

PART 4

LIVING ON THE EDGE: ECONOMIC GROWTH AND RESOURCE CONSERVATION ALONG THE COAST

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MANAGING COASTS AND THEIR WATERSHEDS



The pressures of continuing growth are acutely felt in coastal areas. While largely attributable to activities taking place at the coast, some pressures originate hundreds of miles away in inland watersheds. To more effectively manage coasts, states need a stronger capacity to plan for and guide growth—one that incorporates a watershed approach to govern coastal and ocean resources. In addition, to assist states in such development and support the move toward an ecosystem-based management approach, federal area-based coastal programs should be consolidated to better integrate and capitalize on the strengths of each. Finally, to reach the goal of economically and environmentally sustainable development, changes should be made to federal programs that currently encourage inappropriate growth in fragile or hazard-prone areas.

Attracting Crowds, Creating Opportunities

While coastal watershed counties comprise less than 25 percent of the land area in the United States, they are home to more than 52 percent of the total U.S. population (Appendix C). A study of coastal population trends predicts average increases of 3,600 people a day moving to coastal counties, reaching a total population of 165 million by 2015.¹ These figures do not include the 180 million people who visit the coast every year.²

Population growth and tourism bring many benefits to coastal communities, including new jobs and businesses and enhanced educational opportunities. Burgeoning industries associated with tourism and recreation in coastal areas (such as hotels, resorts, restaurants, fishing and dive stores, vacation housing, marinas, and other retail businesses) have created one of the nation's largest and fastest-growing economic forces (Appendix C).

Implications of Growth

The popularity of ocean and coastal areas intensifies pressures on these environments, creating a number of challenges for managers and decision makers. Increased development puts more people and property at risk from coastal hazards (Chapter 10). Every year, millions of dollars are spent replenishing sand at the nation's beaches and protecting

Box 9.1 Coastal Activities Are Big Business

Across the country, more than 89 million people a year participate in marine-related recreation, such as swimming, scuba diving, surfing, motor boating, sailing, kayaking, and wildlife viewing.ⁱ In just four South Florida coastal counties, recreational diving, fishing, and ocean-watching activities generate \$4.4 billion in local sales and almost \$2 billion in local income annuallyⁱⁱ and more than 2.9 million people visit the Florida Keys each year.ⁱⁱⁱ During the summer of 2000, beach activities in Los Angeles and Orange counties stimulated an estimated \$1 billion in spending.^{iv} The Hawaiian Islands and many U.S. island territories are particularly dependent on tourism for their economic health. Hawaii alone attracts some 7 million tourists each year.^v In 2001, over 8 million people took to the sea aboard cruise ships, and approximately 135 million people visited the nation's aquariums and zoos.^{vi,vii} Although golf and tennis are recognized as major U.S. industries, it is estimated that more Americans participate in recreational fishing than in both of these sports combined.^{viii}

ⁱ Leeworthy, V.R., and P.C. Wiley. *Current Participation Patterns in Marine Recreation*. Silver Spring, MD: National Oceanic and Atmospheric Administration, 2001.

ⁱⁱ Johns, G.M., et al. *Socioeconomic Study of Reefs in Southeast Florida*. Silver Spring, MD: National Oceanic and Atmospheric Administration, 2001.

ⁱⁱⁱ Leeworthy, V.R., and P. Vanasse. *Economic Contribution of Recreating Visitors to the Florida Keys/Key West: Updates for Years 1996-97 and 1997-98*. Silver Spring, MD: National Oceanic and Atmospheric Administration, 1999.

^{iv} Hanemann, M., L. Pendleton, and D. Layton. *Summary Report on the Beach Expenditure Module*. Southern California Beach Valuation Project. Silver Spring, MD: National Oceanic and Atmospheric Administration, 2001.

^v Cesar, H., et al. *Economic Valuation of the Coral Reefs of Hawaii: Final Report (FY 2001-2002)*. Hawaii Coral Reef Initiative Research Program. National Oceanic and Atmospheric Administration and University of Hawaii, 2002.

^{vi} International Council of Cruise Lines. *The Cruise Industry: A Partner in North America's Economic Growth*. Arlington, VA, 2001.

^{vii} American Zoo and Aquarium Association. "The Collective Impact of America's Zoos and Aquariums." <www.aza.org/AboutAZA/CollectiveImpact1/> Accessed January 28, 2004.

^{viii} American Sportfishing Association. *Sportfishing in America: Values of Our Traditional Pastime*. Alexandria, VA, 2002.

coastal property from storms, waves, and erosion. Rising sea level exacerbates the damage to beaches and wetlands. The growth in development, coupled with greater protection for sensitive coastal habitats, also makes it increasingly difficult to maintain public access to beaches and coastal waters for swimming, fishing, and boating.

Poorly planned growth reduces and fragments fish and wildlife habitat (Chapter 11) and can alter sedimentation rates and flows (Chapter 12). It is also well understood that growth in coastal areas contributes to water pollution (Chapter 14), with impacts on fishing, swimming, and many other recreational and economic activities. One of the most serious impacts on ocean and coastal areas is the increasing amount of polluted runoff from urban, suburban, and agricultural areas, which is exacerbated by increases in impervious surfaces, such as roads, parking lots, sidewalks, and rooftops. Some evidence indicates that ecosystem health may be seriously impaired when the impervious area in a watershed reaches 10 percent, particularly in the absence of mitigating factors, such as a high percentage of wetlands or forest cover in the watershed, or urban stormwater best management practices such as riparian buffers along streams. If current coastal growth trends continue, many more watersheds will cross the 10 percent threshold over the next twenty-five years.³

Although the rate of population growth in coastal counties is not greater than in other areas of the country, the sheer number of people being added to fixed coastal land areas, combined with the fragile nature of coastal resources, create disproportionate impacts (Appendix C). In many cases, these impacts are destroying the very qualities that draw people to the coast.

The pattern of coastal growth—often in scattered and unplanned clusters of homes and businesses—is also significant. Urban sprawl increases the need for infrastructure such as roads, bridges, and sewers, degrading the coastal environment while making fragile or hazard-prone areas more accessible to development. Because of the connections between coastal and upland areas, development and sprawl that occur deep within the nation's watersheds also affect coastal resources.

Strengthening Coastal Planning and Management

Multi-layered Decision Making

A complex combination of individuals and institutions at all levels of government make decisions that cumulatively affect the nation's ocean and coastal areas. These institutional processes determine where to build infrastructure, encourage commerce, extract natural resources, dispose of wastes, and protect or restore environmental attributes.

Many of the decisions that affect the nation's coastal areas are made by local governments through land use planning, zoning, subdivision controls, and capital improvement plans. Local decisions are shaped in turn by state policies and requirements. Some coastal states have developed statewide goals and policies for transportation, land use, and natural resource protection, with a few states putting specific emphasis on coastal resources. Recognizing that sprawling patterns of growth are not sustainable, several coastal states have instituted programs intended to manage growth, including Maine, Oregon, Florida, Washington, and Maryland. By applying a variety of land use planning tools, techniques, and strategies, these programs attempt to steer growth toward existing population centers and away from fragile natural areas (Box 9.2).

Existing federal, state, tribal, and local institutional processes have made substantial progress in managing activities that affect the nation's coastal resources. However, local and state governments continue to face a number of obstacles in planning and managing the cumulative impacts of growth, including: disincentives to long-term planning due to the pressures of short political and business cycles; lack of shared values or political will; inadequate information, including locally relevant socioeconomic indicators; difficulty in addressing problems that cross multiple jurisdictions including upland areas; insufficient resources dedicated to protecting coastal ecosystems; and multiple institutions at different levels of government that address isolated aspects of connected problems. Improved policies for managing growth in coastal areas will be essential in protecting and restoring the natural resources that sustain the character and economies of coastal communities.

Although most coastal management activities take place at state and local levels, coastal decision making is also influenced by federal actions, including funding decisions and standard setting. Of the many federal programs that provide guidance and support for

Box 9.2 The Smart Growth Movement

For more than a decade, there has been a call for smart growth, characterized by more compact, land-conserving patterns of growth, through infill and reuse of building sites, pedestrian-friendly and transit-oriented development, and protection of green space. For example, in 1997, Maryland instituted a Smart Growth and Neighborhood Conservation Initiative, which tried to direct growth to more environmentally suitable areas and away from some of the state's most ecologically and economically important landscapes. Under this initiative, state agencies limited funding for infrastructure outside of designated growth areas. The Maryland experience provides one model of growth management for consideration by other state and local governments.

state and local decision making, some address the management of activities and resources within designated geographic areas, while others address the management of specific resources, such as fisheries or marine mammals.

Federal Area-based Coastal Programs

The major area-based coastal programs include the Coastal Zone Management Program, National Estuarine Research Reserve System, and National Marine Sanctuary Program of the National Oceanic and Atmospheric Administration (NOAA); the National Estuary Program of the U.S. Environmental Protection Agency (EPA); and the Coastal Program and Coastal Barrier Resources System of the U.S. Fish and Wildlife Service (USFWS). (These programs and others are also summarized in Appendix D.) In addition to their shared geographic focus, these programs are all implemented at the state and local level and highlight the importance of science, research, education, and outreach in improving the stewardship of ocean and coastal environments.

Coastal Zone Management Program

The Stratton Commission's 1969 report called for a national program to address development and environmental issues in coastal areas and to enhance the capacity of state and local governments to manage activities that affect these areas.⁴ Three years after that report's release, Congress enacted the Coastal Zone Management Act (CZMA), the federal government's principal tool for fostering comprehensive coastal management. The CZMA established a unique partnership between federal and coastal state governments, the primary goal of which is to balance the conservation of the coastal environment with the responsible development of economic and cultural interests.

Administered by NOAA, the CZMA provides two incentives for coastal states to voluntarily develop and conduct coastal management programs: federal grants and federal consistency authority. Federal consistency provisions require federal activities affecting the land, water, or natural resources of a state's coastal zone to be consistent with the enforceable policies specified in that state's approved coastal management program. (See Box 9.4 for an explanation of federal consistency.)

Currently, thirty-four of thirty-five coastal states and territories have coastal programs in place, covering 99 percent of the nation's marine and Great Lakes coastlines. The tools, assistance, and resources provided by the CZMA have enabled states and territories to increase their management capacity and improve decision making to enhance the condition of their coastal areas. These programs facilitate public access to ocean and coastal areas, protect people and property from coastal hazards, conserve critical natural resources, and stimulate economic development by revitalizing urban waterfronts and promoting coastal-dependent industries. The CZMA has also enhanced communication and coordination between federal and state governments and between state and local governments.

Under the CZMA, participating states are given the flexibility to design coastal management programs that address their individual priorities and the programs are approved as long as they meet certain minimum national guidelines. This flexibility has been hailed by many as the CZMA's greatest virtue and by others as its most serious shortcoming.

State-by-state implementation has resulted in wide variations in the strength and scope of state coastal management programs. NOAA has few options to ensure that the programs are meeting national guidelines other than withholding funding or withdrawing program approval. No state program has ever been disapproved. The geographic boundaries of state coastal management programs also differ greatly. The CZMA defines the coastal zone—the area subject to the enforceable policies of a state's program—as stretching from the seaward boundary of state ocean waters (generally 3 nautical miles) to the inland extent deemed necessary by each state to manage activities that affect its coastal resources. Individual state discretion regarding the landward reach of its coastal zone has

The Coastal Zone Management Act has helped immensely over the past 20 years, and I believe it still serves as the model, but new information on policy setting and an influx of financial resources are needed.

—Sarah Cooksey, Administrator, Delaware Coastal Program, testimony to the Commission, January 2002

Box 9.3 What Is a Coastal Watershed?

Everyone in the United States lives in a watershed. A watershed is a geographic area in which water flows on its way to a larger water body, such as a stream, river, estuary, lake, or ocean. The nation's coastal and ocean resources are affected not only by activities in coastal areas but also by those in upland watersheds.

A coastal watershed, as defined by the National Oceanic and Atmospheric Administration, is that portion of a watershed that includes the upstream extent of tidal influence. In the Great Lakes region, a coastal watershed includes the entire geographic area that drains into one of the lakes.ⁱ

ⁱ National Oceanic and Atmospheric Administration. *Coastal Zone Boundary Review. National Summary: State Characterization Reports*. Silver Spring, MD, October 1992.

resulted in major variations. For example, Florida, Delaware, Rhode Island, and Hawaii include the entire state in their coastal zones, while the inland boundary of California's coastal management program varies from a few hundred feet in urban areas to several miles in rural locales.

The CZMA can be strengthened by developing strong, specific, measurable goals and performance standards that reflect a growing understanding of ocean and coastal environments, the basic tenets of ecosystem-based management, and the need to manage growth in regions under pressure from coastal development. Other elements of the CZMA also need to be strengthened, including habitat restoration, community hazards planning and management, ocean management, and special area management planning. A large portion of federal support for the states should be linked to program performance, with additional incentives offered to states that perform exceptionally well. In addition, a fallback mechanism is needed to ensure that national goals are realized when a state does not adequately participate or perform.

The landside boundaries of state coastal management programs also need to be reconsidered. At a minimum, each state should set the inland extent of its coastal zone based on the boundaries of coastal watersheds (discussed in Chapter 1 and Box 9.3). In establishing new management areas, it is necessary for state programs to consider additional factors such as large or growing population centers, areas of considerable land use, and particularly sensitive natural resources, such as wetlands. Social and natural resource assessment and planning at the watershed scale should become a high priority in each state's program.

Funding for CZMA implementation remains a significant concern, having been capped at \$2 million per coastal state since 1992. This level hampers program implementation, limiting the states' ability to effectively carry out important program functions or expand to include coastal watersheds.

Recommendation 9-1

Congress should reauthorize the Coastal Zone Management Act (CZMA) to strengthen the planning and coordination capabilities of coastal states and enable them to incorporate a coastal watershed focus and more effectively manage growth. Amendments should include requirements for resource assessments, the development of measurable goals and performance measures, improved program evaluations, incentives for good performance and disincentives for inaction, and expanded boundaries that include coastal watersheds.

Specifically, CZMA amendments should address the following issues:

- **resource assessments**—State coastal management programs should provide for comprehensive periodic assessments of the state's natural, cultural, and economic coastal resources. These assessments will be critical in the development of broader regional ecosystem assessments, as recommended in Chapter 5.

- **goals**—State coastal management programs should develop measurable goals based on coastal resource assessments that are consistent with national and regional goals. State coastal programs should work with local governments, watershed groups, nongovernmental organizations, and other regional entities, including regional ocean councils, to develop these goals.
- **performance measures**—State coastal management programs should develop performance measures to monitor their progress toward achieving national, regional, and state goals.
- **evaluations**—State coastal management programs should continue to undergo periodic performance evaluations by the National Oceanic and Atmospheric Administration. In addition to the existing evaluation criteria, the performance measures developed by state programs should also be reviewed. The public, representatives of watershed groups, and applicable federal program representatives should participate in these program evaluations.
- **incentives**—Existing incentives for state participation—federal funding and federal consistency authority—should remain, but a substantial portion of the federal funding received by each state should be based on performance. Incentives should be offered to reward exceptional accomplishments, and disincentives should be applied to state coastal management programs that are not making satisfactory progress in achieving program goals.
- **boundaries**—Coastal states should extend the landward side of their coastal zone boundaries to encompass coastal watersheds. Mechanisms should also be established for coordinating with watershed management groups outside of a state's designated coastal zone boundary.

Coastal Barrier Resources System

The Coastal Barrier Resources Act established the John H. Chafee Coastal Barrier Resources System in 1982 to minimize the loss of human life, wasteful federal expenditures, and damage to fish, wildlife, and other natural resources associated with coastal barriers, such as barrier islands. Through this program, which is administered by USFWS, the federal government discourages development on designated coastal barriers in the Atlantic and Gulf coasts, Puerto Rico, the U.S. Virgin Islands, and the Great Lakes by restricting certain federal assistance, including flood insurance coverage, loans, funding for U.S. Army Corps of Engineers development projects, and construction of sewer systems, water supply systems, and transportation infrastructure. Nearly 1.3 million acres of land, wetlands, and water along the East Coast, Great Lakes, and Gulf of Mexico are part of the “full system unit,” with “otherwise protected areas” covering an additional 1.8 million acres of coastal barriers already held for conservation or recreational purposes. The program does not ban development in these areas; rather, it creates disincentives by denying federal subsidies and imposing the full costs of development on the developer or property owner.

National Estuarine Research Reserve System

The CZMA established the National Estuarine Sanctuaries Program in 1972 for the purpose of creating “natural field laboratories in which to study and gather data on the natural and human processes occurring within the estuaries of the coastal zone.” That program evolved into NOAA's National Estuarine Research Reserve System (NERRS), which provides funds to states for acquiring estuarine areas and developing and operating research facilities and educational and professional development programs. The NERRS program currently includes twenty-six reserves.

National Marine Sanctuary Program

In 1972, one hundred years after the first national park was created, a similar commitment was made to preserving marine treasures by establishing the National Marine Sanctuary Program within NOAA. Since then, thirteen national marine sanctuaries have been desig-

nated, representing a variety of ocean environments. The mission of the program is to serve as the trustee for these areas and to conserve, protect, and enhance their biodiversity, ecological integrity, and cultural legacy. Sanctuaries are designated for many objectives, ranging from protecting the breeding and calving grounds of humpback whales to preserving the remains of historic shipwrecks.

National Estuary Program

Created by the 1987 amendments to the Clean Water Act, the National Estuary Program (NEP) was established to improve the quality of estuaries of national importance. EPA administers the program, and provides funds and technical assistance to local stakeholders to develop plans for attaining or maintaining water quality in designated estuaries. The program requires stakeholders to develop a comprehensive conservation and management plan that includes measures for: protection of public water supplies; protection and propagation of fish, shellfish, and wildlife populations; allowance for recreational activities in and on the water; and control of point and nonpoint sources of pollution that supplements existing pollution control measures. Currently, twenty-eight estuaries are included in the program. In several cases, more than one state participates in a single NEP. In contrast to the CZMA's broad scope and focus on state and local government decisions throughout the coastal zone, the NEP concentrates on bringing together stakeholders in particular areas that are in or approaching a crisis situation.

The assessment and planning process used by the NEP holds promise for the future of ecosystem-based management. However, the low level of federal funding for the implementation of NEP plans limits their effectiveness, as do the intergovernmental obstacles that arise when an estuary spans multiple states.

Coastal Program of the U.S. Fish and Wildlife Service

Through its Coastal Program, the USFWS undertakes habitat conservation efforts in bays, estuaries, and watersheds along the U.S. coastline, including the Great Lakes. The program targets funding to sixteen high-priority coastal ecosystems, providing assessment and planning tools to identify priority sites for protection and restoration, conserving pristine coastal habitats through voluntary conservation easements and locally initiated land acquisition, and forming partnerships to restore degraded habitat.

Linking Area-based Programs

The area-based programs described above have made significant progress in managing coastal resources in particular locations, working with communities and decision makers in those areas, and fostering improved coordination between different levels of government. However, because these programs generally operate in isolation from one another, they cannot ensure effective management of all ocean and coastal resources or achievement of broad national goals. As NOAA is strengthened through the multi-phased approach described in Chapter 7, consolidation of area-based coastal resource management programs will result in more effective, unified strategies for managing these areas, an improved understanding of the ocean and coastal environment, and a basis for moving toward an ecosystem-based management approach.

Recommendation 9-2

Congress should consolidate area-based coastal management programs in a strengthened National Oceanic and Atmospheric Administration (NOAA), capitalizing on the strengths of each program. At a minimum, this should include bringing together the Coastal Zone Management and National Marine Sanctuary programs and the National Estuarine Research Reserve System, currently administered by NOAA, and additional coastal programs administered by other agencies, including the National Estuary Program, the John H. Chafee Coastal Barrier Resources System, and the U.S. Fish and Wildlife Service Coastal Program.

Other Relevant Federal Programs

In addition to the area-based programs discussed above, a number of other laws significantly affect coastal resources, including the National Environmental Policy Act, Clean Water Act, and Clean Air Act. Programs related to transportation, flood insurance, disaster relief, wetlands permitting, dredging, beach nourishment, shoreline protection, and taxation also exert a profound influence on the coast. While these laws and policies address specific issues, and have each provided societal benefits, in many cases federal activities under their purview have inadvertently led to degradation of coastal environments.

For example, road construction can have negative impacts on coastal areas and resources—including habitat destruction, increased runoff, and encouragement of inappropriate development—that could be mitigated if transportation infrastructure activities were implemented in the context of comprehensive, ecosystem-based goals and plans. Similarly, Federal Emergency Management Agency hazards-related programs may inadvertently encourage development in high-hazard, flood, and erosion areas (Chapter 10), and certain U.S. Army Corps of Engineers beach nourishment and shoreline protection programs can encourage growth in unsuitable areas (Chapters 11 and 12).

Regional coordination of federal agency activities, along with establishment of regional ocean councils and regional ocean information programs, as recommended in Chapter 5, would greatly improve federal project planning and implementation. Enhancing relationships among federal agencies, state coastal resource managers, and all decision makers would also help to ensure compatibility among the many activities that affect ocean and coastal environments.

Recommendation 9–3

The National Ocean Council should recommend changes to federal funding and infrastructure programs to discourage inappropriate growth in fragile or hazard-prone coastal areas and ensure consistency with national, regional, and state goals aimed at achieving economically and environmentally sustainable development.

Linking Coastal and Watershed Management

In recent years there has been a growing interest in watershed management. This approach acknowledges the hydrologic connections between upstream and downstream areas, including surface and groundwater interactions, and considers the cumulative impacts of all activities that take place throughout a watershed.

The environmental and political characteristics of the nation's watersheds vary tremendously. As a result, watershed management initiatives can differ widely in size and scope. Many watershed groups are formed at the local level by community members concerned about water quality or the health of fish and wildlife populations. Often, these groups work to improve watershed health through partnerships among citizens, industry, interest groups, and government.

The value of a watershed approach was articulated by the National Research Council in a 1999 report: “[w]atersheds as geographic areas are optimal organizing units for dealing with the management of water and closely related resources, but the natural boundaries of watersheds rarely coincide with political jurisdictions and thus they are less useful for political, institutional, and funding purposes. Initiatives and organizations directed at watershed management should be flexible to reflect the reality of these situations.”⁵

The benefits of a watershed focus have been recognized at state, regional, national, and international levels. For example, Oregon has defined watershed groups in law and set up a process for their legal recognition and funding. The New Jersey government includes a Division of Watershed Management that provides coordinated technical, financial, and

Box 9.4 Balancing Federal Ocean Activities with State Coastal Management Programs: The Federal Consistency Tool

In the area of natural resource management, one of the more interesting, innovative, and sometimes contentious features of the nation's system of federalism is the relationship between the federal government and coastal state governments with respect to the control and shaping of ocean activities in federal waters.

Historically, this relationship has taken on many hues and forms, but its policy and legal aspects have been largely structured over the last three decades by the development of one section of a single law, the so-called federal consistency provision (Section 307 of the Coastal Zone Management Act). As noted earlier in this chapter, the promise of federal consistency was one of two incentives (the other being grant money) Congress provided to encourage state participation in this voluntary program.

In very general terms, it is a promise that federal government actions that are reasonably likely to affect the coastal resources of a state with an approved coastal management program will be consistent with the enforceable policies of that program. Under some circumstances, it is a limited waiver of federal authority in an area—offshore waters seaward of state submerged lands—in which the federal government otherwise exercises full jurisdiction over the management of living and nonliving resources.

The underlying principle of federal consistency represents a key feature of cooperative federalism: the need for federal agencies to adequately consider state coastal management programs by fostering early consultation, cooperation, and coordination before taking an action that is likely to affect the land or water use or natural resources of such state's coastal zone. It facilitates significant input at the state and local level from those who are closest to the issue and in a position to know the most about their coastal resources.

The process, however, is not one-sided. For states to exercise federal consistency authority, they must submit and receive approval of their coastal management programs from the Secretary of Commerce. Congress established the general criteria for approval of the programs, including a review by other federal agencies before the plans are officially authorized. A core criterion for program approval is whether the management program adequately considers the national interest when planning for and managing the coastal zone, including the siting of facilities (such as energy facilities) that are of greater than local significance.

Once a state has received approval, federal consistency procedures are triggered. Under current practice, states only review federal actions that have reasonably foreseeable coastal effects. There is flexibility in the law to allow agreements between states and federal agencies that can streamline many aspects of program implementation. For example, there may be understandings with respect to classes of activities that do not have coastal effects. Otherwise, the decisions about such effects are made on a case-by-case basis.

There have been disagreements between federal agencies and states on some coastal issues, the more high profile ones largely in the area of offshore oil and gas development. (For a further discussion of this issue, see Chapter 24.) Nevertheless, in general, the federal consistency coordination process has improved federal-state relationships in ocean management. States and local governments have to consider national interests while making their coastal management decisions and federal agencies are directed to adjust their decision making to address the enforceable policies of a state's coastal management program.

In the event of a disagreement between the state and a federal agency, the agency may proceed with its activity over the state's objection, but it must show that it is meeting a certain level of consistency. In a separate part of the federal consistency section, the coastal activities of third party applicants for federal licenses or permits are required to be consistent with the state's program. If the state does not certify that the activities will be consistent, the federal agency shall not grant the license or permit and the proposed action may not go

forward. An applicant can appeal such a decision to the Secretary of Commerce, who has certain specified grounds on which he or she can overturn the state's finding of inconsistency.

Today, after some thirty years of evolution in the practice and implementation of this rather unusual intergovernmental process, federal agencies do not take the consistency standard lightly, as it is a fairly high threshold to meet. The result, according to National Oceanic and Atmospheric Administration, has been an outstanding level of cooperation and negotiation between states and federal agenciesⁱ such that approximately 93–95 percent of the activities are approved.ⁱⁱ

ⁱ Kaiser, D., Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration. Personal Communication to the U.S. Commission on Ocean Policy, February 17, 2004.

ⁱⁱ National Oceanic and Atmospheric Administration. "Coastal Zone Management Act Federal Consistency Regulations, Preamble to Proposed Rule." *Federal Register* 68, no. 112 (June 11, 2003): 34852.

planning support for twenty watershed management areas within the state. New Jersey also participates, along with Pennsylvania, Delaware, and New York, in the Delaware River Basin Commission, a regional body authorized to manage activities within an area that transcends political boundaries. The Chesapeake Bay Program, the California Bay-Delta Authority (known as CALFED), and the Northwest Power Planning Council are other notable examples of current initiatives that aim to address natural resource issues on a watershed scale. Some existing bi-national watershed initiatives include the Great Lakes Commission, Shared Strategy for Puget Sound, and the Gulf of Maine Council on the Marine Environment.

Federal agencies have also started to adopt a watershed management focus. For example, beginning in the 1990s EPA began to reorient federal and state clean water programs to address certain problems on a watershed basis rather than on a source-by-source or pollutant-by-pollutant basis. As part of that effort, EPA has developed extensive guidance for use by states, territories, tribes, and the public concerning watershed management.

Available information includes guiding principles for a watershed approach, innovative funding mechanisms, intergovernmental coordination techniques, and development of training and education materials. EPA also has developed an online Watershed Academy that provides extensive support for watershed groups, including training courses, a catalog of federal funding sources for water protection, a bibliography of technical references, links to over a dozen state watershed management programs, facilitation techniques for development of successful watershed management frameworks, and a compendium of experiences and lessons learned from various watershed initiatives. EPA, the National Resources Conservation Service, U.S. Forest Service, National Park Service, Tennessee Valley Authority, and other federal agencies have also developed extensive guidance on best management practices for use by public and private watershed managers and groups, and the general public.

Some federal grants are now being distributed on a watershed basis. EPA's Targeted Watershed Grant Program encourages community-based approaches to restore, preserve, and protect the nation's watersheds through competitive grants to watershed organizations. The Department of Agriculture has chosen high priority watersheds in which agricultural runoff is a major source of pollution as the basis for distributing funds under the new Conservation Security Program's environmental stewardship program.

As interest in watershed management continues to grow, so does the need for coordination of available information and funding in support of watershed initiatives. Information currently available through individual agency programs would be more useful if it were

consolidated into a central repository and given increased exposure through public outreach and education efforts. Agency funding can also be coordinated to ensure maximum effectiveness. The National Ocean Council and regional ocean councils can play an important role in these coordination efforts.

Recommendation 9-4

Congress should amend the Coastal Zone Management Act, Clean Water Act, and other federal laws, where appropriate, to provide better financial, technical, and institutional support for watershed management initiatives. The National Ocean Council and regional ocean councils should enhance support for coastal watershed initiatives by coordinating agency programs, technical assistance, and funding and by overseeing development of an accessible clearinghouse of information on watershed best management practices.

Linking Coastal and Offshore Management

As discussed in Chapter 6, the growing number of activities that take place in offshore waters calls for a more comprehensive offshore management regime. While the focus of this chapter is on coastal and watershed management, it is important to recognize the strong relationship between the management of onshore and offshore resources. States have long asserted their interests offshore, both by acting as the trustee for public resources in and beneath state waters, and by exerting their responsibilities for activities that take place in federal waters but affect state resources (principally through the CZMA federal consistency provisions, described in Box 9.4). Several states, including Oregon, California, and Hawaii, have developed comprehensive plans to guide ocean activities, resolve conflicts, and anticipate new uses in their waters. Other states, including Florida, Maine, Mississippi, and North Carolina have conducted extensive studies of ocean issues affecting their states. In 2003, Massachusetts launched an ocean planning initiative. Because there is no wall that separates state and federal waters, state planning and management of the waters under their jurisdiction is an important complement to the coordinated offshore management regime called for in Chapter 6.


Increasing Understanding of Coastal Ecosystems

To improve the management of the nation's oceans and coasts, decision makers at all levels will need to gain a better understanding of ecosystems, both how they function and how they are affected by human activities and natural events. The establishment of regional ocean information programs, as recommended in Chapter 5, is one important vehicle for enabling decision makers to better communicate their information needs to the scientific community and ensuring that new information is converted into useful products. Coastal and watershed management activities, and growing efforts to link these two approaches, should provide the information necessary for the public to be responsible stewards of the nation's oceans, coasts, and watersheds.

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GUARDING PEOPLE AND PROPERTY AGAINST NATURAL HAZARDS



Rising populations and poorly planned development in coastal areas are increasing the vulnerability of people and property to storms, hurricanes, flooding, shoreline erosion, tornadoes, tsunamis, and earthquakes. In addition, climate change may lead to more frequent storms and sea-level rise, both of which increase coastal susceptibility. Not only can natural hazards have devastating impacts on people and property, but they may also have deleterious effects on the environment, particularly sensitive habitats.

To lessen the threat from natural hazards, the federal government should coordinate the efforts of all coastal management agencies to reduce inappropriate incentives created by federal infrastructure investments. It should also improve a number of natural hazards-related activities implemented by the Federal Emergency Management Agency, including hazards mitigation planning, information collection and dissemination, and the National Flood Insurance Program.

Assessing the Growing Cost of Natural Hazards

The nation has experienced enormous and growing losses from natural hazards. Conservative estimates, including only direct costs such as those for structural replacement and repair, put the nationwide losses from all natural hazards at more than \$50 billion a year, though some experts believe this figure represents only half or less of the true costs.¹ More accurate figures for national losses due to natural hazards are unavailable because the United States does not consistently collect and compile such data, let alone focus on specific losses in coastal areas. Additionally, there are no estimates of the costs associated with destruction of natural environments. Between 1967 and 1996, insurance payouts (which cover only a small portion of losses) rose steadily from \$1 billion between 1967 and 1971, to \$61 billion between 1992 and 1996, roughly doubling every five years (Figure 10.1).² While stricter building codes, improved forecasts, and early warning systems have helped save lives, deaths from natural hazards are expected to rise along with development and population along the nation's coasts.³ Climate change may increase storms and sea-level rise, making the coastal zone even more vulnerable.

Improving Federal Management of Hazards in Coastal Areas

Many federal agencies have explicit operational responsibilities related to hazards management, while numerous others provide technical information or deliver disaster assistance. The nation's lead agencies for disaster response, recovery, mitigation, and planning are the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers (USACE). These agencies implement programs that specifically target the reduction of risks from natural hazards. The National Oceanic and Atmospheric Administration (NOAA) and the U.S. Fish and Wildlife Service (USFWS) also have a significant influence on natural hazards management.

NOAA's weather forecasting and ocean observing functions are vital to hazards management. NOAA's National Weather Service plays a key role in collecting atmospheric weather and oceanic real-time data for management, assessments, and predictions.

Through its implementation of the Coastal Zone Management Act, the agency also plays a notable role in discouraging coastal development in areas at risk from natural hazards. (Additional discussion of these roles, and recommendations for enhancing NOAA's contributions, are found in Chapters 9 and 26.) The Coastal Barrier Resources Act administered by USFWS (discussed in Chapter 9), also has significant implications for natural hazards management.

This chapter focuses on those federal programs that specifically target the reduction of losses of life and property due to natural hazards along the nation's coasts. Among the opportunities for improving federal natural hazards management, four stand out: amending federal infrastructure policies that encourage inappropriate development; augmenting hazards information collection and dissemination; improving the National Flood Insurance Program; and undertaking effective and universal hazards mitigation planning.

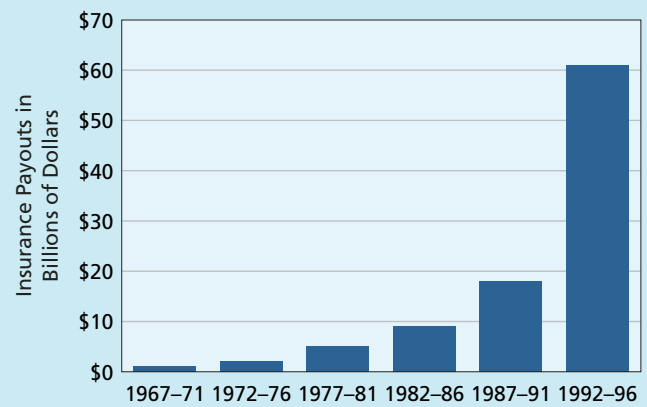
Changing Inappropriate Federal Incentives

The federal government has made substantial investments in infrastructure designed to reduce human exposure to hazards, including flood control and coastal erosion projects. These efforts often eliminate or conflict with the natural buffers that would otherwise help shield communities. Furthermore, because such projects are not accompanied by strict restrictions on subsequent construction, they may actually encourage further commercial and residential development in hazard-prone areas (Box 10.2). In some cases, a federal infrastructure project intended to reduce a hazard merely drives the problem to a nearby location, such as when erosion control efforts lead to further coastal armoring up or down the coast. The cumulative impact of such projects may be weakening the ecosystem's natural resilience to hazards and creating the potential for even greater losses to property, health, and natural resources.

Of course, the federal government is not the sole driver of infrastructure development in coastal areas. State and local governments also build roads and bridges along and over the water, underwrite wastewater treatment, and support water supply projects, all of which have impacts on coastal development and vulnerability.

The great majority of federal infrastructure programs are implemented by USACE, whose hazards-related activities include flood control efforts such as dams, dikes, and levees, and coastal erosion projects such as groins, sea walls, revetments, and beach

Figure 10.1 The Growing Cost of Natural Disasters



In the thirty years between 1967 and 1996, insurance companies have experienced a 6,000 percent increase in payouts to federal and private insurance holders for damages due to natural catastrophes.

Source: Consumer Federation of America. *America's Disastrous Disaster System*. Washington, DC, January 1998.

Box 10.1 Hurricanes Wreak Havoc Along the Coast

In 1989, Hurricane Hugo hit the U.S. Virgin Islands and Puerto Rico before coming ashore at Charleston, South Carolina, causing twenty-six deaths in the United States and an estimated \$9.7 billion in damages. Just three years later, Hurricane Andrew struck southern Florida and Louisiana, causing twenty-three deaths directly and dozens more indirectly. Andrew wrought an estimated \$35 billion in damages, making it the costliest hurricane in U.S. history. And in 1999, Hurricane Floyd, the deadliest of recent hurricanes, made landfall along the Mid-Atlantic and northeastern United States, causing fifty-six deaths and an estimated \$4.6 billion in damage.ⁱ (All figures adjusted to 2000 dollars.)

ⁱ Jarrell, J.D., et al. *The Deadliest, Costliest, and Most Intense United States Hurricanes from 1900 to 2000*. NOAA Technical Memorandum NWS TPC-1. Silver Spring, MD: National Oceanic and Atmospheric Administration, 2001.

nourishment. USACE also has responsibilities for dealing with disaster response efforts such as construction of emergency infrastructure.

Evolving public values that favor environmental protection, as well as a growing understanding of the complex workings of natural systems, have propelled USACE to adopt more environmentally conscious initiatives, including the pursuit of nonstructural approaches to some flood control projects. However, such initiatives are not universally embraced within the agency, by all stakeholders, or in Congress, and remain greatly outnumbered by traditional, construction-oriented USACE projects that may disrupt natural hydrological and geomorphological processes, harm ecosystems, and create incentives for additional human development in high-risk regions.

USACE has also been the focus of debates about the cost-benefit analyses used to review proposed projects. Some experts have suggested that these analyses are often flawed by a reliance on incorrect assumptions and faulty methodologies. In 2001, the National Research Council (NRC) began a comprehensive review of USACE programs and procedures. A 2002 NRC report recommended external review of all controversial or complex USACE civil works projects.⁴

Recommendation 10–1

The U.S. Army Corps of Engineers' Civil Works Program, with guidance from the National Ocean Council, should ensure valid, peer-reviewed cost-benefit analyses of coastal projects, provide greater transparency to the public, enforce requirements for mitigating the impacts of coastal projects, and coordinate such projects with broader coastal planning efforts.

Improving Understanding

The federal government plays an important role in acquiring complex hazards-related data and translating them into information that states and communities can use to reduce their vulnerability to natural disasters. A number of federal agencies and departments, including NOAA, the U.S. Geological Survey, the National Aeronautics and Space Administration, and the U.S. Department of Defense, are charged with increasing both basic understanding and site-specific knowledge about natural hazards. These agencies' principal contributions include: developing and deploying new technologies for understanding land, ocean, and atmospheric processes and their interactions; tracking and predicting hazards, particularly meteorological hazards; assessing hazards risks; conducting post-disaster research; and communicating this information to end users. These contributions have significantly improved the quality and timeliness of weather-related warnings, increasing the lead time for protective measures and evacuations. Implementation of the Integrated Ocean Observing System (discussed in Chapter 26) would improve weather-related warnings and provide

Box 10.2 New Orleans at Risk

Prior to 1965, New Orleans—a community that sits as much as 10 feet below sea level—had suffered substantial losses of protective barrier islands and wetlands and developed an elaborate system of flood control measures. After Hurricane Betsy struck in 1965, causing more than \$1 billion in damages,ⁱ hundreds of millions of dollars were spent to upgrade the flood control system that now includes more than 520 miles of levees, 270 floodgates, 92 pumping stations, and thousands of miles of drainage canals.ⁱⁱ

While the new protections did reduce risks to people and property in developed areas, they also encouraged additional development in flood-prone regions.ⁱⁱⁱ Jefferson Parish and the adjoining Orleans Parish ranked first and second among communities receiving repeat payments for damage claims under the National Flood Insurance Program between 1978 and 1995. These two communities alone accounted for 20 percent of the properties with repeat losses, at an average of nearly three claims per property, for a total of \$308 million in claims.^{iv}

New Orleans' protective levees are designed to withstand only a moderate (Category 3) hurricane storm surge. Were they to fail, the city and surrounding areas could suffer upward of \$25 billion in property losses and 25,000–100,000 deaths by drowning.^{v,vi}

ⁱ Leatherman, S., and V. Burkett. "Sea-Level Rise and Coastal Disasters: Lessons from the East Coast and New Orleans." *Natural Hazards Observer* XXVI, no. 4 (March 2002).

ⁱⁱ Burby, R.J. et al. "Unleashing the Power of Planning to Create Hazard-Resistant Communities." *Journal of the American Planning Association* 65 (Summer 1999): 247–58.

ⁱⁱⁱ Ibid.

^{iv} National Wildlife Federation. *Higher Ground: A Report on Voluntary Property Buyouts in the Nation's Floodplains*. Washington, DC, 1998.

^v Pielke, Jr., R.A., and C.H. Landsea. "Normalized Hurricane Damages in the United States: 1925–1995." Presented at the American Meteorological Society 22nd Conference on Hurricanes and Tropical Meteorology. Fort Collins, CO, May 19–23, 1997.

^{vi} Leatherman, S., and V. Burkett. "Sea-Level Rise and Coastal Disasters: Lessons from the East Coast and New Orleans." *Natural Hazards Observer* XXVI, no. 4 (March 2002).

additional predictive capabilities for tsunamis and for chemical and biological hazards, such as sudden pollutant loadings, harmful algal blooms, and pathogens.

FEMA, as the lead disaster management agency, collects, analyzes, and disseminates hazards-related data. It is also responsible for assessing the effectiveness of its programs. However, these efforts fall short of shaping an effective overall national policy and providing the information state and local decision makers and individuals need to fully understand their risks from coastal hazards. The absence of a standard, centralized data collection system that could produce accurate accounting for losses from natural hazards is only one example. An inability to provide adequate, useful information at the local, state, and regional levels can lead to incorrect estimates of risk, which then affect cost-benefit analyses of proposed development and mitigation projects. Local land use decisions are frequently made without information about cumulative impacts or the vulnerability of individuals and groups in the community, and without an ability to judge the full impact of disasters on humans, institutions, the economy, natural resources, and ecosystem services. This lack of accurate information is likely to reinforce the tendency to underestimate risks from natural hazards and delay taking action to prevent future problems.

Flooding is the most costly of natural hazards, and maps produced by the National Flood Insurance Program are the federal government's primary tool for communicating flood risks to communities and individuals.⁵ Most existing flood hazard maps are not georeferenced, limiting their usefulness for hazards planning.

The combination of mounting federal and nonfederal disaster expenses, vigorous advocacy by the insurance community, state and local governments, and others who rely on flood maps prompted FEMA to design an ambitious map modernization program in 1997.⁶ The incorporation of FEMA into the U.S. Department of Homeland Security

spurred Congress to provide substantial financial support to underwrite the effort beginning in fiscal year 2002. This program will create a digital base map, update and digitize flood hazards information, and provide standard protocols that state and local governments and others can use to incorporate and relate information about other natural and manmade hazards. Though FEMA's map modernization effort is intended to target the highest-risk communities first, the initial selection made in 2003 did not include any coastal communities—despite their status as high-population, high-risk regions. This is attributable to technical difficulties in mapping coastal flood hazards. FEMA's plans call for updating priority coastal community maps starting in fiscal year 2004 when such obstacles are resolved.⁷

Although many communities are in a position to benefit from this opportunity, others may be constrained by a lack of technical and financial resources and expertise. National maps that reflect all hazards (for example, coastal erosion, localized stormwater drainage flooding, potential flood control structure failures, and increased risk from development, land subsidence, and sea-level rise) are needed to communicate the true vulnerability of a community, its social and physical infrastructure, and the surrounding ecosystem. Because relative sea level is rising in many coastal areas, it will be particularly important for maps to reflect this to more accurately analyze the potential impacts of coastal hazards. Such maps will also be essential in informing prospective purchasers of coastal property about potential hazards. FEMA and other relevant agencies will need to work together to make such comprehensive mapping a reality.



Recommendation 10–2

The National Ocean Council should establish a task force of appropriate federal agencies and state and local governments, with the Federal Emergency Management Agency in the lead, to improve the collection and use of hazards-related data.

Under the oversight of the NOC's Committee on Ocean Resource Management, the hazards-related data task force should develop a coordinated effort that includes the following functions:

- systematic collection, storage, analysis, and dissemination of data on post-disaster losses and the cost of mitigation efforts.
- development and transmittal to communities of the information and tools they need to understand the risks of hazards to their residents and their social, physical, economic, and environmental infrastructures.
- cooperation with the Federal Geographic Data Committee and state and local governments to achieve comprehensive, digitized, georeferenced mapping and identification of all natural hazards.
- development of adequate funding proposals for the National Flood Insurance Program map modernization initiative, including a high-priority effort to update maps for high-risk coastal communities.

The Federal Geographic Data Committee, as well as other important issues related to mapping and charting, are discussed in Chapter 25.

The National Flood Insurance Program

Enacted in 1968, the National Flood Insurance Program (NFIP) is the federal government's primary tool for managing flood hazards through a combination of incentives and regulation. In addition to the development of maps identifying flood-prone areas, the NFIP provides (or helps private companies provide) flood insurance to owners of commercial and residential structures in communities that adopt appropriate construction standards. Premiums and fees from property owners cover most program costs. Other NFIP responsibilities include identifying flood hazards, assessing risks, and implementing measures for reducing losses. While the NFIP is a national program, the majority of its



Dave Gatley/FEMA News Photo

Homes built close to shore, like these in Nags Head, North Carolina, are frequently threatened by coastal erosion and high storm surge.

policies, total coverage, and premium revenues are associated with coastal communities.

Without the NFIP, many of the more than 19,000 participating communities most likely would not have had the incentive to develop active programs to manage flood risks. Unlike private-sector insurers, the federal government can carry debt over the long term and replenish funds depleted by catastrophic disasters over time. For this reason, the federal government is able to undertake the expense of mapping flood hazards nationally and subsidize coverage for older buildings. FEMA estimates that NFIP building standards and other floodplain management measures reduce flood losses by \$1 billion per year.⁸

As impressive as these accomplishments are, concerns have been raised that the NFIP may inadvertently facilitate inappropriate coastal development and redevelopment. While many factors weigh heavily in such decisions, including the market forces that make real estate in coastal floodplains and estuarine areas so valuable, the availability of flood insurance also plays a role. Determining the extent of this role is difficult because the impacts of the NFIP have never been comprehensively evaluated. FEMA recently commissioned such an evaluation, with several reports expected to be issued, including a final comprehensive report scheduled for September 2005. This study will help inform the National Ocean Council and may determine any further action. Nonetheless, three aspects of the program—treatment of erosion hazards, coverage of repetitive losses, and availability of insurance in undeveloped floodplain and erosion zones—are issues that merit immediate attention.

Informing the Public about Erosion Risks

Property owners within 500 feet of the shoreline face as large a risk from erosion as from flooding. Under current conditions, approximately one-quarter of all homes within 500 feet of the coast will be lost to erosion in the next sixty years. Insurance rates in areas designated as coastal high-hazard zones would need to double over the next thirty to sixty years to keep pace with these increasing erosion risks.⁹ Although FEMA has developed a plan for undertaking erosion mapping and reflecting actual risks in future NFIP insurance rates, the agency is awaiting congressional authorization to implement the plan. If erosion mapping and rating are not carried out, higher premium rates will have to be spread across all policyholders, losing an important opportunity to discourage building in the riskiest areas.

Repetitive-loss Properties

The NFIP requires that substantially damaged properties be removed or elevated. However, local governments are responsible for determining whether a property is substantially damaged and they are often reluctant to do so when a property owner does not have the

The federal government should eliminate subsidies and incentives for development and redevelopment in coastal high hazard, flood and erosion areas. This is a matter of prudent fiscal and emergency management as much as environmental protection.

—Jane Stahl, Deputy Commissioner of Environmental Protection, State of Connecticut, testimony to the Commission, July 2002

financial resources to move or elevate the home.¹⁰ Absent this designation, many of these properties have been rebuilt in place, leading to repeated claims. Although only 2 percent of NFIP covered properties have received repetitive-loss payments, they account for 40 percent of overall NFIP payments, many at cumulative totals exceeding the property's value. Although a national problem, between 1978 and 1995, Louisiana and Texas accounted for \$1.1 billion, or 40 percent of the \$2.75 billion in total repetitive-loss claims paid by the NFIP.¹¹

Approximately 90 percent of repetitive-loss payments are for buildings that predate NFIP maps.¹² This demonstrates the effectiveness and success of NFIP building standards for new construction in flood-prone areas, but also underscores the program's lack of authority for reducing the vulnerability of older buildings. Many property owners underestimate their risk, resist investments in structural improvements that do not directly translate into higher home prices, and then rely on federal disaster assistance as a fallback when floods occur. For some properties, the most acceptable and economical solution for all concerned will be voluntary buyouts at prices that allow property owners to relocate out of harm's way.

Eliminating Incentives for Development in Floodplains and Eroding Areas

The NFIP was created both as a more desirable alternative to federal disaster relief in the wake of flooding and as a tool to guide development away from flood prone areas through state and local floodplain management. However, of the 6.6 million buildings located in the 100-year floodplains of participating communities, more than a third were built after the NFIP maps were created and floodplain management requirements imposed.¹³ As one of the federal government's principal tools for influencing development in high-hazard areas, the NFIP's risk assessment, mitigation, and insurance components should be revamped to better achieve the original goal of discouraging communities from building in harm's way.

Recommendation 10-3

The National Ocean Council should recommend changes in the National Flood Insurance Program (NFIP) to reduce incentives for development in high-hazard areas.

Specifically, NFIP changes should:

- establish clear disincentives to building or rebuilding in coastal high-hazard zones by requiring property owners at risk of erosion to pay actuarially sound rates for insurance.
- enforce measures that reduce vulnerability to natural hazards, including assistance in retrofitting older structures and buyout programs for susceptible structures with repetitive-loss histories.
- create enforceable mechanisms to direct development away from undeveloped floodplains and erosion zones.

Hazards Mitigation Planning

Hazards mitigation planning—the process of assessing potential hazards and evaluating and identifying actions to reduce or eliminate vulnerabilities—has been required of states for nearly two decades as a condition of receiving disaster relief and other FEMA funding. However, the quality of those plans, and the degree to which they are based on a sound process with adequate stakeholder involvement, vary widely. Major disaster losses in the 1990s led FEMA to increase its attention to hazards mitigation planning, establishing a unit dedicated to that purpose in 1998.

Congress also recognized that deficiencies in mitigation planning prevented the most effective use of disaster assistance funds. Communities recovering from disasters receive little guidance during the rebuilding process to improve their resilience to future disasters. In the Disaster Mitigation Act, passed in 2000, Congress directed FEMA to impose more stringent mitigation planning requirements on states. States that fail to meet FEMA's new criteria can be denied disaster assistance and some other types of funding, while states

that develop excellent mitigation plans are eligible to use a greater proportion of their disaster funding to implement further hazards mitigation projects.

Effective hazards mitigation planning is fully consistent with watershed and ecosystem-based management approaches because they all attempt to consider communities and the effects of human activities within the broader environmental context. Effective watershed management plans that include a hazards component can be used to satisfy FEMA's mitigation planning requirements. The agency has also expressed a goal of integrating sustainable redevelopment into its program, recognizing the interdependence among economic opportunity, community well-being, and protection of the natural environment.

In 2002, FEMA issued regulations implementing enhanced mitigation planning standards, with compliance required for most state and local governments by October 2004. However, many state and local governments are struggling to comply with the new criteria because of severe fiscal constraints, technical difficulties, and relatively low levels of federal support. In addition to providing greater technical and financial assistance, it may be appropriate to withhold other forms of hazards-related federal financial assistance until mitigation plans are in place. For example, the U.S. Small Business Administration has narrowed eligibility for its low-interest Pre-Disaster Mitigation Loan Program to communities with approved plans.


Recommendation 10-4

The Federal Emergency Management Agency (FEMA) should enhance technical assistance to state and local governments for developing or improving their hazard mitigation plans. The National Ocean Council should identify opportunities for conditioning federal hazards-related financial and infrastructure support on completion of FEMA-approved state and local hazards mitigation plans.

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CONSERVING AND RESTORING COASTAL HABITAT



Wetlands, estuaries, seagrass beds, mudflats, sand beaches, mangrove forests, coral reefs... these are just some of the diverse habitats that make up the ocean and coastal environment and provide invaluable benefits to humans and marine life. Marine habitats face increasing pressures as activities within ocean and coastal areas intensify. Coastal habitat conservation and restoration should be integral to ocean and coastal management, as well as to the management of activities within watersheds, and should be strengthened through the development of national, regional, and local goals, the institution of a dedicated program for coastal and estuarine conservation, better coordination of federal habitat-related activities, and improved research, monitoring, and assessment.

Assessing the Threats to Coastal Habitat

The diverse habitats that comprise the ocean and coastal environment provide tangible benefits such as buffering coastal communities against the effects of storms, filtering pollutants from runoff, and providing a basis for booming recreation and tourism industries. These habitats also provide spawning grounds, nurseries, shelter, and food for marine life, including a disproportionate number of rare and endangered species.¹

As more people come to the coast to live, work, and visit, coastal habitats face increasing pressures. Most human activities in coastal areas provide distinct societal benefits, such as dredging rivers and harbors to facilitate navigation, converting forests and wetlands for agriculture and development, and building dams for flood control and hydropower. But these activities can also degrade coastal habitats and compromise their ability to adapt to environmental changes.

Serious habitat degradation is evident in every region, state, territory, and community along the nation's coastline. Since the early settlers arrived in the United States, the nation has lost more than half of its wetlands—over 110 million acres.² California has lost 91 percent of its wetlands since the 1780s.³ The Southeastern United States experienced a loss of over 2.3 million acres of wetlands from the mid-1970s to the mid-1980s.⁴ Significant wetlands loss has also occurred in the Pacific Islands. For example, American Samoa has lost about 25 percent of its wetlands to development, and much of the original extent of wetlands in the Commonwealth of the Northern Mariana Islands has been altered.⁵

Many mangrove forests, seagrass beds, and coral reefs have also fared poorly. Shallow-water reefs near urbanized coasts in the United States have been degraded by environmen-

tal and human disturbances such as hurricanes, fishing activities, coastal development, runoff, and sedimentation.⁶ More than 50 percent of the historical seagrass cover has been lost in Tampa Bay, 76 percent in the Mississippi Sound, and 90 percent in Galveston Bay. Extensive seagrass losses have also occurred in the Chesapeake Bay, Puget Sound, San Francisco Bay, and Florida's coastal waters.⁷ Climate change, rising global temperatures, and sea-level rise place additional stresses on coastal habitats.

Because such a wide range of activities is affecting coastal habitats, an equally wide range of management tools will be needed to keep them healthy. Many of these approaches—maintaining water quality, minimizing trash and other debris, managing development—are discussed elsewhere. This chapter focuses on two types of activities that can be undertaken by governmental and nongovernmental partners to protect the coast: conservation and restoration.

Conserving Coastal Habitat

Conserving valuable ocean and coastal areas not only protects significant habitat and other natural resources, it also precludes the need to undertake costly and scientifically uncertain restoration efforts after an area has been degraded or lost. Current conservation needs, however, are not being met—a situation that will continue to worsen with increasing pressures on ocean and coastal environments and rising demands for coastal land.

Habitat Conservation Programs

Millions of coastal acres have been designated for conservation by various levels of government, and the tools for implementing conservation programs are found in a multitude of statutes. A number of federal programs aim to preserve the natural attributes of specific areas while providing varying levels of access to the public for educational, recreational, and commercial purposes. These include the U.S. Department of the Interior's (DOI's) National Parks and Seashores, National Wildlife Refuges, National Monuments, and National Wilderness Areas; the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Sanctuaries and National Estuarine Research Reserves; and the U.S. Environmental Protection Agency's (EPA's) National Estuary Program.

DOI's U.S. Fish and Wildlife Service (USFWS) administers several programs that provide grants for the acquisition, restoration, and enhancement of coastal lands, including the National Coastal Wetlands Conservation Grants Program. NOAA carries out a number of programs that aim to conserve valuable coastal lands, restore degraded habitat, and advance the science of restoration technology. Several U.S. Department of Agriculture (USDA) forestry- and agriculture-related programs provide incentives for land protection, including coastal land protection. The U.S. Army Corps of Engineers (USACE) conducts a variety of environmental stewardship and restoration programs. And both USACE and EPA are involved in conserving wetland habitats through the wetland permitting program under the Clean Water Act. (Many of these programs and authorities are summarized in Appendix D.)

Coastal habitat conservation programs also exist at the state, territorial, tribal, and local levels. For example, marine protected areas (discussed in greater detail in Chapter 6) can be designated by different levels of government for a variety of reasons, including habitat conservation.

Regulatory and non-regulatory conservation techniques are also used as tools for coastal conservation. Many local governments use a variety of planning and regulatory tools and techniques, including zoning and land use planning. Other tools—including fee simple land acquisition, the purchase or donation of easements, tax incentives and disincentives, and tradable development rights—play a special role in enabling willing landowners to limit future development on their land for conservation purposes. Land

acquisition and easements are often implemented through partnerships among governments, nongovernmental organizations such as land trusts, and the private sector. These groups work together to leverage limited resources from several partners to fund projects and ensure that areas acquired for conservation purposes are properly managed. As coastal populations grow and demands on coastal lands intensify, the resources needed to make such conservation partnerships work will continue to increase.

Conservation is important to maintain critical habitats and the benefits they provide, but it is also cost-effective, avoiding the much larger expense and scientific uncertainties associated with attempting to restore habitats that have already been degraded or lost.

Federal Funding for Habitat Conservation

The Land and Water Conservation Fund is a major source of federal funding for federal, state, and local conservation efforts, authorized to provide up to \$900 million a year in support of these projects. However, since the Fund's inception in 1965, Congress has appropriated less than half of the amount authorized.⁸ A number of agriculture and forestry-related programs administered by USDA represent an even larger source of funds for land conservation projects. Funding for agri-environmental programs is expected to rise to a projected total of \$38.6 billion over the next ten years.⁹ Several of these programs include multi-year contracts with farmers and ranchers to retire and protect certain lands. The Wetlands Reserve Program, Farmland Protection Program, and Grassland Reserve Program, in particular, pay for permanent conservation easements on lands enrolled in those programs. Another USDA program, the Forest Legacy Program, provides funds for conservation easement purchases for forest lands threatened with development. Though these funding sources are not specifically targeted for the conservation of coastal and ocean resources, the funds can be used in those areas. Moreover, conservation of habitat in upland watersheds that enhances water quality indirectly benefits coastal areas.

In addition to the need to increase these programs' focus on coastal habitat protection, the critical nature of coastal habitats—and the alarming rate at which they are being lost—requires more direct attention. Only a small fraction of federal spending on habitat is dedicated to coastal efforts, although habitat conservation is one of the goals of the Coastal Zone Management Act. To further that goal, in 2002, Congress appropriated money for the Coastal and Estuarine Land Conservation Program to provide a dedicated funding source to support coastal conservation partnerships among willing landowners, but this Program has not been made permanent.

Recommendation 11-1

Congress should amend the Coastal Zone Management Act to create a dedicated funding program for coastal and estuarine land conservation. In addition, a larger share of U.S. Department of Agriculture and other federal agency conservation programs should be directed to coastal and estuarine lands. To guide these programs, each state should identify priority coastal habitats and develop a plan for establishing partnerships among willing landowners for conservation purposes, with participation from federal agency, local government, nongovernmental, and private-sector partners.

Restoring Coastal Habitat

Once critical habitat has been lost, or the functioning of those areas diminished, restoration is often needed. Habitat restoration efforts are proliferating in response to heightened public awareness of, and concern for, the health of the nation's oceans and coasts. Several large-scale efforts are underway to restore the nation's unique ecological treasures, including coastal Louisiana, the Florida Everglades, the Chesapeake Bay, the San Francisco Bay-Delta, and the Great Lakes. The goals of these initiatives are extremely ambitious—



Photolink

Coastal habitats provide essential breeding and nursery grounds for numerous marine and estuarine species. They also afford many benefits for humans by safeguarding coastal communities against storms, filtering anthropogenic pollutants, and providing varied recreation and tourism opportunities.

reestablishing thousands of square miles of water flow and habitat to sustain healthy levels of fish and wildlife populations while maintaining water supply for human uses and allowing future development (Box 11.1).

In addition to the large-scale, regional restoration efforts described above, there are numerous smaller-scale projects that collectively make significant contributions to restoring the health of coastal environments. Examples of these efforts include local initiatives to restore wetlands, bays, riverbanks, and streams in coastal communities. Because coastal habitat restoration efforts are often costly and complicated, they require the participation of a wide range of stakeholders to accomplish goals not achievable by any one party (Box 11.2). As a result, these projects often demonstrate the power of public–private partnerships, bringing together community members, government agencies, and businesses to solve common problems. They also require substantial volunteer effort, emphasizing the need for outreach and education among community members to enhance stewardship. The Coastal America partnership, formed in 1991 through a memorandum of understanding signed by several federal departments and agencies, has had notable success in bringing together a wide range of participants to implement restoration projects throughout the nation. The partnership focuses on overcoming institutional barriers and inconsistent federal agency jurisdictions and authorities to achieve mutual restoration goals.

The success of individual coastal habitat restoration efforts in achieving larger ecosystem objectives can be enhanced through the development of comprehensive regional restoration strategies. These strategies will vary according to the unique circumstances in each region, but should also be part of an overarching national strategy that can enhance the effectiveness of regional efforts and provide a basis for evaluating progress.

In 2000, the Estuary Restoration Act called for a national strategy to include the goal of restoring one million acres of estuarine habitat by 2010. The Act established an interagency council to develop the strategy, create a comprehensive approach to estuarine habitat restoration efforts, foster coordination of federal and nonfederal activities, and administer a program for setting priorities and providing appropriate technical and financial assistance. In 2002, the Estuary Habitat Restoration Council—chaired by USACE and made up of designees from NOAA, EPA, USFWS, and USDA—published its final strategy, which encourages an ecosystem-based approach, including strengthening public–private partnerships and applying innovative restoration technologies, monitoring capabilities, and performance measurement tools.¹⁰

The establishment of the Estuary Habitat Restoration Council as a forum for federal agency coordination and communication at the national level is a significant and positive

Box 11.1 Examples of Large-scale Coastal Habitat Restoration Efforts

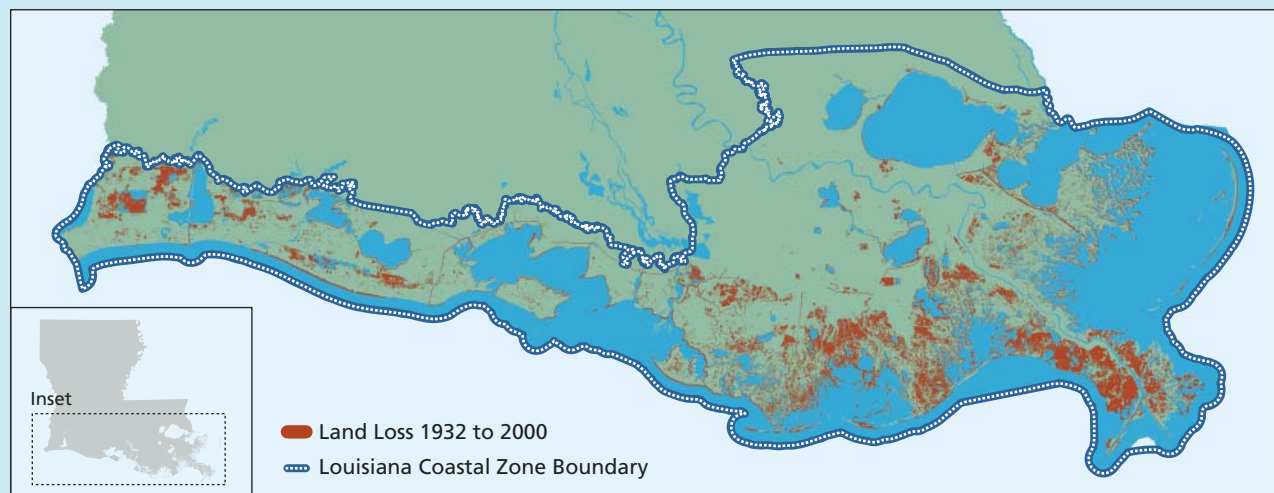
Large-scale restoration efforts are challenging in a number of ways. First, the success of these efforts requires an understanding about how to recreate natural systems and restore historical ecosystem functions, a field still in its infancy. Second, these efforts cross political boundaries and affect a broad range of human activities, requiring support and intense coordination among a wide range of governmental and nongovernmental stakeholders. While some restoration projects have been successful, continued progress will depend on sustained funding, government leadership and coordination, scientific research, and stakeholder support.

Coastal Louisiana

Nowhere is the problem of habitat loss more compelling than in coastal Louisiana, which experiences about 80 percent of the total annual coastal land loss in the continental United States.ⁱ From 1956 to 2000, an average of 34 square miles of Louisiana's wetlands disappeared into the sea every year (Figure 11.1). If this rate of loss continues, an estimated 700 additional square miles of coastal wetlands will be lost over the next fifty years, threatening billions of dollars worth of resources vital to the state's—and the nation's—economic well-being.ⁱⁱ

The devastating losses are the result of a number of converging factors, including both human activities and natural processes. Chief among them are the dams, levees, and channels developed along the Mississippi River and its tributaries, as well as a network of canals that provide access to oil and gas well sites. These projects, which have supported nationally important infrastructure, navigation routes, and energy supplies, have also resulted in a 67 percent decrease in the supply of sediments to the coastal area and have disrupted the natural flow of water that kept the wetlands healthy.ⁱⁱⁱ Sea-level rise, coastal storms, destruction of marsh plants by muskrat and nutria, and the subsidence of the region over geologic time intensify the problem and put the state's more than two million coastal residents at increasing risk.

Figure 11.1 Dramatic Coastal Land Loss in Louisiana



From 1932 to 2000, coastal Louisiana lost 1,900 square miles of land—an area roughly equivalent to the size of Delaware. An additional 700 square miles could potentially be lost over the next fifty years if no new restoration takes place, putting more than 2 million coastal residents at risk from floods and storms.

Source: U.S. Geological Survey. "Without Restoration, Coastal Land Loss to Continue." News release. <www.nwrc.usgs.gov/releases/pr03_004.htm> (Accessed January 2004). Map Source: U.S. Geological Survey, Lafayette, LA.

Restoration efforts have intensified since the passage of the Coastal Wetlands Planning, Protection, and Restoration Act in 1990 (also known as the Breau Act), which focused national attention and significant federal funding on over one hundred conservation and restoration projects. In 1998, a more comprehensive ecosystem-based plan to restore the natural processes of the region's coastal wetlands was jointly developed by the state of Louisiana and the federal government.^{iv} Additional studies are underway to determine the feasibility of sustaining Louisiana's coastal ecosystem.

The Florida Everglades

Another extensive effort to restore a regional ecosystem dramatically altered by human activities is taking place in the Florida Everglades, an unparalleled network of mangroves, coastal marshes, seagrass beds, lakes, rivers, estuaries, and bays that once stretched from Orlando to Florida Bay. A long history of water diversions, flood control projects, and agricultural and urban development in South Florida has reduced the size of the Everglades by half.^v As a result, the region has experienced numerous environmental problems such as nutrient enrichment, threatened or endangered species, pesticide contamination, mercury buildup in plants and animals, widespread invasion by exotic species, increased algal blooms, seagrass die off, and declines in fishery resources.^{vi}

In 1992, Congress authorized a comprehensive review of the potential to restore the Everglades ecosystem. This review resulted in the development of the Comprehensive Everglades Restoration Plan, the largest such effort ever pursued based on the size of the ecosystem and the nearly 200 individual projects being developed to implement the plan.^{vii} Many of these projects involve massive and expensive engineering and construction feats designed to restore natural hydrological functions and water quality throughout the entire region.

Despite its immense size and scope, the Comprehensive Everglades Restoration Plan is only one component of an initiative to restore the southern half of the state and the nearshore waters of Florida. The larger effort is being headed by the South Florida Ecosystem Task Force, which is charged with developing a strategy for coordinating hundreds of projects carried out by several different federal, state, tribal, and local entities, universities, and other stakeholder groups. The Task Force is made up of senior level officials from seven federal agencies, the Florida Department of Environmental Protection, the Miccosukee and Seminole tribes, the South Florida Water Management District, the Florida Governor's Office, and two local governments.

ⁱ Congressional Research Service. *Wetland Issues*. Report #IB97014. Washington, DC: Library of Congress, 2003.

ⁱⁱ U.S. Geological Survey. "Without Restoration, Coastal Land Loss to Continue." News release. <www.nwrc.usgs.gov/releases/pr03_004.htm> Accessed January 2004.

ⁱⁱⁱ Ibid.

^{iv} Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. *Coast 2050: Toward a Sustainable Coastal Louisiana*. Baton Rouge, LA: Louisiana Department of Natural Resources, 1998.

^v Congressional Research Service. *South Florida Ecosystem Restoration and the Comprehensive Everglades Restoration Plan*. Report #RS20702. Washington, DC: Library of Congress, 2001.

^{vi} McPherson, B.F., and R. Halley. *The South Florida Environment: A Region under Stress*. USGS Circular 1134. Washington, DC: U.S. Geological Survey, 1996.

^{vii} U.S. Army Corps of Engineers, Jacksonville District and South Florida Water Management District. *Central and Southern Florida Comprehensive Review Study, Final Integrated Feasibility Report and Programmatic Environmental Impact Statement*. April 1999.

step. There remains, however, a need for a federal coordinating forum with responsibilities and membership that is broader than the Estuary Habitat Restoration Council—one that can coordinate the development and implementation not only of estuarine habitat restoration efforts, but activities that affect all types of coastal habitat and include conservation as well as restoration measures. This forum could also be responsible for fostering the development and implementation of goals and priorities at the regional level.

Improving Habitat Conservation and Restoration

Currently the many entities that administer conservation and restoration activities operate largely independently of one another, with no framework for assessing overall benefits in an ecosystem-based context. The multitude of disjointed programs prohibits a comprehensive assessment of the progress of conservation and restoration efforts and makes it difficult to ensure the most effective use of limited resources.

Consistent local, state, regional, and national goals are vital for prioritizing conservation and restoration needs and orchestrating effective efforts at all levels. In particular, these efforts should be assessed in a regional, ecosystem context. This will be aided by improved regional coordination and the creation of regional ocean councils, as discussed in Chapter 5. The regional ocean information programs, also discussed in Chapter 5, will help meet the information needs essential to the success of these initiatives. Conserving and restoring historical ecosystem functions are significant steps in sustaining the health of the nation's ocean and coastal resources. Over time, the regional ocean councils will also help to improve the management of all activities that affect coastal habitats and the well-being of coastal communities.

Recommendation 11-2

The regional ocean councils, working with state coastal management programs and other governmental and nongovernmental entities, should assess regional needs and set goals and priorities for ocean and coastal habitat conservation and restoration efforts that are consistent with state and local goals. The National Ocean Council should develop national goals that are consistent with regional, state, and local goals, and should ensure coordination among all related federal activities.

An increased and dedicated funding source for coastal conservation activities is called for earlier in the chapter. Similarly, restoration initiatives will require sufficient funding to develop the best techniques, implement restoration activities, and track their success. In addition to federal investments, innovative sources of funding can be identified through partnerships with the private sector.

Enhancing Information and Understanding

One of the most significant obstacles to conservation and restoration efforts is the lack of adequate knowledge about the structure and functioning of coastal habitats and the relative effectiveness of restoration techniques. Furthermore, many individual efforts do not benefit from the knowledge and positive experiences that do exist. Enhanced support for ecosystem restoration science and applied research on effective restoration techniques is needed, as is support for programs that educate practitioners on how to implement these techniques. A better understanding of the connections between human activities and their impacts on coastal habitats will lead to better management of coastal resources and a strengthened stewardship ethic among all stakeholders and citizens.

Box 11.2 A Community Habitat Restoration Effort: Friends of Heeia State Park

There are thousands of examples of local efforts in which concerned citizens, government entities, business, and other stakeholders have helped restore coastal habitats valuable to both native plant and animal species and to the culture of the local community. Friends of Heeia State Park, a nonprofit educational institution located on the Hawaiian Island of Oahu, coordinates several community restoration activities each year during which local volunteers help clean up beaches and streams, monitor water quality, and remove invasive species. Recently, the group received a grant from the U.S. Environmental Protection Agency to conduct a project replacing non-native coastal plants, which were preventing adequate filtering of waters from the watershed to the Heeia Bay, with native species. The project was part of a larger effort to restore portions of the entire Heeia watershed that had become degraded by nonpoint source pollution originating from various human activities. Thousands of volunteers participated in the project.ⁱ

These and other local restoration efforts are vital components of the overall goal of improving the health of coastal habitats nationwide. They also serve a valuable role in promoting coastal stewardship by instilling a sense of ownership and responsibility throughout the community. Improving communication and coordination among these efforts, and enhancing the research efforts needed to determine the most effective restoration strategies, will strengthen the ability of individual projects to contribute to the overall improvement of ocean and coastal health.

ⁱ U.S. Environmental Protection Agency. "He'eia Coastal Restoration Project: Thousands of Volunteers Replace Alien Plants with Native Species." <www.epa.gov/owow/nps/Section319III/HI.htm> Accessed February 1, 2004.

Coordinated and comprehensive inventories and assessments are essential for identifying critical habitats, evaluating the causes of habitat loss and degradation, and setting priorities for conservation and restoration efforts, thus enabling decision makers to focus limited resources on the most pressing needs. The regional ecosystem assessments called for in Chapter 5 will provide timely and comprehensive information on the status of coastal habitats.

In addition to improved understanding and broad national assessments and inventories, the nation needs better ongoing monitoring. Currently, most federal funding available for conservation and restoration efforts can only be used for direct implementation, not for the equally important tasks of monitoring the success of these efforts and further advancing restoration science.

Finally, conservation and restoration efforts must build on past successes to achieve progress. Currently, there is no accessible nationwide system for sharing information, including research results, planning processes, conservation and restoration techniques, and funding opportunities. A broadened and redefined Estuary Habitat Restoration Council could serve as a mechanism for this type of information sharing. Information pertinent to coastal habitat conservation and restoration efforts can also be shared through the regional ocean councils and regional ocean information programs.

Recommendation 11-3

The U.S. Department of the Interior, National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, and U.S. Army Corps of Engineers should enhance their restoration science, monitoring, and assessment activities. Congress should amend relevant legislation to allow greater discretion in using a portion of federal habitat conservation and restoration funds for related research, monitoring, and assessments.

Protecting the Nation's Wetlands: A Special Case

Our state and the nation are facing a true emergency of profound cost. The wetlands loss represents more than just the loss of land. It represents the loss of what sustains much of the state's economy, culture, and national image.

—Jack C. Caldwell,
Secretary, Louisiana
Department of Natural
Resources, testimony
to the Commission,
March 2002

Coastal wetlands, including marshes, swamps, and bogs, are an important and integral component of coastal habitat. USACE regulations define wetlands as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support vegetation that typically lives in saturated soils. Coastal watersheds currently include about 30 percent of all wetlands in the lower forty-eight states, a total of approximately 27 million acres.¹¹ Like other coastal habitats, wetlands provide a variety of valuable ecosystem services, such as improving water quality, providing natural flood control, recharging groundwater, stabilizing shorelines, contributing to recreational value, and serving as nursery areas for thousands of species of plants, fish, and other animals.

The functions and values provided by wetlands have not always been recognized. Prior to the 1970s, federal policies for agriculture, development, and insect control encouraged the draining and filling of wetlands—referred to disparagingly at the time as swamps. A 2001 National Research Council report found that, as a result, by the 1980s the area of wetlands in the contiguous United States had decreased to approximately 53 percent of its extent one hundred years earlier.¹²

In response to this dramatic loss of wetlands, the National Wetlands Inventory (NWI) Program was formed in 1975 to collect information about remaining wetlands. To date, approximately one-half of the United States is represented in the inventory, which includes all wetlands and deepwater habitats, such as lakes, rivers, and streams as well as marshes, bogs, and swamps. NWI data are used by Congress, all levels of government, academia, the private sector, and nongovernmental organizations for a variety of purposes, including resource management, transportation planning, infrastructure siting, and conservation and restoration planning. Despite these important applications, NWI data remain incomplete for much of the nation and relatively inaccessible to many who could put the data to beneficial use.

Recommendation 11-4

The U.S. Fish and Wildlife Service should complete, digitize, and periodically update the National Wetlands Inventory.

By the late 1980s, federal policies had shifted and the protection of wetlands became a national priority. In 1989, President George H.W. Bush acknowledged the importance of wetlands by establishing the goal of “no net loss of wetlands,” a goal that has been supported by subsequent administrations. As a result of these shifts in attitude and policy, the rate of wetlands loss has decreased substantially, although there is some uncertainty as to the extent of the decrease and the functional value of remaining wetlands compared to their historic counterparts.¹³ Despite selected improvements, wetlands continue to be lost due to subsidence, erosion, storms, and human activities, including the conversion of such areas for other uses.

There is no single, comprehensive federal wetlands protection law. Instead, multiple federal statutes and programs provide protections in different forms, including the various conservation and restoration programs described earlier in this chapter. State, local, and tribal wetlands programs add to the success—and the complexity—of wetlands protection efforts.

The Clean Water Act Section 404 program is the primary federal regulatory program providing protection for the nation's wetlands. The goal of the program is to avoid deliberate discharges of materials into wetlands, or to minimize discharges where they cannot be avoided. The program requires permits for discharges of materials (such as dredged materials, or other soil or sand used as fill) into U.S. waters, although several major categories of activities are generally exempted, including certain ongoing farming, ranching, and silviculture operations. When a permit is issued that will result in some wetlands loss, *compensatory mitigation* is often required; that is, wetlands must be restored, enhanced, preserved, or created elsewhere to replace the permitted loss of wetland acres and functions.

Although it has shown some success in slowing the rate of wetlands loss, Section 404 does not constitute a comprehensive national wetlands management and protection program. It does not address many kinds of activities that affect wetlands and its implementation has been uneven; a large gap remains between the mitigation required in connection with permitted activities and that which has actually been achieved. Moreover, the navigation, flood control, and other civil works projects undertaken by the USACE itself may have impacts as great as, or greater than, those of any permitted activity. Mitigation for some federal projects has also fallen far short of what was originally approved. Finally, the Section 404 program has generally failed to give sufficient consideration to the cumulative impacts associated with issuing multiple individual permits, or conducting a variety of federal projects, in the same geographic or watershed area. (Recommendations on improving the ability of USACE to address the regional, cumulative impacts of its activities are provided in Chapter 12.)

Other provisions of the Clean Water Act, such as those dealing with stormwater runoff and certain types of pollution, also provide some measure of wetlands protection, but not in the context of a coordinated wetlands management regime. As the nation recognizes the interconnectedness of upland and downstream areas, considers entire watershed systems, and moves toward an ecosystem approach, comprehensive wetlands protection should be considered as an integral part of ocean and coastal management.


Recommendation 11–5

The National Ocean Council should coordinate development of a comprehensive wetlands protection framework that is linked to coastal habitat and watershed management efforts, and should make specific recommendations for the integration of the Clean Water Act Section 404 wetlands permitting process into that broader management approach.

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MANAGING SEDIMENT AND SHORELINES



The natural flow of sediment over land and through waterways is important for sustaining coastal habitats and maintaining attractive beaches. However, excess or contaminated sediment can destroy habitats, poison the food chain, and endanger lives. Too little sediment can also alter habitats and allow beaches to wash away. Because navigational dredging, infrastructure projects, farming, urban development, and many other necessary and beneficial human activities can interfere with natural sediment processes, their impacts should be understood and managed. A national strategy for managing sediment is needed to reduce harm to natural resources, address ecological and economic needs, and achieve goals such as greater beneficial uses of sediment from navigational dredging. Such a strategy should manage sediments on a multi-project, regional basis, and involve all relevant parties. The strategy should also foster improved methodologies for evaluating beneficial uses of dredged material, along with additional research, monitoring, assessment, and technology development to improve sediment management.

Understanding the Dual Nature of Sediment

Sediment in ocean, coastal, and Great Lakes waters is composed of inorganic and organic particles created through erosion, decomposition of plants and animals, and human activities. Sediment may be carried by wind or water from upland areas down to coastal areas, or may originate in the marine environment. Sediments along coastlines are transported by wind, waves, and currents in dynamic processes that constantly build up and wear away cliffs, beaches, sandbars, inlets, and other natural features.

From a human perspective, sediment has a dual nature—desirable in some locations and unwanted in others (Box 12.1). Sediment can be used to create or restore beaches and to renew wetlands and other coastal habitats. Such activities are referred to as beneficial uses. Undesirable sediment can cloud water and degrade wildlife habitat, form barriers to navigation, and contaminate the food chain for marine plants, animals, and humans.

Whether sediment is desirable or not, its location and movement can have large economic and ecological consequences. For example, excess sediment in shipping channels may cost ports millions of dollars in delayed or limited ship access, while in other locations insufficient sediment deposits could result in the loss of valuable coastal wetlands.

Box 12.1 Sediment: Friend or Foe?

Sediment levels that are too high or too low can be detrimental to both natural environments and man-made structures, including extreme cases where structures are lost due to beach and cliff erosion. But sediment such as sand and gravel can also be viewed as a valuable resource.

Too much sediment can lead to...

- obstructed channels
- overflowing rivers
- smothered reefs
- high turbidity that blocks sunlight

...while too little sediment can lead to...

- disappearing beaches
- eroded riverbanks
- wetlands losses
- altered river profiles

Sediment can also be used for...

- construction material
- beach nourishment
- wetland restoration
- replacement of agricultural soil

The dual nature of sediment as both a threat and a resource to humans and the environment makes its management particularly challenging. To complicate matters further, the natural processes that create, move, and deposit sediment operate on regional scales, while management tends to focus on discrete locations—a single beach, wetland, or port. In addition, the policies that affect sediment location, transport, and quality fall under the jurisdiction of diverse programs within multiple agencies at all levels of government. This complex governance approach makes it difficult to manage sediment at the appropriate scale and in consonance, rather than in conflict, with natural processes. The prospect of global climate changes further complicates matters. For example, predictions of increased storm activity and changes in runoff patterns may adversely affect sediment delivery from upland areas, accelerate shoreline erosion, and result in increased runoff of contaminated sediments to coastal waters.

Reviewing Federal Roles in Sediment Management

The federal government's role in managing sediment in the marine environment covers five areas: navigation-related dredging; beneficial use of sediment; construction of infrastructure to reduce flooding and erosion hazards; management of contaminated sediment; and basic and applied research into sediment processes. As with many ocean and coastal issues, numerous federal agencies are involved.

The U.S. Army Corps of Engineers (USACE) plays a large part in nearly all of these areas and is the lead agency for all but contaminated sediment. The U.S. Environmental Protection Agency (EPA) has oversight of ocean disposal of dredged material, and the cleanup and disposal of contaminated sediment. The National Oceanic and Atmospheric Administration (NOAA) administers the Coastal Zone Management Program, which requires participating coastal states to have enforceable policies to protect ocean and coastal resources, including policies that affect sediment management. NOAA's National Marine Fisheries Service and the U.S. Department of the Interior's (DOI's) U.S. Fish and Wildlife Service have responsibilities for living marine resources and habitat that also give them a role in evaluating the impacts of proposed sediment projects undertaken or permitted by federal agencies. DOI's Minerals Management Service identifies and authorizes access to sand deposits in federal waters suitable for beach nourishment and wetlands protection projects. The U.S. Geological Survey advances research on the sources, transport, impacts, disposal, beneficial use, and other aspects of sediment. USACE, NOAA, and EPA also conduct related research efforts, and the National Science Foundation and Office of Naval Research fund many relevant studies.

Other federal programs have less direct, but no less important impacts on sediment. The U.S. Department of Agriculture's Natural Resources Conservation Service plays a central role in efforts to reduce agricultural soil erosion, much of which finds its way to estuaries and the ocean. USACE and DOI's Bureau of Reclamation operate flood control, water storage, and hydroelectric projects which retain, and occasionally release, large amounts of sediment. Sediment also is addressed extensively through the nation's regulation of point and nonpoint sources of pollution, with EPA and NOAA as the principal federal agencies involved.

Some activities that affect sediment, such as dredging and shoreline erosion control projects, fall under specific laws, often implemented in isolation from each other. Other activities are addressed under broader, less specific authorities. Even seemingly well designed projects can sometimes create more problems than they solve, or encounter frustrating delays, because of poor communication among stakeholders, and confusion about

the many programs that remove, relocate, prevent, or accelerate the transport of sediment. At this time, there is no consistent mechanism to ensure that each individual sediment-related project is considered in a larger ecosystem-based context.

Figure 12.1 Dams Impede Sediment Destined for the Coast



■ Dam Location

To support California's exponential population growth, over 1,400 dams have been constructed across the state for a number of purposes, including water storage, irrigation, flood control, recreation, and hydroelectric power. However, dams constructed in coastal watersheds block the flow of sediments needed for natural beach replenishment.

Source: California Department of Boating and Waterways. "California Beach Restoration Study." <www.dbw.ca.gov/beachreport.htm> (Accessed May 2004).

Altering Sediments through Human Intervention

Changing Sediment Quantities

Many human interventions in sediment processes are unintentional, occurring as a by-product of routine economic activities that overload or deprive natural systems of sediment. Activities such as forestry, agriculture, and urban development yield great benefits to the nation, but also accelerate natural erosion. Excess sediment suspended in the water column or accumulated at the bottom of water bodies can create problems for other industries, such as shipping, fishing, and tourism, and can harm aquatic life.

Conversely, flood control, water supply, and hydroelectric projects prevent the natural movement of sediment, contributing to downstream erosion and subsidence problems (Figure 12.1). As older components of this infrastructure become too costly to maintain, or are rendered obsolete for structural or economic reasons, disposing of the enormous quantities of trapped sediment will pose a new set of problems. Development in coastal communities can also disrupt natural sediment movement, causing erosion in some places and accretion in others. Such projects may have unintended effects on neighboring jurisdictions, both upstream and downstream, that had no role in the planning process.

Changing Sediment Quality

Over the last fifty years, lakes, rivers, and harbors have accumulated bottom sediment contaminated with heavy metals (such as lead, copper, and arsenic) from mining and industrial activities, as well as long-lived toxic chemicals (such as DDT, MTBE, PCBs, and dioxin)(Box 12.2). Continued discharges from municipal waste and industrial plants, and polluted runoff from agricultural and urban sources, perpetuate the problem, while newly identified contaminants such as flame retardants are now being detected in ocean and coastal sediments. Toxic chemicals from sediment can accumulate in marine plants and animals, causing reproductive failure, impaired growth, disease, and death. They may also pose health risks to humans who consume or come in contact with tainted marine products.

Of the 12 billion cubic yards of sediment that comprise the top 2 inches underlying U.S. waters, an estimated 10 percent is thought to be contaminated at levels that pose possible risks to marine life, wildlife, and humans.¹ Of the 300 million cubic yards of sediment the USACE dredges annually to facilitate navigation, an estimated 5 to 10 percent is contaminated.² Once a portion of sediment becomes contaminated, it becomes a source of further contamination downstream.

Currently, six laws and seven federal agencies are involved in the dredging or remediation of contaminated sediment, depending on whether the material is to be removed, deposited, or treated. Different sets of laws apply when navigational dredging or environmental cleanup is the primary focus of activity. A 1997 National Research Council report concluded that this patchwork of laws generally fails to manage contaminated sediment according to the risk it poses to the environment, does not adequately weigh the costs and benefits of different solutions, and imposes lengthy and unnecessary delays in addressing problems.³

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) established the federal Superfund program to clean up the nation's uncontrolled or abandoned hazardous waste sites. At over one hundred locations, bottom sediments in rivers and harbors are so contaminated they are designated as Superfund sites. The EPA estimates that cleanup of the thirty most highly contaminated sites in rivers, lakes, and coastal areas may cost hundreds of millions of dollars.⁴

The presence of contaminated sediment greatly complicates the management of dredged material. For example, such sediment would be inappropriate for use in wetland restoration or erosion control projects. Costs are also much higher for the safe and secure disposal of these materials. The very process of dredging contaminated sediment increases ecological and human health risks because some of the sediment inevitably becomes resuspended and carried to new locations during removal.

Box 12.2 The Legacy of Sediment Contamination

Long-term remedial response action is required at areas on EPA's Superfund list, one of which is Fox River and Green Bay, Wisconsin. From 1954 to 1971, PCBs were released during the manufacture of carbonless copy paper by seven companies along the banks of the river. The chemical releases left 11 million cubic yards of contaminated sediment in Fox River and Green Bay. The EPA estimates that up to 70 percent of the PCBs entering Lake Michigan via its tributaries come from the Fox River. This contamination has affected water quality, recreation, and the health of people, fish, and birds. Elevated PCB concentrations in some Lake Michigan fish have prompted health advisories. Native Americans in the area have been particularly affected because of the importance of subsistence fishing to their community.^{i,ii}

ⁱ Balas, M. "Fox River Cleanup Is Talk of the Town, But What About Restoration." *The Green Bay News-Chronicle*. October 22, 2003.

ⁱⁱ Wisconsin Department of Natural Resources and U.S. Environmental Protection Agency. *Superfund Record of Decision for Operable Units 3, 4, and 5*. Madison, WI, and Washington, DC, June 2003.

Developing Regional Strategies for Sediment Management

Sediments flow continuously downstream to the coast, on and offshore, and back and forth along the coast. A project-by-project approach to sediment management can result in expensive actions that may undermine the interests of other stakeholders. For example, flood and erosion control structures, while temporarily protecting targeted locations, interrupt the natural transport of sediment along the coast, preventing the accumulations that create beaches and maintain wetlands, exacerbating coastal erosion, and potentially threatening life, property, and coastal economies in other locations. Similarly, upstream sediment diversions or contamination can have major impacts in estuaries and other coastal areas.

Coastal stakeholders have increasingly recognized the need to develop more proactive and preventive strategies. However, their absence from broad watershed planning efforts—where decisions about land use and water management could reduce excess and contaminated sediments at their source—makes such change difficult to realize. (A more detailed discussion of watershed planning efforts appears in Chapter 9.) The nation needs both a better understanding of the interactions between human activities and sediment flows, and a better mechanism for involving all potentially affected parties.

Moving toward an ecosystem-based management approach is a critical step. The new National Ocean Policy Framework outlined in Part II creates a structure for regional coordination and cooperation among the many parties affected by sediment. Participation by federal, state, and local entities in watershed management efforts, along with key stakeholders such as coastal planners and port managers, is one way to diminish upland sources of excess and contaminated sediment that harm the marine environment.

Recommendation 12–1

The National Ocean Council should develop a national strategy for managing sediment on a regional basis. The strategy should incorporate ecosystem-based principles, balancing ecological and economic considerations.

In addition, the strategy should:

- acknowledge adverse impacts on marine environments due to urban development, agriculture, dams, dredging, pollutant discharges, and other activities that affect sediment flows or quality.
- ensure involvement of port managers, coastal planners, land use planners, and other stakeholders in watershed planning.
- emphasize watershed management as a tool to address upstream land uses that affect sediment input to rivers and coastal waters.

Regional sediment management will require coordination among diverse interests, political jurisdictions, and levels of government to achieve environmental, social, and economic goals. For example, construction and restoration projects in coastal areas often face long permitting and planning delays, which can substantially add to project costs and be ecologically detrimental. A regional sediment planning process that identifies pre-approved beneficial use sites through a collaborative stakeholder process could help expedite projects, resulting in quicker realization of economic benefits to the region.

A regional approach could also help prioritize projects. In considering beach nourishment proposals for two nearby sites, priority might be given to one of the sites if natural sediment transport processes would result in secondary nourishment of the down-coast site, doubling the impact of the investment. Regional sediment management could also inform coastal land use planning and permitting decisions, moving new development or post-disaster rebuilding away from erosion hot spots, as discussed in Chapter 10.

One of the difficulties in undertaking a regional approach to managing sediment is that the definition of a region may differ substantially among parties engaged in land use planning, port management, coastal development, wetlands protection, or fishery management. To understand the sources and transport of sediment, a region might extend tens to hundreds of miles up and down rivers and the coastline. Alternately, for management of dredged material at a port, the region might be linked to the size of that port. Coastal erosion and living marine resources may define other scales. These definitions should be reconciled to achieve effective sediment management in an appropriate regional context.

Moving Toward Regional Sediment Management at USACE

USACE's traditional protocols for dredging and other sediment management projects consider the impacts of those projects individually and on short-term and local scales—typically from one to thirty years, across areas of less than ten miles—despite widespread recognition that coastal processes operate at regional scales with time frames of up to 250 years and geographic extents of dozens of miles from a project's location.⁵ In many cases, this disregard for the scale over which natural processes operate has resulted in projects having unintended adverse impacts on nearby coastal resources, placing too much sediment in the wrong place or too little where it is needed.

More recently, USACE, with support from Congress, has begun pursuing alternatives to its project-by-project approach. For example, USACE created the Regional Sediment Management Program based on general direction from Congress to develop long-term strategies for disposing of dredged materials and to cooperate with states to develop comprehensive plans for coastal resource conservation. Under this program, USACE collaborates with states, communities, and other diverse stakeholders to develop plans to manage sediment across a region that encompasses multiple USACE dredging projects.

To date, the Regional Sediment Management Program has undertaken six demonstration projects around the country. Early results have yielded technology improvements, information sharing, and the building of a base of experience in more comprehensive management of construction activities affecting sediment. Nevertheless, scientific, technological, and institutional hurdles remain to implementing truly regional sediment management.⁶

[Dredging related] navigation and environmental challenges must be addressed within the context of rapidly increasing population growth in the coastal zone and the resulting tensions between residential, recreational, and economic uses and the need to preserve, protect and restore critically important ecological resources.

—Major General Robert Griffin, Director of Civil Works, U.S. Army Corps of Engineers, testimony to the Commission, October 2002

Recommendation 12-2

Congress should direct the U.S. Army Corps of Engineers (USACE) to adopt regional and ecosystem-based management approaches in carrying out all of its sediment-related civil works missions and should modify USACE authorities and processes as necessary to achieve this goal.

Weighing the Costs and Benefits of Dredging

Navigational Dredging

Widespread adoption of regional sediment management practices will help address many problems. However, until such practices are common—and even once such frameworks are in place—certain sediment activities merit special attention. Dredging for navigational purposes is perhaps the most direct and prominent way humans affect sediments in marine waters, and the federal government is in charge of dredging activities for this purpose.

Navigational dredging in ports and waterways seeks to remove accumulated sediment that blocks or endangers vessels and prevents access by ships that continue to increase in size and draft, requiring wider and deeper channels. An estimated 400 million cubic yards

of sediment (300 by USACE and another 100 by private permittees) are dredged annually to maintain and improve navigation.⁷ As the volume and value of goods transported by water continues to grow, the importance of maintaining efficient, modern ports increases. (Chapter 13 includes a broader discussion of port planning in the context of maritime commerce and transportation.) All dredging, whether related to navigation or not, can have negative impacts. These impacts may include habitat disturbance and the dispersion of sediment—frequently contaminated—to new locations, with unintended impacts on the ecosystem.

One frequent complaint associated with dredging projects is the time involved from conception to completion. Currently, the process of planning, permitting, and completing a navigation channel improvement project (widening or deepening) can take more than twenty years. Reasons for delay include inconsistent funding allocations and congressional approvals, the complexity of the project review process, and scientific uncertainties. Such lengthy time frames can be ecologically and economically detrimental to a region. Delayed access to a port may reduce ship traffic and trade, and environmental impact statements may become outdated. At the same time, certain projects may be legitimately questioned by those who believe there are less costly or environmentally damaging alternatives.

EPA and USACE are currently investigating mechanisms for improving the efficiency of the planning and permitting process for management of dredged material. These efforts should be encouraged. A streamlined process could help evaluate the necessity of a proposed dredging project, look for opportunities to improve sediment management, and set priorities among projects.

Box 12.3 Beach Nourishment: One Use for Dredged Sediment

Dredging of sediment does take place outside the navigation context, most notably for use in beach nourishment to protect recreation, tourism, and beachfront property. Such projects have been a source of great contention. Proponents champion beach nourishment as essential to protecting life, property, and beach-dependent economies. Opponents decry it as a costly taxpayer-subsidized activity that threatens coral reef and other ecosystems and creates incentives for inappropriate development in coastal areas subject to storm, flooding, and erosion hazards. Political representatives are often pressured to support beach nourishment projects where eroding shorelines threaten the economic health and safety of a coastal community.

However, as the National Research Council noted in a 1997 report, the process for determining when, where, and how to use dredged sediment for beach nourishment suffers from a number of deficiencies, including a lack of performance criteria, inadequate technical and economic methodologies, outdated design standards, insufficient stakeholder involvement, an inadequate understanding of the physical and biological mechanisms of beach and littoral systems, and a failure to plan for the long term or in a regional context.ⁱ Because the high costs of undertaking and maintaining these projects are borne in large measure by the public, investments should target projects that will render the greatest benefit and where other alternatives, such as moving development away from eroding areas, are not possible. Achieving this goal will require a better understanding of sediment processes and a method for considering beach nourishment proposals in a regional context.

ⁱ National Research Council. *Contaminated Sediments in Ports and Waterways: Cleanup Strategies and Technologies*. Washington, DC: National Academy Press, 1997.

Beneficial Uses of Dredged Material

Dredged material has long been used to create new land for commercial, residential, and infrastructure developments, as well as to bolster beaches and barrier islands to protect against storm and erosion hazards and enhance tourism and recreation (Box 12.3). Since the 1970s, these beneficial uses of dredged material have also included environmental enhancement, such as restoration of wetlands, creation of wildlife habitat, and improvement of fish habitat. Surprisingly, navigation-related dredged material does not find its way into beneficial use projects as often as perhaps it should. This is due in part to sediment contamination, but also to USACE policies that favor disposal in open waters or in upland dump sites. These policies may be unnecessarily foregoing opportunities to support economic growth or environmental protection and may have serious unintentional consequences for aquatic ecosystems.

Techniques of Cost-Benefit Analysis

Under current USACE policies, navigation-related dredged material is primarily viewed as a waste stream and diversion for beneficial use is considered extraneous to the navigation mission. For the federal government to cover the costs of a navigational dredging project, USACE regulations require that the dredged material be disposed of in the “least costly, environmentally acceptable manner consistent with engineering requirements established for the project.” During its project evaluation process, USACE determines the least-costly disposal method, designated as the Federal Standard, and decides on the appropriate cost-sharing structure with nonfederal partners. If the Federal Standard option is not used, the nonfederal partners must assume a larger portion, sometimes over 50 percent, of the project costs.

Because USACE cost-benefit methodologies tend to undervalue the benefits of projects that use dredged material, while failing to account for the full costs, including environmental and other nonmarket costs, of traditional disposal methods, the least-cost option generally favors open-water disposal of dredged material. A more accurate system for selecting and ranking projects would be based on a comparative net economic and environmental return for the United States rather than a narrow cost-benefit analysis for a specific project. Recognizing the advantages of beneficial-use projects may also justify spreading the costs among a wider array of stakeholders. To check the USACE’s assumptions and methodologies, the analyses should be peer-reviewed, as called for in a recent National Research Council report.⁸

Recommendation 12–3

The U.S. Army Corps of Engineers should ensure that its selection of the least-cost disposal option for dredging projects reflects a more accurate accounting of the full range of economic, environmental, and other relevant costs and benefits for options that reuse dredged material, as well as for other disposal methods.

National and Regional Dredging Teams

Recognizing the benefits of improved sediment management, a number of ports have developed long-term plans for managing dredged material, including the ports of Boston, New York and New Jersey, Houston, Long Beach, Los Angeles, Oakland, Seattle, and others. These long-term plans were intended to avoid delays caused by new environmental testing procedures, the determination that some dredged material was not suitable for ocean disposal, and the lack of disposal alternatives, all of which had added years to the expected completion of some port expansion and navigational dredging projects.

Long-term planning efforts for managing dredged material can bring together federal agencies, port authorities, state and local governments, natural resource agencies, public interest groups, the maritime industry, and private citizens to forge agreements that, among other factors, increase the likelihood of beneficial uses of dredged material. These types of initiatives were encouraged by a 1994 Interagency Working Group report to the Secretary of Transportation, *The Dredging Process in the United States: An Action Plan for Improvement*. Three years after the Action Plan's publication, a 1997 National Research Council report echoed its findings and recommendations.⁹

The Action Plan concluded that early acknowledgment of environmental concerns and effective public outreach could substantially reduce potential conflicts and delays. Specific recommendations included: creation of a timely, efficient, and predictable regulatory process; support for port or regional scale planning by partnerships that involve the federal government, port authorities, state and local governments, natural resource agencies, public interest groups, the maritime industry, and private citizens prior to seeking project approval; involvement of dredged material managers in watershed planning to emphasize the importance of reducing sediment loadings and contamination at their source; and encouragement for the environmentally sound, beneficial use of dredged materials, such as wetlands creation and beach nourishment. The Action Plan also emphasized the need to continually integrate the best available science.

In subsequent years, progress was made on some elements of the Action Plan, most importantly the 1995 establishment of the National Dredging Team co-chaired by EPA and USACE, but other elements lagged. In 2003, the National Dredging Team issued *Dredged Material Management: Action Agenda for the Next Decade*¹⁰ as a successor to the 1994 Action Plan. The Action Agenda's twenty-two recommendations focus on increasing beneficial use of dredged material, using effective watershed planning to improve sediment management, strengthening and expanding the number of regional dredging teams, and improving integration with water quality, coastal management, and fisheries management programs.

Recommendation 12-4

The National Dredging Team should ensure vigorous and sustained implementation of the recommendations contained in its *Dredged Material Management: Action Agenda for the Next Decade*, moving toward more ecosystem-based approaches. Regional dredging teams, working with regional ocean councils, should establish sediment management programs that expand beyond single watersheds to larger regional ecosystems.

Improving Understanding, Assessment, and Treatment

An enormous constraint to improved sediment management is a poor understanding of sediment processes in the marine environment and a paucity of effective management techniques. This is particularly true for contaminated sediment.

Coordinated Strategy Needed

Numerous ongoing research programs exist to improve the nation's understanding of sediments and sediment management techniques, but they are often fragmented, uncoordinated, and inadequately funded. Despite some scientific advances, these programs have not produced the needed engineering models, innovative management techniques and technologies, or comprehensive information about the source, movement, location, volume, quality, and appropriate use or disposal of sediment on a regional and national basis.

The National Shoreline Management Study, a USACE initiative launched in 2002, holds promise for yielding information to better coordinate and synthesize federal sediment activities. The study is examining why, where, and to what extent U.S. shorelines erode or accrete and will investigate other aspects of sediment management, such as economic and environmental issues and the roles of stakeholders in shoreline management. The results could help establish national priorities for shoreline management, but only if there is a mechanism for translating those results into action. In addition to maintaining the National Shoreline Management Study, which looks primarily at physical shoreline processes, USACE should significantly expand support for research and monitoring of ecological and biological functions and processes.

The U.S. Geological Survey (USGS) plays an important role by collecting, analyzing, interpreting, and disseminating data on sediment flows and chemistry independent of any regulatory or operational concerns. Thus, USGS can be instrumental in providing a reliable scientific foundation for a new approach to managing sediments.

Recommendation 12–5

The U.S. Army Corps of Engineers, working with U.S. Department of the Interior agencies, the National Oceanic and Atmospheric Administration, and the U.S. Environmental Protection Agency, in consultation with state and local governments, should develop and implement a strategy for improved assessments, monitoring, research, and technology development to enhance sediment management.

The enhanced sediment monitoring called for in Recommendation 12–5 is an integral part of the national monitoring network described in Chapter 15.

USACE's role in major construction projects that significantly alter watersheds brings with it an obligation to understand the potential impacts of these activities prior to their implementation. Current project-by-project planning and funding, along with severely limited discretionary funds for broader ecosystem research, have made this extremely difficult. Existing funding formulas also severely limit post-project monitoring, precluding long-term analyses of project outcomes and adoption of adaptive management.

Recommendation 12–6

Congress should modify its current authorization and funding processes to require the U.S. Army Corps of Engineers (USACE), or an appropriate third party, to monitor outcomes from past USACE projects and assess the cumulative, regional impacts of USACE activities within coastal watersheds and ecosystems. Such assessments should be peer-reviewed consistent with recommendations from the National Research Council.

Contaminated Sediment

The characterization, containment, and treatment of contaminated sediment in marine environments, whether through removal or treatment in place, continue to be technically difficult and prohibitively expensive. Thus, the best defense against damage from contaminated sediment is to prevent its creation or escape. Unfortunately, because reductions from upland point and nonpoint sources remain a major challenge, additional marine sites will most likely continue to be affected.

Recent EPA and National Research Council reports recognize the difficult ecological and economic problems associated with contaminated sediment management and stress the importance of adopting an adaptive management approach to deal with such problems.^{11,12} Scientifically sound methods for identifying contaminated sediment and developing innovative technologies for source reduction, as well as improved dredging and treatment of this material, are critical steps toward improving the economic and ecological

health of coastal areas. To be successful, these efforts will require new resources and effective regional planning. The contaminated sediment science plan, issued by EPA in draft form in 2002 but never finalized, appears to provide a sound framework for identifying and ranking the science and approaches needed for improved management of contaminated sediment, and for promoting improved coordination within EPA and among the many other federal entities with contaminated sediment responsibilities.

Recommendation 12–7

The U.S. Environmental Protection Agency, working with other appropriate entities, including state and local governments, should build upon EPA's 2002 draft contaminated sediments science plan to develop and conduct coordinated strategies for assessment, monitoring, and research to better understand how contaminated sediment is created and transported. The strategies should also develop technologies for better prevention, safer dredging or onsite treatment, and more effective post-recovery treatment of contaminated dredged material.

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