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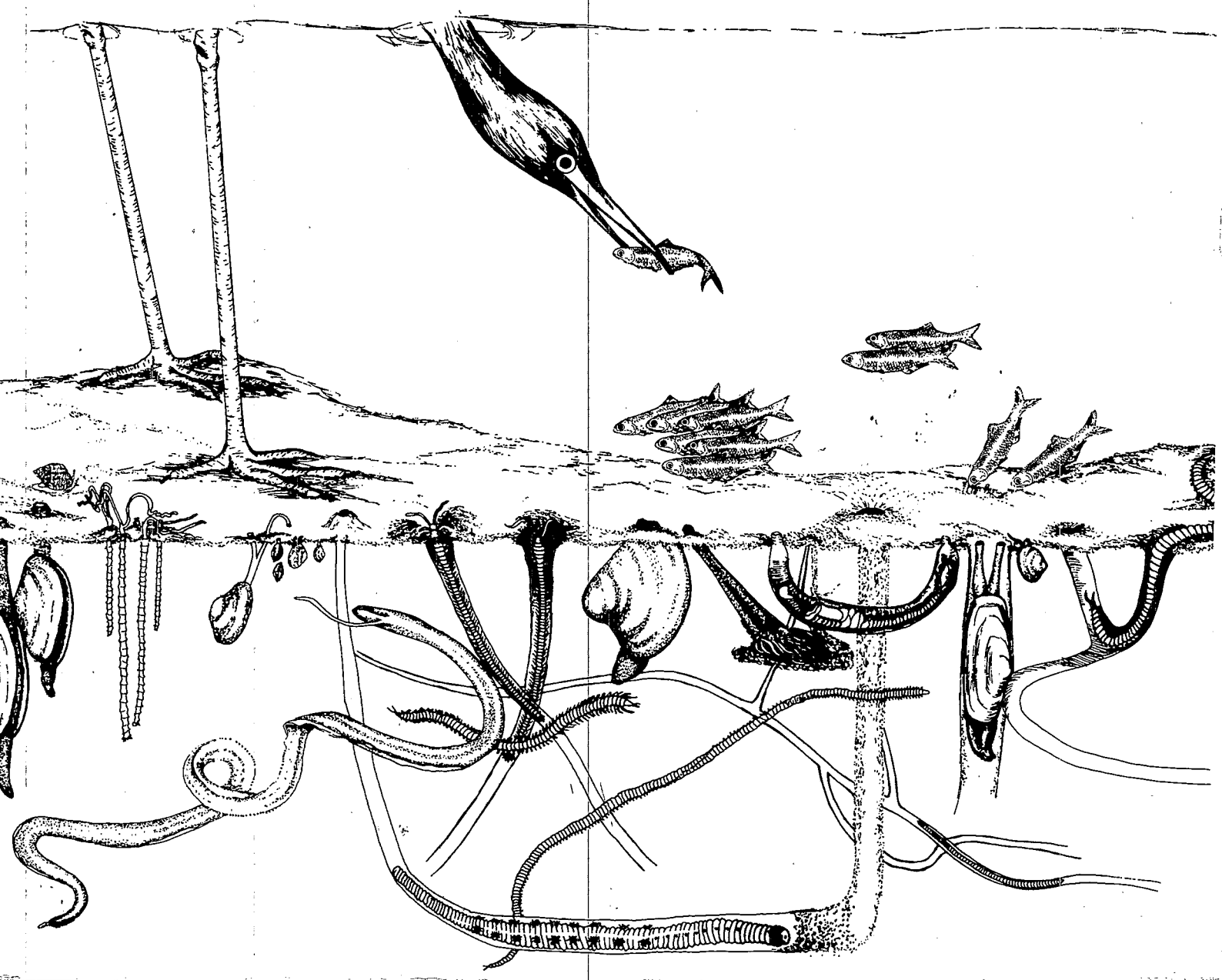
EPA's Contaminated Sediment Management Strategy



EPA's Contaminated Sediment Management Strategy

U.S. Environmental Protection Agency
Washington, D.C. 20460

August 1994

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 25 1994

OFFICE OF
WATER

Dear Reader:

Based on your expressed interest in the Environmental Protection Agency's (EPA) Contaminated Sediment Management Strategy, I am sending you a copy of the document. The Strategy describes specific actions that EPA will take to reduce environmental and human health risks associated with contaminated sediment. The Strategy does not propose new regulations. EPA is acting under existing statutory and regulatory authority to implement policies developed to assess, prevent, and remediate contaminated sediment.

The Strategy describes the cross-program policy framework in which EPA intends to promote consideration and reduction of ecological and human health risks posed by sediment contamination. The goals of the Strategy are: 1) to develop consistent methodologies for assessing contaminated sediments; 2) to prevent ongoing contamination of sediments that may cause unacceptable ecological or human health risks; 3) to clean-up existing sediment contamination that causes significant effects on human health or the environment; and 4) to ensure that sediment dredging and the disposal of dredged material continue to be managed in an environmentally sound manner.

EPA will accept written comments on the Strategy for 60 days after publication of an Executive Summary and a notice of availability in the Federal Register. Comments may be mailed or delivered to: Contaminated Sediment Strategy Clerk, Water Docket MC-4101, Room L102, Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460. Commenters are requested to submit any references cited in their comments. Commenters are also requested to submit an original and 3 copies of their written comments and enclosures. Commenters who want receipt of their comments acknowledged should include a self-addressed, stamped envelope.

Thank you for your interest in this important effort. If you have any questions, please feel free to contact Tudor T. Davies, Director, Office of Science and Technology, at (202) 260-5400.

Sincerely,

Bob Perciasepe

Robert Perciasepe
Assistant Administrator

Enclosure

Acknowledgements

This document was prepared by the U.S. Environmental Protection Agency's Sediment Steering Committee and its staff workgroups. The Steering Committee was chaired by the Deputy Assistant Administrator for Water, Martha G. Prothro.

The cover art is an adaptation of an illustration from Life in the Chesapeake Bay, a book by Alice Jane and Robert Lippson, published by Johns Hopkins University Press, 701 West 40th Street, Baltimore, MD 21211.

EPA's Contaminated Sediment Management Strategy - **Reinventing Government to Streamline Decision-making**

Contaminated sediment poses ecological and human health risks in many watersheds throughout the United States. In these watersheds, sediment serves as a contaminant reservoir from which fish and bottom dwelling organisms can accumulate toxic compounds and pass them up the food chain. Sediment contaminants can be passed to larger fish, birds, and mammals until they accumulate to levels that may be toxic to humans. Toxic chemicals in sediment come from discharges of industrial waste and sewage; stormwater runoff from waste dumps, city streets and farms, and air pollutants contained in rainwater. The magnitude of the sediment contamination problem in the United States is evidenced in more than 1,200 State advisories that have been issued against consuming fish that have accumulated toxic bioaccumulative sediment contaminants.

More than ten Federal statutes provide authority to many EPA program offices to address the problem of contaminated sediment. This has resulted in fragmented, and in some cases duplicative, efforts to complete the necessary research, technology development, and pollution control activities required to effectively manage contaminated sediment. Often it has been difficult for EPA programs to agree even upon the fundamental question of whether sediment at a particular site poses ecological or human health risks. EPA's Contaminated Sediment Management Strategy was developed to streamline decision-making within and among the Agency's program offices by promoting and ensuring: the use of consistent sediment assessment practices, consistent consideration of risks posed by contaminated sediment, the use of consistent approaches to management of contaminated sediment risks, and the wise use of scarce resources for research and technology development.

Goals of the Contaminated Sediment Management Strategy

EPA's Contaminated Sediment Management Strategy describes actions that the Agency will take to accomplish the following four strategic goals: 1) Prevent further sediment contamination that may cause unacceptable ecological or human health risks; 2) When practical, clean up existing sediment contamination that adversely affects the Nation's waterbodies or their uses, or that causes

other significant effects on human health or the environment; 3) Ensure that sediment dredging and dredged material disposal continue to be managed in an environmentally sound manner; 4) Develop and consistently apply methodologies for analyzing contaminated sediments.

What the Strategy Does

The Contaminated Sediment Management Strategy is comprised of six component sections: assessment, prevention, remediation, dredged material management, research, and outreach. In each section, EPA describes actions that the Agency will take to accomplish the four broad strategic goals.

In the assessment section of the Strategy EPA proposes that Agency program offices all use standard sediment toxicity test methods and chemical-specific sediment quality criteria to determine whether sediments are contaminated. Actions that EPA will take to develop a national inventory of sites and sources of sediment contamination (the National Sediment Inventory) are described in the assessment section of the Strategy. The National Sediment Inventory will be used by EPA to target sites for contaminated sediment assessment, prevention, and remediation. These assessment actions will enable EPA to focus on cleaning up the most contaminated waterbodies, and ensuring that further sediment contamination is prevented.

EPA's plan to stop sediment contaminants from reaching the environment is described in the prevention section of the Strategy. In order to regulate the use of pesticides and toxic substances that accumulate in sediment, EPA proposes the use of acute sediment toxicity tests to support registration of chemicals under the Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Control Act. In the prevention section of the Strategy EPA also proposes: developing effluent guidelines for industries that discharge sediment contaminants; using pollution prevention policies to reduce or eliminate sediment contamination resulting from noncompliance with permits; the development of guidelines for design of new chemicals to reduce bioavailability and partitioning of toxic chemicals to sediment; and implementation of point and nonpoint source controls that will protect sediment quality. EPA's prevention actions will stop further contamination of sediment and reduce ecological and human health risks.

In the remediation section of the Strategy EPA proposes using multiple statutes to require contaminated sediment remediation by parties responsible for pollution. These statutes include the Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the Toxic Substances Control Act (TSCA), the Rivers and Harbors Act, and the Oil Pollution Act. EPA states in the Strategy, however, that the Agency will not proceed with a clean-up if a combination of pollution prevention and source controls will allow the sediments to recover naturally in an acceptable period of time. EPA's remediation actions will clean up existing sediment contamination that adversely affects the Nation's waterbodies.

In the dredged material management section of the Strategy, EPA discusses the development of technical guidance regarding dredged material testing, dredged material disposal site selection, and disposal alternatives. EPA actions described in the Strategy will ensure continued disposal of dredged material in an environmentally sound manner.

In the research section of the Strategy, EPA proposes a program of investigative research that is needed to: develop and validate new chemical-specific sediment criteria and other sediment assessment methods; improve EPA's understanding of the transfer of sediment contaminants through the food chain; and develop and evaluate a range of technologies for remediating contaminated sediments. EPA's proposed research program will support improved assessment, prevention, and remediation of contaminated sediment.

The outreach section of the Strategy describes actions that EPA will take to demonstrate, through public involvement, the Agency's commitment to, and accountability for, sediment management efforts. EPA will produce, and make available to the public, regular status reports on sediment management activities.

Next Steps Toward Implementation of a Federal Agency Contaminated Sediment Management Strategy

EPA will begin to track activities of the Agency's program offices as they implement the Contaminated Sediment Management Strategy. However, EPA envisions that this internal strategy

will also be the keystone of a much larger Federal government strategy for the management of contaminated sediment. The Water Resources Development Act of 1992 (WRDA 92) establishes a National Contaminated Sediment Task Force to advise the Federal government on the extent and severity of sediment contamination; sediment restoration methods and technologies; prevention and source control measures; and long-term disposal sites for contaminated dredged material. EPA and the U.S. Army Corps of Engineers will convene the Task Force and submit the Agency's Strategy to the Task Force for use in developing a Federal agency contaminated sediment management strategy. The Task Force can build upon EPA's coordinated research program and the research of the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, and other Federal agencies to improve methodologies for measuring ecological and human health risks from contaminated sediment.

EPA's National Sediment Inventory is a repository of sediment monitoring data generated by Federal agencies to identify contaminated sediment sites. This data base can be used by Federal, State, and local agencies to focus their pollution prevention and remediation efforts on the worst sites of sediment contamination.

EPA's Contaminated Sediment Management Strategy will promote EPA and U.S. Army Corps of Engineers research to develop technologies for remediation of contaminated sediment under authority of the CWA, CERCLA and WRDA. In addition, the Strategy will provide guidance for coordinating EPA Regional and Headquarters roles in the management of dredged material, and set forth ongoing EPA and Headquarters regulatory development activities related to dredged material management.

Guidance provided in the Strategy will facilitate the coordination of dredged material management activities among Federal agencies and nongovernmental organizations. Coordination of dredged material management activities has been called for in the May 1994 options paper drafted by the Federal Interagency Working Group on the Dredging Process. The Working Group was convened by the Secretary of Transportation in the Fall of 1993. The Group has held a series of outreach sessions throughout the country to solicit ideas on improving the dredging process. The Working Group identified important activities needed to improve the dredging process. These activities include: enhanced research and monitoring to improve dredged material disposal decision

making, identification of opportunities to control sources of sediment contaminants, and effective education and communication with the public on the risks and impacts associated with dredged material disposal. The Contaminated Sediment Management Strategy addresses all of these issues. It describes a plan for research on interpretation of bioaccumulation and chronic toxicity tests and dredged material disposal site assessment. It provides a plan for identification and control of sources of sediment contaminants. It also proposes effective ways of interacting with the public.

Listing of Actions Identified in EPA's Contaminated Sediment Management Strategy

EPA's Contaminated Sediment Management Strategy proposes that Agency program offices take the following actions.

Assessment

All EPA program offices will use standard sediment testing methods to determine whether sediments are contaminated. The Office of Water will use standard sediment toxicity and bioaccumulation test methods for monitoring, interpretation of narrative water quality standards, and dredged material disposal testing. The Office of Pesticide Programs and the Office of Pollution Prevention and Toxics will use standard sediment toxicity tests to assess the toxicity of pesticides and chemicals when registering or reregistering these chemicals for manufacture and use. The Office of Emergency and Remedial Response will use standard sediment toxicity and bioaccumulation test methods for Superfund Remedial Investigation/Feasibility studies. The Office of Solid Waste will use biological sediment toxicity test methods for assessing and monitoring hazardous waste facilities.

EPA program offices will use sediment quality criteria, when they are promulgated, to assess contaminated sediment sites. All EPA programs conducting sediment monitoring will use the criteria to interpret sediment chemistry data. Upon promulgation, the criteria may be adopted as State water quality standards and used to set National Pollution Discharge Elimination System (NPDES) permit limits. The criteria will also be used with other information to make site-specific decisions concerning corrective action at hazardous waste facilities, and to assess Superfund sites. EPA has not yet determined how sediment quality criteria will be used in dredged material testing. In FY95, the Agency will develop a more detailed Sediment Quality Criteria User's Manual describing how the Agency's programs will use these criteria.

The National Sediment Inventory will be used by EPA program offices as an assessment tool. The inventory will be used to: identify contaminated sediment sites for consideration for remedial action; target facilities for possible injunctive relief or supplemental enforcement projects; identify problem pesticides and toxic substances that may require further regulation or be targeted for enforcement action; identify impaired waters for National Water Quality Inventory reports or development of Total Maximum Daily Loads; target watersheds for nonpoint source management practices; and to help select industries for effluent guidelines development.

Prevention

In order to regulate the use of pesticides that may accumulate to toxic levels in sediment, EPA intends to propose that acute sediment toxicity tests be included in procedures required to support registration, reregistration, and special review of pesticides likely to sorb to sediment. In fiscal year 1995, EPA will propose incorporating acute toxicity bioassays and spiking protocols into the Agency's pesticide assessment guidelines (40 CFR Part 158). To prevent other toxic substances from accumulating in sediment, EPA will also propose incorporating acute sediment toxicity tests and sediment bioaccumulation tests into routine chemical review processes required under the Toxic Substances Control Act. In addition, EPA intends to call for the development of EPA guidelines for design of new chemicals to reduce bioavailability and partitioning of toxic chemicals to sediment.

EPA's Office of Enforcement and Compliance Assurance will take action to prevent sediment contamination by negotiating, in cases of noncompliance with permits, enforceable settlement agreements to require source recycling and source reduction activities. The Office of Enforcement will also monitor the progress of Federal facilities toward the goal of halving toxic emissions by the year 1999, and will monitor the reporting of toxic releases to the public.

EPA's Office of Water, and other EPA program offices, will work with nongovernmental organizations and the States to prevent point and nonpoint source contaminants from accumulating in sediments. EPA will: 1) promulgate new and revised best available technology effluent guidelines for industries that discharge sediment contaminants; 2) encourage the States to use biological sediment test methods to interpret water quality standards, and to adopt sediment quality criteria as water quality standards; 3) encourage the States to develop Total Maximum Daily Loads for impaired watersheds specifying point and nonpoint source load reductions necessary to protect sediment quality;

4) use the National Sediment Inventory to target active point sources of sediment contaminants for permit compliance tracking, 5) ensure that discharges from CERCLA sites and RCRA facilities subject to NPDES permits comply with permit requirements that protect sediment quality; 6) use the National Sediment Inventory to target watersheds where technical assistance and grants would effectively be used to reduce nonpoint source loads of sediment contaminants.

Remediation

The National Sediment Inventory will be used by EPA's Office of Water, Office of Emergency and Remedial Response, Office of Solid Waste, and Office of Enforcement to help target sites for enforcement action requiring contaminated sediment remediation. EPA's standard sediment toxicity and bioaccumulation tests will be used to identify sites for remediation, assist in determining clean-up goals for contaminated sites, and to monitor the effectiveness of remedial actions.

Dredged Material Management

The U.S. Army Corps of Engineers estimates that a small percentage of the total volume of sediment dredged for navigational channel maintenance requires special handling due to the presence of toxics. The National Sediment Inventory will be used to identify sites where dredged material may be contaminated. EPA standard sediment toxicity and bioaccumulation tests are now used in dredged material testing.

Research

EPA's Office of Research and Development, through its Environmental Monitoring and Assessment Program, will continue to collect new chemical and biological data on sediment quality. These data will be included in the Agency's National Sediment Inventory. EPA's Office of Research and Development will also develop: new biological methods to assess the ecological and human health effects of sediment contaminants, chemical-specific sediment quality criteria, methods to conduct sediment toxicity identification evaluations, dredged material disposal fate and transport models, sediment wasteload allocation models, and technologies for remediation of contaminated sediment.

Outreach

EPA will undertake a program of outreach and technology transfer to educate target audiences about contaminated sediment risk management. Target audiences will include: other Federal

agencies, State and Local agencies, the regulated community, the scientific community, environmental advocacy groups, the news media, and the general public. Technical and nontechnical information will be provided to these audiences by developing a range of outreach products. The National Contaminated Sediment Task Force will monitor implementation of EPA's Contaminated Sediment Management Strategy and development of a federal Strategy.

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TABLE OF ACRONYMS

AEDG . . . . . Aquatic Effects Dialogue Group

ARCS . . . . . Assessment and Remediation of Contaminated Sediments

AVS . . . . . Acid Volatile Sulfides

AWPD . . . . . Assessment and Watershed Protection Division

BAT . . . . . Best Available Technology

BCT . . . . . Best Conventional Technology

BIOS . . . . . Bio-STORET; the portion of STORET containing biological data

BLM . . . . . United States Bureau of Land Management

CAA . . . . . Clean Air Act (1970)[1]

CCMP . . . . . Comprehensive Conservation and Management Plan

CDF . . . . . Confined Disposal Facility

CERCLA . . . . . Comprehensive Emergency Response, Compensation, and Liability Act (1980)[1]

CFR . . . . . Code of Federal Regulations

COE . . . . . United States Army Corps of Engineers

CWA . . . . . Clean Water Act (1977)[1]

CZARA . . . . . Coastal Zone Act Reauthorization Amendments of 1990

CZMA . . . . . Coastal Zone Management Act (1972)[1]

DAIS . . . . . Dredged Analysis Information System

DMATS . . . . . Dredged Material Tracking System

DOD . . . . . United States Department of Defense

DOE . . . . . United States Department of Energy

[1]Date of original enactment

DOJ	United States Department of Justice
DOT	United States Department of Transportation
DWE	Division of Water Enforcement
EAB	Exposure Assessment Branch
EBR	Exposure Based Review
EMAP	Environmental Monitoring and Assessment Program
EPA	United States Environmental Protection Agency
EqP	Equilibrium Partitioning
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act (1972)[1]
GLCPA	Great Lakes Critical Programs Act
GLNPO	Great Lakes National Program Office
GLWQA	Great Lakes Water Quality Agreement
HRS	Hazard Ranking System
HWIR	Hazardous Waste Identification Rule
IRIS	Integrated Risk Information System
ITFM	Intergovernmental Task Force on Monitoring Water Quality
LD_{50}	Concentration of contaminant (lethal dose) which will result in mortality of 50% of exposed organisms
MMS	United States Minerals Management Service
MOU	Memorandum of Understanding
MPRSA	Marine Protection, Research, and Sanctuaries Act (1972)[1]
NAWQA	National Water Quality Assessment
NCAPS	National Corrective Action Prioritization System

[1]Date of original enactment

NEP ..... National Estuary Program

NEPA ..... National Environmental Policy Act (1969)[1]

NOAA ..... National Oceanic and Atmospheric Administration

NPDES ..... National Pollutant Discharge Elimination System

NPL ..... National Priorities List

NRC ..... National Research Council

NS&T ..... National Status and Trends

OCPD ..... Oceans and Coastal Protection Division

ODES ..... Ocean Data Evaluation System

OECA ..... Office of Enforcement and Compliance Assurance

OERR ..... Office of Emergency and Remedial Response

OFA ..... Office of Federal Activities

OPP ..... Office of Pesticide Programs

OPPE ..... Office of Policy, Planning and Evaluation

OPPT ..... Office of Pollution Prevention and Toxics

OPPTS ..... Office of Prevention, Pesticides and Toxic Substances

ORD ..... Office of Research and Development

OST ..... Office of Science and Technology

OSW ..... Office of Solid Waste

OW ..... Office of Water

OWPE ..... Office of Waste Programs Enforcement

OWM. ..... Office of Wastewater Management

OWOW ..... Office of Wetlands, Oceans, and Watersheds

[1]Date of original enactment

PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
ppm	parts per million
POTW	Publicly Owned Treatment Works
PRP	Potentially Responsible Party
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act (1976)[1]
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
ROD	Record of Decision
SAB	Science Advisory Board
SARA	Superfund Amendments and Reauthorization Act of 1986
SCS	Soil Conservation Service
SITE	Superfund Innovative Technology Evaluation
STORET	EPA Office of Water's Storage and Retrieval System
TCLP	Toxicity Characteristic Leaching Procedure
TIE	Toxicity Identification Evaluation
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act (1976)[1]
TVA	Tennessee Valley Authority
USCG	United States Coast Guard

[1]Date of original enactment

USDA . . . . . United States Department of Agriculture

USFDA . . . . . United States Food and Drug Administration

USFS . . . . . United States Forest Service

USFWS . . . . . United States Fish and Wildlife Service

USGS . . . . . United States Geological Survey

WRDA . . . . . Water Resources Development Act of 1992

1. INTRODUCTION

1.1 PURPOSE OF THE STRATEGY

The purpose of the Environmental Protection Agency's (EPA's) Contaminated Sediment Management Strategy is: to describe EPA's understanding of the extent and severity of sediment contamination, including uncertainties about the dimension of the problem; to describe the cross-program policy framework in which EPA intends to promote consideration and reduction of ecological and human health risks posed by sediment contamination; and to describe actions EPA believes are needed to bring about consideration and reduction of risks posed by contaminated sediments.

This Strategy is being issued in support of EPA's regulatory and policy initiatives, and is Agency guidance only. This document does not establish or affect legal rights or obligations. It does not establish a binding norm and is not finally determinative of the issues addressed. Agency decisions in any particular case will be made by applying the law and regulations on the basis of the specific facts.

1.2 DEFINITION OF CONTAMINATED SEDIMENTS

Contaminated sediments are soils, sand, organic matter, or minerals that wash from land and accumulate on the bottom of a water body, and contain toxic or hazardous materials that may adversely affect human health or the environment (U.S. EPA, 1993a). For the purposes of this

Strategy, EPA defines contaminated sediments as those which contain chemical substances at concentrations that pose a known or suspected threat to aquatic life, wildlife, or human health.

1.3 BACKGROUND

1.3.1 Statement of the Problem

The contamination of sediments in waterbodies of the United States has emerged in recent years as an ecological and human health issue of national proportions. Contaminated sediments can have an impact on aquatic life by making areas uninhabitable for benthic organisms, and they can affect fish and wildlife by contributing to the bioaccumulation of contaminants in the food chain. Documented adverse ecological effects from contaminated sediments include fin rot, increased tumor frequency, and reproductive toxicity in fish as well as decreased biodiversity in aquatic ecosystems. Contaminated sediments can also pose a threat to human health when pollutants in sediments bioaccumulate in edible fish tissue. There are numerous examples of cases where fish consumption advisories or bans have been issued for pollutants such as polychlorinated biphenyls, mercury, dioxins, and kepone because of the transfer of the pollutants into the food chain (U.S. EPA, no date).

The presence of contaminated sediments also introduces significant ecological and human health considerations into the decision of whether and how to dredge and dispose of sediments to maintain navigational channels. Where contaminated sediments exist, dredging can result in resuspension of contaminated material which may then become more available to aquatic organisms. Special control techniques may be necessary to prevent this. Contamination can also limit the disposal options available for dredged sediments. Disposal of contaminated dredged material requires

locating a secure site, either on land or offshore, where large amounts of contaminated material can be safely contained. Sediment contamination can also affect commerce, most notably by raising the cost of dredging navigational channels to levels that cannot be borne by local sponsors or commercial/private shipping interests.

While sediment contamination has been recognized as a serious problem for some time, limited success has been demonstrated in mitigating the problem. One reason is the general lack of national guidelines for determining what levels of various pollutants in sediments cause adverse ecological and human health effects. To date, problems have been defined primarily on the basis of observed effects on aquatic life in the field, such as the presence of pollution-tolerant species or diseased fish or the absence of certain benthic organisms. Since 1977, EPA and the U.S. Army Corps of Engineers, however, have been using a wide range of biological and chemical assessment techniques in the dredged material program for the evaluation of both water-column and benthic impacts of potentially contaminated sediment. In some instances EPA Regional or State guidelines, including sediment standards and regionally appropriate bioassays, have also been used effectively for problem definition.

The expense associated with the remediation of contaminated sediments also contributes to the extent of the problem. Not only are specialized dredging techniques and disposal sites sometimes needed, but the sediments often must be dewatered or otherwise treated before disposal can occur. Other complicating factors are the high concentrations of contaminants that sometimes underlie surface sediments, and the difficulty in identifying a responsible party to pay for the clean-up, particularly when old sediments or multiple sources are involved. Frequently, sediment contamination

is the result of historical discharges of pollutants before the National Pollutant Discharge Elimination System regulatory program was established.

1.3.2 Extent and Severity of the Problem

In surveys conducted in 1985 and 1987 (U.S. EPA, 1985 and 1988a), the Office of Water (OW) of EPA first began to document the extent and severity of sediment contamination. Most of the information in the surveys described areas in the Northeast, along the Coast of the Atlantic Ocean and Gulf of Mexico, and in the Great Lakes region. The surveys found that heavy metals and metalloids (e.g., arsenic), polychlorinated biphenyls, pesticides, and polycyclic aromatic hydrocarbons are the most frequently reported contaminants in sediments. Significant ecological impacts were often reported at contaminated sediment sites, including impairment of reproductive capacity, and impacts to the structure and health of benthic and other aquatic communities. Potential human health impacts were noted at a number of sites where fish consumption advisories or bans were issued (U.S. EPA, 1988). In 1989, a study by the National Academy of Sciences entitled Contaminated Marine Sediments - Assessment and Remediation (National Academy of Sciences, 1989), also identified the potential for far-reaching health and ecological effects from contaminated sediments.

Many potential sources of contaminants to sediments are identified in the reports cited above. These sources include: municipal sewage treatment plants; combined sewer overflows; stormwater discharges from municipal and industrial facilities; direct industrial discharges of process waste; runoff and leachate from hazardous and solid waste sites; agricultural runoff; runoff from mining operations; runoff from industrial manufacturing and storage sites; and atmospheric deposition of contaminants.

Many of the sediment data used in the EPA studies were collected prior to regular analysis for such parameters as grain size, total organic carbon, or acid volatile sulfides. Such data are needed to determine bioavailability of sediment contaminants. Rarely is such information available for historical sediment data. EPA believes that better data on sediment quality, as well as direct measurements of chemical concentrations in edible fish tissue, are needed. Large quantities of both published and unpublished data on sediment quality have not been placed in accessible or usable form, and many locations in the country have not been adequately sampled. Several recent national and regional sediment monitoring programs, including EPA's Environmental Monitoring and Assessment Program and the National Oceanic and Atmospheric Agency's National Status and Trends Program, are currently collecting data on physical and chemical characteristics of sediments, parameters describing bioavailability of contaminants, contaminant residues in aquatic organism tissues, and biological community structures.

It is evident from the best data currently available that sediments in many waterbodies across the country are contaminated to levels that harm benthic and aquatic communities and that may contribute to increased cancer and noncancer diseases for consumers of contaminated fish and shellfish. EPA believes that the effects of sediment contamination have been documented sufficiently to confirm their significance as a widespread national problem. To further define the extent of contamination, EPA, under the authority of Section 503 of the Water Resources Development Act of 1992, is developing the first biennial national inventory of contaminated sediment sites for submission to Congress in late 1994.

1.4 GOALS AND PRINCIPLES OF THE STRATEGY

The goals of EPA's Contaminated Sediment Management Strategy are: 1) to prevent further contamination of sediments that may cause unacceptable ecological or human health risks; 2) when practical, to clean up existing sediment contamination that adversely affects the Nation's waterbodies or their uses, or that causes other significant effects on human health or the environment; 3) to ensure that sediment dredging and the disposal of dredged material continue to be managed in an environmentally sound manner; and 4) to develop methodologies for analyzing contaminated sediments.

The Strategy is designed around the following principles:

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

2. In assessing and managing contaminated sediments, EPA will continue to improve coordination of research and regulatory activities among other Federal agencies, State agencies, international organizations, and private parties.

3. EPA will continue to develop and improve methods for identifying contaminated sediments. These methods include numerical sediment quality criteria and improved biological testing methods.

4. Assessment of sediment contamination and any subsequent steps taken by the Agency to reduce risks should be based on sound science. Where scientific information is unavailable, the Agency will utilize conservative scientific assumptions.

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

6. To ensure that data gathered by EPA programs are comparable, EPA will develop standard sampling, analytical, and statistical methods, including the application of numerical sediment quality criteria, to assess sediment contamination and its effects.

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

8. Where sediments are contaminated, the Agency will implement pollution prevention measures and source controls to limit/control further contamination. This is a critical step: 1) to ensure the long-term success of any remedial activity for the site; 2) to minimize the long-term costs of navigational dredging; and 3) to increase opportunities for beneficial reuse of dredged material.

9. Where short-term risks and effects can be tolerated, and statutes or international agreements do not require remediation or establish other preferences (e.g., preference for treatment under the Superfund Amendments and Reauthorization Act of 1986), the preferred treatment of a contaminated sediment site is to implement pollution prevention measures and source controls, and to allow natural processes such as biodegradation, chemical degradation, and the deposition of clean sediments to diminish risks associated with the site. Selection of the appropriate remedial option should, however, be undertaken on a case-by-case basis after careful consideration of the risks posed by the contaminants, the benefits of remediation, and the costs of remediation. In cases where EPA has chosen to allow natural processes to diminish risks, the Agency may still seek restitution for damages to natural resources in coordination with other Federal and State agencies.

10. Remediation of contaminated sediment sites will be undertaken first to limit serious risks to human health and the environment, and then to restore sites to a degree sufficient to support existing and designated uses of the waterbody, including potential uses of the sediment, whenever such restorations are practicable, attainable and cost effective.

11. EPA will not proceed with a clean-up of a contaminated sediment site when implementing the remedial alternative would cause more environmental harm than leaving the contaminants in place.

12. At sites where pollution prevention, source control, and natural processes will not reduce risks and adverse effects in an acceptable time frame, EPA will assign highest priority to remediating contaminated sediment: 1) that is contributing to the most severe effects and substantial risks to aquatic life, wildlife, and human health; 2) where continued delay would result in the spread of contaminants into other areas that were previously unaffected; and 3) where remediation is cost effective.

13. The cost of sediment remediation cannot be borne solely or substantially by Federal, State, and local governments. Appropriate statutory authority will be used to encourage voluntary clean-ups or to compel responsible parties to clean up sediments contaminated by their activities and to seek restitution for damages of natural resources.

14. EPA will continue to work with the U.S. Army Corps of Engineers (COE) to ensure that dredged materials continue to be managed in an environmentally sound manner. Physical, chemical, and biological test methods will continue to be used to guide disposal and management decisions. After sediment quality criteria have been published by EPA, and EPA has issued guidance describing how criteria values and uncertainties will be interpreted, the criteria will be used, along with biological test methods, to guide disposal and management decisions. Interpretation of results to

meet program-specific goals will be maintained, and management alternatives will remain consistent with the requirements of the applicable statutes.

2. WHY EPA NEEDS AN AGENCY-WIDE STRATEGY FOR MANAGING CONTAMINATED SEDIMENTS

EPA needs an Agency-wide strategy for managing contaminated sediments to promote and ensure consistent consideration of risks posed by contaminated sediments.

2.1 CROSS PROGRAM COORDINATION

EPA has the authority under numerous statutes to address contaminated sediments. These statutes include: the National Environmental Policy Act; the Clean Air Act; the Coastal Zone Management Act; the Federal Insecticide, Fungicide, and Rodenticide Act; the Marine Protection, Research, and Sanctuaries Act; the Resource Conservation and Recovery Act; the Toxic Substances Control Act; the Clean Water Act; the Great Lakes Water Quality Agreement of 1978, as amended by protocol signed on November 18, 1987; the Comprehensive Emergency Response, Compensation, and Liability Act; and the Great Lakes Critical Programs Act of 1990. A complete summary of EPA authorities for addressing sediment contamination is provided in Contaminated Sediments - Relevant Statutes and EPA Program Activities (U.S. EPA, 1990a).

Many EPA offices implement these statutory authorities or coordinate implementation in specific geographic areas, such as through the Chesapeake Bay Program, the Great Lakes National Program, and the Gulf of Mexico Program. Depending on statute and program structure, EPA's Regional offices and the States may also exercise wide latitude in their determination of sediment quality and impacts.

Implementation of these programs by different EPA program offices under a wide range of statutory authorities has created inconsistencies in procedures for assessing the relative risks posed by contaminated sediments and has increased the potential for duplication in the areas of research, technology development, and field activities. EPA must strive to coordinate activities among the Agency's program offices to promote and ensure consistent sediment assessment practices, consistent consideration of risks posed by contaminated sediments, consistent decision-making in managing these risks, and wise use of scarce resources for research, technology development, and field activities.

2.2 CLIENT DEMAND

In March 1990, a formal request, in the form of proposed legislation, was made to EPA Administrator William Reilly to create a national program to address contaminated sediments. The request was made by the National Contaminated Sediments Working Group, a coalition of 13 environmental advocacy groups, and was endorsed by 235 Federal, State, and local public interest groups, including labor unions, health organizations, and fishing, sporting, citizen, and environmental groups. Several EPA Regional offices and States have also identified as a high priority the need for technical guidance on assessing sediment quality.

2.3 CONGRESSIONAL INTEREST

Congressional interest in issues related to contaminated sediments has been expressed repeatedly over the past 5 to 10 years. In Section 118(c)(3) of the 1987 Clean Water Act (CWA) amendments, EPA's Great Lakes National Program Office (GLNPO) was authorized to coordinate and conduct a 5-year study and demonstration project relating to the control and removal of toxic

pollutants in the Great Lakes, with emphasis on the removal of toxic pollutants from bottom sediments. To fulfill the requirements of the Act, GLNPO initiated the Assessment and Remediation of Contaminated Sediments (ARCS) program. The Great Lakes Critical Programs Act (GLCPA) of 1990 extended the ARCS program by one year and specified completion dates for interim activities.

Since 1990, EPA has presented testimony concerning contaminated sediments at dozens of Congressional hearings before the House Committee on Merchant Marine and Fisheries, the House Committee on Public Works and Transportation, and the Senate Committee on Governmental Affairs. Members of Congress have also expressed interest in addressing sediment contamination in CWA reauthorization.

The most recent legislation addressing contaminated sediments is the Water Resources Development Act of 1992 (WRDA). Title V of WRDA, the "National Contaminated Sediment Assessment and Management Act," calls for the establishment of a National Contaminated Sediment Task Force to be co-chaired by the EPA Administrator and the Secretary of the Army. Members of this WRDA Task Force will include representatives from the National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), U.S. Department of Agriculture, States, ports, agricultural and manufacturing interests, and public interest organizations. Under WRDA Section 502, the WRDA Task Force is charged with advising the Administrator and the Secretary in the implementation of Title V by: 1) reviewing and commenting on reports concerning sediment quality and the extent and severity of sediment contamination throughout the Nation; 2) reviewing and commenting on programs for the research and development of sediment restoration methods, practices, and technologies; 3) reviewing and commenting on the selection of pollutants for development of sediment criteria and the schedule for

the development of such criteria; 4) advising appropriate officials in the development of guidelines for restoration of contaminated sediments; 5) making recommendations to appropriate officials concerning practices and measures to prevent the contamination of sediments and to control sources of sediment contamination; and 6) reviewing and assessing the means and methods for locating and constructing permanent and cost-effective disposal sites for the long-term disposal of dredged material that is not suitable for ocean dumping, as determined under the Marine Protection, Research, and Sanctuaries Act.

WRDA Section 503 requires the EPA Administrator, in consultation with the Administrator of NOAA and the Secretary of the Army, to conduct a comprehensive national survey of data regarding sediment quality in the United States. EPA is required to compile all existing information on the quantity, chemical and physical composition, and geographic location of pollutants in sediments, including the probable sources of such pollutants. A report to Congress is due in November, 1994.

WRDA Section 503 further requires that EPA conduct, in consultation with NOAA and the COE, a comprehensive and continuing program to assess sediment quality which shall at a minimum: 1) identify the location of pollutants in sediments; 2) identify the extent of pollutants in sediments determined to be contaminated; 3) establish methods and protocols for monitoring the effects of contaminated sediments and the pollutants therein; 4) develop a system for the management, storage, and dissemination of data concerning sediment quality; 5) provide an assessment of sediment quality trends over time; 6) identify locations where pollutants in sediments may pose a threat to the quality of drinking water supplies, fisheries resources, and marine habitats; and 7) establish a clearinghouse for information on technology, methods, and practices available for the remediation, decontamination,

and control of sediment contamination. The results will be reported to Congress biennially, starting four years from the date of enactment.

3. COORDINATION OF STRATEGY IMPLEMENTATION

3.1 INTERAGENCY COORDINATION

Interagency coordination is paramount to successful implementation of the Contaminated Sediment Management Strategy. There are numerous recent examples of successful coordination among agencies, including: 1) the Intergovernmental Task Force on Monitoring Water Quality which is composed of members from EPA, USGS, eight other Federal agencies, and ten State agencies and whose mission is to more effectively collect and present water quality data by formulating national monitoring protocols, quality assurance/quality control (QA/QC) procedures, and data collection and sharing systems; 2) the Federal Interagency Sedimentation Project, which includes representatives from the USGS, the COE, the United States Bureau of Land Management (BLM), the United States Forest Service (USFS), the Tennessee Valley Authority (TVA), and the U.S. Department of Agriculture (USDA), and whose mission is to study physical properties of sediments to determine both the degree to which sediments trap contaminants and the timeframe for biodegradation, chemical degradation, or burial of contaminants; 3) the National Water Quality Assessment Program formed by members of the USGS, USDA, EPA, and USFWS to measure baseline conditions at 60 sites nationwide and monitor conditions over time to define trends; and 4) the U.S. Department of Energy (DOE) Environmental Restoration Program, through which DOE has entered into agreements with several States and EPA to coordinate implementation of remedial actions at DOE facilities.

There are also a number of ongoing staff-level activities which have been successfully coordinated. As an example, EPA and the COE regularly hold jointly administered Ocean Dumping Coordinators and CWA Section 404 Coordinators meetings. At these meetings, issues related to

implementation of the dredged material management programs are discussed. As another example, the State of Florida and NOAA have collaborated on a survey of sediment and biological conditions along Florida's shoreline at over 700 sites (MacDonald, 1993).

The EPA's Contaminated Sediment Management Strategy and the WRDA Task Force will build on established cooperative activities among agencies to promote and maintain consistency in addressing contaminated sediment issues, as described in subsequent Sections of this document. Through the WRDA Task Force, EPA will also propose the development of a national Federal strategy for contaminated sediment management.

3.2 AGENCY COORDINATION

The Office of Science and Technology within OW has coordinated development of the Contaminated Sediment Management Strategy and will continue to coordinate implementation of the Strategy with the relevant program and regional offices. Oversight for coordination of Strategy implementation will be provided by the Agency-wide Sediment Steering Committee.

3.3 STATES' ROLE

States will play a central role in Strategy implementation. States may, for example, promulgate sediment quality standards that are protective of sediment quality. Insofar as possible, the Strategy will be consistent with regional and State policies and will not impede State and local management and prevention measures. Strategy implementation will include State training and information dissemination as described in Section 11, Outreach Strategy.

4. POLICY FRAMEWORK FOR STRATEGY

4.1 BACKGROUND

In 1989, EPA Administrator Lee Thomas formed an Agency-wide Sediment Steering Committee to address the problem of contaminated sediments on a national scale. The committee, chaired by the OW's Assistant Administrator, is composed of senior managers from all program offices with the authority to address contaminated sediments, and a representative from each of EPA's ten Regional offices. A Sediment Technical Committee composed of staff members from each program and EPA Regional office was also established in 1989. The Sediment Technical Committee provides technical input to the Sediment Steering Committee. The regular meetings of the Sediment Technical Committee provide an EPA forum for exchanging information on research, program, and field activities.

In January 1990, the Sediment Steering Committee decided to prepare an Agency-wide Contaminated Sediment Management Strategy to coordinate and focus the Agency's resources on contaminated sediment problems. Four workgroups were established to prepare option papers on how to improve the Agency's efforts to assess, prevent, remediate, and manage the disposal of contaminated sediments. The option papers were distributed to other Federal agencies including the COE, USGS, the United States Food and Drug Administration (USFDA), NOAA, the USFWS, U.S. Minerals Management Service (MMS), U.S. Department of Justice, U.S. Coast Guard (USCG), U.S. Navy, U.S. Army, and representatives of 11 State governments with active contaminated sediment management programs. The views of these Federal and State officials were presented to the Sediment

Steering Committee in May 1991, when preliminary options were selected to form the basis of a draft Contaminated Sediment Management Strategy.

In September 1991, EPA's Deputy Administrator Hank Habicht was briefed on the options selected for developing the Strategy. He suggested that EPA distribute the document in outline form as a proposal for discussion to solicit public comments. Since March 5, 1992, EPA has distributed over 2000 copies of the draft outline to Federal, State, and local environmental and public health agencies, industry and industry coalition groups, national, State, and local environmental advocacy groups, law firms, consulting firms, academia, and other interested parties. To further the outreach effort, OW's Risk Assessment and Management Branch, at the Deputy Administrator's request, sponsored a series of three public forums to solicit feedback on the draft outline.

4.2 FORUMS

The forums were designed to include participants representing all parties responsible for addressing contaminated sediments at the Federal, State, and local levels. The first forum, "The Extent and Severity of Contaminated Sediments," was held April 21 and 22, 1992, in Chicago, IL (U.S. EPA, 1992a). The 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 contaminated sediments are a national problem, and that both human health effects and ecological effects have been documented at a number of sites.

The second forum, "Building Alliances Among Federal, State, and Local Agencies to Address the National Problem of Contaminated Sediments," was held May 27 and 28, 1992, in Washington, DC (U.S. EPA, 1992a). The forum was conducted in three parts corresponding to the assessment, prevention, and remediation elements of the draft Strategy. Forum participants concluded that: 1) EPA should expedite development and implementation of the Strategy; 2) development of a national inventory of contaminated sediment sites was a high priority; 3) all represented agencies would provide data for the national inventory; 4) more attention should be devoted to nonpoint sources of contaminants in the Strategy; 5) the addition of sediment toxicity and bioaccumulation tests to requirements for chemical registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Toxic Substances Control Act was a high priority to prevent point and nonpoint source contamination of sediments; and 6) consideration should be given to developing an integrated Federal agency strategy for managing contaminated sediments.

The third forum, "Outreach and Public Awareness," was held June 16, 1992, in Washington, DC (U.S. EPA, 1992a). The 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. Forum participants agreed that EPA should engage in active dialogue with the public and be responsive to public concerns.

Proceedings of the EPA's Contaminated Sediment Management Strategy Forums (U.S. EPA, 1992a) was published in September 1992. The document includes summaries of all presentations and discussions held at the three forums as well as appendices containing the draft outline of the Contaminated Sediment Management Strategy; a plan entitled "Proposed Outreach Activities to Support Implementation of EPA's Contaminated Sediment Management Strategy"; agendas from the

three forums; and address lists for forum participants and speakers. Over 1000 copies of the document have been distributed.

4.3 WRITTEN COMMENTS

In the March 1992 transmittal letter releasing the draft Contaminated Sediment Management Strategy outline and announcing the three forums, EPA solicited written comments on the Strategy to be submitted by July 15, 1992. The Agency actually received comments until August 31, 1992. Comments were submitted by 11 Federal agencies, 17 State agencies, 4 municipal agencies, 13 business, trade, and industry organizations, 2 environmental consulting companies, 1 environmental coalition representing 12 organizations, 1 government coalition, and 1 law firm. The areas that received the most comments were implementation of sediment quality criteria, consistent minimum testing, and point versus nonpoint source control.

5. STRATEGY FOR ASSESSING SEDIMENT CONTAMINATION

To implement effective pollution abatement and control programs for contaminants that are accumulating in sediments, and to take appropriate remedial action at sites with identified sediment contamination, EPA has developed a strategy for assessing the extent and severity of sediment contamination. The assessment strategy outlines actions that EPA will take to generate and interpret the environmental data needed to: 1) consistently assess the ecological and human health risks of sediment contaminants and take appropriate regulatory action under the Agency's existing statutory authorities; and 2) identify sites where contaminated sediment remediation is needed, and rank those sites according to the extent and severity of contamination as well as associated ecological and human health risks.

5.1 CONSISTENT SEDIMENT TESTING METHODS

5.1.1 Agency-wide Use of Consistent Test Methods

All EPA program offices have committed to using consistent chemical and biological test methods to determine whether sediments are contaminated. Standard test methods will be developed and used to provide high quality data in support of regulatory and enforcement actions for pollution prevention, contaminated sediment remediation, and the management of dredged material disposal. Test methods will be available to address a variety of situations ranging from screening to relatively definitive tests of the effects of contaminated sediments on biological organisms. Test methods will be tiered in order to promote efficient use of resources and screening of sites. EPA's Office of

Science and Technology (OST) within OW will develop a methods manual that will cover all aspects of sediment monitoring, from sample collection to analytical methods to assessment techniques.

5.1.2 Establishment of an Agency-wide Sediment Tiered Testing Committee

An Agency-wide Sediment Tiered Testing Committee, chaired by OST, has been established to select chemical and biological sediment test methods to be standardized and used by all Agency program offices. These methods will also include guidance on statistical analysis of test results. The Sediment Tiered Testing Committee will also develop a tiered testing framework; this framework will identify a consistent set of tests that provides a complete assessment of sediment contamination within each tier. The EPA Science Advisory Board will review the tiered testing framework, and test methods will be proposed by the Sediment Tiered Testing Committee to be standardized for Agency-wide use within the testing framework.

Each EPA program office will develop guidance for interpreting the tests conducted within the tiered framework. Although the standard sediment test methods will be used by all program offices, each office may not always need to perform all of the tests included in a particular tier.

5.1.3 Selection of Sediment Toxicity Tests for Agency-wide Use Within the Tiered Testing Framework

The following solid phase acute sediment toxicity tests and bioaccumulation tests have been selected by the Sediment Tiered Testing Committee for Agency-wide use within the tiered testing

framework. These test methods will be published as EPA standard methods for adoption and use by all Agency program offices in conducting contaminated sediment assessments:

1. Ten day freshwater acute toxicity tests using Hyalella azteca (amphipod or scud) and Chironomus tentans (midge).

2. Twenty-eight day freshwater bioaccumulation tests using Lumbriculus variegatus (freshwater oligochaete worm).

3. Ten day marine and estuarine acute toxicity tests using the amphipods Ampelisca abdita, Rhepoxynius abronius, Hyalella azteca, Eohaustorius estuarius, and Leptocheirus plumulosus.

4. Twenty-eight day marine bioaccumulation tests using Macoma nasuta (clam) and Neries spp (polychaete worm).

These test species and methods were selected for standardization on the basis of consensus reached at an Agency-wide workshop on tiered testing issues for freshwater and marine sediments held September 16 to 18, 1992 (U.S. EPA, 1992b). Test method protocols for Agency-wide use, including QA/QC requirements, have been published for these species (U.S. EPA, 1994a; U.S. EPA, 1994b). Protocols for sediment spiking, collection, handling, and manipulation will also be published in fiscal year 1994. The final protocols will be reviewed by the Agency's Environmental Monitoring Management Council before publication by the Office of Research and Development as EPA Manuals. All OW programs will use the sediment test protocols immediately. The Office of Prevention,

Pesticides and Toxic Substances will develop test rules using these methods, and the Office of Pesticide Programs will incorporate these tests into the Agency's test guidelines for pesticide registration and reregistration. The Superfund Contract Lab Program will not use the protocols at this time, although the Office of Emergency and Remedial Response will consider whether to include the standardized sediment bioassays in the Contract Lab Program in the future. The Regional Environmental Services Division laboratories, however, which perform much of the testing for the Superfund program, plan to use these methods as soon as they are available in fiscal year 1994. As additional test methods are developed, they may be considered by the Tiered Testing Committee for Agency-wide use.

During fiscal years 1994-1996, EPA will develop standard chronic sediment toxicity test protocols and toxicity identification evaluation methods for sediment assessment.

5.1.4 Supplemental Specific Assessment Methods

In addition to the consistent set of standard sediment assessment methods included in the Tiered Testing Framework, each EPA program office may select and use supplemental program specific assessment methods. Each program will develop its own guidance describing specific regulatory actions to be taken on the basis of results derived from the consistent set of standard tests, and any supplemental methods used in tiered testing.

5.2 SEDIMENT QUALITY CRITERIA

Pursuant to Sections 304(a)(1) and 118(c)(7)(C) of CWA, EPA is developing sediment quality criteria for the protection of benthic organisms. These criteria are designed to be applied where total organic carbon (TOC) equals or exceeds 0.2% of the sediment dry weight, the primary route of exposure is direct contact with the sediment, and the sediments are continually submerged or there is information indicating that equilibrium has been established between water and sediments. Documents presenting proposed criteria for five chemicals have been made available for public review; EPA will publish the documents in final form after considering public comments. The documents present sediment quality criteria for the nonionic organic compounds acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene. EPA will develop sediment quality criteria for additional nonionic organic compounds using a methodology called the Equilibrium Partitioning Approach (EqP). EPA selected this method after considering a variety of approaches that could be used to assess sediment contamination. A technical review of the criteria and supporting science was conducted by the Science Advisory Board (SAB) (U.S. EPA, 1992c). EPA will be presenting a methodology for developing sediment quality criteria for metals to SAB in fiscal year 1995. EPA will prepare sediment quality criteria for metals once the SAB review comments on the methodology have been addressed.

The SAB has concluded that sediment quality criteria can be used to support regulatory decisions when the uncertainty associated with the EqP methodology is addressed. The SAB subcommittee reviewing the sediment criteria recommended that "these criteria not be used as a stand-alone, pass-fail value for all applications" (U.S.EPA, 1992c). Therefore, the Agency expects that remediation programs will not use the criteria as mandatory clean-up levels, but rather as a means to identify potential contamination problems and to provide focus and continuity to remediation efforts. To clarify the role of sediment criteria in a regulatory context, OST and the program offices will

develop a users manual that fully describes how sediment criteria values and uncertainty will be interpreted within the context of each regulatory program. Generally, however, program offices will use the criteria as described below. Public comment on the uses of criteria in dredged material management will be requested in the Preamble of the Ocean Dumping Rule. The Ocean Dumping Rule is being revised to address requirements in response to a 1980 lawsuit, National Wildlife Federation v. Costle, 629 F 2nd 118 (D.C. Cir., 1980). The rule will be proposed by EPA in late fiscal year 1994 under the authority of the Marine Protection, Research, and Sanctuaries Act (MPRSA, 33 USC Sec. 1401 et seq.). In addition, public comment on the appendices of the sediment criteria users manual, which will describe how sediment quality criteria will be applied within each program, will be requested as the appendices are completed.

Great Lakes Program. The Great Lakes States and EPA Regions will use the sediment criteria to assist in the ranking of contaminated sediment sites needing further assessment, to target hot spots within an area for remediation, and to serve as a partial basis for the development of State sediment quality standards. The Great Lakes program will also use the criteria to assist in selecting methods for contaminated sediment remediation and determining whether a contaminated sediment site should be added or removed from its list of designated Areas of Concern.

EPA Monitoring Programs. All EPA programs conducting sediment monitoring activities will use sediment quality criteria to evaluate sediment contamination at sites. Acute and chronic toxicity bioassays and bioaccumulation tests will also be used to evaluate ecological and human health risks.

National Pollutant Discharge Elimination System (NPDES). State and Federal permit writers currently have the authority to establish water quality-based effluent limits in NPDES permits for the protection of aquatic resources. NPDES permit limits are currently derived from State water quality standards, which in turn are derived from EPA's water quality criteria. With the availability of sediment quality criteria, State water quality standards and the resulting permit limits can be derived taking into consideration either sediment or ambient water quality criteria. Site and chemical-specific variables will be factored into the calculation of permit limits along with applicable criteria. As State sediment quality criteria are promulgated as standards, the Office of Wastewater Enforcement and Compliance will continue to work closely with OST to develop models that can be used to calculate NPDES permit limits from State water quality standards.

Dredged Material Regulatory Programs. Sediment quality criteria can be integrated into existing regulatory programs administered under MPRSA and CWA. The criteria can be used in the tiered testing framework established for these programs. The testing guidelines are developed by EPA in consultation with the COE. Both agencies have agreed that EPA's sediment quality criteria, when published, can be included in the second tier (Tier II) of required tests, when chemical analyses are performed on dredged material. Both agencies have also agreed that any dredged material that exhibits contaminant concentrations less than or equal to EPA's sediment quality criteria will be required to undergo additional applicable chemical, biological, and other evaluation procedures before a decision on disposal can be made. Additional testing of this material will be required to determine the possible synergistic effects of contaminants present. EPA and the COE are presently developing an approach to managing sediments that exceed EPA's sediment quality criteria. Such cases will generally result in a more detailed assessment and may include additional sampling. As part of the ongoing Ocean Dumping regulation revision, OW's Ocean Dumping Program plans to solicit

comments on options for use of sediment quality criteria in the dredged material regulatory program. A second, draft regulation revision, which will propose a specific option, will be published at a later date. EPA has suggested that the equilibrium partitioning methodology could be used to calculate the bioavailable fraction of contaminant in sediment at a reference site and in the dredged material itself. Under this approach, if the bioavailable fraction of contaminant in the dredged material is less than or equal to the reference area concentration, the material will pass the sediment quality criteria portion of the evaluation. If the bioavailable fraction exceeds the reference area concentration, the material will not be disposed of without special management practices such as capping.

OST, the Office of Policy, Planning and Evaluation (OPPE), and the COE are conducting a study of the benefits and costs associated with the use of EPA's sediment quality criteria guidance in the COE's navigation dredging program. A goal of the study is to provide the best estimate of the benefits and costs of applying sediment quality criteria to dredged material decision-making in a tiered testing framework, both as strict pass/fail numbers and as decision criteria to be used within established statistical confidence limits.

Resource Conservation and Recovery Act (RCRA) Corrective Action Program. The RCRA Corrective Action Program will use the sediment criteria as one of the factors in making site-specific decisions about remediation at hazardous waste facilities. The Office of Solid Waste has a proposed Corrective Action regulation which lists action levels of contaminants that may be used to trigger a study of remedial alternatives. In selecting remedies, the action levels may become clean-up standards. At some facilities, technical feasibility and long- and short- term effectiveness of alternatives could result in clean-up levels that differ from the action levels. If the final corrective

action regulations define specific action levels, sediment criteria will be one of the factors used in setting action levels for remediation projects.

Superfund (CERCLA) Program. The Superfund program intends to use sediment quality criteria as one of the factors to assess CERCLA sites that have contaminated sediments if there is reason to suspect potentially significant contamination of sediments at the Remedial Investigation stage of analysis. The assessment is used to set clean-up targets for remediation pursued under the authority of CERCLA and the Superfund Amendments and Reauthorization Act of 1986 (SARA).

5.3 NATIONAL INVENTORY OF SITES WITH SEDIMENT CONTAMINATION

In accordance with the requirements of Title V of WRDA, OST will conduct a comprehensive national survey of data regarding sediment quality in the United States, hereafter referred to as the Site Inventory. OST will compile all available information currently contained in national and regional computer databases on the quantity, chemical and physical composition, and geographic location of pollutants in sediment. OST will complete a report to Congress on the Site Inventory in 1995. The Site Inventory will be maintained and updated on a regular basis by OST so that it can be used to assess trends in both sediment quality and the effectiveness of existing regulatory programs at the Federal, State, and local levels. The design of the Site Inventory is described in Framework for the Development of the National Sediment Inventory (U.S. EPA, 1994).

5.3.1 Purpose of the Site Inventory

EPA is developing the Site Inventory to: 1) obtain the best possible current assessment of the extent and severity of the problem of contaminated sediments nationwide; 2) distinguish those areas that may be contaminated and need further assessment from those that are not contaminated; and 3) identify areas that are causing high risks or severe effects to human health or the environment. Once hese areas are identified, Agency program offices will target them for appropriate action.

5.3.2 Scope of the Site Inventory

The Site Inventory developed by EPA will contain detailed sediment quality data from both freshwater and marine ecosystems nationwide. The Site Inventory will be developed in two phases. During the first two year phase, EPA will compile and evaluate a database that will include as much data as possible from existing national and regional computer-readable databases. The inventory will include available data on contaminant concentrations in all types of sediments, including those from rivers, lakes, and estuaries, and from all geographical areas. During the second phase of inventory development, EPA will actively solicit, compile, and evaluate detailed State data describing contaminated sediment sites.

5.3.3 EPA Program Office Uses of the Site Inventory

The following EPA program offices intend to use data contained in the Site Inventory for the assessment, pollution prevention, remediation, and dredged material management activities identified below.

Office of Air and Radiation (OAR). Atmospheric deposition may be an important source of sediment contamination. OAR intends to use the Site Inventory to evaluate the contribution of atmospheric deposition to sediment quality problems. The Clean Air Act (CAA) Amendments of 1990 include specific sections to increase protection of aquatic systems from the impacts of atmospheric deposition. Section 112(c)(6) requires EPA to list source categories accounting for 90% of the aggregate emissions of each of seven critical pollutants by 1995. The seven pollutants are alkylated lead compounds, polycyclic organic matter, hexachlorobenzene, mercury, polychlorinated biphenyls, 2,3,7,8-TCDD, and 2,3,7,8-TCDF. Emissions standards are to be promulgated for the listed categories by the year 2000, assuring regulation of these sources of atmospheric contamination of waterbodies.

Section 112(m) requires EPA, in cooperation with NOAA, to conduct extensive monitoring and research to identify and assess the extent of atmospheric deposition of hazardous air pollutants for the Great Lakes, Chesapeake Bay, Lake Champlain, and coastal waters. A report to Congress was required by November 1993 and biennially thereafter to include, for those waters, an assessment of the relative atmospheric contribution to total loadings, an assessment of the environmental and human health effects attributable to atmospheric deposition, and a description of any regulatory revisions necessary to assure adequate protection. Additional regulations found to be necessary are to be promulgated by November 1995.

Once atmospheric pollutants have been identified as sources of sediment contaminants present in the Site Inventory, these data will be referred to the Great Waters Core Project Management Group, which was formed to develop the implementation plan for Section 112(m). The Core Group will review the existing CAA regulations to evaluate their adequacy for control of atmospherically

deposited sediment contaminants. Further emissions standards or control measures will be promulgated as necessary and appropriate.

Office of Emergency and Remedial Response (OERR). OERR intends to identify sites with contaminated sediments so that they can be added to the Site Inventory. In turn, high priority contamination sites identified in the inventory can become candidates for assessment under CERCLA. This assessment may include evaluation with the Hazard Ranking System, which is used to identify sites that may warrant long-term (and often high cost) clean-up under the Superfund program.

Office of Enforcement (OE). OE intends to use the Site Inventory to target areas and industries for inspection, development of injunctive relief, and supplemental enforcement projects. The Site Inventory can also be used to target sites where known sources of sediment contamination can be linked with ecological and human health effects. Where possible, enforcement actions will be initiated to remediate severely contaminated sites. Available statutory authority for enforcement and remediation of contaminated sediments is described in detail in Section 8.

Office of Federal Activities (OFA). OFA, within OE, intends to use the Site Inventory, Source Inventory (discussed in Section 5.4), and other available data on sediment contamination to target issues addressed during environmental reviews conducted as part of the National Environmental Policy Act (NEPA) process. OFA will use the Site Inventory to evaluate the status of sediment quality and potential environmental issues associated with current Federal projects, and to identify areas requiring programmatic, long-term and/or multi-agency NEPA analysis.

Office of Pesticide Programs (OPP). OPP intends to use the Site Inventory to identify currently registered pesticides that are present in high concentrations at sites nationwide. OPP will evaluate whether special review of these pesticides should be undertaken, whether sediment toxicity testing must be required to support registration of additional uses or formulations of these chemicals, and whether special labeling or use restrictions should be required.

Office of Pollution Prevention and Toxics (OPPT). OPPT intends to use the Site Inventory to identify existing chemicals regulated under the Toxic Substances Control Act (TSCA) that occur in areas of sediment contamination. OPPT will evaluate these chemicals for further testing. OPPT will also use the Site Inventory to identify possible violations of TSCA regulations. OPPT will investigate the sources of contaminants occurring at inventory sites and determine whether enforcement actions should be initiated.

Office of Science and Technology (OST). OST intends to use the Site Inventory to target chemicals of concern for sediment criteria development and to evaluate the effectiveness of technology-based effluent guidelines, water quality-based permit limits, and total maximum daily loads.

Office of Waste Programs Enforcement (OWPE). OWPE intends to use the Site Inventory to identify sites where hazardous waste facilities may be contributing contaminants to sediment. The information in the inventory will be used to augment current approaches for identifying sites for investigation and possible remediation.

Office of Wastewater Management (OWM). OWM intends to use the Site Inventory to assess the extent and severity of sediment contamination caused by point source discharges and to identify the pollutants causing sediment toxicity. This analysis will contribute to the identification of watersheds where permitting and enforcement efforts to protect sediment quality will be focused. In some cases, the Site Inventory and modelling may show that violations of water quality-based permit limits are causing an impact on the sediment or that there is a need to develop additional permit limits specifically for the purpose of protecting sediment quality.

Office of Wetlands, Oceans, and Watersheds (OWOW). OWOW intends to use the Site Inventory data to help support its programs in nonpoint source control, estuarine management, and dredged material management. OWOW's Assessment and Watershed Protection Division (AWPD) intends to use the Site Inventory to help identify impaired waters for the National Water Quality Inventory 305(b) reports. States intend to use the Site Inventory to assist in developing a list of sites for development of Total Maximum Daily Loads (TMDLs), and for evaluation of TMDL effectiveness. AWPD also intends to use the Site Inventory to assist State nonpoint source control programs in updating their lists of waterbodies in need of NPS management practices, including control of sediment contaminants entering surface waters from nonpoint sources.

The Oceans and Coastal Protection Division (OCPD) intends to use the Site Inventory in evaluating the extent and severity of sediment contamination in the Nation's estuaries. If the Site Inventory includes contaminated sites located in estuaries that are part of the National Estuary Program (NEP), during review of NEP deliverables, OCPD will recommend that Comprehensive Conservation and Management Plans (CCMPs) for those estuaries include action plans for addressing contaminated sediment.

The Site Inventory may also be used by OCPD, the Wetlands Division, and the EPA Regions to implement the disposal program for dredged material in association with the COE. The Site Inventory may be used to supplement information gathered for Tier I dredged material evaluations to determine whether additional chemical, physical, and biological testing is necessary. The Site Inventory may also be used to help identify possible chemicals of concern in dredged material and to provide data for the development of disposal site monitoring plans. The Site Inventory could be used to generate information on the impact of sediment contamination on wetlands functions as well.

5.3.4 Evaluation of Data Included in the Site Inventory

EPA intends to develop a "weight-of-evidence" approach based on sediment chemistry and biological effects data for evaluating sites described in the inventory. OST will use this approach to rank all sites in the inventory as having known or suspected contamination problems. To be identified as a site of known contamination, biological effects of contaminants at the site must be documented. Depending on the availability of data, the weight-of-evidence approach will employ one or a combination of the following assessment methods to determine whether identified threshold chemical concentration levels or biological effects levels are exceeded at a site: sediment quality criteria using equilibrium partitioning, sediment quality triad, apparent effects threshold, effects ranges derived by Long and Morgan (1990), or Threshold Effects Level or Probable Effects Level (MacDonald, 1993).

5.4 NATIONAL INVENTORY OF SOURCES OF SEDIMENT CONTAMINATION

In fiscal year 1994, OST will develop an inventory of sources of sediment contamination, hereafter referred to as the Source Inventory. The Source Inventory will be useful to: 1) identify sites where sediment contamination may occur at levels adverse to human health and the environment and undertake sediment monitoring at those sites; 2) target pollution prevention and source control activities by identifying industrial categories contributing sediment contaminants to surface waters; 3) select industries for the development of effluent guidelines on the basis of quantities of toxic sediment contaminants discharged; and 4) target NPDES permitting and enforcement actions to protect sediment quality. The Source Inventory, used in conjunction with the Site Inventory and in some cases additional monitoring data, should allow determinations to be made about whether sites are problematic due to past environmental abuses or as the result of ongoing contamination. OST will update the Source Inventory every two years.

5.4.1 Approach to Developing the Source Inventory

EPA intends to undertake the following tasks to develop the Source Inventory:

1. Search databases containing the results of sediment monitoring studies to develop a list of contaminants found in sediment. The following databases will be used to compile the initial list of sediment contaminants: 1) 1987 EPA Sediment Quality Study (Lyman et al., 1987); 2) EPA Region IV/VI Coastal Contaminated Sediment Site Inventory (U.S. EPA, 1992d and 1993c); 3) NOAA National Status and Trends (NS&T) monitoring data; 4) Puget Sound Study data; 5) STORET (OW's Storage and Retrieval system) sediment observations; 6) Ocean Data Evaluation System (ODES)

sediment observations; 7) EPA Region IX Dredged Material Tracking System (DMATS); and 8) EPA Region X Dredged Analysis Information System (DAIS).

2. Identify databases containing information on the sources of the contaminants and amounts discharged. The following databases will be used to compile the initial list of sources of sediment contaminants: 1) EPA Effluent Guidelines Industry Status Sheets database; 2) NPDES Permit Compliance System; 3) Toxics Release Inventory; 4) National Urban Runoff data in STORET; 5) atmospheric deposition data; and 6) pesticides data.

3. Identify those contaminants that can be linked to sources and that are likely to be found in sediments.

4. Determine loadings of identified sediment contaminants according to standard industrial classification codes (Office of Management and Budget, 1987).

5. Evaluate potential contaminants of concern using a fate/toxicity index. The index will be calculated on the basis of: 1) contaminant propensity to bind to sediment; 2) contaminant persistence in the environment; 3) aquatic life toxicity assessed using NOAA effects ranges, apparent effects thresholds, or aquatic life sediment criteria derived using the equilibrium partitioning method; and 4) human health toxicity (systemic toxicity and carcinogenicity) assessed using current Integrated Risk Information System (IRIS) reference doses, IRIS cancer potency slopes, or

mammalian LD_{50} (lethal dose) data. Quantities of contaminants released will be normalized using the fate/toxicity index.

6. Identify point and nonpoint sources of the contaminants (where data are available) and evaluate to determine chemicals, geographic areas, and industrial categories of concern based on the potential for sediment contamination. EPA also intends to identify waterbodies potentially at risk from sediment contamination by calculating the sum of normalized quantities of contaminants released into each waterbody.

5.4.2 Uses of the Source Inventory

Monitoring. The methodology used to develop the Source Inventory is described in Section 5.4.1. EPA anticipates the likelihood that significant sediment contaminant sources will be located where no ambient sediment quality data exist. The Source Inventory can be used to provide information to target sites for sediment monitoring. Knowledge of existing sources of sediment contamination can help distinguish between sites that have been contaminated by historical sources and sites that are currently being contaminated by active sources. This information is useful to States when identifying sources of impairment to rivers, lakes, and estuaries for their CWA Section 305(b) reports. This information can also assist EPA and the States in determining appropriate remediation activities. The presence of contaminated sediments at sites without current or historical sources nearby may indicate potential illegal dumping activities.

Pollution Prevention. OPPT intends to use the Source Inventory to identify reductions in sediment contaminant discharge that can be achieved through the voluntary 33/50 Program, which encourages industries to reduce the generation of toxic wastes.

Effluent Guidelines Development. Under Sections 301, 304, 306, and 307 of the CWA, OST promulgates technology-based national effluent limitations guidelines that control the discharge of toxic chemicals and other pollutants by categories of industrial dischargers. OST selects industries for promulgation of new and revised effluent limitations guidelines based on environmental factors and utility to states and POTWs. OST will include the Source Inventory among the environmental data sources it will use in the selection process. Accordingly, degradation of the sediment environment may be considered in the selection of industries for the development of new or revised effluent limitations guidelines. The effluent limitations guidelines process involves developing and evaluating treatment options reflecting the Best Available Technology Economically Achievable (BAT), Best Conventional Technology (BCT), and New Source Performance Standards and Pretreatment Standards for indirect dischargers. The Source Inventory can be used in technology option development and selection by providing information on chemicals causing the greatest risk to aquatic life and human health. In addition, the Source Inventory data can be used in the environmental assessment of regulatory options.

Total Maximum Daily Loads. Section 303(d) of CWA establishes the TMDL program to allow for water quality-based controls to be implemented when technology-based controls are inadequate to meet water quality standards. State and EPA authorities begin the TMDL process by selecting waterbodies which are water quality limited, targeting high priority waterbodies for TMDL development, and assessing pollutant sources. The Source Inventory can provide EPA and States with

a screening tool to identify contaminant sources and possibly distinguish between point source and nonpoint source loadings. Additionally, when sediment quality standards exist in State water quality standards, the Source Inventory, in conjunction with the Site Inventory, can be used to identify waterbodies which may not attain these standards. State authorities could then target these waterbodies for further assessment and possible TMDL development. Sediment quality criteria and guidance can be used in TMDL studies to derive loading targets for nonpoint sources that are protective of sediment quality. In some waterbodies, sediment contamination has been caused by contaminated sediment washing into the waterbody. EPA will encourage, but cannot require, States to modify or develop their own erosion and sediment control legislation to include consideration of toxics.

Permitting. Through the NPDES permitting program, administered by OWM, EPA and State regulatory authorities establish water quality-based pollutant concentration limits on the effluent of individual discharge facilities and monitor to ensure compliance with those limits. The Source Inventory will be used, in conjunction with the Site Inventory, as a screening tool to identify current point and nonpoint sources of contaminants nearby or upstream from sediment with elevated pollutant levels. Permit issuing authorities can then target watersheds and specific facilities for further assessment and possibly for development of water quality-based permit limits to protect the sediment. EPA headquarters may also use the Source and Site Inventories to identify facilities where procedures for developing water quality-based permit limits for sediment quality could be demonstrated, to identify pollutants contributing to sediment quality problems nationwide, and to evaluate whether current point source permit limits are sufficiently protective of human health and the environment.

Enforcement. The Division of Water Enforcement (DWE) within OE is currently planning a water quality initiative to identify sources contributing pollutants to waterbodies for which a State has issued water quality advisories against fish consumption or swimming because of excess loadings of the pollutants. Frequently, the advisories are a result of sediment contamination. The Source Inventory can assist DWE by providing information on nearby or upstream dischargers of potential sediment contaminants. The Source Inventory could be used to develop the initial list of likely pollutant sources for a given watershed. Further, the inventory can provide data on specific chemicals most likely to cause adverse environmental impact. This could provide DWE with information necessary to identify the discharges or industrial activities that are contributing to the water quality advisory. This information in turn could support enforcement actions that would compel a facility to cease its damaging activities.

Other Potential Uses. Additional program offices within OW may use the Source Inventory to support their activities. For example, OWOW identifies priority watersheds for nonpoint source control strategies and manages the NEP. OCPD, within OWOW, can target waterbodies where sediment is contaminated for management under its program. Knowledge of current sources of sediment contaminants could help both the States and EPA to determine point source and nonpoint source pollutant contributions to waterbodies and to identify potentially significant contaminant sources. The Source Inventory could help OST identify chemicals that are potentially most toxic and are discharged in the greatest amounts, and thus guide the development of sediment quality criteria.

5.5 INCREASE IN SEDIMENT MONITORING IN WATER QUALITY MONITORING PROGRAMS

Section 503 of WRDA requires EPA to establish a comprehensive and continuing program to assess aquatic sediment quality. EPA will comply with this requirement by increasing sediment monitoring in the Agency's water quality monitoring programs. EPA intends to take the following actions to establish the Agency's sediment monitoring program.

1. The Office of Research and Development's Environmental Monitoring and Assessment Program (EMAP) intends to gather chemical and biological data describing sediment quality at EMAP sampling stations.

2. OW intends to develop a sediment monitoring program to be implemented as part of its overall monitoring program framework. The monitoring framework describes how monitoring programs conducted by EPA Headquarters, EPA Regions, and State Agencies will be coordinated.

3. OW intends to include provisions for sediment monitoring in the national monitoring framework which will be developed by the Intergovernmental Task Force on Monitoring Water Quality (ITFM). Through this framework agreements should be reached with other Federal, State, and local agencies concerning incorporation of sediment monitoring protocols, sediment monitoring QA/QC procedures, and appropriate information system linkages into monitoring programs.

4. OW and the Office of Information Resources Management shall 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). OW intends to work with the EPA Regions to ensure that Regional databases developed for the purpose of archiving and analyzing sediment information are compatible with the Agency's national databases.

5. EPA intends to allocate additional resources for the purpose of sediment monitoring if funds are appropriated for monitoring activities authorized under WRDA or CWA.

5.6 ASSESSMENT OF ATMOSPHERIC DEPOSITION OF SEDIMENT CONTAMINANTS

As described above in this strategy document, under Section 112(m) of the CAA, EPA is undertaking a program to assess the effects of hazardous air pollutants on the Great Lakes, Lake Champlain, the Chesapeake Bay, and near-coastal waters. This program is referred to as the "Great Water Bodies Study." As part of this study, EPA will monitor the air deposition of toxics, monitor tissue levels of airborne toxics in aquatic organisms, and develop models of contaminant transport. An initial report to Congress on this program was completed in May 1994. Subsequent reports to Congress on the Great Water Bodies Program are required every two years thereafter. The reports will address contribution of air pollutants to water pollution, sources of pollutants, and whether they contribute to violations of water quality standards. OST will incorporate these results into the Source and Site Inventories.

5.7 COORDINATION OF ASSESSMENT ACTIVITIES WITH OTHER FEDERAL AGENCIES

EPA will coordinate its sediment assessment activities with the USGS and other Federal and State agencies through the ITFM. EPA will also coordinate its sediment assessment activities with the USGS, COE, BLM, USFS, TVA, USDA, and other agencies participating in the Federal Interagency Sedimentation Project through the National Contaminated Sediment Task Force required under WRDA.

6. STRATEGY FOR PREVENTING SEDIMENT CONTAMINATION

Implementation of an effective program to prevent sediment contamination from occurring is the most environmentally protective and, in most cases, cost-effective way to address the problem. EPA's current statutory and regulatory authority is adequate to prevent many sediment contaminants from being released to the environment. The strategy for preventing sediment contamination describes the actions that EPA program offices will take under a number of different statutes, including FIFRA, TSCA, RCRA, CAA, and CWA to prevent sediment contamination.

6.1 OFFICE OF PESTICIDE PROGRAMS ACTIONS

6.1.1 Control of Sediment Contaminants Regulated Under FIFRA

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

6.1.2 OPP Use of the Site Inventory

OPP intends to use the Site Inventory developed by OW to develop a list of pesticides that are posing risks or causing harmful effects on a national scale. OPP intends to evaluate these pesticides to determine whether appropriate regulatory action should be taken.

6.1.3 Memorandum of Agreement with USGS

There is currently a Memorandum of Agreement between OPP and the USGS's National Water Quality Assessment (NAWQA) Program. The NAWQA program is integrating with other programs the results from monitoring most major river basins and aquifer systems. Information will be provided at the regional and national scales. At the start of this program, data collection is focusing on pesticides and nutrients in sediment. OPP has played an active part in the USGS NAWQA Program Federal Advisory Council, has had technical input, and is currently working on several joint USGS/OPP publications.

6.1.4 Pesticide Incident Reports

OPP uses voluntary pesticide incident reports made by citizens, farmers, and pesticide registrants to obtain information on use, misuse, and problems associated with pesticides. OPP also requires information from registrants on adverse effects of pesticides. OPP is currently in the process of finalizing a rule concerning collection of these adverse effect data (required under Section 6(a)(2) of FIFRA). OPP has set up a special process for cataloging, sorting, processing, and using both the voluntary reports and the required registrant adverse effects reports in the regulatory program. OPP will continue to investigate information concerning sediment contamination in these incident reports on a case-by-case basis. If convincing cause-effect data on pesticides in sediment and adverse ecological or human health effects are available, then special review of the chemicals causing the adverse effects, or other appropriate regulatory action, may be undertaken by OPP.

6.1.5 Development of Technical Guidance Documents for Evaluation of Pesticide Risks

OPP intends to continue work to develop technical guidance documents on the evaluation of pesticide risks, and evaluation of pesticides to determine their potential to run off into surface waters, leach into surface waters, or accumulate in sediment.

6.1.6 Aquatic Effects Dialogue Group Recommendations

In 1990, the Conservation Foundation's program on Environmental Dispute Resolution made recommendations on aquatic issues for the Agency's consideration. One topic of the discussions of the Aquatic Effects Dialogue Group (AEDG) was the evaluation of sediment toxicity. AEDG recommended that tests of sediment toxicity to aquatic organisms be considered for pesticides that are likely to sorb to sediment. The following scheme, proposed for EPA consideration, integrated sediment testing with FIFRA testing tiers (World Wildlife Fund, 1992):

Tier I:	Equilibrium partitioning calculations to estimate chemical concentrations in porewater and sediment.
Tier II:	Acute porewater and whole sediment toxicity tests with spiked sediment.
Tier III:	Chronic whole sediment toxicity tests with spiked sediment.
Tier IV:	Benthic community structure, colonization rate, laboratory toxicity tests with field collected sediment, and in-situ sediment toxicity testing within a mesocosm.

Although sediment toxicity testing can be required as a special test pesticides do not routinely address potential ecological and human health effects of sediment contamination. OPP therefore

intends to develop a strategy to systematically evaluate the risk of sediment contamination posed by the registration and use of pesticides. OPP intends to propose the following actions as part of its strategy for evaluating the potential for pesticide contamination of sediments.

1. OPP intends to revise both the regulatory requirements for registration of pesticides at 40 CFR Part 158 and Subdivision E of the Pesticide Assessment Guidelines to incorporate the EPA standard acute whole sediment bioassay methods and spiking protocols developed by the Agency-wide Sediment Tiered Testing Committee. OPP intends to develop Standard Evaluation Procedures for the sediment toxicity tests and submit them for Science Advisory Panel review. OW will provide OPP with supporting information regarding sensitivity of species and appropriateness of life stages used.

2. When chronic sediment toxicity tests are developed by the Agency-wide Sediment Tiered Testing Committee, OPP intends to revise both 40 CFR Part 158 and Subdivision E of the Pesticide Assessment Guidelines to incorporate these methods and protocols. OPP intends to develop Standard Evaluation Procedures for these tests and submit them to the Science Advisory Panel for review.

3. OPP intends to routinely require aquatic fate tests to support many terrestrial uses of pesticides that persist or bioaccumulate.

4. OPP is evaluating the feasibility of integrating into the Pesticide Assessment Guidelines a new test requirement that combines protocols for two existing tests, the

water column monitoring test ("Aquatic Field Dissipation Test") and the aquatic life tissue monitoring study ("Accumulation in Aquatic Non-Target Organisms"). Regulatory requirements for routinely conducting this new test will be proposed.

5. OPP intends to develop better information for distribution to the public on crop management practices and Integrated Pest Management practices that will most effectively reduce the levels of toxic pesticide contaminants in sediment. OPP will work with OW's nonpoint source program to reduce the levels of toxic pesticides in sediment by providing information on best management practices and integrated pest management to farmers.

6. OPP intends to develop criteria for pesticide residues in sediments to be used as one of several screening tools for the determination of "Reduced Risks" (i.e., "Safer") pesticides. This would allow for expedited registration of chemicals that fit into the category and possibly displace use of pesticides that are more harmful to human and ecological health.

7. OPP intends to investigate the feasibility of using the OPPT screening method that uses parameters such as chemical properties, environmental fate, hazard, and exposure for identifying those chemicals which pose a greater risk.

6.2 OFFICE OF POLLUTION PREVENTION AND TOXICS SUBSTANCES

EPA has authority under TSCA to regulate new and existing chemicals that have the potential to contaminate sediments, if the resulting ecological or human health risks are judged to be unreasonable. The Office of Prevention, Pesticides and Toxic Substances (OPPTS) is committed to a program that will incorporate into routine chemical review processes, performed under Sections 4 and 5 of TSCA, assessment of environmental fate and effects of toxic chemicals that could potentially contribute to sediment contamination. EPA believes that OPPT can contribute most significantly to the management of contaminated sediment through its pollution prevention efforts. OPPT therefore intends to take the following actions to prevent sediment contamination:

1. OPPT intends to incorporate the acute whole sediment toxicity test methods and sediment bioaccumulation test methods developed by the Tiered Testing Committee into the OPPTS test guidelines. When chronic whole sediment test methods are developed by the Tiered Testing Committee, OPPT will incorporate them into the OPPTS test guidelines as well.

2. OPPT intends to use the Site Inventory and the Source Inventory to select chemicals for review. OPPT intends to develop, and update on a regular basis, a list of sediment contaminants to be evaluated for review. This list will include all chemicals regulated under TSCA that have been identified to exceed toxic threshold concentration levels at locations included in the Site Inventory. As additional sites are included in the inventory, the list of chemicals for review will be updated. OPPT intends to use the Source Inventory database (compilations of the Toxic Releases Inventory database, the Office of Water Effluent Guidelines database, and the Office

of Water Permit Compliance System database) to evaluate the sources of contaminants on the list of chemicals for review.

3. Through the New Chemicals Program, OPPT can ban or otherwise 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. OPPT intends to use the New Chemicals Program to engage the chemical industry in dialogues on the redesign of chemicals to reduce both bioavailability and partitioning of toxic chemicals to sediment. OPPT intends to draft guidelines and implement a policy encouraging the design of new chemicals having the following characteristics: molecular weight greater than 1000 grams per mole to prevent adsorption through biological membranes; large cross-sectional diameters to prevent movement through cell membranes; functional groups embedded within the molecule to enhance rapid transformation to low toxicity products; and log K_{ow} (octanol-water partition coefficient) values greater than 8 to prevent effects at saturation or less than 3.5 to avoid partitioning to sediment.

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

5. Under the New Chemicals Program, OPPT has developed an exposure based review (EBR) policy. In this program environmental fate and effects tests (e.g., sediment toxicity tests) may be triggered if certain criteria are met in OPPT's initial review. Data gathered in this way will improve the OPPT risk evaluation and management processes. OPPT intends to revise this policy to include criteria triggering requirements for sediment toxicity testing.

6. Staff in OPPT's Exposure Assessment Branch (EAB) have worked with EPA's Region V office to develop a testing strategy to assess the environmental risks associated with biocides used to prevent zebra mussels from fouling water pipes. While the final report of this project is not available, it has been determined that some biocides do not degrade well and therefore can persist in sediment. Region V plans to severely restrict the use of this group of chemical biocides. Some other chemicals used as surfactants or wetting agents in biocides have been identified as potential risk concerns. Region V intends to propose language for paper mill permits limiting the amount of these chemicals used. In addition, permitees may be required to submit plans for the use of different surfactants that will degrade in the environment.

7. OPPT is working with a number of industry trade associations to provide product toxicity testing information and guidance to their member companies. OPPT and other program offices are assisting members of the Ecological and Toxicological Association of the Dyestuffs Manufacturing Industry in developing a pollution prevention program to record pollution prevention achievements, further reduce waste generation, and continue to realize the benefits of pollution prevention in the dye

industry. As part of this pollution prevention program, OPPT intends to specifically document the actions that the dye industry can take to reduce the generation of waste products that concentrate in sediment. The Site and Source Inventories may be used to produce an initial list of toxic waste products that may be present in sediment.

8. In evaluating new chemical registrations, OPPT intends to use the Site and Source Inventories to assist in identifying geographical areas where additional chemical discharges may lead to unacceptable levels of sediment contamination.

6.3 OFFICE OF ENFORCEMENT AND COMPLIANCE ASSURANCE ACTIONS

OECA has issued two policies related to the use of pollution prevention conditions in EPA enforcement settlements. These two policies are: 1) the Policy on the Use of Supplemental Enforcement Projects in EPA Settlements (issued February 12, 1991); and 2) the Policy on the Inclusion of Pollution Prevention Conditions in Enforcement Settlements (issued February 25, 1991). These policies are designed to help reduce or eliminate root causes of noncompliance with permits by commuting penalties, through enforceable agreements, if appropriate source recycling and source reduction activities are undertaken. OECA will aggressively apply both of these policies to negotiate settlements that will reduce sediment contamination. All settlements will emphasize reductions over and above what is required to return to compliance with the requirements of law. Settlements will also emphasize actions which will enhance the prospects for long-term or continuous compliance. OECA intends to take the following actions to implement programs to reduce sources of sediment contamination:

1. OE intends to continue to implement pollution prevention initiatives with the OPPTS, Office of Air Quality Planning and Standards, NPDES, and RCRA compliance programs

2. Under these initiatives the OE intends to provide technical support to EPA negotiation teams to identify and evaluate the feasibility of specific pollution prevention conditions to reduce sediment contamination.

3. OE intends to also monitor respondent or defendant activities in cases pursued and assure compliance with all settlement conditions related to prevention of sediment contamination.

4. OE intends to evaluate and report on the effectiveness of the pollution prevention conditions related to sediment contaminants that are obtained in the settlements.

5. OE intends to develop technical pollution prevention guidance that can be used to train the EPA Regions in enforcement actions that can be taken to reduce sediment contamination.

6. An executive order signed on August 3, 1993 requires Federal facilities to halve their toxic emissions by 1999 and to begin reporting to the public any release of toxic pollutants. EPA will monitor compliance with the executive order.

7. STRATEGY FOR ABATING AND CONTROLLING SOURCES OF SEDIMENT CONTAMINATION

The goal of CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. NPDES permits are the primary means for preventing the discharge of pollutants into water from point sources. Under Sections 301, 304, 306, and 307 of CWA, EPA has set minimum, technology-based requirements for municipal dischargers (e.g., primary and secondary treatment standards) and sets similar requirements for industrial dischargers (e.g., best available technology economically achievable and pretreatment standards for existing sources). Under Section 301 of CWA, NPDES permits must also include additional limits as necessary to achieve applicable water quality standards.

7.1 TECHNOLOGY-BASED CONTROLS FOR POINT SOURCES

To date EPA has promulgated best available technology (BAT) effluent guidelines for 40 industrial categories. Over one billion pounds of the 126 priority pollutants are removed annually as a result of these requirements. EPA has not directly considered sediment contamination in developing these guidelines; however, the program has reduced loadings of toxicants to both water and sediment. In addition to developing these nationally applicable effluent limitations, EPA sets technology-based limitations in permits on a site-specific basis using Best Professional Judgment. Effluent guidelines are also the basis for local pretreatment programs, which require toxics controls on industries discharging into municipal sewage treatment plants. In 1986, it was estimated that 37 percent of the toxic industrial compounds that entered surface waters had passed through sewage treatment plants. As a result of this finding, EPA identified the 1500 municipal sewage treatment plants that handle the

majority of industrial wastewater. EPA required these plants to develop and enforce appropriate effluent limits for industries discharging into their system. An estimated 12,000 significant industrial users in pretreatment cities are required to meet one or more of the effluent guideline categorical standards.

Under Section 304(m) of CWA, EPA is required to publish a biennial Plan that establishes a schedule for the annual review and revision of promulgated effluent guidelines and identifies categories of sources discharging toxic and nonconventional pollutants for which guidelines have not yet been published. Following publication of the first such Effluent Guidelines Plan in 1990, the Natural Resources Defense Council and Public Citizen Inc. filed suit, claiming that the Plan did not fulfill the requirements of Section 304(m). In a Consent Decree dated January 31, 1992, EPA agreed to promulgate 19 new and revised effluent limitations guidelines over an 11 year period. Twelve of the industries for rulemaking have been selected based on need and potential for risk reduction. The remaining 9 must be selected beginning in 1995. The Agency agreed to study these industries in the intervening time and to evaluate the need and risks involved before making the selections.

EPA's effluent guidelines program has evaluated risk as one criterion used to select industrial categories for guidelines development. In the next Effluent Guidelines Plan, the Agency intends to propose adding sediment contamination as a specific factor in the selection of these industrial categories. The Source Inventory would be used for this purpose. The inclusion of sediment contamination as a specific evaluation factor would increase the potential for industries discharging sediment contaminants to be the subject of new or revised effluent limitations guidelines. This would ensure that the Agency will consider sediment contaminants in establishing guidelines in the future. Once an industry has been selected for development or revision of guidelines, it will take a minimum

of 5 years to promulgate the rule. Guidelines are not self-implementing, but only become binding when implemented in permits, so 5 to 10 years is the minimum time period to be expected for implementation of new technology-based NPDES permit limitations.

7.2 WATER QUALITY-BASED CONTROLS FOR POINT SOURCES

Although in many cases past discharges are partly responsible for today's contaminated sediment problem, sediment quality problems are not solely the legacy of past discharges. Monitoring and assessment data compiled by Federal, State, local, and private sources indicate that currently discharging sources do contribute to sediment contamination. On the States' CWA Section 304(l) lists of waterbodies that will not meet water quality standards for toxics because of point source discharges, 11 waterbodies were listed because an active point source was entirely or substantially contributing to or causing sediment contamination and hence impairing uses of the waters. The point sources of sediment contaminants identified by States under Section 304(l) included Publicly Owned Treatment Works (POTWs), power plant outfalls, and industrial discharges. EPA studies have documented additional cases of sediment contamination from stormwater discharges, combined sewer overflows, metal finishing industries, pulp and paper mills, and oil storage terminals. Furthermore, preliminary data from the Source Inventory indicate that active point source discharges are contributing to sediment contamination.

EPA has published water quality criteria identifying the concentrations of specific chemicals in the water column that should not be exceeded in order to protect aquatic life and human health. These criteria are often used by the States as the basis for adoption of legally enforceable water quality standards for waterbodies. Every 3 years, States are required under CWA to review their

water quality standards to determine if they meet the requirements of the Act, and standards are to be revised as necessary. In 1987, Congress amended CWA to require States to adopt numeric toxics criteria in their water quality standards as necessary to support designated uses. By early 1990 only 6 States had met this requirement. EPA initiated action to promulgate Federal water quality criteria for toxic pollutants applicable to those States that had failed to comply fully with the Act. On December 22, 1992, EPA promulgated criteria for toxic pollutants for the jurisdictions that had not yet complied with the Act. Because numeric water quality criteria for toxics are now in place in all 57 States and territories, numeric water quality-based NPDES permit effluent limits for toxics will eventually be developed in all States. Due to the lack of chemical-specific sediment quality criteria and sediment bioassay methods, however, most NPDES permits do not contain limits specifically developed to protect sediment quality. Once EPA has developed a standard set of chemical and biological sediment test methods, EPA and the States will be able to use these methods in the process of developing water quality-based permit limits to protect sediment quality for targeted discharges. Toxicity bioassays may be used to confirm whether point source contamination of sediments causes or contributes to aquatic life toxicity. Sediment toxicity identification evaluations can be performed to identify the chemicals causing the toxicity. For human health and wildlife protection, bioaccumulation bioassays can be used to confirm that the chemicals discharged are bioconcentrating in the food chain.

CWA also includes requirements in Section 303(d) for comprehensive water quality planning. Under recently revised regulations, every two years States must: 1) identify all waters that do not meet water quality standards (including designated uses and sediment criteria) or are threatened; 2) rank the waters in priority order; and 3) develop TMDLs according to the priority ranking. TMDLs specify the particular source reductions necessary to attain and maintain water quality standards. The source reductions are implemented through NPDES permit limits and through State nonpoint source

programs. TMDLs are especially valuable when there are multiple sources or when loadings to threatened waters that may not yet exceed water quality criteria need to be allocated to point source discharges. If chemical-specific sediment quality criteria and standards are available, TMDL modeling can be used to establish effluent limits that meet those criteria. If sediment criteria are not available for problem pollutants, a permit writer may develop sediment toxicity and bioaccumulation limits in NPDES permits, based on a State's narrative water quality standards, in order to protect sediment quality.

OW's Permits Division is field-testing an EPA model that predicts water and sediment concentrations based on receiving water conditions and effluent loadings. The model can be used to calculate wasteload allocations based on compliance with sediment quality criteria. If the model is satisfactory, the Permits Division intends to prepare a users manual on how to use the model to derive wasteload allocations and permit limits to protect sediment quality. The Office of Research and Development (ORD) is investigating methods to link contaminated sediments to point sources. These methods include toxicity identification evaluations to identify the chemicals causing toxicity; contaminated sediment gradient assessment, in which contaminant concentrations are measured as a function of proximity to a pipe; and fingerprinting, which examines the correlation between the specific chemicals produced by a company and the chemicals found in nearby sediments. These methods may be incorporated into the OW guidance as they become available.

Once EPA publishes sediment quality criteria and the accompanying users manual, the States can adopt criteria as necessary to protect sediment quality during their triennial review process. (Note that States are required under CWA Section 303 to promulgate criteria to protect designated uses; if a specific pollutant is not likely to be present in waterbodies at levels sufficient to impair those uses,

then a State is not required to adopt criteria for that pollutant.) States can also develop criteria less protective than EPA's criteria guidance, provided that the State can show that the relevant designated uses nevertheless will be protected. NPDES permits generally are written for a 5-year term so as many as 8 years may pass after EPA promulgation of sediment quality criteria guidance before permits are issued with water quality-based limits specifically to protect sediment quality. Additional time may be allowed for compliance with these limits, if the inclusion of compliance schedules in permits is explicitly allowed by State water quality standards or implementation procedures.

The 1987 amendments to CWA also require EPA and the States to develop permits for discharges from all municipal separate storm sewer systems that serve populations of more than 100,000, and to issue permits for stormwater discharges associated with industrial activity as well. The stormwater rule promulgated in October 1990 provides wide-reaching authority that can be used to prevent contamination of sediments in urban areas, and some authority to control stormwater discharges from silvicultural and mining sources.

The Source Inventory is the first comprehensive evaluation of ongoing discharges of sediment contaminants from point sources. OW intends to use the Source and Site Inventories to screen for geographic areas that have the greatest likelihood of experiencing adverse aquatic life and human health risks due to sediment contaminants. In addition, OW intends to use the inventories to help identify the active point sources and pollutants most responsible for causing such risks. OW also intends to use the inventories to target industrial stormwater discharges, discharges from municipal separate storm sewer systems, and combined sewer overflows that are known to contribute to contaminated sediment. These dischargers will be required to prepare a pollution prevention plan which includes measures to prevent the discharge of sediment contaminants and the occurrence of

sediment toxicity. EPA will develop guidance on how to identify and control sources of sediment contamination that discharge to these sewers. Because these sewer systems receive a large volume of nonpoint source runoff, compliance with end-of-pipe limitations may result in local implementation of nonpoint source runoff controls and practices.

Point source discharges are also addressed through CERCLA and RCRA. Discharges from CERCLA sites and RCRA facilities subject to NPDES permits must comply with requirements in the permit that are protective of sediment quality. As with other NPDES permits, these permits do not currently contain limitations specifically developed to achieve sediment quality. Both on-site and off-site direct discharges from CERCLA sites are required to meet the substantive requirements of NPDES permits. (On-site actions are exempt from actually acquiring the permit.) Under RCRA, hazardous waste facilities that have point source discharges are not exempt from NPDES permit requirements. Run-on and run-off controls are also required at active facilities to control nonpoint source contributions to surface waters. EPA is currently evaluating the need to control nonpoint source contributions from "interim status" facilities that have been shut down, but are still contaminating sediments through stormwater runoff or leaching.

7.3 CONTROLS FOR NONPOINT SOURCES

Section 319 of CWA provides an overall framework for States to prevent and manage all nonpoint sources of water pollution. Under Section 319, States are required to complete a comprehensive assessment of their navigable waters and evaluate the effects of all categories and sources of nonpoint pollutants. In its Nonpoint Source Guidance (U.S. EPA, 1987a), EPA encouraged States to provide information regarding those waters not meeting beneficial uses,

including those not meeting designated uses due to contaminated sediments. The guidance classified contaminated sediments as a nonpoint source pollution category. EPA's Section 319 grant guidance makes contaminated sediment prevention and, in some limited instances, remediation efforts eligible for funding. Section 319 gives EPA authority to award grant funds to States as an incentive for nonpoint source control, including control of sources of sediment contamination. Section 319 grant funds totaled $38 million in fiscal year 1990, $51 million in fiscal year 1991, $52.5 million in fiscal year 1992, and $50 million in fiscal year 1993. Section 319 does not provide any Federal authority to regulate nonpoint sources, however. State nonpoint source management programs are to include plans for preventing and managing nonpoint sources of pollution by encouraging, assisting, or requiring the implementation of best management practices (BMPs). At their own discretion, States can enact legislation or regulations for control of nonpoint sources. The development of TMDLs under Section 303 of CWA is a regulatory tool for addressing nonpoint sources as well as point sources; States are increasingly including nonpoint sources in their TMDLs.

In 1992, EPA set aside $800,000 to fund demonstration of urban and agricultural BMPs specifically designed to remove sediment contaminants in stormwater runoff. Once the results of these demonstration projects are available, EPA will publicize their effectiveness. When EPA develops the Site Inventory, the nonpoint source program can work with the States to target sites for grants and technical assistance to prevent further sediment contamination.

Other EPA programs contribute significantly to the control of nonpoint sources. Under Section 314 of CWA, the Clean Lakes Program provides grants to States for the classification, assessment, study and restoration of lakes. EPA has entered into over 400 Clean Lakes Cooperative Agreements with participating States. Many of these agreements have funded nonpoint source

controls to prevent pollutants originating in the watershed from entering lakes. Several projects have used storm water retrofitting to control urban runoff, and others have used wetlands to buffer and filter pollutants from agricultural and silvicultural areas. The Implementation Memorandum for the fiscal year 1990 Clean Lakes Program encourages States to integrate their Clean Lakes projects with Section 319 nonpoint source programs for targeted watershed demonstration projects. This guidance memorandum also mentions that USDA PL 83-566 projects may offer assistance in watersheds significantly affected by agricultural nonpoint source pollution. As in the case of the Section 319 program, EPA's Site Inventory will be used to target watersheds for Clean Lakes grants to prevent further sediment contamination. Funding for BMPs effective in removing sediment contaminants can be provided to these Clean Lakes sites.

EPA's NEP, authorized under CWA Section 320, is a national demonstration program that uses a comprehensive watershed management approach to address water quality and habitat problems in designated estuaries on the Atlantic, Gulf, and Pacific coasts and in the Caribbean. Under the Act, management conferences, consisting of Federal, State, and local agencies, scientists, citizens, industry, and environmental groups, develop Comprehensive Conservation and Management Plans (CCMPs) within five years of NEP designation. These plans address toxic and pathogen contamination, nutrient overenrichment, habitat loss or alteration, impacts to living resources, and other problems from point and nonpoint source pollution and physical alterations (e.g., dredging and construction). A number of the NEP watersheds have identified contaminated sediments as a problem and are developing action plans to reduce or eliminate the problem through point and nonpoint source controls.

EPA expects States to use the Site Inventory to assist in identifying both estuaries that should be nominated for NEP designation and controls for nonpoint sources of contamination to sediments. The inventory may also provide information to determine whether already designated estuaries should have more attention focused on nonpoint or point source controls for contaminated sediments. If EPA determines that additional NEP management conferences are to be convened, OW's OCPD intends to advise States that nomination packages for new programs should include identification of sites that are included in the Site Inventory. EPA will also advise States that the Agency intends to use this information in evaluating the nominations.

Another important nonpoint source control program is the coastal nonpoint source control program established by the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). Under CZARA, States must implement programs in conformity with EPA guidance. EPA's guidance specifies management measures for nonpoint source categories located within the coastal area. These management measures are considered best available technology for agricultural, silvicultural, urban, hydromodification, and marina nonpoint sources. In addition, CZARA requires States to adopt legally enforceable policies and mechanisms for controlling nonpoint sources in those coastal areas. Failure by the States to adopt approvable programs by the 1995 statutory deadline will result in reductions in Coastal Zone Management Act (CZMA) and CWA grants to violating States, beginning in 1996. As data become available, OW will publicize the measures that are found to be most effective for controlling sediment contaminants and will try to ensure that these measures are incorporated into States' coastal nonpoint source programs as part of EPA's and NOAA's approval decisions.

7.4 COORDINATION WITH OTHER AGENCIES

States play a key role in controlling point and nonpoint source pollution. In order for controls to be focused on sediment quality, the States can, as necessary, adopt sediment quality criteria as part of their water quality standards or use EPA's sediment bioassays to interpret their narrative standards of "no toxics in toxic amounts." Most States are authorized to issue NPDES permits to control point sources, so EPA will work closely with the States to ensure implementation of water quality-based limits to protect sediment quality. Guidance will be developed and workshops will be held to train States how to use EPA-consistent sediment testing methods, how to develop permit limits to protect sediment quality, and how to monitor for compliance with these limits.

In the nonpoint source area, EPA will encourage the States to modify the Model State Act for erosion and sediment control to include consideration of toxics. This Act, developed for the Council of State Governments, is currently directed only at "clean sediment" problems. EPA will also encourage the States to develop their own legislation, based on the Model State Act, for preventing sediment contamination. EPA's nonpoint source program will continue to coordinate with USDA, USFS, and Bureau of Reclamation as in the past, and will include consideration of contaminated sediment as well as clean sediment issues. EPA will also seek to ensure that coordination with Mexico and Canada to control point and nonpoint sources of pollution will address prevention of contaminated sediment. An important means of coordinating with Canada will be through revising the Great Lakes Water Quality Agreement (GLWQA).

8. REMEDIATION AND ENFORCEMENT STRATEGY

EPA may take actions directed at remediation of contaminated sediments under the Comprehensive Emergency Response, Compensation and Liability Act (CERCLA), RCRA, CWA, the Rivers and Harbors Act, TSCA, and the Oil Pollution Act of 1990. Where sediments are contaminated to levels that cause ecological harm or pose a risk to human health, EPA will strive to implement whatever remediation strategy will most effectively reduce the risk. In certain circumstances, the best strategy will be to implement pollution prevention measures as well as point and nonpoint source controls to allow natural recovery processes such as biodegradation, chemical degradation, and the deposition of clean sediments to diminish risks associated with the sites. In other cases, active remediation may be necessary. EPA will not proceed with an active clean-up, however, when implementation of the remedial alternative would cause more environmental harm than leaving the contaminants in place.

EPA will develop criteria for deciding whether natural recovery is the preferred remedial alternative on a site-specific basis, using such factors as: the specific contaminants present and their associated risks; the designated uses impaired during recovery; the size of the affected area; the feasibility of remediation; site hydrodynamics, including the extent of downstream transport; the time required for natural recovery; and the liability associated with active remediation. The specific contaminants present in sediment affect the type (ecological versus human health) and severity (acute versus chronic toxicity) of the impact. Natural recovery is not acceptable where contamination poses severe and substantial risks to aquatic life, wildlife, and human health. In addition, natural recovery may not be the method of choice for contaminants that biodegrade or transform into more persistent, toxic compounds.

Identification of the designated uses impaired by sediment contamination will allow the risk manager to evaluate the tradeoffs involved with short-term, active remediation compared to long-term, natural recovery. The size of the contaminated area is a key parameter to be considered. Widespread, low levels of contaminants favor natural recovery while geographically limited areas containing high levels of contaminants favor active remediation. Technology also plays a part in the use of natural recovery. If it is technically impractical to remediate a site, then natural recovery is the only option. Site hydrodynamics affect the decision because sediments must be stable for clean sediment burial to be effective. If contaminated sediments are continually being transported into more critical habitats or being spread over a wider area where remediation is no longer technically or economically feasible, active remediation should be performed. In some situations, combinations of active remediation and natural recovery may be possible. For example, if fairly discrete areas of contamination are removed, the rest of a site may be left alone for natural recovery. Alternatively, limited capping of contaminated sediment with clean material may be done in anticipation of further natural deposition of clean sediment. Before initiating any remediation, active or natural, it is important that point and nonpoint sources of contamination be controlled.

The amount of time needed for natural recovery will vary from site to site, but will generally be on the order of one or more decades if clean sediment burial, biodegradation, and chemical degradation proceed at average rates. Natural recovery times will obviously be shortened if the area of contamination is small in size, sediment burial rates are high, and all the major sources of contamination are controlled. However, natural resource damage provisions in various environmental statutes may discourage the use of strategies employing natural recovery. The lengthier processes of natural recovery increase the number of years over which damage to natural resources can occur,

thereby making immediate clean-up a more attractive alternative. Responsible parties may wish to solve the problem immediately rather than be liable for additional years of resource damages.

The goal of all natural recovery and active remediation projects is to achieve sediments that pose no acute or chronic toxicity to aquatic life and no significant risk to wildlife and human consumers of fish. It should be noted, however, that the Strategy does not mandate specific clean-up standards for remediation projects. The decision on an appropriate clean-up level for any project must incorporate a number of site-specific factors. These include the beneficial uses of the waterbody, the ecology, geology, and hydrology of the site, technical feasibility, risks that may be posed by the various treatment or disposal options, the benefits of remediation, and economic constraints.

The ranking system being developed for the Site Inventory will provide an analytical methodology for listing sites in priority order for remediation and pollution prevention, and will play a significant role in targeting sites for source controls to protect sediment quality. Each remediation program will then set its own priorities for the sites in the Site Inventory based on statutory and regulatory constraints. A program decision to select natural recovery or active remediation for any site will require the detailed data gathered during a remedial investigation/feasibility study of the environmental impacts, cost-effectiveness, and technical achievability of remedial alternatives.

EPA is committed to using all potential enforcement authorities to obtain sediment remediation. CERCLA, RCRA, CWA, the Rivers and Harbors Act of 1899, TSCA, and the Oil Pollution Act of 1990 contain provisions that, under the appropriate circumstances, can compel responsible parties to contribute to the clean-up of contaminated sediments. Depending on the

particular statute, EPA can use these authorities to: (1) compel parties to clean up the sites they have contaminated; (2) recover costs from responsible parties for EPA-performed clean-ups; and (3) coordinate with natural resource trustees to seek restitution from responsible parties for natural resource damages. The Agency's ability to obtain sediment remediation within a reasonable time frame may be enhanced through the coordinated use of contractor listing (40 CFR Part 15), debarment and suspension (40 CFR Part 32), State or local laws and regulations, and the Agency's criminal enforcement authority.

To date EPA has successfully used only Section 309(b) of CWA and Section 106 of CERCLA in conjunction with its violating facility listing authority to require clean-ups at contaminated sediment sites. In addition, settlements of CWA unauthorized discharge enforcement cases have incorporated sediment clean-up as part of the injunctive relief. Under this Contaminated Sediment Management Strategy, EPA intends to use these statutes and the other authorities described in this section to require sediment remediation by responsible parties. Once EPA develops the Site and Source Inventories, this information will assist in the targeting of enforcement actions for sediment remediation. The Agency-wide consistent tests will be used to identify areas needing remediation and to help provide clean-up goals for enforcement-based remediation. The following sections describe the EPA remedial and enforcement programs that will be used for contaminated sediment clean-up.

8.1 CERCLA REMEDIATION AND ENFORCEMENT

Under CERCLA, OERR has established a comprehensive program for identifying, investigating, and remediating hazardous waste sites. Unless focused clean-up activities that require immediate attention take place under CERCLA's removal program, sites must be placed on the

National Priorities List (NPL) to be eligible for remedial funding. The CERCLA process for assessing sites involves a tiered system for evaluation that is used to screen out sites that do not warrant placement on the NPL. Before a site is added to the NPL, it is evaluated using the Hazard Ranking System (HRS); a resultant score of at least 28.5 is needed to support listing (HRS scores range between 0 and 100).

Local governments, States, and EPA Regional offices typically identify sites that should be evaluated for threats to public health and the environment. Superfund sites with contaminated sediments will be added to the Site Inventory. Sites that are already identified in the Site Inventory and that are not currently under the jurisdiction of another program (e.g., RCRA) may be appropriate for evaluation under CERCLA.

Under CERCLA, EPA carries out a detailed analysis of risks posed by contaminants at the site to human health and the environment, and the feasibility of various response action alternatives to reduce risk. The Risk Assessment Guidance for Superfund (RAGS), (U.S. EPA, 1989a) provides a framework for the assessment of human health and environmental impacts. Various EPA publications, including guidance in RAGS, Ecological Updates, and fact sheets, are used to develop assessments that are presented as a part of the Remedial Investigation/Feasibility Study of a CERCLA site. The process is not designed specifically for sediments, but rather for the purpose of assessing all exposure routes from contamination at CERCLA sites.

The CERCLA program intends to use the EPA-consistent sediment testing methods of the Tiered Testing Framework in the Remedial Investigation/Feasibility Study stage of analysis. OERR intends to provide guidance on the use of the testing methods to promote consistency of these methods

within the CERCLA process. Within one year after the EPA standard protocols for acute sediment toxicity testing are completed, the CERCLA program will develop guidance describing the use of the EPA sediment testing methods. CERCLA program guidance on the use of sediment quality criteria will be issued following completion of the users manual for the criteria.

An evaluation of all CERCLA Record of Decisions (RODs) from 1982 through 1992 identified 335 sites where contaminated sediments were reported. Of these sites, less than half were addressed through remediation. Given that there are approximately 1300 sites for which RODs have been written, this finding indicates that sediment contamination might be reported, even if it is minor, for approximately 30% of the sites evaluated.

CERCLA provides one of the most comprehensive authorities available to EPA to obtain sediment clean-up, reimbursement of EPA clean-up costs, and compensation to natural resource trustees for damages to natural resources affected by contaminated sediments. Once EPA determines that there is a release, or substantial threat of a release, of hazardous substances to the environment, EPA may undertake response action necessary to protect public health and the environment and, if there is imminent and substantial endangerment to public health or welfare or the environment, compel the potentially responsible parties (PRPs) to undertake the clean-up. Liability under CERCLA is "strict," meaning the responsible parties are liable without fault, often "joint and several," meaning that they are collectively responsible for the entire cost of the clean-up, and "retroactive," meaning that liability exists for disposal that occurred prior to CERCLA's enactment. If the contamination resulted from a Federally permitted release, cost recovery is not available. CERCLA defines "hazardous substances" and lists those substances covered by the statute. Removal actions and enforcement actions can be brought at both National Priority List (NPL) and non-NPL sites.

Section 106 of CERCLA authorizes the U.S. Attorney General to secure such relief as is necessary to abate an imminent and substantial threat to the public health or welfare, or the environment, because of an actual or threatened release of a hazardous substance. A judicial action or issuance of an order under Section 106 to compel responsible parties to perform clean-ups may be appropriate. Failure or refusal to comply with the Section 106 order, without sufficient cause, subjects responsible parties to treble damages and penalties up to $25,000 a day.

Section 107 of CERCLA provides that the U.S. may recover all costs of CERCLA response actions, when not inconsistent with the National Contingency Plan, as well as damages for injury to natural resources and costs of health assessments. Liable parties are persons who owned or operated facilities from which there is a release or threatened release, or who were involved with disposal, treatment, or transport of hazardous substances. Section 107(j) provides that EPA cannot recover response costs or damages resulting from a Federally permitted release under Section 107. CERCLA Federally permitted releases include three types of releases from point sources with NPDES permits, as set out in Section 101(10)(A)-(C). Natural resource damages resulting from sediment contamination may be recovered only by the U.S., State, local and foreign governments, and Indian tribes and their members, as provided in CERCLA Section 101(16). Natural resource trustees are routinely notified of any CERCLA clean-up activity, pursuant to Section 122(j) of CERCLA, and are encouraged to participate in negotiations where natural resources under their trust may be affected. The natural resources trustees' participation in settlement negotiations is important to PRPs seeking release from liability. The natural resource trustees can grant a "covenant not to sue" if the PRP agrees to undertake appropriate actions to protect and restore the damaged natural resources.

Section 122 of CERCLA authorizes EPA to enter into settlements with responsible parties to perform response actions. Settlements negotiated under this authority generally will reflect the strength of evidence of liability, the strength of responsible party defenses, and public interest and considerations. Settlements may include compensation for, or remediation of, natural resources damages if the Department of Interior, the State, or another designated natural resources trustee is a party to the settlement.

8.2 RCRA REMEDIATION AND ENFORCEMENT

Subtitle C of RCRA provides EPA with the authority to assess whether releases from a hazardous waste treatment, storage, or disposal facility have contaminated sediments and to require corrective action, including possible remediation, if contamination is discovered. RCRA corrective action authorities apply to all releases of hazardous waste or constituents from any solid waste management unit, regardless of when the waste was placed in the unit (Section 3004(u)). EPA assesses hazardous waste facilities that have RCRA permits. These assessments are called "RCRA facility assessments" (RFAs). If an RFA suggests that a release has occurred, hazardous waste permit writers can prepare permit conditions or enforcement orders requiring facility operators or owners to conduct extensive RCRA facility investigations (RFIs) to determine the extent of any contamination. If the RFI indicates that solid waste management units at the facility caused contamination, the permit can be modified to require sediment remediation. EPA also has enforcement authority to order owners and operators of "interim status" facilities to conduct corrective action, including sediment remediation. "Interim status" facilities are those that qualified to handle hazardous waste prior to the issuance of a final permit.

Section 3004(v) of RCRA authorizes EPA to establish standards requiring corrective action for releases from a facility that have migrated beyond the boundaries of a facility (e.g., offsite sediments), where necessary, to protect human health or the environment, unless the facility's owner or operator demonstrates that he was unable to obtain access to the contaminated areas.

Section 3008(h) of RCRA authorizes EPA to issue orders requiring interim status facilities to take corrective action, or such other response measures that are necessary, to protect human health or the environment from a release of hazardous waste.

To date several facilities have been required to investigate contaminated sediments, pursuant to consent orders entered into under 3008(h) and permit conditions issued under 3004(u) and 3004(v).

Section 7003 of RCRA authorizes EPA to bring suit against persons who contributed to past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste that may present an imminent and substantial threat to human health or the environment. EPA may further order such persons to take other actions as may be necessary to mitigate the threat. This authority has already been used to enter into consent orders whereby the facility has agreed to investigate contaminated sediments.

The Office of Solid Waste (OSW) and OWPE currently use the RCRA National Corrective Action Prioritization System (NCAPS) to prioritize facilities for corrective action. They will use the information in the Site Inventory to supplement the information used for prioritization. For facilities which have not yet been ranked with NCAPS, and where it is clear that releases from a RCRA facility have caused the sediment contamination identified in the Site Inventory, such contamination

will be scored as an "observed release" for the surface water route under the NCAPS. An observed release score will often lead to the classification of a facility as high priority for corrective action. For facilities that have already received an NCAPS score, the information from the Site Inventory can be used to elevate their overall priority.

In fiscal year 1994, when the sediment bioassays and chemical criteria for Agency-wide use become available, OSW has also agreed to include them as an addendum to the RFI guidance. At present, the RFI guidance warns about potential sediment quality problems but does not recommend specific tests to evaluate the ecological and human health risks posed by contaminated sediments.

As a benchmark for the scope and magnitude of the above-described action items, RCRA remediation applies to several thousand sites across the country.

8.3 CWA REMEDIATION AND ENFORCEMENT

Section 115 of CWA directs EPA to identify the location of in-place pollutants with an emphasis on toxic pollutants in harbors and navigable waterways. EPA is authorized, acting through the COE, to make arrangements for the removal and disposal of such materials from critical port and harbor areas. The $15 million authorized by this Section has only been appropriated once, and all the funds were spent in the 1970s.

If new appropriations are made for Section 115, EPA will target the top priority harbors in the Site Inventory for Section 115 remediation. The Agency-wide consistent sediment tests will be used to select clean-up goals and monitor the effectiveness of remedial actions. Section 115 funds

will be effectively used by "piggybacking" the remediation project onto the COE's navigation maintenance projects. "Piggybacking" projects will save the costs associated with dredge mobilization and demobilization and possibly with some sediment testing. A formalized system of coordination between EPA and the COE will be required to facilitate Section 115 and "piggybacking" projects.

Section 309 of CWA authorizes EPA to commence civil action for appropriate relief, including permanent or temporary injunction, for enumerated violations, including any discharges in violation of permit limits. Given establishment of a link between the unpermitted discharge and the contaminated sediment, both Administrative orders and civil suits can require remediation in the form of the removal of illegally discharged pollutants. Enforcement actions can also encourage polluters to undertake sediment pollution removal as an environmentally beneficial expenditure in lieu of a civil penalty. Environmentally beneficial expenditures may be used in conjunction with, but not in lieu of, economic benefit penalties. Even if the sediment contamination is the result of permitted discharges, the facility may be willing to clean up in mitigation of a portion of the civil penalties or to limit possible liability under the other statutes.

Wastewater discharges are typically regulated by Section 402 of CWA. Pollutants found in wastewater discharges and nonpoint source runoff that have been designated as hazardous substances, however, are regulated under Section 311, except for Federally permitted discharges. Section 311 of CWA authorizes the President to act to remove, or arrange for the removal of, an actual or threatened discharge of oil or hazardous substances into navigable waters, adjoining shorelines or waters of the contiguous zone, or that may affect natural resources of the U.S. Section 311 can be utilized to address many of the pollutants which have accumulated in sediments.

Section 504 provides a possibility for injunctive relief if it can be shown that polluted sediments present an imminent and substantial endangerment to the health of persons, or the livelihoods of persons, whose employment might be affected by contaminated sediments. Enforcement actions under Section 504 can compel responsible parties to clean up contaminated sediment even if the contamination resulted from permitted discharges.

OW has developed guidance on how to use CWA enforcement authorities to obtain sediment remediation. Training workshops are also being held in the Regional EPA offices to teach enforcement staffs how to pursue cases of their own.

8.4 TSCA ENFORCEMENT

Unlike CERCLA and RCRA, which require clean-up of hazardous releases no matter when they occurred, TSCA does not explicitly require clean-up of regulated substances other than polychlorinated biphenyls (PCBs) if they were discharged before the effective date of the TSCA regulations requiring such clean-up. Regardless of the date of contamination, any party that removes or handles sediments containing TSCA-regulated substances must follow the regulations promulgated under TSCA for the handling of these substances.

PCB spills that occurred before the effective date of TSCA are subject to regulation under TSCA. The current draft Agency position would allow EPA Regional Administrators discretion on a case-by-case basis to assert TSCA authority over such sites. EPA Regional Administrators can

approve alternatives to incineration or disposal in TSCA-approved facilities for sediments contaminated with PCBs if the disposal is adequately protective of human health and the environment.

8.5 RIVERS AND HARBORS ACT ENFORCEMENT

The Rivers and Harbors Act of 1899 includes two provisions which the U.S., through the Department of Justice (DOJ), may use to bring enforcement actions to address sediment contamination. First, the Act provides for criminal and injunctive relief against anyone who is responsible for obstructing the navigable capacity of any water of the U.S. and for altering the condition of the channel of such waterway. Second, the Act provides for criminal and injunctive relief in response to discharges of "refuse matter" into any navigable water or tributary of a navigable water. Courts have broadly interpreted this Act to prohibit discharges other than those in compliance with a permit under CWA. The injunctive relief available under the Act includes the ability to order the removal of the obstruction or the refuse.

8.6 ENFORCEMENT UNDER CWA SECTION 311

Under CWA Section 311, as amended by the Oil Pollution Act of 1990, EPA may require responsible parties to clean up contaminated sediments resulting from oil spills and discharges. EPA may use this authority to obtain sediment remediation whenever appropriate circumstances exist.

8.7 RELATED LEGISLATION

As part of the 1987 amendments to CWA, Section 118(c) established the ARCS program to assess the extent of sediment contamination in the Great Lakes and to demonstrate bench- and pilot-scale treatment technologies for contaminated sediment. The Great Lakes Critical Programs Act of 1990 extended the ARCS program from 5 to 6 years, requiring a report to Congress in December 1993. The ARCS program is the only EPA effort specifically directed at developing innovative treatment technologies for contaminated sediment. The Superfund Innovative Technology Evaluation (SITE) program does some investigations into sediment remedial techniques, but its resources must be used to evaluate clean-up techniques for all contaminated media.

WRDA requires EPA and the Department of the Army to establish a National Contaminated Sediment Task Force with Federal, State, and private and public interest groups represented. This WRDA Task Force is charged with a number of responsibilities, including: (1) developing guidelines for the restoration of contaminated sediment; and (2) evaluating the research and development of sediment restoration methods, practices, and technologies. This WRDA Task Force will provide an excellent mechanism for promoting the use of innovative technologies in all Federal, State and private remediation projects. Through the WRDA Task Force, EPA can share the results of the ARCS and SITE programs with other interested parties and can learn about the remedial technology research performed by the other groups.

The WRDA Task Force also can assist remediation programs by reviewing and assessing the means and methods for locating and constructing permanent, cost-effective, long-term disposal sites for contaminated dredged material, as required by the statute. At the present time, one of the most

economical ways to remediate contaminated sediment is to dredge it and dispose of it in confined disposal facilities (CDFs). As current CDFs are being filled to capacity, new, long- term disposal sites are needed by both remediation programs and navigational channel maintenance programs.

8.8 COORDINATION WITH OTHER AGENCIES

Facilities of the Department of Defense (DOD) and DOE have on-site sediments contaminated with radionuclides, PCBs, metals, and other toxics. As part of this Strategy, EPA will work with these agencies on assessing their sediment quality problems and remediating the sites to appropriate clean-up levels. DOE has already entered into "Federal facility agreements" with several States and EPA to coordinate implementation of remedial actions at their facilities.

EPA will also coordinate with the Federal Interagency Sedimentation Project. Under this project, USGS, the COE, BLM, USFS, TVA, and USDA have initiated a joint effort to investigate the physical properties of sediments. These agencies are conducting research to determine the degree to which sediments trap contaminants and the timeframe for natural recovery.

EPA will continue to coordinate closely with the COE on remediation. Prior to passage of the Water Resources Development Act of 1990, the COE did not have authority to remediate contaminated sediments on its own initiative. Throughout the 1980's, however, the COE was involved in many clean-up efforts under interagency agreements with EPA (New Bedford Harbor, Commencement Bay, Waukegan Harbor, Sheboygan Harbor, Marathon Battery Site, Upper Hudson River, and others). WRDA authorized the COE to initiate "clean-up" dredging adjacent to and outside authorized Federal navigation channels as long as the projects are cost-shared with a non-

Federal sponsor. The Federal Facilities Compliance Act requires government agencies, including the COE, to meet the same standards for their hazardous waste management as nongovernmental owners/operators. The COE is therefore concerned about implementing this new authority because of questions of liability. The COE does not want to dredge contaminated sediments outside of navigational boundaries without having identified responsible parties for cost recovery. EPA and the WRDA Contaminated Sediment Task Force intend to examine liability issues in sediment remediation and try to identify ways that the COE can implement remedial actions without assuming total liability for the clean-up.

9. STRATEGY FOR DREDGED MATERIAL MANAGEMENT

Approximately 400 million cubic yards of sediment are dredged from the Nation's harbors and waterways each year (Lee, 1992). Of this amount, some 60 million cubic yards of dredged material is disposed in the ocean at sites regulated under MPRSA (Lee, 1992). The remaining dredged material is discharged in open water sites, at confined disposal facilities, and for beneficial uses regulated under CWA, as well as upland (Lee, 1992).

The COE, as the Federal agency designated to maintain navigable waters, conducts a majority of this dredging and disposal under its Congressionally authorized civil works program (Moore and Wilson, 1992). The balance of the dredging and disposal is conducted by a number of local public and private entities. In either case, the disposal is subject to a regulatory program administered by the COE under the above statutes. EPA shares the responsibility of managing dredged material, principally in the development of the environmental criteria by which disposal sites are selected and proposed discharges are evaluated, and in the exercise of its environmental oversight authority. Dredged material management activities are also subject to NEPA, as well as a number of other laws, executive orders, and State and local regulations.

Estimates by the COE indicate that a small percentage of the total annual volume of dredged material disposed, approximately three to 12 million cubic yards, is contaminated such that special handling and/or treatment is required (Lee, 1992). A number of ongoing and recently completed EPA and COE efforts affect the assessment and management of dredged material, contaminated and otherwise. The dredged material management portion of this Strategy outlines the actions of OW, in

cooperation with the COE, to continue consistent implementation of the various statutes and regulations governing dredged material management in an environmentally sound manner.

9.1 DREDGED MATERIAL ASSESSMENT UNDER MPRSA

MPRSA is the primary Federal statute governing the transportation of dredged material to the ocean for the purpose of disposal. Section 102 of MPRSA requires EPA, in consultation with the COE, to develop environmental criteria that must be met before any proposed ocean disposal activity is allowed to proceed (40 CFR 227). In 1991, EPA and the COE published a revised guidance document entitled Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual (U.S. EPA and COE, 1991), known as the Green Book or the Ocean Testing Manual, which describes the technical procedures for determining the potential ecological impacts of dredged material disposal in the ocean. The 1991 publication, which revises and replaces the 1977 edition, describes sample collection, handling and storage, physical and chemical characterization methodologies for sediment and water, and acute bioassay and bioaccumulation test procedures. Tests are conducted in a tiered-testing framework: each successive tier provides increasing investigative intensity until a determination of environmental suitability of material proposed for disposal can be made.

The Ocean Testing Manual and associated regional implementation manuals reflect the significant improvements in the state-of-the-practice of toxicology and environmental assessment since publication of the 1977 version. The manual calls for the use of more appropriate and sensitive organisms for toxicity and bioaccumulation testing to assess effects resulting from the complex mixture of chemicals present in most dredged material. An improved numerical mixing model for predicting water quality compliance at the disposal site is also included in the manual.

A recent review of the 1991 Ocean Testing Manual by SAB indicated that a number of further improvements should be incorporated into the manual (U.S. EPA, 1992e). Among these were the recommendations that EPA should: 1) revise the tiered testing approach to further emphasize reducing uncertainty as the level of tiered testing increases; 2) provide improved guidance on the interpretation of the bioaccumulation test results; 3) clarify how sediment quality criteria will be incorporated into the tiered-testing approach; 4) require testing of appropriately sensitive species; and 5) include appropriately sensitive test species measures of chronic sublethal effects.

EPA and the COE continue to conduct intensive research and development programs to further improve the assessment capability and address concerns of the SAB. The EPA consistent sediment testing methods are already being used in the dredged material testing programs. Additional guidance is also being developed on the translation of tissue residue information into ecological and human health risks. As described in the Assessment Section, the approach for using sediment quality criteria in Tier II will also be decided upon and included in revisions of the Ocean Dumping Rule and will be included as appropriate in future revisions of the Ocean Testing Manual. Likewise, improved QA/QC guidance for sample collection, storage, and manipulation of sediments for chemical analyses and bioassays is being developed and will accompany the dredged material testing manuals for both ocean and inland waters.

EPA will also improve a number of aspects of the dredged material disposal decision-making process. EPA, in consultation with the COE, is currently in the process of revising regulations regarding the transportation and disposal of dredged material in the ocean in order to update its technical and procedural aspects to reflect program experience since the last revisions. In addition, the Site and Source Inventories, under development as a part of this Strategy, may be useful in Tier I

(evaluation of existing information) of the Ocean Testing Manual to help identify potential areas of contamination and chemicals of concern to evaluate. EPA is also developing guidance regarding the use of sediment quality criteria in dredged material evaluations conducted under MPRSA.

9.2 DREDGED MATERIAL ASSESSMENT UNDER CWA

Section 404 of CWA is the primary statute governing the discharge of dredged material into waters of the United States. The Section 404(b)(1) Guidelines (40 CFR 230) are the substantive environmental criteria by which these proposed discharges are evaluated. EPA and the COE are currently developing a document entitled Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters - Testing Manual (known as the Inland Testing Manual), (U.S. EPA and the COE, 1993). The document will provide national guidance on evaluating potential contaminant-related environmental impacts of proposed discharges of dredged material into waters of the United States. The Inland Testing Manual will utilize a tiered testing approach similar to that employed in the Ocean Testing Manual and will incorporate both the SAB recommendations for improvements to the Ocean Testing Manual and additional comments provided by SAB after its review of the draft Inland Testing Manual. The Inland Testing Manual describes the procedures for evaluating dredged material required by the Guidelines, the tests to implement them, collection and preservation procedures, statistical procedures, interpretive guidance, and supporting references.

To the extent practicable, OW and the COE will maintain consistency between the testing procedures and manuals used under CWA and MPRSA to facilitate the evaluation of dredged material disposal alternatives. The draft Inland Testing Manual revises and updates with a number of technical improvements the COE's 1976 interim testing manual for inland waters. As with ocean dumping

activities under MPRSA, the Site and Source Inventories may also be useful in Tier I (evaluation of existing information) of the Inland Testing Manual to help identify potential areas of contamination and chemicals of concern to evaluate. OW will also develop guidance regarding the use of sediment quality criteria in dredged material evaluations conducted under CWA. EPA expects to publish both the Inland Testing Manual and the guidance on the use of sediment quality criteria in dredged material evaluations in 1994.

OW is also developing a proposed rule to revise the testing provisions of the Guidelines by providing for comparisons between dredged material proposed for discharge and reference sediment (U.S. EPA, 1993d). Through these revisions, EPA hopes to make a technical improvement in the testing provisions and to make dredged material testing more consistent with that conducted under MPRSA, which currently employs a reference sediment approach.

9.3 DREDGED MATERIAL MANAGEMENT ALTERNATIVES DOCUMENT

In 1992, OW, OFA, and the COE published a guidance document entitled Evaluating Environmental Effects of Dredged Material Management Alternatives - A Technical Framework (U.S. EPA and the COE, 1992). The document provides guidance for all appropriate testing, evaluation, and management activities. It is a framework for evaluating the potential environmental effects of proposed discharges of dredged material in open water and in confined disposal sites, as well as the possibility of using dredged material for beneficial purposes, such as beach enrichment. The document is designed to facilitate environmental evaluations that meet the substantive and procedural requirements of NEPA, MPRSA, and CWA, and to enhance interagency coordination and consistency

in evaluating management alternatives. The document incorporates the concepts of, and makes references to the details in, the dredged material assessment manuals discussed above.

Specifically, this Framework Document discusses the regulatory requirements of applicable statutes, the equipment and techniques employed in dredging and disposal, the general framework in which alternatives are evaluated, and the more detailed assessments for evaluating open water and confined disposal site options and beneficial use alternatives. The analysis of each of these major alternatives includes a discussion of site characteristics, physical effects or suitability of dredged material, site capacity, contaminant pathways of concern or site suitability, and management actions and contaminant control measures. The Framework Document also contains a brief section on the selection of dredged material management alternatives, which both agencies plan to expand in a future, Phase II, guidance document. EPA and the COE expect the Phase II guidance document to discuss approaches for comparing economic and environmental cost and benefits among environmentally acceptable alternatives, and to present a number of different authorities that could be used to fund more costly, environmentally preferable alternatives.

9.4 OCEAN DISPOSAL SITE MANAGEMENT AND MONITORING GUIDANCE

OW and the COE are developing a comprehensive ocean disposal site designation, management, and monitoring guidance document. Although there are a number of reference documents on the three topics, the joint EPA and COE guidance will integrate and update all aspects of site selection and management. WRDA directs that all ocean disposal sites designated prior to January 1, 1995 shall have site management plans in place by 1997, and that no site shall be designated after January 1, 1995 without such management plans.

9.5 RELATIONSHIP OF CERCLA, TSCA, AND RCRA

CERCLA, TSCA, and RCRA may all affect the management of dredged material, as discussed below.

CERCLA's program of identifying and remediating hazardous substance sites may affect dredged material management if contaminated sediments are present at the site (40 CFR 302.4). Contaminated sediment remedial actions conducted under CERCLA that involve discharges to waters of the U.S. within the CERCLA site do not require CWA Section 404 or any other Federal permit, but must nonetheless meet the substantive environmental standards of the applicable laws (Winer and Starfield, 1990; Edgar, 1985).

TSCA includes special management provisions for handling material containing PCBs (40 CFR 721). TSCA prescribes disposal by incineration that complies with 40 CFR §761.70 and placement in an approved chemical waste landfill, or by an alternate method that is approved by a Regional Administrator if contaminated sediments containing PCB concentrations of 50 ppm or greater were to be dredged. Sediments containing PCBs in these concentrations are typically not dredged for navigational purposes (Engler, 1992).

Some concern has been raised with regard to the potential regulation of dredged sediments as hazardous waste. Hazardous waste management requirements under RCRA Subtitle C apply to "solid wastes" (i.e., materials that are, or intended to be, discarded) that are listed as hazardous in EPA regulations or exhibit any of the four hazardous waste characteristics identified in EPA regulations (RCRA Section 10004(27); 40 CFR § 261.3). The person who generates a solid waste is responsible

for determining whether it is listed as a hazardous waste, and for determining whether it exhibits a characteristic, either by using knowledge of the waste or by testing (40 CFR § 262.22). The knowledge requirement involves applying knowledge of the waste in light of the materials or the processes used. The Agency has specified, by regulation, test methods for the four characteristics. The test for the toxicity characteristic is the Toxicity Characteristic Leaching Procedure (TCLP) (§ 261.24).

The COE took the position in an April, 1988 Federal Register notice that dredged material was not a solid waste and therefore not subject to RCRA authorities. The COE also contended that the TCLP is technically inappropriate for use on dredged material. Furthermore, the COE believes that MPRSA and CWA provide the appropriate regulatory regimes for dredged material.

EPA has historically taken the position that contaminated sediments are not exempt from the definition of solid waste (or from the need to determine if the sediments must be managed as hazardous waste). The most common concern has been whether sediments exhibit the toxicity characteristic as determined by the TCLP. Although current regulations specify the TCLP to be used as the test for the toxicity characteristic, EPA agrees that the Agency should investigate other test methods. OSW is reviewing alternative testing procedures for evaluating sediments. The Agency believes that it is important to recognize that sediments which were found to be toxic under CWA or MPRSA testing, have not failed the TCLP in most cases. Regions should be aware of this when deciding whether dredged materials need TCLP testing.

The Agency is also working on a Hazardous Waste Identification Rule (HWIR) which will address management standards for contaminated media, including sediments. In this rulemaking the

Agency will evaluate, as one proposal, whether adequate Federal oversight of dredged material exists under CWA and MPRSA such that further management under RCRA is unnecessary to be protective of human health and the environment.

9.6 COORDINATION WITH OTHER AGENCIES AND STATES

EPA and the COE have jointly administered the dredged material disposal provisions of CWA and MPRSA for over 20 years. During that period the two agencies have developed and revised numerous dredged material management measures, including many of the assessment procedures EPA is considering for consistent Agency-wide use as a part of this Strategy. EPA is committed to maintaining this coordination on issues such as dredged material testing and assessment, evaluation of sediment management alternatives, monitoring of disposal sites, training of field staff, and research and development activities, in order to continue to ensure that dredged material is managed in an environmentally sound manner.

EPA also has a number of Memoranda of Understanding (MOU) with the COE. These MOU define each agency's respective roles and responsibilities in administering the dredged material management programs and outline coordination procedures. Topics covered by these MOU include ocean disposal site management and procedures for handling elevations and enforcement cases under CWA. EPA will work with the COE to update existing or develop additional MOU as necessary.

Likewise, EPA is committed to a dredged material management process, through established regulatory mechanisms, that coordinates effectively with other Federal agencies, including USFWS, National Marine Fisheries Service, and National Oceanic and Atmospheric Administration, as well as

States. Consultation requirements, State certification requirements, and public notice procedures are a few of the dredged material management mechanisms that are available.

10. RESEARCH STRATEGY

ORD is committed to a comprehensive, coordinated program of research that will identify relationships between sediment contaminants and the viability and sustainability of benthic ecosystems, and ultimately will clarify how such information can be used to direct source control and pollution prevention strategies. The contaminated sediment research strategy describes how ORD intends to support the EPA program offices by undertaking research to develop: 1) methods to assess the ecological and human health effects of sediment contaminants; 2) chemical-specific sediment quality criteria; 3) sediment pollution source allocation methods; and 4) sediment clean-up methods for sites where natural recovery is not appropriate. To complete this research, ORD intends to conduct the projects discussed below as part of sediment quality research initiatives in the budgets for fiscal years 1994 and beyond.

10.1 COLLECTION OF CHEMICAL AND BIOLOGICAL DATA ON SEDIMENT QUALITY IN THE EMAP

EMAP gathers chemical and biological data on sediment quality on a regional scale. The EMAP sampling design is based on probability and covers a well-defined grid to provide unbiased estimates of resource conditions. EMAP will continue to gather sediment data from its sites in order to report national and regional trends in concentrations of organic and inorganic sediment contaminants, sediment toxicity, and macrobenthic community composition and abundance.

10.2 DEVELOPMENT AND VALIDATION OF SEDIMENT QUALITY CRITERIA

10.2.1 Development of Freshwater and Marine Sediment Quality Criteria

ORD intends to develop and validate techniques for the derivation of numerical sediment quality criteria for both marine and freshwater systems. Short-term goals include the validation of equilibrium partitioning as an approach for developing sediment quality criteria for nonionic organic chemicals. Longer-term goals include the development of tissue residue-based sediment quality criteria, sediment quality criteria for metals, and sediment quality criteria based upon human health considerations. Field and laboratory studies will be conducted with both spiked and field-collected contaminated sediments to validate equilibrium partitioning and associated tissue residue approaches for deriving sediment quality criteria for nonionic organic compounds. Similar types of studies will be performed to determine physical and chemical factors in sediments which mediate the bioavailability and toxicity of metals. Research will also be conducted to develop aquatic food chain models to predict the exposure of humans to contaminants associated with sediments.

10.2.2 Chemical Data for Development of Sediment Quality Criteria

ORD intends to determine octanol/water partition coefficients (K_{ow}s) for hydrophobic organic compounds selected for development of numerical criteria. Sorption-desorption kinetics of hydrophobic organic pollutants to and from sediments will also be investigated. This work will permit comparisons between field and laboratory toxicological data used in the development and assessment of sediment quality criteria. In addition, ORD intends to investigate mechanisms by which ionic organics absorb to sediment, and develop an approach to modelling the binding of metals to

sediments. These investigations will provide the basis for developing sediment quality criteria for ionic organics and metals.

10.2.3 Field Validation Studies for Sediment Quality Criteria

ORD has selected a variety of field sites to verify sediment criteria and other sediment assessment methods. At selected sites, contaminant concentrations, sediment toxicity, bioaccumulation, and alterations of benthic communities will be investigated along sediment pollution gradients. Levels of sediment contamination will be compared with sediment criteria to identify sites where adverse ecological effects would be predicted by the criteria. The actual condition of the benthic community, degree of sediment toxicity and bioaccumulation, and partitioning of contaminants among phases will then be compared with predicted conditions. Efficacy of sediment criteria in the field will also be verified through spiking experiments that simulate field observations under controlled laboratory conditions.

10.3 CONTAMINATED SEDIMENT ASSESSMENT METHODS

10.3.1 Biogeochemical and Transport Processes Influencing Metals Bioavailability

ORD intends to develop a prototype biogeochemical transport model for assessing porewater biological exposure to metals in sediments. This model is needed to facilitate the development of sediment quality criteria for metals. The current acid volatile sulfide (AVS) approach for assessing potential toxicity caused by sediment-associated metals is applicable to mature, quiescent sediments. An understanding of the migration of contaminants in sedimentary porewaters, however, is necessary

to decrease the uncertainty associated with use of the AVS procedure. This research will identify those situations where application of the existing AVS procedure is appropriate.

10.3.2 Exposure Assessment Modeling for Aquatic Disposal of Dredged Materials

ORD intends to conduct research to improve, verify, and expand the scope of existing models which are used for ocean disposal scenarios. ORD intends to also develop far-field models which define the movement of dredged material particulates and their associated contaminants. The models developed would provide information on water circulation, particulate movement, and contaminant transport and transformation under a variety of conditions. This information will enhance the technical basis for ocean disposal site selection and improve permitting and monitoring decisions based on site-specific physical processes.

10.3.3 Contaminated Sediment Toxicity Identification Evaluation

ORD intends to develop Toxicity Identification Evaluation (TIE) procedures for sediment contaminants. Through these procedures, interstitial water will be used as a test fraction for direct identification of chemicals responsible for acute toxicity to aquatic organisms. TIE would help guide the selection of appropriate contaminated sediment remediation strategies and augment post-remediation monitoring.

10.3.4 TMDL/Wasteload Allocation Modeling to Evaluate Contaminated Sediments and Source Control Options

ORD intends to conduct research to develop TMDL and wasteload allocation models capable of predicting the partitioning of metals, ionic organic chemicals, and hydrophobic organic chemicals to sediments. A series of models ranging from simplified spreadsheets to complex mass balance models will be designed to relate contaminant concentrations among sediment, the water column, fish, wildlife, and humans. This should allow a better interpretation and comparison of various criteria, including water quality criteria, U.S. Food and Drug Administration fish tissue action levels, region-specific fish tissue action levels, Superfund site-specific sediment clean-up levels, and sediment criteria derived by using various methods. As previously mentioned, OW has also undertaken projects to identify TMDL/wasteload allocation models to protect sediment quality.

10.3.5 Chemical Analytical Methods Development

ORD intends to develop sensitive, low cost, analytical methods to detect sediment contaminants at concentrations compatible with Federal and State water quality criteria. ORD intends to develop methods for measurement of sediment characteristics that control biological availability of chemicals in sediments. Methods would also be developed to minimize or eliminate the use of hazardous solvents and reagents, thereby both reducing the exposure of laboratory workers to these chemicals and minimizing waste which must be disposed of in accordance with RCRA regulations. Research will also be completed to develop sensitive chemical methods for analyzing metals and organics in suspended sediments. Such research may be of particular use in the NPDES permitting program.

10.3.6 Development and Validation of Acute and Chronic Test Protocols

In consultation with EPA's Tiered Testing Committee, ORD intends to develop state-of-the-science standardized protocols for assessing potential impacts of contaminated sediments on aquatic ecosystems. As noted above, the development of these tests is essential to the success of the tiered testing approach adopted by EPA as part of this Strategy. ORD will work with the EPA program offices to develop standard test protocols which can be used in a hierarchical tiered testing approach which proceeds from simple acute toxicity assessments to chronic and sublethal test endpoints. Standard culture, acute toxicity, and chronic toxicity protocols will be developed and validated for a variety of appropriately sensitive freshwater and marine benthic species. The initial group of acute whole sediment toxicity tests that are to be standardized for Agency-wide use are described in Section 5. Methods should be validated by comparing laboratory test results to in-situ impacts. Freshwater species selected for testing include benthic amphipods, chironomids, and oligochaetes, and water column cladocerans and fish species. Marine species include at least six species of marine and estuarine amphipods. Representative bivalves and polychaetes will also be considered for test method development.

10.3.7 Development and Field Validation of Bioaccumulation Test Methods

Demersal (bottom-dwelling) fishes and some benthic taxa, typically molluscs and polychaetes, have a relatively high tolerance to sediment contaminants and are able to survive in very polluted habitats. Unfortunately, such species often accumulate a high body burden of various toxic chemicals in their tissues. In consultation with the Sediment Tiered Testing Committee, ORD intends to develop standard laboratory procedures for determining the bioaccumulation potential for sediment

contaminants, and validate these methods through the use of field studies. The initial bioaccumulation tests to be developed and validated are described in Section 5.

Existing solid phase bioaccumulation protocols must be rigorously validated and the array of test species expanded to be more representative of local species at risk. Test protocols should be field validated by comparing tissue residues measured in organisms collected from selected sites with residue concentrations measured in transplanted organisms as well as in organisms exposed to the same sediments in controlled laboratory exposures. To evaluate precision, results from a variety of analytical laboratories will be compared.

10.3.8 Bioavailability and Trophic Transfer of Sediment- Associated Contaminants

Sediment-associated contaminants may pose a direct risk to wildlife and human health through the direct consumption of contaminated benthic organisms such as clams and lobsters, or an indirect risk through the trophic transfer of contaminants up the food chain into edible fish. ORD intends to conduct research on the bioavailability and trophic transfer of contaminants in sediments with special emphasis on residue levels in shellfish and higher trophic level aquatic species. Information on relationships between contaminant concentrations in sediments and higher trophic level and commercially important aquatic species will be developed. This information will help determine the classes of compounds and the conditions which warrant the generation of sediment criteria protective of human health.

10.3.9 Development of Tissue Residue Thresholds

One of the major uncertainties in assessing the effects of sediment-associated contaminants is the ecological significance of bioaccumulated compounds. ORD intends to undertake research to determine the tissue residue levels of contaminants in fish and invertebrates which result in both death and sublethal effects such as reproductive impairment. Because they rely on internal doses rather than external pollutant concentrations, tissue residue thresholds avoid the errors inherent in predicting the bioavailable fractions of sediment contaminants. Tissue residue threshold levels would be used to identify the toxic agents in sediments with multiple contaminants, derive wasteload allocations based on existing tissue residues, and generate insight into pollutant interactions.

10.3.10 Routes of Biological Exposure

All methods of generating sediment quality criteria require assumptions about the routes of biological exposure and their relative importance in relation to equilibrium conditions. ORD intends to undertake research to evaluate the importance of different routes of exposure in relation to biological variables such as feeding and burrowing behavior of organisms, chemical partitioning behavior, and sediment characteristics. It is expected that this research will produce techniques for incorporating various routes of sediment contaminant uptake by benthic organisms into the derivation of sediment quality criteria.

10.4 REMEDIATION METHODS

10.4.1 Remediation Methods for Contaminated Sediments

ORD intends to develop and evaluate a range of methods for the remediation of contaminated sediments. Methods developed should provide cost-effective solutions to the problem of sediment contamination. ORD intends to evaluate the following remediation approaches: in-situ containment, biological treatment, and metals treatment. Research into in-situ containment will focus on the capping or armoring of sediments. The mobility of contaminants through caps of differing materials will be measured in the laboratory, and hydrodynamic situations where capping or armoring is applicable will be identified. ORD also intends to investigate the modification and use of confined disposal facilities as large bioreactors to degrade contaminants. Research into in-situ treatment will be directed toward the development of technologies for the removal of metals from sediments. Particular emphasis will be given to processes that allow recovery and eventual reuse of metals.

The National Research Council's (NRC) Commission on Engineering and Technical Systems has convened a Committee on Contaminated Marine Sediments. The committee will assess the Nation's capability for cleaning up and remediating or managing contaminated marine sediments. A public NRC report on this subject will be prepared by May 31, 1995. It is expected that the NRC report will: 1) provide additional information to define and describe the nature of problems associated with contaminated sediments; 2) establish categories of contaminated sites for remedial investigation; 3) discuss relevant regulatory frameworks for contaminated sediments; 4) review state of the art of identifying and assessing sites; 5) review remediation technologies currently in use, or likely to be available in the near future; and 6) develop a decision model for one category of remediation problem

sites. EPA will carefully consider the findings of the NRC report as the Contaminated Sediment Management Strategy is implemented.

10.4.2 Resiliency and Natural Recovery of Aquatic Benthic Ecosystems

As stated in this strategy document, the preferred remediation technique for many contaminated sediment sites is implementation of source controls allowing natural recovery to occur. To assist the EPA program offices in developing criteria for determining when natural recovery is the appropriate remedial alternative, ORD intends to conduct research to determine the rates of recovery of benthic communities under different environmental conditions and stresses. Factors which control recovery rates would be identified (e.g., community type, physical factors, and types of stress). Intact benthic communities would be studied in microcosms receiving uncontaminated water; research would also include monitoring rates of recovery at selected field sites.

10.5 COMPLETION OF RESEARCH AND TECHNOLOGY TRANSFER

10.5.1 ORD Clients

In completing the research described in this Strategy, ORD will work closely with its clients to ensure that the methods, tests, and models it develops are useful to EPA program offices and other identified users of research products. ORD will draw upon the technical expertise available in other government agencies, academia, and industry. Major clients who will use ORD research products include: the EPA program offices, EPA Regional offices, the Great Lakes National Program Office, the Gulf of Mexico Program Office, National Estuary Program Management Conferences, the

Chesapeake Bay Program, and State and local regulatory agencies. In addition, other Federal agencies including the COE, NOAA, USFWS, USGS, and the United States Soil Conservation Service (SCS) will use ORD research results. ORD will coordinate its research programs with the ongoing activities of these clients.

10.5.2 Technology Transfer

ORD intends to take the following actions to ensure that the results of its contaminated sediment research programs are available to users.

1. ORD intends to sponsor, and cosponsor with the EPA program offices, workshops and training sessions on such topics as remediating contaminated sediments, use of sediment bioassays, and the use of various sediment contaminant transport and partitioning models.

2. ORD intends to publish research results in peer reviewed scientific, technical, and engineering journals.

3. ORD scientists and engineers intend to present research results at platform and poster sessions at major national and international conferences and at workshops.

4. ORD intends to work with OST to provide regulatory agencies and the regulated community with methods and protocols for assessing and remediating contaminated sediments.

11. OUTREACH STRATEGY

Outreach is a critical component of the EPA's Contaminated Sediment Management Strategy. Public understanding of the ecological and human health risks associated with sediment contamination, and of solutions to the problem, is key to successful implementation of this Strategy. OST therefore intends to initiate an outreach program in support of Strategy objectives. In implementing the outreach program, EPA will draw upon the experiences of successful outreach efforts in the Chesapeake Bay Program, the Great Lakes Program, the Gulf of Mexico Program, the NEP, EPA public-private partnership programs, and the RCRA public outreach program.

The primary goal of EPA's outreach program for this Strategy is to educate key audiences about the risks, extent, and severity of contaminated sediments, the role of the Strategy in solving contaminated sediment problems and the way in which stakeholders will be involved in Strategy implementation. The outreach program described below has four key elements: 1) defining key Strategy themes or 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.

11.1 COMMUNICATION THEMES

Four themes of the Strategy, closely linked to the Strategy's goals, will be conveyed by EPA to target audiences through outreach activities described below. The first theme is that sediment contamination comes from many sources, which must be identified, and that source control options must be evaluated according to risk reduction potential and effectiveness. The second theme is that

sediment contamination poses threats to human health and the environment. The risks must be identified and effectively communicated to the public. Third, sediment contamination can be effectively managed through assessment, prevention, and remediation. And fourth, EPA's strategy for managing contaminated sediment relies on interagency coordination and building alliances with other agencies, industry, and the public.

11.2 INTERAGENCY COORDINATION AND ALLIANCES WITH OTHER AGENCIES, INDUSTRY, AND THE PUBLIC

Communication with other Federal, State, and local agencies and industry will be an important part of EPA's outreach program. EPA's outreach program will be designed to ensure that: all agencies effectively characterize the risks of sediment contaminants; consistent assessment and sediment testing methods are applied; consistent decisions are made at the Federal, State, and local levels; and optimal use of financial and technical resources occurs.

In accordance with the requirements of WRDA 1992, EPA will convene and co-chair, with the Department of the Army, the National Contaminated Sediment Task Force. Through this Task Force, EPA will coordinate its assessment activities with the following agencies: NOAA, USGS, COE, USFWS, and the States. Through the Task Force, EPA will also propose the development of a national Federal strategy for contaminated sediment management.

EPA will also work with other Federal agencies to promote remediation and prevention practices consistent with the Contaminated Sediment Management Strategy. These agencies will include USDA, U.S. Department of Transportation (DOT), DOD, and DOE. EPA will develop

memoranda of understanding and agreement with these and other agencies to promote these practices.

11.3 TARGET AUDIENCES FOR OUTREACH

To effectively implement the outreach plan, EPA will seek to communicate with large and highly diverse audiences, educate and involve the general public in EPA's decision-making processes, and target information to both broad audiences as well as subgroups within those audiences. In designing and targeting its outreach messages, EPA will determine the information needs of each audience by assessing the extent of its knowledge about the topic. The positions and concerns of the audience about the topic will be determined as well as the audience's level of interest, and methods to increase interest and attention will be developed. It will be necessary to determine whether the primary purpose of EPA's message is to inform the audience, change its attitude, or to encourage the audience to take action.

The audiences that EPA will target to receive its outreach materials and messages are be categorized as follows:

1. The general public.

2. Environmental and public interest groups.

3. The scientific community, including academia, laboratories, and professional societies.

4. Congressional representatives and government groups.

5. Federal agencies, including the COE, DOE, DOD, DOT, USDA, and other agencies whose policies and operations directly contribute to the Strategy or affect its goals.

6. State and local agencies.

7. EPA Regional and Headquarters personnel.

8. The regulated community, including businesses and industrial trade associations.

9. News media, including printed media, television, radio, trade and industry journals, and environmental magazines.

11.4 OUTREACH ACTIVITIES

Outreach activities to support implementation of the Strategy will be coordinated by OST, but will include actions taken by a number of different EPA program offices.

11.4.1 Regulatory Actions and Guidance Documents

EPA intends to prepare guidance documents and reports in support of the Agency's regulatory and nonregulatory requirements for contaminated sediment assessment, prevention, and remediation. Guidance documents and reports will focus on issues such as sediment quality assessment

methodologies, sediment toxicity testing methods, use of sediment quality criteria, and assessment of human health and ecological risks of sediment contamination. EPA's initial outreach efforts will focus on preparation of the following guidance documents and reports:

1. OST and ORD intend to prepare guidance documents on methods to be used by all EPA program offices in conducting standardized sediment toxicity tests. Such guidance will address acute and chronic bioassays and bioaccumulation tests.

2. OST will prepare guidance documents on evaluating and selecting techniques for remediation of contaminated sediment. ORD and other EPA offices intend to develop guidance documents on technologies for contaminated sediment remediation.

3. OWM intends to develop guidance for deriving NPDES permits that protect sediment quality.

4. OST intends to prepare guidance for development of mixing zones for NPDES point sources to protect sediment quality.

5. EPA intends to develop guidance for nonpoint source controls to help prevent sediment contamination from nonpoint sources of pollution.

6. OW, in conjunction with the COE, intends to develop national guidance on testing of dredged materials for disposal in inland waters, and will revise existing guidance on testing of dredged materials for ocean disposal.

7. EPA intends to develop guidance on regulatory and associated enforcement actions to address contaminated sediment source control and remediation.

8. OST intends to develop guidance on designing and implementing monitoring programs for sediment contaminants.

9. EPA intends to develop guidance for trade associations on pollution prevention issues, including the contamination of sediments from point and nonpoint sources of pollution.

10. EPA will produce a Report to Congress on the Site and Source Inventories as required by WRDA 1992.

11. EPA will produce a Report to Congress on the Great Water Bodies Study on the effects of hazardous air pollutants. This report will include information on the known effects of air pollutants on sediment quality.

12. EPA will produce a Report to Congress on the activities of the National Contaminated Sediment Task Force required by WRDA 1992.

11.4.2 Outreach Publications

EPA intends to prepare outreach publications and support other agencies in developing their own technical and general audience publications on sediment contamination. EPA intends to 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 problem solutions related to sediment contamination. These materials would be distributed through advertising in bulletins such as the Contaminated Sediments News or at public meetings, workshops, and national conferences on pollution prevention or contaminated sediment.

11.4.3 Advisory Groups, Databases, Clearinghouses, and Other Activities

EPA intends to take the following actions to establish advisory groups, databases, clearing houses and other programs in support of the Contaminated Sediment Management Strategy:

1. EPA intends to maintain the Sediment Steering Committee to oversee implementation of the Agency's Contaminated Sediment Management Strategy. In this role the Committee will track and monitor all aspects of strategy implementation. A report will be developed to document Agency-wide activities and will be distributed to the public on a regular basis.

2. As described in this strategy document, EPA intends to prepare both Site and Source Inventories for contaminated sediments. These data will be made available to the public and reports to Congress will be prepared on a biennial basis.

3. EPA intends to regularly sponsor conferences on contaminated sediments.

4. EPA intends to hold a series of workshops for the public to educate them about the risks of sediment contamination.

5. EPA intends to submit scientific and technical guidance and related materials to the SAB for review. SAB reviews will be announced in the Federal Register as well as other relevant EPA publications.

11.5 OUTREACH PRINCIPLES

EPA recognizes that implementation of the Contaminated Sediment Management Strategy must be a partnership among many organizations. EPA will therefore adopt a number of principles to implement its contaminated sediment management outreach program.

1. EPA will involve the public, including the private sector as well as the general public, as early as possible in the strategy planning process. Community participation will be emphasized.

2. EPA will clearly state its expectations for sediment clean-up efforts at the outset of program implementation. Issues such as cost, the time frame for clean-up, and how local situations compare to sediment clean-up efforts nationwide will all be addressed in the initial planning stages of clean-up efforts.

3. EPA will focus on "keeping the momentum" going with respect to citizen involvement. Short term goals will be created to highlight accomplishments.

4. Wherever possible, EPA will tie the issue of sediment contamination to tangible effects such as fish consumption advisories.

5. EPA will demonstrate the Agency's commitment and accountability to sediment management efforts through consistent involvement of the public in reviewing major actions under the Strategy.

6. EPA will utilize existing information networks and communication systems as mechanisms for public involvement and information dissemination.

7. EPA will provide guidance, information, and support to the States but will, where possible, allow the States flexibility in making decisions and adapting the outreach information to local conditions.

8. EPA will prepare written materials and guidance on sediment contamination, but will also use workshops and face-to-face contact in disseminating information.

9. EPA will provide the public with a balanced risk framework that is understandable and includes information about comparative risks.

10. EPA will provide public information at a level of detail that allows the public to formulate decisions.

11. EPA will work toward building consensus among all of its audiences.

12. EPA will work toward developing a management framework of institutions that will be self-sustaining and will carry the work of sediment management into the future.

12. CASE STUDIES

Well-documented cases of human health and ecological effects caused by sediment contamination have been published in the peer-reviewed literature. This appendix contains a few case examples that reflect both human health and ecological effects that may be expected at sites where severe sediment contamination is evident.

12.1 CASE STUDIES OF HUMAN HEALTH RISKS

For the purposes of this Strategy, risk is defined as the probability of harm or likelihood of an adverse consequence or effect caused by the presence of contaminants in the environment. Various EPA programs have different acceptable risk levels, generally ranging from 10^{-4} to 10^{-6}; therefore "unacceptable risk" determinations must be made on a program specific basis.

In 1987, EPA completed a study entitled Unfinished Business: A Comparative Assessment of Environmental Problems (U.S. EPA, 1987b). Toxic chemicals in sediments, included as a category of nonpoint source pollution, were ranked as the eleventh most significant environmental problem of thirty-two identified in the report. In 1989, EPA Administrator William Reilly asked the SAB to review "Unfinished Business." The SAB is a public advisory group that provides scientific information and advice to EPA. In a report entitled Reducing Risk: Setting Priorities and Strategies for Environmental Protection, SAB supported EPA's ranking of the human health risks posed by contaminated sediments (U.S. EPA, 1990b). In this report, SAB indicated that cancer and non-cancer illnesses can be caused by bioaccumulation of toxic chemicals from sediments in fish and shellfish which are then consumed by humans. Both EPA and SAB gave contaminated sediments a medium

risk score as a causative agent of non-cancer illnesses. SAB judged that consumption of contaminated fish posed a low cancer risk, but noted that bioaccumulation in fish of chemicals in contaminated sediments was the primary route of human exposure to carcinogens in surface waters.

In comparative risk analyses performed by EPA Regions I, II, III, V, and X, sediment contamination was given a medium-high score for cancer risks to consumers of fish and shellfish (U.S. EPA, 1989b). Since actual risks may be higher for certain ethnic groups due to fish consumption patterns, environmental equity concerns have been raised in certain parts of the country. In 1993, there were 1280 waterbodies with fish consumption advisories in the United States, with sediments identified as a potential source of contamination at many sites.

12.1.1 Quincy Bay and New Bedford Harbor, Massachusetts

In June 1988, EPA released a report, completed at the request of Congress, entitled Assessment of Quincy Bay: Summary Report (U.S. EPA, 1988b). 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, polycyclic aromatic hydrocarbons, and metals were elevated in sediments and in the marine species studied. Winter flounder and soft-shelled clams were found to exhibit an extremely high incidence of conditions believed to be associated with environmental stress: cancerous lesions; liver, intestinal, and pancreatic pathologies; and neoplasms.

The human health risk assessment concluded that regular consumption of tomalley (hepatopancreas) from Quincy Bay lobsters posed a high cancer risk comparable to risks reported in the case studies described below for Upper New York Harbor or Lake Michigan. The maximum upper bound estimated lifetime cancer risk for the maximally exposed individual consuming a mixed diet of clams, flounder, lobster meat, and lobster tomalley from Quincy Bay was calculated to be 2.3 x 10^{-2} (U.S. EPA, 1988b). The lifetime cancer risk of a typical local consumer of the same mixed diet was calculated to be 1.3 x 10^{-3} (U.S. EPA, 1988b).

At the New Bedford Harbor Superfund site in Massachusetts, PCB concentrations in sediments range from a few parts per million (ppm) to over 100,000 ppm. PCB levels as high as 10 ppm in fish tissue have been measured in certain areas at the site; 10 ppm is five times the FDA's action level of 2 ppm for PCBs. Thousands of acres have been closed to the harvesting of shellfish, finfish, and lobsters since New Bedford Harbor's appearance on the National Priority List (NPL) in 1982. Many individuals regularly consumed seafood from the area before the extent of contamination was known, however, and some residents still harvest both finfish and shellfish for personal consumption.

A human health risk assessment was conducted for consumption of lobster, flounder, and clams using an 8 ounce meal size (pers. comm. with G. Garman, 1993). PCB levels in edible lobster tissue (including tomalley) of 2.3 ppm produced a lifetime cancer risk of 1 x 10^{-2} for weekly consumption (52 meals/year) and 2.5 x 10^{-3} for monthly consumption (12 meals/year). PCB levels in flounder tissue of 0.37 ppm produced a lifetime cancer risk of 1.7 x 10^{-3} for weekly consumption and 3.9 x 10^{-4} for monthly consumption. The fish were taken from an area of intermediate contamination.

PCB levels in clam tissue of 0.23 ppm produced a lifetime cancer risk of 1.1×10^{-3} for weekly consumption and 2.4×10^{-4} for monthly consumption.

12.1.2 Puget Sound, Washington

Another comprehensive study was completed on consumption of seafood taken from Puget Sound (Puget Sound Estuary Program, 1988). A high background incidence of cancer was observed and it was determined that 25% of the individuals in the Puget Sound region would develop cancer during their lifetimes. The health risk assessment predicted that two additional cases of cancer would be added to the 2500 cases expected per 10,000 individuals consuming an average quantity of seafood (a risk level of 2×10^{-4}), and 40 additional cases of cancer would be added to the 2500 expected per 10,000 individuals consuming a large quantity of seafood (a risk level of 4×10^{-3}). The principal carcinogens identified in this study were PCBs in fish and polycyclic aromatic hydrocarbons in seaweed.

12.1.3 Los Angeles-Long Beach Harbor, California

Following a risk assessment analysis of toxic contaminants in fish, the California Department of Health Services issued a health advisory concerning the consumption of local sport fish from the Santa Monica Bay, Palos Verdes Peninsula, and Los Angeles-Long Beach Harbor areas (Gossett et al., 1989). Sediments in these areas are contaminated with PCBs, DDT, and DDT metabolites which were discharged in the 1960s and early 1970s. Analysis showed that the bottom-feeding white croaker was particularly contaminated, and that cancer risks to the population consuming white croaker were significantly higher than levels generally considered to be acceptable (cancer risk levels

on the order of 10^{-3} to 10^{-4} were calculated). In the Los Angeles area, significantly higher levels of DDT and its metabolites were found in the blood serum of local and sport fishermen who ate their catch than in the blood serum of nonconsumers.

12.1.4 Lake Michigan

In the mid-1970s, PCB levels as high as 20 ppm were found in fish from Lake Michigan (Swain, 1992). Human exposure to PCBs was determined using data from extensive epidemiological studies of two matched cohorts of exposed individuals (Swain, 1988). One cohort consisted of sport anglers and the other cohort consisted of mothers and their newborn infants. These groups were exposed to significant quantities of PCBs from consumption of contaminated freshwater fish from Lake Michigan.

A 1974 study of 178 adult sport anglers showed that the longer the period of time during which anglers consumed fish from Lake Michigan, the higher their PCB body burdens (Swain, 1988). A study of 991 adults in 1982 showed that persons consuming fish from Lake Michigan had higher PCB body burdens than did non-fish eating individuals (Humphrey, 1987). Risk analyses were not performed as part of these studies.

A study of mothers and their newborn infants showed that as the period of time over which fish was consumed from the lake increased, so did the mothers' body burdens of PCBs (Swain, 1988). Exposed mothers were found to have increased levels of PCBs in whole blood serum and breast milk. The higher the PCB body burdens, the more intense were the effects exhibited by the infants (Fein et al., 1984; Jacobsen and Fein, 1985). Infants of highly exposed mothers were born at

reduced birth rates and reduced gestational ages, had smaller head circumferences, and exhibited neuro-motor effects.

12.1.5 New York

The New York Department of Environmental Conservation's Clean Water Act Section 304(l) List states that contaminated sediments cause more than 20% of all river miles in New York to fail to meet their designated uses under CWA authority. Many of New York's major rivers are affected, including the entire 38 mile length of the Niagara River, the entire 109 mile length of the St. Lawrence River lying in New York, and the entire 180 mile reach of the Hudson River from Fort Edward in the Upper Hudson to the Battery at Manhattan. About 30,000 acres (90%) of New York's lakes are also a problem for fish consumers, due primarily to PCB contamination. Other sediment contaminants identified include DDT, chlordane, and mercury. Fish consumption advisories or bans have been issued for several or all species at each site.

12.1.6 Pago Pago, American Samoa

In 1991, the American Samoan government issued a public health directive instructing the public not to eat any fish or shellfish caught in inner Pago Pago Harbor. A ban on the sale of fish from the inner harbor was also issued. The directive was based on the results of a study which examined chemical concentrations in water, sediment, and fish (American Samoa Department of Health, 1991). Sediments were reported to be highly contaminated with PCBs, oil and grease, and heavy metals.

EPA Region IX analyzed the data for health risks and identified the following risks of greatest concern: 1) Potential brain damage. If lead contamination alone were considered, lead concentrations in fish could reach levels that would cause 70% to 80% of children who regularly eat 3 to 4 fish meals per week to suffer a permanent reduction in intelligence. 2) Increased cancer risk. Consuming fish from the inner harbor at a rate of 3 to 4 fish meals per week over a lifetime would significantly increase the risk of cancer due to arsenic contamination. 3) Increased non-cancer health risks. Using a hazard index in which non-cancer health risks occur at levels greater than a value of "1", EPA Region IX calculated the hazard index at 1-3 for adults consuming inner harbor fish and at 2-3 for children consuming inner harbor fish (Baker, 1993).

12.2 CASE STUDIES OF ECOLOGICAL EFFECTS/RISKS

In the SAB and EPA Regional comparative risk studies, contaminated sediments received a high score for their potential to cause adverse ecological effects on both local and regional scales. The studies also determined that the "recovery period" for areas with sediment contamination may be decades or longer. Several documented cases of adverse ecological effects due to contaminated sediments are presented below.

12.2.1 Elizabeth River, Virginia

The Elizabeth River is a sub-estuary of the Chesapeake Bay and is heavily contaminated with a variety of pollutants, particularly polycyclic aromatic hydrocarbons (PAHs). Sediment gradients of PAHs were measured in the following studies: Hargis et al., 1984; Bieri et al., 1986; and, O'Connor and Huggett, 1988. Examination of benthic communities in the Elizabeth River suggests that

contaminated sediments have adverse effects. Uptake of organic compounds in fish has been observed by assaying bile from exposed fish. Bioaccumulation of PAHs 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 (mainly Leiostomus xanthurus, spot) have been correlated with the extent of sediment contamination (Van Veld et al., 1990). Laboratory studies have been conducted to elucidate whether the sediments were responsible for the observed effects (Van Veld et al., 1990). 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.

12.2.2 Commencement Bay, Washington

Field and laboratory studies were the basis for a comprehensive assessment of ecological risks caused by toxic sediments in Commencement Bay (U.S. EPA, 1993e). Using amphipod and oyster larvae bioassays, investigators determined that sediments from 24 of 52 stations caused significant toxicity compared to a reference area. Benthic infauna measurements were also used to determine chronic effects. This investigation was the basis for one of the case studies reviewed by EPA's Ecotoxicity Subcommittee charged by the Agency's Risk Assessment Council with responsibility for the development of ecological risk assessment guidelines.

12.2.3 Great Lakes

In the Great Lakes, PAH contamination of sediments has been linked to increased incidence of tumors in certain fish (Baumann, 1989). Brown bullheads from the industrialized Black River in Ohio exhibited higher levels of organic contaminants, particularly PAHs, and a higher incidence of skin, liver, and lip tumors than bullheads taken from a nearby reference site (Baumann et al., 1987). By applying criteria established for human epidemiology studies to the data from numerous reports on the Black River, a cause and effect relationship can be determined between the presence of PAHs in the sediment and the occurrence of liver cancer in native fish populations (Baumann et al., 1987).

Also in the Great Lakes region, organochlorine contaminants have been linked to reproductive problems in Forster's tern and to reproductive failure and mortality in mink. The reproductive success of Forster's terns inhabiting contaminated Green Bay on Lake Michigan was significantly lower than that of terns inhabiting relatively uncontaminated Lake Poygan in Wisconsin (Kubiak et al., 1989). Reproductive failures have been linked to intrinsic factors (e.g., egg viability) and extrinsic factors (e.g., parental attentiveness), both of which are affected by sediment contaminants. Reproductive problems in mink were first reported in the 1960s at mink farms that fed the mink Great Lakes fish; high levels of PCBs in the fish were identified as the cause (Auerlich et al., 1973). These two examples are indicative of the risks to fish-eating birds and mammals posed by a PCB-contaminated food chain, and may provide clues to explain why certain fish-eating birds and mammals may have disappeared or become rare in ranges where they were historically found.

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