ISSUES RELATED TO THE ASSESSMENT AND RESOLUTION OF PROBLEMS ASSOCIATED WITH CONTAMINATED SEDIMENT

U.S. ENVIRONMENTAL PROTECTION AGENCY
SEDIMENT STEERING COMMITTEE

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1. INTRODUCTION

Aquatic sediment traps and holds many pollutants entering surface waters. When present at elevated concentrations in bioavailable forms, pollutants in sediments can have long-term adverse impacts on the biota that normally live in these habitats and on the quality of overlying waters. In turn, the beneficial uses of entire water bodies may be affected. Toxic sediments prevent a balanced population of aquatic life, and pollutants in sediments may be bioaccumulated and transferred up the food chain causing human health problems when contaminated fish are eaten. Pollutants in sediments may slowly leach into the water column, restricting the water's use as a drinking water supply and extending the area of contamination far downstream. These considerations have not been commonly used as part of the U.S. Environmental Protection Agency's pollution control programs, primarily because the tools and understanding necessary to prevent sediment contamination or to remediate sediments have thus far not been available. Recent advances have occurred as a result of studies of aquatic sites by EPA Superfund (New Bedford Harbor, Massachusetts), EPA Great Lakes National Program Office (Green Bay, Wisconsin), EPA Office of Research and Development (Trenton Channel/Detroit River, Michigan), the State of Washington (Puget Sound), and others.

The Office of Water Regulations and Standards, Criteria and Standards Division, is developing sediment quality criteria based on chemical-specific and toxicity testing methods that might be used in a variety of regulatory settings. The sediment quality criteria would be based on cause-effect relationships rather than on the mere presence or total concentration of a particular contaminant, which has been the approach typically used in the past. The question is not whether the contaminant is there but, rather, whether it is having an unacceptable adverse impact. The EPA Science Advisory Board is reviewing the proposed methods for deriving sediment quality criteria to ensure that they are scientifically correct. Under the Clean Water Act (CWA), sediment quality criteria are analogous to water quality criteria in that the value of a criterion for a pollutant or toxicity is set at a level that protects aquatic organisms and human health from adverse effects. Under the CWA, water quality criteria and sediment quality criteria could be used in the same way: if chemical-specific or toxicity criteria are exceeded, some type of action is required to return the environment to an acceptable state. Appropriate actions might include reduction of point source and nonpoint source discharges through application of total maximum daily loads and waste load allocations, identification and control of nonpermitted discharges, or sediment remediation.

Sediment quality criteria in concert with other assessment methods might also be used in additional ways - in determining the acceptability of dredged material for aquatic disposal, or in determining (in part) whether remediation or corrective action is necessary for contaminated sediments. If remediation is deemed necessary, meeting sediment quality criteria might serve as one of the cleanup goals. The use of criteria in these settings and the way that criteria are derived give rise to the major issues that are discussed below.

This document outlines a general procedure for dealing with contaminated sediments, indicates the Federal statutes relating to the activities that comprise the procedure, and discusses implementation issues as they relate to the activities and environmental laws.

2. GENERAL PROCEDURE FOR CONTAMINATED SEDIMENTS

A general procedure for dealing with contaminated sediments is outlined in the following subsections. In this procedure, it is assumed that the objective is to find contaminated sediments, evaluate the level of contamination, and remediate sediments when contamination is deemed excessive. There is also another way in which issues on contaminated sediments can arise - navigational dredging - and the disposal of sediments dredged for navigational purposes. These issues are special considerations in the remediation and disposal of contaminated sediments, and are covered under those topics. The procedures the U.S. Army

Corps of Engineers (COE) use to evaluate dredged material have some of the same elements of the general procedure presented here. However, the COE procedures are limited to the case of determining disposal options for sediments. The COE procedures do not address the issues of prevention of sediment contamination or determining the need to take remedial actions when the sediments are not slated for dredging.

The rationale for the general framework is described in the following subsections. It is designed for two purposes: 1) to isolate specific activities that are necessary if contaminated sediments are to be addressed by EPA programs, and 2) to structure the approach to contaminated sediments by concentrating effort on the most contaminated sediments. The steps involved are diagrammed in Figure 1 and are outlined below.

1. Locate areas where contaminated sediments might occur

2. Determine whether possibly contaminated sediments are in fact contaminated and to what degree

3. Control discharges or releases of contaminants to the environment that contribute to sediment contamination

4. Remediate (reduce the level of contamination) of contaminated sediments when appropriate, and

5. Dispose of contaminated sediments if the best remediation action is removal (or if they are being dredged for navigational reasons).

These activities are discussed in the following subsections.

2.1 Locating Potentially Contaminated Sediments

Contaminated sediments can occur in all parts of the country and in all types of aquatic environments. Since most regulatory programs have focussed on water quality rather than sediment quality, however, there are few data that adequately characterize the sediments of most water bodies. Data that do exist typically consist of only bulk sediment chemistry, without bioavailability information, or are limited scope (geographic coverage, numbers of samples). The COE has a large volume of sediment data for navigational channels that they maintain. However, these data are limited to navigational channel sediments and often represent only bulk sediment chemistry, not bioavailability. Although there are exceptions in some parts of the country where efforts are underway to adequately characterize the distribution of contaminants and their toxic and bioaccumulative effects (the Great Lakes and Puget Sound for example), in most parts of the country the data are not adequate for assessing the environmental problems posed by contaminated sediments. In the absence of adequate data, it is necessary to determine areas where sediment contamination may occur in order to target areas for sampling and contamination assessment.

EPA's authorities to search for contaminated sediments reside in one of three environmental statutes: the CWA, the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Under each of these statutes, EPA or delegated agencies can actively determine the quality of the environment. In fact, continuing activities in programs authorized by these acts have generated significant amounts of data that can now be used to locate potentially contaminated sediments.

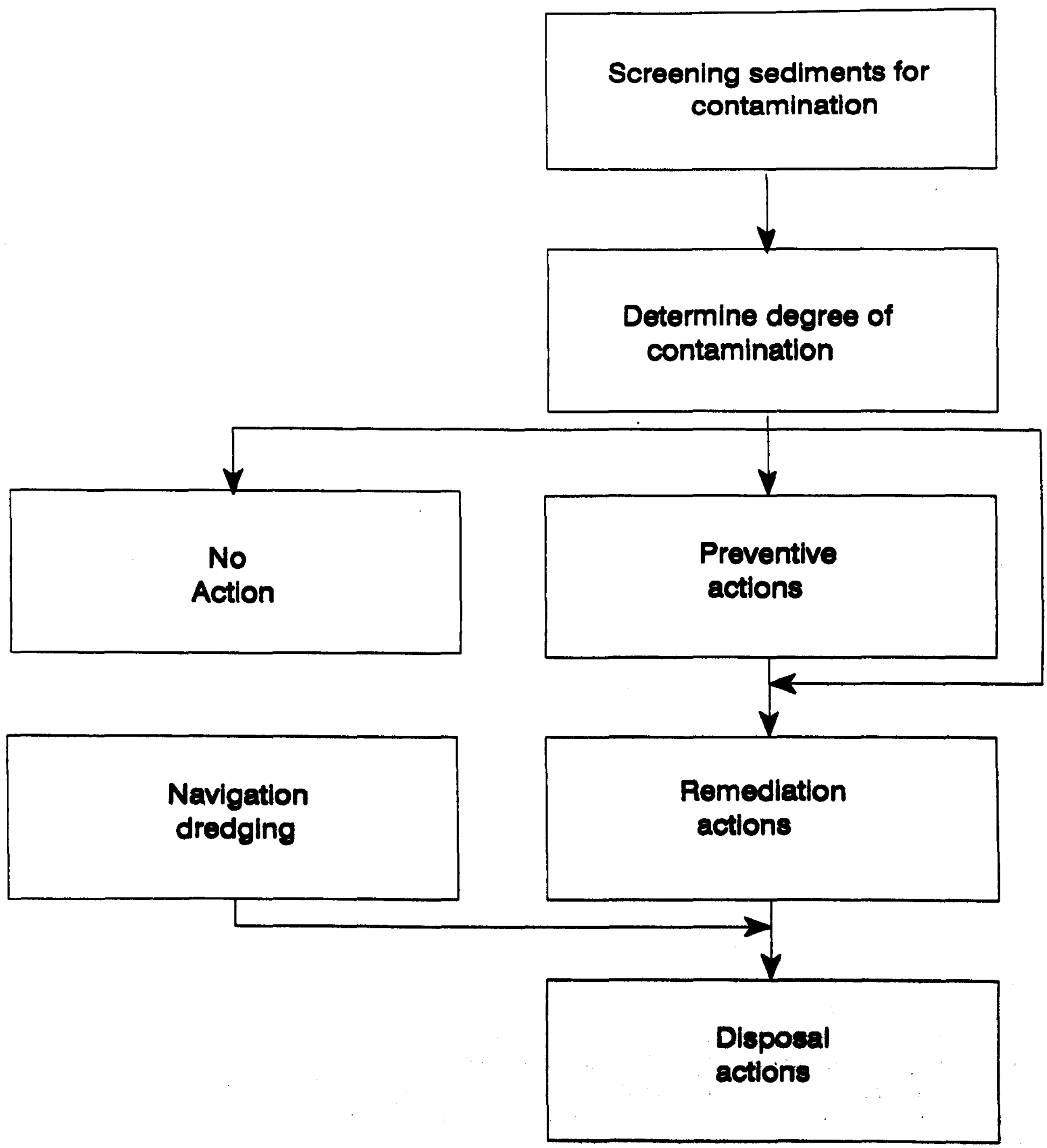

Figure 1. General procedure for handling contaminated sediment.

Under the CWA, States are required to report on environmental quality. The biennial §305(b) reports prepared by States contain information on water bodies that are not meeting State Water Quality Standards or are not supporting beneficial uses designated for them. The Nonpoint Source Assessments required by §319 also contain information on non-attainment including information on fish kills, fish consumption health advisories, shell fish bed restrictions, algal blooms, spills, and other environmental problems. §304(l) requires States to report on waters that do not meet standards due to toxic discharges. It can be presumed that waters exceeding standards or not meeting use designations potentially have contaminated sediments. §115 calls for EPA to identify the location of contaminated sediments ("in-place toxic pollutants") and work through the COE to remove them from critical port and harbor areas.

RCRA and CERCLA programs also have data that can be used to indicate where sediment contamination may exist. Aquatic sites on CERCLA's National Priority List (NPL) obviously have documented sediment contamination. Other locations or water bodies have been identified for Superfund evaluation, but may not have been added to the NPL, have not yet been evaluated, or may not have contaminated sediments. Similarly, detected releases from solid waste management units (SWMUs) at RCRA-permitted treatment, storage, or disposal facilities (TSDFs) may have resulted in sediment contamination. Solid waste programs may be able to provide information on locations where such releases have occurred.

The data sources listed above can be used to identify the most likely locations of possible sediment contamination. Other information that is not routinely reported or recorded by EPA can also be used to indicate possible locations with sediment contamination. Declines in fish catches recorded by State natural resource or fisheries agencies; health department advisories against fish or shellfish consumption; water contact or consumption; or public complaints about water quality all may indicate some level of sediment contamination. Reports of fish deformities often coincide with sediment contamination.

Even if these data sources do not indicate the possibility of sediment contamination, large cities and industrial areas often generate sediment contamination problems from storm water or combined sewer discharges. Water bodies receiving these discharges are usually suspect.

Compiling these data allows an assessment of potential sediment problems for a watershed, State, or region of the country. Actions to be taken depend on other considerations, such as the level of contamination and the contaminants. These considerations are presented in the next subsection.

2.2 Evaluating Contamination

Once locations that might be contaminated have been identified, more detailed information is generally required to determine the nature and extent of the contamination and its potential impacts. The information is used to determine the severity of the contamination and whether action should be taken to alleviate adverse impacts on human health or the environment. Possible actions are authorized by each of the environmental statutes, each statute relating to specific types of facilities, specific types of pollutants, or specific types of adverse effects. Often these statutes require certain actions under certain circumstances. The requirement for action implies that criteria must be available to decide when the action is necessary, but it must be recognized that sediment (or water) quality criteria (or assessment procedures) may be only one of the factors that is considered before actions become mandatory.

Evaluating contamination is a step-wise process that proceeds from identifying changes in biota, toxicity, bioaccumulation, or pollutant-by-pollutant contaminant levels and their distribution in the sediment; to calculating the risks to human health and the environment; to comparing toxicity, bioaccumulation, or human health risks with criteria developed to measure the acceptability of contaminant levels and risks. If numerical or biological criteria are exceeded, some action may be needed to alleviate the negative impacts associated with one or more of the pollutants. The nature of the action, however, depends on the magnitude of the exceedence, the nature of adverse effects experienced, and sometimes on the costs of possible actions. These are discussed more fully in the following sections.

A tiered approach to evaluating contamination is important because full characterization of sediments is a significant and potentially avoidable expense. Using quick, inexpensive methods, the general "health" of the sediments can be determined. Only if there is presumptive evidence that sediments are contaminated should the next, more expensive tier be used. Such a tiered scheme might rely on available information such as fish or shellfish consumption advisories, fish kills, and water quality standards exceedences at the lowest level; chemical characterization of sediments and comparison with sediment quality criteria at the second level; toxicity testing and measurement of bioaccumulation at the third level; and complete bioassessment and toxicity characterization at the highest level. Decision points for proceeding from one tier to the next rely on presumptive evidence that significant environmental or human health risks exist at the site. At the lowest level, for example, extensive fish deformities and health advisories can be taken as strong evidence that the sediment may be contaminated. At the highest tier, it may necessary to fully characterize the biota, all pollutants, and to determine relative contributions of significant pollutants to overall sediment toxicity so as to focus on specific contaminant sources that may need to be controlled.

Existing regulatory programs already use similar tiered approaches to environmental actions. In the dredged material programs covered by the Marine Protection, Research, and Sanctuaries Act (MPRSA), open-water disposal is permitted without further testing if there is no presumptive evidence that the sediment is contaminated. Thus, if sediment is removed from a clean water body segment, no further testing is required before it can be disposed of in an aquatic environment. On the other hand, if discharges are present in the segment, chemical analyses and toxicity testing may be required to determine whether potential hazards preclude its disposal in open water. Specific published criteria simplify the decision-making in these programs, although the availability of sediment quality criteria may change the way in which existing criteria are used.

Since criteria are often used in decision-making, it is often presumed that sediment quality criteria values will have a strong and direct relationship to all EPA programs. In the short term, this may not be the case. While sediment quality criteria and assessment methodologies can be seen to be a "trigger" for preventive action under the CWA, they may most likely serve as a benchmark in most other EPA programs (see below). Nevertheless, the greater the exceedences of the criteria, the more pressure there will be for other programs to take corrective action on contaminated sediments. Some of the actions that can be taken are described in the next two subsections.

2.3 Preventive Action

There are two major options available to improve environmental quality when contaminated sediments are encountered: let nature take its course to cover up contaminated sediments with cleaner sediments, the "no action" alternative, or undertake remedial action. In either case, some form of input source control is generally necessary in order to prevent further sediment contamination. Source control is important whether or not the sediments are remediated. Since natural sedimentation may provide a "cap" to the sediments, reducing bioavailability and transfer of contaminants to the water column, source control may be sufficient to attain acceptable environmental quality. Similarly, sediments may need to be dredged for navigational purposes where sediment contamination presents a disposal problem, and source control may simplify disposal issues by reducing levels of contamination.

Preventive actions can be taken under essentially all environmental statutes, but the most direct preventive measure is to further reduce point source inputs through water quality-related effluent limitations under the CWA. There may be situations where point sources are meeting best available technology (BAT) and water quality-based permit conditions in urban areas, but the resulting loadings are still causing sediments to exceed sediment quality criteria. There may be other cases where even though the individual dischargers are in compliance with sediment and water quality criteria, sediment quality problems are being caused at some distance downstream in depositional areas. There may also be situations where numerical sediment quality criteria are being met for individual chemicals, yet the combined (synergistic) effects result in toxicity to benthic organisms. In these cases, even more stringent effluent limitations may be needed. In addition, existing methods to perform wasteload allocations need to be extended to include sediment/water/biota interactions. Storm water outfalls and combined sewer overflows (CSOs) may also be contributing significantly to sediment contamination and may need to be targets for reduction. Nonpoint sources may also have to be address, particularly outside of urban areas. This becomes problematic in agricultural areas that are not controlled under the CWA. Nonpoint source controls may also be weak, depending on the State, so progress may be difficult to achieve. In some parts of the country, such as the Great Lakes, atmospheric loadings are a major source of pollutants including chlorinated organics and metals. In this case, controls under the Clean Air Act (CAA) would also be appropriate, including source controls on emissions at great distances from the receptor watersheds.

Under RCRA, releases of hazardous materials from TSDFs can be controlled under corrective action provisions when materials contaminate surface water. At Superfund sites, corrective action may include isolating a site to reduce ground water input to water bodies, or surface runoff from the site can be controlled through berms and other physical structures.

When contaminants are demonstrated to be widespread, even though criteria may be exceeded in only a few places, actions that are more regional or national in scope may be taken. Under FIFRA, the use of a biocide can be regulated to limit its use or the conditions under which it is used. Application near surface waters is a common restriction for many biocides under FIFRA, and more extensive restrictions may be necessary, for example, for heavily used agricultural biocides that have contaminated sediments. Under TSCA, specific chemicals such as PCBs can be banned from production and use when it is demonstrated that they have pervasive adverse effects on the environment. Under the CAA, emissions of contaminants that enter surface waters from the air can be controlled, either at a State or national level. Each of the actions under these statutes are less likely to be taken than those under the CWA, RCRA, and CERCLA, however.

If sediment quality criteria are equivalent to water quality criteria and are adopted as State Water Quality Standards, they would be used to set NPDES discharge permit limits. In addition, like water quality criteria, sediment quality criteria could then be used to "reopen" NPDES permits before their normal expiration in order to add additional limits or to "strengthen" existing water quality-based limits. It is logical, then, that actions under the CWA to protect water quality would be invoked at lower levels of sediment contamination than actions under other environmental statutes. Figure 2 indicates when actions might be invoked under different environmental statutes as a function of increasing sediment contamination. Priorities of dealing with other, more contaminated sites, or requirements to consider factors other than the level of sediment contamination are the primary reasons why higher sediment contamination is allowed before action is taken under other environmental statutes.

In addition to preventive measures, remediation measures may be required. These are discussed in the following subsection.

2.4 Sediment Remediation

Sediments that are sufficiently contaminated to pose substantial risk to human health or the environment may need to be remediated. There are three sediment remediation options: do nothing and let natural sedimentation cover them over; treat them in-place; or relocate them to another area with or without treatment (see Figure 3). EPA has the authority to take each of these actions under one or more

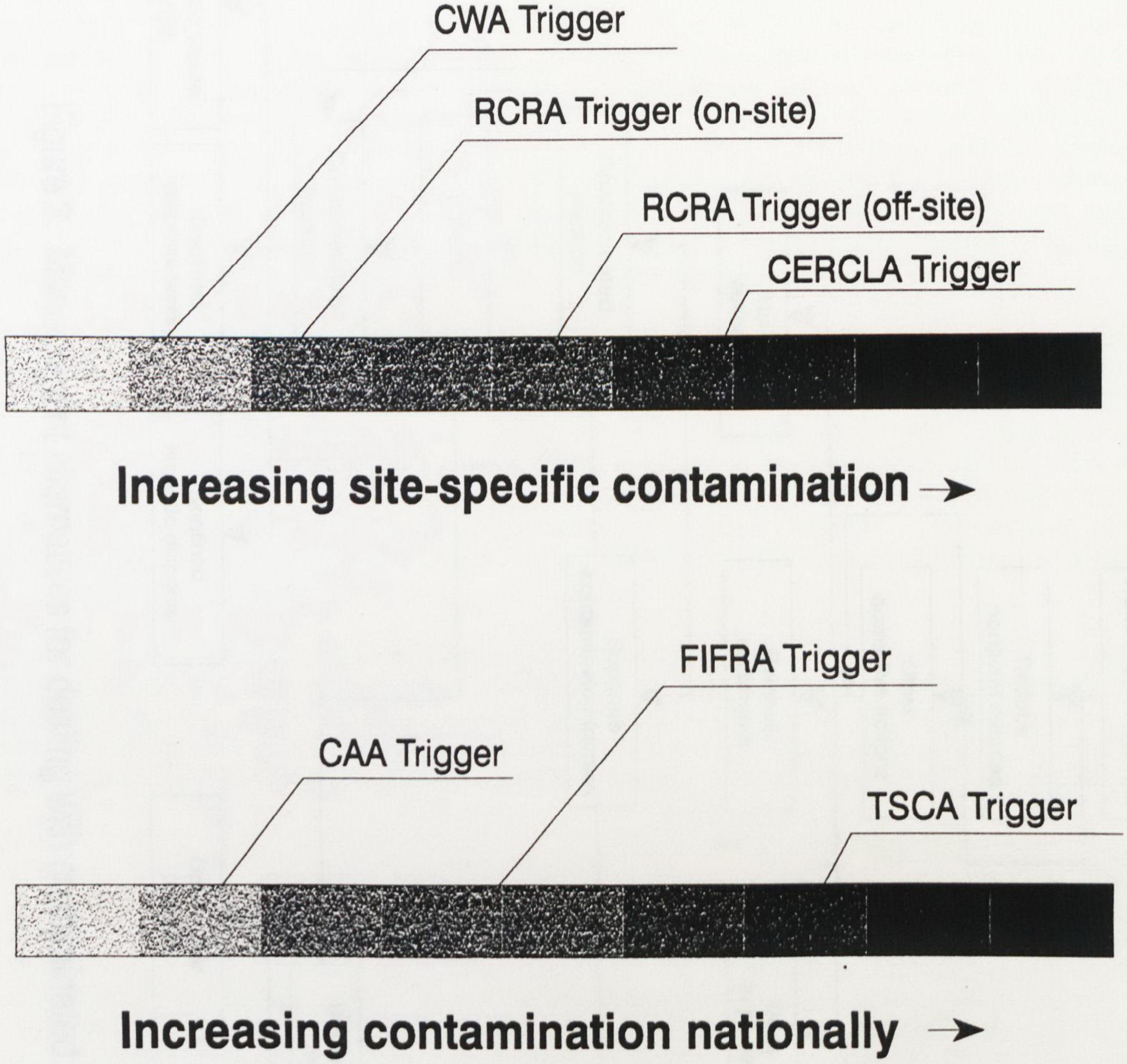

Figure 2. Sediment contamination levels at which action might be taken under various environmental statutes.

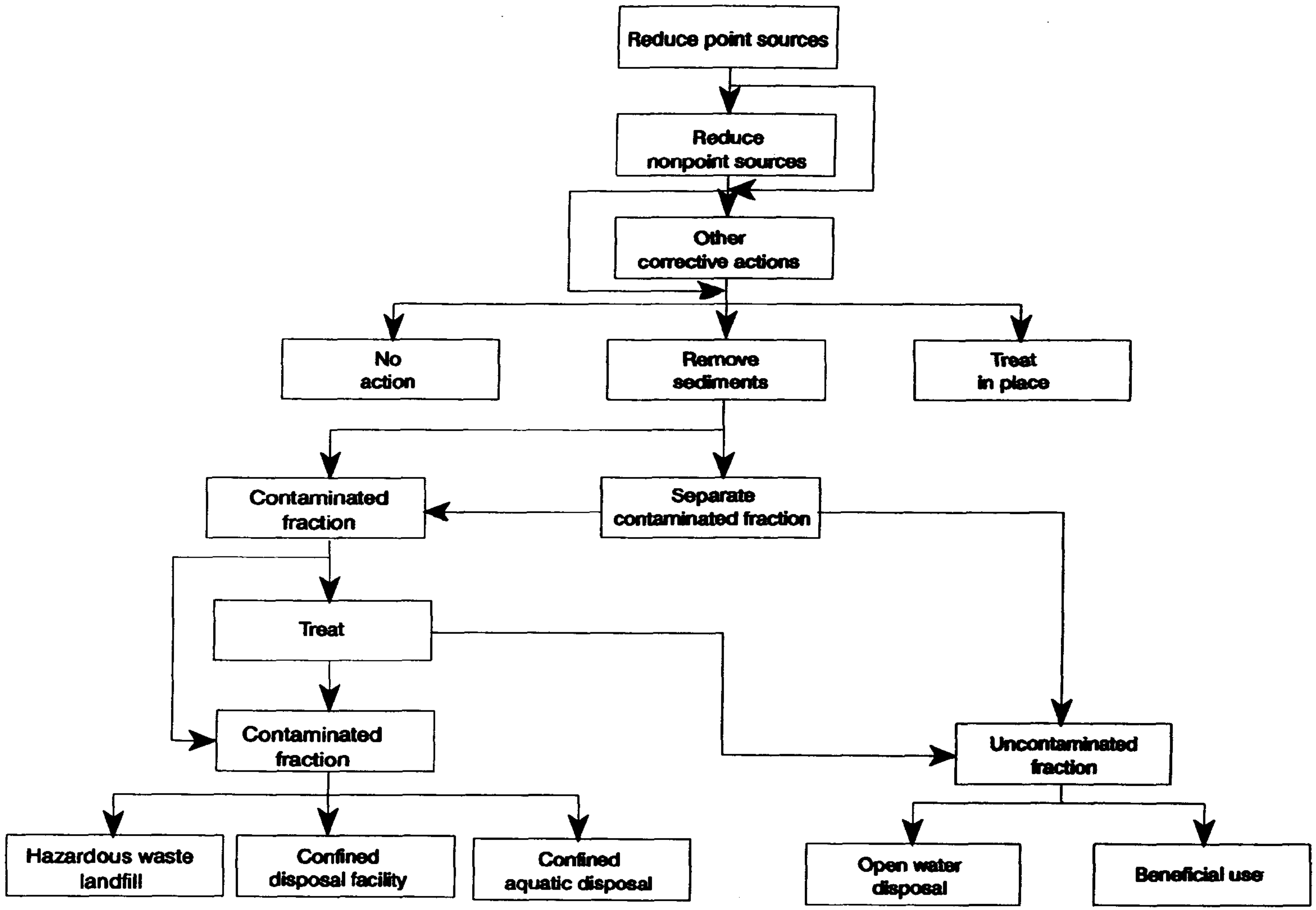

Figure 3. Management alternatives for dealing with contaminated sediments.

of each of the following acts: CWA, RCRA, and CERCLA. CWA authority for remediation under §115, however, is limited to navigable waters and harbors and has never been funded, and actions under RCRA and CERCLA have been rare. To date, the issue of contaminated sediments has typically been raised in the context of dredging and disposal, and filling projects. The Rivers and Harbors Act (RHA) requires the COE to *maintain navigation*. When sediments need to be dredged for navigation or construction activities, EPA and the COE have to satisfy themselves under the CWA or MPRSA, as appropriate, on the environmental acceptability of the proposed options for disposal of the dredged material. These statutes provide for assessing the extent of contamination and selecting disposal sites to minimize environmental impacts of disposal. Because the areas needing dredging are also heavily populated and industrialized, the sediments that need to be removed are often contaminated by point and nonpoint sources. Sediment contamination complicates the process of selecting appropriate disposal options for removed sediments (discussed in the following section). The process of dredging agitates sediments, and may release contaminants which may impact the waterbody or be transported to other locations. Therefore, for highly contaminated sediments, the methods used to dredge sediments also become important.

When the COE dredges for navigational purposes, the volume of sediments removed is determined by traffic patterns, the draft of ships expected to use the waterway and Congressional authorization. When sediments are remediated, the depth and area that must be treated or dredged is more problematic. It is often assumed that remediation should achieve sediment contamination levels that are low enough to protect human health and the environment, e.g., by levels specified as sediment quality criteria. But attaining such levels might be prohibitively expensive and involve such extensive areas that disposal of contaminated sediment in a safe manner may not be technologically or economically feasible. The extent to which remediation is desirable or necessary and the level to which sediment contamination is reduced thus becomes a site- or locality-specific decision.

Similar difficulties occur when deciding when sediments are sufficiently contaminated to warrant remediation and what remediation approach should be taken. "Optimal" remediation may involve all three remediation options - ignoring some areas; capping some areas; and removing and disposing of the rest - depending on the location and extent of contamination within a site. Which options to choose are site- or locality-specific and may depend on the resources available and potential disposal options (see below).

2.5 Disposal Options

Unlike the other steps in this procedure, there are only limitations (not authorities) under environmental statutes to dispose of contaminated sediment that has been removed from a water body. The CWA and MPRSA limit disposal options in the aquatic environment; RCRA requires sediment that is a hazardous waste to be placed in a RCRA-permitted (Subtitle C) facility; CERCLA encourages that wastes be treated to reduce adverse environmental effects before disposal in RCRA-permitted facilities; and TSCA requires that sediments contaminated with PCBs be disposed of according to TSCA-approved methods. This combination of requirements severely limits the choices that can be made. In any case, disposal will likely be a very expensive proposition, particularly if treatment is required.

For navigational dredging, the COE has developed a series of procedures with EPA that determine whether dredged material can be disposed of in marine (under MPRSA) waters. These procedures use a tiered approach including examination of existing data ("initial evaluation") to determine the need for testing, followed by increasingly specialized chemical and biological testing (if warranted) to address specific potential impacts of particular disposal options. The COE procedures are used on a case-by-case basis to select an acceptable method of disposal. Similar procedures exist, depending on the EPA Region involved, for aquatic disposal under CWA §404.

Aquatic disposal followed by capping or confined aquatic disposal (CAD) are potential options that may be appropriate under certain circumstances, particularly if the sediments to be dredged meet COE-EPA procedures but exceed sediment quality criteria. In confined aquatic disposal, a "hole" is dredged in clean sediments, contaminated sediments are deposited in the hole, and the clean sediments are placed on top, sealing off the contamination. Substantial cost savings can be achieved with this method, but its use may be limited to relatively "uncontaminated" contaminated sediments. With higher levels of contamination, the use of confined disposal facilities (CDF) may be appropriate. Confined disposal facilities are diked areas, usually near the shoreline, where dredged materials can be isolated from the environment.

If sediment removal is undertaken primarily to reduce the environmental or human health risk of leaving the sediments in-place (under CERCLA, RCRA, or CWA), disposal becomes even more problematic, primarily because considerably more expensive treatment and disposal options are required for these very highly contaminated sediments. It is unclear whether the COE's confined disposal facilities would be acceptable for the highly contaminated sediments removed through these cleanup programs. Treatment may be required before disposal in CDFs. Some demonstrations of alternative dredging and disposal methods for highly contaminated sediments have been done at the New Bedford Harbor, Massachusetts Superfund site. A number of different dredges were evaluated and CDF and CAD disposal were also tested.

To date, treatment of contaminated sediment before disposal has only been done on a pilot scale. Although a number of promising technologies exist - some borrowed from wastewater treatment facilities, some developed to remove or immobilize contaminants in hazardous wastes - the costs (between $200 and $1,000 per cubic yard) associated with treating large volumes of contaminated sediment become extremely expensive. Superfund has been evaluating treatment technologies through its Superfund Innovative Treatment Evaluation (SITE) program. EPA's GLNPO is starting a contaminated sediment treatment technology demonstration program mandated by CWA §118(c)(3).

In some cases, it may be possible to separate the sediments and/or the treatment residuals into contaminated and uncontaminated fractions (Figure 3). Then only the contaminated fraction would need to be handled in a secure (and costly) way, while the uncontaminated fraction could either be disposed of with few restrictions or, optimally, could be used in a beneficial way. This separation into contaminated and uncontaminated residuals is a strong point of some of the treatment technologies, since it can reduce ultimate disposal costs due to the reduced volumes of contaminated materials that need to be disposed of using methods such as hazardous waste landfills. However, to realize this potential cost savings, the treatment technologies must be able to reduce chemical concentrations, toxicity or mobility sufficiently so that the "uncontaminated" residuals can be classified as non-hazardous or non-toxic under RCRA or TSCA regulations, respectively. If the treatment technology is not able to achieve the needed reductions, treatment, in some cases, could actually increase rather than decrease the volumes of "contaminated" material that has to be disposed of in a costly manner. Even in this case, however, treatment may be warranted if it reduces the hazard posed by the sediments from unacceptable to acceptable levels.

3. ENVIRONMENTAL LAWS PERTAINING TO CONTAMINATED SEDIMENTS

Major environmental statutes that relate to one or more of the steps described in the previous section include:

- Clean Water Act (CWA)
- Resource Conservation and Recovery Act (RCRA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

- Marine Protection, Research, and Sanctuaries Act (MPRSA)
- Toxic Substances Control Act (TSCA)
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- Clean Air Act (CAA)
- National Environmental Policy Act (NEPA)
- Rivers and Harbors Act (RHA)
- Endangered Species Act of 1973

In addition, the Great Lakes Water Quality Agreement between the United States and Canada contains certain provisions for dealing with contaminated sediments in the Great Lakes Basin. The U.S. is also a signatory of the London Dumping Convention (implemented through the Marine Protection, Research, and Sanctuaries Act), an international agreement that limits disposal of materials in the ocean. A general summary of the major provisions of these acts are presented in Table 1. The relationship between each of these acts or agreements are discussed in the following sections.

3.1 Clean Water Act

The CWA was designed to restore the physical, chemical, and biological integrity of the nation's navigable waters. Within this broad goal, various CWA provisions address one or more of the five steps outlined in the previous section. Each of the steps, and the general CWA provisions that apply are discussed below.

There are broad, general requirements under the CWA to locate waters that are not meeting water quality standards, and, by extension, waters that have contaminated sediments. Section 305(b) requires States to assess and report on the quality of navigable waters biennially. While there are no specific requirements in this section to assess sediment quality, the section is general enough to include areas where sediment contamination contributes to water quality problems. Similarly, States must identify waters not meeting water quality standards due to toxics discharges under §304(l) and identify publicly owned lakes impaired by toxics or nutrients biennially under §314.

In addition, the CWA has specific provisions for identifying contaminated sediments: §115 authorizes EPA to identify contaminated sediments in harbors and navigable waterways; §117, to identify contaminated sediments in the Chesapeake Bay; §118, to identify contaminated sediments and demonstrate remedial options in the Great Lakes; §320, to identify contaminated sediments in estuaries in the National Estuary Program (NEP). Although §115 has never been funded, active programs for locating and describing contaminated sediments are being carried out in Chesapeake Bay, the Great Lakes, and under the NEP.

The determination of whether sediment is contaminated or not, step 2, implies the existence of benchmarks or criteria. Besides the general provisions of the CWA that authorize EPA to determine the effects of water pollution on human health and the aquatic environment (§§104 and 105), §304(a) requires EPA to develop criteria for water quality and to develop assessment procedures not based on individual pollutants. The development of sediment quality criteria and sediment assessment procedures could both respond to this section and provide a basis for water quality-related effluent limitations discussed below. To date, EPA's focus on criteria and assessment procedures for sediments have been on toxicity or on pollutants that are toxic. But under §304, the Agency may expand such criteria and assessment procedures to include nutrients, oxygen demanding materials, pathogens, and water-transported sediments.

Table 1. Provisions of Major Environmental Statutes That Apply to Contaminated Sediments.

Statute	Section	Provision
CERCLA	102	EPA may designate any substance which presents substantial danger to public health or the environment as a hazardous waste. EPA notification required if threshold release occurs.
CERCLA	104	Authorizes investigation and remediation where hazardous substances have been released or there is a substantial threat of release presenting an imminent and substantial danger to public health or welfare. Includes on- or off-site investigations of release's extent and danger to health or the environment.
CERCLA	105(a)	Revises the National Contingency Plan developed under CWA §311 to include the national hazardous response plan. Response plan establishes procedures and standards for responding to hazardous releases including identifying potentially contaminated sites, evaluating remedial options, determining appropriate clean-up goals, and setting national remediation priorities for identified sites.
CERCLA	105(a)(8)(A)	Establishes the Hazard Ranking System to set remediation priorities among known or potential hazardous releases. Criteria are based on real or potential danger to public health, welfare, or the environment.
CERCLA	105(a)(8)(B)	Establishes the National Priority List to rank sites evaluated under the Hazard Ranking System. Sites scoring above a certain level are given the highest priority for remediation.
CERCLA	105(c)	Amends Hazard Ranking System to require consideration of human health risks associated with surface waters used for drinking water supply and/or recreation that are contaminated by release or potential release from a site.
CERCLA	106(a)	Authorizes remediation to abate danger or threat from actual or threatened release of a hazardous substance if EPA determines there may be imminent and substantial danger to public health, welfare, or environment.
CERCLA	107	Establishes cradle to grave liability for clean-up and associated cost. Person(s) involved in ownership of storage, transport, disposal or treatment facility or vessel from which release occurred are liable for response and clean-up costs.
CERCLA	121	Establishes clean-up standards to protect human health and environment. Any remediation must be as environmentally strict as State or federal appropriate or relevant and applicable requirements (ARARs). Favors treatment that permanently reduces the volume, toxicity, or mobility of hazardous substance. Off-site transport and disposal without treatment is least favored. Off-site waste disposal must be deposited in a RCRA-permitted facility. Factors to evaluate alternatives include uncertainty of land disposal, RCRA goals, nature of the hazardous substances, potential for adverse human health effects, potential threat from remediation.

Table 1. Provisions of Major Environmental Statutes That Apply to Contaminated Sediments (continued).

Statute	Section	Provision
CERCLA	121(d)(2)(B)(i)	In deciding if remediation must conform to water quality criteria, EPA will consider designated uses of the water, the environmental media affected, the purpose of the criteria and the latest information available.
CERCLA	121(4)	Establishes remedial cleanup level exemptions to ARARs. Factors include marginal cost of clean up, technical feasibility, and human health risks associated with remediating to ARAR levels.
CWA	101(a)(3)	Prohibits toxic discharges. Has been used by some States to prohibit large discharges of contaminated sediment.
CWA	104	Establishes national programs for prevention, reduction and elimination of pollution through research, demonstration, and experiments. Includes study on effects of sedimentation on estuarine aquatic life.
CWA	115	Authorizes EPA, in conjunction with the U.S. Army Corps of Engineers, to identify, remove, and dispose of in-place pollutants with emphasis on toxics in harbors and navigable waterways.
CWA	117	Establishes Chesapeake Bay Program Office. Authorizes study to determine impact of sediment deposition in Chesapeake Bay. Identify sources, rates, routes, and distribution of sediment. Determine impacts of chlorine, acid rain, dissolved oxygen, and toxics on living resources.
CWA	118	Formally establishes Great Lakes Program Office. Authorizes Great Lakes surveillance system to identify waters impacted by toxic pollutants, 5-year study and demonstration projects to control and remove toxic pollutants in the Great Lakes, emphasizing toxic removal from sediments.
CWA	301(b)	Establishes effluent limitations for point sources based on best available technology.
CWA	301(b)(1)(C)	Requires effluent limitations more stringent than BAT when necessary to meet State Water Quality Standards.
CWA	303	Requires States to adopt water quality standards that meet or exceed federal water quality criteria. Requires States to develop waste load allocations for certain pollutants at a level necessary to achieve water quality objectives.
CWA	304	Requires EPA to establish water quality criteria based on 1) pollutants' negative impacts on human health, welfare, and biological communities, 2) the concentration and dispersal of pollutants through biological, chemical or physical processes. Requires methods for establishing and measuring water quality criteria for toxic pollutants on other bases than chemical specific criteria, including biological monitoring and assessment methods.

Table 1. Provisions of Major Environmental Statutes That Apply to Contaminated Sediments (continued).

Statute	Section	Provision
CWA	304(l)	Requires States to identify waters not meeting water quality standards due to toxic pollutant discharges. Develop control strategies to reduce toxic discharges based on revised effluent limitations and water quality standards.
CWA	305	Requires biennial State reports on waters not meeting water quality standards or not attaining best uses. Report includes inventory of all point source discharges and describes actions necessary to achieve water quality objectives for non attaining waters. Describes nature and extent of nonpoint sources and recommendations to control sources.
CWA	307	Requires EPA to develop effluent limitations based on best available technology for toxics, authorizes EPA to designate disposal of dredged material as a category subject to §307(b) toxic effluent limitations.
CWA	314	Clean Lakes Program - States must report biennially on water quality in public lakes, including status and trends in water quality in lakes impaired due to toxic pollution from point and nonpoint sources. Demonstration program on point and nonpoint source control, removal of silt which impairs lake quality, and structural and non-structural means to prevent or stop sediment deposition.
CWA	319	Requires States to identify sources and types of nonpoint source pollution and affected waters and to develop and implement management programs to reduce nonpoint source pollution.
CWA	320	Authorizes the National Estuary Program. Focuses management attention on specific estuaries requiring additional pollution control to maintain or attain water quality standards. Includes collecting data on toxics to identify cause of environmental problems.
CWA	401	Establishes State Water Quality Certificates. Requires that any discharge into navigable waters requiring Federal license or permit meets State Water Quality Standards. Provides for interstate coordination/involvement.
CWA	402	Requires a National Pollution Discharge Elimination System permit for all point source discharges. To receive a NPDES permit, all applicable effluent limitations and water quality criteria must be met.
CWA	403(c)	Requires EPA to promulgate guidelines for regulating NPDES discharges to the ocean.
CWA	404	Regulates dredging and discharge of dredged and fill material into all navigable waters. 404(b)(1) guidelines are used to evaluate whether proposed dredge and fill activities and discharges meet CWA requirements.

Table 1. Provisions of Major Environmental Statutes That Apply to Contaminated Sediments (continued).

Statute	Section	Provision
FIFRA	3	EPA may limit the distribution, sale or use in any State of any pesticide to prevent unreasonable adverse effects on the environment.
MPRSA	102	Establishes EPA permit system and criteria for ocean dumping. Dumping allowed if material doesn't unreasonably degrade or endanger human health, welfare, amenities, marine environment, ecological systems, or economic potentialities.
RCRA	1003(b)	National policy to treat, store and dispose of hazardous waste so as to minimize the present and future threat to human health and the environment.
RCRA	1006(a)	If RCRA is inconsistent with CWA, Safe Drinking Water Act, MPRSA, or Atomic Energy Act then RCRA does not apply to any activity or substance covered by the conflicting section(s).
RCRA	1008(a)(2)	EPA to publish solid waste management guidelines that protect public heath and welfare, ground and surface water and, air quality,
RCRA	1008(a)(2)(c)	Publish solid waste guidelines that protect surface water quality from TSD runoff "through compliance with effluent limitations under the CWA".
RCRA	3001	Requires criteria for identifying hazardous wastes and publishing a list of such wastes subject to RCRA. EPA to establish standards for use, reuse, recycling and reclamation of hazardous wastes for small quantity generators.
RCRA	3002	EPA to establish operation and notification standards for hazardous waste generators to protect human health and the environment.
RCRA	3003(a)	Requires EPA to establish standards applicable to transporters of hazardous wastes. Transport of contaminated sediments must comply with transportation requirements specified in regulations.
RCRA	3004	Prohibits land disposal of certain wastes in liquids or liquids associated with any solid or sludge.
RCRA	3004(u)	Requires reporting and corrective action for all past or present releases from solid waste management units on site of treatment, storage, or disposal facilities applying for a RCRA permit.

Table 1. Provisions of Major Environmental Statutes That Apply to Contaminated Sediments (continued).

Statute	Section	Provision
RCRA	3004(v)	Authorizes corrective action to be taken beyond the TSDF boundary to protect human health or the environment from on site solid waste management unit releases.
RCRA	3005	Establishes permit system and requirements for treatment and storage at hazardous waste disposal facilities.
RCRA	3008(h)	EPA can require corrective action to protect human health or the environment from past or present releases from interim status TSDFs.
RCRA	7003	If EPA finds TSDF activity may present an imminent and substantial endangerment to health or the environment EPA can sue responsible party(ies), stop such activity, and take such action as may be necessary. EPA may also issue "such orders as may be necessary to protect health and the environment.
TSCA	4	Requires testing of a chemical, substance or mixtures of chemicals or substances for their human and environmental effects. Priority list of chemicals for testing established under § 4(e).
TSCA	5	EPA can prohibit or limit the manufacturing, processing, distribution or disposal of new chemicals EPA determines present unreasonable health or environmental risk.
TSCA	6(a)(6)(A)	EPA can prohibit or otherwise regulate any manner or method of disposal of chemical or material (e.g., sediments) containing the chemical by any person disposing of it for commercial purposes.
TSCA	6(e)	Requires regulations for methods of disposing of PCBs. (Regulations generally set 50 ppm PCB for wastes not subject to TSCA-controlled disposal.)
CAA	112	Requires air emissions standards for hazardous air pollutants that may cause increased mortality or serious illness. Standards apply to stationary sources and are enforced and implemented by States to ensure emission standards protect human health.
NEPA	102(2)(c)	Major federal actions which significantly affect the environment must prepare a report describing the environmental impact of the action, unavoidable adverse environmental effects, and alternatives to the proposed action.
GLWQA	Art-II	The Agreement's purpose is to restore and maintain the chemical, physical, and biological integrity of water quality in the Great Lakes Basin Ecosystem.

Table 1. Provisions of Major Environmental Statutes That Apply to Contaminated Sediments (continued).

Statute	Section	Provision
GLWQA	Ann-2	Areas of Concern, those areas with water quality problems, including contaminated sediments, that impair beneficial uses or aquatic life, are designated. Site-specific Remedial Action Plans establish a management framework for assessing different remediation options and their implementation.
GLWQA	Ann-7	Parties have agreed to develop criteria, classify polluted sediments in areas undergoing navigational dredging.
GLWQA	Ann-14	Contains commitments to identify, treat, and research the impacts of contaminated sediments on the Great Lakes System.

Preventive measures under the CWA relate primarily to the National Pollution Discharge Elimination System (NPDES). Under §402, all point source discharges must be permitted to be in compliance with water quality-based effluent limitations [§303(c)] and total maximum daily loads [§303(d), limitations that ensure the maintenance of balanced populations of indigenous fish, shellfish, and wildlife and protect human health. If concentrations of pollutants in the water column have been such that balanced populations have not been maintained, point source discharges must be reduced in order to restore the biological integrity of the water body. Water quality criteria (as implemented through State water quality standards) and aquatic toxicity tests have been the benchmarks for setting water quality-based effluent limitations in those States where they have been implemented, and it is possible that sediment quality criteria and assessment procedures might take on similar importance in the future.

In addition to water quality-based effluent limitations for point sources under §303, CWA §319 requires States to develop Nonpoint Source Management Programs - programs that may (or may not) attempt to reduce nonpoint source pollution in areas where there are contaminated sediments. The federal-level enforcement provisions of this section are weak, however, and States are not required by §319 to limit nonpoint sources if State Water Quality Standards are exceeded.

Remediation of contaminated sediments is covered by §§115 and 118 in the CWA. Section 115 authorizes EPA to identify and remove contaminated sediments from harbors and navigational waterways. Although $15 million was authorized for sediment remediation, no funds were ever appropriated, and activity under this section was limited. Section 118 calls for demonstrations of ways to address contaminated sediments in the Great Lakes and authorizes up to $4.4 million per year for a five year program. The GLNPO is currently carrying out this program under the name "ARCS" (Assessment and Remediation of Contaminated Sediments). In addition to demonstrating remedial technologies, the ARCS program is also addressing the development and refinement of protocols to assess and predict the hazard posed by contaminated sediments if they were merely left alone ("no action" alternative) or if various remedial actions were undertaken.

Dredging and dredged material disposal in freshwater and estuarine environments must comply with §§401 and 404 of the CWA. Under §401, all activities must comply with State Water Quality Standards and criteria. Generally this means that dredging and disposal activities must not cause water quality standards to be exceeded at any time or for more than specified periods of time, but many States specifically exempt dredging activities by regulation. On the other hand, some States (e.g., Wisconsin) have required that discharges from confined disposal facilities be permitted as point source discharges under §402. §404 requires that all dredge and disposal activities be permitted, and the COE and EPA have jointly developed procedures to determine whether dredged material can be disposed of in open waters under this general requirement.

3.2 Resource Conservation and Recovery Act

RCRA's overall objectives are to minimize the generation of hazardous waste and to treat, store, and dispose of hazardous wastes so as to minimize present and future threats to human health and the environment. Since one of the Act's main goals is to prevent the initial release of hazardous wastes into the environment, all treatment, storage, or disposal facilities (TSDFs) must meet detailed design, operation, maintenance and monitoring requirements before receiving an EPA operating or closure permit. While protecting the environment is given equal status with protecting human health in the Act, EPA implementation has focused much more on human health concerns than environmental concerns.

RCRA provisions concern each of the five steps in the general procedure for dealing with contaminated sediments. Relevant provisions are discussed below.

Under certain circumstances, RCRA permittees or applicants for RCRA permits might have to locate contaminated sediments. Standards under §3004(u) require facilities applying for a permit to identify past hazardous waste releases or exposures, including releases that may have contaminated sediments. EPA may then require the applicant to search for contaminants in all media, including sediments. Similarly, EPA can require an interim status facility to investigate all media for contamination under §3008(h) if it is believed that a release has occurred or may have occurred from a solid waste management unit (SWMU). Sediment quality criteria might serve as a benchmark in determining whether contamination has occurred.

Methods have been developed to ascertain whether a waste has one or more hazardous characteristics [§3001(a)], but none of these methods are generally applicable to determining the contamination level of sediments. The EP Tox test, for example, deals only with leachates from a material, not the effects of the material in the environment. Leachates from contaminated sediments disposed of on land might be problematic, however, and some extremely contaminated sediments may be classified as hazardous under these procedures. The more restrictive procedure for dredged material is the filter paper test, discussed under disposal options below.

Both preventive and remediation actions can be taken under RCRA §§3004(u), 3008(h), and 7003. If a release of hazardous materials has occurred or is occurring, EPA can require a facility to cease the activity generating the release or contain the release. For materials that would commonly end up in sediments, berms or similar constructions could prevent surface runoff, and groundwater sources could be controlled by adding liners or removing contaminated soils. With releases that have contaminated sediments, RCRA provisions could theoretically require a permittee to remediate the sediments in many circumstances.

The restrictions placed by RCRA on the disposal of hazardous dredged material are particularly limiting. For this reason, the COE has argued that dredged material from federal projects is not a solid waste but a natural material that must be relocated from one place to another. Since, they argue, dredged material is not a solid waste, it is not subject to RCRA provisions. Although the argument can be viewed as semantic, the fact that almost all dredged materials would fail the filter paper test (a test that measures the amount of liquid in a hazardous material) and thus not be allowed to be disposed of on land creates conflicts for disposal of dredged materials resulting from navigational projects.

3.3 Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA objectives are to protect human health and the environment by responding to potential or existing hazardous substance releases, remediating or cleaning up contaminated areas, and assessing liability for remediation actions and resource damages. In general, CERCLA provisions relate either to contamination at abandoned sites where there is a continuing threat of more wide-spread contamination or emergency spills. Currently-used sites generally are covered by RCRA. This Act applies to all steps in dealing with contaminated sediments.

Section 104 provides a generally broad authority to locate areas with contaminated sediments. EPA can undertake studies or investigations if it believes a hazardous substance release has occurred or may occur. Studies on the degree and extent of contamination and potential routes of human exposure to a hazardous substance are generally determined through preliminary assessments (PA), but may include sampling and testing sediments during site investigations (SI). Identified sites are maintained in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), a useful database source for finding potentially contaminated sediments.

Evaluating the level of contamination under CERCLA is done through the Hazard Ranking System, a classification and evaluation scheme that considers many possible risks to human health and the environment. The greater each individual hazard, and the more hazards posed by a site, the higher the overall score. With sufficiently high overall scores, contaminated sites (on land or water) are put on the National Priority List (NPL), a list that designates sites for remedial investigation/feasibility studies (RI/FS) and remediation.

Because of the Hazard Ranking System, sediments that exceed sediment quality criteria may or may not be designated for preventive or remedial action under CERCLA. But there are broad authorities that allow EPA to take such actions. Sites on the NPL can be presumed to be subject to remedial action, but other sites in the CERCLIS database may not receive substantial attention for many years. Small sites that pose imminent danger to human health or the environment can be cleaned up even if not on the NPL if cleanup costs do not exceed a set level, currently $1,000,000. Such sites are handled on a case-by-case basis as time and resources permit.

For remedial activities, CERCLA §121 specifies cleanup goals, requiring "water quality criteria ... where such ... criteria are relevant and appropriate" as a cleanup standard. Thus it could be assumed that sediments must conform to sediment quality criteria after remediation because water quality criteria might be construed as applicable and relevant appropriate requirements (ARARs). Although EPA policy on the interpretation of water quality criteria is not finalized, it would seem that unless remedial action were required under all circumstances where sediment quality criteria were exceeded, selecting sediment quality criteria as the cleanup goal would be too stringent a requirement. Section 121, recognizing that ARARs are sometimes too restrictive, allows exemptions to ARARs for several reasons, including the marginal decrease in risk per unit cleanup cost. Exemptions are also allowed when remediation is only part of a whole solution. Natural sedimentation may, in many circumstances, suffice to isolate contaminated sediments from biologically active zones, and thus be considered part of an overall remedial strategy. Thus, the level of cleanup through remediation technologies would not necessarily be to sediment quality criteria levels.

Also under §121, CERCLA generally states that permanent remedies are preferred. In this sense, contaminated sediments should be treated or contained to immobilize contaminants no matter what the disposal option. Under certain circumstances, such treatment may be necessary or desirable, but the costs of treatment should be carefully weighed against the reduction in risk to human health and the environment that would be obtained.

3.4 Marine Protection, Research, and Sanctuaries Act

The major purpose of MPRSA is to regulate the dumping of all sewage sludge, industrial waste, and dredged material into the ocean "in order to prevent or strictly limit the dumping into ocean waters of any material that would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." MPRSA relates only to dredged material disposal in the Territorial Sea and seaward. §102(a) of MPRSA calls for the EPA to establish "criteria" for the review and evaluation of ocean dumping permits. The language of §102(a) describes these "criteria" as an evaluation process for systematically considering the various adverse environmental, health, and economic impacts that ocean dumping could have. Thus, the term "criteria" as used in MPRSA does not equate to the numerical sediment quality criteria discussed throughout this report. However, sediment quality criteria would likely have a role in the MPRSA evaluation procedures in so far as they would help in assessing the likelihood of impacts on the aquatic biotic community, which are required to be considered in evaluating dumping permits.

As in the CWA 404 Program, the COE and EPA have jointly developed protocols to determine if dredged materials can be disposed of in the ocean. The tiered testing scheme relies on a subjective judgement on whether the sediment could be contaminated or not, chemical analyses to determine whether contaminants banned by the London Dumping Convention are present at levels greater than trace amounts and toxicity tests to determine whether the sediment is toxic or not. Under the present protocol, over 90% of the sediments that are dredged for navigational reasons in the coastal zone are "uncontaminated." But the toxicity testing procedures are presently being revised and with new procedures, fewer sites may yield dredged material that is acceptable for ocean dumping. Sediment quality criteria may conflict with either the existing or new protocols.

3.5 Toxic Substances Control Act

TSCA's objective is to ensure that the manufacturing, processing, distribution, use, and disposal of chemical substances and mixtures do not present an unreasonable risk of injury to human health or the environment. TSCA applies to the procedure for dealing with contaminated sediments in two ways: first, any contaminant that is commonly found in sediments in excess of sediment criteria may be subject to manufacturing bans, and second, sediments contaminated with greater than 50 ppm PCBs may have to be disposed of by TSCA-approved methods.

The TSCA provisions that allow the banning or use restriction of chemicals [§§5(f) and 6] give EPA powerful authorities for the control of ubiquitous toxic substances. PCBs were banned under TSCA, and mounting evidence for a number of other chemicals routinely found in contaminated sediments could also lead to TSCA bans. For preventive purposes, TSCA action could thus be the most effective action that could be taken for contaminants with widespread distributions.

Under §§5(f) and 6, disposal practices for materials that contain greater than 50 ppm PCBs have been restricted. This restriction limits disposal to incineration, landfilling in a hazardous waste landfill, or a "third alternative" that can be determined by a Regional Administrator. As with RCRA restrictions on land-based disposal, the COE claims that TSCA restrictions do not apply to dredged material disposal because it is not disposed of for commercial purposes. If both the TSCA and RCRA restrictions applied to dredged material, all dredged material disposed of on land would have to be dried prior to disposal, and in some cases would have to be disposed of in RCRA-permitted facilities.

3.6 Federal Insecticide, Fungicide, and Rodenticide Act

FIFRA provisions are similar to TSCA provisions in that the use of a biocide could be restricted nationwide or in certain regions of the country if it commonly exceeded sediment quality criteria. Many of the persistent pesticides have use restrictions under FIFRA, and with good evidence, others could be included in the FIFRA list. Evidence would need to include a ubiquitous distribution of the biocide in sediments, above sediment quality criteria levels, for at least a significant portion of the nation before action is likely to be taken under this act.

3.7 Clean Air Act

The CAA is similar to both FIFRA and TSCA in that emission control provisions would only become important if it could be demonstrated that air emissions were responsible for sediment contamination over wide-spread areas.

3.8 National Environmental Policy Act

NEPA requires the preparation of Environmental Impact Statements for many federally-funded projects. Its intent is to incorporate environmental considerations into decision-making at the federal level.

Navigational dredging projects are typical of the type of projects that require EISs, and EIS preparation provides an opportunity to explore the options available for dredging and disposal of contaminated dredged material. NEPA does not provide the legal authority for making decisions, however, and all aspects of control of dredging and dredged material disposal are covered by other environmental statutes.

3.9 Rivers and Harbors Act

The Rivers and Harbors Act provides authority for the COE to carry out projects for the improvement of navigation (§540). It does not authorize dredging for environmental improvement, i.e., the removal of contaminated sediments. The only authorization for the COE to be involved in sediment remediation is CWA §115.

3.10 Endangered Species Act of 1973

Dredge and fill projects, as well as remedial activities regarding contaminated sediments would have the potential to have adverse effects on threatened and endangered wildlife species due to habitat degradation or destruction. Therefore, these activities would fall under the jurisdiction of the Endangered Species Act of 1973. Section 7 of that law requires all federal agencies to confer with the U.S. Department of the Interior regarding any agency decision which is likely to jeopardize the continued existence of any species listed or proposed to be listed under §4, or result in the destruction or adverse modification of critical habitat proposed to be designated for such species.

3.11 Great Lakes Water Quality Agreement

The GLWQA between Canada and the United States is an agreement to restore and enhance water quality in the Great Lakes System. Annexes 2, 7, and 14 of this agreement apply to contaminated sediments. Annex 2 provides the basis for the designation of the 42 Areas of Concern in the Great Lakes Basin. Forty-one of the 42 areas have contaminated sediments, and there is a commitment in Annex 14 to identify, treat, and research the impacts of contaminated sediments. Under Annex 7, the International Joint Commission Dredging Subcommittee has developed specific protocols for classifying polluted sediments in areas requiring navigational dredging to assist in determining appropriate disposal options.

4. ISSUES

This section describes the issues that have been raised by commenters on various drafts of documents prepared for the development of sediment quality criteria. Comments in general can be divided into four general groups:

1) The magnitude of the sediment contamination problem and the need for a national assessment of contaminated sediments.

2) The technical basis for sediment quality criteria: what sediment quality criteria are designed to protect, the relationship between technical procedures and the goals of sediment quality criteria, and the nature of the sediment assessment procedures.

3) How sediment quality criteria can or should be used in decision-making under various environmental statutes.

4) Decision-making on options for mitigating the adverse effects of contaminated sediments.

Each of these major categories are discussed below. Where appropriate, statutory authorities are explicitly referenced. Tables listing all comments and their organization by step or by statute are presented in the Appendix.

4.1 Need for Criteria Development and National Sediment Contamination Assessment

Some commenters wondered about the size of the sediment contamination problem and the need for a major EPA effort in developing criteria and assessing sediment quality nationwide. One commenter said it most succinctly:

> *Is sediment contamination a big enough environmental problem to justify the criteria, programmatic and regulatory effort?*

The resolution of this issue depends on whether sediments are contaminated in general and whether existing regulatory tools and criteria can be applied with sufficient stringency to ameliorate the sediment contamination problems that exist. The tools that can be used under existing legislation have been described above. Without further information on how and where these tools have been applied, it is a matter of judgment as to whether they are effective or not. It is generally accepted among commenters, however, that not enough is known about the national distribution of contaminated sediments. The following comments indicate this general belief:

- Need better understanding of national, regional, and local scope of contamination problems.
- Need overview on where sediments are a problem and are going to be a problem
- A national inventory of contaminated sites would be helpful in determining relative contamination of sites.
- Need national site-specific assessment to understand breadth of potential biological effects.
- A national assessment needs consistent methodology in order to compare sites.

One other comment (discussed in the final subsection) suggested that it might be necessary to convince Congress that sediment contamination problems can be successfully dealt with. It might also be necessary to convince Congress that sediment contamination is indeed a significant enough problem to warrant expanded funding for criteria development and remediation. In general, this issue can be stated as:

> *Should sediment contamination be assessed nation-wide to determine whether it is sufficiently problematic to warrant further criteria and regulatory development?*

4.2 Technical Basis for Sediment Quality Criteria

Sediment quality criteria are in many ways water quality criteria that are authorized under §304 of the CWA. Since the purpose of the CWA is to restore and maintain the physical, chemical, and biological integrity of the nation's waters, sediment quality criteria should be a measure of the integrity of waters. Integrity, by itself, cannot be measured, so other measures must be used as surrogates - measures that reflect the uses of the water, including environmental conservation, natural resource protection, and human use.

Many comments on the technical basis of sediment quality criteria focus on the adequacy of any particular criterion in measuring "integrity." The majority of commenters who raised this issue were apparently concerned that the current emphasis on the equilibrium partitioning approach was too limited in scope. Comments that emphasized this concern included:

- Sedimentation degrades aquatic habitat through physical smothering.
- Sediment contamination is manifested in habitat loss, fish bioaccumulation, and isolated [sic] point sources.
- Sediment oxygen demand is the most significant cause of hypoxia in Long Island Sound.
- Mercury in Lake Onondaga bioaccumulates in sport fish causing fishing advisories.
- Address effects of toxics and organic enrichment.
- Nature of contamination, i.e., non-toxic (phosphorus/nitrogen) versus toxic (metals/PAHs) define different problems and different remedial actions.
- Need to measure impacts on populations of endangered and threatened species.

These comments essentially address the breadth of possible adverse effects that should be addressed by sediment quality criteria or assessment procedures in determining acceptable environmental health. All commenters apparently accepted the fact that toxicity (including carcinogenicity, mutagenicity, and teratogenicity) must be covered by sediment quality criteria, but some commenters mentioned other adverse effects that might also be considered: effects on fish, wildlife, and humans of bioaccumulation of contaminants through the food chain; the smothering effects of sedimentation; the reduction in dissolved oxygen due to sediment oxygen demand; and the effects of nutrients stored in sediments. While the greatest emphasis probably should be placed on sediment toxicity, many of the other effects are important considerations on a site-by-site basis. These concerns can be succinctly stated as

In the development of sediment quality criteria and sediment assessment procedures, what emphasis should be placed on toxicity and what emphasis should be placed on other adverse effects of sediment contamination?

There are many technical procedures that can be used for establishing the state of a particular sediment: the concentrations of chemicals, the type and abundance of species present, the physical properties of sediment grains and interstitial spaces, the toxicity of the sediment. It is more problematic to determine when any of these measures for a particular sediment are acceptable, i.e., represent a system with "integrity."

With regard to methods, it was generally accepted that both direct toxicity measurement and chemical-specific measurement were appropriate and desirable. Comments that point to this approach include:

- Need more than one method of assessment: include chemical-specific, biological community, and sediment toxicity tests.
- Need to develop whole-effluent approach to sediments.
- Develop procedures to identify specific chemicals causing sediment toxicity.

- Develop standard chronic toxicity testing procedures for several taxa and life styles of sediment-associated organisms.

- Develop sediment criteria based on residue-toxicity relationships for sensitive organisms.

- Develop procedures for deriving sediment criteria to protect wildlife and humans from adverse exposure via aquatic food chains.

- What chemicals are covered by the equilibrium partitioning approach?

- How is combined impact of chemical mixtures determined?

- How can metals be managed when methods won't be available for another year?

- State-of-the-art of sediment-water-biota geo/biochemical interaction is not developed such that numerical sediment quality criteria are feasible.

- How should toxicity tests be used in developing criteria?

- Can sediment criteria be based on both generic and site-specific methods?

- Use toxic component identification procedures with toxicity and bioaccumulation potential to provide chemical-specific targets to regulate wasteloads.

Overall sediment toxicity overcomes some of the difficulties inherent in chemical-specific criteria, particularly in assessing the combined effects of several toxic chemicals and in assessing situations where criteria have not been developed for a large number of potentially toxic chemicals. Many commenters suggested that toxicity procedures be developed or incorporated into sediment quality criteria, and one commenter suggested that a whole-effluent approach be developed for sediment along with a procedure for identifying the toxic constituents in the sediment. Such an approach would be useful in the absence of criteria for many chemicals, and, would allow the early identification of problem contaminants in the great majority of contaminated sediments.

The issue then becomes one of relative focus and priority for EPA action. Whole sediment toxicity tests exist for sediment-dwelling animals, and these tests are being refined for general application to sediment assessment procedures. On the other hand, developing criteria on a chemical-specific basis is a slow and expensive process, except where it can use existing water quality criteria. While developing sediment quality criteria not based on water quality criteria will result in defensible and accurate values, their development may delay implementation of sediment quality criteria-based effluent limitations. The issue thus becomes:

Within the approach to developing sediment quality criteria and assessment procedures to protect against sediment toxicity, what relative effort should be devoted to whole-sediment rather than chemical-specific procedures?

4.3 Application of Sediment Quality Criteria under Environmental Statutes

EPA or Congress could, through regulation or statute, require the States to adopt sediment quality criteria within their water quality standards. The States now have the authority to adopt sediment quality criteria and standards on their own if they want to. The State of Washington is preparing to issue sediment management standards including numerical sediment criteria derived using the Apparent Effects Threshold (AET) method.

It is important to note that EPA water quality criteria are only advisory until they are adopted as State water quality standards. If sediment quality criteria get the same treatment, they would also be advisory until adopted under State water quality standards. Once adopted as standards, they can be used to require more stringent effluent limitations than BAT under the provisions of CWA §301(b)(1)(C).

There were extensive comments on the use of sediment quality criteria in environmental management. Since the criteria are being developed under authority of the CWA, issues related to implementation of the criteria under the CWA were generally more specific than those relating to other statutes. In the following subsection, the CWA issues are presented first, followed by issues related to other environmental statutes.

The major comments concerning effluent limitations point to uncertainties as to the legal and technical status of sediment quality criteria, and the role source controls might play in mitigating sediment contamination. Comments on the legal status of sediment quality criteria included:

- Will sediment quality criteria be legally defensible if used in the same way as water quality criteria for NPDES permits?

- Will technical people treat sediment criteria as advisories?

The uncertainty can be expressed as:

Will sediment quality criteria be water quality criteria as defined in §304 of the Clean Water Act?

If action is taken to make sediment quality criteria equivalent to water quality criteria, then sediment quality criteria will play a large role in CWA programs. In this case, the major use of sediment quality criteria or assessment procedures under the CWA would relate primarily to the control of point sources using water quality-based effluent limitations under §303 using total maximum daily limits and waste load allocations. Some relationships may also exist between sediment quality criteria and control of nonpoint sources under §319, but individual States may have very different approaches to controlling nonpoint sources to water bodies that exceed water quality standards.

Although criteria may be appropriate for determining the acceptability of disposal of dredged material in aquatic environments, existing procedures developed jointly by the COE and EPA may continue to have precedence over sediment quality criteria. However, sediment quality criteria adopted as State Water Quality Standards under §303 could become one of the bases for Water Quality Certifications (§401), and thus have a regulatory impact on dredging projects. However, under the COE's dredging regulations (33CFR Parts 335-338, April 26, 1988), the COE's policy is that the added costs of complying with State requirements that exceed the "federal standard" and are "excessive or technically unjustified" should be borne by the State or the project sponsor. If the State or project sponsor do not agree to pay the added costs of compliance, the COE may defer dredging while it decides whether the project is economically justified and is not contrary to the public interest. The federal standard issue has come up in relation to COE dredging activities in the States of Wisconsin and Washington.

Since water quality criteria are used and sediment quality criteria would be used not only for effluent limitations under the CWA but as cleanup standards (ARARs) under CERCLA (§121), whether or not sediment quality criteria are water quality criteria is a significant, cross-program issue.

The major comments concerning effluent limitations point to uncertainties as to the technical defensibility of sediment quality criteria, and the role source controls might play in mitigating sediment contamination. On the first issue, comments included:

- How will sediment criteria be connected to the wasteload allocation process?
- Establish contaminant load/sediment relationships to determine whether environment is improving or if further regulatory action is needed.
- Pursue mass balance approach to determine extent of system loadings and whether sediments are source or sink of contaminants.

In examining this list, it is apparent that some commenters felt that the technical procedures to use sediment criteria in wasteload allocations lag behind the criteria development efforts, and thus even if the criteria were finally published, there may be no technically defensible way to link them to regulatory controls. If there is no guidance or clearly presented evidence that relates the levels of pollutant discharges to levels of sediment contamination, wasteload allocations using sediment quality criteria might not be implemented by States. Thus the question of technical defensibility of wasteload allocation relates to the actions the Agency might take on equating sediment quality criteria with water quality criteria:

Are there technically defensible procedures that can be applied to allocate discharges of sediment contaminants among point source dischargers and nonpoint sources?

On the second issue, opinions were divided on whether point source controls were effective means to control sediment contamination, to wit:

- Is zero discharge the cost-effective long-term solution for contamination resulting from low level discharges over many years?
- Must have ability to distinguish and control sources.
- Determining whether a single source is responsible for contamination is major effort.
- Should a strategy be developed to identify and control both point and nonpoint sources of sediment contaminants? Is there enough information to make a rational decision?
- Transboundary and cross-media transfers of pollutant loads confuse preventive and remediation options.
- Would use national criteria to help States establish standards for these pollutants. Useful in regulating point sources, nonpoint sources, and dredge material disposal.
- Need evidence that low level discharges from multiple sources actually contaminate sediments.
- Since many dischargers are already facing stringent water quality-based effluent limits, and since sediment quality criteria are likely to drive these limits even lower, can we reasonably expect dischargers to be able to comply with the limits necessary to protect sediment quality, especially when some of the limits may be at concentrations below present analytical detection limits?

- Will zero discharge be required in order to meet sediment quality criteria for some chemicals?
- Is zero discharge the only chance of not recontaminating?
- Is zero discharge an abstract concept that is irrelevant?
- Have any wasteload allocations resulted in very low allowable discharge levels for some chemicals?
- To prove their value, should focus Agency resources on examining situations where source controls have reduced sediment contamination levels.
- How can the public be convinced that source prevention is preferable to sediment remediation?

Thus some commenters remain unconvinced that of the options to deal with contaminated sediments, point source control is a viable option. Others thought that essentially zero discharge (very low wasteload allocations) of sediment contaminants might be an appropriate long-term solution. Since there appears to be a general belief that technically defensible procedures do not yet exist, the first step in the process of developing such a procedure would be to address this issue:

Can sediment contamination result from low level discharges from multiple dischargers over long period of time? Is there evidence that sediment contamination is reduced when point source discharges are reduced?

For all other acts except CERCLA, sediment quality criteria are advisory only. Under CERCLA (§121), if sediment quality criteria are defined as water quality criteria, they may become the de facto cleanup standard for sediment remediation, an ARAR. There are exceptions to this general requirement, particularly when projected costs of remediation are high relative to the reduction in risks to human health and the environment. However, one commenter raised the question directly: will sediment quality criteria be ARARs. Whether sediment quality criteria will or will not be ARARs is an EPA policy decision that probably should be made at the same time as the decision on whether sediment quality criteria are water quality criteria. The issue:

If sediment quality criteria are water quality criteria as defined in CWA §304, are they ARARs under CERCLA §121?

4.4 Options for Mitigating Adverse Effects of Contaminated Sediments

By far the greatest number of comments related to decisions that should or might be taken when contaminated sediments are encountered. Particular concerns were placed on coordination of approaches both within EPA and with States and local governments. Other concerns related to what can be done about contaminated sediments, and how to select appropriate alternatives. These issues are discussed below.

From the large number of comments on this topic, it was apparently accepted by commenters that sediment remediation was a complicated, costly, and demanding process. The legal framework for sediment remediation is convoluted, and many people need to be involved in remedial decisions if remediation is to be successfully completed. Comments relating to this issue included:

- Need an institutional framework so EPA and different government levels arrive at rational consensus on remediation of sites.

- Cleanup program - need improved information transfer procedures, possibly coordination requirements.

- There is need to increase coordination among all involved agencies.

- States and counties have frequently objected to selected alternatives relatively late in process.

- Increased coordinated enforcement between state and federal agencies may be useful in obtaining appropriate remedies and funding.

- Should sites be managed locally with site-specific steering committees?

Each of these comments points to the need for the early involvement of all potentially affected parties and the public. Because of the costs and complexities of sediment remediation activities, decisions on whether to remediate and how to remediate are crucial. A suggestion for a local, site-specific steering committee to guide alternative selection and implementation emphasized the importance of local involvement. If remediation involves removing sediment, for example, local disposal options are paramount. Unless a disposal site can be found, remediation will not proceed. At the state and federal levels, however, there are similar issues: what program will pay for activities, what authorities will be used to take action, what conditions must be met? A serious, nation-wide emphasis on sediment remediation thus raises the issue:

> *What institutional arrangements are appropriate for coordinating the remediation of sites at the national, state, and local levels?*

A large number of comments focussed on what alternatives to consider, when to consider them, and in some cases, what factors should be involved in making decisions concerning alternatives. The following list represents the what and when comments:

- Is it politically feasible to have four remediation options: 1) do nothing, 2) worry a little and continue to look, 3) consider a variety of alternatives, 4) dredge at all costs and stop inputs?

- Cleanup issue: consider sediment recovery time resulting from sediment deposition, source control, and mixing in surface sediment types.

- Consider combinations of institutional controls, source controls, navigational dredging, and if necessary, sediment remedial action.

- Only three feasible remedial measures - removal, leave in-place, cap it.

- Discussion on toxic pollutants in Lake Ontario include chronology, burial, removal, mobilization, dredging.

- In case of immediate threat, need flexibility to take action in separate operable units.

- Sediment contamination is not being fully used by TSCA when considering new chemicals.

- Under what conditions is capping the preferred alternative?

- May be cases where new controls suppress toxic sources and natural sedimentation can bury the problem.

- In short term, may want to remove only most egregious sediments.

- It is inefficient for all projects to consider every remedial technology.

In most cases, commenters were putting forward their thoughts on important options for control of contaminated sediments. Taken together, they indicate that a wide range of options should be explored. Logically, most of the options need to be considered, but at different levels of detail, and in most cases, exploration of options can be done rationally. Figure 3, for example, lays out categories of options in a way that structures decision-making. There are seven major decision points, and depending on decisions made at the top of the diagram, some options may not need to be considered. On the other hand, appropriate information for making decisions at each of these points may not be available, and may thus frustrate the process.

Considering the major options available (no action, capping, removal and disposal with or without treatment), the basis for decision-making is a more critical issue. In general terms, decision-making criteria are specified by the legislation that provides the authorities for action. But different statutes specify different criteria, and sometimes choices have to be made between actions taken under one statute with actions taken under another. If both are feasible, which is more appropriate? The cheaper one, the one that's easier to implement, the one that provides the least risk to human health and the environment, the one that poses the least risk to human health? What if the remedial action damages habitat of threatened or endangered species? Commenters suggested several factors that are important in selecting alternatives. The primary concerns appeared to be the costs of alternatives (and the costs of alternatives selection), the technical and institutional feasibility of alternatives, the risk posed by the sediment if left alone, and the risk posed by remedial actions. Sample comments included:

- Develop a comprehensive, long-term strategy for remediation of contaminated sediments including 1) multi-faceted assessments, 2) prioritizing sites, 3) remedial goals, 4) likelihood of success, 5) evaluation of potential remedial actions, 6) use of remedial technologies, and 7) post-remedial audits.

- Ways to identify best management alternatives for site: 1) cost/benefit analysis, 2) funding availability, 3) technical feasibility of implementation, 4) EIS alternatives, 5) timing of cleanup.

- When is "no action" the best alternative: 1) low mobility of toxics, 2) high cost of remediation, 3) adverse short-term environmental impacts from remediation, 4) institutional constraints to remediation.

- Sediment ranking should be guided by area's use, biological significance, and potential for biological damage.

- Costs and institutional constraints can also lead to the no-action alternative.

- No-action alternative often selected when disposal sites unavailable, Superfund liability overshadows navigational benefits, or solutions are not affordable.

- Policy should include assessment of risks of remediation options.

The general thrust of these comments relate to costs of different options, risks of different options, and the institutional framework in which the options are to be implemented. Two additional considerations, the probability of success, and flexibility of approach were also mentioned. In essence, the issue related to the basis of selection of options is:

> *What is the appropriate framework for selecting alternatives for control of contaminated sediments based on costs, technical feasibility, institutional feasibility, environmental and human health risks of doing nothing, and environmental and human health risks of each alternative?*

And in selecting sediment control options,

> *Are the most appropriate groups of alternatives for any site those that 1) are implemented at lowest cost, 2) are implemented in the shortest time, 3) achieve the greatest protection for human health and the environment, or 4) achieve the greatest reduction in risk to human health and the environment at lowest cost?*

The COE has developed a detailed strategy, the Dredged Material Alternative Selection Strategy (DMASS), for selecting appropriate control/treatment alternatives for dredged sediments including site-specific contaminant release problems. The DMASS consists of five phases:

- Presumption of contaminant pathway - consists of identifying whether the sediments are contaminated enough to require some restrictions on disposal.
- Confirmation of site-specific contamination - is an in-depth look at the potential contamination pathways that could occur from disposal in particular locations.
- Alternative development and screening - consists of developing alternative ways to eliminate or minimize the site-specific contamination problems identified in the previous phase.
- Detailed evaluation and ranking - involves determining ranking criteria and applying them in a systematic manner to the alternatives developed in the previous phase in order to choose the most desirable alternative(s).
- Alternative selection - is the final step in which the "best" alternative is selected by whatever process the decision-makers have agreed to use to reach the final decision.

The procedures established in the DMASS could be very helpful in selecting the appropriate disposal/treatment alternatives in the management plan for dealing with contaminated sediments when it is decided that sediment removal is needed (Figure 3).

APPENDIX

COMMENTS AND THEIR RELATIONSHIP TO ENVIRONMENTAL STATUTES AND POTENTIAL ACTIVITIES RELATING TO CONTAMINATED SEDIMENTS.

Table A-1. Relationship between Comments and Environmental Statutes.

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
–	–	–	–	–	–	–	–	–	Is EPA going to be given one independent piece of legislation like Aquafund?
–	–	–	–	–	–	–	–	–	Is sediment contamination a big enough environmental problem to justify the criteria, programmatic and regulatory effort?
–	–	–	–	–	–	–	–	–	Need to measure impacts on populations of endangered and threatened species.
–	–	–	–	–	–	–	–	–	What if the remedial action damages habitat of threatened and endangered species?
–	–	√	–	–	–	–	–	–	Since many dischargers are already facing water quality-based limits, and since sediment quality criteria may drive these limits lower, can dischargers comply with new, lower limits?
–	–	√	–	–	–	–	–	–	Will zero discharge be required to meet sediment quality criteria?
–	–	–	–	–	–	–	–	–	State-of-the-art of sediment-water-biota geo/biochemical interaction is not developed such that numerical sediment quality critera are feasible.
–	–	√	–	–	–	–	–	–	Should quality criteria be the same for water as sediment?
–	√	–	–	–	–	–	–	–	Will sediment quality criteria be ARARs?
–	√	–	–	–	–	–	–	–	Can toxics in sediments be addressed with the current Hazard Ranking System?
–	–	–	–	–	–	–	–	–	How should toxicity tests be used in developing the criteria?
–	–	–	–	–	–	–	–	–	How should information on biological impacts due to toxics be factored into toxics criteria?
–	–	√	–	–	–	–	–	–	Will sediment quality criteria be legally defensible if used in the same way as water quality criteria for NPDES permits?
√	–	√	–	–	–	–	–	–	Will technical people treat sediment criteria as advisories?
√	√	√	–	–	–	–	–	–	Under what conditions is capping the preferred alternative?
√	√	–	–	–	–	–	–	–	Quantitative risk assessment can only be done on site-specific basis.
–	√	–	–	–	–	–	–	–	Should sites be managed locally with site-specific steering committees?
–	–	–	–	–	–	–	–	–	Is a major technical transfer effort needed?
–	–	√	–	–	–	–	–	–	What is best method of communicating that EPA believes sediment contamination is a site-by-site problem when there are national criteria for some chemicals?
–	–	–	–	–	–	–	–	–	Are there major conflicts between Apparent Effects Threshold and Equilibrium Partitioning?
–	–	–	–	–	–	–	–	–	Beyond Science Advisory Board review, are additional public/peer reviews indicated?
–	–	–	–	–	–	–	–	–	What is EPA's strategy of discussing methodology with States before it becomes final?
√	√	√	–	–	–	–	–	–	What is the potential impact of the numbers generated so far?
–	–	–	–	–	–	–	–	–	What are the major contaminants not covered by either Apparent Effects Threshold or Equilibrium Partitioning?

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
–	–	–	–	–	–	–	–	–	How can metals be managed when methods won't yield values for another year?
–	–	–	–	–	–	–	–	–	Are there surrogate methods for metals we have not anticipated or pursued? Do States (NY) or Regions have other methods?
–	–	–	–	–	–	–	–	–	Who should work with States on methodological issues?
–	–	–	–	–	–	–	–	–	Is it possible to separate technical questions from policy considerations?
–	–	–	–	–	–	–	–	–	Should the policy analysis separate chemical-specific problems from chemical mixture problems?
–	√	–	–	–	–	–	–	–	Look at CERCLA's site-specific field instructions prior to developing guidance.
–	–	–	–	–	–	–	–	–	Need national site-specific assessment to understand breadth of potential biological effects.
–	–	–	–	–	–	–	–	–	Should sediment contamination situations be classified?
–	–	√	–	–	–	–	–	–	How should water quality data bases be used in deciding how clean is clean?
–	–	–	–	–	–	√	–	–	Learn from Ministry of the Environment-Canada and OMEP/COE manual on assessments for dredging disposal options.
√	√	√	–	–	–	–	–	–	Is it politically feasible to have four remediation options: 1) do nothing, 2) worry a little and continue to look, 3) consider a variety of alternatives, 4) dredge at all costs and stop inputs?
√	√	√	–	–	–	–	–	–	What cost models are needed to evaluate trade-offs between remediation and controlling inputs?
√	√	√	–	–	–	–	–	–	What is role of quantitative risk assessment in developing a solution to a site-specific problem?
–	–	√	–	–	–	–	–	–	Is zero discharge the cost-effective long-term solution for contamination resulting from low level discharges over many years?
√	√	√	–	–	–	–	–	–	How are costs of different options estimated?
–	–	–	–	–	–	–	–	–	European dredging technologies are perceived to be better for removal than US methods.
–	–	–	–	–	–	–	–	√	Is Jones Act and/or COE inertia the barrier to implementation of European methods?
–	–	√	–	–	–	–	–	–	Need case studies to show that controlling sources works.
√	√	√	–	–	–	–	–	–	Is it feasible not to remediate until sources have been controlled?
–	–	√	–	–	–	–	–	–	Need evidence that low level discharges from multiple sources actually contaminate sediments.
–	–	√	–	–	–	–	–	–	Is zero discharge the only chance of not recontaminating?
–	–	√	–	–	–	–	–	–	Is zero discharge an abstract concept that is not relevant?
–	–	√	–	–	–	–	–	–	Have any wasteload allocations resulted in very low allowable discharge levels for some chemicals?

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
√	√	√	–	–	–	–	–	–	How can the public be convinced that source prevention is preferable to sediment remediation?
–	–	–	–	–	–	–	–	–	What information exists on Aquafund?
–	–	√	–	–	–	–	√	–	Will remediation be driven by the COE navigational dredging program?
–	–	√	–	–	–	–	√	–	Is new legislation required for COE to dredge contaminated sediment for other than navigational reasons?
–	√	–	–	–	–	–	–	–	Superfund clean-up is slow. Need to define whether delays have been driven by technical gaps or strategies to avoid corporate liability.
–	–	√	–	–	–	–	–	–	Is a national inventory of contaminated sediments valuable? It won't explain degree to which source control prevents sediment contamination.
–	–	√	–	–	–	–	–	–	To prove their value, should focus Agency resources on examining situations where source controls have reduced sediment contamination levels.
√	√	√	–	–	–	–	–	–	A national inventory of contaminated sites would be helpful in determining relative contamination of sites.
–	–	–	–	–	–	–	–	–	National assessment needs consistent methodology. Since only existing national inventory uses Equilibrium Partitioning, need to assess sites by measuring chemical concentration relative to Equilibrium Partitioning value. Hence need field verification of criteria and criteria limitations.
–	–	–	–	–	–	–	–	–	If National Assessment done, it should address different types of geological environments and their component chemical mixtures. This information has potential for predictive application.
–	–	–	–	–	–	–	–	–	Sediment quality assessment methods for use in management: 1) sediment quality triad, 2) apparent effects threshold, 3) sediment bioassay, 4) infauna community structure, 5) screening level concentrations, 6) equilibrium partitioning.
–	–	√	–	–	–	–	–	–	Sedimentation degrades aquatic habitat through physical smothering.
–	–	√	–	–	–	–	–	–	Sediment contamination is manifested in habitat loss, fish bioaccumulation, and isolated point sources.
–	–	√	–	–	–	–	–	–	In Region VII, sediment information is factored into nonpoint source assessment and management programs, program reviews, monitoring decisions, CWA §304(l) negotiations, and State fishing bans.
–	–	–	–	–	–	–	–	–	Lake Ontario - comparing present sediment with pre-colonial sediment shows increased Cd, Cu, Cr, Fe, Ni, Pb, Zn and very high Hg levels.
–	–	–	–	–	–	–	–	–	Sediment oxygen demand is most significant cause of hypoxia in Long Island Sound.
–	–	–	–	–	–	–	–	–	Mercury in Lake Onandaga bioaccumulates in sport fish causing fishing advisories.
–	–	–	–	–	–	–	–	–	Lake Ontario - Eleven toxics found in fish tissues and/or water column exceeding standards. Five of them are banned. Suspect lake sediments act as reservoir for toxics causing continued exceedences.
–	–	√	–	–	–	–	–	–	Discussions on toxic pollutants in Lake Ontario include chronology, burial, removal, mobilization, dredging.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
-	-	-	-	-	-	-	-	-	Role of sediments as a chemical contaminant source to aquatic environment is poorly understood.
-	-	-	-	-	-	-	-	-	Research needed to better predict natural capping of contaminated sediments.
-	-	√	-	-	-	-	-	-	Decrease in sediment contamination in Lake Ontario conincided with decreased loadings due to bans, restrictions and reduced production.
√	√	√	-	-	-	-	-	-	Possible sediment criteria uses: 1) sediment contaminant impact assessment, 2) site inventory screening, 3) site priority for investigation or remediation, 4) perspective for development and use of national data base, 5) clarify disposal issues.
√	√	√	-	-	-	?	-	-	National assessment creates consistency - consistency with States, Superfund site ranking and remediation, navigational dredging site review, enforcement.
-	-	-	-	-	-	-	-	-	Problems with sediment criteria: still in development, far from promulgation, multiplicity of approaches, lack of agreement on best, don't replace case-by-case assessment, don't replace modelling or simulation, sediments may not be the problem they seem, legally defensible?, exaggerate or underestimate problems.
√	√	√	-	-	-	-	-	-	Barriers to effective sediment assessment and control: lack of effective control techniques, lack of effective federal control program and mechanisms.
-	-	√	-	-	-	-	√	-	COE dredging program has institutional and political barriers to solving to sediment control problems.
√	√	√	-	-	-	-	-	-	There is perception of contaminated sediments as an aquatic life problem not a human health one.
-	-	√	-	-	-	-	-	-	There are grossly inadequate State and federal programs for CSO and storm water control.
√	-	√	-	-	-	-	-	-	There are few good preventative tools for nonpoint source.
√	√	√	-	-	-	-	-	-	There are few good clean-up goals.
-	√	√	-	-	-	-	-	-	Need better understanding of national, regional, and local scope of contamination problems.
-	-	-	-	-	-	-	-	-	Need adequate funding and resources for federal/state program development.
-	√	√	-	-	-	-	-	-	Transboundary and cross-media transfers of pollutant loads confuse preventative and remediation options.
√	√	√	-	-	-	-	-	-	Should EPA's basis for controlling sediment contaminants be human health, ecosystem health, or both?
-	-	√	-	-	-	-	-	-	Should tissue residue criteria for protecting aquatic life and its uses be incorporated into water quality criteria documents? If yes, guidance needed for criteria use and deviations.
-	-	√	-	-	-	-	-	-	How will sediment criteria be connected to wasteload allocation process?
-	-	-	-	-	-	-	-	-	Can sediment criteria be based on both generic and site-specific methods?
-	-	-	-	-	-	-	-	-	Develop sediment criteria based on residue-toxicity relationships for sensitive organisms to set safe contaminant levels on either site-specific or ecosystem basis.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
–	–	–	–	–	–	–	–	–	Develop standard chronic toxicity testing procedures for several taxa and life styles of sediment-associated organisms.
–	–	–	–	–	–	–	–	–	Develop procedures for deriving sediment criteria to protect wildlife and humans from adverse exposure via aquatic food chains.
–	–	–	–	–	–	–	–	–	Evaluate and/or demonstrate protectiveness of selected sediment criteria on a site-specific or ecosystem basis.
√	–	√	–	–	–	–	–	–	Develop procedures to identify specific chemicals causing sediment toxicity.
–	–	–	–	–	–	–	–	–	To focus EPA regulatory effort, determine extent of ammonia toxicity versus contaminant toxicity associated with organic sediments.
–	–	–	–	–	–	–	–	–	How is the combined impact of chemical mixtures determined?
–	–	–	–	–	–	–	–	–	Can aquatic ecosystems with contaminated sediments be protected by reference site evaluations or must broader areas be surveyed?
–	–	–	–	–	–	–	–	–	Using residue approach, what chemicals and mixtures in sediments can be evaluated for toxic effects?
–	–	√	–	–	–	√	–	–	Would use national criteria to help States establish standards for these pollutants. Useful in regulating point sources, nonpoint source and dredged material disposal.
–	–	–	–	–	–	–	–	–	Sediment criteria will increase monitoring of sediments and increase knowledge of condition of a water body.
√	√	√	–	–	–	–	–	–	What is known about the impact of remediation options?
√	√	√	–	–	–	–	–	–	Policy should include assessment of risks of remediation options.
–	–	√	–	–	–	–	–	–	Should a strategy be developed to identify and control both point and nonpoint sources of sediment contaminants? Is there enough information to make a rational decision?
√	√	√	–	–	–	–	–	–	Water bodies that may benefit from sediment criteria: 1) those associated with CERCLA or RCRA sites, 2) those receiving chlorine-bleached pulp and paper mill effluents, 3) those on CWA §304(l) list, 4) those with fish advisories, 5) those with documented toxic sediments.
–	–	√	–	–	–	–	–	–	Protection of benthic organisms is important relative to the "fishable" goal of CWA and the justification of need for sediment criteria.
–	–	–	–	–	–	–	–	–	Site managers need guidance document that provides - sampling plan, types of samples to take, relative and technical costs, available methods and what they provide, data use and its legality in court.
√	√	√	–	–	–	–	–	–	Site managers need guidance on establishing, comparing and interpreting risk of no action and various clean-up options.
–	–	–	–	–	–	–	–	–	Need framework to provide standards for sediment tools, methods and applications, for sediment categories and for specific site types.
–	–	–	–	–	–	–	–	–	Need sediment criteria and indices with defined, specific uses and credibility boundaries for different sediment scenarios.
√	√	√	–	–	–	–	–	–	Suggest a sediment SWAT team of experts be involved in all phases to record the remedial action and its effectiveness.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
-	-	-	-	-	-	-	-	-	Need sediment remediation data bank that includes case studies on the success of various remedial options.
-	-	-	-	-	-	-	-	-	Need better information exchange.
-	-	-	-	-	-	-	-	-	Need practical guidance on sediment assessment using criteria or advisory numbers.
-	√	√	-	-	-	-	-	-	Need improved national sediment data base - nonpoint source or CERCLA programs may help.
√	√	-	-	-	-	-	-	-	Need on-line, real-time technical support and guidance on assessment, remediation, monitoring, and modelling for "very hot spots" and "moderate hot spots."
√	√	√	-	-	-	-	-	-	Need better interagency (state and federal) cooperation in assessment, planning, remediation and enforcement.
√	√	-	-	-	-	-	-	-	Improve approaches to involving PRPs in assessment and remediation of problems.
√	-	√	-	-	√	√	-	-	Need clarification on disposal issues.
√	√	√	-	-	-	-	-	-	Need prioritization of sediments for remediation.
√	√	√	-	-	-	-	√	-	Need enhanced remediation resources: Corps piggy-back, states, Superfund ranking revision, CWA §115, enforcement, Aquafund.
-	-	√	-	-	-	-	-	-	Need inventory of sediments tied into CWA §304(l).
√	√	√	-	-	-	-	-	-	Need overview on where sediments are a problem and are going to be a problem.
√	√	√	-	-	-	√	-	-	Need consistency on how to address problems.
-	-	-	-	-	-	-	-	-	Need more than one method of assessment: include chemical-specific, biological *community, and sediment toxicity tests.*
-	-	-	-	-	-	-	-	-	For verification, need field test of methods and a calibrated data set for intercomparisons.
-	-	-	-	-	-	-	-	-	Need assessment approaches that meet client needs.
-	-	-	-	-	-	-	-	-	Need specific guidance on the use of biological data, including community change, in assessments.
-	-	-	-	-	-	-	-	-	Develop data bases for comparing methods of classification.
-	-	√	-	-	-	-	-	-	Need to develop whole-effluent approach for sediments.
-	-	-	-	-	-	-	-	-	Determine how sediment properties affect bioavailability.
-	-	-	-	-	-	-	-	-	Determine sensitivity of biological effects models to interactions among contaminants.
-	-	-	-	-	-	-	-	-	Develop an understanding of human health and ecological implications of tissue residues.
-	-	-	-	-	-	-	-	-	Develop standardized toxicity tests.
-	-	-	-	-	-	-	-	-	Develop statistical techniques for use in benthic analysis.
-	-	-	-	-	-	-	-	-	Address effects of toxics and organic enrichment.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
–	–	–	–	–	–	–	–	–	Develop methodologies for carcinogenesis/mutagenesis.
–	–	–	–	–	–	–	–	–	Develop sediment-related toxicity data base.
–	–	–	–	–	–	–	–	–	Need guidance (sampling, monitoring, analysis) on major problem contaminants - include all information available from all approaches.
–	–	–	–	–	–	–	–	–	Need decisions on test methods and test requirements for States.
–	–	–	–	–	–	–	–	–	Hazard Ranking System moving toward adoption of human health parameter.
√	√	√	–	–	–	–	–	–	In setting management priorities, estimation of human and ecological risks necessary.
–	–	–	–	–	–	–	–	–	Clear need for test protocols and interpretive guidance.
√	√	√	–	–	–	–	–	–	Should action criteria be uniform national criteria?
–	–	–	–	–	–	–	–	–	Need biological damage potential index that includes benthic and bioassay techniques.
–	–	–	–	–	–	–	–	–	Sediment ranking should be guided by area's use, biological significance, and potential for biological damage.
–	–	–	–	–	–	–	–	–	Need technical, regulatory and policy information exchange.
√	√	√	–	–	–	–	–	–	Deciding what to do with marginal sediments is difficult: a finding of NY-NJ case study.
√	–	√	–	–	√	–	–	–	Need standards for confined disposal facilities.
√	√	√	–	–	–	–	–	–	For remediation decision, need technical and cost feasibility.
√	√	√	–	–	–	–	–	–	Determining "how clean is clean" is necessary for identifying clean-up targets.
–	–	–	–	–	–	–	–	–	Must have new dredge designs.
–	–	–	–	–	–	–	–	–	Need major effort to refine excavation techniques.
–	–	–	–	–	–	–	–	√	Use of more advanced European technologies is inhibited by US law and absence of definitive ecological damage data.
–	–	–	–	–	–	–	–	√	Creating a market for new dredge designs probably requires Congressional and COE cooperation.
–	–	–	–	–	–	–	–	–	Cost and other issues argue against national monitoring.
–	√	√	–	–	–	–	–	–	Many control alternatives are currently untested.
√	–	√	–	–	√	–	–	–	Puget Sound has three standards or guideline categories: 1) general sediment standards, 2) effluent guidelines for particulate limits, 3) unconfined disposal of dredged material.
√	–	√	–	–	–	–	–	–	Must have ability to distinguish and control sources.
–	–	√	–	–	–	–	–	–	EPA Region X includes sediment-related conditions in NPDES permits for Puget Sound area.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
–	–	√	–	–	–	–	–	–	Determining if single source responsible for contamination is major effort.
–	–	√	–	–	–	–	–	–	National Assessment data base may be useful in judging feasibility of back-tracking to one source.
–	–	√	–	–	–	–	√	–	Navigational dredging may become driving force behind decisions to excavate.
–	–	–	–	–	√	–	–	–	Sediment contamination is not being fully used by TSCA when considering new chemicals.
–	–	–	–	–	–	–	–	–	If sediments contaminated: what is contaminant, the concentration, total volume and origin?
√	√	√	–	–	–	–	–	–	Only three feasible remedial measures - removal (where is it put, who pays?), leave in place, cap it.
√	√	√	–	–	–	–	–	–	Problem with no action and capping is that sediments may be scoured from bottom and distributed over great areas, i.e., by hurricanes.
√	√	√	–	–	–	–	–	–	Nature of contamination, i.e., non-toxic (phosphorus / nitrogen) vs toxic (metals/ PAH) define different problems and different remedial actions.
√	√	√	–	–	–	–	–	–	Sediment contamination is a site-specific problem.
–	√	√	–	–	–	–	–	–	May be cases where new controls suppress toxic sources and natural sedimentation can bury the problems.
√	√	√	–	–	–	–	–	–	In short term, may want to remove only most egregious sediments, e.g., erosion containing biocides, or "hot spots."
–	–	–	–	–	–	–	–	–	Bulk sediment bioassays should be the standard method for toxicity and bioaccumulation potential.
–	–	–	–	–	–	–	–	–	Benthic test organisms should have continuous contact with sediment for test duration. Overlying water must be standardized.
–	–	–	–	–	–	–	–	–	Methods that produce dose-response functions in bulk sediments assays should be the standard.
–	–	–	–	–	–	–	–	–	Establish relationships among interstitial water, sediment elutriate, sediment extract toxicity and bulk sediment toxicity.
–	–	√	–	–	–	–	–	–	Use toxic component identification procedures with toxicity and bioaccumulation potential to provide chemical-specific targets to regulate wasteloads.
√	√	√	–	–	–	–	–	–	Develop method to relate risk for sediment organisms to human risk.
–	√	√	–	–	–	–	–	–	Develop integrated, multimedia approach to evaluate sources, transport, fate, exposure, bioaccumulation and effects of toxicants for site-specific cases.
–	–	√	–	–	–	–	–	–	Set interim sediment quality criteria guidelines using a whole-effluent, toxicity-based approach.
–	–	–	–	–	–	–	–	–	Place greater emphasis on study of vertical contamination and toxicity in sediment to evaluate remedial and preventative options.
–	–	√	–	–	–	–	–	–	Methods to measure and predict impact of sediment resuspension on water column require further development.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
√	√	√	–	–	–	–	–	–	Select demonstration sites to show Congress that active sediment remediation is an Agency priority, is possible, and is taking place.
–	–	√	–	–	–	–	–	–	Establish contaminant load/sediment relationship to determine whether environment is improving or if further regulatory action needed. Relationship should predict wasteload allocation and remediation benefits over time.
√	√	√	–	–	–	–	–	–	If contaminant loadings to system are continuing, the probability of successful, long-term remediation is decreased.
–	–	√	–	–	–	–	–	–	Pursue mass balance approach to determine extent of system loadings and whether sediments are source or sink of contaminants.
–	√	√	–	–	–	–	–	–	Develop a comprehensive, long-term strategy for remediation of contaminated sediments including 1) multi-faceted assessments, 2) prioritizing sites, 3) remedial goals, 4) likelihood of success, 5) evaluation of potential remedial actions, 6) use of remedial technologies, and 7) post-remedial audits.
√	√	√	–	–	–	–	√	–	Need an institutional framework so EPA and different government levels arrive at rational consensus on remediation of sites.
–	√	√	–	–	–	–	–	–	Need policy to integrate waste management practices and requirements in all environments to resolve cross-program inconsistencies.
–	–	–	–	–	–	–	–	–	Problems applying RCRA technical procedures to classify aquatic sediments: EP test does not characterize true toxicity potential, RCRA not designed to address large volumes of low-concentration waste.
–	–	–	–	–	–	–	–	–	Suggest different classes of sediment quality, e.g., water body class system.
–	√	√	–	–	–	–	–	–	Ways to identify best management alternatives for site: 1) cost/benefit analysis, 2) funding availability, 3) technical feasibility of implementation, 4) EIS alternatives, 5) timing of clean-up.
–	√	√	–	–	–	–	–	–	When is "no action" best alternative: 1) low mobilty of toxics, 2) high cost of remediation, 3) adverse short-term environmental impacts from remediation, 4) institutional constraints to remediation.
–	–	–	–	–	–	–	–	–	How should risks associated with open-water, nearshore, and upland disposal be compared?
–	√	–	–	–	–	–	–	–	Need to waive "contagious" liability under CERCLA/SARA to facilitate clean-up and encourage clean-up contribution from navigational actions.
–	√	–	–	–	–	–	√	–	COE has no authority for clean-up of sediments.
–	√	√	–	–	–	–	–	–	Relationship of RCRA, TSCA, CERCLA, CWA and MPRSA merits development of multimedia waste management policy.
–	√	–	–	–	–	–	–	–	Permanent remedies need better definition in acknowledging limitation on sediment disposal.
–	√	–	–	–	–	–	–	–	Conducting remedial action on-site is impractical - may be precluded by navigation, high energy environments, or public perception.
–	√	–	–	–	–	–	–	–	Relying on accepted engineering practices conflicts with the need to consider innovative technologies for remedial action.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
–	√	√	–	–	–	–	–	–	Mitigation (source control) policies should be considered when considering management alternatives.
–	√	√	–	–	–	–	–	–	No-action alternative often selected when disposal sites unavailable, Superfund liability overshadows navigational benefits, or solutions are not affordable.
–	√	√	–	–	–	–	–	–	Two types of no action: no source control with sediment remedial action; source control with no sediment action.
–	√	√	–	–	–	–	–	–	Short-term habitat loss should be considered when weighing alternatives.
–	√	√	–	–	–	–	–	–	Short-term impacts are manageable relative to long-term *in-situ* risks of no action.
–	√	–	–	–	–	–	–	–	Clean up consideration: are contaminants in a biologically active zone or are they isolated?
–	√	√	–	–	–	–	–	–	Clean-up issue: consider sediment recovery time resulting from sediment deposition, source control, and mixing in surface sediment layer.
–	√	–	–	–	–	–	–	–	NRDA should be viewed as a useful tool to assess no-action alternative. NRDA results should provide evidence of ecological harm and identify resource users.
–	√	√	–	–	–	–	–	–	Costs and institutional constraints can also lead to the no-action alternative.
–	√	√	–	–	–	–	–	–	It is inefficient for all projects to consider every remedial technology.
–	√	–	–	–	–	–	–	–	Many dredging/disposal technologies only worth considering for smaller volumes or for sediments with highly mobile contaminants.
–	–	–	–	–	–	–	–	–	Conventionally available dredge equipment often suffices for remedial actions.
–	–	–	–	–	–	–	–	–	Specialty dredges may be necessary at times, e.g., dredging around structures.
–	√	–	–	–	–	–	–	–	Cap design must accommodate episodic events, bioturbation, diffusion of contaminants.
–	√	–	–	–	–	–	–	–	Two major alternatives: dredging and disposal, dredging/treatment/disposal. Material volume primary constraint on alternative selection.
–	√	–	–	–	–	–	–	–	*In-situ* containment: inappropriate for navigation channels, public perception problem for material contained, often need more than simple sand cap.
–	√	–	–	–	–	–	–	–	Institutional controls – use or access restrictions, monitoring, education programs – are necessary components of remediation but not sufficient since they don't discourage frequent user and often ignore unresolved problems.
–	–	–	–	–	–	–	–	–	Disposal options - on-site or off-site CAD, nearshore or land disposal, ocean disposal.
–	–	–	–	–	–	–	–	–	Dispersive ocean disposal should be considered. Advantages: reduced human health exposure, reduced concentration through dispersion. Disadvantages: uncertain accountability and public perception.
–	–	–	–	–	–	–	–	–	Risk quantification is a useful tool for evaluating assumptions, but resulting numbers not a good way of expressing risks to public.
–	√	√	–	–	–	–	–	–	Need detailed approach to identify preferred method. CERCLA guidance for clean-up and COE/WES's Dredged Material Alternative Selection Strategy may help.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
-	√	√	-	-	-	-	-	-	Decision guidance for selecting best alternative should clearly define when, where, and how costs are considered.
-	-	-	-	-	-	-	-	-	Need demonstration project on most contaminated material to prove remedial actions feasible, to accelerate clean-up projects, to enhance public relations.
-	√	√	-	-	-	-	-	-	Quantifying selection process - strictly quantitative or narrative? Alternatives should be expressed relatively, not as absolute criteria.
-	-	-	-	-	-	-	-	-	Clean-up program - need improved information transfer procedures, possibly coordination requirements.
-	√	√	-	-	-	-	-	-	Alternatives evaluation not "bottom line" solutions but rather process for identifying implications of key assumptions and developing informed decision.
-	√	√	-	-	-	-	-	-	100% source control unlikely. Initiating remedial action before source control fully implemented may be desirable.
-	√	√	-	-	-	-	-	-	Best management alternative - consider combinations of institutional controls, source controls, navigational dredging, and if necessary, sediment remedial action.
-	-	√	-	-	-	-	-	-	Sediment regulations should also apply to floodplains, wetlands, tidal flats, ephemeral and intermittent water bodies.
-	-	√	-	-	-	-	-	-	Define aquatic environment as including 100-year floodplain.
-	-	-	-	-	-	-	-	-	100-year floodplains contain majority of contaminated areas.
-	-	-	-	-	-	-	-	-	Bioassay obviously inappropriate for floodplains, maybe only equilibrium partitioning can be used.
-	-	-	-	-	-	-	-	-	Equilibrium partitioning approach problematic in ephemeral water bodies - concentrations in sediments vary widely with flow. When dry, sediment could exceed criteria.
-	-	-	-	-	-	-	-	-	Regulation could cause upstream operation to cease even though no environmental damage caused. Normalizing concentrations (e.g., to carbon content) may reduce effect although overall impact of normalizing in this context is unclear.
-	-	-	-	-	-	-	-	-	Using equilibrium partitioning is difficult because sediment concentrations vary by orders of magnitude over very short distances.
-	-	-	-	-	-	-	-	-	To cope with spatial variability, use a multi-tiered standard.
-	-	-	-	-	-	-	-	-	Tiered approach - Equilibrium partitioning used as preliminary indicator. Peak allowable concentration set on mortality. Second tier based on average concentration and mutagenicity.
-	-	-	-	-	-	-	-	-	Turbulence will affect sediment composition and sampling results. Sampling criteria must consider seasonal H_2O [O_2] shifts and sediment size relationships to contaminant affinity.
-	-	-	-	-	-	-	-	-	Sediment criteria should be biologically based.
-	-	√	-	-	-	-	-	-	Thorny jurisdictional and regulatory problems surround contaminated sediments in 100-year floodplains due to location of people and agriculture.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
–	–	–	–	–	–	–	–	–	Communication is key to coordination with local officials and public.
–	–	–	–	–	–	–	–	–	There is need to increase coordination among all involved agencies.
–	–	–	–	–	–	–	–	√	Jones Act restriction on foreign hulls can be resolved by moving dredge to a U.S. hull.
–	–	–	–	–	–	–	–	–	States and counties have frequently objected to selected alternatives relatively late in process.
–	√	–	–	–	–	–	–	–	Anticipate local or state concern by not dismissing any reasonable alternative.
–	–	–	–	–	–	–	–	–	Enhance communication with state/county and federal agencies via interagency groups or bioassessment groups.
–	√	–	–	–	–	–	–	–	Raise NRDA issues early. PRPs may be reluctant to remediate before NRDA is resolved.
–	–	–	–	–	–	–	–	–	Need early involvement of resource agencies.
–	√	–	–	–	–	–	–	–	Resource agencies, i.e., DOI, need to develop Type A and Type B models so they can respond to NRDA issues.
–	–	–	–	–	–	–	–	–	Resource agencies need to be on same time frame as regulatory agencies. PNRSs may be useful way to ensure timely involvement.
–	√	–	–	–	–	–	–	–	Relationships with PRPs can be improved via early involvement, communicating potential responsibilities and keeping litigation option open.
–	–	–	–	–	–	–	–	–	Risk communication is increasingly important issue for toxic sediment problems during implementation. Evaluation should not be limited to cancer risks, include non-cancer and environmental risks.
–	√	√	–	–	–	–	–	–	Implementation takes too long!
–	–	√	–	–	–	–	–	–	In case of immediate threat, need flexibility to take action in separate operable units.
–	–	√	–	–	–	–	–	–	Need criteria to measure success and monitoring to evaluate effectiveness of action on a site-specific basis.
–	–	√	–	–	–	–	–	–	Measuring success of remediation: chemistry data alone are appropriate for smaller sites but biological data are desirable for larger sites, especially if fish and shellfish resources contaminated.
–	–	–	–	–	–	–	–	–	If response to remediation not as expected, check remedy execution and structure; evaluate fundamental assumptions and predictive relationships; check for re-opener in consent judgement.
–	√	√	–	–	–	–	–	–	Changing regulations during implementation is a major constraint - happened in Hudson River and Everett Navy Home Port cases.
–	–	√	–	–	–	–	–	–	Multiagency enforcement groups (i.e., Urban Bay Action Teams- Puget Sound) may help address unregulated or nonpoint contaminant sources.
–	–	√	–	–	–	–	–	–	Need analytical tools to determine influence of source controls on magnitude and extent of sediment contamination to determine if sediment contamination will return if a certain sediment alternative is implemented.
–	√	√	–	–	–	–	–	–	CERCLA/SARA and CWA have been useful in pursuing actions and for funding.

Table A-1. Relationship between Comments and Environmental Statutes (continued).

RCRA	CERCLA	CWA	CAA	FIFRA	TSCA	MPRSA	RHA	Jones	Comment
–	–	√	–	–	–	–	–	–	Increased coordinated enforcement between state and federal agencies may be useful in obtaining appropriate remedies and funding.
–	√	√	–	–	–	–	–	–	If funded, CWA §115 potentially useful for clean-up actions and may be quicker and more efficient than CERCLA in some cases.
–	–	√	–	–	–	–	–	–	May be substantial opportunities to piggy-back toxic sediment removal projects onto COE maintenance dredging projects. CWA §115 may be source of additional funding, if needed.

Table A-2. Relationship between Comments and Activities.

F	E	P	R	D	O	Comment (*See last page of table for key.*)
–	–	–	–	–	√	Is EPA going to be given one independent piece of legislation like Aquafund?
–	–	–	–	–	√	Is sediment contamination a big enough environmental problem to justify the criteria, programmatic and regulatory effort?
–	√	–	–	–	–	Should quality criteria be the same for water as sediment?
–	√	–	√	–	–	Will sediment quality criteria be ARARs?
–	√	–	–	–	–	Can we address toxics in sediments with the current Hazard Ranking System?
–	√	–	–	–	–	How should toxicity tests be used in developing the criteria?
–	√	–	–	–	–	How should information on biological impacts due to toxics be factored into toxics criteria?
–	–	√	–	–	–	Will sediment quality criteria be legally defensible if used in the same way as water quality criteria for NPDES permits?
–	–	√	–	–	–	Will technical people treat sediment criteria as advisories?
–	–	√	√	√	–	Under what conditions is capping the preferred alternative?
–	√	–	–	–	–	Quantitative risk assessment can only be done on a site-specific basis.
–	–	√	√	√	–	Should sites be managed locally with site-specific steering committees?
–	–	–	–	–	√	Is a major technical transfer effort really needed?
–	–	–	–	–	√	What is best method of communicating that EPA believes sediment contamination is a site-by-site problem when there are national criteria for some chemicals?
–	√	–	–	–	–	Are there major conflicts between Apparent Effects Threshold and Equilibrium Partitioning?
–	√	–	–	–	√	Beyond Science Advisory Board review, are additional public/peer reviews indicated?
–	–	–	–	–	√	What is EPA's strategy for discussing methodology with States before it becomes final?
–	–	√	√	√	–	What is the potential impact of the numbers generated so far?
–	√	–	–	–	–	What are the major contaminants not covered by either Apparent Effects Threshold or Equilibrium Partitioning?
–	√	–	–	–	–	How can metals be managed when methods won't yield values for another year?
–	√	–	–	–	–	Are there surrogate methods for metals we have not anticipated or pursued? Do States (NY) or Regions have other methods?
–	–	–	–	–	√	Who should work with States on methodological issues?
–	√	–	–	–	√	Is it possible to separate technical questions from policy considerations?
–	√	–	–	–	√	Should the policy analysis separate chemical-specific problems from chemical mixture problems?
√	–	√	√	√	–	Look at CERCLA's site-specific field instructions prior to developing guidance.
√	√	√	√	√	–	Need national site-specific assessment to understand breadth of potential biological effects.
√	√	–	–	–	–	Should sediment contamination situations be classified?
–	√	–	–	–	–	How should water quality data bases be used in deciding "how clean is clean?"

Table A-2. Relationship between Comments and Activities.

F	E	P	R	D	O	Comment (*See last page of table for key.*)
_	_	_	_	√	_	Learn from Ministry of the Environment-Canada and OMEP/COE manual on assessments for dredge material disposal options.
_	_	√	√	√	_	Is it politically feasible to have four remediation options: 1) do nothing, 2) worry a little and continue to look, 3) consider a variety of alternatives, 4) dredge at all costs and stop inputs?
_	_	√	√	√	_	What cost models are needed to evaluate trade-offs between sediment remediation and controlling inputs?
_	_	_	√	√	√	What is role of quantitative risk assessment in developing a solution to a site-specific problem?
_	_	√	√	√	_	Is zero discharge the cost-effective long-term solution for contamination resulting from low-level discharges over many years?
_	_	√	√	√	_	How are costs of different options estimated?
_	_	_	√	_	_	European dredging technologies are perceived to be better for removal of contaminated sediments than US methods.
_	_	_	√	_	_	Is Jones Act and/or COE inertia the barrier to implementation of European methods?
_	_	√	_	_	_	Need case studies to show that controlling sources works.
_	_	√	√	_	_	Is it feasible not to remediate until sources have been controlled?
_	_	√	_	_	_	Need evidence that very low discharges from multiple sources actually contaminate sediments.
_	_	√	_	_	_	Is zero discharge the only chance of not recontaminating?
_	_	√	_	_	_	Is zero discharge an abstract concept that is not relevant?
_	_	√	_	_	_	Have any wasteload allocations resulted in very low allowable discharges for some chemicals?
_	_	√	√	_	√	How can the public be convinced that source prevention is preferable to sediment remediation?
_	_	_	_	_	√	What information exists on Aquafund?
_	_	_	√	_	_	Will remediation be driven by the COE navigation dredging program?
_	_	_	√	_	_	Is new legislation required for COE to dredge contaminated sediment for other than navigation reasons?
_	_	_	√	_	_	Superfund clean-up is slow. Need to define whether delays have been driven by technical gaps or strategies to avoid corporate liability.
√	_	√	_	_	_	Is a national inventory of contaminated sediments valuable? It won't explain the degree to which source control prevents sediment contamination.
_	_	√	_	_	√	To prove their value, should focus Agency resources on examining situations where source controls have reduced sediment contamination loads.
√	_	_	√	_	_	A national inventory of contaminated sites would be helpful in determining relative contamination of sites.
√	√	_	_	_	_	National assessment needs consistent methodology. Since only existing national inventory uses Equilibrium Partitioning, need to assess sites by measuring chemical concentration relative to Equilibrium Partitioning value. Hence need field verification of criteria and criteria limitations.
√	_	_	_	_	_	If National Assessment done, it should address different types of geological environments and their component chemical mixtures. This information has potential for predictive application.

Table A-2. Relationship between Comments and Activities.

E	E	P	R	D	O	Comment (See last page of table for key.)
_	√	_	_	_	_	Sediment quality assessment methods for use in management: 1) sediment quality triad, 2) apparent effects threshold, 3) sediment bioassay, 4) infauna community structure, 5) screening level concentrations, 6) equilibrium partitioning.
_	√	√	_	_	_	Sedimentation degrades aquatic habitat through physical smothering.
_	√	_	_	_	_	Sediment contamination is manifested in habitat loss, fish bioaccumulation, and isolated point sources.
_	_	√	_	_	_	In Region VII, sediment information is factored into NPS assessment and management programs, program reviews, monitoring decisions, 304(l) negotiations, and state fishing bans.
_	_	_	_	_	√	Lake Ontario - comparing present sediment with pre-colonial sediment shows increased Cd, Cu, Cr, Fe, Ni, Pb, Zn and very high Hg levels.
_	√	_	_	_	_	Sediment oxygen demand is most significant cause of hypoxia in Long Island Sound.
_	√	_	_	_	_	Mercury in Lake Onandaga sediments bioaccumulates in sport fish causing fishing advisories.
_	√	_	_	_	_	Lake Ontario - Eleven toxics found in fish tissues and/or water column exceeding standards. Five of them are banned. Suspect lake sediments act as reservoir for toxics causing continued excedences.
_	_	√	√	_	_	Discussions on toxic pollutants in Lake Ontario include chronology, burial, removal, mobilization, dredging.
_	√	_	_	_	_	Role of sediments as a contaminant source is poorly understood.
_	_	√	√	_	_	Research needed to better predict natural capping of contaminated sediment.
_	_	√	_	_	√	Decrease in sediment contamination in Lake Ontario coincided with decreased loadings due to bans, restrictions and reduced production.
_	√	_	_	_	_	Possible sediment criteria uses - 1) sediment contaminant impact assessment, 2) site inventory screening, 3) prioritize sites for investigation or remediation, 4) perspective for development and use of national data base, 5) clarify disposal issues.
√	_	_	_	_	√	National assessment creates consistency - consistency with States, Superfund site ranking and remediation, navigational dredging site review, enforcement.
_	√	_	_	_	_	Problems with sediment criteria: still in development, far from promulgation, multiplicity of approaches, lack of agreement on best, don't replace case by case assessment, don't replace modelling or simulation, maybe sediments aren't the problem they seem, legally defensible?, exaggerate or underestimate problems.
_	_	√	√	_	_	Barriers to effective sediment assessment and control program: lack of effective control techniques, lack of effective federal control program and mechanisms.
_	_	_	√	_	_	COE dredging program has institutional and political barriers to solving sediment control problems.
_	√	_	_	_	√	There is a perception of contaminated sediments as an aquatic life problem not a human health one.
_	_	√	_	_	√	There are grossly inadequate State and federal programs for CSO and stormwater control.
_	_	√	_	_	_	There are few good preventative tools for NPS.

Table A-2. Relationship between Comments and Activities.

E	E	P	R	D	O	Comment (*See last page of table for key.*)
_	_	√	√	_	_	There are few good clean-up goals.
√	√	√	√	√	√	Need better understanding of national, regional, and local scopes of contamination problems.
_	_	_	_	_	√	Need adequate funding and resources for federal/state program development.
_	_	√	√	_	_	Transboundary and cross-media transfers of pollutant loads confuse preventative and remediative options.
_	√	_	_	_	_	Should EPA's focus for controlling sediment contaminants be based on human health, ecosystem health, or both?
_	√	√	_	_	_	Should tissue residue criteria for protecting aquatic life and its uses be incorporated into water quality criteria documents? If yes, guidance needed for criteria use and deviations.
_	√	_	_	_	_	How will sediment criteria be connected to wasteload allocation process?
_	√	_	_	_	_	Can sediment criteria be based on both generic and site-specific methods?
_	√	_	_	_	_	Develop sediment criteria based on residue-toxicity relationships for sensitive organisms to set safe contaminant levels on either site-specific or ecosystem basis.
_	√	_	_	_	_	Develop standard chronic toxicity testing procedures for several taxa and life styles of sediment associated organisms.
_	√	_	_	_	_	Develop procedures for deriving sediment criteria to protect wildlife and humans from adverse exposure via aquatic food chains.
_	√	_	_	_	_	Evaluate and/or demonstrate protectiveness of selected sediment criteria on a site-specific or ecosystem basis.
_	√	√	_	_	_	Develop procedures to identify specific chemicals causing sediment toxicity.
_	√	_	_	_	_	To focus EPA regulatory effort, determine extent of ammonia toxicity versus contaminant toxicity associated with organic sediments.
_	√	_	_	_	_	How is the combined impact of chemical mixtures determined?
_	√	_	_	_	_	Can aquatic ecosystems with contaminated sediments be protected by reference site evaluations or must broader areas be surveyed?
_	√	_	_	_	_	Using residue approach, what chemicals and mixtures in sediments can be evaluated for toxic effects?
_	_	√	_	√	_	Use national criteria to help States establish standards for pollutants. Useful in regulating point sources, NPS and dredge disposal.
_	√	_	_	_	_	Sediment criteria will increase monitoring of sediments and increase knowledge of condition of a water body.
_	_	√	√	√	_	What is known about the impact of remediation options?
_	_	_	√	_	_	Policy should include assessment of risks of remediation options.
_	_	√	_	_	√	Should a strategy be developed to identify and control both point and nonpoint sources of sediment contaminants? Is there enough information to make a rational decision?
_	_	√	√	_	_	Water bodies that may benefit from sediment criteria: 1) those associated with CERCLA or RCRA sites, 2) those receiving chlorine bleached pulp and paper mill effluents, 3) those on 304(l) list, 4) those with fish advisories, 5) those with documented toxic sediments.

Table A-2. Relationship between Comments and Activities.

E	E	P	R	D	O	Comment *(See last page of table for key.)*
-	√	-	-	-	-	Protection of benthic organisms is important relative to the "fishable" goal of CWA and justification of need for sediment criteria.
-	-	√	√	√	√	Site managers need guidance document that provides - sampling plan, types of samples to take, relative and technical costs, available methods and what they provide, data use and its legality in court.
-	√	-	-	-	√	Site managers need guidance on establishing, comparing and interpreting risk of no action and various clean-up options.
-	√	-	-	-	-	Need framework to provide standards for sediment tools, methods and applications, for sediment categories and for specific site types.
-	√	-	-	-	-	Need sediment criteria and indices with defined, specific uses and credibility boundaries for different sediment scenarios.
-	-	√	√	-	√	Suggest a sediment SWAT team of experts be involved in all phases to record the remedial action and its effectiveness.
-	-	-	√	-	-	Need sediment remediation data bank that includes case studies on the success of various remedial actions.
-	-	-	-	-	√	Need better information exchange.
-	√	-	-	-	-	Need practical guidance on sediment assessment using criteria or advisory numbers.
√	-	-	-	-	-	Need improved national sediment data base - NPS or CERCLA programs may help.
-	√	√	√	√	√	Need on-line, real-time technical support and guidance on assessment, remediation, monitoring, and modelling for "very hot spots" and "moderate hot spots."
-	√	√	√	-	√	Need better interagency (state and federal) cooperation in assessment, planning, remediation and enforcement.
-	-	-	√	-	√	Improve approaches in involving PRPs in assessment and remediation of problems.
-	-	-	-	√	-	Need clarification on disposal issues.
-	-	-	√	-	√	Need prioritization of sediments for remediation.
-	-	-	√	-	√	Need enhanced remediation resources: Corps piggy-back, states, Superfund ranking revision, CWA § 115, enforcement, Aquafund.
√	-	-	-	-	-	Need inventory of sediments tied into CWA § 304(l).
√	-	-	-	-	-	Need overview on where sediments are a problem and going to be a problem.
-	-	√	√	√	√	Need consistency on how to address problems.
-	√	-	-	-	-	Need more than one method of assessment: include chemical-specific, biological community, and sediment toxicity tests.
-	√	-	-	-	-	For verification, need field test of methods and a calibrated data set for intercomparisons.
-	√	-	-	-	-	Need assessment approaches meet client needs.
-	√	-	-	-	-	Need specific guidance on the use of biological data, including community change, in assessments.
-	√	-	-	-	-	Develop data bases for comparing methods of classification to address shortcomings.
-	√	-	-	-	-	Need to develop whole-effluent approach for sediments:
-	√	-	-	-	-	Determine how sediment properties affect bioavailability.

Table A-2. Relationship between Comments and Activities.

F	E	P	R	D	O	Comment *(See last page of table for key.)*
_	√	_	_	_	_	Determine sensitivity of biological effects models to interactions among contaminants.
_	√	_	_	_	_	Develop an understanding of human health and ecological implications of tissue residues.
_	√	_	_	_	_	Develop standardized toxicity tests.
_	√	_	_	_	_	Develop statistical techniques for use in benthic analysis.
_	√	_	_	_	_	Address effects of toxics and organic enrichment.
_	√	_	_	_	_	Develop methodologies for carcinogenesis/mutagenesis.
_	√	_	_	_	_	Develop sediment-related toxicity data base.
√	_	_	_	_	√	Need guidance (sampling, monitoring, analysis) on major problem contaminants - include all information available from all approaches.
_	√	_	_	_	_	Need decisions on test methods and test requirements for States.
_	√	_	_	_	_	Hazard Ranking System moving toward adoption of human health parameter.
_	√	√	√	√	_	In setting management priorities, estimation of human and ecological risks necessary.
_	√	_	_	_	_	Clear need for test protocols and interpretive guidance.
_	_	√	√	√	√	Should action criteria be uniform national criteria?
_	√	_	_	_	_	Need biological damage potential index that includes benthic and bioassay techniques.
_	√	_	_	_	_	Sediment ranking should be guided by area's use, biological significance, and potential for biological damage.
_	_	_	_	_	√	Need technical, regulatory and policy information exchange.
_	_	√	√	√	_	Deciding what to do with marginal sediments is difficult: a finding of NY-NJ case study.
_	_	_	_	√	_	Need standards for confined disposal facilities.
_	_	_	√	√	_	For remediation decision, need technical and cost feasibility.
_	√	√	√	√	_	Determining "how clean is clean" necessary for identifying clean-up targets.
_	_	_	√	_	_	Must have new dredge designs.
_	_	_	√	_	_	Need major effort to refine excavation techniques.
_	_	_	√	_	_	Use of more advanced European technologies is inhibited by US by law and absence of definitive ecological damage data.
_	_	_	√	_	_	Creating a market for new dredge designs probably requires Congressional and COE cooperation.
√	_	_	_	_	_	Cost and other issues argue against National monitoring.
_	_	√	√	√	_	Many control alternatives are currently untested.
_	_	√	√	√	_	Puget Sound has three standards or guideline categories: 1) general sediment standards, 2) effluent guidelines for particulate limits, 3) unconfined disposal of dredged material.
_	_	√	_	_	_	Must have ability to distinguish and control sources.
_	_	√	_	_	_	EPA region X includes sediment-related conditions in NPDES permits for Puget Sound area.
_	_	√	_	_	_	Determining if single source responsible for contamination is major research effort.

Table A-2. Relationship between Comments and Activities.

F	E	P	R	D	O	Comment *(See last page of table for key.)*
_	√	√	_	_	_	Need to measure impacts on populations of endangered and threatened species
_	_	_	√	_	_	What if the remedial action damages habitat of threatened or endangered species?
_	_	√	_	_	_	Many dischargers are facing stringent water quality-based effluent limits which will be made more stringent by sediment quality criteria. Can dischargers comply with the lower limits?
_	_	√	_	_	_	Will zero discharge be required to meet sediment quality criteria?
_	√	_	_	_	_	State-of-the-art sediment-water-biota geo/biochemical interaction is not developed such that numerical sediment quality criteria are feasible.
√	_	√	_	_	_	National Assessment data base may be useful in judging feasibility of back-tracking to one source.
_	_	_	√	_	_	Navigational dredging may become driving force behind decisions to excavate.
_	_	√	_	_	_	Sediment contamination is not being fully used by TSCA when considering new chemicals.
_	√	√	√	_	_	If sediments contaminated: what is contaminant, the concentration, total volume and origin?
_	_	_	√	√	_	Only three feasible remedial measures - removal (where is it put, who pays?), leave in place, cap it.
_	_	_	√	_	_	Problem with no action and capping is that sediments may be scoured from bottom and distributed over great areas, i.e., by hurricanes.
_	_	√	√	√	_	Nature of contamination, i.e., non-toxic (phosphorus/nitrogen) vs toxic (metals/ PAH) define different problems and different remedial actions.
_	√	√	√	√	_	Sediment contamination is a site-specific problem.
_	_	√	√	_	_	May be cases where forthcoming controls suppress toxic sources and natural sedimentation can bury the problems.
_	_	_	√	_	_	In short term, may want to remove only most egregious sediments that are being renewed, e.g., erosion containing biocides, or "hot spots."
_	√	_	_	_	_	Bulk sediment bioassays should be the standard method for toxicity and bioaccumulation potential.
_	√	_	_	_	_	Benthic test organisms should have continuous contact with sediment for test duration. Overlying water must be standardized.
_	√	_	_	_	_	Methods that produce dose-response functions in bulk sediments assays should be the standard.
_	√	_	_	_	_	Establish relationship among interstitial water, sediment elutriate, sediment extract toxicity and bulk sediment toxicity.
_	√	√	_	_	_	Use toxic component identification procedures with toxicity and bioaccumulation potential to provide chemical-specific targets to regulate wasteloads.
_	√	_	_	_	_	Develop method to relate risk to benthic organisms to human risk.
_	√	√	√	√	√	Develop integrated, multimedia approach to evaluate sources, transport, fate, exposure, bioaccumulation and effects of toxicants for site-specific cases.
_	√	_	_	_	_	Set interim sediment quality criteria guidelines using a whole-effluent, toxicity-based approach.

Table A-2. Relationship between Comments and Activities.

E	E	P	R	D	O	Comment *(See last page of table for key.)*
_	√	_	_	_	_	Place greater emphasis on study of vertical contamination and toxicity in sediment to evaluate remedial and preventative options.
_	√	_	_	_	_	Methods to measure and predict impact of sediment resuspension on water column require further development.
_	_	_	√	_	√	Select demonstration sites to show Congress that active sediment remediation is an Agency priority, is possible, and is taking place.
_	_	√	_	_	_	Establish contaminant load/sediment relationship to determine whether environment is improving or if further regulatory action needed. Relationship should predict wasteload allocation and remediation benefits over time.
_	_	√	_	_	_	If contaminant loadings to system are continuing, the probability of successful, long-term remediation is decreased.
_	_	√	√	√	_	Pursue mass balance approach to determine extent of system loadings and whether sediments are source or sink of contaminants.
_	_	√	√	√	√	Develop a comprehensive, long-term strategy for remediation of contaminated sediments including 1) multi-faceted assessments, 2) prioritizing sites, 3) remedial goals, 4) likelihood of success, 5) evaluation of remedial actions, 6) use of remedial technologies, and 7) post-remedial audits.
_	_	√	√	√	√	Need an institutional framework so EPA and different government levels arrive at rational consensus on remediation of a site.
√	√	√	√	√	√	Need policy to integrate waste management practices and requirements in all environments to resolve cross-program inconsistencies.
_	√	√	√	√	_	Problems applying RCRA technical procedures to classify aquatic sediments: EP test does not characterize true toxicity potential, RCRA not designed to address large volumes of low concentration waste.
_	√	_	_	_	_	Suggest different classes of sediment quality, e.g., water body class system.
_	_	√	√	√	_	Ways to identify best management alternatives for site: 1) cost/benefit analysis, 2) funding availability, 3) implementation technical feasibility, 4) EIS of alternatives, 5) timing of clean-up.
_	_	√	√	√	_	When is "no action" best alternative: 1) low mobilty of toxics under current conditions, 2) high cost of remediation, 3) adverse short-term environmental impacts from remediation, 4) institutional constraints to remediation.
_	_	_	_	√	√	How should risks associated with open-water, nearshore, and upland disposal be compared?
_	_	_	√	√	_	Need to waive "contagious" liability under CERCLA/SARA to facilitate clean-up and encourage clean-up contribution from navigation actions.
_	_	_	√	_	_	COE has no authority for clean-up of sediments.
_	_	√	√	√	√	Relationship of RCRA, TSCA, CERCLA, CWA and MPRSA merits development of multimedia waste management policy.
_	_	_	√	√	_	Permanent remedies need better definition in acknowledging limitation on sediment disposal.
_	_	_	√	_	_	Conducting remedial action on-site is impractical - may be precluded by navigation, high energy environments, or public perception.

Table A-2. Relationship between Comments and Activities.

F	E	P	R	D	O	Comment (See last page of table for key.)
–	–	–	√	√	–	Relying on accepted engineering practices conflicts with need to consider innovative technologies for remedial action.
–	–	√	√	√	–	Mitigation (source control) policies should be considered when evaluating management alternatives.
–	–	√	√	√	–	No-action alternative often selected when disposal site unavailable, Superfund liability overshadows navigation benefits or solutions are not affordable.
–	–	√	√	–	–	Two types of no action: no source control with sediment remedial action, source control with no sediment action.
–	–	√	√	√	–	Short-term habitat loss should be considered when weighing alternatives.
–	–	√	√	√	–	Short-term impacts are manageable relative to long-term *in-situ* risks of no action.
–	–	√	√	–	–	Clean up consideration: are contaminants in a biologically active zone or are they isolated?
–	–	√	√	–	–	Clean up issue: consider sediment recovery time resulting from sediment deposition, source control, and mixing in surface sediment layer.
–	–	√	√	–	–	NRDA should be viewed as a useful tool to assess no-action alternative. NRDA results should provide evidence of ecological harm and identify resource users.
–	–	√	√	√	–	Costs and institutional constraints can also lead to the no-action alternative.
–	–	√	√	√	v	It is inefficient for all projects to reconsider every remedial technology.
–	–	–	√	√	–	Many dredging/disposal technologies only worth considering for smaller volumes or for sediments with highly mobile contaminants.
–	–	–	√	–	–	Conventionally available dredge equipment often suffices for remedial action.
–	–	–	√	–	–	Specialty dredges may be necessary at times, e.g., dredging around structures.
–	–	–	√	–	–	Cap design must accommodate episodic events, bioturbation, diffusion of contaminants.
–	–	–	√	√	–	Two major alternatives: dredging and disposal, dredging / treatment / disposal. Material volume primary constraint on alternatives.
–	–	–	√	√	–	*In-situ* containment: inappropriate for navigation channels, public perception problem for material contained, often need more than simple sand cap.
–	–	–	√	√	√	Institutional controls: use and access restrictions, monitoring, education programs – necessary component of remediation, but not sufficient since don't discourage frequent user and often ignore unresolved problems.
–	–	–	–	√	–	Disposal options - on-site or off-site CAD, nearshore or land disposal, ocean disposal.
–	–	–	–	√	–	Dispersive ocean disposal should be considered. Advantages: reduced human health exposure, reduced concentration, through dispersion. Disadvantages: uncertain accountability and public perception.
–	–	–	–	√	√	Risk quantification is a useful tool for evaluating assumptions, but resulting numbers not a good way of expressing risks to public.

Table A-2. Relationship between Comments and Activities.

E	E	P	R	D	O	Comment *(See last page of table for key.)*
–	–	√	√	√	√	Need detailed approach to identify preferred method. CERCLA guidance for clean-up and COE/WES's Dredged Material Alternative Selection Strategy may help.
–	–	√	√	√	√	Decision guidance for selecting best alternative should clearly define when, where, and how costs considered.
–	–	–	√	√	√	Need demonstration project now on most contaminated material to prove remedial actions feasible, to accelerate clean-up projects, enhance public relations.
–	√	√	√	√	√	Quantifying selection process - strictly quantitative or narrative? Alternatives should be expressed as relative indices not as absolute criteria.
–	–	√	√	√	√	Clean-up program - need improved information transfer procedures, possibly coordination requirements.
–	–	√	√	√	√	Alternatives evaluation not "bottom line" solutions but rather process for identifying implications of key assumptions and developing informed decision.
–	–	√	√	–	–	100% source control unlikely. Initiating remedial action before source control fully implemented may be desirable.
–	–	√	√	√	–	Best management alternative - consider combinations of institutional controls, source controls, navigation dredging, and if necessary, sediment remedial action.
–	√	√	√	–	–	Sediment regulations should also apply to floodplains, wetlands, tidal flats, ephemeral and intermittent water bodies.
–	√	√	√	–	–	Define aquatic environment as including 100-year floodplain.
√	–	–	–	–	–	100-year floodplains contain majority of contaminated areas.
–	√	–	–	–	–	Bioassay obviously inappropriate for floodplains, maybe only equilibrium partitioning can be used.
–	√	–	–	–	–	Equilibrium partitioning approach problematic in ephemeral water bodies - concentrations in sediments vary widely with flow. When dry, sediment could exceed criteria.
–	√	–	–	–	–	Regulation could cause upstream operation to cease even though no environmental damage caused. Normalizing concentrations (e.g., to carbon content) may reduce effect although overall impact of normalizing in this context is unclear.
–	√	–	–	–	–	Using equilibrium partitioning is difficult because sediment concentrations vary by orders of magnitude over very short distances.
–	√	–	–	–	–	To cope with spatial variability, use a multi-tiered standard.
–	√	–	–	–	–	Tiered approach - Equilibrium partitioning used as preliminary indicator. Peak allowable concentration set based on mortality. Second standard based on average concentration and mutagenicity.
–	√	–	–	–	–	Turbulence will affect sediment composition and sampling results. Sampling criteria must consider seasonal H_2O [O_2] shifts and sediment size relationships to contaminant affinity.
–	√	–	–	–	–	Sediment criteria should be biologically based.
–	–	√	√	–	–	Thorny jurisdictional and regulatory problems surround contaminated sediments in 100-year floodplain due to location of people and agriculture.
–	–	√	√	√	√	Communication is key to coordination with locals officials and public.
–	–	–	–	–	√	There is a definitive need to increase coordination among all involved agencies.

Table A-2. Relationship between Comments and Activities.

F	E	P	R	D	O	Comment *(See last page of table for key.)*
–	–	–	√	–	–	Jones Act restriction on foreign hulls can be resolved by moving dredge to a U.S. hull.
–	–	√	√	√	√	States and counties have frequently objected to selected alternatives relatively late in process.
–	–	√	√	√	√	Anticipate local or state concern by not dismissing any reasonable alternative.
–	–	√	√	√	√	Enhance communication with state/county and federal agencies via interagency groups or bioassessment groups.
–	–	–	√	–	–	Raise NRDA issues early. PRP may be reluctant to remediate before NRDA is resolved.
–	–	√	√	√	√	Need early involvement of resource agencies.
–	–	√	√	√	√	Resource agencies, i.e., DOI, needs to develop Type A and Type B models so they can respond to NRDA issues.
–	–	√	√	√	√	Resource agencies need to be on same time frame as regulatory agencies. PNRSs may be useful way to ensure timely involvement.
–	–	√	√	√	√	Relationships with PRPs can be improved via early involvement, communicating potential responsibilities and keeping litigation option open.
–	√	√	√	√	√	Risk communication is increasingly important issue for toxic sediment problems during implementation. Evaluation should not be limited to cancer risks, include non-cancer and environmental risks.
–	–	√	√	√	√	Implementation takes too long!
–	–	√	√	√	√	In case of immediate threat, need flexibility to implement actions in separate operable units.
–	√	√	√	√	–	Need criteria to measure success and monitoring to evaluate effectiveness of action on a site-specific basis.
–	√	√	√	√	–	Measuring success of remediation: chemistry data alone appropriate for smaller sites, but biological data desirable for larger sites, especially if fish and shellfish resources contaminated.
–	–	√	√	√	–	If response to remediation not as expected, check remedy execution and structure; evaluate fundamental assumptions and predictive relationships; check for re-opener in consent judgement.
–	√	√	√	√	√	Changing regulations during implementation is a major constraint - happened in Hudson River and Everett Navy Home Port cases.
–	–	√	–	–	√	Multiagency enforcement groups (i.e., Urban Bay Action Teams-Puget Sound) may help address unregulated or nonpoint contaminant sources.
–	√	√	√	–	–	Need analytical tools to determine influence of source controls on magnitude and extent of sediment contamination to determine if sediment contamination will return if a certain sediment alternative is implemented.
–	–	–	√	–	–	CERCLA/SARA and CWA have been useful in pursuing actions and for funding.
–	–	–	√	–	√	Increased coordinated enforcement between state and federal agencies may be useful in obtaining appropriate remedies and funding.
–	–	–	√	–	–	If ever funded, CWA §115 potentially useful for clean-up actions and may be quicker and more efficient than CERCLA in some cases.

Table A-2. Relationship between Comments and Activities.

F	E	P	R	D	O	Comment *(See last page of table for key.)*
–	–	–	√	–	–	May be substantial opportunities to piggy-back toxic sediment removal projects onto COE maintenance dredging projects. CWA §115 may be source of additional funding, if needed.

KEY:

- F Find potentially contaminated sediments.
- E Evaluate whether sediments are contaminated or not.
- P Preventive actions to be taken when sediment is contaminated.
- R Remediation actions to be taken when sediment is contaminated.
- D Disposal actions to be taken when dredged sediments must be disposed of.
- O Other considerations.