Session No. 10

Course Title: Breaking the Disaster Cycle: Future Directions in Natural Hazard Mitigation

Session Title: Coastal Erosion Issues: Shifting Hazardous Development Costs to Users

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Time: 150 minutes + 15 minute break

Objectives:

10.1 Understand the nature of coastal erosion processes.
10.2 Discuss the political, social, and economic issues raised by erosion impacts.
10.3 Describe the proposed structural and regulatory solutions to coastal erosion.
10.4 Review the costs of coastal hazards and how they are paid.
10.5 Discuss issues of who should pay for protection of property in hazardous areas.
10.6 Discuss proposed approaches to shifting the costs of hazardous development to property owners, such as risk based taxation.

Scope:

During the first part of this class, the instructor describes the natural and man-made forces that lead to coastal erosion, the issues raised by such erosion and the efforts to combat it. The instructor will discuss, in some detail, the different approaches to mitigate coastal erosion. Some of the approaches were touched on in Session 6.

The second part of the session provides a review of the costs of coastal hazards and a discussion of who should pay to protect coastal property from erosion. This is followed by a discussion of how the costs of coastal hazards could be born to coastal property owners. Finally, the session concludes with a role-playing exercise in which students will present arguments for or against a proposed policy to tax residents of hazardous areas to pay for hazard mitigation and disaster response and recovery.

Reading:

Instructor and Student Reading

Platt, Rutherford H. 1999.Ch. 4. Property Rights Organizations: Backlash Against Regulations; Ch. 5. The Takings Issue and the Regulation of Hazardous Areas; and Ch. 6. Fire Island: The Politics of Coastal Erosion, pp. 111-214. *Disasters and Democracy: The Politics of Extreme Natural Events*.

Pilkey, Orrin, and Katherine Dixon. 1996. Ch. 1. America and the Beach, Ch. 2. Coastal Processes and What to Do about them, pp. 1-53, and Ch. 4. Beach Replenishment, pp. 75-101, *The Corps and the Shore*.

Deyle, Robert, and Richard Smith. 2000. "Risk-Based Taxation of Hazardous Land Development," *Journal of the American Planning Association*, 66:4, Autumn, pp. 421-434.

Boswell, Michael, Robert Deyle, Richrd Smith, and Jay Baker. 1999. "A Quantitative Method for Estimating Probable Costs of Emergency Management for Hurricanes." *Environmental Management*, 23:3, pp. 359-372.

Burby, Raymond, et al. 1991. Financial Planning Strategies, Ch. 4 in *Sharing Environmental Risks: How to Control Government's Losses in Natural Disasters*. Boulder, CO: Westview. Pp. 66-68.

Godschalk, David R., David Brower, and Timothy Beatley. 1989. Ch. 2, Alternative Approaches to Mitigating Coastal Storm Hazards, pp. 23-48. *Catastrophic Coastal Storms: Hazard Mitigation and Development Management.* Durham, NC: Duke University Press.

H. John Heinz III Center for Science, Economics, and the Environment. 2000. *The Hidden Costs of Coastal Hazards: Implications for Risk Assessment and Mitigation*. Washington, D.C.: Island Press.

Handouts:
None

Power Point Slides:

Overheads:
10.1 Coastal Erosion Forces
10.2 Mitigating Coastal Erosion: Structural Approaches
10.3 Saga of a Seawall
10.4 Mitigating Coastal Erosion: Non-Structural Approaches
10.5 Relocation of Cape Hatteras Lighthouse

General Requirements:

During the first part of the session, the instructor presents a lecture on coastal erosion, its causes and consequences. The lecture includes numerous examples of structural and nonstructural approaches to mitigate the impacts of coastal erosion and leads a discussion on the issues raised by the implementation of these measures. In the second part, students engage in a role-playing exercise that is designed to explore some of the key questions about coastal erosion and who should pay to mitigate its impacts.

Remarks:

Some of the issues and techniques explored in this session will have been covered in Session 6. However, the focus of this session is not on mitigating natural hazards in general, but specifically on coastal erosion. Traditionally, our nation's approach to mitigating the impacts of coastal erosion has been to build "hard" structures such as jetties, groins and seawalls. More recently, however, the trend has been toward "soft" measures that present fewer adverse environmental impacts. Both approaches are expensive and controversial and usually rely on federal subsidies.

Course Introduction

Objective 10.1 Understand the nature of coastal erosion processes.
America's coastlines are dynamic and diverse environments that change in response to natural processes and human intervention (Heinz, 2000:9). Natural processes include wind, waves, currents and sea level rise. Human interventions include the construction of jetties or groins or dredging inlets so ships can pass safely, or the construction of dams upstream that obstruct the flow of sand and sediments to the coast (*Figure 10.1: Coastal Erosion Forces*).

Changes can occur rapidly as a result of severe storms, such as Nor'easters or hurricanes, or more slowly in response to the constant pounding of waves. Waves striking a beach knock sand into suspension. The sand can be carried by currents along the shore in a process known as "littoral drift." The drifting sand can be carried for miles until it comes to rest along another beach or behind a natural or man-made obstacle. During severe storms, strong waves can flatten dunes or erode sand cliffs and transport the sand off shore to form sand bars. Following the storm, calmer waves gradually transport much of this sand back to shore, replenishing the beach. Over time, wind-blown sand forms ridges and dunes, and the cycle begins again when the next storm arrives.

According to Pilkey and Dixon, (1996:31), for all practical purposes, the American shoreline is eroding everywhere. There are exceptions, however, where beaches are accreting or growing in response to sand deposition. Some coastal areas are more

susceptible to erosion than others. The rocky coast of Maine, for example, stands firm in comparison to the narrow, low-lying barrier islands that extend along most of the North Carolina coast. Erosion rates vary considerable along the U.S. coast. The average erosion rate along the Atlantic coast is two-three feet per year and along the Gulf coast, six feet per year (Beatley, Brower & Schwab, 2002:68). Along the Pacific coast, beaches are narrow and typically backed by steep cliffs. Average erosion rates are lower, generally less than one foot per year. Average rates can mask the severe erosion that is taking place in some areas, such as along the Louisiana coast.

The key factor influencing the rate of coastal erosion is sand supply. Sand moves from place to place: it is transported along the shore, carried out to sand bars and beyond, and blown onto dunes. Yet, as long as the sand being lost is replenished, the beach remains relatively stable. When the sand supply is restricted or cut off, either by natural or manmade obstructions, erosion occurs.

Objective 10.2 Discuss the political, social, and economic issues raised by erosion impacts.

In his book, *Islands at the Edge of Time*, (1993) Gunnar Hansen observed that beaches do not stand still, which is contrary to the way people think of land as behaving. Houses, apartments, condominiums and hotels are static, beaches are not. As beaches erode, they undermine structures in their path, which brings calls from property owners for erosion control.

The problem of beach erosion can be particularly acute for dynamic coastal landforms such as barrier islands, which are extremely popular places to develop. Lying parallel to the shore, barrier islands function as buffers, protecting the mainland against the destructive forces of storm-driven waves, hence the name barrier. The barriers themselves survive the occasional onslaughts by migrating inland, at varying rates, in response to wind, waves, and rising sea levels that roll the sand off their outer edges back and into their interiors. Similarly, coastal inlets migrate as well, sometimes dramatically. For example, Mason's Inlet north of Wilmington, North Carolina shifted dramatically over the course of a decade and threatened to undermine the $22 million Shell Island Resort. When it was first constructed, the nine-story resort stood one-half a mile from the inlet. After Hurricane Fran struck the North Carolina coast in 1996, however, the inlet had closed to within 150 feet of the resort. The resort was built after the state had adopted a ban on seawalls and other hardened structures designed to control erosion. In a controversial decision, the state's Coastal Resources Commission granted the resort permission to build a temporary sandbag wall to halt the inlets migration and begin dredging to relocate the path of the inlet.

Where no structures are present, a migrating beach does not pose a problem. As it moves, it retains its shape, albeit in a different position. However, as a barrier island or inlet area migrates, the beach gradually shifts out from under beachfront property, leaving houses and other property stranded in the surf. The main focus of efforts to control erosion is not to save the beach, but to save beachfront property.

According to the Heinz Center for Science, Economics, and the Environment, an estimated 350,000 structures are located within 500 feet of the shoreline of the U.S., excluding Alaska (Heinz, 2000:xxv). This does not include homes in dense areas of large coastal cities such as Miami, Chicago, Los Angeles and New York. According to the Center, over the next 60 years, erosion will claim about one-forth or 87,500 of these structures, unless of course, some are protected by erosion control measures. The number of structures destroyed by erosion could increase as more buildings are constructed on what are now vacant lots.

Coastal erosion raises several challenging issues, such as:

- Do beachfront property owners have a right to take whatever steps are necessary to protect their property from erosion, even if it may exacerbate erosion in other areas or result in loss of, or restricted access to, the recreational beach? Several states, e.g., North and South Carolina, restrict the use of hardened erosion control measures along the coast (see discussion of such measures in Session 10.3).

- Who should bear the costs for erosion control measures? Should beachfront property owners, who bear the brunt of damage from coastal erosion, pay for the costs of erosion control measures, or should society pay, since we all enjoy visiting the coast?

- Should realtors be required to disclose to potential buyers that the property they are thinking of buying is in a high-erosion area? Several states require such disclosure, although some require it at closing, thus undermining the effectiveness of the notice.

- Should landowners be allowed to build in erosion-prone areas, e.g., high-hazard areas? Of the 30 states that border the coast, 19 incorporate erosion risks into the approval process for new construction close to the shore (Heinz, 2000:xxxvi). Landowners may argue that government restrictions on building in erosion-prone areas are a taking of their property without compensation.

- Is the government putting people and their property at risk by encouraging or facilitating development in erosion-prone areas of the coast? For example, the National Flood Insurance Program does not map coastal erosion areas, so not only are people not made aware of erosion risks, but the added risk of building in a high-erosion area is not reflected in insurance premiums.

Objective 10.3 Describe structural and nonstructural approaches to coastal erosion. In Session 6, we discussed structural approaches to mitigating natural hazards along rivers and along the coast. In this session, we focus on various methods of reducing the adverse impacts of coastal erosion and some of the impacts of these methods.

There are three main approaches to protecting *existing* property from beach erosion: hard stabilization, soft stabilization and relocation. In addition, land use regulations and other nonstructural approaches can help discourage people from constructing *new* buildings in harm's way. Each of these approaches will be discussed in this section.

Structural Approaches

Hard Stabilization

Traditional approaches to controlling beach erosion include "hard" structures such as groins, jetties, seawalls and breakwaters, each of which is designed to either block and dissipate wave energy or trap sand to widen the beach. The most common types of hard erosion control structures, as discussed previously in Session 6, are summarized below (*Figure 10.2: Mitigating Coastal Erosion: Structural Approaches*).

- *Seawalls*, as their name suggests, are vertical walls built on land and parallel to the beach to absorb wave energy. They are the most common type of hardened shoreline protection measure and are typically constructed from heavy concrete steel or rocks. Seawalls typically function to halt the retreat of the shoreline into adjacent buildings but are not designed to block storm waves.

- *Bulkheads* are similar to seawalls, but are generally smaller than seawalls. They are usually used to protect headland areas and inlet channels.

- *Breakwaters* are fixed or floating structures that parallel the coast but are built just offshore. They serve to reduce the energy of waves before they hit the shoreline.

- *Revetments* have a similar purpose, but may be angled and typically use riprap or interconnecting concrete blocks to protect dunes and beaches from erosion (Bush, et al.,1996).

- *Jetties* and *groins* are rock walls or piles built perpendicular to the beach. Jetties typically serve to interrupt the flow of sand along shore and prevent ship channels from filling in, while groins usually are built to capture migrating sand and increase the width of beaches.

Impacts of hard structures

Properly maintained, hard structures are probably the most dependable way to protect property, but they are not without problems. Groins and jetties, which are usually built of large boulders, pose threats to the health of surfers and swimmers alike. In addition, such structures trap sand carried by currents, called longshore currents, flowing along the beach. Suspended sand is deposited on the updrift side, while the downdrift side erodes. Also,

A classic case is the New Jersey coast, where hundreds of groins jut out from the beach. Once a groin is built, it robs sand from adjacent, downdrift beaches, which must then build their own groin to capture whatever sand floats by or risk watching their beach

erode. Eventually, every downdrift community along the coast must build a groin or lose its beach. The net effect is that every few hundred yards or so, a line of boulders extends from the beach virtually the entire length of the New Jersey shore. This is often referred to derisively as the "New Jerseyization" of the coast. To prevent this from happening, some states, such as North and South Carolina, prohibit the use of hardened structures such as groins or seawalls along the beach, with few exceptions.

Similarly, breakwaters, which are designed to dissipate wave energy and reduce erosion, can cause erosion of adjacent areas by interrupting downdrift flow of sand in the longshore currents and perhaps by impeding the flow of offshore sand to the beach (Pilkey and Dixon, 1996:45). Finally, seawalls may protect beachfront property, but at the expense of the beach. An oft-cited example is the seawall in Seabright, New Jersey, where a massive, 17-foot tall seawall protects an area of less than one-square mile and a population of fewer than 2,000 year-round residents. The wall has protected the city from coastal storms, but at the cost of its beach (*Figure 10.3: Saga of a Seawall*). By the mid-1990s, the beach, robbed of its local sand supply by the seawall and probably impacted by redistributed wave energy (off the wall) had all but disappeared (Bush, et al., 1996). In addition, the wall blocks the views of the sea. In 1995, however, the Corps of Engineers embarked on a massive effort to replenish the disappearing beaches along all 127 miles of New Jersey's coastline by pumping sand onto the beaches, a process known as beach nourishment, discussed below (Grunwald, 1999).

Given the adverse impacts of hardened structures, a few states, notably North Carolina and South Carolina, have banned new hardened erosion control structures along the beach. Nationwide, the trend over the past 10 years or so has been toward "soft" measures, as described below.

Soft Stabilization

In contrast to hard structures, which involve the construction of walls built of rocks, concrete or steel to protect beaches from erosion, "soft" measures typically involve the replenishment and reshaping of beaches and/or dunes. The most common soft stabilization measure is *beach replenishment or nourishment*, which involves adding sand to an eroding beach, usually by pumping or trucking it in from another source, such as an offshore sand bar or from sand deposits on the bay side of a barrier island. Such measures are gaining in popularity because they are viewed as less intrusive than hardened structures. Soft stabilization can be just as costly as hard stabilization, but it poses fewer environmental and aesthetic problems.

Beach nourishment can be expensive, primarily because of the high cost of transporting sand, but also because nourishment projects often require repeated applications of sand. For example, from 1962 to 1995, the beach at Cape May, New Jersey was nourished 10 times at a total cost of nearly $25 million. Ocean City, New Jersey's beach has been nourished 22 times, from 1952-1995, at a cost of more than $83 million (Duke University Program for the Study of Developed Shorelines). Beach nourishment costs and effectiveness varies widely. According to a 2000 report by the Heinz Center, from 1950 -

1993, the Corps of Engineers spent approximately $700 million (1993 dollars) to nourish about 200 miles of beach in the U.S, or $3.5 million per mile (Heinz, 2000:x1i). The Corps' beach nourishment project along the entire New Jersey coast is estimated to cost about $60 million a mile (Grunwald, 1999).

The experience with beach nourishment has been mixed: some nourished beaches last for years, while others have been washed away in months. For example, in 1982, Ocean City, Maryland completed a $5.2 million beach nourishment project. Within 3 months, the nourished portion of the beach had all but disappeared. In contrast, the nourishment of Miami Beach, Florida has lasted for decades.

Beach nourishment is controversial. Supporters claim that nourishment of beaches is the most environmentally sound way to maintain the wide recreational beaches that are essential to the economies of coastal communities. Detractors point to the uncertain costs and short life span of nourishment projects. In addition, they assert that beach nourishment projects benefit primarily coastal landowners.

Nonstructural Approaches

Structural measures such as groins or jetties typically are constructed to protect buildings from erosion. They seek to allow buildings (e.g., single-family homes, condominiums, hotels and restaurants) to remain in areas prone to coastal erosion by shielding them from the ravages of the sea. In contrast, nonstructural measures have been used to either move structures to safer ground or to discourage people from building in harms' way in the first place. Some of these measures are described below (*Figure 10.4: Mitigating Coastal Erosion: Nonstructural Approaches*).

<u>Relocation</u>

Rather than replenish beaches narrowed by erosion or build structures (e.g., groins or seawalls) to shield the coast against the pounding of waves, another approach is simply to move buildings out of harms' way. That is, to relocate buildings back from the beach. One of the best-known examples of relocation is the Cape Hatteras lighthouse on Hatteras Island, North Carolina (*Figure 10.5: Relocation of Cape Hatteras Lighthouse*). When first constructed in 1803, the 208-foot lighthouse (the tallest in the United States) stood 1,500 from the sea. Over time, the barrier island on which the lighthouse was built migrated towards the mainland, leaving the lighthouse behind. By the mid-1900s, waves lapped at its foundation. In 1999, the lighthouse was moved inland some 2,900 feet at a cost of nearly $10 million (National Park Service, 2003).

Over 100 years before, the Brighton Beach Hotel on Coney Island, New York was moved nearly 1,000 feet inland to protect it from the eroding shoreline. Built in 1878, the hotel was threatened by beach erosion. It took six steam locomotives to pull the 460-foot long, three-story hotel to safer ground.

The advantage of relocation is that, unlike hardened erosion control structures, it does not seek to combat or alter natural forces that shape the beach. Relocation will not, for example, exacerbate erosion of areas downdrift of a jetty or result in the loss of a beach.

The beach can erode (or accrete) without affecting beachfront property. The disadvantage, however, is that relocation can be expensive. Also, relocation may be limited by the availability of suitable areas in which to relocate. In many beach communities, vacant lots are scarce and expensive.

Land use controls

Another approach to mitigating the impacts of coastal erosion is to prohibit or discourage development in erosion-prone areas, which in many cases means any beachfront property. This can be accomplished in a variety of ways. For example, 25 states and territories impose some form of *coastal setback* requiring new development to locate a certain distance landward from the ocean, as measured from mean high water, first line of vegetation, or some other mark (Beatley, et al., 2002:138). In North Carolina, for example, most small-scale structures, such as a single-family house, must be set back a minimum of 30 times the annual erosion rate. For larger structures (e.g., hotels, motels, and condominiums) the minimum setback is 60 times the average annual erosion rate. Setback provisions help ensure that structures are not built too close to the ocean. However, given the dynamic nature of coastal areas, particularly coastal barriers, setback provisions will not necessarily prevent structures from succumbing to coastal erosion, they simply delay the inevitable (*Figure 10.6: States with Building Setback Requirements*).

In addition, *zoning and subdivision ordinances* can be used to discourage construction in erosion-prone coastal areas. Such ordinances can be used to regulate the type, density, amount and location of development along the coast. Ideally, these ordinances would be incorporated into a comprehensive plan that guides growth and development in a community and identifies areas suitable and unsuitable for development. A local plan may establish, for instance, that erosion-hazard areas in a coastal community should be reserved for recreational uses or for low-density development (Godschalk, et al., 1989:165).

Zoning and subdivision ordinances are the most widely used development management tools. In a 1984 survey of 602 coastal communities in 1984, Godschalk, et al., (1989) found that zoning and subdivision ordinances were used by over 86 percent of the communities. In comparison, 54 percent adopted setback requirements and only 27 percent had used special hazard area ordinances.

Land acquisition

Rather than prohibit or restrict development in hazard areas, which may pose a taking of private property, state or local governments may choose to buy erosion-prone property instead. While expensive, this approach avoids many legal pitfalls and provides the greatest level of control over land use. There are several ways to purchase property, including acquiring property outright (fee simple), buying only an easement in vacant property, or purchasing the development rights. By far, fee simple acquisition is the simplest and most common approach. Twenty-two states have established programs to acquire property in flood-prone or erosion hazard areas (Godschalk, et al., 1998:65).

Expenditure Limitation

Communities may also use their infrastructure policies or capital improvement plan to steer growth away from erosion-prone areas. For example, a coastal community could discourage development in an erosion-hazard area by not extending water and sewer lines to such areas. This is the mechanism used by the federal Coastal Barrier Resources Act or CBRA, which prohibits the use of federal funds for infrastructure and federal flood insurance for designated areas along the U.S. coast. A few states have adopted CBRA-like laws as well. These laws do not prohibit development in coastal areas prone to erosion, they simply seek to discourage development in such areas by transferring the cost from the public to private landowners.

Public Notification

Public notification or disclosure requirements put buyers on notice about the potential risks or threats to property that they are considering buying. Several states require potential purchasers of property to be notified within a reasonable amount of time prior to purchase that a property is subject to hazard conditions, including coastal erosion. For example, California requires disclosure for property lying in earthquake zones. Similarly, South Carolina, Texas and Massachusetts all require sellers to notify potential purchasers of coastal property about coastal hazards (Godschalk, et al., 1998:20). The disclosure requirements enable buyers to make informed decisions about the risks of coastal erosion, but it does not guarantee that they will not purchase coastal property that is prone to erosion.

Objective 10.4 Review the costs of coastal hazards and how they are paid.

According to the Heinz Center, development density in several of the high-risk coastal areas increased by more than 60 percent over the past twenty years (Heinz, 2000:3). Unfortunately, many of the coastal areas so attractive to development are also the most dangerous. Thus, as our coastal areas continue to grow, more properties and people will be at risk. Heinz estimates that roughly 1,500 homes and the land on which they were built will be lost to erosion each year, on average, for the next several decades. Costs to coastal property owners will average a total of $530 million per year. Additional development along the most erosion-prone areas will lead to even higher losses (Heinz, 2000:3).

In addition to losses by coastal property owners, coastal hazards cost the public as well. For example, the public often pays for emergency services, emergency shelters, search and rescue operations, evacuation, debris removal, and infrastructure repairs during and after major coastal storms. Noneconomic losses can add up as well, such as environmental pollution, habitat destruction and, in some instances, death.

Increasingly, the federal government h as been called upon to assume a major share of state, local and private economic costs of disasters through grants, subsidized loans, and government backed insurance programs (Platt, 1999:xvii). For example, to reduce their financial risks, many coastal property owners purchase flood insurance under the National Flood Insurance Program, which was discussed in Session 5. And while the

NFIP covers damages caused by coastal erosion, insurance premiums do not directly take into account the risks posed by coastal erosion. Since federal flood insurance rates for coastal properties do not reflect the true risk, taxpayers are subsidizing insurance premiums for coastal properties. To fully reflect risk, insurance rates in the highest risk coastal areas must be, on average, doubled (Heinz, 2000:3).

And the NFIP is heavily coastal. About 59 percent of policies in force and 63 percent of insurance coverage in force pertain to coastal communities. As defined by the NFIP, these include municipalities and counties that border on coastal waters. The largest share of the policies and value of coverage is on or near the actual coastlines (Platt, 1999:31). NFIP's payout for erosion-related losses over the next few decades is likely to be about $80 million per year (FEMA, 2000). This reflects increased development along the coast and the increased values of coastal properties.

Property owners along the coast can claim a casualty loss deduction for uninsured losses to real property. Also, interest from a mortgage on a second home is deductible; most homes along the coast are not used for primary residence.

Finally, there are social costs associated with coastal hazards and efforts to mitigate them. For example, seawalls do an excellent job of protecting *private* property, but often at the cost of the *public* beach. Seawalls can restrict public access to the beach and pose a health hazard as well.

Objective 10.5 Discuss issues of who should pay for protection of property in hazardous areas.

Before the 1950s, the costs of most disasters were born locally; by individuals and local governments. Starting in the 1950s, however, an implicit new social compact was gradually forged between government and citizenry in which the former assumed a larger share of disaster losses arising from the bad luck or bad judgment of the latter (Platt, 1999:11). After the Disaster Relief Act of 1970, the federal government assumed a permanent role as the primary source of funds and expertise to deal with major and some not-so-major disasters (Platt, 1999:15).

Rutherford Platt raises the question of whether federalizing the costs of disasters is helping to lighten the overall burden of disasters or, perversely, whether it is making matters worse (Platt,1999:xvi).

Several critics of federal policies assert that the burden of paying for natural hazards should be shifted back toward individual property owners and to local governments. Several studies have shown that federal hazard mitigation policies have encouraged more people to build in hazard-prone areas.

Shifting costs to property owners certainly has some merit. If coastal property owners had to bear the full costs of coastal hazards, perhaps they would choose not to build in

hazard prone areas. This assumes, however, that decisions about building on the coast are rational.

The key issues are who benefits from coastal hazard mitigation and who pays? Coastal property owners assert that the public in general benefits from protecting coastal property. Millions of people flock to the beach each summer for their vacations, and they need a place to eat, sleep and play. Also, the tax revenues generated by coastal properties supports local governments. Without these revenues, coastal communities could not afford to pay for public services such as police and fire, libraries and schools.

Others argue, however, that coastal property owners, particularly those on the beachfront, are the primary beneficiaries of hazard mitigation efforts and therefore they should bear the cost. Moreover, those who put their property and lives at risk should bear the primary burden of paying the costs of coastal hazards, not taxpayers in general. Orrin Pilkey, an outspoken critic of federal coastal hazard mitigation policies, asserts that the coastal erosion problem and the resulting need for mitigation is caused by imprudently sited buildings. The real threat to America's beaches is neither storms nor sea level rise, but people (Pilkey and Dixon, 1996:34). If people did not build in hazard-prone locations, there would be no need for mitigation. We would still have wide, healthy beaches, but perhaps no buildings.

Currently, there are few incentives to avoid building in areas prone to coastal erosion. Most coastal properties are built to generate revenues, and in most coastal communities, beach properties command high rents. When a building eventually succumbs to coastal storms or erosion, flood insurance and casualty loss deductions cover the loss.

In some instances, coastal property owners pay a special tax to cover part of the cost of hazard mitigation projects such as beach nourishment. For the most part, however, the federal government remains the primary source of funds for such projects.

Objective 10.6 Discuss proposed approaches to shifting the costs of hazardous development to property owners, such as risk based taxation.

Over the last 50 years or so, the responsibility for natural hazard mitigation has shifted gradually from individual property owners and local governments to the federal government. This shift has removed much of the risk and cost of building in hazard-prone locations and has encouraged more people to build in harms' way. It also has caused taxpayers in non-hazardous areas to subsidize those who build in hazard-prone areas.

One way to help ensure that property owners pay the true costs of building in natural hazard areas is to allocate an appropriate share of the expected (extra) costs to each parcel in hazardous areas. This has been called risk-based taxation. Under this method, when property owners decide to develop parcels in hazardous areas, a local tax is levied based on the expected cost of providing services such as emergency planning, preparedness, recovery and mitigation. By shifting the risk and cost of natural hazards to those who

choose to build in natural hazard areas, risk-based taxation may encourage individuals to avoid construction of vulnerable structures in hazardous areas and can guide development toward more suitable places. Furthermore, this tax could serve as a contingency fund to pay for the costs of disaster response and recovery.

Two essential steps are involved in creating a successful system of risk-based taxation. One step is to define and measure the services currently utilized by the various properties. Parcels in especially high-risk areas will require more notification of and protection from natural disasters. These areas will also incur greater costs during cleanup and recovery modes. Another step is to define the benefits consumed by the property owners. Different parcels will consume different amounts of services. Services consumed are a function of the potential exposure of a property to the hazard and the vulnerability of the structure to damage (Deyle and Smith, 2000).

Implementation of a risk-based tax hinges on several key factors, including local authority to implement such a tax and perceived fairness of the tax. If a proposed tax is viewed as unfair, it will not likely be adopted. Special assessments may be the best way to implement a risk-based taxation method. Property owners are required to pay a special assessment, but such assessments are only applied to properties that benefit from the improvements and are proportioned according to benefits received from the improvements and services (Deyle and Smith, 2000).

Risk-based taxation can be complicated to administer and may not be popular politically, but it can shift at least some of the risks and costs to those who build in natural hazard areas and may in fact encourage individuals to seek to build on safer ground.

Exercise
Assume that the state emergency management agency has proposed a new policy of taxing residents of hazardous areas to pay for hazard mitigation and disaster response and recovery. The proposal is to levy a state property tax of one percent of the assessed valuation of the property, to be paid into a state "rainy day" fund that will be used to carry out hazard mitigation and to pay for expenses of disaster response and post-disaster recovery. Students will be assigned roles representing affected stakeholders and will present arguments for and against the proposed policy at a hearing before a state legislative study committee.

<u>Roles</u>:
Local property owner in erosion-hazard area
Property owner from elsewhere in the state (not on the coast)
Local elected official, e.g., mayor or city councilman (councilperson?)
State elected official
State hazard mitigation planner
Local business owner
Local environmentalist
Representative from Taxpayers for Common Sense (anti-tax group)
Local emergency services person

Figure 10.1. Coastal Erosion Forces

Natural Processes:

- wind
- waves
- current (longshore)
- sea level rise

Human Interventions:

- construction of jetties and groins
- construction of dams
- dredging channels or inlets

Figure 10.2. Mitigating Coastal Erosion: Structural Measures

Hard

- **Seawalls** - Vertical walls built on land and parallel to the beach to absorb wave energy.

- **Bulkheads** - Similar to seawalls, but are generally smaller. Usually used to protect headland areas and inlet channels.

- **Breakwaters** - Fixed or floating structures that are built just offshore, parallel the coast. They serve to reduce the energy of waves before they hit the shoreline.

- **Revetments** - Riprap or interconnecting concrete blocks used to protect dunes and beaches from erosion.

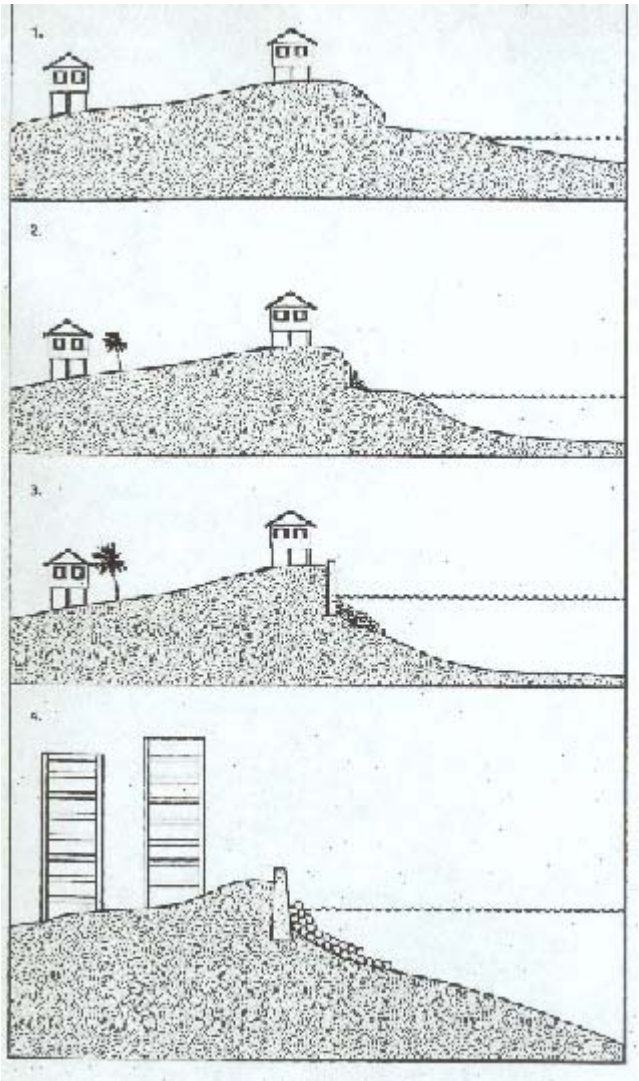
- **Jetties** - Rock walls or piles built perpendicular to the beach. Generally used to block flow of sand and prevent ship channels from filling in.

- **Groins** - Similar to jetties. Usually built to capture migrating sand and increase the width of beaches.

Soft

- **Beach nourishment** – placing sand on an eroding beach.

Figure 10.3: Saga of a Seawall



1) An eroding shoreline threatens buildings. 2) In response, homeowners build seawall. 3) Overtime, the wall's size is increased, and the beach has disappeared. 4) Fifty years later, the seawall is huge, the beach is gone, the shoreface has steepened, and the house is gone. Condominiums replace beach cottages, but no beach remains for visitors to enjoy.

Source: Adapted from Pilkey and Dixon, 1996:42

Figure 10.4. Mitigating Coastal Erosion: Nonstructural Approaches

Relocation

- Removing or relocating structures away from eroding areas

Land Use Controls

- Zoning - divides land into separate land-use districts or zones and establishes the uses and density of development allowed in each zone.

- Subdivision ordinances - governs the division of land into smaller parcels for development or sale.

- Building setbacks – establishes minimum distance that new construction must be set back from the ocean's edge

Acquisition

Public purchase of property prone to erosion

Expenditure Limitation

Limits public expenditures for infrastructure that supports development in erosion-prone coastal areas

Public Notification

Notifies potential purchasers of potential threats from erosion

Figure 10.5. Relocation of Cape Hatteras Lighthouse

Photo credit: National Park Service

Figure 10.6. Building Setback Requirements

Alabama	**yes**
Alaska	**no**
California	**yes**
Connecticut	**no**
Delaware	**yes**
Florida	**yes**
Georgia	**no**
Hawaii	**yes**
Louisiana	**no**
Maine	**yes**
Maryland	**yes**
Massachusetts	**no**
Michigan	**yes**
Minnesota	**yes**
Mississippi	**no**
New Hampshire	**yes**
New Jersey	**yes**
New York	**yes**
North Carolina	**yes**
Ohio	**no**
Oregon	**yes**
Pennsylvania	**yes**
Rhode Island	**yes**
South Carolina	**yes**
Texas	**no**
Virginia	**yes**
Washington	**yes**
Wisconsin	**yes**
American Samoa	**yes**
Guam	**yes**
Northern Marianas	**yes**
Puerto Rico	**yes**
Virgin Islands	**yes**

Source: Beatley, et al., 2002:138

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