PLANNING FOR NATURAL HAZARDS:

Coastal TRG

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Oregon Department of Land Conservation & Development

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Section 1:
Introduction to the Coastal Technical Resource Guide

Coastal hazards include: ocean flooding, beach and dune erosion, dune accretion, bluff recession, and landslides. Human activities can contribute to and increase the severity of hazards, and coastal communities in Oregon must know what hazards they are subject to and be prepared to address them. The purpose of this guide is to help planners, local decision-makers, and community leaders reduce risk to life and property from coastal hazards. The guide is designed to help your local government address coastal hazard issues through effective comprehensive plan inventories, policies and implementing measures.

1.1 The Threat of Coastal Hazards to Oregon Communities

Coastal communities are subject to a variety of life threatening geologic and climatic hazards. Nationally, weather related losses from hurricanes and other storms cause billions of dollars in damage and many deaths each year. Chronic erosion, landslides and flooding all result from an annual barrage of wind and waves driven by storms battering the Oregon Coast, causing ever-increasing property damage and loss. Geologic hazards, such as offshore subduction zone earthquakes and the resulting tsunamis, occur on the Pacific Coast and can have catastrophic impacts on coastal communities' residents and infrastructure. There is no location on the Oregon coast that is immune to coastal hazards.

Population changes on the coast and development pressures have led to construction in hazard areas, and the most desirable locations are often the most at risk. The economic impacts of natural disasters on businesses, private citizens, the public sector, and infrastructure can be quite significant. Storm damage to infrastructure in Oregon results in significant long-term costs due to road closures, lost business and reduced services.[1] By regulating development in areas of known risk, communities can better protect life, property and economic livelihood.

Tip Box

Organization of the Natural Hazards Technical Resource Guide

The Natural Hazard Technical Resource Guide consists of eight chapters. The three preliminary *Planning for Natural Hazards* chapters include hazard-related information on reviewing your comprehensive plan, the elements of a comprehensive plan, and legal issues. Reviewing your comprehensive plan gives your community an opportunity to assess the adequacy of its existing natural hazard inventories and policies. The five hazard-specific chapters then provide detailed information on flood, landslide, coastal, wildfire, and seismic hazards. Appendices include information on Goal 2,7,17 and 18, a resource directory and a land use tools matrix for hazard mitigation.

1.2 How to Use the Coastal Technical Resource Guide:

The Coastal Technical Resource Guide provides information to help communities in Oregon plan for coastal hazards. Each section heading asks a specific question to help direct you through information related to strengthening your comprehensive plan's factual base, policies and implementing measures. This guide also contains numerous references and contacts for obtaining additional information about coastal hazards.

Section 2:
Is Your Community Threatened by Coastal Hazards?

Section 2 presents an overview of the causes and characteristics of coastal hazards, and provides information to assist communities in coastal hazard identification.

Section 3:
What are the Laws in Oregon for Coastal Hazards?

Section 3 summarizes current laws that Oregon communities are required to address for coastal hazards.

Section 4:
How can Your Community Reduce Risk from Coastal Hazards?

Section 4 describes evaluation techniques for the development review process and hazard mitigation methods to help communities reduce risk from coastal hazards.

Section 5:
How are Oregon Communities Addressing Coastal Hazards?

Section 5 examines how three Oregon communities are reducing risks from coastal hazards. These examples illustrate plan policies and implementing measures for coastal hazards.

Section 6:
Where can Your Community find Resources to Plan for Coastal Hazards?

Section 6 is a resource directory listing contacts, programs, and documents that planners, local governments and citizens can use to get more information on coastal hazards.

Section 2:
Is Your Community Threatened by Coastal Hazards?

Identifying hazard areas is a key step in developing effective plan policies and implementing measures. This section assists local planners and decision-makers in understanding how coastal hazards may affect current and future development. An overview of the causes and characteristics of coastal hazards, and information on identifying coastal hazards in your community is also included.

2.1 What are Coastal Hazards?

The Oregon coastal zone is subject to the same natural hazards that exist in non-coastal regions: flooding, landslides resulting from slope instability, forest fires, and earthquakes. In addition, a variety of processes at work in the near-shore zone present hazards that are unique to coastal areas. These include coastal flooding from storm surges or tsunamis, periodically high rates of beach erosion, and mass wasting of sea cliffs due to wave attack and geologic instability. These processes can interact in complex ways, increasing natural hazard risk in coastal areas.

2.2 How are Coastal Hazards Classified?

Natural hazards that affect coastal regions can be divided into two general classes - chronic and catastrophic.

> *Chronic hazards* are those we can see clear evidence of along the shore – beach, dune, and bluff erosion, landslides, slumps, gradual weathering of sea cliffs, and flooding of low-lying lands during major storms. The damage caused by chronic hazards is usually gradual and cumulative. The regional, oceanic and climatic environments that result in intense winter storms determine the severity of chronic hazards along the coast.
>
> *Catastrophic hazards* are regional in scale and scope. Cascadia Subduction Zone earthquakes, and the ground shaking, subsidence, landsliding, liquefaction, and tsunamis that accompany them are catastrophic hazards.

Chronic hazards are local in nature, and the threats to human life and property that arise from them are generally less severe than those associated with catastrophic hazards. However, the wide distribution and frequent occurrence of chronic hazards makes them a more immediate concern.

Oregon coastal communities should focus planning efforts on the chronic coastal hazards of flooding, erosion and landslides. Due to the relative infrequency of catastrophic events, this guide does not provide detailed evacuation plans or other information to assist in planning for catastrophic hazards. The coastal guide does provide information on the occurrence of coastal earthquakes and tsunamis.

Tip Box

Hazard Inventories

Oregon Statewide Planning Goal 2 requires cities and counties to develop a factual base (including inventories) as part of their comprehensive plans. Statewide Planning Goal 7 requires communities to inventory known hazards. Inventories contain facts about land use, natural resources, public facilities and development trends within the planning area, and provide the basis for comprehensive plan policies. Inventories must be periodically updated to reflect the best current information about resources, trends and local conditions that would affect plan decisions.

TRG Key

More information on tsunamis and seismic events can be found in the Seismic Hazard Technical Resource Guide.

Sidebar

Sand Inundation

The concepts of sand supply and the sediment budget involve viewing a given segment of shoreline in terms of the positive or negative transfers of sediment that occur within it. The resultant balance of the sediment budget is determined by comparing the volume of sediment gained from sources (positive transfers) to the volume lost to sinks (negative transfers). A negative balance means that more sand is leaving than is arriving and, as a result, that segment of shoreline is eroding. Conversely, a positive balance means that more sand is arriving than is leaving so that the segment of shoreline is expanding. Along the Oregon coast, potential sources of sand include rivers, bluffs, dunes, and the inner shelf. Potential sinks include, bays, dunes, offshore dredging, and mining.

Attention is often focused on the effects of beach and dune erosion. Yet, there are segments of Oregon's coast where the principal dilemma is too much sand deposition. These areas tend to be located at the north ends of headland-bounded segments of shoreline. While growth in the height and width of the foredune in these areas has enhanced ocean flood/erosion protection potential, the rapid and heavy sand accumulation has also resulted in the inundation of dwellings, restriction of ocean views, and loss of beach access.[5]

2.3 What are the Conditions that Contribute to Coastal Hazards?

Wave attack and *mass wasting* are short term, chronic events resulting in coastal flooding, erosion, and landslides. These natural events operate over relatively short time periods in limited geographic areas and affect shoreline stability. *Human activities* also produce conditions that contribute to coastal hazards.

Factors Affecting Shoreline Stability

Wave attack, mass wasting and human activities are factors that operate across a broad range of geographic areas and time frames. Figure 1 illustrates the distinction between long-term trends and short-term events affecting shoreline stability and should be used as a reference to illustrate the information provided in this section. Because the main factor(s) affecting shoreline stability vary from setting to setting, it is useful to make a distinction between *dune-backed*, *bluff-backed*, *slide-backed*, and *inlet-affected* segments of shoreline.

2.3.1 Wave Attack

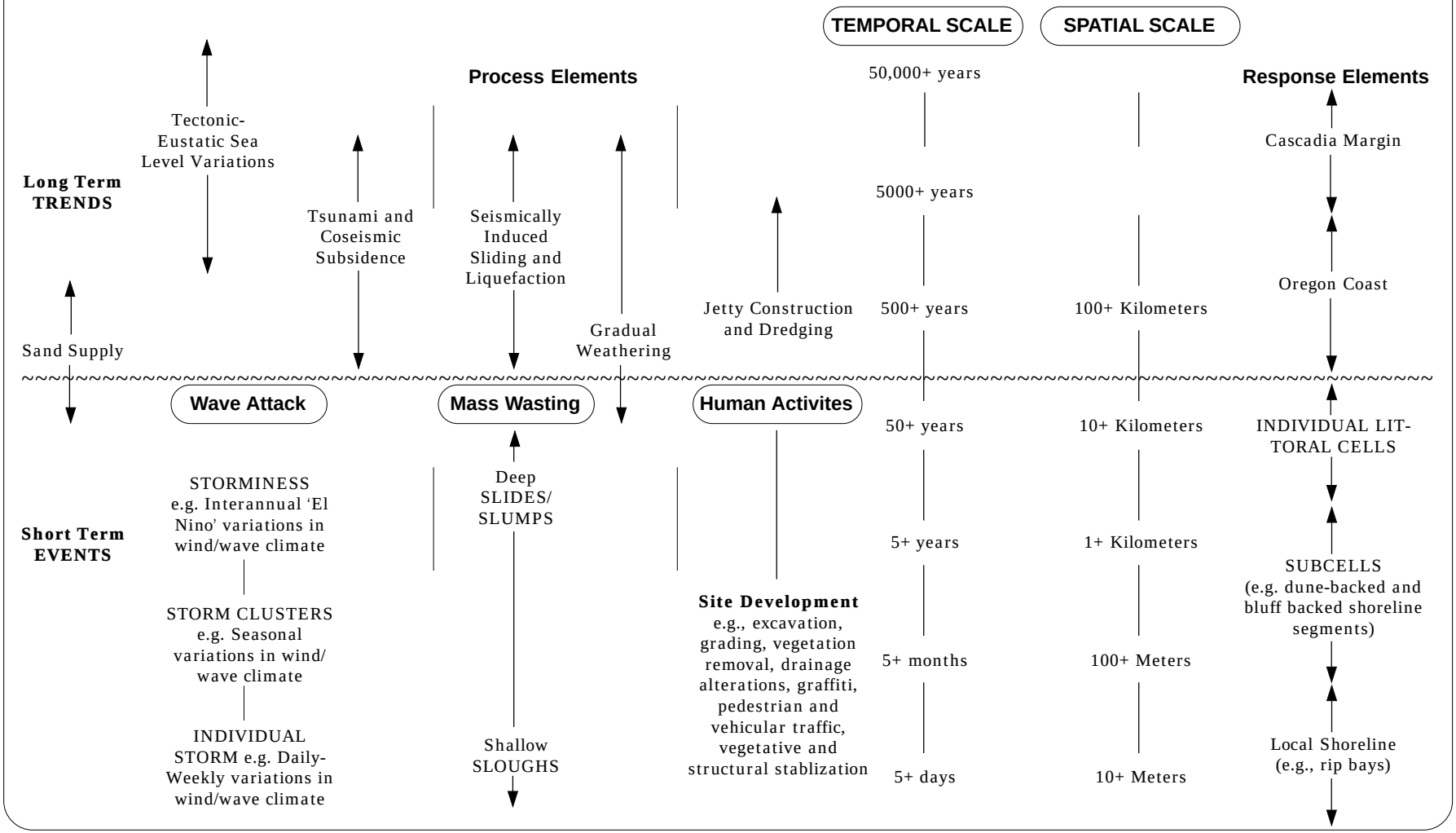
Along dune-backed shorelines, processes of wave attack, including *wave overtopping* (e.g., flooding) and *undercutting* (e.g., erosion), are the primary processes affecting shoreline stability. Ocean flooding occurring during storms is seen at the shoreline as wave runup, and results from the simultaneous occurrence of long-term water level elevations and short-term storm events.

Wave Attack

DLCD Coastal Division

Because winds and waves tend to arrive from the southwest during the winter and from the northwest during the summer, Oregon coast littoral cells (defined later in this section) generally exhibit a seasonal reversal in the direction of sand trans-

Figure 1: Factors Affecting Shoreline Stability along the Oregon Coast



Source: *Shoreland Solutions. Chronic Coastal Natural Hazards Model Overlay Zone. Salem, Ore.: Oregon Department of Land Conservation and Development (1998) Technical Guide-3.*

port along the shoreline. Specifically, net sand transport tends to be offshore and to the north in winter and onshore and to the south during the summer. El Nino events have been shown to exaggerate the characteristic seasonal pattern of erosion and accretion. For example, significant short-term variation in shoreline extent and location has been associated with the 1982-83 and 1997-1998 El Nino events.[2]

The processes of wave attack significantly affect shorelines characterized by indentations, known as inlets. Wave attack processes interact with ocean tides and river forces to control patterns of inlet migration. Recent examples of the importance of inlet dynamics are the Bayshore Spit at Waldport and the Netarts Spit near Oceanside.

2.3.2 Mass Wasting

Along bluff-backed and slide-backed shorelines, processes of mass wasting affect shoreline stability. Mass wasting refers generally to a broad range of gravity-driven rock, soil, or sediment mass movements. This includes weathering processes that result in gradual bluff recession, such as direct wind and rain impact. For the purposes of this guide, the term mass wasting refers to episodic slope movements also known as landslides. The distinction between mass wasting in bluff-backed and slide-backed shorelines results from differences in the scale of slope movement. Simple surface *sloughing* is the dominant process along bluff-backed shorelines. Complex deep-seated *landsliding* and *slumping* are the dominant processes along slide-backed shorelines. Landslides move in contact with the underlying surface and can include rockslides – the downslope movement of a rock mass along a plane surface. Slumps are the sliding of material along a curved (rotational slide) or flat (translational slide) surface.[3]

Mass Wasting

DLCD Coastal Division

A number of factors affect slope stability by acting to increase driving forces and/or reduce resisting forces. The geologic composition of the bluff is a primary control on slope stability. Headlands, generally composed of basalt, while not immune to mass wasting, do not readily give way. In contrast, soft bluff-forming sandstone and mudstone are highly susceptible to slope movement. Prolonged winter rains saturate these porous bluff materials, both loading the slope and lowering cohesive strength to further decrease slope stability. The geometry and structure of bluff materials also affect slope stability by defining lines of weakness and controlling surface and subsurface drainage. By removing sediment from the base of bluffs and by cutting into the bluffs themselves, processes of wave attack may also affect slope stability. The extent to which the beach fronting the bluff acts as a buffer is important in this regard.[4]

2.3.3 Human Activities

Human activities affect the stability of all types of shoreline. Large-scale human activities such as jetty construction and maintenance dredging are factors that affect shoreline stability for longer time periods and larger geographic areas. This is particularly true along dune-backed and inlet-affected shorelines. Cumulative effects of shoreline hardening and specifically, the planting of European Beachgrass, have markedly affected shoreline stability along dune-backed shorelines of the Oregon coast.

Examples of human activities that affect shoreline stability over shorter time periods and smaller geographic areas include those associated with residential and commercial development. Activities such as grading and excavation, surface and subsurface drainage alterations, vegetation removal, and vegetative as well as structural shoreline stabilization can all affect shoreline stability. With the exception of the latter two, these activities tend to be a particular concern along bluff-backed shorelines. Pedestrian and vehicular traffic, typically associated with heavy recreational use, are other types of human activities that affect shoreline stability over shorter time and smaller space scales. Because these activities may result in the loss of fragile vegetative cover, they are a particular concern along dune-backed shorelines. Along bluff-backed shorelines graffiti carving associated with heavy recreational use can be added to the list of human activities that affect shoreline stability.[6]

Tip Box

Tsunami Inundation Zones

Under the authority of ORS 516.090, the Department of Geology and Mineral Industries (DOGAMI) has mapped tsunami inundation zones in coastal communities. The maps should be used by local governments for the purpose of developing evacuation routes and to identify areas where the development of certain critical and essential facilities, and major structures are restricted in accordance with ORS 455.446 and 455.447 (refer to Section 3's examination of Oregon Building Codes in this guide). Local governments can work with DOGAMI to create maps and develop evacuation routes. A listing of DOGAMI maps is included in Section 2 of the Seismic Technical Resource Guide.

2.4 What are the Causes of Catastrophic Coastal Hazards (Earthquakes and Tsunamis)?

Earthquakes and the resulting tsunamis occur over larger geographic areas and time frames than chronic coastal hazards. Although not as frequent in occurrence, the damage caused by these catastrophic events is immediate and life threatening.

Subduction zone earthquakes off Oregon's coast can be generated along the sloping boundary between the descending Juan de Fuca plate and the North American plate. This area — known as the Cascadia Subduction Zone — could produce an earthquake of magnitude 8.0 to 9.0, or greater. An earthquake of this size would cause enormous damage to the coast and large portions of Western Oregon. In many areas, especially on the coast, liquefaction and landslides could damage buildings and their foundations, destroy bridges and cause massive loss of life. A subduction earthquake could last as long as four minutes.[7]

Recently, a great deal of attention has been given to Cascadia Subduction Zone earthquake events. Summarizing the work of a number of investigators, DOGAMI (1995) suggests that the Oregon coast could experience a magnitude 8 or 9 earthquake in the near future. Specifically, they report that there is a 10 percent to 20 percent chance that such an earthquake event could occur in the next 50 years. Geologists, by studying a series of buried wetland soils and trees, discovered that earthquakes of this magnitude occur on average once every 500-600 years, with some gaps between events as little as 200 years and as large as 1,000 years. Analysis of detailed Japanese records (spanning over 400 years) on damage-causing tsunamis suggests that the last Cascadia Subduction Zone earthquake was a magnitude 9 event that occurred at about 9:00 P.M. on January 26, 1700.[8] This is consistent with Native American legends, which say the earthquake occurred on a winter night.[9]

Such an event would produce more than just ground shaking damage. Earthquake induced liquefaction, landsliding, subsidence and tsunami events would also occur. A generalized scenario of such an event includes the following. At the onset, the great subduction earthquake produces severe ground shaking which could last as long as four minutes. During this time, amplification and liquefaction effects occur in areas of unconsolidated, saturated sediment. Massive ancient landslides are reactivated. Rapid, coast-wide subsidence on the order of two to six feet also occurs in association with the release of accumulated strain during the earthquake. Although flooding associated with subsidence would occur immediately in some low-lying areas, the effects of subsidence are more likely to be manifest over the long term as increased flooding and coastal erosion during storms. This scenario is further complicated by the likely occurrence of locally generated tsunamis expected to arrive within 5 to 40 minutes after the initial earthquake and to continue to arrive at intervals over a period of several hours. Shorelines of bays, estuaries, and low-lying sand barriers would experience immediate flooding and erosion.[10]

2.5 How are Coastal Hazards Identified?

Standardized coastwide mapping (1"=1 mile) and assessment of coastal natural hazards was conducted in 1973 by the state's principal hazard research agency, the Department of Geology and Mineral Industries (DOGAMI). Since then, most counties and cities have prepared more detailed hazard assessments for comprehensive land use planning. There have also been other hazard studies for dune management and development site planning or shore protection. FEMA has mapped flood hazards, including oceanfront "velocity" zones. DOGAMI has also mapped tsunami "run-up" zones for coastal areas. There have been significant advances in understanding coastal hazards and processes through research on beach erosion, sea cliff recession, and the impacts of shore protection structures. This research produces information which can enhance existing hazard inventories.

2.5.1 Flood Maps

Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies are also often used in characterizing and identifying flood-prone areas.

TRG Key

For more information on flood maps see Section 2 of the Flood Technical Resource Guide.

The Flood Insurance Studies and FIRMs produced for the National Flood Insurance Program provide assessments of the probability of flooding at a given location. Water surface elevations are combined with topographic data to develop FIRMs. FIRMs illustrate areas that would be inundated during a 100-year flood. In some cases, FIRMS also include floodway areas, elevations marking the 100-year-flood level (the base flood elevation or BFE) and areas located within the 500-year floodplain.[11] FIRMs delineate Special Flood Hazard Areas, or floodplains where National Flood Insurance Program regulations apply.

FEMA conducted many Flood Insurance Studies in the late 1970s and early 1980s. These studies and maps represent flood risk at the point in time when FEMA completed the studies. They do not reflect changes within the study area that might affect flooding since the studies.

2.5.2 Littoral Cells

Headlands divide the Oregon coast into compartments that form ideal planning and scientific boundaries. Basalts deposited some 15 to 45 million years ago form the resistant headlands on the Oregon coast. These prominent features restrict longshore transport of sediment and thereby define discrete segments of shoreline, also known as littoral cells. Twenty-one littoral cells have been identified along the Oregon coast.

Littoral Cells and Planning

A littoral cell management plan is a comprehensive, integrated, area-wide hazard management strategy unique to different physical and social settings found along the Oregon coast. It is focused on the reduction of risk to new and existing oceanfront development from chronic coastal natural hazards. A littoral cell management plan should include: littoral cell inventories, a chronic hazards manage-

ment strategy, and implementing mechanisms. For detailed information contact the Department of Land Conservation and Development (see Section 6) for a copy of Littoral Cell Management Planning along the Oregon Coast.

2.6 Summary: Identifying Coastal Hazards in Your Community

Communities can identify coastal hazard locations by knowing the geologic and geographic factors of their environment, and through mapping and inventories.

Progress is being made by the DLCD and other agencies to increase assistance to communities in developing inventories based on sound technological research. While this process takes significant time to complete, there are a variety of strategies communities and state agencies can use to improve their inventories:

- ❒ *Establish criteria and standards* for collecting, reporting, and mapping information about chronic and catastrophic coastal natural hazards.
- ❒ *Inventory and catalog* existing coastal natural hazards studies, maps, digital data, and other information available from city, county, state, federal, university, private, and other resources.
- ❒ *Develop standardized coastal hazard maps* for priority areas along the Oregon Coast.
- ❒ *Fund basic and applied research* on chronic coastal hazards based on: alternative shore protection methods, effects of hard shore protection structures, near-shore circulation processes and sediment budgets, sea cliff erosion processes, and other hazard processes.[12]

TRG Key

The first step of hazard assessment is hazard identification, estimating the geographic extent, intensity and occurrence of a hazard. More information on the three levels of hazard assessment can be found in Chapter 2: Elements of a Comprehensive Plan.

Planning for Natural Hazards: Reviewing your Comprehensive Plan

The factual base of your community's comprehensive plan should reflect a current inventory of all natural hazards and a vulnerability assessment. The inventory should include a history of natural disasters, maps, current conditions and trends. A vulnerability assessment will examine identified hazards and the existing or planned property development, current population, and the types of development at risk. A vulnerability assessment will set the foundation for plan policies.

Your community should ask the following questions in determining whether or not your comprehensive plan has adequately inventoried coastal hazards.

- ❒ Are there coastal hazards in your community?
- ❒ Does your comprehensive plan hazard inventory describe coastal hazards in terms of the geographical extent, the severity and the frequency of occurrence?
- ❒ Has your community conducted a community wide vulnerability assessment?

Section 3:
What are the Laws in Oregon for Coastal Hazards?

Oregon communities have a statutory mandate to develop comprehensive plans and implementing ordinances. As a part of the comprehensive planning process, cities and counties must address areas with "known" natural hazards. This section of the Coastal Technical Resource Guide presents laws that Oregon communities are required to address.

3.1 Oregon Laws Related to Coastal Hazards

3.1.1 Goal 7: Areas Subject to Natural Disasters and Hazards

Goal 7 is the Statewide Planning requirement that directs local governments to address natural hazards in their comprehensive plans. Goal 7 states that "Developments subject to damage or that could result in loss of life shall not be planned or located in known areas of natural disasters and hazards without appropriate safeguards. Plans shall be based on an inventory of known areas of natural disasters and hazards..."

3.1.2 Goal 17: Coastal Shorelands

The purpose of Goal 17 is to conserve, protect, develop, and where appropriate, restore the resources and benefits of all coastal shorelands. In addition, Goal 17 aims to reduce the risks to human life and property. Goal 17 provides for the protection of major marshes, significant wildlife habitat, coastal headlands, and exceptional aesthetic resources included in community inventories.

Coastal shoreland *inventories* are required to identify and provide information on the nature and location of areas subject to geologic and hydrologic hazards within the designated coastal shorelands planning area. These areas include lands subject to ocean flooding and within 100 feet of the ocean shore or within 50 feet of an estuary or coastal lake, and adjacent to areas of geologic instability related to or impacting a coastal water body.

Goal 17's implementation requirements include:

- Development of special practices by the Department of Forestry to protect and maintain the coastal shoreland;
- Identification of shoreland areas that shall be protected to fulfill the mitigation requirement of the Estuarine Resources Goal;
- Maintenance of riparian vegetation;
- Land use management practices and non-structural solutions to problems of erosion and flooding are preferred to structural solutions; and
- Local government and the Oregon Parks and Recreation Department (OPRD) will work to increase and retain public access.

3.1.3 Goal 18: Beaches and Dunes

Goal 18 is designed to conserve, protect, where appropriate develop, and where appropriate restore the resources and benefits of coastal beach and dune areas. The goal also aims to reduce the hazard to human life and property from natural or man-induced actions associated with these areas. Coastal areas subject to this goal include beaches, active dune forms, recently stabilized dune forms, older stabilized dune forms and interdune forms.

Uses shall be based on the capabilities and limitations of beach and dune areas to sustain different levels of use or development, and the need to protect areas of critical environmental concern, areas having scenic, scientific, or biological importance, and significant wildlife habitat as identified through application of Goals 5 and 17.

TRG Key

Goals 2, 7, 17 and 18 can be found in Appendix A of the Natural Hazards Technical Resource Guide.

Inventories are required to identify and designate beach and dune uses and policies. The inventories describe the stability, movement, groundwater resource, hazards and values of the beach and dune areas. These areas include beaches, dune and interdune forms.

Goal 18's implementation requirements include the following.

- Decisions on coastal plans will be based on specific findings.
- Local governments, and state and federal agencies shall prohibit developments on active foredunes, dune areas subject to ocean undercutting and wave overtopping, and interdune areas subject to ocean flooding.
- State and local agencies will regulate actions within these areas to minimize erosion and groundwater drawdown. Foredunes shall be breached only to replenish sand supply in interdune access areas and only if breaching and restoration after breaching is consistent with sound principles of conservation.
- Local governments are required to identify areas that were developed prior to January 1, 1977. Only these properties are eligible for permits to have beachfront protective structures.

Goal 18's guidelines suggest that local governments adopt strict controls for carrying-out implementation requirements for evaluating beach and dune plans. These controls should include: the requirement of a site investigation report financed by the developer, the posting of performance bonds to assure that adverse effects of development can be corrected, and the requirement of re-establishing vegetation within a specific time.

Foredune grading needs to be planned for on an area-wide basis because the geologic processes of flooding, erosion, sand movement, wind patterns, and littoral drift affect entire stretches of shoreline. Dune grading cannot be carried-out effectively on a lot-by-lot basis because of area-wide processes and the off-site effects of changes to the dunes.

3.1.4 Ocean Shore Regulation

The Oregon Parks and Recreation Department (OPRD) is responsible for protecting the scenic, recreational, and natural resource values of the Oregon coast. OPRD accomplishes this through an extensive permitting program for shoreline protection under the authority of The Ocean Shore Law (ORS 390.605 – 390.770), also known as the "Beach Bill." While not responsible for activities above the statutory vegetation line, the survey line, or the line of established vegetation, OPRD is the permitting authority for actions affecting the ocean shorelands. This distinction can be seen visually at the line of established vegetation that backs the shoreline.

The Division of State Lands (DSL) has co-authority with the OPRD over rocky intertidal areas. The DSL manages the state-owned seabed within three nautical miles of low tide at the ocean shore. Specifically, the DSL regulates removal and filling of seabed and estuaries, including any dredged materials or seabed minerals. DSL may also issue leases for the harvest of Bull Kelp, a large seaweed in rocky areas of Oregon's coast.

The Beach Bill requires that a permit be obtained from the OPRD for all "beach improvements" west of a surveyed beach zone line. Communities can check their comprehensive plan or contact OPRD to obtain the location of this surveyed line. The Removal/Fill Law and implementing regulations (ORS 196.800 – 196.990) contain specific standards and requirements for riprap and other bank and shore stabilization projects in areas that extend from the Pacific Ocean shore to the line of established upland vegetation or the highest measured tide, whichever is greater. OPRD administers the removal/fill regulations jointly with the Ocean Shore Permit Authority. Activities permitted under these regulations are required to comply with the Statewide Planning Goals and be compatible with corresponding provisions of local comprehensive plans.[13] *Permits for shoreline protective structures may be issued only when development existed prior to January 1, 1977, as required under Goal 18.*

Foredune management plans, often implemented as hazard mitigation strategies, require a permit from OPRD because these strategies affect the structure of the shoreline. Other hazard mitigation strategies that require OPRD approval include: natural product (dirt) removal, resloping of a vertical bank below the statutory line of vegetation, and mitigating for erosion by altering the course of a stream that flows into the ocean.

When a community expresses interest in implementing hazard mitigation projects, the following process is completed by OPRD:

1. Permit request
2. Public notice and review period
3. Notice posted at site
4. Mailing sent to interested parties
5. Thirty day comment period
6. If a hearing is scheduled, OPRD has 45 days after the hearing to announce its decision.
7. If a hearing is not requested, OPRD has 60 days from the original request to announce its decision.

3.1.5 Oregon State Building Codes

The Oregon Building Codes Division adopts statewide standards for building construction that are administered by state and local municipalities throughout Oregon. ORS 455.447 and the Structural Code establish restrictions on the location of emergency response facilities, critical facilities, such as hospitals, fire and police stations and special occupancy structures, such as large schools and prisons, in tsunami inundation zones along the coast. There are exceptions from the statute for existing facilities and water dependent development as well as exemptions for certain facilities based on the need for strategic location or school district boundaries.

The One- and Two-Family Dwelling Code and the Structural Specialty Code contain provisions for elevating buildings in flood prone areas at least one foot above the base flood elevation. These codes contain provisions for flood proofing, underfloor drainage and directing storm water away from buildings. The local building department having jurisdiction, generally coordinates with others to ensure that permit applications for new construction meet these requirements. Verification of the floor elevation is obtained during the permitting and inspection process. State building codes contain provisions for design and construction of buildings subject to ground shaking from earthquakes.

TRG Key

For more information on seismic zones, refer to Section 2 of the Seismic Technical Resource Guide.

Coastal areas are subject to significant subduction type seismic activity. The northern coast is currently designated as Zone 3. Zone 4 extends from Otter Rock (just north of Newport) to the southern border of the state. These are the two highest risk zones addressed by building codes. The codes also contain provisions for the design and construction of buildings to resist lateral loads from earthquakes. The Dwelling Code simply incorporates prescriptive requirements for foundation reinforcement and framing connections based on the applicable seismic zone for the area.

The Structural Code contains more detailed engineering requirements for the design of larger and unusually shaped buildings. ORS 455.447 and the Structural Code require a seismic site hazard report to be performed for projects including essential facilities such as hospitals, fire and police stations and emergency response facilities, and special occupancy structures, such as large schools and prisons. The report must take into consideration such things as the seismic zone, tsunami inundation zones, soil types including identification of liquefaction soils, any known geologic faults or activity and potential landslides. The findings of the report must be taken into consideration in design of the building. Any site that has a soils report where the lot is found to contain expansive soils is also required to have that information documented and filed with the deed for the property. The building codes do not regulate public utilities and facilities constructed in public right-of-ways such as bridges that are regulated by the Department of Transportation.[14]

3.2 Federal Programs Related to Coastal Hazards

3.2.1 National Flood Insurance Program (NFIP)

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP). The NFIP was created by Congress in 1968 to minimize the response and recovery costs, and reduce the loss of life and damage to property caused by flooding. The four goals of the NFIP are to:

1. Provide flood insurance coverage not generally available in the private market;
2. Stimulate local floodplain management to guide future development;
3. Emphasize less costly nonstructural flood control regulatory measures over structural measures; and
4. Reduce costs to the federal government by shifting the burden from the general taxpayer to floodplain occupants.

The two fundamental objectives of the NFIP are to:

1. Ensure that new buildings will be free from flood damage; and
2. Prevent new developments from increasing flood damage to existing properties.[15]

TRG Key

For a more complete discussion of flood hazards and the National Flood Insurance program, see the Flood Technical Resource Guide.

Community Participation in the NFIP

Participation in the NFIP by a community requires the adoption and enforcement of a floodplain management ordinance that controls development in the floodplain. Such an ordinance should ensure that a community is in compliance with NFIP requirements, under which a jurisdiction is responsible for the following:

1. Requiring development permits for all proposed construction and other developments within the community's designated 100-year floodplain;

2. Reviewing the permit to be sure that sites are reasonably safe from flooding;
3. Reviewing subdivision proposals to determine whether the project is safe from flooding and provides adequate drainage;
4. Requiring residential structures to have the lowest floor (including basement) elevated to one foot above Base Flood Elevation (BFE);
5. Requiring non-residential structures to have the first floor elevated or flood proofed one foot above BFE;
6. Requiring manufactured homes to be elevated and anchored;
7. Requiring water supply systems to be designed to eliminate infiltration of flood waters;
8. Requiring new replacement sanitary sewage systems to be designed to minimize or eliminate infiltration of flood waters;
9. Ensuring flood carrying capacity of altered or relocated watercourses is maintained;
10. Maintaining records of all development permits; and
11. Verifying and documenting first-floor elevations of new or substantially improved structures.

V-Zone Construction

In many of Oregon's coastal communities, FEMA has mapped "V zones" (velocity zones), areas of special flood hazard that are subject to high velocity wave action from storm surges or seismic events. Because of the potential force associated with this wave action, special regulations apply for new construction and substantial improvements in "V zones."

In coastal "V zones," all new and substantially improved structures must be elevated on pilings and columns so that:

- The bottom of the lowest horizontal structural member of the lowest floor is elevated to one foot or more above the 100-year flood level
- The pile or column foundation and attached structure are anchored to resist flotation, collapse, and lateral movement from wind and water loads acting simultaneously on all building components
- The space below the lowest floor is either free of all obstructions or is constructed with non-supporting breakaway walls

In V-zones, fill cannot be used for the structural support of buildings nor can sand dunes be altered in a manner that will increase flood potential.

3.2.2 Army Corps of Engineers Permit Program

The U.S. Army Corps of Engineers is responsible for the protection and development of the nation's water resources, including navigation, flood control, energy production through hydropower management, water supply storage and recreation. The Corps administers a permit program to ensure that the nation's waters are used in the public interest, and requires any person, firm, or agency planning work in the waters of the United States to first obtain a permit from the Corps. Permits are required even when land next to or under the water is privately owned. It is a violation of federal law to begin work before a permit is obtained and penalties of fines and/or imprisonment may apply. Examples of activities in waters that may require a permit include: construction of a pier, placement of intake and outfall pipes, dredging, excavation and depositing of fill. Permits are generally issued only if the activity is found to be in the public interest. Local planning agencies are required to sign off on any permits issued by the U.S. Army Corps of Engineers.[16]

3.3 Summary: State and Federal Coastal Hazard Laws and Programs

State Policies

- ❒ Oregon Statewide Planning Goal 7
- ❒ Oregon Statewide Planning Goal 17
- ❒ Oregon Statewide Planning Goal 18
- ❒ Oregon Parks and Recreation Department / Division of State Lands Fill and Removal Permit Program
- ❒ Oregon State Building Codes

Federal Policies

- ❒ National Flood Insurance Program
- ❒ Army Corps of Engineers Permit Program

A number of state and federal agencies are involved in regulating land use in and near coastal hazards. Local planning departments must coordinate their review of development permits for coastal hazard areas with other agencies. For example:

1. Permits for new structures in coastal hazard areas should be coordinated with the State Building Codes Division;
2. Coastal developments need to comply with State Land Use Goals 17 and 18.[17]

Planning for Natural Hazards: Reviewing your Comprehensive Plan

Statewide Planning Goal 2 requires that comprehensive plan policies be supported by an adequate factual base. Section 3 of the Coastal Technical Resource Guide describes laws that communities are required to address in their comprehensive plans.

Your community should ask the following questions after identifying coastal hazards in your area:

- ❒ Does your community's comprehensive plan contain an inventory of coastal hazards, a vulnerability assessment and policies addressing coastal hazards?
- ❒ Has your community's comprehensive plan been updated to reflect the latest information on ocean shore regulation, V-zone construction, and other coastal policy issues?
- ❒ Does your comprehensive plan have policies and implementing measures to reduce risk to existing and future development in coastal hazard areas?

Section 4:
How can Your Community Reduce Risk from Coastal Hazards?

Avoiding development in hazard areas is the most effective way to reduce risk. There are, however, many areas in Oregon where some degree of hazard is unavoidable. Communities in vulnerable areas should manage and reduce their risk from coastal hazards if the risk cannot be completely eliminated.

Section 4 describes methods for site-specific development evaluation and implementing measures to reduce risk from coastal hazards. Implementing measures are the ordinances and programs used to carry out decisions made in the comprehensive plan. They include zoning ordinances, and other land use regulations, which directly regulate land use activities.

A wide range of techniques is available to reduce risks associated with chronic coastal hazards. While hazard avoidance is the ideal method to reduce risk, it is not always an option and other approaches may be needed. The type of hazard and physical location are fundamental considerations when choosing a technique for risk reduction. For example, methods that address flooding and erosion along dune-backed shorelines may not be applicable to bluff-backed shorelines where landslides rather than flooding are the primary concern. Distinctions between levels and types of development (e.g., density of development and new versus existing construction) should also be made, as they may influence the type of risk reduction needed. A broad range of economic, social, and environmental factors should be considered in evaluating each alternative in order to choose the most beneficial mitigation technique (See Hazard Alleviation Technique table in section 4.2.).[18]

Risk reduction techniques for catastrophic hazards are primarily directed at community education and establishment of tsunami evacuation routes. Priority needs, including development of guidance and maps for local governments, are being met through National Oceanic and Atmospheric Administration (NOAA), FEMA, and state hazard mitigation funding.

4.1 How can Your Community Plan for Coastal Hazards?

It is possible to plan, at least to some degree, for coastal hazards. The nature of your community's response will depend on severity of the hazard. Avoiding, or significantly limiting development in coastal hazard areas through careful planning and zoning lessens the need for other types of mitigation measures, and is the safest strategy for reducing risks to development in the most dangerous locations.

To successfully plan for coastal hazards, consider the following steps:

✓ **Identify the hazard**
Hazard identification is the first phase of hazard assessment and is part of the foundation for developing plan policies and implementing measures for natural hazards.

Coastal Key

Section 2 of this document provides information that can assist your community in identifying coastal hazards.

Tip Box

The Three Levels of Hazard Assessment

1. Hazard Identification
2. Vulnerability Assessment
3. Risk Analysis

If your community identifies coastal hazards through a hazard identification process or a vulnerability assessment, you should adopt a process to review individual development permits in those coastal hazard-prone areas. For further description of the three levels of hazard assessment, refer to Chapter 2: Elements of a Comprehensive Plan.

✓ **Avoid the hazard**
Restrict development in hazard-prone areas. For areas with high density and potential for severe property damage or loss of life, this option should be followed.

✓ **Evaluate site-specific development**
Communities can require geotechnical reports to evaluate site-specific development for coastal hazards. Section 4.2 describes techniques for evaluating these hazards.

✓ **Implement mitigation measures**
Hazard mitigation techniques may be considered individually, and in some cases can be implemented on a site-specific basis. Hazard mitigation techniques are most effective when considered together and implemented on an area-wide basis (an example of a mitigation technique is minimizing development in hazard areas through low density and regulated development which can reduce risk of property damage and loss of life). Section 4.3 provides information on specific mitigation measures.

✓ **Indirect hazard mitigation approaches**
Additional mitigation strategies and non-regulatory measures can further reduce risk from coastal hazards. Section 4.4 and 4.5 provide information on additional methods and indirect approaches for reducing risk from coastal hazards.

TRG Key

For more information on how geotechnical reports are conducted, refer to Section 4 of the Landslide Technical Resource Guide.

4.2 How is Development in Coastal Hazard Areas Evaluated?

Geotechnical reports may be required for proposed development in identified hazard areas. Such reports are appropriate for the siting of new development and also the protection of existing development.

Important factors to consider when conducting a chronic hazard assessment or preparing a geotechnical report include:

Regional Setting

- Major geographic features
- Major geologic features

Long-term Trends of Shoreline Change

- Historical dune/bluff retreat
- Relative sea-level rise
- Sediment budget

Short-term Events

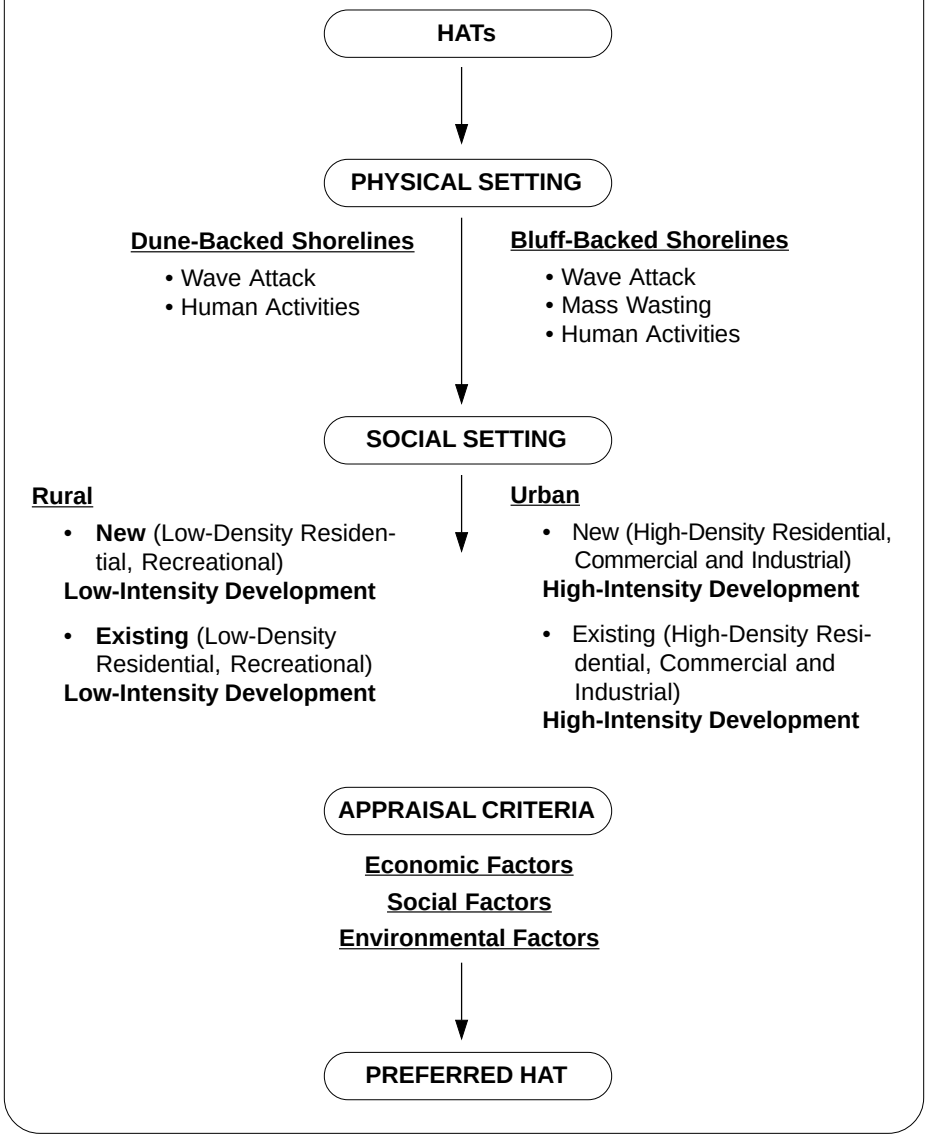
- Episodic Flooding/Erosion
  - Projected wave overtopping/undercutting
  - Direct evidence from existing and antecedent conditions
  - Dune stability

- Episodic Sloughing/Sliding
  - Surface features
  - Material properties and structural characteristics
  - Surface/Subsurface drainage
  - Wave attack
- Inlet Dynamics
- Human Activity

Coastal Key

The full text of the outline is published in the Chronic Coastal Natural Hazards Model Overlay Zone, published by the DLCD. Refer to Section 6 of this guide for information on contacting DLCD and obtaining this publication.

Hazard Alleviation Technique (HAT): Identification and Evaluation Framework



Source: *Shoreland Solutions. Appraisal of Chronic Hazard Alleviation Techniques. Salem, Ore.: Oregon Department of Land Conservation and Development (1994) p. 2.*

Coastal Key

For information on littoral cell planning refer to Section 2 of this guide.

4.3 What Role Does Land Use Planning Play in Reducing Risk from Coastal Hazards?

Land use planning can play an important role in reducing risk from coastal hazards by influencing the location, elevation, and design of existing and new development. The following land use tools do not prevent or retard the processes of wave attack or mass wasting. Rather, they allow these natural processes to occur by minimizing development that would require structural mitigation. Specific hazard mitigation techniques included within this category are: zoning regulations and infrastructure planning; site, design and construction standards; construction setbacks; and relocation incentives and land acquisition programs. These tools are potentially applicable to new and existing development along shorelines with both rural and urban levels of use.[19]

4.3.1 Zoning Regulations and Infrastructure Planning

Zoning regulations can be used to require low development densities in identified hazard areas (e.g., down-zoning, clustering). Infrastructure planning can also be used to encourage low development densities in identified hazard areas by limiting the level of services available. All jurisdictions along the Oregon Coast implement land use planning techniques through local comprehensive plans and zoning ordinances that are acknowledged for compliance with the Statewide Land Use Planning Goals.

4.3.2 Siting, Design, and Construction Standards

Siting, design, and construction standards regulate aspects of development in an identified hazard area. These standards range from site preparation to building design and construction. With respect to site preparation, examples include standards governing the removal of existing vegetation, excavation and drainage controls. For building design and construction, examples include foundation standards, frame, and roof design and required construction materials. Although such standards are generally applied to new or remodeled structures, existing structures may be retrofitted to meet new construction standards.

4.3.3 Construction Setbacks

Construction setbacks are requirements for locating new development (e.g., structure and infrastructure) some minimum horizontal distance landward of an identified hazard. Although construction setbacks are typically applied to new development, they may also be applied to remodeling or repair of existing development. Construction setbacks are appropriate for both dune-backed and bluff-backed shorelines.

4.3.4 Relocation Incentives and Land Acquisition Programs

Relocation incentives and land acquisition programs are provided to move existing development away from an identified hazard. In some instances development is relocated on-site. In other instances it is necessary to move development off the site, or perhaps to demolish it, and reestablish it elsewhere at a new, safer location. Generally, some sort of subsidy is required to encourage relocation. In some instances, rather than partially subsidizing relocation, the most viable option may be to buy the entire parcel at market value. Land acquisition programs have broader applicability than relocation incentives because they may apply to undeveloped areas as well as to areas with existing development. Undeveloped areas can be acquired and preserved for recreation, open space, or other appropriate public purposes. Such programs generally include specific criteria establishing priorities for acquisition.

4.4 What Additional Methods can be Used to Reduce Risk from Chronic Coastal Hazards?

The following hazard mitigation techniques work to prevent and retard the processes of wave attack or mass wasting. The techniques can be divided into the following categories: options for wave attack - soft stabilization; options for wave attack - hard stabilization; and options for mass wasting.

4.4.1 Soft Stabilization

Soft stabilization refers to techniques which reduce potential risk by enhancing the inherent buffering capabilities of the natural shoreline system to retard the effects of wave attack. Although the shoreline is stabilized in a relative sense through the application of these techniques, it is still expected to experience displacements during storm events. Specific hazard mitigation techniques included within this category are: foredune enhancement, beach nourishment, and boulder berms. Soft stabilization techniques are potentially applicable along both dune-backed and bluff-backed shorelines with both high intensity and low intensity use.

4.4.2 Hard Stabilization

Hard stabilization refers to techniques that reduce potential risk by attempting to fix the position of the shoreline to prevent the effects of wave attack. Thus, in most instances the shoreline is stabilized in a real sense through the application of these techniques and does not experience displacements during storm events. Specific hazard mitigation techniques included within this category are: groins, breakwaters, and revetments/ seawalls. Hard stabilization techniques are potentially applicable along both dune-backed and bluff-backed shorelines. They are potentially applicable along shorelines with high as well as low levels of development.

Tip Box

DLCD's Chronic Coastal Natural Hazards Model Overlay Zone

This document outlines a model ordinance for regulating development in hazardous coastal areas. The model ordinance contains provisions to identify potentially hazardous coastal areas, specifies a methodology to assess the potential risks to life and property those hazards may pose, and reduces potential risks by requiring appropriate mitigation. Two guides accompany the model ordinance: a planners guide and a technical guide. The planners guide is intended for city and county planners, planning commissions, city councils, and boards of commissioners considering amending provisions of their plans and ordinances. Copies of the model ordinance are available from the Department of Land Conservation and Development, (503) 373-0050.

4.4.3 Options for Mass Wasting

Options for mass wasting include a variety of techniques which reduce potential risk by improving slope stability and retarding weathering of the slope surface. Specific hazard mitigation strategies included within this category are: vegetation management, drainage controls, slope regrading, reinforcing structures, and surface fixing. Although they are treated separately in the Appraisal of Hazard Alleviation Techniques report, these techniques are typically applied in combination. Options for mass wasting are principally applicable along bluff-backed shorelines with both high and low levels of use.

4.5 What are Indirect Approaches for Risk Reduction?

Indirect approaches to risk reduction influence the location and design of new and existing structures (e.g., residential, commercial, industrial buildings) and infrastructure (e.g., roads, water, sewer). These indirect approaches are potentially applicable along all types of shoreline.[20]

4.5.1 Education Programs

Education programs play a pivotal role in reducing risk from coastal hazards. Techniques used for hazard preparedness by an individual are primarily a function of their level of awareness. Realistic perceptions can minimize potential risk by influencing siting and design decisions.

4.5.2 Natural Resource Protection Laws

Natural resource protection laws are generally designed to protect significant resource areas, but they often result in some degree of hazard mitigation. When viewed as a risk reduction technique, natural resource protection planning is closely related to construction setbacks. Both attempt to reduce potential risk by influencing the location of development. Oregon's Statewide Planning Goal 17 requires protection of "major marshes, significant wildlife habitat, coastal headlands, and exceptional aesthetic resources." These requirements, as well as the requirement to maintain riparian vegetation, are all forms of natural resource protection law. With respect to dune-backed shorelines, Statewide Planning Goal 18 requires that local governments and state and federal agencies "prohibit residential developments and commercial and industrial buildings on beaches, active foredunes, on other foredunes which are conditionally stable and that are subject to ocean undercutting or wave overtopping, and on interdune areas that are subject to ocean flooding." These requirements qualify as natural resource protection laws and actually address risk reduction directly. Statewide Planning Goal 5 may indirectly affect risk reduction, particularly flooding, through protection of wetland and riparian areas.

4.6 Summary: Reducing Your Community's Risk from Coastal Hazards

In order to reduce risk of life and property from coastal hazard events, communities can incorporate methods reviewed in this section within their comprehensive plans.

- *Land use tools for coastal hazard management* can influence the location, type, intensity, and design of existing and new structures and infrastructure.
- *Siting, Design, and Construction Standards* encompass standards that govern aspects of development in an identified hazard area. These methods range from site preparation to building design and construction.
- *Additional methods for coastal hazard mitigation* include soft stabilization and hard stabilization techniques. Soft stabilization techniques enhance the inherent buffering capabilities of the shoreline while hard stabilization techniques attempt to permanently fix the position of the shoreline, thus reducing the effects of wave attack.
- *Indirect approaches to coastal hazard mitigation* include education programs and natural resource protection laws. These methods are applicable along any type of shoreline and serve to both educate coastal landowners and preserve the natural environment.

Planning for Natural Hazards: Reviewing your Comprehensive Plan

Implementing measures tied to specific actions are essential to carrying out plan policies in a comprehensive plan. Your community should ask the following questions in assessing the adequacy of your comprehensive plan in addressing coastal hazards:

- Do your comprehensive plan policies authorize lower density zoning provisions for areas of high vulnerability to natural hazards?
- Has your community implemented a process for evaluating site-specific development?
- Does your community have an approach to reduce risk from coastal hazards through a combination of regulatory and non-regulatory measures?
- Do the implementing measures carry out your comprehensive plan's policies related to coastal hazards in your community?

Section 5:
How are Oregon Communities Addressing Coastal Hazards?

This section describes how three Oregon communities are addressing coastal hazards.

5.1 Strengthening Local Review in Lincoln County, Oregon

Lincoln County has taken steps to strengthen its ordinances to implement its comprehensive plan. The new draft ordinances increase standards for geotechnical reports prior to development and provide a quantifiable measure for hazard risk zones.

Background

The initial inventory and factual base used by Lincoln County to map hazard areas was completed in the late 1970's and early 1980's in response to Statewide Planning Goals 7, 17 and 18. The geologic hazards provision was completed separately from the flood hazard inventory. Methods used to complete the geologic hazards provision were considered "state of the art" at the time. Recently, however, planners in Lincoln County have noted aspects of the geologic hazard provision that need to be revised to ensure maximum effectiveness.

Features identified during the inventory process include coastal recession and active landslide areas. Information from DOGAMI is currently used as a catalyst in Lincoln County for site-specific geologic investigations and is compiled in map form. When Lincoln County planners initially review a prospective development proposal, the first step is a review of the maps. If the proposal is located in an identified area of natural hazards, a site-specific geotechnical report must be completed before the proposal is approved.

Investigation into the risks of developing in hazard-prone areas is currently limited by the out-dated nature of the inventory and limited staff resources. DOGAMI has provided additional information for the inventory, but the county is currently taking steps to further update its factual base. With the DOGAMI work complete, the DLCD is incorporating the new information into a Geographic Information System (GIS) for the county. The GIS is only partially complete with one segment of the coast mapped. Work is currently progressing toward completion of a county-wide GIS. The first step in this process is to complete the parcel layer. The parcel layer should be completed late in the summer of 2000. The GIS has already proven to be useful. It serves as an analytical tool for the county as they determine the threat of hazards to a specific site.

The information contained in the completed GIS will be used by the county to define relative risk zones and adopt regulations based on the relative level of risk associated with these zones. Currently, the process of assessing risk is completed with a non-systematic site report. The problem with this existing approach is that there is no way to quantify the risk.

Policy

Lincoln County is currently in the process of revising section 1.1910 Development Guidelines, section 1.1925 Geologic Hazards, and section 1.1930 Beaches and Dunes, of the Lincoln County Land Use Codes. There are two different proposals currently in draft form. The proposals take two different approaches to revising the same section of the current county code. The first draft proposal, "*Development Guidelines*," is intended to clarify and improve the application of this section of the codes by adding content requirements for site-specific geologic hazard reports. In essence, this proposal continues the county's present approach to hazard management, but provides greater clarity and detail.

The second draft proposal, "*Chronic Coastal Natural Hazards*," is also a revision to the development guidelines section of the code. However, it proposes a fundamental change in the approach to managing coastal hazards. The intent of this proposal is to quantify relative levels of risk based on a standardized set of factors. The ordinance then prescribes regulatory standards, based on this relative risk (e.g., the "risk zone").

The Chronic Hazards Ordinance represents a completely different approach from Lincoln County's current system of subjectively evaluating site-specific reports. Although the current system is effective at identifying and disclosing the existence of various hazards, it does not really answer the most basic question of, "Is this an acceptable level of risk?" The Chronic Hazards Ordinance will allow the county to address that question in a quantifiable and systematic way.

Implementation

The Chronic Hazard Ordinance will be effective because it can be applied on a case-by-case basis to site-specific reports. To be successful, the GIS mapping of the risk zones needs to be completed countywide. This work is currently underway, but it will take some time to complete. Negative aspects of the Chronic Hazard Ordinance are that it is fairly technical and complicated, and is conceptually hard to grasp for a lot of planners. However, these obstacles are easily overcome. The DLCD provides expert assistance in interpreting and using the formulas included in the Chronic Hazard Ordinance.

Revisions to both the Chronic Hazard Ordinance and the Development Guidelines Ordinance are only in the draft stage at this point. County decision-makers have not yet considered them. Given the complexity of the Chronic Hazards Ordinance, it could be a fairly lengthy process to build the support needed to put it in place. The Development Guidelines Ordinance, on the other hand, is just a refinement of the present approach, and could represent an interim step in improving hazards management while the concepts behind the Chronic Hazards Ordinance are more fully developed.

Draft Development Guidelines Chronic Hazards Ordinance for Lincoln County

1.1910 Intent

The intent of development guidelines is to provide procedures necessary to secure the desirable attributes of the county from depletion and otherwise protect against hazardous or otherwise undesirable developments. "Development," as used in LCC 1.1910 to 1.1940, means the act, process or result of developing, but excludes those forest operations and associated activities that are governed by the Oregon Forest Practices Act and Rules.

1.1915 Scope

Development guidelines shall apply to those areas of concern as described in the following sections and identified on the Comprehensive Plan and Zoning maps and the Comprehensive Plan Inventory for Lincoln County.

1.1920 Procedure

The following procedure shall be followed in determining the suitability and desirability of development being proposed in areas of concern as described in this section:

(1) *Application:* Applicants requesting approval of (land use actions) *development* in areas subject to the provisions of this section shall be required to submit, along with any application for a building permit or other *required* development *approval*, a detailed site plan and/or written statement demonstrating how the proposed activity takes into account each of the applicable considerations and conforms to each applicable standard specified in this section.

(2) *Review: The provisions of this section shall be applied in the review of all applications conducted pursuant to LCC 1.1210.* Statements and diagrams of recognition of considerations and conformance with standards submitted along with requests for development will be reviewed in the following manner:

(a) *Building Permits Approval:* For development proposed which has impact only to the immediate area, as determined by the Planning Division, the above mentioned statements and diagrams will be reviewed by the Planning Division as part of the Building Permit approval procedures. If the proposed development appears to adequately recognize the applicable considerations and conforms to all applicable standards outlined above, the Building Permit will be approved. If questions are raised regarding recognition of considerations or conformance with standards, a meeting date shall be set by the Planning Division to discuss the areas in question. If such questions can be resolved satisfactorily, the building permit will be approved. For development proposed which has an impact greater than the surrounding vicinity, as determined by the Planning Division, or for development proposed which the Planning Division cannot satisfactorily resolve questions regarding recogni-

tion of considerations, the requests will be referred to the County Planning Commission for resolution.

(b) *Other Approvals:* Statements and diagrams of considerations and standards for subdivisions, land partitioning, conditional uses, rezones, and other development activities which do not require building permit approval shall be reviewed by the Planning Division for those activities which have an impact only to an immediate area. If the Planning Division determines such considerations are satisfactorily recognized, requests will be approved for those decisions, which this Chapter authorizes. If such a proposal is determined by the Planning Division to have an impact greater than the surrounding vicinity; or if the Planning Division is not authorized to make a decision on the matter; or if agreement is not reached between the requestor and the Planning Division that the considerations have been satisfactorily recognized, the item will be referred to the Planning Commission for resolution.

Draft Chronic Coastal Hazards Development Guidelines

The second approach being considered by Lincoln County, the "Chronic Coastal Hazards Development Guidelines," provides a method to assess the risks associated with site development in reviewing a permit application.

1.1925 Coastal Hazard Assessment

In areas subject to the provisions of this section, a coastal hazard assessment is required for any application to construct new structures or to expand existing permanent structures, semi-permanent structures and regular infrastructure. A coastal hazard assessment shall be prepared by a registered professional geologist or certified engineering geologist. A coastal hazard assessment shall:

(a) Examine the full range of geologic and oceanographic factors affecting chronic shoreline stability including short term events and long term trends attributable to processes of wave attack (overtopping/undercutting), mass wasting (sloughing/landsliding), wind-driven dune erosion or accretion, inlet migration, and human activities, as well as relative sea level rise and the sediment budget (sources/sinks);

(b) Identify areas of high and moderate relative risk, or 'risk zones', pursuant to the requirements of this section;

(c) Describe the proposed development, including plan maps and cross-sections showing the location of proposed structures on the property and the structures in relation to property lines and identified risk zones; and

(d) Describe potential adverse impacts to adjacent development and measures to avoid or minimize such impacts.

Determination of Relative Risk Zones

(a) Dune Hazard Areas: In designated dune hazard areas the horizontal extent of high and moderate risk zones shall be determined according to the following formula: Relative Risk in Dune Hazard Areas = $[(S_{dune} + D) + (L_R \times T_p)+(L_r \times T_p)]$

(Formula 210) where S_{dune} = the total horizontal extent of shoreline erosion (wave undercutting) projected to occur during a design storm event or cluster of storm events (feet). A storm having a two percent chance of being equaled or exceeded in any given year (50-year storm) shall be used to calculate high relative risk and a storm having a one percent chance of being equaled or exceeded in any given year (100-year storm) shall be used to calculate moderate relative risk;

D = the dune topographic stability factor (feet). This factor shall be calculated as 1.5 times the height of the primary dune;

L_R = the average annual rate that the shoreline is projected to migrate landward due to

L_r = the average annual rate that the shoreline is projected to migrate landward due to relative sea level rise (feet/year); and

T_p = the planning period (years). Time spans of 50 years and 100 years shall be used to calculate high and moderate relative risk respectively.

The distances determined through the application of Formula 210 shall be measured landward from the following reference locations:

- The Ocean Shores Vegetation Line; or
- The existing vegetation line, whichever is further landward.

(b) Bluff Hazard Areas: The horizontal extent of high and moderate risk zones in designated bluff hazard areas shall be determined according to the following formula: Relative Risk in Bluff Hazard Areas = $[S_{bluff} + (L_R \times Tp)+(L_r \times Tp)]$ (Formula 220) where S_{bluff} = the total horizontal extent of erosion projected to occur during a simple, shallow sloughing event (feet);
L_R = the average annual rate that the bluff line is projected to migrate landward due to mass wasting (feet/year);
L_r = the average annual rate that the shoreline is projected to migrate landward due to relative sea level rise (feet/year); and
T_p = the planning period (years). Time spans of 50 years and 100 years shall be used to calculate high and moderate relative risk respectively.
The distances determined through the application of For-

mula 220 shall be measured landward from the following reference locations:

- The Ocean Shores Vegetation Line; or
- The toe of the bluff, whichever is further landward.

(c) Slide Hazard Areas:
The horizontal extent of high and moderate risk zones in designated bluff hazard areas shall be determined by the following formula: Relative Risk in Slide Hazard Areas = [S_{slide} + S_{bluff}]

(Formula 230) where S_{slide} = the total horizontal extent of erosion projected to occur during a complex, deep-seated landsliding event (feet); and

S_{bluff} = the total horizontal extent of erosion projected to occur during a simple, shallow sloughing event (feet).

The distances determined through the application of Formula 230 shall be referenced to one of the following locations:

- The Ocean Shores Vegetation Line;
- The toe of the bluff; or
- The landward-most active headscarp crest.

(d) Inlet Hazard Areas:
The horizontal extent of risk zones in inlet hazard areas shall be determined by the following formula: Relative Risk in Inlet Hazard Areas = L_{inlet}

(Formula 240) where L_{inlet} = the maximum historical extent of along shore inlet migration (feet).

The distances determined through the application of formula 240 shall be referenced to one of the following locations:

- The location of the ebb channel;
- The location of the toe of the scarp on the eroding bank; or
- Relevant cultural features (e.g., property boundaries, existing structures, etc.).

5.2 Improving the Hazard Inventory in Waldport, Oregon

The initial inventory used by the City of Waldport to map hazard areas was completed in the late 1970's and early 1980's in response to the Statewide Planning Goals 7, 17 and 18. Problems with landslides led planners to reorganize and update provisions for Waldport. The city's efforts initially focused on improving elements of the inventory identifying coastal hazard areas. This triggered the need for a site-specific geologic investigation.

Inventory documents, such as DOGAMI maps and reports, were collected and reviewed. They were used to identify four types of hazard areas: oceanfront/bayfront lots; geologically recent landslide areas; weak foundation soils; and slopes greater than 20 percent with weak foundation soils and all slopes greater than 30 percent. Standards applying to each of these hazard areas were then developed.

For example, if development is proposed in an area known to have weak foundation soils, then a qualified soils expert shall make a detailed soils analysis. Similarly, a site-specific geological investigation is required for all development proposed within 100 feet of a geologically recent landslide. For oceanfront/bayfront lots where the only known hazard is coastal recession or minor slope sloughing, a site specific geological investigation is required only if the proposed development would deviate from an established minimum setback.

Done as a comprehensive plan periodic review work task, Waldport has created development guidelines listed below under *Natural Hazard Areas*. The guidelines, which use the enhanced inventory and new standards, are waiting for adoption by Waldport's city council at the time of this guide's production.

Article 9. Waldport Development Guidelines

Intent: The intent of development guidelines is to provide procedures necessary to secure the desirable attributes of the city from depletion, and to protect against hazardous or otherwise undesirable development activities.

Scope: Development guidelines shall apply to those areas of concern delineated on the City of Waldport Zoning Map and in its Comprehensive Plan and Plan Inventories or any area determined potentially hazardous by the Planning Commission and shall also apply to any property that has a 30 percent slope or greater as defined by a (3:1) ratio, 3 horizontal: 1 vertical. Development guidelines do not apply to development limitations within the Coastal Shorelands overlay zone and federally designated flood hazard areas, which are discussed in Sections 3.380 and 3.390 respectively.

Natural Hazard Areas: The following development guidelines are applicable to hazards identified above and in the State Department of Geology and Mineral Industries, Bulletin 81, Environmental Hazard Inventory, Coastal Lincoln County, Oregon, RNKR Associates, 1978. The above documents and mapping are referenced and adopted as a part of the Comprehensive Plan and available at the office of the City Recorder.

1. Purpose: Various geological formations in the city have different characteristics with respect to suitability for development because of landslide potential, high groundwater, and soil characteristics. The following development guidelines have been prepared in order that geological hazards will be recognized and the losses resulting therefrom will be lessened.
2. Areas of Concern: The primary areas of concern are active and potential landslides, high groundwater, weak foundation soils, coastal recession, and steep slopes.
3. Considerations: The most important consideration with respect to natural hazard factors are:
   A. That development approved is not hazardous to buildings, structures or the inhabitants thereof.
   B. That protection to unsuspecting purchasers of property having natural hazards is provided.

C. That unjustified expenditure of public funds or losses incurred due to natural hazards resulting in damage to development which should not have been approved initially, is prevented.

4. Standards: The following shall be required in hazard areas as identified:
   A. Oceanfront/Bayfront Lots: A site specific geotechnical analysis by a qualified registered professional geologist or engineering geologist *except* when the only known or suspected hazard is coastal recession and minor slope sloughing which can be compensated for by using the established minimum setbacks as set forth in the Environmental Hazard Inventory; RNKR (page 35) rates of coastal erosion are identified on the Comprehensive Plan hazard maps. *Deviations from required shore front setbacks may be permitted upon submission of a site specific geotechnical analysis prepared and stamped by a professional geologist or certified engineering geologist which specifies adequate safeguards to compensate for the reduced setback.*
   B. Geologically Recent Landslide Areas: A site specific geotechnical analysis by a qualified professional geologist or engineering geologist including all property outside of known or suspected hazard that is within 100 feet. *The geotechnical analysis, which shall be stamped by the professional geologist or certified engineering geologist, shall identify the nature and extent of the hazard or hazards present and shall provide specific recommendations for measures adequate to safeguard the proposed development from the identified hazard or hazards.*
   C. Weak Foundation Soils: In areas known to have weak foundation soils for construction of buildings and roads, a detailed soils analysis shall be made by a qualified soils expert. The analysis shall include a recommendation to overcome identified limitations prior to development approval.
   D. Slopes Greater than 20 percent with Weak Foundation Soils and All Slopes Greater than 30 percent: A site specific geotechnical analysis by a qualified professional geologist or engineering geologist will be required. *The analysis, which shall be stamped by the professional geologist or certified engineering geologist, shall determine the suitability of the site for development and shall recommend specific measures which may be required to safeguard life and property.*

5.3 Planning for Shoreline Stability in Manzanita, Oregon

Since the late 1960's the shoreline fronting Manzanita has exhibited a net westward migration due to sand accumulation in the foredune area. Typically, attention is focused on the threats posed by beach and dune erosion. However, there are segments of the Oregon coast where too much sand is the problem. Over the last 10 years sand accumulation has been particularly dramatic in Manzanita. This

increase in beach and dune sand volume has enhanced ocean flood/erosion protection potential. It has also presented problems for local residents and visitors alike, as the accumulating sand and the accompanying growth in height and width of the foredune area has led to the inundation of oceanfront homes, the restriction of ocean views, and the blockage of beach access points.

In Manzanita, efforts were undertaken by individual homeowners to implement provisions of Statewide Planning Goal 18, Implementation Requirement #7, that provide for dune grading or sand movement necessary to maintain views or prevent sand inundation as part of an overall foredune management plan. Manzanita residents formed the Manzanita Neah-Kah-Nie Dunes Management Association Inc., and hired a consultant to complete the work. Throughout the development of the plan they worked in cooperation with state, county, and city government representatives, and held numerous public meetings in the Manzanita area.

The plan consists of a Background Report, which reviews the factors affecting the stability of shoreline in the management area; a Management Strategy, which details the types of sand management practices to be applied in the management area; a Monitoring Program, which outlines a program for the regular collection and analysis of information needed to evaluate the success of the management strategy; a Maintenance Program, which outlines follow-up activities needed to ensure the success of the management strategy; and an Implementing Ordinance, which formally outlines the procedures for carrying out prescribed management practices.

The plan was approved and adopted by the City of Manzanita. At the time of this writing the plan has been in implementation for over four years. To date it has been a success. Since initial grading and planting, minimal amounts of sand have accumulated along the crest and backslope of the primary foredune. Also, the bulk of the foredune area has maintained its integrity during several episodes of wave attack.

Manzanita's efforts are unique in that, while the City of Manzanita was very supportive, the planning activities were homeowner-based. Manzanita's efforts provide an example of proactive, area-wide planning that may be applicable to other areas of coastal hazards management.

5.4 Summary: Lessons from Oregon Communities Addressing Coastal Hazards

- *Lincoln County* has taken steps to address weak aspects of ordinances used to implement its comprehensive plan. They are also working to develop a county-wide GIS that will improve the county's ability to address natural hazards. The new draft ordinances increase standards for geotechnical reports prior to development and provide a quantifiable measure for hazard risk zones.
- *Waldport* offers an example of how one community inventoried known hazards and improved standards for site-specific reports to address the hazards found within their community.
- *Manzanita* offers an example of proactive, community driven action designed to mitigate for hazardous levels of sand inundation.

Planning for Natural Hazards: Reviewing your Comprehensive Plan

Your comprehensive plan should be coordinated with and reflect other comprehensive plans and implementing measures of other communities within your region. Natural hazards do not respect community boundaries making it important to coordinate with other jurisdictions in your area. In reviewing your comprehensive plan, your community should ask the following questions in developing plan policies for coastal hazards:

- ❒ What plan policies should be added or amended to assist your community in dealing with coastal hazards?
- ❒ Are there communities that face similar coastal threats that have developed ordinances or non-regulatory programs that could be adopted by your community ?
- ❒ Is your comprehensive plan consistent with plans or actions of other jurisdictions and regional plans and policies (such as school, utilities, fire, park, and transportation districts?)

TRG Key

For additional resource information on flood, landslide and seismic hazards, refer to Section 6 of the appropriate hazard-specific guide.

Sidebar

The Governor's Interagency Hazard Mitigation Team (GIHMT) is an important organization for interagency coordination, formalized by Governor Kitzhaber after the 1996-97 flood and landslide events. One of the most important roles of the GIHMT is to provide a forum for resolving issues regarding hazard mitigation goals, policies and programs. The team's strategies to mitigate loss of life, property and natural resources are reflected in the state's *Natural Hazards Mitigation Plan*. This plan is dubbed the "409 plan" since it is required by section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (P.L. 93-288). The GIHMT reviews policies and plans and makes recommendations with an emphasis on mitigation and education. Representatives from Oregon Emergency Management staff the GIHMT.

Section 6:
Where can Your Community find Resources to Plan for Coastal Hazards?

This section is a resource directory including contacts, programs, documents and internet resources available to communities as they plan for coastal hazards.

6.1 State Agency Resources

Department of Land Conservation and Development (DLCD)

DLCD is an important resource for coastal communities making land use planning decisions. DLCD administers Oregon's Statewide Planning Program and the federally approved Oregon Coastal Management Program (OCMP). Detailed information on the OCMP is included in the first recommended coastal publication listed below.

Contact: Coastal Specialist
Address: 635 Capitol St. NE, Suite 150
Salem 97301-2540
Phone: (503) 373-0050 ext. 249
Fax: (503) 378-5518
Web: http://www.lcd.state.or.us

Oregon State Police (OSP)-Office of Emergency Management (OEM)

OEM assists coastal jurisdictions (counties, cities, and fire protection districts) with tsunami warnings and evacuation planning. For example, OEM has helped coastal jurisdictions develop and print evacuation map brochures. The brochures (distributed to residents and tourists) contain general tsunami information, evacuation safe zones and, if identified by the community, evacuation routes and sites. In addition, many tsunami hazard zone, evacuation route and evacuation site signs have been distributed to counties and placed by the jurisdictions in various locations on the coast.

Contacts: Earthquake and Tsunami Program Coordinator: ext. 237
OEM Hazard Mitigation Officer: ext. 247
Recovery and Mitigation Specialist: ext. 240
Address: 595 Cottage Street NE,
Salem OR 97310
Phone: (503) 378-2911
Fax: (503) 588-1378
Website: http://www.osp.state.or.us/oem

Department of Geology and Mineral Industries (DOGAMI)

DOGAMI assists communities by producing maps and reports on coastal erosion, bluff hazards, tsunami inundation, and landslide hazard analysis in the coastal zone. DOGAMI staff chair the interagency State Map Advisory Council, which coordinates the preparation of various types of geologic maps, and computerized information. DOGAMI develops, stores and disseminates geologic information about the state that in turn serves as a basis for prudent decision-making in resource development and land management.

Contact: Coastal Field Office
Address: 313 SW 2nd, Suite D
Newport, OR 97365
Phone: (541) 574-6642
Fax: (541) 265-5241
Website: http://sarvis.dogami.state.or.us

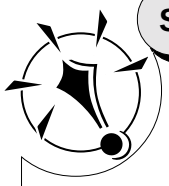
Oregon Parks and Recreation Department (OPRD)

OPRD has the authority over the "Ocean-shore Recreation Area" (that width of the ocean shore that is submerged by the daily tides) as well as the adjacent "dry sands beach" up to the "beach zone line" set by state law. OPRD has management authority over rocky intertidal areas as well as upland state parks. Contact the OPRD coastal land use coordinators for information on the permit application process and recommendations.

North Coast
Address: 5580 South Coast Highway
Newport, OR 97366

Phone: (541) 867-3340
Fax: (541) 867-3254
Website: http://www.prd.state.or.us

South Coast
Address: 10965 Cape Arago Hwy
Coos Bay OR 97420
Phone: (541) 888-9324
Fax: (541) 888-5650
Website: http://www.prd.state.or.us



Sidebar

Project Impact: Building Disaster Resistant Communities

FEMA's Project Impact is a nationwide initiative that operates on a common sense damage reduction approach, basing its work and planning on three simple principles:

1. Preventive actions must be decided at the local level;
2. Private sector participation is vital; and
3. Long-term efforts and investments in prevention measures are essential.

Project Impact began in October of 1997 when FEMA formed partnerships with seven pilot communities across the country. FEMA offered expertise and technical assistance from the national and regional level and used all the available mechanisms to get the latest technology and mitigation practices into the hands of the local communities. FEMA has enlisted the partnership of all fifty states and U.S. Territories, including nearly 200 Project Impact communities, as well as over 1,100 businesses.[53]

Benton, Deschutes, and Tillamook counties, and Multnomah County with the city of Portland are the Oregon communities currently participating in this initiative to build disaster resistant communities. Application for participation in the program in Oregon is through the OSP-Office of Emergency Management in Salem.[54] For more information about Project Impact visit **http://www.fema gov** or **(http://www.fema.gov/impact/**impact00.htm), or contact the OSP-Office of Emergency Management.

6.2 Federal Agency Resources

Federal Emergency Management Agency (FEMA)

FEMA Region 10 serves the northwestern states of Alaska, Idaho, Oregon and Washington. The Federal Regional Center (FRC) for Region 10 is located in Bothell, Washington. FEMA is an agency of the federal government whose purpose is to reduce risks, strengthen support systems, and help people and their communities prepare for and cope with disasters regardless of the cause. FEMA's mission is to "reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based emergency management program of mitigation, preparedness, response and recovery."

Contact: FEMA, Federal Regional Center, Region 10
Address: 130-228th St. SW
Bothell, WA 98021-9796
Phone: (425) 487-4678
Website: http://www.fema.gov

To obtain FEMA publications,
Phone: (800) 480-2520

To obtain FEMA maps,
Contact: Map Service Center
Address: P.O. Box 1038
Jessup, Maryland 20794-1038
Phone: (800) 358-9616
Fax: (800) 358-9620

6.3 Recommended Coastal Publications

A variety of documents exist to assist communities as they develop strategies for natural hazard mitigation. The following list groups publications into three categories: primary, secondary, and technical. Documents listed as primary are those that every community should have in its resource library. Secondary documents may not be as essential as primary documents or as readily accessible, yet they still provide useful information to communities. Technical documents are those that focus on a specialized aspect of coastal hazard mitigation. In addition, there are many DOGAMI publications on coastal hazards. Visit the DOGAMI website to find these resources.

Primary Resources

A Citizen's Guide to the Oregon Coastal Management Program.
Oregon Department of Land Conservation and Development (1997)

This document is a how-to book about coastal management. It explains who makes the decisions, the legal requirements for decisions, and gives elected and appointed officials useful information as they decide how and where new development will occur.

To obtain this resource contact: Oregon Department of Land Conservation and Development

Oregon's Statewide Planning Goals & Guidelines. Oregon Department of Land Conservation and Development (1995)

> Since 1973, Oregon has maintained a strong statewide program for land use planning. The foundation of that program is a set of 19 Statewide Planning Goals. The goals express the state's policies on land use and on related topics, such as citizen involvement, housing and natural resources. This booklet contains the complete text of the 19 goals.
>
> *To obtain this resource contact:* Oregon Department of Land Conservation and Development

The Pacific Northwest Coast: Living with the Shores of Oregon and Washington. Komar, P.D., (1997) Duke University Press

> This book serves as a source of information about the coast of the Pacific Northwest, its geological setting, the natural responses of beaches and cliffs to ocean processes, and the ever-present problem of erosion. It examines lessons taught by human interactions with the coast.
>
> *To obtain this resource contact:* Oregon State University or your local bookstore

Improving Natural Hazards Management on the Oregon Coast. Natural Hazards Policy Working Group (1994)

> This document contains 23 issues and 79 recommendations developed by a 20-member hazard policy-working group over a two-year time period. Information on natural hazard policy in Oregon, hazard assessment and information access, beach and shore protection procedures, land use planning, and tsunami preparedness is also included in this document.
>
> *To obtain this resource contact:* Oregon Sea Grant or the Department of Land Conservation and Development

Secondary Documents

Appraisal of Chronic Hazard Alleviation Techniques. Shoreland Solutions / Oregon Coastal Zone Management Association, (1994) Oregon Department of Land Conservation and Development

Littoral Cell Management Planning along the Oregon Coast. Shoreland Solutions (1995) Oregon Department of Land Conservation and Development

Chronic Coastal Natural Hazards Geographic Information System. National Oceanic and Atmospheric Administration (1999) Department of Land Conservation and Development

Chronic Coastal Natural Hazards Model Overlay Zone. Shoreland Solutions (1998) Oregon Department of Land Conservation and Development

TRG Key

For more information on public agency coordination refer to the discussion on coordination in Chapter 2: Elements of a Comprehensive Plan.

Contents of Geotechnical Reports Related to the Impacts of Coastal Erosion and Related Hazards. Komar, P.D. (1993) Department of Land Conservation and Development

Technical Resources

Department of Geology and Mineral Industries Explanation of Mapping Methods and Use of the Tsunami Hazard Maps of the Oregon Coast. DOGAMI (1995) Open File Report 0-97-67

Impacts of Climate Variability and Change – Pacific Northwest. JISAO/SMA Climate Impacts Group (1999, November) University of Washington (pg. 109)

Inventory of Critical and Essential Facilities Vulnerable to Earthquake or Tsunami Hazards on the Oregon Coast. Charland, J.W. and Priest, G.R. DOGAMI (1992) Open File Report 0-95-02.

Beach Processes and Sedimentation. Komar, P.D. (1998) Prentice-Hall Inc (2nd Edition, pp. 544)

Erosion Impacts Along the Oregon Coast: Report to the Oregon Department of Land Conservation and Development. Komar, P.D., Diaz-Mendez, G., and Marra, J.J. (1999) Department of Land Conservation and Development (pp. 39)

The Rational Analysis of Setback Distances: Applications to the Oregon Coast. Komar, P.D., McDougal, W.G., Marra, J.J. and Ruggiero, P., (1999) Shore and Beach (Vol. 67, pp. 42-49)

The Wave Climate of the Pacific Northwest (Oregon and Washington): A Comparison of Data Sources. Tillotson, K. and Komar, P.D. (1997) Journal of Coastal Research (Vol. 13:2, pp. 440-452)

Erosion of Netarts Spit, Oregon: Continued Impacts of the 1982-83 El Nino. Komar, P.D., Good, J.W., and Shih, S.M. (1989) Shore and Beach (Vol. 56, pp. 11-19)

Regional Sediment Dynamics and Shoreline Instability in Littoral Cells of the Pacific Northwest. Peterson, Curt D., Hansen, M., Briggs, G., Yeager, R., Saul, I.A., Jackson, P.L., Rosenfeld, C.R., White, G., Booth, B., Zhang, H., Assail, D., Terich, T., (1992) CZM 309 Program: Final Project Report

Cliff Erosion Along the Oregon Coast: A Tectonic – Sea Level Imprint Plus Local Controls by Beach Process. Komar, P.D., and Shih, M. (1993) Journal of Coastal Research (Vol. 9, pp. 747-765)

The Budget of Littoral Sediments – Concepts and Applications. Komar, P.D. (1996) Shore and Beach 64 (n. 3): 18-26

The Wave Climate of the Pacific Northwest. Komar, P.D., and Tillotson, K. (1997) Journal of Coastal Research (Vol. 13, pp. 440-452)

Coastal Erosion – Underlying Factors and Human Impacts. Komar, P.D. (2000, January) Shore and Beach

Analysis of the Magnitudes of Foredune Erosion on the Oregon Coast. Komar, P.D. (1993) Department of Land Conservation and Development

Contents of Geotechnical Reports Related to the Impacts of Coastal Erosion and Related Hazards. Komar, P.D. (1993) Department of Land Conservation and Development

Coastal Erosion Processes and the Assessment of Setback Distances. Komar, P.D. et. al. (1997) Department of Land Conservation and Development

Analysis of the Susceptibility of Coastal Properties to Wave Erosion. Komar, P.D. (1993) Department of Land Conservation and Development

Cascadia Subduction Zone Tsunamis: Hazard Mapping at Yaquina Bay, Oregon. Priest, G.R., Myers, E., Baptista, A.M., Fleuck, P., Wang, K., Kamphaus, R.A., Peterson, K.D., (1997) Department of Geology and Mineral Industries

Explanation of Mapping Methods and Use of the Tsunami Hazard Maps of the Oregon Coast. Priest, G.R., (1995) Department of Geology and Mineral Industries

Estimates of Coastal Subsidence from Great Earthquakes in the Cascadia Subduction Zone, Vancouver Island, B.C., Washington, Oregon, and Northernmost California. Peterson, C.D., Barnett, E.T., Briggs, G.C., Carver, G.A., Clague, J.J., and Darienzo, M.E. (1997) Department of Geology and Mineral Industries

6.3 Internet Resources

The Oregon Coastal Index

http: //www.lcd.state.or.us/coast/index.htm

The primary purpose of The Oregon Coastal Index is to provide access to information about the state's program for managing coastal resources for present and future Oregonians. The index is a doorway to sites that have some relationship to Oregon's coast, to its coastal communities and to the resources that support those communities.

Department of Geologic and Mineral Industries

http://sarvis.dogami.state.or.us/coastal/default.htm

DOGAMI has compiled a variety of information specific to coastal programs. Questions regarding El Nino and La Nina, tsunami inundation maps, and the Pacific Marine Environmental Laboratory, can all be researched at this site. You will also find numerous links to other sites relevant to coastal processes and hazards.

Pacific Marine Environmental Laboratory (PMEL)

http://www.pmel.noaa.gov/tsunami-hazard

The Pacific Marine Environmental Laboratory Tsunami Program was created to mitigate the tsunami hazards affecting the Pacific Coast, Alaska, and Hawaii. The program is designed to reduce the impact of tsunami inundation through warning, guidance, mitigation, and hazard assessment. The PMEL web site includes sections on field observations, modeling and forecasting, tsunami events and data, inundation mapping, and the National Tsunami Hazard Mitigation Program, a joint effort of a consortium of state and federal agencies.

HazNet

http://www.haznet.org

In 1998, when El Nino had spawned violent weather around the globe, and when many scientists anticipated continuing weather extremes, the national Sea Grant network created HazNet, a Web site devoted to coastal hazards awareness and mitigation. The HazNet site gathers information and resources from Sea Grant programs, the National Oceanographic and Atmospheric Administration, and other public and private sources to help people meet the challenges presented by such natural hazards as riverine flooding, storm surge, coastal erosion, seismic events, and hurricanes. The site includes fact sheets, examples of community hazard mitigation plans, and a discussion of mitigation policy and planning tools relating to hazards and the built environment.

State of the Coast Report

http://state-of-coast.noaa.gov

The National Oceanic and Atmospheric Administration (NOAA) created the *State of the Coast Report* provided at this Web site in response to Al Gore's challenge to federal agencies to create a "report card" of environmental issues. The foundation of the report is a series of essays on important coastal issues; two of these essays are entitled "Population at Risk from Natural Hazards," and "Reducing the Impacts of Coastal Hazards." These thorough articles include overviews of the problem on a national scale, regional analyses, specific case studies, interviews with experts, suggested readings and references, and glossaries.

Planning for Natural Hazards: Reviewing your Comprehensive Plan

Coordination and consistency is essential to implementing plan policies that reduce landslide risk within your community. Your community should ask the following questions in reviewing your comprehensive plan to assist you in identifying resources to strengthen plan policies and implementing regulations:

- ❒ Have you made use of technical information and assistance provided by Oregon agencies to assist your community in planning for coastal hazards?
- ❒ What documents or technical assistance does your community need to find to further understanding of coastal hazards and begin the process of assessing community risk from coastal hazards?

Coastal Endnotes:

[1] Klarin, Paul. Personal Interview. May, 2000

[2] Department of Land Conservation and Development. (1998). Chronic Coastal Natural Hazards Model Overlay Zone. Oregon: Shoreland Solutions.

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[4] Department of Land Conservation and Development. (1998). Chronic Coastal Natural Hazards Model Overlay Zone. Oregon: Shoreland Solutions.

[5] Marra, John. Personal Interview. May, 2000

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[7] Seismic Hazards Technical Resource Guide, (2000) Community Planning Workshop. Department of Land Conservation and Development.

[8] Department of Land Conservation and Development. (2000). Coastal Division. Salem, Oregon: John Marra.

[9] The Pacific Northwest Coast: Living with the Shores of Oregon and Washington. Komar, P.D., (1997) Duke University Press.

[10] Department of Land Conservation and Development. (2000). Coastal Division. Salem, Oregon: John Marra.

[12] Oregon Sea Grant. (1994). Recommendations of the Coastal Natural Hazards Policy Working Group. Oregon.

[13] Littoral Cell Management Planning along the Oregon Coast (1995)

[14] Collins, Peggy, Personal Interview. 10 May 2000

[15] Beier, Ann. Personal Interview. 23 May 2000

[16] Army Corps of Engineers Regulatory Permit Program Brochure. (1989) United States Army Corps of Engineers.

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[18] Department of Land Conservation and Development. (1994) Appraisal of Chronic Hazard Alleviation Techniques. Oregon: Shoreland Solutions.

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[20] (ibid.)

[21] Federal Emergency Management Agency, http://www.fema.gov (March 2000)

[22] Murray, Joseph. Personal Interview. 9 Feb 2000.