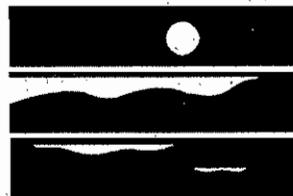


Coastal Erosion
Management
Strategy

Policy Alternatives for
Coastal Erosion Management

Coastal Erosion Management Studies, Volume 6

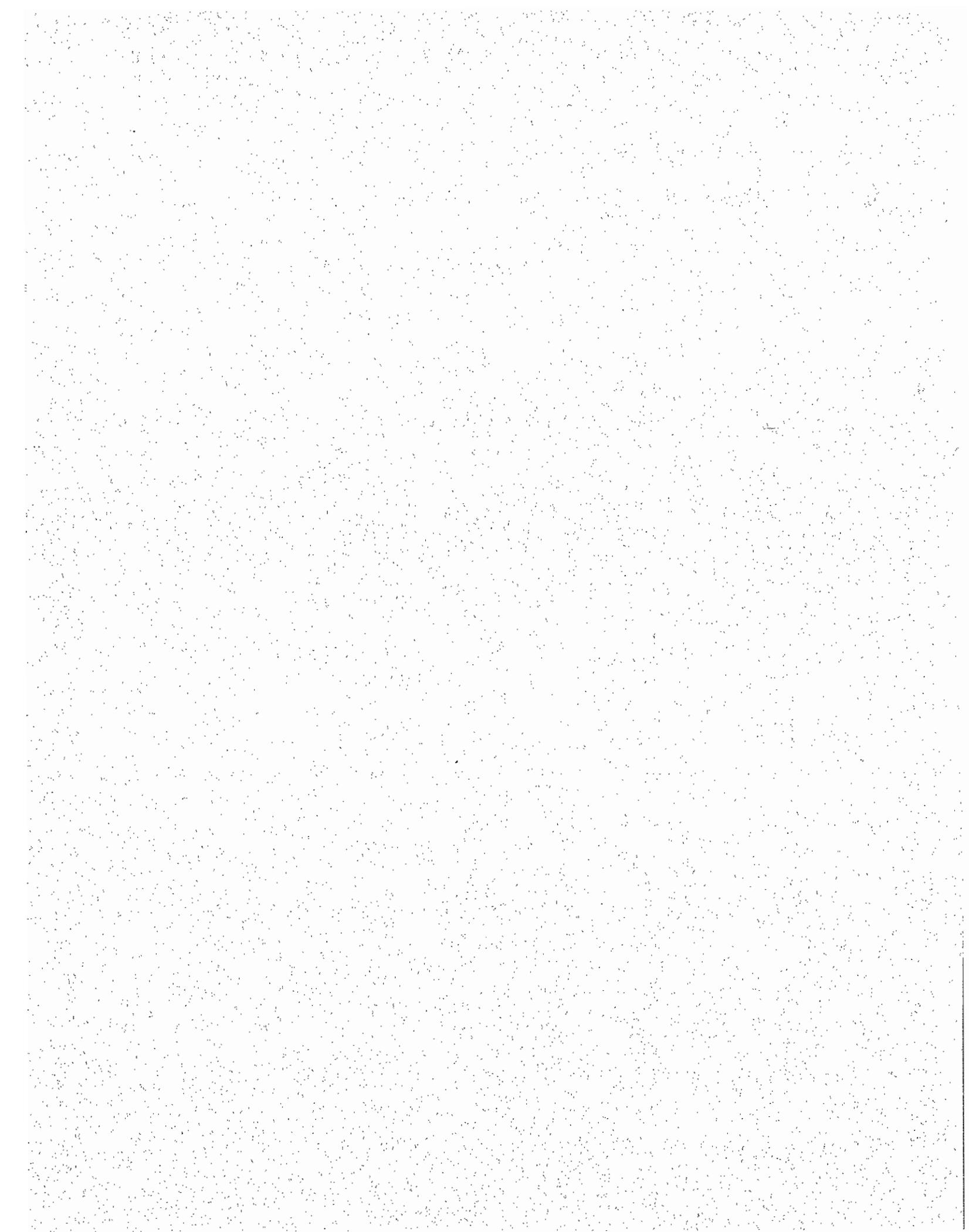


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Policy Alternatives for Coastal Erosion Management

Coastal Erosion Management Studies, Volume 6

June 1994

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Report 94-79

Shorelands and Water Resources Program
WASHINGTON DEPARTMENT OF ECOLOGY
Olympia, Washington 98504-7600

Coastal Erosion Management Strategy

This report is one in a series of reports commissioned or completed by the former Shorelands and Coastal Zone Management Program of the Washington Department of Ecology in fulfillment of the Coastal Erosion Management Strategy project. The project is dedicated to seeking answers to questions on appropriate technical standards for coastal erosion management, the environmental impact of shoreline stabilization techniques, and the assessment and development of policy alternatives. The reports in the series are listed on page iii. Inquiries about the Coastal Erosion Management Strategy project should be directed to the project manager and series editor:

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Coastal Erosion Management Studies

Volumes in the Coastal Erosion Management Studies series will be published over a period of time. At the time of publication of this volume, the printing schedule was as follows.

Volume	Title	Status
Volume 1	Coastal Erosion Management Studies Executive Summary	January 1995
Volume 2	Coastal Erosion Management: Annotated Bibliographies on Shoreline Hardening Effects, Vegetative Erosion Control, and Beach Nourishment	Published June 1994
Volume 3	Inventory and Characterization of Shoreline Armoring, Thurston County, Washington, 1977 - 1993	In press
Volume 4	Engineering and Geotechnical Techniques for Coastal Erosion Management in Puget Sound	Published June 1994
Volume 5	Shoreline Armoring Effects on Physical Coastal Processes in Puget Sound, Washington	Published August 1994
Volume 6	Policy Alternatives for Coastal Erosion Management	Published June 1994
Volume 7	Shoreline Armoring Effects on Living Resources and Coastal Ecology in Puget Sound, Washington	Published August 1994
Volume 8	Geotechnical and Land Use Techniques for Coastal Bluff Management in Puget Sound	Published August 1994
Volume 9	Regional Approaches to Address Coastal Erosion Issues	Published June 1994
Volume 10	Coastal Erosion Management in Puget Sound: Final Environmental Impact Statement	Scheduled, 1995
Volume 11	Coastal Erosion Management in Puget Sound: Technical and Policy Guidance for Local Government	Scheduled, 1995

Preface

The shores of Washington's inland coast—greater Puget Sound—undergo both shoreline erosion and landsliding. The overall rates of shoreline retreat are usually minor, maybe an inch or two a year, but in some areas may average as much as half a foot per year. This is usually due to a combination of bluff undercutting and steep slope failure, resulting in landslides. At any particular location, landslides occur infrequently, often decades apart. Simple shoreline wave erosion *by itself* is not often the problem in Puget Sound.

Marine shoreline erosion is a concern to both coastal property owners and the users and managers of coastal public resources. Coastal property owners are naturally concerned with protecting their investments in land and buildings. Unfortunately, houses and other buildings are often built dangerously close to the shoreline. Most property owners react to incidents of erosion by erecting erosion control structures such as concrete or rock bulkheads. If properly constructed, these shoreline armoring structures can slow most forms of wave induced shoreline erosion for a period of time, but will probably do little to prevent continuing landsliding. Many shoreline property owners consider shoreline armoring critical to the protection of their real estate.

Resource managers are, of course, concerned about any adverse effects on the habitats which support biological resources such as fish and shellfish and are charged with protecting the public property right in those resources. The scientific literature seems to indicate that shoreline armoring (and the associated vegetation clearing) typically results in the following adverse effects:

- Sediment supply to nearby beaches is cut off, thus leading to “starvation” of the beaches for the sand and other fine grained materials that typically make up a beach.
- The hard face of shoreline armoring, particularly concrete bulkheads, reflects energy back onto the beach, thus exacerbating beach erosion.
- In time, a sandy beach is transformed into gravel or cobbles, and may even be scoured down to bedrock, or more commonly in the Puget Sound basin, a hard clay. The footings of bulkheads are exposed, leading to undermining and failure.
- Vegetation which shades the upper beach is eliminated, thus degrading the value of the beach for spawning habitat.
- Any transformation of the character of the beach affects the kind of life the beach can support.

Request for Investigation and Assessment

The Thurston and Mason County Commissioners, and the Pierce County Executive, in 1991, requested that the Department of Ecology (Ecology) investigate the effects of wide spread shoreline armoring and prepare a programmatic environmental impact statement on the cumulative effects of bulkheading and other forms of armoring. These elected officials were reacting to the large numbers of bulkhead permit applications in recent years, and were voicing concern over their uncertainty about the wisdom of permitting large scale unmitigated shoreline armoring.

Legislative Action

In an action unrelated to the local government requests, the Washington State Legislature in 1992 passed *Engrossed Senate Bill 6128* which amended the Shoreline Management Act to provide for the following:

- Local governments must have erosion management standards in their Shoreline Master Programs. While most local governments have erosion sections in their SMP, these existing regulations may not be as comprehensive as ESB 6128 requires.
- These standards must address both structural and non-structural methods of erosion management. Structural methods are typically bulkheads or rip rap. Non-structural methods include building setbacks and other land use management approaches.
- The standards must give a preference for permitting of erosion protection measures for residences occupied prior to January 1, 1992 where the erosion protection measure "is designed to minimize harm to the shoreline natural environment." This implies no preference for protection measures first occupied after January 1, 1992.
- ESB 6128 expands erosion protection from just a residence to "single family residences and appurtenant structures."
- Permit application processing by local government must be carried out in a timely manner. Shoreline property owners testifying for the bill cited local government delays in permit approval as onerous. Local governments report that most permit delays are caused by incomplete or inaccurate information on the permit application.

The Coastal Erosion Management Strategy

The legislature was unable to provide local governments or Ecology with the funds necessary to carry out the intents of ESB 6128 because of reduced tax revenues. Fortunately, Ecology was successful in obtaining a grant under the federal Coastal Zone Management Act to carry out a comprehensive Coastal Erosion Management Strategy.

CEMS—the Coastal Erosion Management Strategy—is a three year, multi-task program aimed at (1) satisfying local elected officials' requests for assessment of the cumulative effects of shoreline armoring, (2) developing the standards for shoreline erosion management mandated by ESB 6128, and (3) assessing regulatory alternatives for erosion management. Tasks 1 - 4 were completed in 1992-93. Tasks 5 - 7 were completed in 1993-94, and tasks 8 and 9 in 1994-95.

Task 1. Inventory and Characterization of Shoreline Armoring, Thurston County, Washington, 1977 - 1993. Thurston County was selected as the study area for a pilot project because of the availability of large amounts of relevant information already in data management and GIS (geographic information system) computer file formats. This study provides quantitative estimates of the rate and character of shoreline armoring which are not readily available for most of Puget Sound.

Task 2. Engineering and Geotechnical Techniques for Shoreline Protection in Puget Sound. The generally accepted engineering and geotechnical techniques for selected erosion management alterna-

tives (bulkheading, revetments, wave attenuation, beach nourishment, etc.) appropriate to the tidal range, wave energy, and geologic conditions characteristic of Puget Sound are assessed. This report provides the basis (in part) for development of State guidance recommendations to local government for adoption of standards for appropriate erosion management measures.

Task 3. Shoreline Armoring Effects on Physical Coastal Processes in Puget Sound. The key assumptions and questions about the effects of shoreline armoring on coastal processes are evaluated based on the technical literature, and sensitized to Puget Sound conditions. Selected local case examples are provided.

Task 4. Coastal Erosion Management Regulation: Case Examples and Critical Evaluation. Regulatory approaches to coastal erosion management in Puget Sound and other states are evaluated, and policy alternatives for Washington are assessed. This report will provide the basis (in part) for development of State guidance recommendations to local government for adoption of coastal erosion management procedures.

Task 5. Shoreline Armoring Effects on Biological Resources and Coastal Ecology in Puget Sound. Following on from Task 3, the direct effects of shoreline armoring and the secondary effects of changes to coastal processes and conditions upon biological resources are assessed. Selected local case examples are provided.

Task 6. Coastal Bluff Management Alternatives for Puget Sound. A large measure of bulkheading is in reaction to slope failures, not shoreline erosion *per se*. Slope instability is caused by a combination of inherent geologic weaknesses, ground water loading, and toe erosion. Following on from tasks 2 and 4, this task addresses coastal bluff management alternatives.

Task 7. Regional Approaches to Coastal Erosion Management. Traditionally, shoreline management and erosion control permitting has been on a case-by-case basis. Many "soft" approaches to erosion management (e.g. beach nourishment) or mitigation for adverse effects must be carried out on a regional basis to be effective. Both the technical and political feasibility of regional erosion management is assessed.

Task 8. Coastal Erosion Management Environmental Impact Statement. This task will integrate the special study reports and other information into a programmatic environmental impact assessment.

Task 9. Coastal Erosion Management Recommendations for Puget Sound. Based largely on the foregoing studies, this task will formulate specific model elements which can be recommended as amendments to local Shoreline Master Programs. The guidance will be published as a chapter in Ecology's *Shoreline Management Guidebook*.

Task 1, Inventory and Characterization, was completed by Thurston Regional Planning Council. Tasks 2 through 7 were completed CH2M Hill and Battelle Memorial Laboratories under contract to Ecology. Tasks 8 and 9 will be completed by Ecology.

Tasks 1 through 7 are each designed to answer a relatively narrow set of questions, therefore each task completion report presents only a very limited portion the study. Until the entire project has been completed, the analytical studies have been integrated (Task 8), and Ecology has developed its guidance to local government (Task 9), no conclusions should be drawn from the individual study reports.

The CEMS project is a balancing of concerns and mandates. The Shoreline Management Act (SMA) has goals of both "planning for and fostering all reasonable and appropriate uses" while at the same time "protecting against adverse effects to the public health, the land and its vegetation and wildlife, and the waters of the state and their aquatic life." ESB 6128, in amending the SMA, gave a preference for permitting of erosion protection measures for residences occupied prior to January 1, 1992 where the erosion protection measure "is designed to minimize harm to the shoreline natural environment."

This review and evaluation of policy alternatives for coastal erosion management was intended to be, and is, theoretical in nature. The conclusions reached do not represent Washington State policy or proposed policy. The Department of Ecology will develop and issue its recommendations for coastal erosion management policy in a subsequent volume in this series.

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Second, we would like to recognize the individuals who were interviewed and who responded to the questionnaire. Their input was invaluable and created the basis from which we were able to identify coastal erosion management issues in the Puget Sound area and potential policy and support tools to address them.

Third, we would like to thank the individuals from other states whom we interviewed. They shared with us their perception of the effectiveness of the policy alternatives and, at times, suggested new alternatives for us to consider.

We would also like to express our appreciation to our reviewers, Professor Marc Hershman of the University of Washington, School of Marine Affairs, and Kristi Branch and Mark Curran of the Battelle Seattle Research Center. These individuals provided us with comments on both the content and presentation of this report.

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1. Executive Summary

This report represents the final product of the study of policy alternatives for coastal erosion management. It was created by Battelle's Seattle Research Center under contract to CH2M Hill to fulfill the requirements of contract No C9300102 of the Washington State Department of Ecology (Ecology). The purpose of this study was to provide Ecology with a menu and critical evaluation of coastal erosion management policy alternatives appropriate to Puget Sound which may be further considered in Task 7 [Volume 9] of the Coastal Erosion Management Strategy Program. This report presents an overview of the current policy framework being used in Puget Sound to address coastal erosion, identifies coastal erosion management issues faced by Puget Sound public and private stakeholders, offers a list of alternative erosion management policies, strategies for combining policies, and policy support tools that may enhance the existing management framework, and presents a critical evaluation of these policies.

The range of coastal erosion management issues confronting local Puget Sound managers, planners, property owners, and contractors was identified through a mail questionnaire and personal interviews. In addition, national literature was reviewed to identify complimentary policies and programs being used by other states to address issues similar to those being faced in Puget Sound. Furthermore, interviews were conducted with shoreline managers from targeted states with innovative policies and programs to determine effective alternatives. This information was used as an integral part of the policy analysis for Washington State. Based on this research, eight key issues were identified that provide the focus for evaluating coastal erosion policy alternatives. These issues are summarized in Table 1.1.

The range of policy alternatives, strategies for combining policies, and policy support tools that have been identified as potentially useful in addressing these issues fall into five categories:

1. **Broad Environmental**
 - Enhance environment designation provisions
 - Encourage coordinated environmental impact review

Table 1.1 Coastal Erosion Management Issues in Puget Sound

- Inadequate private property owner involvement in evaluating shoreline modification alternatives
- Inefficient and complicated shoreline modification application permit process
- Limited use of available soft shoreline modification solutions, where appropriate
- Reliance on hard shoreline modification solutions that results in negative impacts
- Frequent use of variances for residential development that creates a demand for future shoreline modification solutions
- Lack of familiarity with potential risks associated with shoreline property
- Inadequate environment designation provisions to control inappropriate development
- Lack of guidance or consensus on the appropriate balance between private and public property rights

2. Shoreline Modification

- Require evaluation of shoreline modification alternatives
 - Application form including alternative evaluation
 - Preference for soft solutions
- Enhance use of soft solutions
 - Market incentives to encourage the use of soft solutions
- Reduce reliance on hard solutions
 - Technical peer - review of hard solutions applications
 - Structural design limitations on hard solutions

3. Residential

Undeveloped Lands

- Restrict inappropriate residential development
 - Setbacks
 - Post construction standards
 - Public health ordinances
 - Hard structure limits
- Create market incentives to reduce inappropriate development
 - Tax credits
 - Transferable development rights
 - Land acquisition

Developed Lands

- Create incentives for relocation or removal of threatened structures
- Require property listing disclosures

4. Strategies for Combining Policies

5. Policy Support Tools

- Develop research, monitoring and data collection programs
- Develop education and outreach programs

Discussion of these policy alternatives includes examples and lessons learned from coastal erosion policies and practices in other coastal (including the Great Lakes) states.

The following matrix (Figure 1.1) illustrates the connection between the coastal erosion management issues facing Puget Sound stakeholders and the policies, strategies, and policy support tools outlined above. Visual analysis suggests the relative importance of certain issues and the extent to which certain policies, strategies for combining policies, and support tools offer solutions to more than one issue.

These policy alternatives are evaluated in terms of six factors. These factors include technical effectiveness, environmental appropriateness, legal and regulatory acceptability, net cost of implemen-

tation, socio-political acceptability, and ease of implementation (an integration of the other five factors). It must be recognized that the task of evaluating the advantages and limitations of particular policies is complicated by the high degree of uncertainty associated with the timing, magnitude, physical impacts, and nature of environmental changes associated with natural coastal erosion. In addition, there is uncertainty as to human behavioral changes that may occur as a result of policy implementation that may significantly affect the implications of policy decisions. The policy analysis provided in this report is designed to make transparent the advantages and limitations of each alternative for Ecology's consideration, not to make recommendations on which policies and support tools to endorse. This second-level of analysis is to occur in Task 7 [Volume 9].

One finding from conducting the research and analysis for this report is that future coastal erosion management is best addressed within the context of ongoing policies and programs. New coastal erosion management policies can be incorporated into the existing statutory/regulatory programs and administered by existing institutions/agencies. That is, policy enhancement and modification may be accomplished through the Washington State Guidebook and the local Shoreline Management Programs.

A second finding, which can be used as a straw position from which to build a strategy for Task 7, is that the results of this report can be used in a two-phased approach. Under Phase 1, Ecology and local jurisdictions could enhance the effectiveness of the existing coastal erosion management policy/regulatory framework (the Shoreline management Guidebook and local Shoreline Master Programs) by using the policy support tools outlined in the report. These tools include education and outreach and research, monitoring, and data collection programs. The tools may be employed simultaneously with a focus on priority drift cells that are expected to see an increase in development and for which physical and biological conditions are not well understood. Research, monitoring, and data collection and education and outreach efforts could be targeted on these specific drift cells to make this Phase 1 approach more cost effective. The Western Washington University net shore-drift studies held by Ecology may be a good starting point for updating the baseline maps and shoreline inventories for the drift cells. Likewise, outreach activities could be targeted for the stakeholders in these drift cells.

The use of policy support tools may have limited effectiveness in addressing the extent of coastal erosion issues identified. The existing coastal erosion management policy/framework could be enhanced by modifying the policies and in some cases establishing new policies. The research and analysis conducted for this study indicate that some policies may be more effective than others in addressing coastal erosion. Some policies address more than one coastal erosion management issue. Other policies are found to be important because they address an issue seen as critical by many surveyed/interviewed. These policies are listed in Table 1.2 in order of their perceived effectiveness in addressing the suite of issues raised. It should be noted that this list may be different for different regions of Puget Sound and is presented below primarily as a means to encourage discussion in Task 7 [Volume 9].

These policies could be initially implemented in reviewing applications under the priority drift cells identified under Phase 1. Those policies found to be most effective could then be implemented comprehensively.

This two-phased approach could be presented as a starting point for Task 7 [Volume 9]. It will be imperative to have all the public (e.g., state and local government agencies) and private (e.g., property owners, shoreline modification contractors, and interest groups) stakeholders represented in designing a coordinated management approach for addressing coastal erosion in Puget Sound. The policy

alternatives and support tools described under this task could be further analyzed to better determine what combination of policies and tools will best meet the shoreline managers' needs while addressing other stakeholders' concerns.

Table 1.2 Critical Policies and Strategies for Addressing Coastal Erosion in Puget Sound

- **Coordinated environmental impact review**
- **Shoreline modification alternatives analysis**
- **Market incentives to reduce inappropriate residential development**
- **Market incentives to encourage the use of soft solutions**
- **Strategies for combining policies**
- **Enhanced environment designations**
- **Restrictions on inappropriate residential development**

Figure 1.1 Policy & Policy Support Tools and Puget Sound Coastal Erosion Issues

POLICY & POLICY SUPPORT TOOLS	PUGET SOUND COASTAL EROSION ISSUES							
	Inadequate Property Owner Involvement in Application Process	Inefficient Shoreline Modification Permit Process	Limited Use of Soft Solutions	Reliance on Hard Solutions	Frequent Use of Variances for Residential Development	New Homeowner Unawareness of Erosion Risks	Inadequate Environment Designations in Master Program	Balancing Public and Private Property Rights
1. Broad Environmental								
• Enhance environment designation provisions								
• Encourage coordinated environmental review								
2. Shoreline Modification								
• Require evaluation of alternatives								
• Enhance use of soft solutions								
• Reduce reliance on hard solutions								
3a. Residential: Undeveloped								
• Restrict inappropriate residential development								
• Market incentives to reduce inappropriate development								
3b. Residential: Developed								
• Incentives for relocation of threatened structures								
• Require property listing disclosures								
4. Strategies for Combining Policies								
5. Policy Support Tools								
• Research, monitoring, and data collection programs								
• Education and outreach programs								

Note: Shaded cells indicate that the policy & policy support tool(s) are relevant to that coastal erosion issue.

2. Introduction

2.1 Purpose and Challenge of this Report

This report presents an overview of the current policy framework being used in Puget Sound to address coastal erosion and provides a critical evaluation of alternative erosion management policies, strategies, and policy support tools that may enhance the framework. This critique includes a review of relevant policies and support tools being used by other states that may be appropriate to Puget Sound. A menu of potentially feasible policy alternatives is provided for the Washington State Department of Ecology (Ecology) to consider in developing its management guidelines for local government. A future task planned by Ecology will provide the opportunity for decision makers and stakeholders to discuss and critique these alternatives in further detail and to begin to make recommendations on which ones to use.

Management of estuarine development has been a challenge for two primary reasons. First, as reported by Nordstrom (1992), estuarine shorelines are different in terms of physical processes, beach responses, social perceptions, intrinsic values, human use values, levels and types of development pressure, and public investment in recreational resources and shore protection. However, the same management policies used for open ocean shorelines are often applied to estuarine shorelines. In a critique of estuarine shorelines, Nordstrom found that they are inevitably mismanaged "when framed within the scientific knowledge and cultural attitudes about exposed coasts" (Nordstrom, 1992, p. 171).

The second challenge to managing estuarine development is the need to balance the interests of private property owners who want to develop and stabilize their shoreline to protect their investment and the mandate to public agency resource managers to conserve, through rational management, public resources. Estuarine shorelines are typically more developed than their open ocean counterparts; thus, balancing private property rights and public interests is more critical in creating and implementing many of the estuarine management policies.

2.2 Methodology and Organization of the Report

The research for this report was conducted using four primary methods. First, a planning meeting of Puget Sound shoreline managers was used as a forum to solicit their views on the issues and problems they are confronting in coastal erosion and managing individuals' response to perceived and/or real coastal erosion. Second, a questionnaire was sent out to 223 individuals to further understand the range of issues and problems being confronted. Appendix A provides a list of the 50 questionnaires returned by the types of individuals who returned them. Also in Appendix A is a copy of the questionnaire form. The third method used to better understand the current framework was a review of the state Shoreline Management Guidebook (Ecology, 1990) which includes the Administrators' Manual, the Handbook, and the Urban Waterfront Policy Analysis Addenda. Each of these documents is referred to in this report collectively as the Guidebook. In addition, local government Shoreline Master Programs (SMPs) were reviewed to understand how local governments developed their programs, based on the Guidebook. Finally, phone interviews were conducted with local government shoreline administrators (city and county), private property owners, and bulkhead contractors to

understand how the SMPs are being used. Individuals interviewed from Washington State are listed in Appendix B.

A description of this current policy framework is presented in Section 3. This framework is critical to understanding the issues and problems facing property owners, erosion control contractors, and local shoreline managers in addressing erosion in Puget Sound. Section 4.0 describes the issues and problems. Specific comments and suggestions received from individuals, via any of the methods described above, are provided to enrich the description. Section 5.0 presents a description of the policy alternatives, strategies, and policy support tools that can be considered to address these issues and problems. In describing the alternatives this section also draws from experiences gleaned in other states. Section 6.0 provides the analysis of the policy alternatives and support tools. This section begins with a description of the range of factors that will be used to analyze these alternatives. These factors are intended to help the reader focus on the advantages and limitations of each policy alternative. Appendix C is a list of the individuals from other states interviewed.

2.3 Context of the Report

Before presenting the current policy framework (Section 3.0), it is important to understand the types of environments (physical and legal/regulatory) in which erosion is being managed in Puget Sound. An overview of these two environments is provided below. Social and institutional considerations are discussed in the context of the legal/regulatory environment.

2.3.1 Physical Environment

It is impossible to generalize about the physical features and processes in Puget Sound; they vary tremendously from the exposed shorelines along the Straits of Juan de Fuca and Georgia to the more tranquil areas in southern Puget Sound. As described by Downing (1983, p. 1), “rock cliffs rising vertically more than 100 meters (328 feet) from breaking waves, broad tidal mud flats of imperceptible relief, and smooth sandy beaches all exist within a distance of fewer than 50 kilometers (30 miles).”

Table 2.1 presents a list of the range of coastal features, based on erosion and deposition, found in Puget Sound (Downing, 1983). The table provides example locations in Puget Sound for each of the coastal features listed. The Task 2 report of this study — “Engineering and Geotechnical Standards for Shoreline Protection in Puget Sound” [Volume 3; CH2M, 1993a]— uses four landform terms to describe Puget Sound:

- marshes
- beaches
- banks
- bluffs

Table 2.1 Classification of Coastal Features in Puget Sound

Coastal Features	Beaches and Sediment Characteristics	Locations where features are common
Depositional	Various major morphological features produced by a large supply of sediment deposited in a nearshore area.	
River deltas	<ul style="list-style-type: none"> • Variety of sediment types from mud to gravel depending on wave climate 	Major river mouths—Skagit, Nooksack, Nisqually, etc.
Tidal flats/salt marshes (no substantial fluvial sediment input)	<ul style="list-style-type: none"> • Wide mud and sand beaches; extensive intertidal bars and low-tide terrace • Sand, silt, clay sediment mixtures with dense vegetation 	Southern Puget Sound—Lynch Cove, Budd Inlet, Henderson Bay, Eld Inlet
Spits	<ul style="list-style-type: none"> • Sand or mixed sand and gravel with large backshore area. Fine sediments in lagoon 	Eastern Strait of Juan de Fuca—Dungeness Spit, Ediz Hook, Sequim Bay, Port Madison; common throughout Puget Sound
Tombolos	<ul style="list-style-type: none"> • Sand or mixed and gravel; lagoon or marshy area between double spits; large backshore area 	San Juan Islands and Strait of Juan de Fuca; common throughout Puget Sound
Cuspate forelands	<ul style="list-style-type: none"> • Sand or mixed sand and gravel beaches; large backshore enclosing lagoon or marsh 	Discovery Bay, west side Whidbey and Camano islands, eastern Clallam County (Sequim Bay), Diamond Point
Dunes	<ul style="list-style-type: none"> • Sand or mixed and gravel beach; backshore with sand dunes behind 	Northwest Whidbey Island (Cranberry Lake Region); otherwise rare in intracoastal areas of Washington
Neutral	Erosion resistant bedrock or sedimentary strata. Minimum erosion or deposition: low scarps, minor depositional features	
	<ul style="list-style-type: none"> • Residual sediment (gravel, cobbles, and boulders) armoring beach; no backshore • Mixed sand, gravel, and cobbles on foreshore with small backshore area • Small shore platform of bedrock with or without veneer of boulders and cobbles 	Protected shores in San Juan County
Erosional	Large erosional scarps cut into bedrock or unconsolidated sediment by marine processes. Occur in regions of vigorous wave action	
Erosional scarps in bedrock	<ul style="list-style-type: none"> • Wave-cut platform with or without a veneer of residual sediment (gravel, cobbles, and boulders) • Pocket beaches between rocky headlands composed of mixed sand, gravel, and cobbles, with a berm and backshore 	Outer Strait of Juan de Fuca, San Juan Islands (exposed shores)
Erosional scarps in unconsolidated sediment	<ul style="list-style-type: none"> • Residual sediment (gravel, cobbles, and boulders) armoring beach; no backshore • Cobble and rocks in areas of high wave action; no backshore area • Mixed sand, gravel, and cobbles on foreshore with small backshore area 	Throughout Puget Sound where glacial material is abundant West side Whidbey Island, eastern Strait of Juan de Fuca (Dungeness–Port Angeles)
<i>(Source: Downing, 1983, p. 58)</i>		

Marshes are defined as areas that “tend to be located in relatively quieter water (low-energy) settings at the distributaries of rivers, streams, and creeks. They are low and flat, are often inundated at high tide, and have vigorous growth of vegetation. They are classified as sensitive coastal wetland habitats and are subject to rigorous regulatory controls” (CH2M Hill, 1993a). The Nisqually River delta is a prime example of an undeveloped marsh area.

Beaches along Puget Sound are often broad and flat and flooded to varying degrees by the tides. The portion of beaches that are “dry” are typically narrow and lack vegetation, although they can be repositories of large pieces of driftwood. Beach sediments range in texture from fine sand and mud to coarse gravel and cobbles; typically, the coarser the material the steeper the beach. (CH2M Hill, 1993a). Puget Sound is home to pocket beaches, spits, and other small- to medium-scale beaches or sandy accretion areas.

Banks rarely have a dry sand beach at high tide; ordinary high water is usually at the base of the bank. Banks typically have grade changes of 5 to 10 feet. Because they are dry land close to water, banked shorelines are the most commonly developed areas for recreational or residential use. They are, therefore, often the focus of shoreline modification applications (CH2M Hill, 1993a).

Bluffs are higher than banks and are generally formed from various layers of glacial till, sands, and clays. The different sediment layers can affect groundwater flow and, thereby, the stability of the slope. Banks and bluffs can be a challenge to development because material at their base can be eroded, causing a slumping of the slope, or the upland area can slip due to ground or surface water runoff (CH2M Hill, 1993a). Bluffs can, however, also be made of bedrock (e.g., in the San Juan Islands), which is very stable and resists erosion.

Coastal landforms within Puget Sound are exposed to wide variety of wave energies. Wave climates differ between Puget Sound’s long stretches of exposed water and its relatively sheltered bays and inlets. The direction of wave approach, the availability of sediment (due to the shoreline feature and the geology), and the distance in which waves are generated by a wind (fetch length) are the most important factors influencing sediment transport (CH2M Hill, 1993b).

Longshore transport of sediment in drift cells in Puget Sound appears to be at low rates and occurrences are infrequent (CH2M Hill, 1993b). A drift cell, also known as a drift sector or littoral cell, is a segment of shoreline along which littoral, or longshore, sediment movement occurs at noticeable rates. Each drift cell includes a feed source of sediment, a driftway along which the sediment can move, an accretion point (where the sediment is deposited), and boundaries that delineate the ends of the drift section. Disturbing the transport of sediment through a drift cell (e.g., by building a jetty or some other hard structure including a bulkhead) can cut off the normal supply of sediment through a drift cell and result in beach starvation and erosion. In isolated areas where longshore transport of sediment is moderate or high, care must be taken to not accelerate erosion by modifying the shoreline.

Keuler (1988) found that erosion rates in Puget Sound vary between 0 and 30 centimeters/year (Canning, 1992a). The Coastal Zone Atlas, developed by the state, found 30 percent of Puget Sound shoreline to be actively eroding. A much larger percentage is believed to be subject to more gradual or episodic erosion (Canning, 1992a). In general, erosion is not catastrophic or life-threatening, but can result in locally large losses of property.

Property owners have generally turned to armoring their shorelines (e.g., using bulkheads and revetments) to protect their homes. There are several reasons why “hard” structures have been

preferred. For example, contractors generally recommend hard solutions to controlling erosion because they are most familiar with them and because there is limited information and standards on "soft" solutions (e.g., beach nourishment, vegetation, gravel berms). In addition, property owners are often risk-averse and choose solutions that they perceive will definitely protect them. As of the mid-1970s, roughly 8 percent of the Puget Sound shoreline was armored, and this number has probably increased dramatically over the past decade (particularly for residential shorelines) (Morrison, Kettman and Haug, 1993). There is concern that widespread shoreline armoring will reduce sediment input to shoreline systems, thereby starving beaches of the necessary fine-grained materials, resulting in cobbled beaches, more pervasive shoreline and beach erosion, and degraded fisheries habitat (Canning, 1992b).

Landslides can also be a problem in some areas. Over 30 percent of Puget Sound's shoreline is mapped as unstable, and in some counties the percentage is much higher (Canning, 1992a, p. vi). Bluff stability is touched on in this report but will be covered much more thoroughly in Task 6.

2.3.2 Legal and Regulatory Environment

Given the number and variation of federal and state laws, regulations, policies, and related guidance, Washington State is faced with a major challenge. The state must integrate the various federal, state, and local agencies/institutions with relevant laws, policies, and regulations in an efficient and orderly manner. This section briefly summarizes the various laws and regulations that need to be considered in designing and implementing a comprehensive shoreline erosion management program.

Washington Shoreline Management Act and Related Federal Laws and Programs

The Shoreline Management Act (SMA) was enacted in 1971 to provide a uniform set of rules governing the development and management of shoreline areas throughout the state (RCW 90.58). The SMA is designed to balance private property rights with public interests while minimizing adverse environmental impacts. The law also attempts to balance local and state interests. This attempt to balance multiple interests has made it difficult to implement the law. The state (Ecology) provides great flexibility in its guidance to the local governments on how to design and implement their local SMPs. Collectively, the local SMPs institute the state Shoreline Master Program.

The Federal Coastal Zone Management Act (CZMA) of 1972 (Public Law 92-583, 16 U.S.C. 1451-1464) declared a national interest in managing and using the country's coastal zone (12,383 miles of oceanside — 88,633 miles if the entire tidal shoreline of bays, estuaries, and other inlets is included — plus 4,530 miles of coastline along the Great Lakes). The law provided federal guidelines for developing coastal management programs but left participation voluntary. It encouraged and assisted the states in developing and implementing comprehensive plans, emphasizing ecological, cultural, and aesthetic values and policies that did not exist in many states.

The Coastal Zone Management Program, which was established under the CZMA, requires each state in the program to have a comprehensive set of resource and development policies to enhance the likelihood that consistent and predictable decisions on allocation and use of coastal resources will be made in the best interest of society. In 1976, Washington's Shoreline Management Program, which was developed from the state SMA, became the first Coastal Zone Management Program approved by the Secretary of Commerce under the CZMA.

The CZMA was amended in 1977 to establish other purposes of the law. One such amendment was a requirement for state plans to include:

a planning process for assessing the effects of, and studying and evaluating ways to control, or lessen the impact of, shoreline erosion, and to restore areas adversely affected by such erosion (Sec. 306[d][2][I]).

A more recent amendment to the CZMA — the Coastal Zone Reauthorization Amendments of 1990 — established the Section 309 Coastal Zone Enhancement Grants Program. One of the Program's improvement objectives is the elimination of development and redevelopment in high-hazard areas and the management of development in other hazard areas. Another improvement objective is to develop and adopt procedures to assess, consider, and control cumulative and secondary impacts of coastal growth and development. Both of these objectives point clearly to the need for a menu of policy alternatives, strategies, and policy support tools to achieve them. This Section 309 program is administered by the Office of Ocean and Coastal Resource Management (OCRM) of the National Oceanic and Atmospheric Administration (NOAA) (Canning, 1992a). Federal (OCRM) guidance for implementing Section 309 discourages shoreline armoring (hard solutions) and establishes a preference for alternative approaches such as development set back requirements.

A recent amendment to the state SMA (Engrossed Senate Bill 6128 [RCW 90.58.100]), may further influence shoreline erosion management in Washington. It requires local government SMPs to contain standards governing the protection of single family residences and appurtenant structures against damage or loss due to shoreline erosion. Erosion protection for existing structures and erosion hazard management for new construction are both addressed by the law. It states:

Each master program shall contain standards governing the protection of single family residences and appurtenant structures against damage or loss due to shoreline erosion. The standards shall govern the issuance of substantial development permits for shoreline protection, including structural methods such as construction of bulkheads, and nonstructural methods of protection. The standards shall provide for methods which achieve effective and timely protection against loss or damage to single family residences and appurtenant structures due to shoreline erosion. The standards shall provide a preference for permit issuance for measures to protect single family residences occupied prior to January 1, 1992, where the proposed measure is designed to minimize harm to the shoreline natural environment (Engrossed Senate Bill 6128, 1992, p. 6-7).

SMA Policies and Regulations

One of the primary state codes (WAC-173-16-040) established to implement the SMA calls for each SMP to recognize plans and programs of the other government units, adjacent jurisdictions, and private developers. This language sets the stage for the type of coordination necessary to fully implement the SMA.

The code also establishes the environment designations to be used in planning and managing coastal regions. Its intent is to base the designations on varying goals for use of characteristically different shorelines "since every area is endowed with different resources, has different intensity of development and attaches different social values to these physical and economic characteristics." The basic designations provided in the code are natural environment, conservancy environment, rural environment, and urban environment. Some local jurisdictions have broadened this list to include additional designations.

Two broad policy and related regulatory areas address an individual's interest in controlling erosion. These areas are residential development and shoreline modification (e.g., applications to control erosion via using a hard or soft method). A detailed discussion of these policy/regulatory areas is provided in Section 3.0.

It is important to note that the SMA and its regulations exempt single-family residences from having to obtain a substantial development permit (SDP) to construct a bulkhead to protect their existing homes and/or appurtenant structures (e.g., garages). These exemptions do not mean that applicants are exempt from all review by the local government when modifying shorelines, only that they are exempted from the SDP requirement for bulkheading. Many jurisdictions will require a SDP for fill if the bulkhead extends too far onto the beach. Similarly, other extraordinary circumstances might involve a SDP process for a bulkhead. While most applications for shoreline armoring are of a scale and design that fall within the exemptions from the SDP, the armoring (e.g., bulkheading) must still be consistent with standards in the SMP. Each local jurisdiction has its own means of enforcing SMP standards outside the formal shoreline permit process. Some use a "letter of exemption" which clearly states the required standards. Others apply the SMP standards through a building permit.

Washington code establishes strict guidance for granting variances. Variances are to be used only "where there are extraordinary or unique circumstances relating to the property such that the strict implementation of the master program will impose unnecessary hardships on the applicant." Variances are typically requested for changes to dimensional standards such as setback requirements for building a residence back from a bluff. As in the SMA, there is an inherent struggle in the code between protecting property owner rights (e.g., variances should be granted if the master program "precludes or significantly interferes with a reasonable use of the property not otherwise prohibited by the master program") and public rights (e.g., "public interest shall suffer no substantial detrimental effect" and the design of the project "will not cause adverse effects to adjacent properties or the shoreline environment"). One potential problem associated with variances is that allowing a home to be built closer to a bluff than is standard can result in a demand for future shoreline armoring.

One condition established in the state code that could be useful in assessing the merits of a variance application is "to consider 'the cumulative impact' of additional requests for like actions in the area. For example, if variances were granted to other developments in the area where similar circumstances exist, the total of the variances shall also remain consistent with the policies of RCW 90.020 and shall not produce substantial adverse effects to the shoreline environment" (WAC 173-14-150[4] emphasis added). While this language may appear helpful in assessing the granting of variances, many shoreline managers and planners are concerned that lack of knowledge of cumulative impacts and legal uncertainty makes it difficult to actually use as a basis for denying a variance.

A property owner can also request a conditional use permit for erosion control measures; such permits are typically requested for off-standard bulkheads. A state code (WAC 173-040) establishes guidelines for local governments to use in granting a conditional permit. The code prescribes the following five conditions that must be met before a conditional use permit can be granted:

- The proposed use is consistent with the policies of RCW 90.58.020 and the policies of the master program.
- The proposed use will not interfere with the normal public use of public shorelines.

- The proposed use of the site and design of the project is compatible with other permitted uses within the area.
- The proposed use will cause no unreasonable adverse effects to the shoreline environment in which it is located.
- The public interest suffers no substantial detrimental effect.

The Guidebook recommends that a conditional use permit be required by the local SMP before beach nourishment be used to control erosion. Although the Guidebook says that soft solutions to erosion control should be preferred over hard solutions, this requirement for a conditional use permit is seen by some shoreline managers as a deterrent to favoring hard solutions. Refer to Section 3.0 for a more thorough description of the existing policy framework.

Related State Laws and Regulations

This section addresses other related state laws implemented by other agencies, or for which the implementation is shared with other agencies.

Hydraulic Project Approval Law (RCW 75.20) The state Hydraulic Project Approval Law requires that anyone proposing to build a structure (e.g., bulkhead) within the high water areas of the state obtain a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife. The intent of the law is to protect fish and other aquatic life from damage. RCW 75.20.160 is for permitting marine beach front protective bulkheads. Unlike the SMA, which exempts single-family residences from the requirement of receiving an SDP for building, the HPA law requires even single-family residences to obtain a hydraulic permit for a bulkhead or rock wall to be constructed below the ordinary high water line. As mentioned, the law also requires that the structure not result in the permanent loss of critical food fish or shellfish habitats.

Hydraulic code rules are found in WAC 220-110. The rules state that protection of fish life shall be the only ground upon which an approval for a shoreline protection method may be denied or conditioned. WAC 220-110-280 establishes technical provisions for bulkheads and associated fills.

Growth Management Act (RCW 36.70A) Under the Growth Management Act (GMA) local governments are required to identify natural resource lands and critical areas. Such areas include (but are not limited to) wetlands, fish and wildlife habitat areas, and geologically hazardous areas. Local governments must protect critical areas and are to consult with Ecology regarding these areas. It is unclear how areas subject to substantial erosion would fall into these GMA critical areas. This is an area under current debate in the state. Effective strategies for meshing the GMA and the existing SMA at both the state and local level are needed. In Task 7, alternative (non case-by-case) methods for managing coastal erosion will be identified.

The State Environmental Policy Act (RCW 43.21) The State Environmental Policy Act of 1971 (SEPA) is the state's most comprehensive statement on environmental policy, requiring environmentally sound planning and the disclosure of issues concerned with agency decision making pertaining to proposed activities and development (RCW 43.21C). The intent of SEPA is to assure that environmental impacts are recognized, evaluated, and where possible, mitigated during agency decision-making and that an opportunity is provided for public comments to be solicited on a proposed project

and addressed by the oversight agency. SEPA may provide an opportunity to evaluate cumulative impacts.

Related Federal Laws

The Coastal Barrier Resources Act The Coastal Barrier Resources Act (CBRA) of 1982 (Public Law 97-348) was designed to "help minimize loss of human life, expenditures of federal revenues and damages to natural resources by restricting federal financial assistance for most private development, including construction or purchase of buildings, roads and other support infrastructure or static erosion protection projects on barriers within the Coastal Barrier Resource System. The effect of the act is to place financial risk associated with development on those who live on or invest in the coastal barriers" (Nordstrom, 1992, p. 159). No areas within Washington are part of the coastal barriers system at present, though some areas may be eligible according to the definition of a coastal barrier (Shipman, 1993). An area is eligible for inclusion in the coastal barrier system if it:

- consists of unconsolidated sedimentary materials
- is subject to wave, tidal, and wind energies
- protects landward aquatic habitats including the adjacent wetlands, marshes, estuaries, inlets and nearshore areas
- is undeveloped land with one, or less than one, walled and roofed structure per five acres of land.

CBRA was reauthorized in 1990 with its Section 6 directing the Department of Interior to study the feasibility of extending the provisions of CBRA to the Pacific Coast. In 1992, the U.S. Fish and Wildlife Service prepared preliminary maps, including 81 possible undeveloped coastal barriers in Washington (Shipman, 1993). These maps are in the process of being revised and public comment is being solicited through 1993. Public involvement to achieve acceptance has been and will likely continue to be critical in designating CBRA sites (Shipman, 1993). This designation process will need to be monitored to determine its implication for shoreline modification and development restrictions.

The Clean Water Act and the Rivers and Harbors Act The U.S. Army Corps of Engineers is required to regulate discharges of dredged and fill material into U.S. waters and associated wetlands under Section 404 of the Clean Water Act. Included in this authority is shore protection structures and any associated earth moving and landfilling (Canning, 1993). The Corps is also required to regulate construction within navigable waters under the Rivers and Harbors Act. The Department of the Army Permit is a consolidated permit application and processing program covering the Corps' responsibility under both laws. The Rivers and Harbors Act also authorizes the Corps to construct small beach restoration and protection projects. These projects have the potential for enhancing estuarine beach resources but only if the protection strategy that is chosen includes beach fill (Nordstrom, 1992).

Upton-Jones Amendment Two congressmen from states affected by coastal erosion (Michigan and North Carolina) proposed a new erosion component of the National Flood Insurance Program (NFIP). The Upton-Jones Amendment to the NFIP (Public Law 100-242, Sec. 544; 42 U.S.C.A. Sec. 401[c]) authorizes payments from the National Flood Insurance Fund for certain costs of demolishing or relocating insured structures that are "subject to imminent collapse or subsidence as a result of erosion." As of May 2, 1991, only 228 claims had been approved nationwide and only 51 had been

approved for relocation (Platt, 1992). Under the Upton-Jones Amendment, the Federal Emergency Management Agency (FEMA) will pay up to 40 percent of the insured value of the house to move it to a site away from a flood hazard area. The amendment also allows payments of up to 110 percent of the value of the policy to owners who raze their houses entirely and restore the beach (Griffin, 1992). The *CQ Researcher* quoted Frank Thomas of FEMA as saying, "We expected a larger number of claims, but people have an emotional attachment to their beach houses. They haven't taken advantage of relocation" (Griffin, 1992, p. 112). The author of the article goes on to point out that "the program still guarantees insurance no matter how many times the property is damaged by flood or storm, and with no increase in rates."

Summary of Legal and Regulatory Overlaps and Potential Conflicts

The above discussions of the legal/regulatory environment highlights the difficult task facing the Washington State and local jurisdictions in trying to implement the varying, and sometimes conflicting, legislation that calls for multi-agency oversight and regulation. The agencies with a role in addressing shoreline erosion in Washington State have mixed mandates and expectations as to the appropriate approach for addressing such erosion. For example, SMA has a goal to both foster appropriate development and protect environmental values. Residential bulkheading is exempted from the SDP requirement but is expected to otherwise comply with SMA interests. ESB 6128 grants a preference for erosion control measures for single family residences first occupied prior to January 1, 1992, but is silent on explicit policy regarding residences occupied after January 1, 1992. Ecology and local jurisdictions must be responsive to the preference in ESB 6128 for erosion protection, while at the same time meet their other responsibilities under the SMA policies and regulations to protect environmental values. This challenge is magnified when considering the overlap and potential conflict with other state agencies' roles and responsibilities (e.g., Washington State Fish and Wildlife's responsibilities under the HPA law). Identification and resolution of these overlaps and potential conflicts is the focus of Task 7.

2.4 Report Scope

This report addresses regulation of coastal erosion management under existing SMA authorities. The report's intent is to build on the existing policy framework. Future tasks planned under this study will develop the analysis further. Task 5 [Volume 7] will review shoreline armoring effects on biological processes in Puget Sound and Task 6 [Volume 8] will analyze slope stability issues being faced in Puget Sound. Finally, Task 7 [Volume 9] will integrate the knowledge gained and information presented in the previous task reports to analyze innovative regional approaches for managing coastal erosion and human response to coastal erosion in Washington State.

As described in Section 2.2, the remainder of this task report is divided into four sections. Section 3.0 describes the current policy framework for managing coastal erosion in Washington. Section 4.0 describes the issues seen as causing the current framework to be inadequate in managing coastal erosion. Section 5.0 presents a description of the policy alternatives, strategies for combining policies, and policy support tools that may be considered in addressing these issues. In addition, Section 5 illustrates the experiences of other states with related policy implementation. Section 6 provides an analysis of policy alternatives, strategies for combining policies, and policy support tools discussed in Section 5. The advantages and limitations of individual policies and programs are analyzed according to a set of six factors as well as experiences gleaned from other states.

3. Existing Policy and Regulatory Framework

Before evaluating policy alternatives available to coastal erosion managers, it is helpful to first outline the regulatory framework currently in place in the Puget Sound area. The existing framework can be divided into two categories; those policies and regulations suggested by Ecology based on their interpretation of the SMA and presented in the Washington State Department of Ecology Shoreline Management Guidebook, and those adopted in city and county SMPs.

The Guidebook was developed by the Ecology Shorelands Program to enhance communication and cooperation between the state and local planning and other departments that administer the SMPs and provide assistance in updating SMPs and administering shoreline management regulations. The Guidebook includes a Shoreline Master Program Handbook (updated from the original 1983 publication of the same title), which provides procedural and policy guidance and suggested regulatory language for updating SMPs. The following outline of relevant policies and regulations is derived from the Handbook, organized into two main categories, and presented in the tables below. Subsequent annotated text is provided with each table. This text describes the range of approaches used at the local level to implement the state's guidelines. The information provided is based on reviewing eleven Puget Sound county SMPs and interviews with local shoreline administrators (county and city).¹ The policy categories discussed are: Shoreline Modification Provisions (General Provisions, Soft Shoreline Modification Solutions, Hard Shoreline Modification Solutions) and Residential Development Policies.

3.1 Shoreline Modification Provisions

This section addresses General Provisions, Soft Solutions, and Hard Solutions. Each area is summarized in a table followed by a discussion of Local Jurisdiction Response.

3.1.1 General Provisions

The Guidebook lists policies and general regulations for local jurisdictions to follow (see Table 3.1).

¹Of the jurisdictions interviewed, two are currently updating their SMPs, one county updated theirs in 1988, another in 1990, and still another in 1992. Two jurisdictions have not updated their SMP and have no short term plans to do so.

Table 3.1 State Guidebook General Shoreline Modification Provisions

POLICIES
<ul style="list-style-type: none"> • Soft stabilization and protection projects are preferred over hard. Hard shoreline modification solutions should be allowed only after it is demonstrated that non-structural solutions are not able to reduce the damage. • Riprapping and other bank stabilization measures should be located, designed, and constructed primarily to prevent damage to existing development. • New development should be located and designed to prevent or minimize the need for shoreline stabilization measures. New development requiring shoreline stabilization should be discouraged (regulation included with the same language). • Shoreline development must conform to Environmental Designation Provisions (see Table 3.2)
REGULATIONS
<ul style="list-style-type: none"> • City/County shall require and use the following information in its review of shoreline modifications proposals: <ul style="list-style-type: none"> • existing shoreline stabilization devices within 1/2 mile on each side; • predicted impact upon area shore and hydraulic process, adjacent properties, shoreline and water uses, and upland stability; and • alternative measures (including non-structural) which will achieve the same purpose. • Upon project completion, all disturbed shoreline areas shall be restored to as near preproject configuration as possible and replanted with native grasses, shrubs, and/or trees in keeping with existing bank vegetation. • Shoreline stabilization works are prohibited in wetlands and on point and channel bars. • Shoreline stabilization works are prohibited in salmon and trout spawning areas except for fish or wildlife habitat enhancement.

Local Jurisdiction Response

Several jurisdictions encourage the use of soft or non-structural shoreline modification solutions through, for example, informal conversations with property owners and video presentations. However, few actually endorse the policy that structural solutions should be allowed only after it is demonstrated that non-structural solutions would not be able to reduce damages. Several jurisdictions reported that they are not convinced that soft solutions work, while others reported that they hesitate to strengthen regulatory language regarding the use of soft solutions over hard solutions because of the lack of evidence regarding the success or feasibility of non-structural approaches. One shoreline administrator felt that soft solutions are not practical in his jurisdiction. Kitsap County and the city of Bremerton related experiences where they had tried to encourage soft solutions but met with conflict with the Washington State Department of Fish and Wildlife. Some jurisdictions allow a combination approach.

For example, Thurston County explicitly states that the preference of soft solutions over hard “...is not intended to preclude a combination of structural and vegetative methods.”

A majority of the jurisdictions have a strong policy regarding the use of hard solutions to shoreline modification where development exists. Only one jurisdiction mentions rip rap revetment explicitly, but a majority of the jurisdictions maintain the policy that bulkheads should be constructed only for protection of upland properties or facilities not for the indirect purpose of creating land by filling behind the bulkhead.

Two counties have policies that residential development should not be permitted if it requires bulkheading or other shoreline armoring. Several others, however, have policies for residential development along shorelines to be designed and sited to make shore protection unnecessary. Only two jurisdictions’ SMPs include any regulatory language on this issue. For example, in one case residential development will not be approved for which shoreline protection measures may be required unless a variance is obtained. Most of the jurisdictions felt that the SDP exemptions established in the SMA and the lack of data to forecast future development impacts make it very difficult to deny residential development on these grounds.

The degree to which various jurisdictions conform to the Environment Designation Provisions recommended in the Handbook is varied. Table 3.2 indicates the degree of conformity between the state guidelines and actual policies in the SMPs. Several shoreline administrators felt that the provisions actually do little to restrict shoreline development and recommended either redefinition of Environment Designation Provisions or a strengthening of existing provisions. Thurston County has instigated a special marine bluff ordinance to deal with the inadequacies of the existing Environment Designation Provisions, while Bainbridge Island has defined a new Tidal Inlet Designation to better meet the needs of its jurisdiction.

Table 3.2: State Guidebook Shoreline Development Environment Designation Recommendations

Environment Designation Provisions	Bulkheads	Revetments	Beach Enhancement
Natural	Prohibited ^{***}	Prohibited [*]	Prohibited ^{**}
Conservancy	May be allowed as conditional use ^{**}	May be allowed as conditional use [*]	May be allowed as conditional use [*]
Rural	May be allowed as conditional use ^{***}	May be allowed as conditional use [*]	May be allowed subject to permit conditions and SMP [*]
Suburban	May be allowed subject to permit conditions and SMP ^{**}	May be allowed as conditional use ^{NA}	May be allowed subject to permit conditions and SMP [*]
Urban-Maritime	May be allowed subject to permit conditions and SMP ^{NA}	May be allowed subject to permit conditions and SMP ^{NA}	May be allowed subject to permit conditions and SMP ^{NA}
Urban	May be allowed subject to permit conditions and SMP ^{***}	May be allowed subject to permit conditions and SMP [*]	May be allowed subject to permit conditions and SMP [*]
Aquatic	May be allowed as a conditional use over-water if allowed in adjacent upland environments [*]	May be allowed over water if allowed in adjacent upland environments [*]	May be allowed as a condition use over-water if allowed in adjacent upland environments
<p>County SMP observance of shoreline development environmental recommendations</p> <p>NA no counties following</p> <p>* few counties following</p> <p>** some counties following</p> <p>*** majority of counties following</p>			

Few jurisdictions have included the recommended set of general shoreline modification regulations outlined in the Handbook and summarized in Table 3.1. Only one jurisdiction includes the list of required information (excluding the identification of all alternative measures that will achieve shoreline protection) for review of applications. A few other jurisdictions, however, require that proposals for structural works should include an indication that more flexible natural works are infeasible or that applicants must demonstrate that soil bio-engineering will not be effective in bank stabilization. A few of the jurisdictions explicitly address the requirement of vegetative restoration. They require that revegetation must be part of the stabilization project or that all vegetation should be reestablished as soon as possible following its removal. Only one jurisdiction has regulations regarding stabilization works on wetlands, points, and channel bars. In this case any activity, development, or use which damages or detrimentally affects a bar or spit are not permitted. One SMP has a policy that no development or use which damages or detrimentally affects smelt spawning areas should be allowed. Regulations regarding fish and shellfish habitat are less restrictive, requiring only that these areas be given special consideration. For example, "areas of significance in spawning, nesting, rearing or residency of aquatic and terrestrial biota should be given special consideration in reviewing shoreline protection actions." Most of the jurisdictions leave review of impacts on fisheries habitat to the Washington State Department of Fish and Wildlife, their application approval being conditioned on meeting the requirements of the state Hydraulic Code. Island County and Whatcom County, however, have included the Aquatic Conservancy Zone in order to preserve a rare and valuable habitat and species.

3.1.2 Soft Solutions

As found under the hard solutions section, the Guidebook lists policies and corresponding regulations and more general regulations that apply to all shoreline development activities. These policies and regulations are listed in Table 3.3.

Table 3.3 State Guidebook Soft Shoreline Modification Solutions	
POLICIES	
<ul style="list-style-type: none"> • Require the design and use of naturally regenerating systems for prevention and control of beach erosion over bulkheads and other structures where: <ul style="list-style-type: none"> • the length and configuration of the beach will accommodate such systems; <p>Regulation - Such solutions cannot detrimentally interrupt littoral drift, or redirect waves, current or sediments to other shorelines.</p> <p>Regulation - Beach enhancement may be permitted as a conditional use when the applicant has demonstrated that no significant change in littoral drift will result which will adversely affect adjacent properties or habitat.</p> • such protection is a reasonable solution to the needs of the site; • it will reverse otherwise erosional conditions. 	<ul style="list-style-type: none"> • Require supplementary beach nourishment where structural stabilization projects are likely to increase impoverishment of existing beach materials at or downdrift from the site.
GENERAL REGULATIONS	
<ul style="list-style-type: none"> • Design alternatives can include: <ul style="list-style-type: none"> • gravel berms • drift cells • beach nourishment • beach enhancement • planting with short-term mechanical assistance • Such solutions cannot disturb significant amounts of valuable shallow water fish/wildlife habitat, unless such habitat is immediately replaced by new habitat that is comparable or better. • Such solutions are prohibited within spawning, nesting breeding habitat and also where littoral drift of the materials enhancement adversely affects spawning grounds or other areas of biological significance. 	

Local Jurisdiction Response

As mentioned above, while several jurisdictions encourage the use of soft or non-structural shoreline modification solutions, few actually have the policy that structural solutions should be allowed only after it is demonstrated that non-structural solutions would not be able to reduce damages. None of the jurisdictions have policies as stringent as those provided in the Guidebook. Generally it is felt that little is actually known about the success of soft solutions in controlling erosion, and property owners and contractors are thus more likely to engage in solutions that are perceived as more highly engineered and thus less risky.

With regards to other policies and regulations on the use of soft shoreline modification solutions, the Puget Sound counties' SMPs are relatively silent. Skagit County has regulatory language that the creation or enhancement of beaches for general enjoyment of the public shall be allowed where no adverse impacts will occur to shoreline processes and aquatic and shoreline biology. The city of Bremerton and Snohomish County clearly have the most extensive language in their SMPs. Amendments to the city of Bremerton SMP include policies and regulations on beach enhancement including restrictions on beach enhancement, criteria for approval, application requirements, design criteria, and construction standards. According to the city of Bremerton Planner, the state used their language on beach enhancement as a guide for the recent Guidebook amendments.

Snohomish County, in their recent amendments to their SMP, clearly embraced the use of soft solutions. Their new SMP includes a separate section on beach and stream enhancement. It states that all beach enhancement should ensure that aquatic habitats, water quality, flood conveyance, and flood storage capacity not be degraded by the action. In addition, the design and use of naturally regenerating systems for prevention and control of beach erosion over bulkheads and other structures is required where (1) the length and configuration of the beach will accommodate such a system; (2) such protection is a reasonable solution to the need of the specific site; and (3) beach restoration/enhancement will recreate or enhance the shoreline conditions, create or enhance natural habitat, or reverse otherwise erosional conditions, enhance access to the shoreline, especially to public shorelines. Following the state guidelines, Snohomish's SMP also includes regulations stating that beach enhancement may be permitted as a conditional use when the applicant has demonstrated that no significant change in littoral drift will result which will adversely affect adjacent properties or habitat. In addition, the SMP states that design alternatives shall include gravel berms, drift cells, beach nourishment, beach enhancement, and planting with short-term mechanical assistance as well as several additional regulations on design criteria and natural beach restoration construction standards.²

3.1.3 Hard Solutions

The Guidebook lists hard shoreline modification solution policies and regulations to implement these policies, as well as more general regulations that apply to all shoreline development activities. Table 3.4 lists the policies, indents the corresponding regulations, and lists the broader regulations.

Mason County also includes conditional use permitting for soft shoreline modification solutions but states that soft solutions are typically exempted as landscaping so as not to deter their use.

Table 3.4 State Guidebook Hard Shoreline Modification Solutions

Policies

- Soft stabilization and protection projects are preferred over hard.
 - Regulation** - Natural materials and processes shall be utilized to the maximum extent possible.
 - Regulation** - Proposals need to demonstrate that use of natural materials and processes and that non-structural solutions to bank stabilization are unworkable in protecting existing development.
- Bulkheads are not suitable for feeder bluffs, particularly in areas that are not already developed or are not already subject to shoreline modification.
- Bulkheads should be located, designed and constructed primarily to prevent damage to existing structures.
 - Regulation** - Bulkheads may be allowed only when evidence demonstrates that a) serious wave erosion threatens an established use or existing building(s) on upland property and/or b) bulkheads are necessary to the operation and location of water-dependent and water-related activities provided that all alternatives have proven infeasible.
- New development requiring a bulkhead or similar protection methods should be discouraged.
 - Regulation** - Use of a bulkhead to protect a platted lot where no structure presently exists is prohibited.
- Shoreline uses should be located in a manner so that bulkheading is not likely to become necessary in the future.
- Affected property owners and public agencies should be encouraged to coordinate bulkhead development for an entire drift sector or homogenous reach in order to avoid exacerbating erosion on adjacent properties.
- The cumulative effects of allowing bulkheads segments of shoreline should be evaluated prior to granting individual permits or exemptions.
- Bulkheads should not be approved as a solution to geophysical problems caused by factors other than wave erosion.

General Regulations

- Bulkheads are prohibited for any purpose if they will cause significant adverse erosion or beach starvation.
- Revetments shall be constructed and maintained in a manner that does not reduce water quality and/or fisheries habitat.
- Revetments shall be sited and designed using appropriate engineering principles.

Local Jurisdiction Response

As mentioned above, while several jurisdictions encourage the use of soft or non-structural shoreline modification solutions, few actually endorse the policy that structural solutions should be allowed only after it is demonstrated that non-structural solutions would not be able to reduce damages. As stated above, only a few of the jurisdictions reviewed have regulations which require that either proposals for rigid works should include indications that more flexible natural works are infeasible or that an applicant must demonstrate that soil bio-engineering will not be effective for bank stabilization.

A few jurisdictions prohibit the building of bulkheads on feeder bluffs through regulation. Feeder bluffs are bluffs that naturally erode, providing feeder material for the adjacent shoreline. If this natural erosion is stopped, due to the placement of a bulkhead, adjacent shorelines can be starved. In one jurisdiction, however, "the use of bulkheads on feeder bluffs is permitted if clear and significant danger to established development exists." In another jurisdiction "bulkheads are not permitted unless it is necessary to protect existing development."

Only two jurisdictions' SMPs include the policy that bulkheads should be located, designed, and constructed primarily to prevent damage to existing development. However, four jurisdictions include regulations requiring that bulkheads be allowed only when evidence demonstrates that a) serious wave erosion threatens an established use or existing building(s) on upland property and/or b) bulkheads are necessary to the operation and location of water-dependent and water-related activities provided that all alternatives have proven infeasible. Two jurisdictions are more prescriptive than the state in that they include two additional requirements for evidence that demonstrates that bulkheads are the preferred method of stabilizing a landfill and that a bulkhead is necessary to stabilize existing beach conditions. Generally, shoreline managers find that language in the SMA makes it very difficult to restrict the approval of shoreline modification applications.

As stated above, two counties discourage new development requiring bulkheading and/or similar protection. A few others have policies that encourage the location of shoreline uses in a manner so that bulkheading is not likely to become necessary in the future. Snohomish County and San Juan County have regulatory language that bulkheads shall not be permitted in conjunction with new projects when other design alternatives, not requiring the use of bulkheads, are practicable.

None of the jurisdictions reviewed encourage the coordination of bulkhead development for an entire drift cell or homogeneous reach in order to avoid exacerbating erosion on adjacent properties. While all of the jurisdictions appear to support the notion of evaluating an application in terms of cumulative effects, none actually include the policy that the cumulative effects (as found in the questionnaire responses and interview comments) of allowing bulkheads along segments of shoreline should be evaluated prior to granting individual permits or exemptions except for Snohomish County. One jurisdiction regarded coordination to be unnecessary given the existing highly developed/modified nature of its shoreline.

None of the jurisdictions have any policy language to the effect that bulkheads should not be approved as a solution to geo-physical problems caused by factors other than beach erosion. Most shoreline administrators feel they have inadequate information to deny an application on these grounds.

Regulations on location of bulkheads (if included at all) vary considerably from jurisdiction to jurisdiction. Snohomish and San Juan County require that bulkheads constructed on Class I marine

beaches must be located behind a berm.³ Skagit County regulatory language states that on marine accretions and along driftways, bulkheads must be set back a minimum of twenty feet landward of Ordinary High Water Mark (OHWM) except for sloping bluff/cliff shores in which case the bulkhead shall be placed as far landward of OHWM as possible. Whatcom County requires that bulkheads be located twenty feet landward of the OHWM while Mason County states that bulkheads may be located as far seaward as necessary to excavate footings, but no more than six feet waterward the OHWM. Finally, Kitsap County requires that bulkheads be constructed in line with adjacent bulkheads where they exist.

With regard to bulkhead design, again, the jurisdictions vary widely in their regulatory language. San Juan County states that bulkheads must conform to the requirements of the Washington State Department of Fish and Wildlife except where the County feels the design is incompatible with protection of shoreline corridor and operating systems. Similarly, Snohomish County requires that bulkhead design conform with the state Hydraulic Code. Kitsap County states a preference for use of rip rap bulkhead (i.e., rock) construction over timber and concrete. Island County states a preference for the use of open piling construction over solid type bulkheads and requires that bulkhead design should adhere to the provisions set forth in the Washington State Department of Fish and Wildlife guidelines. Whatcom and Mason counties state that bulkheads should be sited and designed consistent with appropriate engineering principles. Whatcom County also requires that bulkheads be designed to permit the passage of surface or groundwater, that the top of the bulkhead be one foot higher than maximum high water, the waterward vertical face of concrete bulkheads shall slope upward from toe to crest at a maximum ratio of four units of vertical distance in one unit of horizontal distance, and that concrete bulkheads shall develop an ultimate compressive strength of 3000 pounds per square inch and shall be reinforced with steel to the satisfaction of the County building inspector. Mason County also requires that beach materials not be used as fill and the use of junk is prohibited in the construction of bulkheads. Finally, Skagit County prohibits the use of nonerodable materials in the construction of bulkheads and requires that bulkheads must be designed to allow for the passage of surface and groundwater and the top of a bulkhead must be at least one foot higher than maximum high water level.

None of the jurisdictions has explicit policies or regulations regarding revetments.

3.2 Residential Development Policies

State policies and corresponding regulations for residential development are listed in Table 3.5.

³ Class I beach means a beach having a more or less permanent backshore composed of a storm-tide berm of sand, gravel, and/or driftwood that is wetted only under extreme tide and wave conditions. A Class I beach is almost always an accretion shoreform.

Table 3.5 State Guidebook Residential Development Policies

POLICIES

- Prohibit development in environmentally sensitive areas such as areas with fragile biophysical characteristics and/or with significant environmental resources.

Regulation - All development shall be set back from these areas to prevent hazardous conditions and property damage, as well as protect valuable shore features.

- Prohibit development over water in marshes, bogs, swamps, in floodways, and in geologic hazard areas.

Regulation - It is unacceptable to create residential lots or site area from submerged lands.

- Provide adequate setbacks and natural buffers from the water (see Table 3.6).

- Make provisions for erosion control, drainage systems, protection of aquatic and wildlife habitat, and preservation of geo-hydraulic processes.

Regulation - Submit plan for control of erosion during and after construction, resulting in permanent shoreline stabilization.

Regulation - Wherever feasible use soil bioengineering techniques to arrest erosion (vegetation management).

- Preserve existing shoreline vegetation.

Regulation - submit plans for preservation of shoreline vegetation.

Local Jurisdiction Response

In general there is much less guidance in the SMP with respect to what is and is not allowed for in shoreline residential development. This may be an artifact of the private/public conflict that jurisdictions face. Many shoreline administrators feel that existing setbacks are politically determined, usually based strictly on existing zoning codes, and inadequate in their ability to restrict shoreline develop-

ment. One shoreline administrator feels that his SMP is not meant to be a guide to restrict development but rather to guide development; others felt that the exemption clause of SMA impeded any attempts on their part to deter residential development requiring shoreline modification and subsequent geohydraulic and environmental impacts.

It is clear that the response of jurisdictions to state guidance on shoreline residential development is varied. Local policies and regulations are reflective of political environments, existing land use and physical characteristics, and interpretation of the Guidebook.

Three of the Puget Sound counties' SMPs include the policy prohibiting development in environmentally sensitive areas. Island County has a policy which prohibits residential development within intertidal zones and dune areas. Skagit County states that shoreline areas subject to geologic hazards such as bank and bluff sluffing, failure, or excessive erosion and other shorelines sensitive to adverse impact from development should not be subject to residential development. Finally, Whatcom County has language suggesting that development should not be permitted in hazardous, sensitive, and unique areas. None of the jurisdictions, however, include regulatory language to support these policies.

While several of the jurisdictions have policies discouraging residential development over surface water and in geologic hazard areas, none have specific language prohibiting development over water in marshes, bogs, or swamps, and in floodways except San Juan County. Jefferson County has contradictory language with regards to geologically hazardous areas. The SMP states that residential structures located upon geologically hazardous areas or in floodways are prohibited and later states that residential development in geologically hazardous areas or in areas subject to flooding should be discouraged.

One county has no policies or regulations regarding the provision of setbacks and natural buffers while another has very vague development provisions by environment designations. One county has development provisions by environment designation and no setback requirements while several others have setback requirements but no development provisions. Many of the counties have no policies but do include regulations regarding development and setbacks by environment designation provisions. Table 3.6 indicates the range of setback requirements by environmental designation for those counties that have explicit setback provisions.

Similar to development provisions and setbacks, provisions for erosion control, drainage systems, protection of aquatic and wildlife habitat, and geo-hydraulic processes vary widely among county SMPs. Several jurisdictions have policies which make provisions for erosion control in residential development determinations, however, only two include regulatory language on the subject. One county has regulatory language on residential development in shoreline areas. Structures must be designed to preserve natural drainage. Another has provisions regarding maintenance of shoreline integrity. None of the jurisdictions include provisions for the protection of fish and wildlife habitat. Many shoreline administrators feel these concerns are adequately dealt with by the Washington State Department of Fish and Wildlife requirements. One county added a provision for groundwater supplies, while another added a provision for aesthetics. Approximately half of the jurisdictions have policies regarding the preservation of existing shoreline vegetation; however, only three counties require plans for the preservation of shoreline vegetation as part of the shoreline modification plan.

Table 3.6 Guidebook Environment Designation Provisions for Developing Single-Family Residences

Environment Designation	Development	Setbacks*	Range of County Setbacks Requirements
Natural	Prohibited	NA	75-100'
Conservancy	May be allowed subject to permit conditions & Provisions in SMP	100'	50-100'
Rural	May be allowed subject to permit conditions & Provisions in SMP	75'	20-50'
Suburban	May be allowed subject to permit conditions & Provisions in SMP	50'	25-50'
Urban-Maritime	May be allowed subject to permit conditions & Provisions in SMP	25'	—
Urban	May be allowed subject to permit conditions & Provisions in SMP	25'	15-50'
Aquatic	Prohibited	NA	NA

** If adjacent properties do not meet these setbacks, then the structure may be setback common to the average of setbacks for existing dwelling units within 50' of the site.*

4 Issues in Puget Sound Coastal Erosion Management

From a review of questionnaire responses and telephone interviews with shoreline administrators, other local government officials, property owners, and shoreline protection contractors and from a review of various documents, a list of issues concerning Puget Sound coastal erosion management was identified. These issues include:

- Inadequate private property owner involvement in evaluating shoreline modification alternatives
- Inefficient and complicated shoreline modification application permit process
- Limited use of available soft shoreline modification solutions, where appropriate
- Reliance on hard shoreline modification solutions that results in negative impacts
- Frequent use of variances for residential development that creates a demand for future shoreline modification solutions
- Lack of familiarity with potential risks associated with shoreline property
- Inadequate environment designation provisions to control inappropriate development
- Lack of guidance or consensus on the appropriate balance between private and public property rights

4.1 Inadequate Private Property Owner Involvement in Evaluating Shoreline Modification Alternatives

Several of the shoreline administrators interviewed stated that property owners are not adequately involved in the shoreline modification permit application/review process. Typically the contractor, not the property owner, deals with the permit application process. As a result, there is no point in the permit process at which property owners can be made aware of alternative shoreline modification solutions and involved in the choice of the most optimal solution. Property owners tend to opt for the modification method with which they are most familiar (i.e., bulkheading or riprapping) or the method that is offered to them as a solution by the contractor or engineer hired to address a real or perceived erosion problem. Residents frequently know very little about "soft" alternative stabilization methods and defer to the contractor to make all determinations. The local jurisdictions have little opportunity to aid in this education process under the current system. One solution suggested by two shoreline administrators is to design and use a shoreline modification application form that includes the entire range of criteria that a property owner should consider before choosing a shoreline modification solution. This solution would enhance the property owner's awareness of alternatives and potential concerns associated with the choice of each alternative.

4.2 Inefficient and Complicated Shoreline Modification Application Permit Process

Some contractors, applicants, and property owners stated that the shoreline modification application permit process is cumbersome, costly, and extremely time consuming. One contractor reported that an application review may take up to two years to complete. This is of particular concern to contractors and property owners when erosion protection is clearly necessary. Stated reasons for such inefficiencies include contradictory policies and guidance from state resource managers and local government permit reviewers and lack of coordination between agencies with overlapping jurisdictions.

4.3 Limited Use of Available Soft Shoreline Modification Solutions Where Appropriate

Soft shoreline stabilization methods are infrequently used in Puget Sound. Local SMPs generally encourage property owners to use soft solutions in controlling erosion; however, shoreline administrators have found that there are often serious impediments to using such solutions. One shoreline administrator stated that he has not denied any bulkhead construction applications because he has no evidence to provide property owners that soft solutions will adequately protect their property with the exception of applications for bulkheading on accreting beaches. Some individuals contacted felt that the state Guidebook and SMPs need to be updated to provide better information on the appropriateness and requirements of soft solutions to enhance their consideration and/or use. Related impediments include the following:

- Very little is actually known about soft shoreline stabilization methods. Limited data or empirical evidence exists as to their feasibility, impacts on shoreline processes, impacts on water quality and fish and wildlife habitats, and actual success in private property protection.
- Soft solutions to coastal erosion are inappropriate in some jurisdictions because of the physical nature of the shore (e.g., high bluff or accretion beaches) or because adjacent properties within a drift cell are already hardened.
- Though encouraged verbally in the permit process or through SMP policies, most SMPs do not have adequate standards or binding regulatory language for soft solutions.
- Shoreline property owners often face opposition to their use of soft solutions from other government agencies.
- Few educational materials and outreach activities are available to provide information about soft solutions and their ability to meet shoreline property owners' needs. One particular educational need is to design and provide materials that clarify the rationale behind the preference of soft shoreline stabilization solutions over hard solutions, describe why and when soft solutions are appropriate, and list contacts for finding out more about soft solutions.
- While in some jurisdictions property owners would like to use soft solutions, they and their contractors have the perception that soft solutions are less reliable because they are not as highly engineered as hard solutions.

- Unless neighboring property owners in the same drift cell employ soft solutions, an individual property owner's stabilization project may be worthless in protecting his shoreline.
- There are potential impacts on fish and their habitats from the use of soft solutions.
- There is a lack of interagency cooperation in the support of soft shoreline modification solutions.
- Some jurisdictions believe that conditional use permits deter property owners from using soft solutions.

4.4 Reliance on Hard Shoreline Modification Solutions That Results in Negative Impacts

Most of the individuals interviewed reported that their jurisdictions' shorelines are becoming more and more hardened. Several shoreline administrators who responded to the questionnaire or were interviewed stated that hard solutions were generally approved even though their SMPs may discourage such solutions. According to all of the administrators interviewed, the following are reasons that bulkheading continues (despite empirical evidence that in some cases it is having detrimental impacts on shoreline processes, water quality, and fish and wildlife habitat):

- The data necessary to adequately review applications (e.g., drift cell analysis) are often lacking.
- Educational programs and materials regarding the potential negative impacts of hard solutions are limited.
- Cumulative impact assessment and drift cell analysis are rarely included in the application review process.

All of the administrators stated that application reviewers do not have the data to determine the potential future impacts of bulkhead and rip rap construction on shore and hydraulic processes, adjacent properties, shoreline and water uses, and upland stability. Nor do they have the information to validate allegations that erosion is threatening an existing structure (e.g., a home) and a modification solution is necessary. Information is also often lacking or not readily available to enable reviewers to determine whether erosion is due to wave erosion or upland geophysical problems. Data necessary to validate an applicant's statements that a soft solution will not be adequate do not exist. One administrator noted emphatically that he must know and be able to quantify the causal relationship between the modification and its impacts before denying an application for a hard solution. Several others felt that they needed state support in updating adequate baseline maps, inventories, and general geophysical and environmental data collection.

Most individuals contacted stated that increased familiarity is necessary among property owners, insurers, realtors, engineers, and contractors as to the potential impacts of hard shoreline modification solutions, alternatives to hard solutions, and the actual physical and geohydraulic conditions of Puget Sound. Without such education, the predisposition in favor of hard solutions to perceived coastal erosion impacts will continue. The general topics that require attention include (1) the difference

between episodic events (erosion occurring on a once a decade basis) and average erosion rates; (2) the difference between unstable bluff erosion and wave-induced erosion; and (3) drift cell impacts and the rationale behind stakeholder coordination.

Finally, many of the shoreline administrators interviewed raised the need to comprehensively manage shorelines by drift cell (combining the need for coordination and the goal of measuring and forecasting cumulative impacts). Approximately half of the jurisdictions stated that they confer with adjacent jurisdictions on shoreline modification cases, but few actually do any kind of formal drift cell analysis or explicit coordination among affected property owners and agencies in the permit process. There was unanimous support by Puget Sound local governments for measuring cumulative (both temporally and spatially) impacts; however, several mentioned the need for state guidance on the assessment of cumulative impacts (the focus of this study). Some jurisdictions cite, again, the lack of data as the major deterrent to using drift cell assessment in the application review process. Several jurisdictions feel that drift cell management should be required as part of the application review process. The city of Bremerton amended its SMP, requiring applicants to address the characteristics of the area within a drift cell; the city, however, has not to date received any complete applications under these new regulations.

4.5 Frequent Use of Variances for Residential Development

Many shoreline administrators feel that there are no standards/criteria for property owners to obtain a variance for residential development. Frequent use of variance for residential development may increase demand for future shoreline modification solutions. Similar to the issue of hard versus soft solutions, the problem of variance approval may be related to:

- lack of data necessary to adequately review applications;
- lack of education about the potential negative impacts of future needed shoreline modification; and
- limited cumulative impact assessment and drift cell analysis in the application review process.

While some administrators feel that setback requirements are arbitrary, most feel that they are adequate but ineffective in managing residential development along shorelines, particularly in critical and sensitive areas. Property owners find few deterrents to obtaining the variances they desire to build new structures or improve existing structures in these sensitive areas. This situation may be exacerbated by:

- general policies favoring private property rights over public resource conservation and preservation; and
- lack of incentives for encouraging owners of shoreline property not to build in critical and sensitive areas.

None of the Puget Sound local governments have any form of incentives to encourage property owners not to build in areas that may require shoreline modification solutions in the future or to relocate or raze homes that are located in unsafe or hazardous areas.

4.6 Lack of Familiarity with Potential Risks Associated with Shoreline Property

A few administrators stated that property owners are often unaware of the risks associated with shoreline property. When buying a lot with the intent to build a home or buying a lot with an existing home, the property owner may not be aware of the potential for erosion by either wave action or bluff instability. One local government official recommended that a seller be required to disclose all known past erosion or bluff instability conditions at the time the property is listed to sell.

4.7 Inadequate Environment Designation Provisions to Control Inappropriate Development

All of the SMPs use the environment designation provisions defined in the Guidebook. However, many find that the provisions do little to restrict inappropriate shoreline development or that they are arbitrary and irrelevant to their coastal erosion management planning. The Guidebook is only intended to provide guidance and encourages local jurisdictions to establish designations that best fit their specific shoreline and economic development and environmental policies. As a result, jurisdictions have created new designations that are more appropriate to the local environment. For example, Bainbridge Island has created a Tidal Inlet designation based on criteria for designating certain tidal inlets established by Ecology (Hruby, 1993). Administrators from Burien and Whatcom County suggested that shoreline modifications be related to geologic and biologic features (e.g., accretion beach) instead of land use. That is, environment designation provisions should be based on science and not zoning. Another administrator suggested the determination of environment designations by drift cell, while still another recommended the use of parallel environment designations, for example by establishing a natural designation along a shoreline area backed by a parallel rural designation with building restrictions.

4.8 Lack of Guidance or Consensus on the Appropriate Balance Between Private and Public Property Rights

Overall, the jurisdictions find it difficult to balance private property and public rights. The law (SMA) and its corresponding regulations emphasize both, yet are subsequently vague as to how to handle the conflict, leaving it up to the jurisdictions to interpret the regulatory language as they see fit.

In some Puget Sound jurisdictions, use of or entitlement to private property supersedes environmental concerns. In others, protection of environmentally sensitive areas and valuable natural resources and habitat is very important. From some private property owners' perspectives, the SMA has confused protection of ocean coasts (predominantly publicly-owned, undeveloped natural shoreline) with protection of inland waters, which are predominantly privately owned. They feel this over-protective interpretation of inland waters is impeding their ability to protect their investments. In contrast, conservationists feel that the SMA is not being interpreted strictly enough and that unnecessary hardening of shorelines is resulting in physical and biological detrimental impacts. This conflict will likely not be resolved without a legislative amendment or further judicial interpretation.

5 Policy Alternatives

The previous sections have outlined the current policy framework being used in Puget Sound to address coastal erosion and described the problems and issues confronting shoreline managers in addressing coastal erosion and individual responses to perceived and/or real coastal erosion. This section will provide a wide array of policy alternatives, strategies for combining policies, and policy support tools to be considered by Ecology in its development of management guidelines to address the issues presented. These policies, strategies, and support tools are based on discussions with shoreline administrators, various state officials, property owners, and contractors. Table 5.1 outlines the policies, strategies, and policy support tools that have been identified as potentially useful in addressing coastal erosion. Each is discussed in further detail, in the subsequent text.

Table 5.1 Alternative Policies, Strategies and Policy Support Tools
Broad Environmental Policies
<ul style="list-style-type: none"> • Enhance environment designation provisions • Encourage coordinated environmental impact review
Shoreline Modification Policies
<ul style="list-style-type: none"> • Require evaluation of shoreline modification alternatives • Enhance use of soft solutions • Reduce reliance on hard solutions
Residential Policies
<ul style="list-style-type: none"> • Undeveloped Land <ul style="list-style-type: none"> • restrict inappropriate residential development • create market incentives to reduce inappropriate residential development • Developed Land <ul style="list-style-type: none"> • create incentives for relocation or removal of threatened structures • require property listing disclosures
Strategies for Combining Policies
Policy Support Tools
<ul style="list-style-type: none"> • Develop research, monitoring and data collection programs • Develop education and outreach programs

5.1 Broad Environmental Policies

Certain policy alternatives either address the management of coastal erosion or the management of the human response to erosion. Broad policies that fall into these categories are described below.

5.1.1 Enhance Environment Designation Provisions

Existing environment designation provisions could be modified and enhanced to make them more useful in evaluating residential development and shoreline modification applications. Enhancement of local SMP environment designation provisions could result in more effective evaluation of proposed residential and shoreline modification projects. Existing land use environment designations could be expanded to include environmentally sensitive areas, as defined in the Guidebook, and/or critical areas as defined by the GMA. Areas found to be hazardous, due to their physical features, or requiring protection, due to their natural resources, could be defined by new environment designations. Environment designations could also include parallel designations. Such a designation would establish natural or environmentally determined designations along the shoreline parallel to an existing upland rural or suburban designation with standard building restrictions. Such an approach would more appropriately represent physical and biological characteristics of a shoreline area, likely leading to enhanced environmental conservation. At the same time, this approach would allow for residential development where property owners might benefit from the enhanced surrounding environmental amenities.

Several other states offer interesting examples of environment designation provisions. Michigan has an environment designation of "high-risk erosion areas" that, while not appropriate for Puget Sound, illustrates the use of designations based on physical features. Michigan also has a designation of "environmental areas" for protecting environmental resources. This designation is similar to the existing Washington State Guidebook broad policy for environmentally sensitive areas. Similarly, Virginia has a "geographic areas of particular concern" designation in its Virginia Coastal Resources Management Plan. Areas experiencing high erosion rates or subject to damage from wind, tidal surge or flooding are included as unusual natural hazards. Valuable natural resources such as spawning, nursery and feeding grounds, as well as wetlands are also included (Blair and Rosenberg, 1987). In Maine, the entire coast is mapped according to environmental characteristics. Applications for shoreline modification projects are reviewed according to these characteristics.

5.1.2 Encourage Coordinated Environmental Impact Review

A coordinated environmental impact review could be encouraged or required as a method for coordinating stakeholders (public agencies and private interested parties) involved or interested in a shoreline modification project. A coordinated environmental impact review could be used in the application review process to expedite the permit process and to ensure that all concerns are considered. Coordination could be emphasized to increase the level of familiarity with cumulative and drift cell processes when evaluating a shoreline modification project. Coordination could include review and integration of regulatory functions across agencies and jurisdictions. Furthermore, coordinated environmental impact reviews may be useful as a planning tool as most permit applications are not subject to full SEPA environmental review.

Nordstrom describes the use of regional authorities and commissions that can provide planning and management functions for estuarine systems. Across the United States these entities take on a wide variety of forms and functions. Some of these entities have an economic development focus while others have an ecological protection/conservation focus. In New Jersey, for example, the Bayshore Development Office for Raritan Bay shoreline was created to rejuvenate the Raritan Bay waterfront. The Office was established under the direction of the New Jersey Division of Community Affairs and subsequently taken over by the Department of Commerce and Economic Development. The role of the Office is to serve as an intermediary between state and local governments in guiding development applications through the state review process. In contrast, the Bay Conservation and Development Commission for San Francisco Bay has an ecological focus. This Commission operates outside the existing local government structure, acting as a buffer against local government's pressure to fill the Bay for development purposes. Finally, the Virginia Public Beach Conservation Act uses a reach concept in design and planning of corrective measures at its beaches (Nordstrom, 1992).

Nordstrom (1992) observes that there is a need for incentives to encourage property owners to organize to evaluate erosion control measures that are appropriate for an entire drift cell. Maryland uses tax incentives to encourage property owners to work together in selecting a shoreline modification solution. The Maryland Shore Erosion Control Program has provisions for creating Shore Erosion Control Districts (special taxation districts) for property owners in a single community who are affected by serious erosion problems. If a hard shoreline control structure is found to be warranted, the state works with the District to decide what kind and where it should be built. If the erosion problems of a reach or drift cell in the District are judged to be sufficiently severe, zero interest loans for 25 years are available to the property owners to pay for the building of the structure. A resident can decide not to coordinate with his/her neighbors in building the structure at the price of foregoing any state support. The program, effective since 1972, operates like a revolving loan fund in that property owners' payments from earlier years are now paying for new structures being built (Loran, 1993).

5.2 Shoreline Modification Policies

Shoreline modification policies are meant to address coastal erosion management issues. These may include policies regarding appropriate or acceptable shoreline modification works (bulkheading, riprapping, beach enhancement, revegetation) as well as policies dictating the decision process by which an alternative is chosen. Policies in this category include required evaluation of shoreline modification alternatives, enhanced use of soft solutions, and reduced reliance on hard solutions.

It is important to note that ESB 6128 provides a preference for protecting properties with a residence occupied prior to January 1, 1992 and is silent on a policy to address erosion protection of residences occupied later. Erosion control measures for these older residences are to be effective and timely in their protection while designed to minimize harm to the shoreline natural environment. The attributes of an "effective and timely" protection measure must be defined to understand whether the state or local jurisdictions have authority to require property owners of older residences to consider non-structural erosion control measures. If the requirement of these policies is deemed inappropriate, they could be offered as guidance or included in a state or local jurisdiction education and outreach programs. The following policies may be more appropriate for properties with residences occupied after January 1, 1992.

5.2.1 Require Evaluation of Shoreline Modification Alternatives

An evaluation of various shoreline modification alternatives such as bulkheading, riprapping, beach enhancement, and revegetation, for example, may be included in the application process. It should be noted that the evaluation of shoreline modification alternatives may include the no action alternative. One approach to evaluating alternatives is to design a new application form that includes a hierarchy of alternatives for the applicants' consideration. Such an application would allow the applicant to consider the range of appropriate alternatives for given situations. This approach will increase private property owners' and their contractors' awareness of potential impacts from alternative modification solutions.

North Carolina has a management approach which has an established hierarchy of stabilization methods that define what shoreline modification solutions are most appropriate under particular conditions (Watts, 1987) (See Figure 5.1). Massachusetts has taken this approach one step further. The State Department of Environmental Protection (DEP) has designed an application form that requires the applicant to evaluate all possible shoreline modification alternatives as part of the application process. The DEP oversees the local review and intervenes if necessary to ensure that the most appropriate solution is selected (O'Connell, 1993). This policy may be especially valuable in the Puget Sound area.

5.2.2 Enhance Use of Soft Solutions

The use of the most non-intrusive or environmentally benign methods for shoreline protection, if appropriate could, be required. Soft solutions allow some drift cell processes to occur naturally without interruption from a hard structure. Soft solutions are, however, not appropriate everywhere (e.g., high energy areas or active feeder bluffs). Incentives for using such methods, particularly if in a drift cell basis, could be instituted. For example, a tax credit might be offered to applicants proposing soft shoreline modification solutions.

Florida has a very strict policy regarding the use of soft solutions. In Florida, a property owner must prove that their property is vulnerable to a five year storm and that there are no other methods available to protect their property before a permit for armoring will be granted. In many cases residents are required to attempt to control erosion by revegetation or beach enhancement before they may be considered eligible for a hard shoreline modification permit (Green, 1993).

Maryland uses an incentive approach to encourage the use of soft solutions. It has a cost-sharing program (established in 1985) in which the state generally bears 50 percent of all marsh planting projects. This percentage share may be increased to as much as 65 percent in the case of environmentally critical areas (Loran, 1993). As with the interest free loan program described above, support is provided based on the priority of the site. A resident has to use the methods and materials recommended by the state if they are to be awarded the support (Pito, 1993).

Some states (e.g., Virginia) have found that working with shoreline modification contractors to help them understand the importance of using soft solutions, where appropriate, has been effective. Virginia has recently worked with one contractor to use grasses to stabilize a 1500 foot shoreline development project (Hardaway, 1993). This project has served as a positive demonstration of the successful use of soft solutions.

5.2.3 Reduce Reliance on Hard Solutions

While recent emphasis on conservation and protection of natural resources has led to a preference for non-structural solutions to erosion problems in many states, in general, state programs have great flexibility built into their programs and static structural alternatives are usually carefully considered (Nordstrom, 1992). In Washington State, one possible policy is to phase out, where feasible, the current reliance on hard protective structures for both public and private properties. An additional policy could be to impose structural design standards where hard solutions are needed, thereby allowing natural forces of a major storm to reshape the coast uniformly. This second policy could require a structure to only withstand minor storms thus limiting the damage a structure could cause to adjacent properties in a major storm event.

California currently endorses the first policy to phase out reliance on hard protective structures for both public and private properties (Griggs, et al., 1992). Twelve percent of the California coastline is armored, representing a \$5-15 million dollar per mile investment. Protective armoring has largely been paid for or subsidized by the public sector in the form of state projects, state or federal disaster relief, government assistance or low interest loan programs, or directly through insurance payments. California has a recommendation in the report *California's Coastal Hazards: A Critical Assessment of Existing Land-Use Policies and Practices* that every proposal for a hard works should be accompanied by a technical evaluation of site geology and oceanography, long-term erosion history, structural design criteria, and an evaluation of the effectiveness of any adjacent protective works (Griggs et al., 1992). The report suggests that these evaluations be prepared by experienced professionals and appropriately peer reviewed.

The second hard solution policy outlined above—using structural design standards on hard works where a hard solution is needed—is being considered in two states, Massachusetts and Florida. Massachusetts has recently begun to encourage property owners to build structures that are as low as possible to allow the upper bank/bluff to slump in times of severe storm action, thus allowing for the natural influx of upland materials (O'Connel, 1993). The policy also requires that residents nourish the bank with compatible bank/bluff material after severe storm action so that material is available for future storms (O'Connel, 1993). Florida's similar policy requires that hard protective structures be designed to withstand minor (5-10 year) but not severe (100 year) storm events. The notion is, again, that the natural force of the storm should be able to reshape the coast uniformly (Green, 1993).

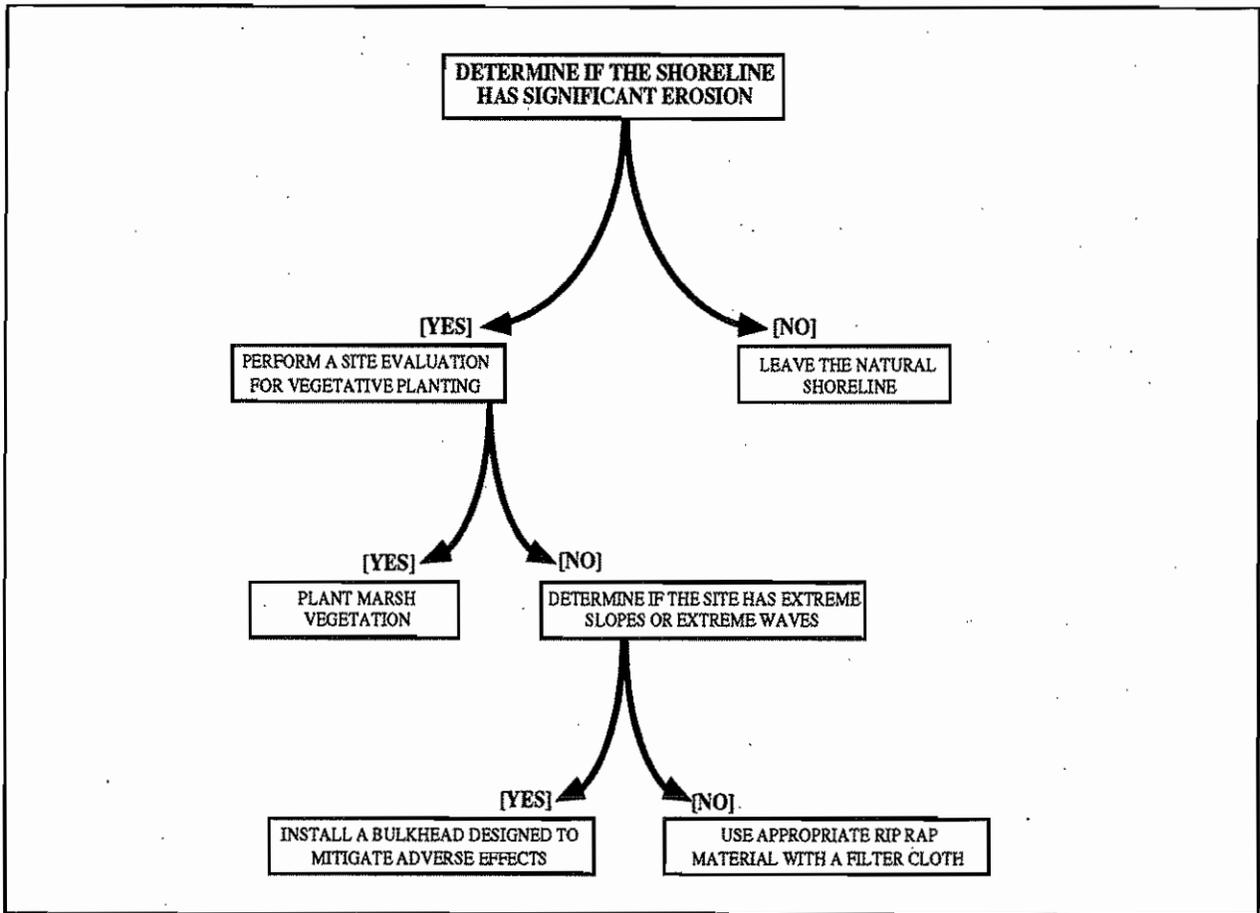


Figure 5.1 Examples of Using the Hierarchy of Stabilization Method (Source: Watts, 1987, p. 32)

5.3 Residential Policies

5.3.1 Undeveloped Lands

Residential development policies address the management of increased shoreline residential development and human responses to perceived and/or real coastal erosion or bank failure. The policies suggested here represent two approaches to address inappropriate residential development. The first set of policies attempt to limit inappropriate development that leads to either increased erosion or the need for erosion protection works. The second set of policies offer incentives that could lead to a decrease in inappropriate development in areas of high erosional risk or critical and sensitive areas. These may be viewed as economic or market strategies to reduce inappropriate shoreline development practices and hence the potential need for shoreline stabilization.

Restrict Inappropriate Residential Development

Setbacks: Use of more stringent requirements for fixed or dynamic setbacks that site development away from erosion prone areas and reduce the need for coastal protection devices that exacerbate erosion problems may be appropriate. While setbacks are already part of the existing management structure, it may be appropriate to enhance existing provisions to better reflect critical and sensitive areas. More than one-third of all coastal states have established minimum setbacks for new construction (Griffin, 1992). However, it was found from the Washington State interviews that setbacks are often not enforced to the degree they could.

Post-construction Standards: Development of a set of post-construction standards, such as bank revegetation, may be a means to improve shoreline residential development.

Public Health Ordinances: Inappropriate residential development could be limited through the use of existing health ordinances that regulate development densities. For example, jurisdictions could (and sometimes do) regulate on-site waste disposal and location and construction of on-site water supplies. It has been noted (Nordstrom, 1992) that county governments are typically in a better position to regulate development than municipalities in that they have the authority to establish health regulations that may help preserve or enhance estuarine resources, including beaches. While an in-depth consideration of this method is beyond the scope of this report, limitations on sewer hook-ups or septic system installation could be viewed as a potential constraints to shoreline residential development.

Limitations to Hard Shoreline Modification: Limits on the construction of bulkheads to protect new residences could be established. An example of the latter is an outright ban on the use of hard shoreline modification structures for new development, as is the case in Massachusetts' homes built after August 1978 (O'Connell, 1993).

Create Market Incentives to Reduce Inappropriate Residential Development

Tax Credits: A system of tax credits or exemptions could be designed to preserve erosion prone areas in their natural state. Tax breaks could be used to encourage property owners to donate undevelopable lands or adapt land to appropriate compatible uses or open space. Such policies could be incorporated into the state Open Space Act. Alternatively, tax credits could be instituted that create incentives to limit development to a portion of a particular parcel.

Transferable Development Rights: A system of transferable development rights could be created for designated shoreline areas. The state could establish a quota of developable shoreline, which would require special zoning. In addition, a system for market transfer could be created as well as a method for assessing development rights and value. The use of transferable development rights would mimic a market place for scarce shoreline made available through state zoning ordinances, allowing those with the highest value for shorefront property to acquire it while restricting the total amount available.

Land Acquisition: One approach to shoreline conservation is to identify and acquire critical shoreline and beach areas directly through publicly sponsored acquisition and open space programs or through support from private conservation groups. Land acquisition offers a property owner the opportunity to sell property to the state at a fair market value, especially in cases where land is inappropriate for development. This approach would allow for the transfer of established private property rights to the state for the future conservation/preservation of these critical and sensitive areas in their natural state for the public as a whole. Property owners would be compensated by an amount equal to the opportunity cost of their land holdings.

Examples of the incentive programs outlined above are found in California, North Carolina, and New Jersey. California has a menu of incentives including transfer of development rights, open space and conservation easements, life estates, and public acquisition of high-risk lands. Public acquisitions are typically made through the Coastal Conservancy, land trusts, or other appropriate institutions or organizations (Griggs, 1992). North Carolina's coastal management program has a million dollar provision in its beach access law for acquiring lands that are inappropriate for permanent development (Platt, 1992). This program grew from an original setback program which left many ocean front lots unbuildable (Benton, 1993). The Department of Environmental Health, and Natural Resources sets priorities for purchasing such property. New Jersey also has what is called the Green Acres Program which acquires land for recreational site development (Nordstrom, 1992).

5.3.2 Developed Lands

The institutional policies described below reflect at the conceptual level public programs/institutions that could be established to address erosion control management problems. The determination of funding for such programs or how they would actually be implemented is beyond the scope of this report.

Create Incentives for Relocation or Removal of Threatened Structures

Provision of direct financial incentives for property owners to relocate (or remove) structures away from erosion prone and hazardous bluff areas or eroding shorelines could reduce the need for shoreline stabilization works and subsequent downdrift impacts. Such incentives could include use of the Upton-Jones Amendment or tax credits. As mentioned in the shoreline modification policies' section, this policy alternative may be more relevant to residences first occupied after January 1, 1992. Property owners of residences occupied before this date may choose to armor their shorelines or take advantage of incentive mechanisms available to relocate or remove structures.

Several states have programs that create incentives for relocating and/or removing threatened structures. Michigan established an Emergency Home Moving Program in 1985 to provide financial assistance to homeowners to relocate their homes away from eroding shores. Under this program, homeowners are provided interest rate subsidies or grants to assist them in relocating or razing their homes (Platt, 1992). The purchase of additional property is also eligible if needed for relocation. This

program offers aid to a property owner before rather than after any disastrous storm or erosion event. Of the 273 applications received between August 1985 and February 1987 (the initial phase), 199 were found to be potentially eligible for assistance. Out of the 199, many applicants dropped out for various reasons resulting in 62 relocation projects being funded. It is unclear whether Michigan's legislature will continue to fund the Emergency Home Moving Program given that the Upton-Jones Amendment to the National Flood Insurance Program is now available (Jannerth, 1993). Michigan's program is more comprehensive than Upton-Jones with regard to who is covered.

California also has plans to establish a program to assist threatened properties in hazardous areas. Griggs et al. (1992) identify three relevant strategies to assist threatened properties. They include: relocation of structures, phased-out public assistance, and phased-in prohibition of structural solutions.

Require Property Listing Disclosures

A requirement to disclose bluff stability and erosion hazards (with or without a structure on it) in property listings could be established. Such a requirement would serve to educate realtors and property owners about the risks associated with certain shoreline properties and the potential need for future shoreline stabilization.

Three states have been identified that require property listing as a means of notifying buyers of potential storm or erosion dangers associated with particular parcels of land. These states are Florida, Michigan, and California. Florida requires real estate agents to notify buyers of any potential storm or erosion dangers through a Coastal Property Exposures Statement. Buyers must indicate on the contract that they have been notified about the dangers (Bernd-Cohen, 1993).

Michigan's Level Reference Study Board has recently issued a recommendation of a real-estate disclosure requirement where the seller must disclose whether the property is within a mapped or known flood or erosion hazard area to prospective buyers. The buyer, in turn, would be expected to sign an acknowledgment that he/she has been informed of the risk (Levels Reference Study Board, 1993). This disclosure requirement has not been passed by the Michigan legislature.

California has two separate policies relating to property listing requirements: a deed posting requirement and a full-disclosure statement. Under the deed posting requirement, if a property owner applies for a permit to build a structure to protect his/her property following damage from a storm or other hazardous event (e.g., geotechnical) and the permit is approved, a statement is added to the property owner's deed noting that the property is in a hazardous area. Under the full-disclosure statement requirement, the property seller must submit a form, acknowledged and signed by the buyer, that describes all of the sites characteristics.

5.4 Strategies for Combining Policies

It may be most appropriate to combine various policies described above. For example, in the instance that a soft solution is not adequate to protect a residence from eventual shoreline erosion, a low rock bulkhead could be constructed which would be reinforced and visually enhanced by revegetation. Similarly, toe protection of a bluff could be provided by a revetment augmented with a sand beach (for additional protection) and revegetated regraded slope to prevent additional erosion from runoff. Another example would be to combine the use of setbacks with the required use of soft solutions to address potential future shoreline erosion. A combination policy could also call for coordinated environmental impact reviews and the evaluation of alternatives by using a modified application form.

Combination policies have historically been identified as a means to provide flexibility in coastal erosion management. A 1981 U.S. Army Corps of Engineers report (Corps, 1981) suggests that a combination approach can be the best solution among the menu of alternatives.

Designing strategies for combining policies will depend on the goals and objectives of the agency (state or local). Moreover, strategies could be selected and implemented as part of a multi-agency coordination effort. This may be an outcome of Task 7 [Volume 9].

From the research conducted for this study, two states' combination policies warrant mention. Florida has a combination policy requiring an individual proposing construction of a protection structure to also apply for and maintain compatible beach sand seaward of the structure. This beach sand is to replace the material that would have been eroded if the shore protection structure had not been built (Terchunian, 1988). Florida requires performance bonds and automatic removal of structures (e.g., bulkheads) found in violation of such permit conditions. These incentives are aimed at keeping property owners liable for maintaining the placement of beach material. Massachusetts is another state found to be using an innovative combination policy. Massachusetts, similar to Florida, has a policy that limits structural design of hard shoreline modification structures and requires bank or bluff nourishment in cases of high storm or natural erosion activity. Local jurisdictions in Massachusetts also require property owners to add sand to beaches every 3-5 years where armoring has been used in the past (O'Connel, 1993).

5.5 Policy Support Tools

5.5.1 Develop Research, Monitoring, and Data Collection Programs

Data and technical studies are critical to the management of erosion control and reactions to erosion control. Western Washington University's Puget Sound net shore drift studies could provide a first step in filling existing data gaps. Shorelines with the greatest information needs should be targeted by their jurisdictions. Baseline maps and inventories for these shoreline areas could be updated and enhanced with the integration of development and land use patterns. Enhanced data bases can also be used to update/modify environment designation provisions. Research on full drift cells (e.g., determination of littoral drift), erosion rates, and the monitoring of modification solution impacts would be encouraged under this alternative.

Nordstrom (1992) indicates that the first step in a comprehensive coastal erosion management program is an inventory of existing private and public beaches. Other recommended research needs include: cumulative effects of shoreline modification structures on loss of beach resources at the local and regional scale; the effects of structures on water quality and organisms; and, the extent to which non-bulkheaded shoreline segments are at risk when bounded by neighboring bulkheads. Nordstrom also indicates the need for a comprehensive biological research program to inventory estuarine beach communities and specify the natural values of estuarine beaches in order to make informed decisions on whether there will be irreplaceable losses to biota if beaches are eliminated through human activities. (Nordstrom, 1992). Michigan is an example of a state with a strong research and monitoring program. It updates its shoreland and recession studies every ten years and changes its environment designations accordingly.

5.5.2 Develop Education and Outreach Programs

Programs could be developed to educate the general public, shoreline property owners, developers, architects, insurers, contractors, engineers and financial institutions concerning the natural dynamic properties of the shoreline and the possible impacts upon them from shoreline protection. The same group of stakeholders could be provided with information on soft solutions to stabilize shorelines. Educational programs could include:

- workshops for property owners, engineers/architects, and others to describe the possible application of soft solutions including why and when soft solutions are preferred over hard and who to contact to find out more about them
- seminars and workshops for property owners, insurance writers, realtors, and appraisers on:
 - coastal erosion
 - how to distinguish between episodic event erosion and average annual erosion rates
 - how to distinguish between unstable bluff failure and coastal erosion
 - how a drift cell works, how particular methods of shoreline modification affect the drift cell, and why coordination among drift cell stakeholders is encouraged
 - what a jurisdiction's policy is for evaluating shoreline modification alternatives.
- grassroots education programs such as "Beach Watchers"
- written materials on coastal erosion for property owners (distributed by realtors, appraisers, contractors, architects, and insurance companies and direct mailing)
- shoreline modification application form that clearly describes the screening or hierarchy approach a property owner should use to determine the appropriate method/structure for a particular site
- demonstration projects using non-structural engineering to mitigate shoreline and beach erosion such as vegetative restructuring and beach enhancement.

Several states have education programs relating to coastal erosion. Virginia has a state funded Shoreline Erosion Advisory Service which provides assistance to property owners in preventing erosion of waterfront lands (Blair and Rosenberg, 1987). Michigan has held several workshops as part of its Emergency Home Moving Program. The workshops were held in several locations along the shoreline to educate property owners about shoreline property protection alternatives (Platt, 1992, p. 164). Michigan also had a newsletter called "Update" produced by its Levels Reference Study Board - International Joint Commission. Furthermore, Michigan held public forums to explain the purpose of the study and to solicit feedback. Under Michigan's Shorelands Protection and Management Act, the Michigan Department of Natural Resources Land and Management Division produced a booklet in 1992 that defines landowners' involvement in designating high risk erosion areas. North Carolina has a handbook entitled A Handbook for Development in North Carolina's Coastal Area provided by the North Carolina Department of Natural Resources and Community Development (Watts, 1987). The

handbook provides extensive information on bulkheads as compared to soft shoreline modification measures. In addition, North Carolina Sea Grant has published a pamphlet entitled *A Homeowner's Guide to Estuarine Bulkheads* that provides information on bulkheads only. North Carolina recognizes that the latter pamphlet's focus is too narrow in that it omits soft solutions (Watts, 1987). The fear is that property owners will inevitably choose bulkheads over other soft alternatives without this information.

Finally, Coast Weeks [now known as Water Weeks] is a national annual event that helps the public understand coastal geology and ecology. Such information can help coastal residents understand appropriate measures to take in protecting their property from coastal erosion.

6 Evaluation of Policy Alternatives

This section presents an analysis of the three categories of policy alternatives, strategies for combining policies, and policy support tools discussed in Section 5. Individual policies and programs within each of these categories are analyzed according to the factors outlined in Table 6.1 as well as lessons learned from other states. The analysis is not intended to result in policy prescription. Rather, it is intended to offer a broad outline of the advantages and limitations of the menu of policies, strategies for combining policies, and policy support tools provided. Furthermore it is intended to serve as a guide in selecting the policies that warrant more detailed evaluation in Task 7.

6.1 Factors to Consider in Analyzing Policy Alternatives

In evaluating coastal erosion management policy alternatives, it is important to consider various factors in order to identify the advantages and limitations of each alternative. These factors fall into the six general categories listed in Table 6.1.

Not all factors will necessarily be appropriate in evaluating all policy alternatives. Whether a factor is included in the decision process will depend on the specific jurisdiction and the type of policy being evaluated. For example, consideration of technical appropriateness may be more pertinent to evaluating a hard versus soft preference policy while socio-political acceptability may be more pertinent to the consideration of a policy requiring stakeholder coordination in the application process. Consideration of the various factors is viewed as an iterative rather than sequential process.

6.2 Broad Environmental Policies

Two policies identified in this study that may be appropriate for addressing general environmental issues associated with Puget Sound coastal erosion are enhanced environment designation provisions and coordinated environmental impact reviews. The inclusion of a coordinated environmental impact review in the shoreline modification application process is offered as one method by which to facilitate coordination of public and private stakeholders and encourage drift sector and cumulative impact analyses.

6.2.1 Enhanced Environment Designation Provisions

Existing environment designation provisions could be modified and enhanced to make them more useful in evaluating residential development and shoreline modification applications. Designations could be modified to more closely match the emphasis on critical areas in the Growth Management Act. That is, designations could be based more on physical features and processes than on land use. An alternative to the latter approach is to design parallel designations that establish a natural or environmentally determined designation along a shoreline area parallel to a rural or suburban designation with standard building restrictions.

Table 6.1 Factors for Analyzing Policy Alternatives

Technical Effectiveness
<ul style="list-style-type: none"> • Ability to meet objectives in short- and long-term • Certainty or uncertainty associated with the policy's ability to meet objectives • Flexibility to apply other policies at a future time • Reliability/durability/efficiency of technologies • Compatibility with geologic and hydraulic site characteristics • Compatibility with existing land use
Environmental Appropriateness
<ul style="list-style-type: none"> • Consideration of environmentally sensitive and critical areas (including fish and wildlife habitat) • Consideration of general environmental impact including water quality
Legal And Regulatory Acceptability
<ul style="list-style-type: none"> • Ability to comply with federal, state, and local laws and regulations • Consistency with ESB 6128 amendment of State SMA • Compatibility with state shoreline and growth management priorities and other state and local programs
Net Cost Of Implementation
<ul style="list-style-type: none"> • Public and private benefits • Capital costs • Administrative costs • Discount rate • Uncertainty • Irreversibility
Socio-Political Acceptability
<ul style="list-style-type: none"> • Balancing environmental conservation/protection and economic growth • Public perception of impacts on private property rights and/or the environment • Familiarity and simplicity of technical concepts and terms • Level of public participation in actual decision-making process
Ease Of Implementation (An Integration of Other Factors)
<ul style="list-style-type: none"> • Legal and regulatory constraints • Cost of implementation • Political acceptability • Level of understanding of policy implications • Level of coordination among stakeholders

Technical Effectiveness

Environment designations based on physical features and processes, as well as environmental conditions, may be more effective in the optimal selection of shoreline modification solutions. These designations, however, may need to be modified over time to ensure that they remain relevant to the rate of environmental change. Michigan, for example, reviews its designations on a decade by decade basis in order to update them as needed.

Environmental Appropriateness

Some jurisdictions see existing environment designation provisions as inadequate in the protection of environmentally sensitive and critical areas and/or water quality. Modifying the environment designations either to reflect physical features and physical and biological processes, or to include such conditions by using parallel designations could address this concern.

Legal and Regulatory Acceptability

The use of environment designations is consistent with the environmental conservation objectives of most relevant federal and state legislation and programs, and is, therefore, likely to be seen as acceptable from a legal and regulatory perspective. The SMA clearly empowers local jurisdictions to expand/modify the list of designations in their SMP as they see fit. Local zoning ordinances would have to be made consistent with new environment designations.

Net Cost of Implementation

The costs associated with establishing new environment designation provisions are dependent on baseline map modification needs, assuming existing documentation is not adequate. Additional costs may be incurred through the administration of amendments to an SMP. While the benefits of new designations are uncertain, there is a high probability that enhanced environment designation provisions will lead to little private property loss and relatively large environmental conservation gains.

Socio-political Acceptability

Many local shoreline administrators are anxious to strengthen environment designation provisions to better manage shoreline development. Ecology is responding by encouraging local jurisdictions to develop new designations that more appropriately represent existing environmental and land use conditions. Since alternative environment designation provisions will only affect a portion of existing developable lands (and therefore should not deny all economic use of available developable lands), such a policy would likely withstand the challenge of a "taking." Public perception may, however, be one of increased protection of the shoreline and thus loss of private property rights. Parallel environment designations could address such concerns. Moreover, adequate information and public outreach to distinguish conservation from preservation may help to limit opposition. Implementation of this policy may require sufficient incentives for local governments to commit staff and resources.

Ease of Implementation

New environment designations would likely be technically and environmentally appropriate and consistent with state laws and regulations. The parallel designation concept may be a good compromise since it allows development but provides protection for sensitive areas immediately adjacent to the shore. In any case, stakeholder involvement in the design of alternatives will help expedite policy development and implementation. Alternative designations may involve more technical support and assistance as well as additional baseline data. Existing expertise and data collected subsequent to making the original designations should ease expected costs.

6.2.2 Coordinated Environmental Impact Review

A coordinated environmental impact review could be required as part of the shoreline modification application process. Such a requirement may facilitate the coordination of public (e.g., state and local agencies) and private stakeholders. A coordinated environmental impact review could encourage drift cell analysis and enhance the understanding of the cumulative impacts from a proposed shoreline modification.

Technical Effectiveness

The technical effectiveness of a coordinated environmental impact review (i.e., the coordination among stakeholders of a common drift cell and the focus on current and predicted assessments of cumulative impacts of shoreline protection) is dependent on having the data that define the drift cell boundaries and the processes that have historically influenced that cell. Such data will be needed for appropriate decision making. Without such data, arguments for and against a proposed shoreline modification solution are difficult to evaluate. For example, Florida's efforts to implement a cumulative impact analysis as part of their shoreline modification application process has been hampered by the lack of adequate technical information.

Environmental Appropriateness

Coordination of stakeholders within a drift cell is likely to improve the local jurisdiction's understanding of the processes occurring within a cell and the impacts on fish and wildlife habitat. Most natural scientists and ecologists support using a drift cell and cumulative impact analysis approach in evaluating shoreline modification projects.

Legal and Regulatory Acceptability

The Washington Administrative Code (WAC 173-14-150) addresses cumulative impacts in its reference to granting variance permits. It states that "consideration shall be given to the cumulative impact of additional requests for like actions in the area. For example, if variances were granted to other developments in the area where similar circumstances exist, the total of the variances shall also remain consistent with the policies of RCW 90.58.020 and shall not produce substantial adverse effects to the shoreline environment." It has been noted, that the data are not necessarily available to make such determinations. Therefore, it maybe appropriate for the state to establish the policy of merely encouraging stakeholder coordination and cumulative impact assessment rather than requiring it. Alternatively, the state could develop case examples of cumulative impact assessment by sponsoring one or more pilot projects.

Cost of Implementation

Coordinated environmental impact reviews may initially be costly if the quality of data available for a particular drift cell is not adequate for the review. Additional research on drift cells targeted for development would be much less expensive than updating all baseline maps for Puget Sound. Studies done on net shore-drift and the Coastal Atlas held by Ecology may offer a solution to primary research needs. Other costs are associated with stakeholder coordination and review and integration of regulatory functions across agencies and jurisdictions as necessary. In contrast to these costs is the greater efficiency in the permit process that could result from interagency coordination. Other long-term gains from stakeholder coordination, while uncertain, could be significant in terms of reduction in loss and degradation of shoreline natural resources, aesthetics, and public access. Maryland has found that a property owner who does not comply with coordination requirements may pay as much as three times more for a modification structure given the denial of access to the zero interest, state provided loan.

Socio-political Acceptability

While some view coordinated environmental impact reviews positively, other are skeptical because of data limitations. One potential solution to counter opposition would be to create market incentives such as those devised by Maryland through the Maryland Shore Erosion Control Program. Creation of Maryland's special tax districts offers property owners the opportunity to gain from coordinating with their drift cell neighbors. The Maryland program has been found to be very effective in coordinating shoreline modification projects (Loran, 1993). Commissions composed of stakeholders with varying perspectives as used in California's Bay Conservation and Development Commission for San Francisco Bay have also been effective in coordinating shoreline modification projects. Commissions made up of participants with varying perspectives can help legitimize the group and thus increase political acceptability.

Ease of Implementation

The technical effectiveness and environmental appropriateness of conducting coordinated drift cell analysis as part of the shoreline modification application process would encourage appropriate development that considers cumulative impacts. However, the successful implementation of coordinated environmental impact reviews will depend on the commitment of relevant local and state agencies to work together and support such an approach. Success may also be dependent on incentives provided to the private stakeholders (i.e. property owners) within the drift cell in question. Data quality and the ease by which new, pertinent information can be acquired may be another limiting factor in implementing coordinated environmental impact reviews. Education and outreach programs (a policy support tool described later) can help in the successful implementation of this policy.

6.3 Shoreline Modification Policies

Shoreline modification policies are a means to address coastal erosion and individuals' responses to coastal erosion. Such policies address appropriate or acceptable shoreline modification including hard solutions (bulkheads and revetments), soft solutions (revegetation and beach enhancement), and the no action alternative. Whichever alternative is chosen, the ESB 6128 preference for erosion control for existing residences first occupied prior to January 1, 1993 must be considered. Shoreline modification policies offered in this report include an evaluation of shoreline modification alternatives as part of the permit application process, the enhanced use of soft solutions, where appropriate, and reduced reliance on hard solutions when feasible.

6.3.1 Evaluation of Shoreline Modification Alternatives

An evaluation of shoreline modification solutions could be included in the application process. An evaluation of shoreline modification alternatives (including the no action solution) may help educate property owners about alternative solutions which in turn may result in the selection of more appropriate solutions. Such solutions will, theoretically, be more environmentally sensitive while at the same time effective in protecting shoreline property.

Technical Effectiveness

A policy to evaluate shoreline modification alternatives is aimed at ensuring that the most technically effective solution to shoreline protection is selected. Technical effectiveness (including the durability, reliability and efficiency of the technology) will depend on existing physical and geohydraulic conditions of the site as well as existing modification solutions used within the drift cell.

Environmental Appropriateness

The objective of a policy to evaluate shoreline modification alternatives is to ensure that the most environmentally sensitive solution to shoreline protection is selected.

Legal and Regulatory Acceptability

No legal or regulatory problems associated with adding a shoreline modification alternative evaluation section to the application form have been identified. Doing so appears to be consistent with the ESB 6128 provision that the erosion control measure in question be designed to minimize harm to the shoreline natural environment.

Net Cost of Implementation

While the cost to public agencies to design and administer a new application form would be moderate, there may be additional costs imposed on the applicant. The benefits in terms of the most efficient and environmentally sensitive modification solution are uncertain but probably positive and significant in the long run.

Socio-political Acceptability

An application form that includes a shoreline modification alternative evaluation may be viewed by the applicant as an additional bureaucratic step. Such an imposition may meet with significant opposition. Education and outreach programs and the inclusion of informational materials with the application may counter such opposition and emphasize the long-term efficiency gains of such a policy.

Ease of Implementation

An augmented application form may be relatively easy to design and administer. The use of a form will encourage the selection of the most technically effective and environmentally appropriate solution for a particular site given its physical and biological conditions. Long-term efficiency gains from using such an application form, while uncertain, may offset any additional cost burdens imposed on applicants. An added benefit of the augmented application is that it will serve to educate property owners and contractors on alternative shoreline modification solutions.

6.3.2 Use of Soft Solutions

The use of non-structural methods of shoreline protection, if appropriate, could be required. Implementation of policies that enhance the use of soft shoreline modification solutions could be one means of reducing the adverse impacts from residential development and shoreline hardening.

Technical Effectiveness

The physical and biological characteristics of a site will dictate the appropriateness of soft solutions. Garbisch et al. (1975) notes that a factor limiting the provision of appropriate guidelines for soft solutions is the variability created by the specific physical, chemical, and biological conditions prevailing at a particular site. Periodic fertilization, among other things, may be essential for vegetative establishment on some substrates and in areas subject to high degrees of physical stress. In addition, soft solutions, especially beach nourishment, may not be effective for individual properties with only a small shoreline segment. To be effective, appropriate guidelines and standards for the use of non-structural solutions will need to be sufficiently flexible to deal with these variables. Unfortunately, there is only limited empirical evidence to suggest the level of reliability and effectiveness of soft solutions in different circumstances. Careful monitoring and analysis of soft solution projects will

be important in filling existing empirical data gaps. One factor in favor of using soft solutions is that they are flexible enough to allow for the application of other stabilization or protective measures in the future and can generally be modified more easily than hard solutions.

Environmental Appropriateness

Soft solutions to shoreline modification may disrupt natural physical shoreline processes less than other protection works. However, the degree to which soft solutions may affect environmentally sensitive and critical areas, including fish and wildlife habitat, is uncertain. Recognizing this, Maryland has a policy that the receptor environment must be considered carefully before a soft solution is implemented (Loran, 1993). If the receptor environment is an oyster bed that can be detrimentally impacted, for example, then a soft solution will not be allowed.

Legal and Regulatory Acceptability

A preference for the use of soft solutions is stated explicitly in the Guidebook. There are potential conflicts, however, between a strict soft solution policy and the standards established in the Hydraulic Code. This inconsistency will have to be addressed.

Net Cost of Implementation

The use of soft shoreline modification works may be less costly than hard solutions depending on the scale and location of the project. The costs to private property owners associated with the implementation of a soft shoreline modification solution are dependent on the type of solution, the scale, the source of materials, and the physical and biological characteristics of the site. Costs may vary from very expensive, bio-engineering projects, to low cost options such as maintenance of a stand of trees located on a bank or bluff. In Maryland, soft solutions such as grass planting are found to be as little as one-sixth the cost of hard structures (Loran, 1993). With regards to the actual imposition of required consideration of soft solutions as an alternative means of shoreline protection, costs again may cover a wide range. In Florida, the proof that a soft solution will not adequately protect shoreline development is predicated on actual implementation of a soft solution. Such a requirement may impose significant costs to residents interested in protecting their shoreline property. These costs, however, may be offset by the benefits of the enhanced use of soft solution.

Socio-political Acceptability

The lack of familiarity with soft solutions and skepticism about their feasibility and success in property protection could be a problem in implementing soft solution policies. Public involvement in the choice of alternative modification solutions will be critical to the acceptance of soft solutions. Virginia has interacted with contractors to enhance the use of soft solutions. In Florida, the increased use of soft solutions was based partially on the public's perception that such solutions enhance the preservation of loggerhead turtle habitat.

Ease of Implementation

Frequently, the implications of soft solution policies are misunderstood (e.g., they are an inadequate means of shoreline protection). Such misunderstandings may make soft solution policy implementation difficult. Ecology and the local jurisdictions need to decide under what conditions soft solution will be required and the degree of enforcement that will be used. Education and public involvement as well as coordination among agencies (especially Washington State's Department of Fish and Wildlife) will be critical in the implementation of soft solutions.

6.3.3 Reliance on Hard Solutions

Policies aimed at reducing the reliance on hard solutions could include the phase out of hard shoreline modification projects, where appropriate and feasible, and the use of structural design standards where hard solutions are needed. A rigorous technical peer-review of hard solution applications may offer a method for legitimizing allegations that a hard solution is necessary.

Technical Effectiveness

Both of the above policies would likely be technically effective in reducing the reliance on hard erosion control structures. The use of technical peer-review has been shown to be effective as a means of phasing out hard shoreline modification solutions in California (Griggs, 1993). In this case, the state provides a reviewer to a jurisdiction that lacks the necessary resources (financial or staff). The use of structural design standards on hard solutions may prove to be an effective means of providing feeder material to a drift cell in times of severe storm action, as evidenced by recent experiences in Massachusetts and Florida.

Environmental Appropriateness

The phase out of hard shoreline modification solutions may reduce negative impacts to fish and wildlife habitat and water quality. Structural design standards for hard solutions will allow ecosystems to adjust uniformly following a severe storm.

Legal and Regulatory Acceptability

Understanding that ESB 6128 gives clear priority to erosion control measures for properties with a residence occupied prior to January 1, 1992, the phase out of hard shoreline modification projects and use of structural design limitations for new construction would both likely be acceptable under current laws and regulations.

Socio-political Acceptability

Private property owners tend to opt for static structural control solutions (especially in the case of relocation of threatened structures) and generally have the necessary influence to persuade regulatory officials to approve applications for such projects. The level of acceptance for policies which limit or deter the use of hard solutions or limit their structural design may be low. Market incentives such as the Maryland 50-50 cost sharing program for soft solution projects could be created to enhance hard solution phase out. Alternatively where hard solutions are necessary, zero interest loans could be offered to create incentives to build low, unobtrusive hard works of limited structural design.

Ease of Implementation

While the phase out of reliance on hard shoreline modifications may be relatively easy administratively, it would probably be necessary to launch a substantial public education and outreach program that could also be supportive of the coordinated environmental impact reviews policy. Limiting the structural design of hard works may also be relatively easy to implement, but will require incentives to encourage property owners to comply with design restrictions and to renourish areas after severe storms.

6.4 Residential Policies

6.4.1 Undeveloped Lands

Residential development policies could be designed to encourage appropriate development on shoreline properties subject to coastal erosion. Such policies may include command and control methods that actually prohibit development in limited circumstances, or restrictions to development such as setbacks. Alternatively, economic or market incentives could be established and used to discourage development in erosion-prone or critical and sensitive areas.

Inappropriate Residential Development

One strategy for reducing impacts from inappropriate shoreline development could be to establish new, and in some cases, more restrictive residential development requirements to deter such development. Policy alternatives include more stringent setback requirements, post-construction standards, public health ordinances, and design limitations of hard shoreline modification solutions.

Technical Effectiveness: The technical effectiveness of restrictions on inappropriate development is dependent on how well the policy is implemented. Florida has found that the use of setbacks has been effective given that existing setback restrictions are strictly enforced. In general, Nordstrom (1992) notes that county governments are typically in a better position to effectively regulate development than municipalities. They have the authority to establish health regulations that may also help preserve or enhance estuarine resources.

Environmental Appropriateness: All of the limitations to inappropriate residential development outlined above would enhance environmentally sensitive and critical areas as well as water quality through the reduction in human pressure on the natural environment.

Legal and Regulatory Acceptability: Limitations to residential development must be balanced with private property rights such that "takings" is not an issue. The Public Trust Doctrine has relevance in this area. Case law is extensive on the issue of taking private property rights in the name of protecting public rights.⁴ A distinction must be made between new residential construction on existing small lots and new land subdivision development. Limitations applied to existing lots are more sensitive to the "takings" issue.

Net Cost of Implementation: Costs of limiting inappropriate shoreline residential development may include lost property tax revenues to the state and lost capital asset value to property owners. Other costs could include administrative and enforcement costs associated with the new or enhanced restrictions. However, such costs must be weighted against the public benefits of natural resource conservation/ preservation.

Socio-political Acceptability: Limits to residential development may be viewed as inappropriate by private property owners. The tradeoff that must be made between economic growth and environmental conservation/ protection is clear in this case. Private property owners may view such policies as reducing the value of their investment. Realtors and contractors may feel that their livelihoods are at stake. Shoreline Administrators, on the other hand, may view such policies as the only reliable method to reduce the negative impacts on natural shorelines. While the technical concepts and terms

The Washington Department of Ecology hosted a symposium on the Public Trust Doctrine, November 18, 1992.

surrounding development limitation policies may be relatively well understood, public involvement and educational programs may be a necessary component to policy implementation.

Ease of Implementation: The technical effectiveness of residential development limitations would depend on how well the policy is actually implemented. If adequately implemented, it is expected that such policies would have significant beneficial impacts on the environment, especially for critical and sensitive areas. Limitations on residential development may not be well received politically. Such policies would have to be evaluated in light of existing state and local laws and regulations including the feasibility of replatting small plots which are inappropriate for residential development. Both public and private parties would face costs of implementation. It is likely that over the long term, public benefits of environmental conservation would outweigh such costs. Finally, the number of stakeholders impacted by limits to inappropriate residential development may be great and their perspectives varied. Coordination among these interested parties would be critical.

Market Incentives to Reduce Inappropriate Residential Development

Some of the management problems associated with coastal erosion are more amenable to influence by economic and market strategies rather than command and control. The principle incentive approaches identified in this study with the potential to reduce inappropriate shoreline residential development include tax credits, transferable development rights, and land acquisition.

Legal and Regulatory Acceptability: The use of tax credits should not result in particular legal or regulatory issues so long as due process is observed and the agency providing the incentive has authority to engage in the financing. Transferable development rights rely on the marketability of such rights. This may require an entirely new land use plan for the jurisdiction in order to establish the units of development and the zone areas. Necessary rezoning may be challenged by property owners. In addition, a small number of land owners may create a monopoly on development rights. This could be avoided by ensuring that all the affected parties are well informed and understand the process and by requiring that anyone who buys the transferable development right has property that is appropriately zoned and regulated through a local SMP.

Net Cost of Implementation: The cost of a tax incentive program is determined by the amount of credit per unit and the number of units to which the tax credit applies. These types of programs can be very costly. Depending upon the specific structure of the incentive program, the program could reduce revenues otherwise received from taxes. Land acquisitions are not frequently used as a means of incentives not to develop since they can be prohibitively expensive. Land acquisition clearly involves substantial up-front capital investment on the part of the institution making the purchase. For example, California's coastline is so expensive that its land acquisition program has had limited success. Maryland uses priority needs criteria to target high hazard or environmentally sensitive lands that need to be acquired as soon as possible. Transferable development rights may also be quite costly due to their heavy administrative demands including staff time and administrative effort. All of these costs must, once again, be weighed against the value of coastal areas preserved in their natural state.

Socio-political Acceptability: Tax incentive programs would likely be successful if the incentive is nearly comparable to the financial benefit from the "less desirable" use. In areas experiencing little development pressure, tax incentives may be effective in preserving natural areas, but in rapid growth areas, the financial benefits gained from development generally are too great to be significantly offset by tax incentive programs. Since most incentive programs such as tax credits are voluntary and represent a relatively non-intrusive method of influencing behavior, they tend to be politically acceptable. However, issues of equity may be raised if the incentive programs go to only a small

segment of the population, especially if that segment is perceived to be disproportionately wealthy and powerful.

Generally speaking, transferable development rights may be an accepted method for balancing private property interests and environmental protection. The influence of transferable development rights on shoreline residential development is sensitive to variations in the market and other external factors leading again to a high degree of uncertainty as to the ability of such policy actions to meet the stated objectives. Available experience indicates that transferable development rights are only partially successful in achieving the target objectives. The success of transferable development rights will be highly dependent on the familiarization of the terms and concepts of such a program and the degree of public participation on the part of affected neighborhood, community, and environmental interest groups.

Land acquisition may be the most effective means of guaranteeing that natural resource areas (including critical and sensitive areas) are able to evolve naturally as with environmental forces overtime. Florida and North Carolina have both received broad public support for acquisition initiatives as a method of protecting critical natural resource areas despite the costs of such public programs.

Ease of Implementation: Tax incentives to preserve undeveloped areas are fairly easy to implement because the appropriate institutional structures are generally in place. Transferable development rights, on the other hand, are often complicated and require significant administrative and management effort. They would partly require rezoning, assessment of property values, and an administrative structure for transferring development rights. They would also require negotiation and coordination of each transfer with both property owners and affected local community. The process of acquiring land can be lengthy and complicated because it involves the transfer of ownership. The use of such programs, however, has met in the past with a fair degree of public support.

6.4.2 Developed Lands

The two policies identified as potentially appropriate for addressing existing residential development issues include the creation of incentive programs for relocating or removing threatened structures and property listing disclosures. The latter is suggested as a means to inform realtors and potential buyers of shoreline property erosion hazards.

Policies for addressing developed land shoreline erosion management issues are complicated in that ESB 6128 provides a clear preference for protecting properties with a residence first occupied prior to January 1, 1992 and is silent on a policy for protecting properties with a residence occupied after this date. Understanding that these property owners of older residences have more options available to them (e.g., to build hard shoreline protection structures), it is envisioned that the policies described in this section would be implemented on a volunteer basis by property owners of these older residences and more strongly encouraged or required of owners of properties with residences occupied after January 1, 1992. These policies could also be described as guidance in state and local government agencies' education and outreach programs.

Incentives for Relocation or Removal of Threatened Structures

Direct financial incentives for property owners to relocate or remove structures away from erosion prone and hazardous areas could be created to reduce the need for shoreline stabilization works.

Technical Appropriateness: Programs that provide incentives for relocating or removing structures from hazardous areas are technically appropriate if applied properly to areas that are truly threatened.

Legal and Regulatory Acceptability: ESB 6128 provides a clear preference for effective erosion control for properties with a residence first occupied prior to January 1, 1992. In these cases, relocation could not be required without a change in legislative policy.

Net Cost of Implementation: Similar to the tax incentive programs discussed above, programs that provide incentives for relocating or removing structures from hazardous areas can be very expensive. Michigan has found, however, that relocation of homes is less expensive in the long run than constructing and maintaining erosion-control structures. Additional benefits associated with reduction in loss of life or property and negative environmental impacts may outweigh program costs.

Socio-political Acceptability: Most incentive programs are voluntary and represent a relatively non-intrusive method of influencing behavior. Therefore, they tend to be politically acceptable.

Ease of Implementation: Incentives to relocate or remove structures are fairly easy to implement because the appropriate institutional structures are generally already in place and given their voluntary nature, tend to be politically acceptable. Reimbursement programs, such as the Upton-Jones Amendment, will require property value assessments and funding allocations. Incentive programs, while costly in the short run, may prove to be less expensive in the long run than constructing and maintaining erosion-control structures.

Property Listing Disclosures

A disclosure of bluff stability and erosion hazards could be required of all property listings. Such information could reduce levels of uncertainty in purchase decision making and potentially reduce future coastal erosion protection needs.

Legal and Regulatory Acceptability: The legal and regulatory acceptability of property listing requirements is uncertain. Given that other states implement such programs, it appears that they are feasible. However, property listing requirements in Washington may require legislative authorization.

Net Cost of Implementation: A coastal property disclosure statement should not imply significant additional costs. If properly implemented, a property listing disclosure could provide significant benefits in terms of reduced need for potentially costly and environmentally detrimental shoreline protection works.

Socio-political Acceptability: A coastal property disclosure statement is intended to provide potential buyers of shoreline property with information on site characteristics and the level of risk associated with potential storm or erosion hazards. Such a program should be politically acceptable unless sellers of shoreline property feel that such disclosures will impede and add unwarranted transaction costs to the sales process.

Ease of Implementation: A disclosure program should be fairly easy to implement because institutional structures are generally already in place. That is, a disclosure requirement would only involve addition of a simple document to the standard sales/purchase contract process and provide potential large net benefits to the public and future property purchases.

6.5 Strategies for Combining Policies

Combining some subset of the policies described above may, in many cases, be the strategy the state or a local jurisdiction chooses. Designing a strategy for combining policies will depend on the goals and objectives of the agency (state or local). Moreover, strategies could be selected and implemented as part of a multi-agency coordination effort. Examples of strategies for combining policies include combining soft and moderate hard solutions for protecting shorelines, combining the use of setbacks with the required use of soft solutions, and combining coordinated environmental impact reviews with the use of a modified application form.

6.5.1 Technical Effectiveness

The ability of combination policies to meet the short- and long-term objectives of coastal erosion management will depend not only on the type of actions involved but the interactions between alternatives. Combination policies will require a high degree of scientific and engineering expertise and fine tuning. In the case of down drift beach enhancement, the method and timing of the placement of materials is critical. In addition, there exists the practical problem of obtaining necessary materials. However, examples such as the Massachusetts and Florida limited design requirement actually serve to enhance natural shoreline processes. Low bulkheads and bank nourishment enable upland materials to feed drift cells during large storms, thus allowing natural shorelines to respond uniformly.

6.5.2 Environmental Appropriateness

The environmental appropriateness of combination policies is highly uncertain. It depends in large part on the alternatives chosen and the conditions under which they are used. If used appropriately, combination policies can be more environmentally appropriate than using one solution (e.g., hard) in isolation.

6.5.3 Legal and Regulatory Acceptability

The use of combination policies will have no distinct legal and regulatory conflicts.

6.5.4 Net Costs of Implementation

Generally, the costs and benefits of combination policies should be similar to their component parts. In the case of combined hard and soft solutions, however, there may be some additional costs associated with enforcement of property owner's application of soft materials when required.

6.5.5 Socio-political Acceptability

Combination policies should meet with limited socio-political opposition given they are by nature often a compromise solution.

6.5.6 Ease of Implementation

There may be practical problems with applying strategies that combine policies. Problems in combining hard and soft solutions noted by Terchunian (1988) include obtaining the source material, cost of the material, method and timing of placement of material, political will, and scientific and engineering fine tuning. Two states interviewed have found these potential hurdles to be outweighed by the policies' benefits (O'Connell and Green, 1993).

6.6 Policy Support Tools

Policy support tools are intended to enhance policy implementation. Among the support tools identified as potentially appropriate and effective in addressing coastal erosion management are research, monitoring and data collection programs, and education and public outreach programs.

6.6.1 Research, Monitoring, and Data Collection Programs

Research, monitoring, and data collection are essential to understanding physical and biological processes occurring in environmentally sensitive and critical areas. Research, monitoring, and data collection programs could include updating baseline maps and inventories and integrating such data with development and land use patterns. Basic research on full drift cells, erosion rates, and the monitoring of modification solution impacts would also be valuable. Given limited funding, it may be appropriate for local jurisdictions to first target drift cells that are subject to increasing development.

Technical Effectiveness

A well-designed research and monitoring program will help fill in existing data gaps and subsequently lead to more technically effective approaches to coastal erosion protection.

Environmental Appropriateness

In order to protect environmentally sensitive and critical areas and water quality, it is necessary to assess resource baseline conditions. Research and monitoring will help fill in existing ecological and biological data gaps, leading to the selection of coastal erosion management strategies that are more environmentally sensitive.

Legal and Regulatory Acceptability

There are no particular legal or regulatory issues related to research or monitoring programs.

Net cost of Implementation

The cost of research, monitoring, and data collection programs are dependent on the scope and detail of the project. Initial mapping and inventory studies may be costly but the subsequent monitoring programs may be relatively inexpensive. Early research and monitoring programs can be established on a limited scale to limit initial program costs and allow for further refinement of priority data needs. The value of the information provided by such programs may be significant.

Socio-political Acceptability

Research, monitoring, and data collection are frequently viewed as having few substantial political implications. However, such programs are often considered less pressing than more immediate, action

oriented programs. As a result, such programs are often not funded because of budgetary constraints and the relatively long-term nature of the programs.

Ease of Implementation

Research, monitoring, and data collection programs require staff and financial resources over an extended period, thus it is critical that priority data gaps are addressed first. Given necessary funding and available staff time, such programs, generally meet with limited legal or socio-political opposition.

6.6.2 Education and Outreach Programs

Education programs may be instituted to provide information to property owners, engineers/consultants, insurance writers, realtors, property appraisers, and county commissioners. Programs could include workshops, seminars, grass roots education and outreach programs, written materials and demonstration projects. Program topics could focus on: how to distinguish between episodic event erosion and average annual erosion rates; how to distinguish between unstable bluff failure and coastal erosion; implications of the use of soft over hard shoreline modification solutions; how drift cells work; how particular methods of shoreline modification can affect a drift cell; why coordination among drift cell stakeholders is encouraged; and actual jurisdiction policies for evaluating shoreline modification alternatives. Finally, a method of coordinating stakeholders (public and private) could be established to provide a forum for enhancing the understanding of the cumulative impacts and drifts cell processes and ensuring that all concerns are considered.

Legal and Regulatory Acceptability

There are no particular legal or regulatory problems associated with the implementation of education and outreach programs.

Net Cost of Implementation

The costs of implementing education and outreach programs will probably be moderate, involving staff time for either the development and distribution of information materials or the implementation of public workshops and seminars. Michigan found that by helping property owners protect their homes before storm damage occurred, costs for repairing the damage were avoided. Furthermore, the total cost of the emergency program was reduced. In addition to such cost savings, there are uncertain but probable long-term benefits from such programs as a result of public behavior modification and subsequent reduction in the loss and/or degradation of coastal natural resources.

Socio-political Acceptability

There should be little political opposition to education and outreach programs since they are voluntary, by no means regulatory, and do not represent a change in policy. However, the lack of short-term benefits may be an impediment to gathering support (financially and ideologically) for such programs. Education and outreach programs can not guarantee a significant change in the general public's perception of the risk posed by coastal erosion and subsequent desire to protect shoreline properties. However, such programs may result in beneficial modifications to property owner behavior and support for new policies addressing erosion. Education and outreach may lead to heightened awareness about negative impacts of shoreline protection against coastal erosion on critical and sensitive areas and water quality. As a result, such programs may lead to increased conservation/preservation of these natural resources without the need for command and control type strategies.

Ease of Implementation

The design and implementation of education and public outreach programs require a concerted staff time and effort, other resources, and funds. The lack of discernible short-term benefits may make it difficult to justify the allocation of funds for such programs.

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Appendix A Coastal Erosion Questionnaire

Reproduced here is the questionnaire circulated to local government staff, resource managers, representatives of NGOs (non-governmental organizations), and the general public. Table A1 summarizes responses to the questionnaire.

Recipients of the questionnaire were asked to 'respond where appropriate - even if you are not an official planner or manager.'

1. Does your jurisdiction have a comprehensive policy addressing coastal erosion and coastal hazard issues? Y N Comment:

If so, does this policy adequately address your needs as a planner given the coastal environments with which you are concerned? Y N Comment:

2. Are structural remedies the primary method used to address coastal erosion and hazard issues in your region? Y N Comment:

Are soft methods such as beach nourishment and stabilization with vegetation employed?
 Y N Comment:

3. What percentage of your waterfront area has been armored or stabilized for industrial purposes?

What percentage of your waterfront area has been armored for residential structure protection?

4. Has your jurisdiction experienced the loss of any structures or developed property due to erosion or other coastal hazards within the past 15 years? Y N Comment:

How many instances?

Were any of these structures or properties insured through FEMA/FIA? Y N Comment:

What was their estimated value?

5. Does your jurisdiction currently employ a coastal setback policy? Y N Comment:

Is this policy linked to coastal erosion rates? Y N Comment:

To potential recession and bluff failure due to coastal hazards? Y N Comment:

6. Does your jurisdiction have any structures currently threatened by coastal erosion or coastal hazards. Y N Comment

7. Does your jurisdiction employ incentives for the removal of structures endangered by coastal hazards? Y N Comment:

8. Does your jurisdiction grant exceptions to coastal development restrictions in coastal hazard zones? Y N Comment:

How frequently?

Do you perceive these exceptions as a potential problem? Y N Comment:

If so, within what time frame?

9. Do you confer with planners from neighboring or regional jurisdictions when planning coastal erosion or hazard management programs? Y N Comment:

10. Is management of shoreline areas in your jurisdiction accomplished on a property by property basis? Y N Comment:

How are adjacent property owners notified when permits are applied for?

11. Is consideration of feeder bluffs, down-drift beaches, and other off-site impacts during permit reviews for beach armoring structures mandatory? Y N Comment:

12. Does your jurisdiction have a public education program addressing bluff instability, shoreline erosion, and other coastal hazards? Y N Comment:

13. How often are waterfront properties in your jurisdiction reviewed for zoning violations?

(The following questions are optional)

Jurisdiction:

Title and Signature:

Table A1 Response to Questionnaire

Category	Number Sampled	Number of Responses
Federal Agency	18	2
Washington State Agency	39	7
City/County Planner or Administrator	61	20
Tribal Government	14	4
Academic	17	5
Engineer/Consultant	28	3
Marine Contractor	3	0
NGO Environmental	9	0
NGO Industry	1	0
General*	33	3
TOTAL	223	44
* Includes coastal property owners and others		

Appendix B Individuals Interviewed: Washington State

Jack Allingham, Bremerton Department of Community Development
Rene Beam, Kitsap County Department of Community Development
Grant Beck, Clallam County Department of Community Development
Robert Campbell, Property Owner, Bainbridge Island
Doug Canning, Washington State Department of Ecology
Andrew Driscoll, Property Owner, Bainbridge Island
Robert Garwood, Burien Department of Planning
Roger Geibelhaus, Thurston County Planning Department
Ed Good, Whatcom County Hearing Examiner
Bob Goodwin, Washington Sea Grant
Oscar Graham, Skagit County Planning Department
Donald Meehan, Washington State University Beach Watchers
Phyllis Meyers, Suquamish Tribe
Grace Miller, Mason County Department of General Services
Mike Morten, Island County Planning Department
Robert Ruth, Des Moines Planning Department
Hugh Shipman, Washington Department of Ecology
Russell Trask, Bainbridge Marine Services, Bainbridge Island
Kay Wilson, Bremerton Department of Community Development

Appendix C Individuals Interviewed: Other State and Federal Agencies

Jeff Benoit, Massachusetts Executive Office of Environmental Affairs

Steve Benton, North Carolina Division of Coastal Management

Tina Bernd-Cohen, Florida Coastal Zone Management Program

David Brownee, Calvert County Department of Planning and Zoning

Evan Brunson, North Carolina Coastal Zone Management Program

Phil Flood, Property Owner, Florida Department of Natural Resources

Kirby Green, Florida Department of Environmental Protection

Gary Griggs, Marine Science Division, University of California, Santa Cruz

Scott Hardaway, Virginia Institute of Marine Sciences

Martin Jannereth, Michigan Coastal Zone Management Program

Ralph Kantrel, Florida Coastal Zone Management Program

Joseph T. Kelly, Department of Geological Sciences, University of Maine

Jordan Loran, Maryland Department of Natural Resources, Shore Erosion Control Program

Dave McKinney, Office of Coastal Resource Management

Eric Nelson, U.S. Army Corps of Engineers

Jim O'Connel, Massachusetts Executive Office of Environmental Affairs

Vincent Pito, Maryland Coastal and Watershed Resources Division

Chris Schafer, Michigan Coastal Zone Management Program

Stuart Stevens, Georgia Coastal Zone Management Program

Acronyms

CBRA	Coastal Barrier Resources Act
CZMA	Coastal Zone Management Act
Ecology	Washington Department of Ecology
GMA	Growth Management Act
Guidebook	Washington State Department of Ecology Administrators' Manual, Handbook, and the Urban Waterfront Policy Analysis Addenda
HPA	Hydraulic Project Approval
NFIP	National Flood Insurance Program
OHWM	Ordinary High Water Mark
SEPA	State Environmental Policy Act
SMA	Shoreline Management Act
SMPs	Shoreline Master Programs

