representative of the Chemical Manufacturers Association (CMA), Mr. Schwer expressed CMA's eagerness to contribute to developing the Strategy and to provide feedback on the proposed outreach activities. CMA, which represents more than 90 percent of the productive capacity for manufacturing basic industrial chemicals in the United States, believes the Strategy may

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have far-reaching implications for the industry. Mr. Schwer's comments reflected his concern for what he perceived to be a lack of adequate information on the extent and severity of the contaminated sediment problem. He stated that the data from the 1985 Office of Water's contaminated sediments study were limited, lacked consistency and quality controls, and did not relate contaminant chemistry to biological effects. He further stated that the Office of Water's 1987 study and the 1989 study by the National Academy of Sciences used the same data base. According to Mr. Schwer, more recent and comprehensive data are needed to assess the problem. He believes that available data suggest "hot spot," rather than widespread, contamination. Mr. Schwer feels that EPA must present the regulated community with an environmentally relevant and consistent definition for the term "contaminated sediment." He is concerned that sediment contamination will be judged on the basis of chemical concentration rather than bioavailability, and he recommended a tiered site-specific approach to assessment. Mr. Schwer cited risk communication as another need. The regulated community and the public require balanced factual information on assessment, methodologies, and management alternatives. This information must be conveyed in a clear and understandable manner so that stakeholders in the Strategy become informed decision-makers.

In his critique of EPA's proposed outreach plan, Mr. Schwer supported EPA's intention to have the Science Advisory Board review all aspects of the Strategy for sound science. He strongly endorses EPA's willingness to form a Citizen's Advisory Council that would serve as an information resource and periodically review the Strategy. He is pleased with EPA's involvement of industry in the process. He would like to see the formation of a task force that would include the private sector and would bring together federal agencies and affected parties to facilitate Strategy implementation. Some of his concerns are that EPA continues to emphasize point over nonpoint sources in the Strategy and that the consultation center mentioned in the proposed outreach activities appears to be limited to EPA rather than allowing access by the private sector as well.

Mr. Schwer felt that EPA could improve upon its outreach efforts by providing information expressed in terms of the public's values and concerns. Information on issues such as the relationship between sediment contamination and fish consumption advisories must be communicated to the public. EPA needs access to technically knowledgeable people, and the regulated community can provide some of that expertise. Mr. Schwer emphasized the need for all groups to work together, including both the regulators and the regulated community, and cautioned that conflict can create mistrust. Mr. Schwer stated that guidance should be available for nonpoint as well as industrial point sources of contamination, and that it is critical to link these sources to contaminated sites with demonstrated cause-and-effect data. EPA technical assistance also should be available to the public, for example, through a hotline staffed by knowledgeable people. Mr. Schwer also recommended that the information obtained and conclusions reached at this forum series should be widely published.

4.2.2.2 Donna Tomlinson, Eastman Chemical Company

Ms. Tomlinson's presentation focused on CMA's Responsible Care Program, an industry outreach initiative to improve performance, health and safety, and environmental quality. Participation in Responsible Care is a requirement for participation in CMA. Responsible Care was founded to foster two-way communication with the public, and to establish the chemical industry's commitment to improved performance in response to public concerns. Public perception of the chemical industry has traditionally been lower than that of the oil industry or the nuclear

industry. CMA believes that public understanding and support will increase if the public has a way of participating in the decision-making process.

CMA achieves public involvement in Responsible Care through a National Public Advisory Council and a broad public outreach program supported by member companies. The Public Advisory Council, assembled and managed by an outside group, includes local government officials, emergency responders, environmental and consumer activists, and representatives from agriculture and industry who review and evaluate codes of management practices. The panel's membership represents two key constituencies: citizens living in areas with high industrial concentrations and those on the leading edge of public opinion.

Performance improvement is accomplished through implementing codes of management practices that address community awareness and emergency response, pollution prevention, process safety, employee health and safety, and product stewardship. Each code has a self-evaluation form to help companies identify areas that need improvement and to track improvement of each member company for the purpose of informing the public. In addition, executive leadership groups composed of senior industrial executives meet regularly to discuss progress, share experiences with Responsible Care implementation, and offer help to member companies.

The code most relevant to this forum is the Community Awareness and Emergency Response (CAER) code. The CAER code requires facilities to initiate an outreach program to communicate useful information responsive to the public's concerns about health, safety, and the environment. It is based on performance objectives rather than standards, thus allowing member companies flexibility in how to achieve the code's goals. The CAER code emphasizes interaction with many audiences, including employees, emergency responders, government officials, and the general public. Outreach efforts have included establishing community advisory panels and toll-free information numbers; providing information about waste minimization, emissions reduction, health effects of chemicals, and efforts to ensure safe transport; and distributing summary publications, press releases, and progress reports.

Ms. Tomlinson closed by reiterating CMA's support of EPA's Strategy development process and CMA's willingness to continue to offer constructive criticism toward the development of a balanced, environmentally sound, and effective Strategy.

4.2.2.3 Summary of Regulated Community Recommendations

- EPA should communicate the importance of the sediment management issue with reference to salient public concerns, such as fish consumption advisories.

- EPA should evaluate carefully what data are needed to draw relevant conclusions about sediment contamination and subject all data and conclusions to rigorous review.

- EPA must develop and consistently apply a definition of "contaminated sediments" that incorporates environmental and human health effects.

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- EPA should provide the public with a balanced risk framework that is understandable and includes information about comparative risks. The Agency must also determine what the public values, and express risk analyses results in those terms.

- EPA should efficiently utilize the National Consultation Center and a sediment hotline to provide the public with accurate information. EPA also should publish widely the information and conclusions from the three sediment forums.

- EPA should seek input and participation from the public and the private sector through the formation of a Citizen's Advisory Council on Sediment Management.

- Industry initiatives such as CMA's Responsible Care Program can help foster the goals of EPA's Contaminated Sediment Management Strategy.

4.2.2.4 Questions Addressed to the Regulated Community Representatives

Aren't the terms "better data" and "sound science" often used by industry as buzzwords for delaying implementation of environmental action?

Mr. Schwer responded that data collection and analysis methods had improved little in 5 years, and that much of the data in the STORET data base predates 1985. Considering the costs and implications of decisions that would be made based on these data, he felt that updating the data was critical. He recognized, however, that data collection as an end in itself could become a trap which must be avoided. One issue that particularly interests Mr. Schwer is whether the contamination problem is nationwide or whether effects from contamination are limited to selected areas. He feels strongly that more data would contribute to deciding whether a "shotgun" or "scalpel" approach to management was necessary.

How active is the Responsible Care Program, and how might EPA's Strategy be incorporated into Responsible Care?

Ms. Tomlinson replied that the program has received a number of calls in response to the toll-free numbers published in popular magazines such as *Time* and *Newsweek*. Questions are answered by CMA staffers or by the environmental management departments of individual member companies. The program is expecting the number of calls to increase as the toll-free number is more widely publicized. Ms. Tomlinson said that EPA's Strategy would add another responsibility to the Responsible Care initiative.

In what form would CMA's member companies prefer to receive information related to the Strategy and its implementation?

Mr. Schwer responded that information should be targeted to specific audiences within a company. For example, company management would be interested in information concerning public relations, the bottom line, and the future of the company's operations; whereas project

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managers would most need to know what they are required to do for compliance and what tools are available to help them. Scientists and consultants within a company would be most interested in the scientific and technical basis for decisions. Mr. Schwer further explained that CMA would be able to advise EPA on how material should be structured but would not be able to develop the materials themselves.

What should an environmentally relevant definition of contaminated sediments include?

Mr. Schwer replied that such a definition would need to combine a number of endpoints, such as information on bioaccumulation and toxicity as they relate to the aquatic environment in a particular location.

Is CMA responsible for leading the chemical industry effort in pollution prevention methods and technologies?

Mr. Schwer responded that such an effort would need to be developed on a company-by-company or even a process-by-process basis. Mr. Schwer was not aware of any centralized authority for such information.

Are there any examples or case studies of effective models of risk communication from an industry point of view?

Mr. Schwer responded that CMA would need more time to identify and prepare such examples. Dr. Southerland said that she would be very interested in learning about successful examples.

4.2.3 Environmental Advocacy Groups

4.2.3.1 Glenda Daniel, Executive Director, Lake Michigan Federation

Ms. Daniel's Lake Michigan constituency is well acquainted with issues related to contaminated sediments. Many of their concerns are technically specific: how EPA's sediment criteria will be used, what it means to have numerical sediment criteria, how acute differs from chronic toxicity, whether bioaccumulation is being taken into account, and how EPA determines and evaluates exposure and risk. Other concerns relate to the decision-making process, including such issues as why sediment contamination wasn't publicized earlier, why the public was excluded from Strategy discussions, where cleanup money will come from, how priorities for cleanup will be selected, and where cleanup will take place.

Ms. Daniel urged EPA to address public interests, both to assuage irrational fears and to foster justifiable concerns. For example, citizens perceive that dredging will stir up dangerous sediments. They need to be informed that contaminated sediments are being constantly stirred up by winds, currents, ships, and wildlife and assured that measures will be taken to control sediment dispersal during dredging. Similarly, citizens need more information on noncancer risks, because

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the potential dangers from contaminated sediments appear to be as much neurological and behavioral as carcinogenic.

Commenting on EPA's proposed activities, Ms. Daniel suggested that current modes of public outreach are inadequate. Public meetings tend to be rigid and formulaic; citizens feel as if they are being "talked down to." Written and visual information tends to be unengaging, in need of a fresher, more attractive presentation. Ms. Daniel cited the professional advertising campaign to increase public awareness of radon as a successful model. Whenever possible, the sediment problem should be linked to current events like the Spring 1992 flood in Chicago, which threatened to bring contaminated sediments into people's basements. Most importantly, EPA must convey a willingness to remain flexible and to engage in two-way dialogue with the public. Such dialogue not only increases public trust but may produce critical information for EPA. Ms. Daniel mentioned specifically a meeting that provided valuable information for EPA. At the meeting, parents indicated that their children swam in a river where EPA had assumed that there was little human exposure.

Given the wide geographic area and diverse interests of her region, Ms. Daniel noted the importance of assembling interested parties on a regular basis to identify disagreements and lay out parameters for discussion. Constant effort is required to identify and include missing groups in the discussion. She felt that one model for public involvement, the Assessment and Remediation of Contaminated Sediments (ARCS) Program, while clumsy in scale, proved to be effective. Under this program, people from NOAA, the U.S. Fish and Wildlife Service (FWS), COE, EPA, Bureau of Mines, environmental groups, fisheries, and industry formed three committees to address specific needs. The Toxicity Chemistry Committee assessed the extent of contamination, the Risk Assessment Committee used computer modeling to determine associated health risks, and the Technology Project Committee generated and tested potential cleanup strategies. This task-specific structure successfully avoided isolating nongovernmental and nontechnical people from the decision-making process. The ARCS Program plans a number of outreach methods to publicize its work at five demonstration sites established to evaluate various remedial approaches. Data from these sites will be presented in technical and nontechnical guidance documents, and at technology transfer workshops, to inform workers at other sites of the progress that has been made. To keep the public informed, ARCS also is developing newsletters, slideshows, and videos to display their progress at each site.

Commenting on EPA's draft outline for the Contaminated Sediment Management Strategy, Ms. Daniel called for stronger language. She pushed EPA to define more precisely what constitutes an unacceptable risk to human health (Goal A). She questioned whether EPA's commitment to clean up contamination when practical (Goal B) meant, in effect, when convenient or when unopposed. She requested assurance that EPA's commitment to continue sediment disposal (Goal C) included a commitment to explore innovative technologies. She questioned the efficacy of natural cleanup processes (Principle J), suggesting that nearly every site requires intervention to facilitate biodegradation. Finally, she urged EPA to set higher goals (Principle K) and to strive always for "fishable, swimmable, and drinkable" waters.

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4.2.3.2 Beth Millemann, Coast Alliance

Ms. Millemann built a strong case for implementation of a program to inform the public on issues related to contaminated sediments and to involve them in the formation of the Contaminated Sediment Management Strategy. Levels of public involvement in the Strategy thus far have been low, in marked contrast to the levels of involvement among industry, scientists, lawmakers, and public officials. Affected industries are already deeply involved in tracking this issue. COE and port authorities are collecting information and passing it on to lawmakers, journalists, and trade organizations. Congress is presently considering bills that could result in action on disposal of contaminated sediments. The international community is studying contaminated sediments as they pertain to the London Dumping Convention. In essence, the public is the last to become involved. Historically, prolonged public ignorance of environmental issues has led to litigation, long-term arbitration, and disenchantment with state and federal agencies.

There is a clear need for better outreach so that the public can make informed decisions about contaminated sediments as the issue affects their lives. In coastal areas, the public is already beginning to face questions that require knowledge of issues related to contaminated sediment management. For example, there is a proposal to dredge contaminated channels in Oakland Harbor, but commercial fishing organizations and environmental groups are opposing it. In Boston, plans are being made for a third harbor tunnel, and citizens want to know where the dredged material will be disposed of. There is little public confidence that EPA has a rational, defensible program to deal with contaminated sediments. Public distrust can be dangerous: bans on ocean dumping of sludge and industrial waste exemplify the public's tendency to support stiff regulation rather than compromise.

Ms. Millemann urged EPA to use existing avenues of communication to introduce the topic of contaminated sediments to the public. She suggested several forums for public involvement in coastal areas. Annual conventions of environmental groups such as the National Audubon Society are well advertised, well attended, and offer opportunities for EPA staff to discuss contaminated sediment issues. Labor unions such as the Teamsters, responsible for handling contaminated sediments, host environmental panels at their national conventions. Organizations such as the Coastal Society and the Coastal States Organization offer similar opportunities to publicize contaminated sediment issues. Citizens advisory committees such as those active in the National Estuary Program offer existing networks for public outreach at both the state and federal level. Watershed organizations like Great Lakes United and the Conservation Law Foundation of New England offer opportunities to reach their large and diverse constituencies. In addition, many states have coastal zone management programs that come under review every 2 years, with citizen advisory committees already in place.

4.2.3.3 Summary of Environmental Advocacy Group Recommendations

- EPA should get the public involved as early as possible in Strategy planning.
- EPA should provide information at a level of detail that allows the public to formulate decisions. People want to hear the "meat" of the message and to be treated as a sophisticated audience.

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- Data collection and analysis should be thorough and scientifically sound.

- EPA should take advantage of existing communications systems, such as newsletters and annual meetings of environmental groups or union groups, to disseminate information.

- EPA publications and presentations should employ interesting visuals and engaging formats.

- Face-to-face interaction through meetings, workshops, or conferences is the most effective way to communicate EPA's messages.

4.2.3.4 Questions Addressed to Environmental Advocacy Group Representatives

How frequently should citizen advisory groups meet and how are such meetings typically funded?

Ms. Daniel responded that advisory groups work cheaply. To her knowledge, participants have been reimbursed only for travel and lodging, never on a per diem basis. She suggested that meetings be scheduled frequently enough to keep citizens involved in the decision-making process. Ms. Millemann suggested using conference calls to minimize expenses. Mr. Schwer said that the regulated community would provide time for members to participate in citizen advisory groups and noted that meeting only once a year would probably not provide EPA with sufficient input. He suggested quarterly meetings during the first year to foster working relationships between citizens and Agency staff. After 1 or 2 years, meetings could be scheduled every 6 months with quarterly consultations if necessary.

How would you suggest that EPA strike a balance between technical and nontechnical information when addressing the public?

Ms. Daniel pointed to problems experienced at the recent "all-hands" annual meeting for ARCS. The meeting was divided into very technical presentations and presentations for RAP advisory groups. The technical presentations were too technical and were presented out of context; advisory group presentations consisted merely of "headlines." The meeting suffered as a consequence. Ms. Daniel emphasized the importance of interpreting the research being done and illustrating those interpretations with well-chosen examples.

Randall Ransom, Dow Corning, warned against the assumption that all news is bad news. Mr. Ransom pointed to the NOAA National Status and Trends Program, which indicates that most sediments are not contaminated.

Is there a compendium of public groups with names to contact and information on annual meetings?

Ms. Millemann suggested the *Conservation Directory*, available from the National Wildlife Federation Office in Washington, DC.

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What are some other examples that could help EPA use existing mechanisms for public outreach?

Suzanne Bolton, NOAA, urged EPA not to neglect mechanisms within other federal agencies, such as agriculture extension services within the U.S. Department of Agriculture and Sea Grant within NOAA, that deal with individual localities. In addition, Ms. Bolton pointed to successful use of teleconferencing by the Economic Development Administration, U.S. Travel and Tourism Administration, and the U.S. Information Agency during a recent conference on rural tourism.

Ruddie Clarkson, J.M. Consulting Engineers, indicated that industries, community groups, and local governments are calling for basic, yet sufficiently detailed, information on the health and ecological effects of contaminated sediments. She added the U.S. Public Health Service and Public Health Department to the list of existing networks that EPA should use for public outreach; these organizations can disseminate basic information on sediment toxicity issues via hospitals and private physicians.

What kinds of results can EPA show citizens to demonstrate that the public is having an impact on sediment cleanup?

Ms. Daniel recognized the need to warn citizens that cleanup may be slow, but she stressed the importance of celebrating interim successes. Such successes, however slow in coming, put the overall plan for cleanup into a more comprehensible and manageable perspective and allow goals to be more clearly articulated.

Ms. Clarkson commented that many community programs fail because goals and strategies are not clearly articulated. The public must recognize up front that cleanup will require a long-term commitment; this recognition makes what Ms. Daniel calls "interim celebrations" more satisfying.

Which audiovisual techniques are most effective for public outreach?

Ms. Daniel indicated that computer bulletin boards and networks do not work well. Too many small groups have only one computer, which is used primarily for word processing. Ms. Millemann suggested that people are more effective communicators than videotapes, but that videos are better than written reports which simply do not get read. Oral presentations should be accompanied by slides and short fact sheets so as to make a visual link between "dirty mud" and health impacts on fish and birds.

4.2.4 Public Awareness Group

4.2.4.1 Frances Flanigan, Alliance for the Chesapeake Bay

Ms. Flanigan amplified a theme stressed by other speakers, stating that EPA must find ways to involve the public in working to improve environmental quality. The public's interest in this issue

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is clear: its tax dollars, health, and well being are at stake. Ms. Flanigan believes that public participation should be seen as a means to enact good policy, and she outlined three roles the public can play. First, they can help to define the extent of the problem. Whether or not Chesapeake Bay has a sediment problem is a value judgment; such judgments should be made by more than a few people. Second, the public can define the level of risk they find acceptable, making a distinction between voluntary risk and risk imposed externally. Third, the public can contribute to the development of cost-effective solutions. If they have defined the problem themselves, they will often feel a greater stake in finding solutions. EPA's outreach should be designed to encourage public participation in these aspects of policy-making.

Public outreach is more complicated when the public is part of the problem. Citizens often fail to realize that pollutants from toilets and cars can cause as much damage as those from negligent industries. The Alliance for the Chesapeake Bay has raised public consciousness of nonpoint pollution through a peer-to-peer network. For example, farmers whose fertilizers pollute ground water are contacted through the leadership of farm organizations. Ms. Flanigan's program has also sought to avoid assigning blame. Farmers learn that agrichemicals are part but not all of the problem. Whenever possible, environmental messages are delivered in terms that make economic sense. Farmers are informed that excessive fertilizer application is simply a waste of money. Fostering voluntary compliance greatly reduces government expense.

Ms. Flanigan urged EPA to be accountable to citizens participating in environmental programs; citizens want to know that their input brings results. She suggested several steps to ensure accountability to the public, including publication of an annual report, preparation of technical documents, or soliciting annual meetings. For example, in the Chesapeake Bay Program, an executive council, including governors and EPA Administrator Reilly, meets annually to review accomplishments and plan future activities. Accountability becomes more important as policy implementation begins. Since implementation is usually long term, EPA must try to remain accountable for short-term goals established early in the development of environmental programs. When initial implementation fails, new courses of action need to be charted. At this stage, there is a strong temptation to exclude the public, but EPA must continue to keep the public involved.

The goal of Ms. Flanigan's public information program has been to create "an environment of awareness." The message has been simple: "The Bay is in trouble, and we are all at fault. Here's what others are doing and what you can do. Here's what it will cost and how long it will take." The Alliance has conveyed the message in four formats: an inexpensive introductory brochure, fact sheets on particular local interests, a newsletter funded by EPA, and a booklet with more detailed information. Ms. Flanigan questioned the necessity of expensive, glossy, written materials when targeting an audience with a vested interest in the information. Such materials are more useful when courting audiences with no particular interest in contaminated sediments. In addition, Ms. Flanigan has found that highly technical information is unnecessary to foster support for action.

Ms. Flanigan stressed the importance of targeting diverse audiences: chambers of commerce, farm organizations, civic organizations, and recreational groups. EPA must develop and maintain an up-to-date mailing list of contacts and get on these organizations' agendas. Ms. Flanigan emphasized the feasibility of building consensus at the broad policy level, if not at the level of regulation. Citizen advisory committees bring together diverse interests, and discussions within these groups build consensus by narrowing the fields of disagreement. In concluding, Ms. Flanigan

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stated that the Alliance has successfully set up an institutional network among existing governmental and nongovernmental agencies that can sustain long-term implementation.

4.2.4.2 Summary of Public Awareness Group Recommendations

- EPA should first identify ways to get people interested and concerned about the contaminated sediment problem, and then get them involved in the process of implementing solutions.
- EPA must recognize that public involvement is a process and a means to achieving the Strategy goals.
- Communications tools should be developed in response to specific audiences and specific needs. EPA should be involved in designing information pieces to close knowledge gaps.
- EPA must work toward building consensus among all of its audiences.
- EPA must demonstrate accountability by achieving interim goals and providing information on the status of activities.
- EPA should work toward developing a management framework of institutions that will be self-sustaining and carry the work of sediment management on into the future.

4.2.4.3 Questions Addressed to the Public Awareness Group Representative

How would you describe the infrastructure needed to support an effort as successful as yours in disseminating information to the public?

Ms. Flanigan replied that the Alliance for Chesapeake Bay is fortunate to have support from other organizations. For example, the Chesapeake Bay Foundation, an advocacy group with 80,000 members, 100 full-time staff members, and a $7 million budget, does extensive work in education, lobbying, and litigation. The Alliance for Chesapeake Bay, with three offices, 15 full-time professionals, and a $800,000 budget focuses on public outreach. Ms. Flanigan emphasized that substantial work can be done relatively inexpensively by organizations committed to remaining lean and "unbureaucratic."

Has the Alliance worked on methods to explain comparative risks?

Ms. Flanigan remarked that little work had been done overall. She added that the Chesapeake Bay Program had a Toxics Committee, chaired by Clay Jones, doing work in this area. Dierdre Murphy, Maryland Department of the Environment, pointed out that risk estimates represent upper bounds. In some cases, there may be little or no risk at all. She urged EPA to put

these risk figures into meaningful language, perhaps by comparing them to risks that are encountered in everyday experience.

How does the Alliance get its information from EPA and which channels are most useful?

Ms. Flanigan suggested that newsletters, reports, and press releases arriving by mail are the most common sources of information. Despite the volume of these items, she expressed concern that she might still be missing other sources of information. In filtering through material from EPA, Ms. Flanigan looks for pieces that are relevant and well written. She suggested that EPA might identify audiences more carefully and make phone contact to call attention to important documents.

With regard to the nutrient problem in Chesapeake Bay, Ms. Flanigan replied that fact sheets from EPA tended to be too technical to be useful. As a nontechnical group, she and her staff found it more effective to serve as translators between the technical community and the public. People at the Alliance attend meetings and make sense of the information, then write their own fact sheets to distribute to the public. Ms. Flanigan suggested that presentations, well delivered, detailed, and supported with interesting graphics, are by far the most useful form of communication. Even if the information is very technical, these presentations convey a sense of who has done significant research and who is to be trusted.

4.2.5 National Environmental Education Act

4.2.5.1 Michael Baker, Acting Deputy Director, Office of Environmental Education

The signing of the National Environmental Education Act (NEEA) in 1990 added education to EPA's regulatory and enforcement activities. The NEEA is authorized for 5 years, and funded at approximately $12 million per year. In FY 1992, $6.5 million was appropriated by Congress. The message behind the NEEA, said Mr. Baker, is the encouragement of partnership among academia, government and nongovernmental organizations, and the private sector. Many of the grant programs focus on ways that different sectors of society can cooperate in funding and implementing environmental education activities.

According to Mr. Baker, the NEEA's environmental education programs have received a tremendous response this first year. Over 3,000 proposals requesting over $100 million dollars were received for this year's grants programs. Proposals for less than $25,000 were evaluated by EPA regional offices and a peer panel; proposals of more than $25,000 were evaluated by headquarters and peer reviewers. The winners of these awards were announced by Administrator William Reilly at the end of June. A single 3-year grant was awarded to the University of Michigan to establish a National Training Program Center based on a train-the-trainer model. In addition to the grants programs, NEEA is sponsoring an intern fellowship program, which places individuals in federal agencies across the country.

Mr. Baker described the NEEA's use of advisory boards to involve all sectors of society in implementation activities. These groups include a 38-member internal EPA advisory board; a federal task force consisting of EPA and 16 other federal agencies; and an 11-member national

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advisory council composed of representatives from state and local governments, nongovernmental organizations, schools and universities, and industry.

Other outreach activities include the development of a user friendly clearinghouse on environmental education resources; EPA's *Earth Notes* newsletter for educators; and an international memorandum of agreement among the United States, Canada, and Mexico.

4.2.5.2 Questions on the National Environmental Education Act

What is the nature of the interaction between the Office of Environmental Education and other EPA offices?

Mr. Baker responded that representatives from the program offices provide input through the EPA advisory board. These representatives then share information on planning and implementation of NEEA activities with their respective offices.

Will the National Training Program Center be available for training scientists and regulators in monitoring and testing methods for sediments?

Mr. Baker replied that would be one of its services.

Will money from the NEEA be available to customize educational programs to individual schools?

Mr. Baker replied that such funds could be procured through the Section 6 grants program.

4.3 EPA SUMMARY OF COMMENTS AND DISCUSSIONS ON OUTREACH AND PUBLIC AWARENESS THEMES

Dr. Southerland expressed her appreciation for the many valuable comments and recommendations made by the speakers and other participants in the forum. Below is a summary of some of the input regarding major areas of concern to EPA.

4.3.1 Citizen's Advisory Group

Every speaker commented that some form of citizen's advisory group that could monitor the development and implementation of the Contaminated Sediment Management Strategy would be worthwhile. Such a group should not isolate nongovernmental organizations and the private sector from other federal agencies, but bring them together to discuss concerns. It is important to clearly define the roles of all group members, whether involved as advisors or as participants in decision-making. Also, it is critical to ensure that members continue to represent their constituents throughout the process.

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4.3.2 Types of Outreach Materials

Forum participants agreed that the most effective forms of outreach involve face-to-face interaction, such as through advisory groups, public meetings, or workshops. These methods allow two-way communication. Through this kind of interaction, information can be targeted to meet the specific needs of individual audiences. Teleconferencing was suggested as a next best alternative to in-person contact. It was noted that videotapes are more useful than printed materials, but still allow for only one-way communication instead of a dialogue.

4.3.3 Content of Outreach Information

Speakers stressed the importance of conveying complete information to the public, without skimping on details. EPA should be careful to explain the significance of projects under way; the public wants to know why certain activities are being pursued. EPA also must be clear at the outset of its program about the time frame for remedial activities and what is expected to be accomplished. In the ARCS Program, goals were not clearly communicated, and many people did not realize that the success of demonstration projects did not represent ultimate cleanup. Publicizing interim successes, however, will help the public feel a sense of accomplishment and progress toward long-term restoration.

Participants also felt that outreach programs should be tailored to respond to geographical issues and concerns.

4.3.4 Information Dissemination

Many forum participants encouraged EPA to use existing networks for outreach and public participation, especially those in other federal agencies such as the extension services in USDA and Sea Grant in NOAA. Other outreach mechanisms described by speakers included the RAP process in Wisconsin, the CMA Responsible Care Program, and meetings of environmental groups.

4.3.5 Risk Communication

The need for effective risk communication was discussed, but participants could offer few examples of successful programs. Risk must be communicated both in terms of voluntary and involuntary risk, and ecological and human health risks. EPA is very interested in appropriate and useful examples of comparative risks related to contaminated sediments.

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APPENDIX A

EPA'S CONTAMINATED SEDIMENT MANAGEMENT STRATEGY DRAFT OUTLINE

March 4, 1992

Draft Outline

EPA's Contaminated Sediment Management Strategy:

A Proposal for Discussion

I. **Purpose**

A. Describe EPA's understanding of the extent and severity of sediment contamination, including the uncertainties about the dimension of the problem.

B. Describe the policy framework in which EPA intends to promote consideration and reduction of ecological and human health risks posed by sediment contamination.

C. Describe specific actions EPA will take to bring about consideration and reduction of sediment risks.

II. **Definition of Contaminant:** any solid, liquid, semisolid, dissolved solid, gaseous material or disease causing agent which upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, may, on the basis of information available to the Administrator, pose a risk of or cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations, in the organism or their offspring.

III. **Goals**

A. Prevent ongoing contamination of sediments that may cause unacceptable risks to human health or cause ecological harm, so that beneficial uses of the nation's surface waters are maintained.

B. When practical, clean up existing sediment contamination that adversely impacts the nation's surface waters or their uses or that causes other significant effects on human health or the environment.

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C. Ensure that sediment dredging and the disposal of dredged materials continue to be managed in an environmentally sound manner.

IV. Principles

General

A. EPA programs with authority to address sediment contamination operate under the mandate of many statutory provisions. Thus, regulatory decisions must be based on sets of considerations that are not always consistent. EPA programs should respond to the risks of sediment contamination as consistently as is possible, taking into account statutory requirements and the need for programs to address other problems that may pose similar or higher risks.

B. EPA will assign highest priority to activities with the greatest potential for reducing unacceptable risks to human health and the environment.

C. EPA should continue to improve coordination of research and regulatory efforts to assess and manage contaminated sediments with other State and Federal agencies, with international organizations, and with private parties.

Assessment

D. EPA should continue to develop and improve methods for identifying contaminated sediments that are causing harmful ecological effects and/or posing unacceptable risks to human health.

E. Assessment of sediment contamination, and any subsequent steps taken by the Agency to reduce risks, should be based on sound science.

F. To better assess the extent and severity of sediment contamination, the Agency should conduct an inventory of sediment quality and improve its monitoring for sediment contamination. The Agency should identify a list of chemicals of concern based on toxicity, persistence and propensity to bind to sediment particles and of sources of these chemicals.

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G. The Agency should use consistent methods to assess sediment contamination and its effects, so that data gathered by EPA programs are comparable and to focus methods development efforts.

Prevention

H. Where sediment quality is sufficient to support, or could support, the full beneficial uses of a waterbody, the Agency should ensure that existing pollution prevention measures and source controls will maintain or achieve the appropriate level of sediment quality.

I. Where sediments are contaminated to levels that cause ecological harm or pose an unacceptable risk to human health, the Agency should implement pollution prevention measures and source controls to prevent further contamination and allow toxic sediments over time to become nontoxic. This is a critical step to ensure the long-term success of any remedial activity for the site, to minimize the costs of navigational dredging, and to increase opportunities for beneficial reuse of dredged materials (e.g., wetland restoration).

Remediation

J. Where short term risks and effects can be tolerated and statutes do not require remediation or establish other preferences (e.g., preference for treatment under the Superfund Amendments and Reauthorization Act), the preferred remedy is to implement pollution prevention measures and source controls and to allow natural cleanup processes such as biodegradation and the deposition of clean sediments to restore the site. In these cases, the Agency may still seek restitution for damages to natural resources in coordination with other Federal and State agencies.

K. Remediation should be prioritized to limit serious risks to human health and the environment first, and then to restore sites to current and reasonably expected future uses, whenever such restorations are practicable, attainable, and cost-effective.

L. EPA will not proceed with a cleanup when technically and economically achievable remedial techniques would cause more environmental harm than leaving the site alone.

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M. Where pollution prevention, source control, and natural remediation will not reduce risks and effects in an acceptable time frame, EPA will assign highest priority to remediating sediment contamination:

1. that is contributing to severe effects or substantial risks to aquatic life, wildlife, and human health,

2. where continued delay would result in the spread of harmful levels of contamination over a wider area where remediation is no longer technically or economically feasible, or

3. where continued delay would result in the spread of harmful levels of contamination into areas that provide important habitat.

N. The cost of sediment remediation cannot be borne solely by Federal, State, and local governments. Under appropriate statutes, authorities should be used to encourage voluntary cleanups or compel responsible parties to cleanup sediments contaminated by their activities and to seek restitution for damages to natural resources.

V. Statement of the Problem

A. Knowledge about the Extent of Contamination

1. EPA's Office of Water Studies

a. 1985 -- National Perspective on Sediment Quality.

b. 1987 -- An Overview of Sediment Quality in the United States (EPA/905/9-88/002).

2. 1989 National Academy of Sciences report, "Contaminated Marine Sediments -- Assessment and Remediation."

3. Conclusion

a. Based on available data, it appears that sediments in all types of waterbodies at hundreds of locations across the country, are contaminated at levels that harm benthic

and other aquatic communities, and that potentially threaten human health and wildlife.

b. The sediment contaminants of greatest concern appear to be heavy metals and persistent, toxic, bioaccumulative organic compounds. Some evidence suggests that short term exposures to non-persistent compounds (e.g., pesticides) may be a problem in certain circumstances.

c. There are many potential sources of these contaminants -- municipal sewage treatment plants, combined sewer overflows from older municipal sewage systems, stormwater-related discharges from municipal sewers and industrial facilities, industrial discharges of process wastewaters, runoff and leachate from hazardous waste and solid waste disposal sites, agricultural run-off, mining operations, run-off from industrial manufacturing and storage sites, and atmospheric deposition of contaminants.

d. More and better data on sediment quality are needed. Many locations have not been adequately sampled. Much of the available data on levels of chemical contaminants in sediment do not include information that is needed to determine the bioavailability of the sediment bound chemicals. For lack of better methods, data on sediment toxicity were obtained by performing acute tests on species that are not sensitive to sediment contamination. Chronic toxicity tests and other endpoints that use or reflect the sensitivity of more sensitive organisms are more appropriate for sediment evaluation.

B. Human Health Risks

1. Comparative Risk Studies

a. *Unfinished Business*: In 1987, EPA completed a study entitled, *Unfinished Business: A Comparative Assessment of Environmental Problems. Unfinished Business* ranked in-place toxics in sediments (as part of a

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nonpoint source category) as the eleventh most significant environmental problem of 32 identified.

b. The EPA Science Advisory Board (SAB) is a public advisory group that provides scientific information and advice to the EPA. In early 1989, Administrator Reilly asked the Science Advisory Board to review *Unfinished Business.* SAB supported EPA's ranking of the human health risks posed by in-place contaminated sediments.

c. EPA and SAB judged that contaminated sediments pose a medium risk for non-cancer illnesses. Non-cancer illnesses result from toxics (e.g., mercury) in sediments bioaccumulating up the food chain to fish and shellfish. Consumption of contaminated fish was judged to pose a low risk for cancer, but the SAB noted this was the primary route of human exposure to carcinogens in surface waters.

d. Relative risk ranking projects by EPA Regions in the North and mid-Atlantic and mid-West (Regions 2, 3, and 5) scored nonpoint sources, including in-place contaminated sediments, as a medium-high or high risk. This evaluation is due primarily to the consumption of sport fish containing toxic compounds bioaccumulated from sediments.

2. Examples of Case Studies

a. Quincy Bay, Massachusetts: elevated cancer risk from consuming lobster tomalley.

b. Lake Michigan: Developmental problems in children whose mothers consumed large amounts of fish.

c. Los Angeles-Long Beach Harbor: Up to 10^{-3} to 10^{-4} cancer risk from consuming white croaker.

d. Puget Sound: As much as 2×10^{-4} cancer risk for moderate seafood consumers and 4×10^{-3} cancer risk for high-quantity consumers.

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C. Ecological Risks

1. SAB and Regional Comparative Risk Studies

a. Contaminated sediments received a high risk ranking on the spatial extent of the problem, affecting areas on a local, regional, and global scale.

b. High risk rankings were attributed to contaminated sediments for the potential to cause ecological effects and responses.

c. Recovery period for areas with sediment contamination may be decades or longer.

2. Examples of Case Studies

a. Elizabeth River, Virginia: severe fin and gill erosion, tumors, mortality.

b. Ashtabula River, Ohio: fish tumors and other abnormalities in brown bullheads.

c. Great Lakes: reproductive problems in Forster's Tern, reproductive failures and mortality in mink.

d. Commencement Bay, Washington: mortality in amphipods and oyster larvae.

D. Limited public or private funds are available to respond to sediment contamination that is causing severe ecological effects or unacceptable risks to human health.

VI. Why EPA Needs an Agency-wide Management Strategy for Contaminated Sediments

A. Various statutes give EPA authority to address contaminated sediments.

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1. Clean Water Act (CWA)

   a. National Pollutant Discharge Elimination System (NPDES) permits for point sources, including the authority to require monitoring and to enforce against violations of permit conditions.

   b. Grants and guidance for State programs that control nonpoint sources.

   c. Regulation of the discharge of dredged or fill materials into inland waters of the U.S.

   d. Emergency powers to bring suit to stop the discharge of pollutants presenting an imminent and substantial endangerment to health or welfare (livelihood) of persons.

   e. Identification of locations of in-place pollutants in harbors and navigable waterways.

2. Marine Protection Research and Sanctuaries Act (MPRSA) -- site designation, criteria development on effects, and permit review for the disposal of dredged materials in the oceans.

3. Federal Insecticide Fungicide and Rodenticide Act (FIFRA) -- effects of a pesticide on nontarget organisms vs. benefits of its use.

4. Toxic Substances Control Act (TSCA)

   a. Regulation of new and existing chemicals that may cause sediment contamination.

   b. Disposal of material contaminated with PCBs.

5. Comprehensive Environmental Response Compensation and Liability Act (CERCLA or "Superfund")

   a. Placement of sites on the National Priorities List (NPL).

   b. Emergency response.

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c. Enforcement authority for non-NPL sites.

6. Resource Conservation and Recovery Act (RCRA)

   a. Corrective action to address contamination caused by hazardous waste facilities.

   b. Emergency powers to require the abatement of imminent and substantial endangerment caused by past or present handling of solid or hazardous waste.

7. National Environmental Policy Act (NEPA) -- preparing environmental impact statements (EIS).

8. Great Lakes Water Quality Agreement (GLWQA)/Great Lakes Critical Programs Act (GLCPA)

   a. Remedial action plans for 31 Areas of Concern partly or wholly in U.S. waters.

   b. Assessment and Remediation of Contaminated Sediments (ARCS) program (originally established under Section 118 (c)(3) of the CWA).

9. Coastal Zone Management Act (CZMA) -- EPA/National Oceanic and Atmospheric Administration (NOAA) Guidance for controlling nonpoint sources in States with approved coastal zone management programs and degraded coastal waters.

10. Clean Air Act (CAA) -- regulation of hazardous air pollutants that contaminate sediments via atmospheric deposition and in Section 309, reviewing major Federal actions (i.e., EIS's of other Federal Agencies) with the potential to significantly affect the human environment.

11. For more information on EPA's authorities for addressing sediment contamination, see the document "Contaminated Sediments -- Relevant Statutes and EPA Program Activities" (EPA 506/6-90/003).

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B. Many EPA Offices implement these statutory authorities or coordinate their implementation in specific geographic areas:

1. Office of Water (OW)

2. Office of Emergency and Remedial Response (OERR)

3. Office of Waste Programs Enforcement (OWPE)

4. Office of Solid Waste (OSW)

5. Office of Pesticide Programs (OPP)

6. Office of Pollution Prevention and Toxics (OPPT)

7. Office of Air Quality Planning and Standards (OAQPS)

8. Office of Radiation Programs (ORP)

9. Office of Enforcement (OE)

10. Office of Federal Activities (OFA)

11. Office of Policy, Planning, and Evaluation (OPPE)

12. Office of Research and Development (ORD)

13. Chesapeake Bay Liaison Office

14. Great Lakes National Program Office (GLNPO)

15. Gulf of Mexico Program (GOMP)

16. Office of Information Resources Management (OIRM)

17. Ten EPA Regional Offices -- Depending on statute and program structure, Regional Offices may have wide latitude in how they assess and manage sediment contamination.

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C. EPA needs coordination among these offices with authority to address sediment contamination to promote:

1. consistent consideration of sediment risks,

2. consistent decision-making at Federal and State levels in managing these risks,

3. wise use of scarce resources for research, technical and field activities, and

4. consistent sediment assessment practices.

VII. Policy Framework

A. Administrator Thomas formed an Agency-wide Sediment Steering Committee in 1989

1. Chaired by OW Deputy Assistant Administrator (DAA).

2. Members include DAA's and Office Directors across the Agency.

B. In January 1990, the Steering Committee decided to prepare a Management Strategy for Contaminated Sediments. (At a later date, the Agency may prepare a companion strategy to improve the assessment and management of problems caused by sedimentation and physical/hydrological modification of habitats.)

C. The Sediment Steering Committee will be an ongoing body to oversee development and implementation of the Strategy.

VIII. Strategy for Assessing Sediment Contamination (Principles D-G)

A. EPA has committed to use a consistent, minimum set of chemical and biological methods across Agency programs to determine whether sediments are contaminated. These methods will produce data of high quality which can be defended in regulatory and enforcement

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actions. These methods will be used for prevention, remediation, and the management of dredged material disposal programs.

B. An Agency-wide work group is in the process of selecting the minimum set of methods. Recommendations will be made to EPA's Sediment Steering Committee for review and approval.

C. Each EPA program may use supplemental, program-specific assessment methods and develop its own guidance detailing the specific regulatory actions to be taken based on the assessment.

D. Different programs within EPA may require compliance with all assessment methods, while another program may not. This is because environmental statutes vary in their requirements to prevent or eliminate all contamination. For example:

1. CWA requires control of point source discharges as necessary to achieve water quality standards, regardless of cost.

2. FIFRA requires consideration of costs in deciding whether to register or restrict the use of a pesticide.

3. TSCA provides authority to address unreasonable risks posed by new or existing chemicals.

4. RCRA decisions on corrective action cannot consider costs.

5. CERCLA remediation decisions must express a preference for treatment but must also consider cost.

D. EPA will request resources for an inventory of sites with contaminated sediments.

1. An EPA work group is now designing a national inventory of sites with contaminated sediments based on existing information on sediment quality. Pilot efforts are underway in EPA Regions in the mid-West, Southeast, and Gulf Coast (Regions 4, 5 and 6). The purpose of this activity is:

a. to obtain the best possible, near-term assessment of the national extent and severity of problem,

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b. to identify areas which may be contaminated and need further assessment, and

c. to identify areas with sufficient data to be characterized as causing high risks or severe effects, so that Agency programs can target those areas for appropriate actions.

2. EPA will also conduct a pilot study to gather additional data on sediment quality most efficiently. Current information is sufficient to identify: 1) the potential for a large-scale problem and 2) specific sites where sediments are highly contaminated. However, additional data are needed because:

a. in many areas of the country, few data on sediment quality have been collected.

b. much of the data on the concentrations of specific chemicals in sediment does not include basic information that would allow determinations to be made as to what portion of the contaminant is available to aquatic life.

c. much of the data on sediment toxicity was developed using acute tests on organisms that are not as sensitive to contamination in short-term tests (e.g., clams).

E. Inventory of sources of sediment contamination

1. EPA will develop a pilot inventory of sources of sediment contamination using:

a. Toxics Release Inventory (TRI) data,

b. effluent guideline data, and

c. other sources.

2. An inventory of sources will be useful to target sediment sampling: 1) in the pilot effort to inventory contaminated sites using new data (see above), and 2) in water quality monitoring programs (see below).

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3. A source inventory will also be useful for targeting pollution prevention activities and source control efforts, including selection of industries for development of effluent guidelines, permitting and enforcement actions.

4. The inventory will be closely coordinated with OPPT pollution prevention activities including participation in the voluntary 33/50 Program which encourages industrial sources to reduce toxic waste generation.

5. Depending on the results of the pilot effort to inventory sources of sediment, EPA may conduct a similar effort on a larger scale.

6. A source inventory will be useful in targeting enforcement actions.

F. EPA will work to increase sediment monitoring in water quality monitoring programs.

1. ORD's Environmental Monitoring and Assessment Program (EMAP) will gather important chemical and biological data on sediment quality.

2. OW will include sediment monitoring issues in its overall monitoring program framework that includes EPA Headquarters, EPA Regions, and State Agencies.

3. OW is negotiating with the United States Geological Survey (USGS) to form the Water-Quality Monitoring Intergovernmental Task Force (ITF) with Federal, State, and local representation. ITF will design a national monitoring framework, information system linkages, monitoring protocols, and QA/QC procedures which will include sediments.

4. OW and OIRM will continue to assure that the capability to store and use sediment data is enhanced as part of the ongoing modernization of the Agency's water quality data systems, STORET, BIOS, and ODES. Some of EPA's Regions are also developing or have developed data bases for sediment information that are (or will be) compatible with these national databases.

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5. EPA is considering an increase in its monitoring program during reauthorization of the CWA.

G. Under Section 112(m) of the CAA, EPA is undertaking a program ("Great Water Bodies Study") to assess the effects of hazardous air pollutants on the Great Lakes, Lake Champlain (on the New York/Vermont Border), the Chesapeake Bay, and near coastal waters.

1. This Study (funded in the CAA) includes air deposition monitoring, monitoring of biota, and toxic contaminant transport modeling.

2. An initial report is due to Congress in 1993, and every two years thereafter. Among other topics, the reports will address: contribution of air pollutants to water pollution, sources of pollutants, and whether they contribute to violations of water quality standards.

H. EPA will coordinate its assessment strategy and activities with the National Oceanic and Atmospheric Administration (NOAA), U.S. Geologic Survey (USGS), the U.S. Army Corps of Engineers (COE), U.S. Fish and Wildlife Service (FWS), and the States.

IX. Strategy for Preventing Sediment Contamination
(Principles H and I)

A. FIFRA gives EPA the authority to ban or restrict the use of pesticides that have the potential to contaminate sediments, if the risks to nontarget organisms are judged to be unreasonable. In making decisions on pesticides, FIFRA requires EPA to consider economic, social and environmental costs and benefits.

1. Sediment toxicity is not currently addressed in routine test procedures and risk assessments for pesticide registration, reregistration, and special review.

2. Although past registrations of pesticides did not routinely address potential ecological effects of sediment contamination in terms of ecological effects, OPP is currently developing a strategy to do so. As appropriate and accepted sediment toxicity testing and test guidelines are developed, OPP can

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accelerate its efforts accordingly. Efforts will eventually include revision of test requirements in 40 CFR Part 158 and protocols in Subdivisions of the Pesticide Assessment Guidelines.

3. OPP is considering the following actions:

   a. Routinely require aquatic fate tests to support many terrestrial uses of persistent or bioaccumulative pesticides. For these tests, OPP would need to determine the degree of persistence and bioaccumulation potential that would trigger testing.

   b. Integrate the water column monitoring ("Aquatic Field Dissipation") test requirement with the aquatic life tissue monitoring study ("Accumulation in Aquatic Non-Target Organism").

   c. Require analysis of benthic organism tissues in the currently required procedures.

   d. In ecological risk assessment, require special field testing when the Agency suspects sediment problems.

   e. Work to reduce pesticide use in general by providing information on better management practices and Integrated Pesticide Management.

4. If the national inventory of contaminated sediment sites indicates that certain pesticides are posing risks or causing harmful effects on a national scale, OPP may select these pesticides for special review. Replacements need to be identified for these pesticides in the form of biological and bioengineered controls, as well as other alternatives to chemical pesticides (e.g., Integrated Pest Management).

5. OPP is currently developing a Memorandum of Agreement with USGS for work in the National Water-Quality Assessment (NAWQA) Program. USGS has developed and is testing protocols for conducting ecological surveys and for collecting and analyzing water samples for pesticides and synthetic organic compounds. OPP will investigate whether sediment could be added to the analyses.

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6. OPP uses incident reports which are often voluntary reports made by citizens, farmers, and registrants for information on use, misuse, or other problems associated with pesticides. OPP will investigate sediment contamination in these incident reports on a case-by-case basis. OPP is in the midst of setting up a special process for cataloging, sorting, processing, and using such incident reports in EPA's regulatory framework.

7. OPP is involved in various pollution prevention efforts. Specifically, OPP is involved in technical guidance documents on evaluation of pesticide risks, evaluation of a chemical pesticide for its potential to runoff or to leach, possible pesticide grants for examining specific areas with problems, and other related topics.

B. TSCA gives EPA the authority to regulate new or existing chemicals that have the potential to contaminate sediments, if ecological or human health risks are judged to be unreasonable.

1. In assessing risk, OPPT gathers important information for predicting whether chemicals have the potential to accumulate in sediments. However, in only a few cases has OPPT required the submission of data on the effects of potential sediment contamination (e.g., in the June 1991 test rule for brominated flame retardants).

2. OPPT will seek resources to begin incorporating Agency-wide tests into TSCA test guidelines and modeling databases.

3. OPPT will use the national inventory of contaminated sediment sites and the pilot inventory of sources to select chemicals for review.

4. OPPT will analyze TRI data to see if additional sources of sediment contamination can be identified.

5. Through the New Chemicals Program, OPPT can ban or regulate the production of chemicals that could contribute to sediment contamination and result in unreasonable risk to human health or the environment. OPPT can and has prevented pollution from occurring. By encouraging the chemical industry to re-design chemicals (e.g., molecular weights > 1000 to prevent

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absorption through biological membranes; K_{ow} values > 8 for no effects at saturation or < 3.5 to avoid partition to sediment), OPPT can prevent pollution to aquatic and sediment environments.

6. OPPT is working on an assessment of a cluster of chemicals that may be persistent bioaccumulators. Chemicals which are persistent bioaccumulators are likely to accumulate in sediments. To the extent that this cluster, or elements thereof, are shown to pose an unreasonable risk to human health or the environment, OPPT will engage industry in discussions to mitigate this risk through voluntary pollution prevention measures.

7. Under the New Chemicals Program, OPPT has developed an exposure-based review (EBR) policy. In this program, environmental fate and effects tests (i.e., sediment toxicity tests) may be triggered if certain criteria are met in initial review. Data gathered in this way will improve the OPPT risk evaluation and management processes, and therefore prevent sediment contamination.

8. OPPT is also proposing a geographic initiative that is designed to develop a closer partnership between OPPT and the Regions that will focus OPPT, TSCA, and pollution prevention on selected site-specific problem areas. Many of these may well be areas that include contaminated sediments. OPPT also continues to work with the Great Lakes National Program Office and EPA's Regional Office in Chicago (Region 5) to explore ways to apply TSCA authorities to problems in the Great Lakes region.

9. OPPT is assisting EPA's Region 5 in developing a testing strategy which will provide the data necessary to complete an environmental risk assessment for biocides which are potentially toxic and could potentially bind to sediment. These biocides are proposed for use in large volumes to control fouling of pipes and other surfaces by Zebra mussels in power plant cooling systems. OPPT is working with the Region, the manufacturer of the biocide, and other EPA program office representatives, to construct a series of tests to determine the biodegradability of the biocide under environmentally relevant

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conditions and the potential for the substance to inhibit sediment communities.

10. OPPT is working with trade associations providing insight and guidance to their member companies. For example, OPPT and other program offices are assisting members of the Ecological and Toxicological Association of the Dyestuffs Manufacturing Industry (ETAD) to develop a pollution prevention program to record their past pollution prevention achievements, further reduce waste generation, and continue to realize the benefits of pollution prevention in the dye industry.

C. The Office of Enforcement issued two policies related to the use of pollution prevention conditions in Agency enforcement settlements: Policy on the Use of Supplemental Environmental Projects in EPA Settlements (issued February 12, 1991) and Policy on the Inclusion of Pollution Prevention Conditions in Enforcement Settlements (issued February 25, 1991)

1. These policies are designed to help reduce or eliminate root causes of noncompliance by commuting the violation (via enforceable agreements) to undertake appropriate source reduction or recycling activities. This policy can be applied to settlements on sediment contamination.

2. Settlements will emphasize reductions over and above what is required to return to compliance with the requirements of law and projects which enhance the prospects for long term (or continuous) compliance.

3. OE is managing a pollution prevention initiative with the participation of OPTS, Stationary Air, NPDES, and RCRA compliance programs over the next two years. Funds for the initiative will be used to:

   a. provide technical support to Agency negotiation teams to identify/evaluate the feasibility of specific pollution prevention conditions,

   b. monitor the respondent's or defendant's activities and assure compliance with all settlement conditions,

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c. evaluate the effectiveness of the pollution prevention conditions obtained in the settlements, and

d. develop enforcement-oriented technical pollution prevention guidance for training purposes.

X. Strategy for Abating and Controlling Sources of Sediment Contamination (Principles H and I)

A. Technology-Based Controls for Point Sources

1. Under the CWA, EPA sets minimum technology-based effluent limits defined as Best Available Technology Economically Achievable (BAT) for industries discharging directly into surface waters and Pretreatment Standards for existing and new industries discharging into municipal sewer systems.

2. To date, the BAT program has not considered sediment contamination in selecting industries for regulation.

3. OW will use information on sediment contamination from the national inventory of sites, the pilot inventory of sources, or other available reports in deciding which industries will be regulated by new or revised effluent guidelines.

4. Pollution prevention in the form of best management practices (BMP's) or other in-plant approaches will be considered when developing effluent guidelines.

B. Sediment Quality-Based Controls for Point Sources and Other Limitations in NPDES Permits that Will Improve Sediment Quality.

1. To date, no NPDES permits have been issued with chemical-specific or whole effluent toxicity limits designed to protect specified levels of sediment quality. However, the NPDES program continues to make progress in establishing water quality-based effluent limitations in permits where they are necessary to protect state water quality standards. These improved water quality-based permits will result in additional reductions in the release of toxics from point sources into

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surface water and will contribute indirectly to the protection of sediment quality.

2. In FY 92, OW will continue to conduct case studies on deriving NPDES permit limits based on sediment quality. OW will prepare a draft guidance manual deriving permit limits and conditions to protect sediment quality and release the manual for public comment. Both chemical-specific and whole sediment toxicity approaches will be addressed. OW will also work with ORD to develop and apply sediment toxicity identification evaluations to determine which pollutants from which point sources are causing sediment contamination.

3. OW will seek FY 93 resources to begin implementation of NPDES permit limits based on sediment criteria for high priority discharges.

4. OW will use the national inventory of sites, the pilot inventory of sources, or other available data to target point sources for NPDES permit limits based on sediment quality.

5. OW will continue development, validation and application of methods for screening and regulating point sources based on their discharge of bioconcentratable contaminants. These contaminants are also potential sediment contaminants.

6. OW will continue to focus on preventing and controlling industrial stormwater discharges, discharges from municipal separate storm sewer systems, and combined sewer overflows which are known sources of sediment contamination. Each facility covered by a general stormwater permit will be required to prepare a pollution prevention plan.

7. OW will continue to require use of BMP's in NPDES permits to minimize accidental spills of pollutants that may harm sediment and water quality.

8. Permit limits must be based on sediment quality and on in-plant pollution prevention techniques.

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C. Nonpoint Source Control Program

1. Section 319 of CWA gives EPA authority to award grant funds to States as an incentive for nonpoint source control.

2. OW's FY 91 Section 319 grants designate projects that prevent sedimentation or contamination of sediments as eligible for funding.

3. Section 314 of the CWA provides Clean Lakes grants to States. Grants are used to develop methods and procedures to control sources of pollution and restore water quality.

4. In FY 92, OW will allocate a portion of the 5% "national incentive" set-aside in the grants program under Section 319 of the CWA for preventing sediment contamination.

5. OW will work to include measures for prevention of sedimentation and sediment contamination in EPA's Agricultural Pollution Prevention Strategy.

6. In June 1990 EPA and NOAA issued proposed national guidance for nonpoint source controls under the Coastal Zone Management Act Reauthorization Amendments of 1990. These controls will help prevent sediment and water quality problems due to nonpoint sources of pollution.

D. OW will use the national inventory of contaminated sediment sites in evaluating strategies and projects under the National Estuary and Near Coastal Waters management programs.

E. OSW has issued technical guidance to hazardous waste generators on how to minimize waste and offers technical assistance through EPA's Pollution Prevention Clearinghouse.

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XI. Remediation Strategy
(Principles J-N)

A. Enforcement-based Remediation

1. The following statutory provisions may be used in appropriate circumstances to compel viable responsible parties to cleanup the sites they have contaminated to levels which are causing ecological harm or unacceptable risk to human health; to recover costs from responsible parties for EPA-performed cleanups; and to coordinate with natural resource trustees to seek restitution for damages to natural resources:

   a. CWA Sections 309, 311, 504

   b. CERCLA Sections 104, 106, 107, 122

   c. RCRA Sections 3004(u), 3004(v); 3008(a), 3008(h), 3013, 3005(c)(3), 7003

   d. TSCA Section 7

2. EPA will use all of its existing statutory authorities in a consistent, coordinated manner to pursue remediation of contaminated sediments that are causing ecological harm or posing unacceptable risks to human health. EPA will take care to focus on compelling cases involving substantial environmental damage or risks to human health.

3. EPA will coordinate its efforts with Federal and State regulatory partners with additional authorities.

4. EPA will use additional authority for sediment remediation and enforcement, if provided, when appropriate statutes are reauthorized.

5. OE will seek a special FY 93 budget initiative to develop enforcement cases in which the Agency will seek to require that parties responsible for sediment contamination remedy the harm and risks posed by their actions.

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6. OW will provide guidance to EPA Regional offices on successful enforcement-based remediation cases under the CWA and urge them to pursue cases of their own. OW will also analyze for any correlations between dischargers with histories of permit violations and sediment problems, as identified by the EPA's inventories of sediment sites, sources, and other available information.

B. Remediation under the CWA

1. Section 115, which authorizes EPA and COE to cleanup contaminated sediments, was funded only once in the 1970's.

2. In conjunction with OW and other interested program offices, OFA will develop a Memorandum of Agreement (MOA) between COE and EPA to remediate under Section 115 of the CWA, CERCLA, Section 10 of the Rivers and Harbors Act, or other such authority. The MOA would define the general roles and responsibilities of COE and EPA in sediment remediation projects.

3. EPA will use the national inventory of contaminated sediment sites to select potential areas for remediation under Section 115 authority.

4. EPA will use the Agency-wide minimum set of testing methods to assess sediment contamination at sites selected for potential remediation under Section 115. Cleanup levels will be determined on a site-specific basis, taking into account technical and economic feasibility, and the hazards or risks that would be posed by other technically and economically feasible alternatives.

5. EPA will consider options for broadening the CWA sediment remediation program as part of CWA reauthorization.

C. Remediation under CERCLA

1. As part of the 1990 revisions to the Hazard Ranking System (HRS), contaminated sediments received explicit consideration in the scoring of sites. For sites scored under the new system,

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contaminated sediments now provide a basis for placement on the NPL.

2. OERR will consider the results of a national inventory of sites with contaminated sediments in the selection of sites for scoring with the HRS.

3. OERR and OWPE are participating in an Agency-wide work group to develop consistent tiered testing methods that will be used in the Remedial Investigation/Feasibility Study stage of Superfund remediation.

4. OERR has developed guidance for determining health-based site-specific cleanup levels for remediation projects and is developing guidance for determining levels to protect aquatic life. These procedures may be revised as a result of the Agency's effort to develop a comprehensive, consistent, risk-based approach to managing remediation wastes in its contaminated media cluster.

D. Remediation under RCRA Authorities

1. OSW will use the information in the national inventory of contaminated sediment sites or the pilot inventory of sources for prioritizing RCRA facilities for corrective action. An "observed release" will be scored for the surface water route under the RCRA National Corrective Action Prioritization System (NCAPS) for facilities which appear in the national or pilot inventory. An observed release will often lead to the classification of a facility as "high priority" for corrective action.

2. If a RCRA Facility Assessment indicates that a release to surface waters has occurred, extensive RCRA Facility Investigations (RFI) will be required and include sediment considerations.

3. OSW will use the Agency-wide minimum set of testing methods in RFI by specifying these tests in the RFI Guidance.

4. OSW will develop site-specific cleanup levels using the Agency-wide comprehensive, consistent risk-based approach to

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managing remediation wastes developed by the contaminated media cluster.

E. Application of TSCA to remediation of PCB-contaminated sediments under non-CERCLA authorities.

1. In FY 92, OPPT will use the principles for remediation developed by the Agency's contaminated media cluster to determine the appropriate management scheme under TSCA for sediments contaminated with PCBs.

2. TSCA already provides the EPA Regional Administrators with flexibility in approving alternatives to the disposal methods specified in the regulations implementing TSCA requirements (incineration or disposal in TSCA-approved facilities).

F. EPA will coordinate its remediation strategy with NOAA (natural resource damage claims), COE (remediation under CWA authority, technical issues encountered in remediation projects under various statutes) and with States.

XII. Dredged Material Management Strategy
(Principles C, D, and E)

A. EPA will work with the COE to ensure that dredged materials continued to be managed in an environmentally sound manner. EPA and the COE will take the following steps to improve the management of dredged material:

1. OW will ensure implementation of the recently revised national testing manual ("Green Book") for evaluating dredged material to be discharged into ocean waters under the MPRSA.

2. OW will continue to work with the COE to develop the first national testing manual for evaluating discharges of dredged material into inland waters of the U.S. under CWA authority. This new manual will:

a. supplement the existing CWA Section 404(b)(1) Guidelines for these evaluations,

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b. be consistent with the Green Book testing manual for ocean waters, and

c. include physical and chemical tests, bioassay and bioaccumulation tests, and QA plans and data evaluation.

3. OW and OFA will work with the COE to develop a dredged material management strategy document that identifies alternative disposal options and relevant environmental factors for each alternative.

4. OW will develop additional guidance on designating, monitoring, and managing ocean sites where dredged materials are disposed to ensure that adverse impacts will not occur.

B. RCRA and TSCA requirements for treating and disposing of contaminated sediments are based upon testing procedures and methodology that were not developed for the sediment media.

1. In FY 92, OSW will use the principles for remediation developed by the Agency's contaminated media cluster to determine the appropriate management scheme for dredged material under RCRA.

2. In FY 92, OPPT will use the principles for remediation developed by the Agency's contaminated media cluster to determine the appropriate management scheme for dredged material contaminated with PCBs under TSCA. TSCA already provides the EPA Regional Administrator with flexibility in approving alternatives to the disposal methods specified in the regulations implementing TSCA requirements.

C. EPA will coordinate its strategy for managing the disposal of dredged materials with COE and with States.

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XIII. Research Strategy
(Principles C - G)

A. ORD will gather important chemical and biological data on sediment quality in the surface water component of its EMAP program.

B. ORD will submit a sediment quality research initiative in the budgets for FY 92 and beyond to focus resources on:

1. Continued development of sediment quality criteria to protect aquatic life.

2. Continued development of sediment quality criteria to protect wildlife and human consumers of aquatic life.

3. Continued development of sediment physical and chemical testing procedures for freshwater, estuarine, and marine sediments.

4. Continued development of sediment chronic toxicity tests and improved acute toxicity tests for sediments using freshwater, estuarine and marine organisms.

5. Continued development of sediment bioaccumulation tests using freshwater, estuarine and marine organisms.

6. Enhancement and validation of sediment fate and transport models.

7. Improvement of Sediment Toxicity Evaluations.

8. Additional assessment of remedial techniques and development of innovative methods.

C. In all of these activities, ORD will work closely with the program offices and EPA Regions to ensure that the methods, tests, and models it develops are useful to Agency programs. ORD will also coordinate with COE, FWS, NOAA, USGS, and other Federal agencies.

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D. Technology transfer

1. ORD will establish a Resource Center to provide the EPA program offices and EPA Regional offices with technical assistance in evaluating sediment contamination and its effects.

2. ORD will sponsor workshops and training sessions, such as the recent workshop series on remediating contaminated sediments.

3. OW will co-sponsor workshops and training sessions with the COE on sediment sampling and analysis.

XIV. Outreach Strategy

A. Building Alliances with Other Federal Agencies and States

1. EPA will work toward an integrated Federal strategy versus individual memoranda of understanding with other agencies.

2. Work with COE field offices to develop region specific workshops to deal with regional issues.

3. Target sediment issues at the biannual meetings of the Interagency Coordination Committee.

4. Work with the Department of Agriculture to ensure agricultural practices are consistent with the goals of this strategy.

5. Work with the Bureau of Reclamation to consider sediment contamination from irrigation.

6. EPA liaison to the Department of Defense will promote the sediment considerations outlined in the strategy.

7. Identify ways in which the Department of Transportation can use the strategy to minimize sediment contamination from highways.

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8. Work with the Department of Energy to ensure that current and future environmental policies are considerate of sediment contamination.

9. OFA's awards to other Federal agencies on exemplary environmental work will consider sediment contamination issues.

10. EPA will strive to ensure that all Federal and State agencies share research findings and innovative technologies.

B. Public Awareness

1. Include contaminated sediment issues in implementation of the National Environmental Education Act.

2. Disseminate contaminated sediment information to the public in a clear, accurate, and timely fashion.

3. As materials related to this strategy are developed, EPA will request a review by the SAB.

4. Incorporate information from the public in EPA contaminated sediment activities.

5. Sponsor National Conferences on Contaminated Sediments.

6. Promote and support the formation of a citizen group to track and monitor implementation of the strategy.

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APPENDIX B

PROPOSED OUTREACH ACTIVITIES TO SUPPORT IMPLEMENTATION OF EPA'S CONTAMINATED SEDIMENT MANAGEMENT STRATEGY

June 3, 1992

PROPOSED OUTREACH ACTIVITIES TO SUPPORT IMPLEMENTATION OF EPA'S CONTAMINATED SEDIMENT MANAGEMENT STRATEGY

I. Overview

A. Background

1. Contamination of sediments in water bodies of the United States is an ecological and human health issue of national proportions. Contamination has been identified in the sediments of water bodies at levels high enough to harm human health and wildlife.

   a. 1985 and 1987 Office of Water (OW) surveys found PCBs, pesticides, PAHs, and metals at hundreds of sites.

   b. A 1989 study by the National Academy of Sciences identified the potential for far-reaching health and ecological effects of contaminated sediments.

2. EPA's Contaminated Sediment Management Strategy

   a. In 1989, EPA formed the Agency-wide Sediment Steering Committee, chaired by OW's Deputy Assistant Administrator.

   b. In January 1990, the Steering Committee prepared the Strategy to:

      - Prevent ongoing contamination of sediments that may cause unacceptable risks to human health and the environment

      - Clean up existing sediment contamination where practical

      - Ensure that sediment dredging and disposal of dredged materials are managed in an environmentally sound manner

3. 10 Statutes Deal with Management of Contaminated Sediments

   a. Clean Water Act (CWA)

   b. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

   c. Toxic Substances Control Act (TSCA)

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d. Clean Air Act (CWA)

e. Resource Conservation and Recovery Act (RCRA)

f. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

g. Marine Protection Research and Sanctuaries Act (MPRSA)

h. National Environmental Policy Act (NEPA)

i. Great Lakes Water Quality Agreement (GLWQA)/Great Lakes Critical Programs Act (GLCPA)

j. Coastal Zone Management Act (CZMA)

4. EPA would like to build on other successful models in which government and public and private interests have worked together to strengthen government programs (e.g., Chesapeake Bay Program, Public Private Partnerships, RCRA's Outreach Program, National Estuary Program.)

5. EPA also would like to apply new legislation, such as the National Environmental Education Act (NEEA), to implement programs in schools and communities that will provide public education on sediment contamination.

B. **Forum Series on the Contaminated Sediment Management Strategy.** Goal: to allow key constituency groups to provide EPA with feedback about their concerns and information needs.

1. Forum 1. Extent and Severity of Contaminated Sediments, Chicago, IL, April 21-22.

2. Forum 2. Coordination among Federal, State, and Local Agencies, Washington, DC, May 27-28.

3. Forum 3. Outreach and Public Involvement, Washington, DC, June 16.

C. **Goals of the Proposed Outreach Plan**

1. Primary goal is to educate key audiences about the problem of contaminated sediments and EPA's Contaminated Sediment

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Management Strategy to solve the ecological and health problems related to contaminated sediments.

2. EPA will focus on:

- Defining key Strategy themes and messages
- Identifying specific target audiences and information needs
- Developing appropriate outreach materials (technical and non-technical guidance, brochures, fact sheets, guidance documents, videos, posters, etc.) to educate the public and the regulated community about the problems associated with contaminated sediments and how they should contribute to solutions
- Providing channels and forums through which interested parties can become involved in Strategy implementation and learn more about the issue of contaminated sediments (e.g., newsletters, meetings, workshops, etc.)

II. Communication Themes

A. Sediment Contamination Comes from Many Sources

- Industrial effluent and emissions
- Agricultural, industrial, and urban nonpoint source controls
- Publicly owned treatment works
- Combined sewer overflows
- Stormwater
- Runoff and leachate from hazardous waste disposal sites
- Atmospheric deposition

B. Sediment Contamination Poses Threats to Human Health and the Environment

1. Heavy metals and toxic compounds that are persistent and bioaccumulate are of greatest concern. Bioaccumulation is the

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process by which contaminants that persist in body tissues accumulate in greater and greater concentrations with each animal higher on the food chain.

2. Case Studies

   a. In Ohio's Black River, where sediment contamination has been documented, six species of fish have had frequent occurrence of tumors.

   b. In the Elizabeth River, Virginia, contaminated sediments appear to be contributing to fish fin and gill rot as well as the growth of tumors.

   c. In the Great Lakes, contaminated sediments have been found to affect the reproductive abilities of certain species of fish-eating birds and mammals.

   d. Significant contamination has been detected in fish in bays and estuaries of California and Quincy Bay, just south of Boston Harbor.

   e. Fishing bans or fishing advisories are in effect in all but six states (e.g., in the Great Lakes region, there are 1,000 fish advisories).

3. Risk Communication. Education is needed about how to communicate risks clearly and effectively in specific situations and how to interpret the relative risks from sediment contamination in the context of other relevant environmental and health risks.

C. Sediment Contamination Can Be Effectively Managed through Assessment, Prevention, and Remediation

1. EPA will respond to sediment contamination as consistently as possible, assigning highest priority to activities with the greatest potential for reducing unacceptable risks.

2. Assessment Activities

   a. Create a national inventory of sites that may be used to:

      - Pinpoint geographic areas and potential sources of sediment contamination

      - Provide data to rank sites according to level of risk

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- Measure extent and severity
- Provide data to target sites for pollution prevention and control measures, or for remediation

b. Create an inventory of sources of point and nonpoint sediment pollution

c. Establish a standardized set of testing and monitoring procedures that will be:

- Based on sound science
- Implemented consistently throughout EPA and other federal agencies

3. Pollution Prevention Activities

a. Evaluate the effects of pesticides and other persistent chemicals in the environment and ban or restrict their use where necessary to protect human health and the environment

b. Develop an agricultural pollution prevention strategy as a critical component of the sediment strategy

c. Consider sediments when regulating industrial effluent discharge, and setting permit limits for sediment quality, bioaccumulation, toxic air pollutants, and high-priority dischargers

4. Remediation Activities

a. Use the national inventory of sites to provide data for priority sites for remediation under RCRA and CERCLA

b. As the preferred remedy, implement pollution prevention measures and source controls, then allow natural recovery through processes such as biodegradation and deposition of clean sediments

c. Where pollution prevention, source control, and natural remediation will not reduce risks in an acceptable time frame, EPA will:

- Enforce cleanup of high-priority sites by responsible parties
- Recover costs for cleanups performed by the Agency

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- Coordinate with natural resource trustees to seek restitution

5. Dredged Materials Management Activities

   a. Work with the U.S. Army Corps of Engineers (COE) to ensure the sound management of sediment dredging and disposal of dredged materials

   b. Develop testing methods for assessing dredged material to be disposed at sea and in fresh water

D. EPA's Strategy for Managing Contaminated Sediment Relies on Inter-Agency Coordination and Alliances with Other Agencies, Industry, and the Public

1. Communication and integration of efforts among all affected audiences are necessary to promote:

   - Consistent characterization of risks
   - Consistent decision-making at the federal, state, and local levels
   - Best use of financial and technical resources
   - Consistent assessment and testing methods

2. EPA will work with other federal agencies and states to implement an integrated approach to managing contaminated sediments and to:

   a. Coordinate assessment activities with the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), the U.S. Army Corps of Engineers (COE), the U.S. Fish and Wildlife Service (FWS), and the states

   b. Work with the U.S. Department of Agriculture (USDA), the Department of Defense (DOD), the Department of Transportation (DOT), and the Department of Energy (DOE) to promote remediation and prevention practices consistent with the Strategy

3. EPA intends to coordinate research and regulatory activities with other state and federal agencies, international organizations, and private groups.

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4. EPA must work internally to coordinate, among Agency enforcement programs, the 10 statutes that address contaminated sediments.

5. EPA will work with both private industry and the general public who can each contribute to solutions and encourage the use of sound practices consistent with the goals of the Strategy and implementing voluntary actions to reduce risks posed by sediments.

6. Consideration of the development of a National Contaminated Sediment Strategy Task Force and development of a national Federal strategy for contaminated sediments.

III. Target Audiences

A. To Implement an Effective Outreach Plan, EPA Must:

1. Communicate with large and highly diverse audiences

2. Educate and involve the general public in EPA's decision-making processes

3. Target some information materials to broad audiences and others to subgroups within these audiences

B. The Steps EPA Must Take in Designing and Targeting Its Messages Include:

1. Determining the information needs of each audience by assessing the extent of their knowledge on the topic

2. Determining the audiences' positions and concerns about the topic

3. Determining the level of interest in the topic and develop ways to increase interest and attention

4. Assessing how the topic fits in with the audience's agenda

5. Determining whether the primary purpose of the message is to inform the audiences, change their attitudes, or encourage them to take action

C. The Major Audiences EPA Intends to Target with Its Outreach Program Are:

1. General public

2. Environmental and public interest groups

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3. Scientific community including academia, laboratories, and professional societies

4. Congressional representatives and government groups

5. Federal agencies, including the U.S. Army Corps of Engineers, the U.S. Department of Energy, the U.S. Department of Defense, the U.S. Department of Agriculture, and other agencies whose policies and operations directly contribute to the sediment Strategy or affect its goals

6. State and municipal agencies

7. Regional and Headquarter's EPA personnel

8. Regulated community including businesses and industrial trade associations

9. News media including printed media, television, radio, and trade and industry journals and environmental magazines

IV. Outreach Activities

A. Many EPA Offices May Contribute to the Development of Outreach Materials

As with the Contaminated Sediment Strategy itself, the outreach plan will require the coordination and cooperation of various EPA Program Offices

B. Planned Activities Include the Following:

1. EPA May Undertake Regulatory Actions and Prepare Major Guidance Documents (Testing Methods, Sediment Criteria and Support Documents, Risk Assessment Guidance, and Strategies That Focus on Aspects of Assessment, Prevention, and Remediation)

    a. Standards for minimum testing including acute and chronic bioassays, chemical criteria, and bioaccumulation tests and models

    b. Guidance for regulatory action following assessment of contaminated sites

    c. Report to Congress on Great Water Bodies Study on the effects of hazardous air pollutants

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d. Remedial guidance and technologies on specific remedial alternatives for contaminated sediment sites including descriptions of technologies and remedial techniques

e. Bans or restrictions on the use of pesticides and chemicals that may cause unreasonable risks to human beings or the environment

f. Revision of TSCA test guidelines and modeling data bases that address new or existing chemicals with the potential to accumulate in sediments

g. Guidance for trade associations on pollution prevention issues, including the contamination of sediments from point and nonpoint source pollution

h. Agricultural Pollution Prevention Strategy that includes methods for reducing erosion, controlling irrigation, and minimizing runoff of pesticides and fertilizer that contribute to nonpoint source pollution

i. Section 319 (CWA) grant programs for nonpoint source control

j. Guidance manual for deriving permit limits and conditions to protect sediment quality (chemical-specific and whole sediment toxicity approaches)

k. Proposed national guidance for nonpoint source controls to help prevent sediment and water quality problems due to nonpoint source pollution

l. National guidance on dredged materials testing of ocean waters

m. National guidance on dredged materials testing of inland waters

n. Strategy document on the environmental factors to consider when evaluating disposal options for dredged materials

o. Additional guidance on designating, monitoring, and managing ocean sites where dredged materials are disposed

p. Guidance for determining site-specific cleanup levels for remediation projects

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2. Public Outreach Publications and Multimedia Materials

   a. EPA may prepare outreach publications and support other agencies in developing their own technical and general audience publications.

   b. EPA may develop journal articles, pamphlets, brochures, fact sheets, slide shows, and other multimedia materials to inform a variety of technical and nontechnical audiences about issues and solutions related to sediment contamination.

   c. These materials could be distributed through a hotline; through advertising in bulletins (such as the *Contaminated Sediments News* quarterly bulletin); or at public meetings, workshops, and national conferences on pollution prevention or contaminated sediments.

3. Other (Advisory Groups, Data Bases, Clearinghouses, Workshops)

   a. EPA may support the establishment of a Citizen's Advisory Council on Sediment Management. This council could:

      - Track and monitor implementation of the Strategy

      - Be composed of members of the regulated community, including businesses and trade associations; federal, state, and local governments; environmental groups; the scientific community; educators; and private citizens

      - Meet on an annual or biannual basis to review Strategy achievements and policies, provide additional information, and make recommendations

   b. National inventory of contaminated sediment sites that lists specific geographic areas and potential sources, and provides data to rank risk levels as high, medium, or low, or known vs. suspected risk

   c. Environmental Monitoring and Assessment Program (EMAP) to gather and make available important chemical and biological data on sediment quality

   d. Pilot inventory of sources listing specific industries using the Toxic Release Inventory (TRI), effluent guidelines data, and other data

e. Water-Quality Monitoring Intergovernmental Task Force (ITF) to design a national monitoring framework, information system linkages, monitoring protocols, and QA/QC procedures that include sediments

f. Pollution Prevention Clearinghouse that includes waste minimization measures to reduce the potential for contamination of sediments from runoff, leaching, industrial effluent, or other sources

g. National Consultation Center to provide EPA program and Regional offices with technical assistance in evaluating sediment contamination and its effects

h. Interagency Coordination Committee meetings to target sediment issues

i. Memoranda of Understanding and Agreement with other agencies to work toward an integrated federal strategy for managing contaminated sediments

j. National Task Force on Contaminated Sediment Management to replace the memoranda of understanding and agreement approach to agency cooperation

k. Contaminated sediments management hotline to answer questions and respond to requests for information concerning sediment contamination and issues related to the Strategy's implementation

l. EPA awards to federal agencies on exemplary environmental work to highlight projects related to sediment contamination

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APPENDIX C

AGENDAS OF THREE CONTAMINATED SEDIMENT MANAGEMENT STRATEGY FORUMS

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U.S. Environmental Protection Agency

PUBLIC FORUM ON EPA'S CONTAMINATED SEDIMENTS MANAGEMENT STRATEGY

THE EXTENT AND SEVERITY OF SEDIMENT CONTAMINATION

Holiday Inn - Mart Plaza
Chicago, IL
April 21-22, 1992

AGENDA

TUESDAY, APRIL 21

7:30 AM — Registration/Check-in

8:30 AM — Welcome
Timothy J. Kasten
Contaminated Sediments Section, U.S. Environmental Protection Agency

8:45 AM — Overview of the Contaminated Sediments Management Strategy
Tudor T. Davies, Director
Office of Science and Technology, U.S. Environmental Protection Agency

Extent and Severity of Sediment Contamination: EPA's Management Strategy for Contaminated Sediments
Timothy J. Kasten
Contaminated Sediments Section, U.S. Environmental Protection Agency

9:00 AM — Forum Overview
Charles Menzie, Forum Moderator
Menzie - Cura & Associates, Inc.

Extent of Sediment Contamination

9:15 AM — The Extent and Severity of Sediment Contamination in the Estuaries of the Mid-Atlantic Region
Richard W. Latimer, Acting Technical Director
EMAP Program, U.S. Environmental Protection Agency

9:35 AM National Distribution of Sediment Contamination
Thomas P. O'Connor, Manager
National Status and Trends Program, National Oceanic and Atmospheric Administration

9:55 AM Compiling Sediment and Pollutant Databases from the Historical Record: Results of the Studies from the Boston Harbor - Massachusetts Bay Program
Frank T. Manheim, Senior Research Geologist
U.S. Geological Survey

10:15 AM Break

10:35 AM U.S. Army Corps of Engineers National Dredging Program
Charles R. Lee
U.S. Army Corps of Engineers

10:55 AM Sediment Contamination in the Great Lakes
Steve Garbaciak
Great Lakes National Program Office, U.S. Environmental Protection Agency

11:15 AM Formal Comment Period

11:45 PM Open Discussion

12:45 PM Lunch

Severity of Contaminated Sediments - Human Health Effects

2:00 PM Estimating the Severity of Human Health Effects Caused by Chemically Contaminated Sediments in California
Gerald A. Pollock, Acting Chief of Fish and Sediment Contamination Evaluation Unit
Pesticide and Environmental Toxicology Section, California Environmental Protection Agency

2:20 PM The Impacts of Contaminated Sediments on Human Health: A Case Study from the Great Lakes
Wayland R. Swain, Vice-President
Eco Logic International, Inc.

2:40 PM Break

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3:00 PM	Risks Associated with Seafood Consumption: Perception vs. Reality - The Quincy Bay Case Study Nancy Ridley, Director Bureau of Environmental Monitoring, Massachusetts Department of Public Health
3:20 PM	Human Health Risks Associated with Dermal Contact and Incidental Ingestion of Contaminated Sediments William R. Alsop, Environmental Scientist ENSR Consulting & Engineering
3:40 PM	Formal Comment Period
4:10 PM	Open Discussion
5:00 PM	Adjourn
5:30 - 7:30 PM	Cash Bar Reception

WEDNESDAY, APRIL 22

Severity of Contaminated Sediments - Ecological Effects

9:00 AM	PAHs in Sediment Cause Liver Tumors and Reduced Lifespan in Brown Bullhead Paul C. Baumann U.S. Fish and Wildlife Service
9:20 AM	Integrative Sediment Assessments Peter M. Chapman, Director EVS Environment Consultants
9:40 AM	Break
10:00 AM	Ecological Effects of Contaminated Sediments in the Elizabeth River, Virginia Robert C. Hale, Division Head Virginia Institute of Marine Science
10:20 AM	Case Studies of the Ecological Effects of Contaminated Sediments in the Northeastern Gulf of Mexico Barry A. Vittor, President Barry A. Vittor and Associates, Inc.
10:40 AM	Formal Comment Period

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11:10 AM	Open Discussion
12:00 PM	Recommendations for the Sediment Steering Committee and Strategy Summary of Forum
12:30 PM	Adjourn

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U.S. Environmental Protection Agency

PUBLIC FORUM ON EPA'S CONTAMINATED SEDIMENTS MANAGEMENT STRATEGY

BUILDING ALLIANCES AMONG FEDERAL, STATE, AND LOCAL AGENCIES TO ADDRESS THE NATIONAL PROBLEM OF CONTAMINATED SEDIMENTS

Holiday Inn Capitol
Washington, DC
May 27-28, 1992

AGENDA

Wednesday, May 27

8:00 AM Registration/Check-in

9:00 AM Welcome & Overview of EPA's Contaminated Sediments Management Strategy
U.S. EPA, Office of Water
Betsy Southerland

9:30 AM Forum Overview
Virginia Tippie, Forum Moderator
Council on Environmental Quality, Executive Office of the President

ASSESSING SEDIMENT CONTAMINATION

9:40 AM EPA's Proposed Assessment Strategy
U.S. EPA, Betsy Southerland

- National Inventory of Contaminated Sediment Sites
- National Inventory of Contaminant Sources
- Use of a Standard Sediment Toxicity Test
- Monitoring

10:00 AM Federal and State Agency Discussion to Address:

- What agencies are doing to assess sediment contamination
- How it coincides with EPA's activities outlined in the strategy
- The strengths and weaknesses of the assessment approach in EPA's Draft Strategy Outline
- How two or more agencies could work together to address assessment of contaminated sediments

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Wednesday, May 27 (continued)

10:00 AM	U.S. Geological Survey Gail Mallard
10:20 AM	U.S. Army Corps of Engineers David Moore and Joseph Wilson
10:40 AM	National Oceanic and Atmospheric Administration Andrew Robertson
11:00 AM	Break
11:20 AM	U.S. Fish and Wildlife Service Donald Steffeck
11:40 AM	Florida Department of Environmental Regulation Fred Calder

12:00 PM Open Discussion and Public Comment

12:45 PM Lunch

PREVENTING SEDIMENT CONTAMINATION

2:00 PM EPA's Proposed Prevention Strategy

U.S. EPA

Judy Nelson

- Pollution Prevention: Registration of Pesticides and Toxic Substances

Stuart Tuller

- Non-Point Source Controls under Section 319 of Clean Water Act, Agricultural Pollution Prevention Strategy

James Pendergast

- Point Source Controls: Effluent Guideline considerations, NPDES permit limits based on sediment quality

James Edward

- Enforcement Based Prevention

2:20 PM Federal and State Agency Discussion to Address:

- What agencies are doing to prevent sediment contamination
- How it coincides with EPA's activities outlined in the strategy
- The strengths and weaknesses of the prevention approach in EPA's Draft Strategy Outline
- How two or more agencies could work together to address prevention of contaminated sediments

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Wednesday, May 27 (continued)

2:20 PM	U.S. Department of Agriculture, Agriculture Research Service David Farrell
2:40 PM	U.S. Department of Agriculture Forest Service Warren Harper
3:00 PM	National Oceanic and Atmospheric Administration: Coastal Zone Management Program James Burgess
3:20 PM	Break
3:40 PM	Wisconsin Department of Natural Resources Duane Schuettpelz
4:00 PM	California State Water Resources Control Board Craig Wilson

4:20 PM Open Discussion and Public Comment

5:00 PM Adjourn

Thursday, May 28

REMEDIATION OF CONTAMINATED SEDIMENTS

9:00 AM EPA's Proposed Remediation Strategy

U.S. EPA

Richard Nagel

- Enforcement Based Remediation
  - Clean Water Act
  - Comprehensive Environmental Response Compensation and Liability Act (Superfund)
  - Resource Conservation and Recovery Act (RCRA)
  - Toxic Substances Control Act (TSCA)

Lawrence Zaragoza

- Superfund Remediation
  - Siting: Hazard Ranking System
  - Remedial Investigation/Feasibility Study
  - Health Based Site Specific Clean-Up Levels

Denise Keehner

- RCRA Remediation
  - Facility Investigation
  - Corrective Action Prioritization
  - Dredged Material

Tony Baney

- TSCA Remediation
  - PCB Remediation
  - Dredged Material

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Thursday, May 28 (continued)

9:30 AM Federal and State Agency Discussion to Address:

- What agencies are doing to remediate sediment contamination
- How it coincides with EPA's activities outlined in the strategy
- The strengths and weaknesses of the remediation approach in EPA's Draft Strategy Outline
- How two or more agencies could work together to address remediation of contaminated sediments

9:30 AM Department of Energy
Bruce Kimmel

9:55 AM U.S. Army Corps of Engineers
Norman Francingues and Joseph Wilson

10:20 AM Break

10:40 AM Washington State Government Representative
Keith Phillips

11:05 AM Open Discussion and Public Comment

12:00 PM Summary of Forum Recommendations

12:30 PM Adjourn

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U.S. Environmental Protection Agency

PUBLIC FORUM ON EPA'S CONTAMINATED SEDIMENTS MANAGEMENT STRATEGY

OUTREACH AND PUBLIC AWARENESS

Holiday Inn Capitol
Washington, DC
June 16, 1992

AGENDA

Tuesday, June 16

8:00 AM Registration/Check-in

9:00 AM Welcome and Introduction
U.S. EPA Office of Water (OW)

9:15 AM Overview of EPA Contaminated Sediments Management Strategy
Betsy Southerland, U.S. EPA, Office of Science and Technology

9:30 AM Forum Overview
Charles Menzie, Forum Moderator, Menzie-Cura & Associates

9:40 AM EPA's Ideas for Outreach and Public Awareness
Tom Armitage, U.S. EPA, Office of Water

10:10 AM BREAK

10:30AM **PANEL PRESENTATIONS**
Panelists include representatives from various targeted audiences: 1) State Government; 2) Regulated Community; 3) Environmental Advocacy Groups; and 4) Public Awareness Groups.

Each panelist will make a 25-minute presentation to include:

1. Discuss what the targeted audiences already know or need to know about contaminated sediments and the environmental and human health risks that they may pose.

2. Provide feedback on EPA's outreach activities and suggestions for activities not presented by EPA.

3. Present successful examples of outreach and public awareness activities. Correlations will be drawn between the example presented and its applicability to contaminated sediment issues as outlined in the Draft Strategy. Reasons for the particular success of the program will be discussed. Examples may include technical transfer activities, guidance supplied to the regulated community, and programs to build public support for and awareness of environmental protection efforts similar to the contaminated sediments management strategy.

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Each presentation will be followed by 20 minutes of questions, comments, and dicussion.

PANEL PRESENTATIONS

STATE GOVERNMENT

10:30AM	Representative from State Government David O'Malley, Wisconsin Department of Natural Resources
10:55AM	Discussion Period
11:15AM	Representative from the Regulated Community Chemical Manufacturer's Association
11:40AM	Discussion Period
12:00PM	LUNCH (90 minutes)

PANEL PRESENTATIONS CONTINUE

ENVIRONMENTAL ADVOCACY

1:30PM	Lake Michigan Federation Glenda Daniels
1:55PM	Discussion Period
2:15PM	Coast Alliance Beth Millemann
2:40PM	Discussion Period
3:00PM	BREAK

PUBLIC AWARENESS

3:15PM	Alliance for the Chesapeake Bay Frances H. Flanigan
3:40PM	Discussion Period
4:00PM	Open Discussion and Comment on Outreach and Public Awareness Themes
4:30PM	Summary of Panel and Discussion of EPA's Contaminated Sediment Management Strategy
5:00PM	Adjourn

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APPENDIX D

FORUM SPEAKERS

U.S. Environmental Protection Agency

PUBLIC FORUM ON EPA'S CONTAMINATED SEDIMENTS MANAGEMENT STRATEGY

THE EXTENT AND SEVERITY OF CONTAMINATED SEDIMENTS

Holiday Inn - Mart Plaza
Chicago, IL
April 21-22, 1992

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U.S. Environmental Protection Agency

PUBLIC FORUM ON EPA'S CONTAMINATED SEDIMENTS MANAGEMENT STRATEGY

BUILDING ALLIANCES AMONG FEDERAL, STATE, AND LOCAL AGENCIES TO ADDRESS THE NATIONAL PROBLEM OF CONTAMINATED SEDIMENTS

Holiday Inn Capitol
Washington, DC
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U.S. Environmental Protection Agency

PUBLIC FORUM ON EPA'S CONTAMINATED SEDIMENTS MANAGEMENT STRATEGY

OUTREACH AND PUBLIC AWARENESS

Holiday Inn Capitol
Washington, DC
June 16, 1992

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APPENDIX E

FORUM ATTENDEES

U.S. Environmental Protection Agency

PUBLIC FORUM ON EPA'S CONTAMINATED SEDIMENTS MANAGEMENT STRATEGY

THE EXTENT AND SEVERITY OF CONTAMINATED SEDIMENTS

Holiday Inn - Mart Plaza
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PUBLIC FORUM ON EPA'S CONTAMINATED SEDIMENTS MANAGEMENT STRATEGY

BUILDING ALLIANCES AMONG FEDERAL, STATE, AND LOCAL AGENCIES TO ADDRESS THE NATIONAL PROBLEM OF CONTAMINATED SEDIMENTS

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