COASTAL NATURAL HAZARD INFORMATION FOR
PROPERTY OWNERS, SELLERS, AND PROSPECTIVE BUYERS
IN THE PACIFIC NORTHWEST
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IN THE PACIFIC NORTHWEST

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PREFACE

About NCIC

The Northwest Coastal Information Center (NCIC) is a regional reference and referral service providing local, state and federal agencies, legislators, educational institutions, environmental organizations, private industry, public interest groups, and concerned citizens with useful information in such fields as estuarine and coastal processes, environmental laws and regulations, and coastal management techniques.

The primary goals of the NCIC program are to:

1) Increase the awareness of this broad user community of the existence of coastal information sources;
2) Enhance the accessibility of coastal information, making it easier and less costly to obtain;
3) Improve the availability of existing coastal information by providing centralized points for acquisition and dissemination which do not otherwise exist; and
4) Enhance the evaluation of information by acting as an information broker or middleman between those users who need expert advice and those who can provide such advice.

NCIC Publication Series

The NCIC publication series was initiated in 1979 to summarize available information on coastal topics for which there was an increasing demand from various user groups. This series has included the production of bibliographies from extensive literature searches conducted for clients, and production of short summaries of information compiled from various existing sources.
INTRODUCTION

The Pacific Northwest coastal zone is an attractive area which has been experiencing increased development pressures for residential, business, and recreational facilities. The unique beauty of this coastal zone has been created by geologic processes and the interaction of ocean forces with adjacent landforms. The sheer cliffs, sand spits with long beaches, sand dunes, and floodplains of coastal rivers and streams, despite their beauty and appeal, can be sites of natural hazard activity which destroy buildings and property, and endanger human lives.

As suitable building sites become scarce, the pressure to develop in natural hazard areas increases. Many citizens are not aware of the potential dangers which exist in hazard-prone areas. In response to this lack of awareness, the following information has been compiled to aid property owners, sellers, and buyers learn about natural hazards along the Pacific Northwest coast.

The following summary of information will briefly describe common natural hazards and discuss their significance in relation to various land types found along the coast; provide some guidelines for identifying possible hazard areas and indicate some special precautions which may be necessary in such areas; and list sources of additional information for those seeking answers to specific questions or problems.
COASTAL NATURAL HAZARDS

Natural hazards exist in many geographic locations. However, several natural hazards are commonly found along the Pacific Northwest coast. Natural hazards vary in severity, and are often "triggered" by natural or man-induced actions. Common natural hazards associated with coastal areas include:

1. Ocean flooding - inundation of lowland areas by salt water resulting from storm surge, tidal flooding, or tsunamis (high velocity, long period waves generated at sea by such occurrences as earthquakes, under-water volcanic eruptions, huge landslides into water, or nuclear explosions).

2. Stream flooding - bank overflow and inundation of lowlands occurring when stream channels can no longer contain all the water flowing into them.

3. High ground water - water table is close to the ground surface forming ponds in areas where the water table intersects the ground surface.

4. Mass movement - movement of rock and soil materials downslope in response to gravity; commonly classified as slump, debris avalanche, mudflow, soil creep, or earthflow.

5. Rockfall - extremely rapid drop of bedrock blocks and boulders from very steep slopes and sea cliffs.

6. Wave erosion - removal and/or damage to land by waves breaking against the shore; affects headlands, beaches, marine terraces, sea cliffs, and sand dunes in varying degrees.

7. Stream bank erosion - undercutting of banks of streams within flood-plain areas resulting from the force of the current being directed against the bank.

8. Wind erosion - transport of sand by wind when an abundance of sand, absence of protective vegetation over large areas, and persistent winds occur over much of the year.
LANDFORMS AND ASSOCIATED NATURAL HAZARDS

Beaches, sand spits, sand dunes, sea cliffs, headlands, lakes and marshes, marine terraces, hillslopes, and floodplains are typical coastal landforms susceptible to damage from natural hazards. Particular landforms, in addition, are more prone to damage from specific hazards. For example, headlands may experience rockfalls or landslides while sand spits would not. The following table lists common coastal landforms, brief descriptions of those landforms, and the hazards commonly associated with those landforms.
<table>
<thead>
<tr>
<th>Land Type</th>
<th>Description</th>
<th>Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaches and Sand Spits</td>
<td>Transient, ever-changing landforms created by sand erosion and deposition present as continuous, broad sandy stretches, or short sandy beaches extending from the low tide line landward to the line of effective wave or tidal action, broken by headlands, bays and estuaries.</td>
<td>Ocean flooding</td>
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<td></td>
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<td>Tsunamis</td>
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<td></td>
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<td>Differential settling</td>
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<td></td>
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<td>Wave erosion</td>
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<tr>
<td></td>
<td></td>
<td>Possible liquefaction</td>
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<td></td>
<td></td>
<td>during earthquakes</td>
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<td></td>
<td></td>
<td>Caving of excavations</td>
</tr>
<tr>
<td>Sand Dunes</td>
<td>A ridge or hill of sand formed by wind including foredunes, hummock dunes, stabilized dunes, parallel-ridge dunes, transverse-ridge dunes, oblique-ridge dunes, and parabola dunes.</td>
<td>Wind erosion</td>
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<td></td>
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<td>Sand deposition and advancing dunes</td>
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<td></td>
<td></td>
<td>Wave erosion (foredunes)</td>
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<tr>
<td></td>
<td></td>
<td>Ground water flooding</td>
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<tr>
<td></td>
<td></td>
<td>Impermeable pans of iron-cemented sands at shallow depths</td>
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<tr>
<td></td>
<td></td>
<td>(high water table areas)</td>
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<tr>
<td>Sea Cliffs</td>
<td>Steep erosional cliffs bordering the ocean without an intermediate beach, frequently associated with rocky protrusions with oversteepened faces.</td>
<td>Wave erosion</td>
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<td></td>
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<td>Rockfall</td>
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<td></td>
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<td>Landslide</td>
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<tr>
<td>Headlands</td>
<td>A promontory or rock along the coast that is relatively resistant to erosion, so the rate of retreat is usually quite slow.</td>
<td>Wave erosion</td>
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<tr>
<td></td>
<td></td>
<td>Rockfall</td>
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<tr>
<td></td>
<td></td>
<td>Landslide</td>
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<tr>
<td>Deflation Plains, Wet Interdunes, Lakes, and Marshes</td>
<td>Wet areas or standing water found immediately inland from beaches and dunes or next to rivers and/or estuaries, formed by natural impoundment of streams or a water table intersecting the ground surface.</td>
<td>High ground water</td>
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<td>Flooding</td>
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<td>Caving of excavations</td>
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<td></td>
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<td>Compressible soils</td>
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<td></td>
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<td>Ocean flooding by waves</td>
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<td></td>
<td></td>
<td>cut through foredunes</td>
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<tr>
<td>Land Type</td>
<td>Description</td>
<td>Hazards</td>
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<tr>
<td>Marine Terraces</td>
<td>Flat, wave-cut platforms with surfaces usually sloping gently seaward, or ending at the beach in a bluff.</td>
<td>Ocean flooding</td>
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<td>Wave erosion</td>
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<td></td>
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<td>Stream bank erosion</td>
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<td></td>
<td></td>
<td>Caving of excavations near edges of terraces</td>
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<tr>
<td></td>
<td></td>
<td>Debris tossed onto terrace by sea waves</td>
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<tr>
<td></td>
<td></td>
<td>Bogs formed in poorly-drained areas</td>
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<tr>
<td>Floodplains</td>
<td>Broad, flat, low-lying areas adjacent to streams and rivers formed from river deposits of sediment and usually containing meandering streams.</td>
<td>Stream flooding</td>
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<tr>
<td></td>
<td></td>
<td>High ground water</td>
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<tr>
<td></td>
<td></td>
<td>Sedimentation</td>
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<td></td>
<td></td>
<td>Settling of ground and/or undercutting of structures</td>
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<tr>
<td></td>
<td></td>
<td>Stream bank erosion</td>
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<td></td>
<td></td>
<td>Sheet scour erosion</td>
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<tr>
<td></td>
<td></td>
<td>Caving of excavations</td>
</tr>
<tr>
<td>Hillslopes and Seaward-dipping Slopes</td>
<td>Ground that forms a natural or artificial incline usually on the side of a rounded natural elevation often composed of mixed layers of consolidated and unconsolidated stata inclined toward the ocean.</td>
<td>Slump</td>
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<tr>
<td></td>
<td></td>
<td>Soil creep</td>
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<tr>
<td></td>
<td></td>
<td>Mudflow</td>
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<td></td>
<td></td>
<td>Debris slide</td>
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<td>Runoff erosion</td>
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</table>
IDENTIFYING POTENTIAL NATURAL HAZARDS

Coastal natural hazards cannot always be easily identified. While some hazards are clearly visible in the field, other hazards remain hidden to all but the trained observer. In addition, it is not always possible to determine the severity of a natural hazard. In many instances, poor planning can aggravate the environmental situation and "trigger" destructive activities.

The following lists of questions have been compiled to aid untrained observers locate and identify potentially hazardous situations in the coastal zone. The list should be used while in the field during examination of property and/or buildings. If, after careful inspection, a hazard is suspected, appropriate actions can be taken. These actions may include requesting an in-depth geologic, engineering, soils, and vegetation study of the area by a registered engineer, geologist, soil scientist, or other person with appropriate background and training to analyze the specific hazard.

BEACHES AND SAND DUNES

1. Which direction is the shoreline moving—seaward or landward? This should be checked for the past twenty years since temporary changes (for 1-3 years) cannot provide an overall picture of shoreline movements. Consulting historical county maps and aerial photographs (preferred over maps) can be beneficial.

2. What is the relative rate of erosion? Signs of rapid erosion include: tree stumps and clumps of bank on the beach; steep scarps, especially with protruding plant roots; a short distance between the high-tide shoreline and the first dune; evidence of previous attempts to stabilize the shoreline (remnants of groins, seawalls, and bulkheads); and a steep scarp in a foredune in which the plant community immediately above the scarp contains intermediate stabilization species such as scotch broom and tree lupin and/or semipermanent stabilization species such as shorepine and red alder and/or permanent stabilization species such as Sitka spruce and western red cedar (these species would not occur on the ocean side of an active foredune, however, the presence of these species above a steep scarp would indicate that the ocean side of a foredune had been recently undercut by the ocean, or that an active foredune had been cut through so that the plant species on the back of the dune are exposed above the scarp).
3. What happened to the beach during the last big storm? Did erosion occur? Did most of the sand return within the next few months? Was there damage to any houses? Was debris such as drift logs or rocks thrown into houses? If possible, check with residents of the area to learn about past storm damage, or check back issues of the local newspapers for stories appearing during the storm season.

4. Are neighbors constructing bulkheads, groins, or jetties on their property? If so, there is the possibility that erosion to adjoining pieces of property will occur as a result of these activities.

5. Are there any streams draining into the ocean near the property? During ocean flooding sea level rises and hinders stream drainage causing flooding near the mouth of the stream channel.

6. Has there been a history of tsunamis in the area? Tsunamis, when they arrive at the shore, cause flooding of tidelands and marshes and lowlands; damage moorings, vessels, and structures built near the water; and injure or drown people on beaches, in isolated coves, and on low-lying terrain. Check with residents on the local history and/or consult historical documents with local planners, historical societies, or libraries.

7. Are there accumulations of driftwood on the beach or logs buried in the sand? Materials carried onto shore or uncovered by waves can be tossed inland during storm periods.

8. Are structures constructed near the zone of wave attack? Waves constantly wear away landforms including beachfront and sand spits.

9. Do foredunes form one continuous line parallel to the beach, or are there breaches between dunes? These breaches could provide avenues through which waves and wind-blown sands can funnel.

10. Is there standing water in any sand dune areas? This can indicate a high water table, poor drainage, or flooding.

11. Are sand dunes stabilized with vegetation, or are they actively moving? Moving or advancing sand dunes can quickly and easily bury roads, buildings, and other structures.

12. Is there any evidence of sand-blasting on established structures? During high wind periods damage from sand-blasting can occur in addition to damage to roofs of structures.

13. Is there a septic tank and drainfield on the property? If the facilities are not adequate, contamination of the water supply can occur or fouling of beach areas can occur.

14. Are there regulations to control off-road vehicles in dune areas? Vehicles can destroy stabilizing dune vegetation and set sand dunes in motion. Do local regulations and politics assure long-term protection for dunes?
15. Are there any structures blocking winds? Blockage of winds in dune areas will cause sand to be deposited in the lee of the blockade. Parking lots, roads and lawns have been covered in this manner.

CLIFFS, HEADLANDS, HILLSLOPES, TERRACES

1. What types of materials make up the cliff—solid rock or gravel and shale? Solid rock will not erode as quickly as gravel. A layer of shale or unconsolidated material between hard-rock layers can indicate potential landslide hazards for structures built above.

2. Is the base of the cliff littered with evidence of previous cliff failure? Do not disregard a clean, smooth beach as the waves may have removed any signs of erosion at high tide.

3. Examine the cliffs for layering in the geologic formation. If layers are present, do they incline toward the sea? If they do, this can provide a natural "slide" for cliff failure into the water.

4. What has been the history of bluff failure in the area? Are there any remnants of roads or foundations which have partially disappeared? Does the deed to the property or do other records show any other lots between yours and the water? This could provide evidence that a similar lot may have already eroded.

5. If the lot is on an eroding site, is the lot sufficiently deep to allow the structures to be moved back if threatened? Local zoning ordinances should be checked for minimum lot sizes and set-back regulations.

6. Are there any landfills on the upper portions of slopes or excavating at the toes of slopes? These activities can initiate a landslide.

7. Are there any roads constructed across steep, unstable terrain? This can initiate a landslide.

8. Is the property vegetated? Clearcutting vegetation with consequent destruction of soil-binding roots on steep slopes can initiate a landslide.

9. Is the property a marine terrace? Within some marine terrace soils moisture can accumulate between soil layers under ground from runoff and septic tank drainage. This moisture creates a slick upon which the overlying soil layers can rapidly slide. Construction on the edges of marine terraces can initiate landslides.

10. Are there bent trees and/or water-filled sag ponds visible? These may indicate landslide areas with slowly-moving substrate. This type of movement can cause continual damage to a structure with increasing maintenance costs.

11. Are cliffs located near structures or recreation property? Rockfalls can occur as blocks and boulders break loose from steep slopes and sea cliffs and drop rapidly to the ground.
12. Are there accumulations of water or moisture along the base of cliffs or hillslopes? Are there seeps or damp spots on cliff or slope faces? This moisture could accumulate between bedding planes and provide a slick surface for landslides.

FLOODPLAINS AND MARSHES

1. What is the elevation of the property? The level of the 100-year floodplain is recommended as a minimum for construction. Building in the floodplain may not be prohibited, but insurance costs will probably be more; your house will probably cost more to construct as a result of site-specific design modifications; and should there be a flood, your life may be in danger.

2. What flood prevention measures are present? Flood prevention measures including channelization and diking can worsen flooding downstream from the modified section of channel by moving the flood waters downstream faster than they would normally flow, causing a higher flood peak to form downstream.

3. Are there any artificial channel fills on the property or within the floodplain? Artificial channel fills can decrease the capacity of the stream channel to contain its waters by constricting the size of the stream channel.

4. Has the property or lot been artificially elevated? This is probably an indication that flooding may be a persistent problem, or has been a problem in the past.

5. Are there high water marks present? This is an indication that recent flooding has occurred.

6. How close are buildings or roads to outside edges of meander bends of streams? Objects built too near outside edges of meander bends can be undercut by streams.

7. Have the boundaries between state-owned and privately-owned lands, especially on waterfront sites, been clearly defined? These boundaries are important when erosion and accretion issues surface, or when leasing of land is necessary.

8. Is the property suitable for septic tanks? If so, are there strong, well-enforced regulations to protect ground water from pollution by septic tanks and cesspools? Frequently a layer of marsh mud, buried by natural processes or by man, prevents septic tank effluent from percolating down. If the area becomes contaminated in the future, construction of an expensive central sewage collection system may be necessary.

9. Is there evidence of shrink-swell (i.e. cracks in structures or road surfaces)? Shrink-swell behavior of clay-rich soils can cause future damage.
10. Are there any indications of differential settling of large to moderate-sized structures?

11. What happens to the lot during rainy weather? Areas with high ground water can become marshes during wet seasons as rain accumulates in areas with poor drainage or high water tables.

12. Does the property fall within the jurisdiction of the National Floodplain Insurance program? There may be specific restrictions on land use in such lands.

13. If vegetation borders streams, is it well-established? In areas with frequent flooding there will be few well-established or older trees and shrubs and an abundance of saplings or semi-permanent shrubs and grasses.

14. Have marsh areas been diked in the past? Have any of the dikes been breached? There may be legal restrictions on what can or cannot be done to land that has been reclaimed by estuaries or streams. In addition, there may be disputes with land ownership in such situations.
CONSTRUCTION IN NATURAL HAZARD AREAS

Construction can occur in most coastal areas where minor hazard damage potential exists. In most cases the hazard will not disappear, but with careful planning, stabilization and construction techniques, work can proceed with minimal impacts to the environment or the structure. Specific guidelines, design criteria, and zoning ordinances have been designated by local, state, and federal agencies for application in sites where natural hazard damage potential exists. The following list of statements has been compiled which highlight some of these guidelines, regulations, and design criteria.

1. Review background information, plans and governmental regulations that affect development. A thorough review of information and approval requirements will save time and money, and insure that the governmental approval process will proceed as quickly as possible. The initial contact should be made with local planning commissions or planning agencies.

2. Be sure buildings and building site plans conform to city and county zoning regulations regarding type of structure, location with respect to terrain, and other provisions of applicable zoning laws.

3. In flood-prone locations, be sure to check with the National Floodplain Insurance program. Usually the local planning commission or planning agency can provide information on this program.

4. Be sure all applicable permits have been obtained before construction begins. In some cases a detailed geologic, engineering, or soils report will be necessary before issuance of permits. Construction in wetland or in navigable waters will require a permit from the U.S. Army Corps of Engineers.

5. Construction activities should emphasize structural soundness, even if it means an increase in building costs of up to 10 percent.

6. When constructing a building on pilings or posts, be sure the floors are securely fastened to each pile.

7. Choosing the exact site of a structure is extremely important in hazard-prone areas. The following should be taken into consideration: climate, flooding, ground water table, geology, stability of the site especially in sandy areas, and soil composition.
8. Roof design is important in windy locations. The more planes the roof is broken into, the less lift the wind can generally apply. A hip roof sloping in four directions is usually more secure than a gable roof sloping in two directions.

9. Determine weather conditions which exist in your area. Design for the worst, working in other needs around safety.

10. Does the location exhibit signs of ground subsidence or sinking? If so, this must be taken into account in design and access routes.

11. In some locations it is wise to design a structure to withstand the impact of floating debris. If necessary, consult with a construction engineer to determine minimum and maximum resistance values.

12. Structures must not block access to public beaches. Zoning ordinances should be checked along with state laws.

13. Plan to retain as much natural vegetation as possible to protect against landslides on cliffs, and wind and wave erosion. If natural vegetation is removed, plan to revegetate in an appropriate fashion.

14. If septic tanks are in use, care should be taken that tanks are installed properly and contamination of groundwater will not occur.

15. If the water supply is derived from surface water sources, be sure to check into the local supply to insure that it is properly managed and maintained, and that the water is of acceptable quality.

16. Persons planning on utilizing an existing well supply for water should make sure that the well is properly constructed, and that water quantity and quality is adequate. Those considering drilling a new well should hire only a licensed well contractor and driller, and should thoroughly examine the suitability of the site for providing an adequate ground water supply.

17. Be sure to adhere to building codes. Building codes are designed to provide adequate safety for inhabitants.

18. Are you prepared to take all the risks of partial or total destruction for the sake of the benefits of your location?
AGENCY RESPONSIBILITIES

Within the Pacific Northwest there is no single agency or office which has responsibility for managing coastal hazards or hazardous areas. Instead, there are numerous agencies and/or offices with advisory or jurisdictional authority for specific aspects of individual hazards.

The following list has been compiled to aid in directing individual questions to appropriate sources for answers. Following this list there is a listing of the agency address and phone numbers.
### FEDERAL AGENCIES

<table>
<thead>
<tr>
<th>Agency</th>
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<tbody>
<tr>
<td>U.S. Army Corps of Engineers,</td>
<td>Develops flood plain information studies based on the flood occurrences of the 100-year and larger floods; and plans and constructs flood control projects to regulate flood flows. Establishes criteria to guide in flood plain usage and development of flood hazard reduction programs.</td>
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<tr>
<td>Flood Plain Management Section</td>
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<tr>
<td>U.S. Army Corps of Engineers,</td>
<td>Issues dredge and fill permits for work in navigable waterways(^1) and all wetlands(^2) attendant to navigable waters. Responsible for enforcement of permit compliance.</td>
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<tr>
<td>Permit Section</td>
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<tr>
<td>U.S. Army Corps of Engineers,</td>
<td>Prepares information on shorefront protection techniques and practices.</td>
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<tr>
<td>Navigation Section</td>
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<tr>
<td>U.S. Bureau of Land Management,</td>
<td>Identifies limiting physical factors including: erosion susceptibility, earthquake faultlines, areas of periodic or potentially severe flooding, major landslide areas, and areas with unstable soils.</td>
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<tr>
<td>Division of Resource Management</td>
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<tr>
<td>U.S. Department of Housing and</td>
<td>Reviews environmental statements and development proposals with particular interest in potential flood-prone site characteristics. Sets guidelines to determine the feasibility of Federal financing of mortgage and credit in areas that may be subject to flooding; and designates areas that are eligible for flood plain insurance. Reviews impact statements and sets guidelines to determine feasibility of financing mortgages and credit in areas that may be subject to construction constraints imposed by various geologic conditions (i.e. landslides, seismic movement, erosion hazard, sheet and gully erosion, etc.).</td>
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<tr>
<td>Urban Development</td>
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</tbody>
</table>

\(^1\)Those waters of the U.S. which are subject to the ebb and flow of the tide, and/or are presently, or have been in the past, or may be in the future susceptible for use for purposes of interstate or foreign commerce. Generally determined by the U.S. Army Corps of Engineers and the U.S. Coast Guard.

\(^2\)Those land and water areas subject to regular inundation by tidal, riverine, or lacustrine flows. Generally included are inland and coastal shallows, marshes, mudflats, estuaries, swamps, and similar areas in coastal and inland navigable waters.
<table>
<thead>
<tr>
<th>Agency</th>
<th>Description</th>
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<tr>
<td>U.S. Environmental Protection Agency</td>
<td>Develops guidelines and reviews the issuance of permits to discharge and fill into navigable waters and adjacent wetlands. Administers sanitary and environmental health standards for drinking waters supplied to individuals and non-licensed commercial businesses.</td>
</tr>
<tr>
<td>U.S. Fish and Wildlife Service</td>
<td>Reviews wetlands projects to determine the effects of the developments on fish and wildlife resources and recommends measures for the prevention of losses and damages to those resources.</td>
</tr>
<tr>
<td>U.S. Geological Survey</td>
<td>Provides geological and geophysical information for the effective planning of programs for development and management of natural resources and the efficient planning and operation of interrelated projects at Federal, state, and local levels.</td>
</tr>
<tr>
<td>U.S. Soil Conservation Service</td>
<td>Identifies hazard characteristics by soil association indicating: slope, runoff, erosion hazard to dwellings without basements, septic tank absorption fields, sewage lagoons, local roads and streets, pond reservoirs, and pond embankments and dikes. Provides engineering interpretations from soils data including: soil features affecting highway location, farm ponds, foundations for low buildings, terraces and diversions, grassed waterways, and winter grading; limitations on residential siting; and selection of plant varieties, seeding methods and rates, and cultural practices for establishing stabilizing vegetation. Provides technical planning, construction supervision, and financial aid to local project sponsors in providing flood protection through the conservation of upstream watersheds and the construction of dams, reservoirs, and channel work.</td>
</tr>
<tr>
<td>Oregon Department of Emergency Services</td>
<td>Provides current reports on weather, roads and flood stages and identifies hazards. Advises and assists local jurisdictions regarding all emergency-related plans including warning, response, and recovery.</td>
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<tr>
<td>Oregon Department of Environmental Quality, Water Quality Control Division</td>
<td>Provides information relative to issuance and review of permits for waste discharge into surface waters, and enforces permit compliance. Implements standards to prevent water pollution, health hazards, and nuisance conditions and control on-site sewage disposal.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Oregon Department of Environmental Quality, Subsurface Sewage Disposal Section</td>
<td>Provides information on subsurface sewage disposal systems (i.e. septic tanks), issuance and review of permits for subsurface waste discharge, and enforcement of permit compliance.</td>
</tr>
<tr>
<td>Oregon Department of Fish and Wildlife</td>
<td>Technical consulting in reviewing stream alteration work including: stream alteration and channel change; commercial sand and gravel removal; filling in streams, lakes, estuaries, marshes and wetlands; standards for bank stabilization; and organic debris removal; to ensure that fish and wildlife are not unnecessarily degraded or diminished.</td>
</tr>
<tr>
<td>Oregon Department of Geology and Mineral Industries</td>
<td>Publishes bulletins identifying mass movement (landslides and related processes) by type including: falls, slides, mudflows, earthflows; also bulletins identifying flood plain areas, groundwater tables, streambank erosion, earthquakes, and adverse engineering conditions of bedrock. Maintains an extensive geology library available to the public.</td>
</tr>
<tr>
<td>Oregon Department of Human Resources, Health Division</td>
<td>Provides technical assistance, training, policy development and consultation to the local health departments concerning sanitary and environmental health standards. Inspects and certifies for sanitary compliance in the fields of safe drinking water supplies to licensed commerical ventures and recreational facilities. Enforces health hazard violations.</td>
</tr>
<tr>
<td>Oregon Department of Land Conservation and Development</td>
<td>Reviews planning activities and land use actions of local, state, and Federal government units for compliance with statewide planning goals. Resolves conflicts between plans and identifies capabilities and limitations of resources. Assures proper protection and management of critical geographic areas, and implements state coastal zone management program.</td>
</tr>
<tr>
<td>Oregon Department of Transportation, Highway Division</td>
<td>Maintains highways and bridges and has data on hazards which interfere with highway construction and maintenance.</td>
</tr>
</tbody>
</table>
Oregon Department of Transportation, Parks and Recreation Division
Requires permits for beach construction, shorefront protection on state lands, and removal of sand or installation of pipelines, cables and conduits. Also responsible for beach assess and management.

Oregon Department of Water Resources
Identifies flood-prone areas, flood elevations, other flood information for floods of between 10 and 500-year intervals. Investigates, defines, and regulates critical groundwater basins, and aquifers within the state. Provides information on water law and well construction standards, generates and distributes groundwater reports, and maintains well construction records. Reviews design, construction maintenance, and operation of dams and hydraulic structures. Prepares flood insurance rate study reports for the U.S. Department of Housing and Urban Development. Each report identifies 100-year, 500-year flood plain, floodways, elevation reference marks, and flood insurance rate zones.

Oregon Division of State Lands
Responsible for issuing fill and removal permits and enforcement of such permits in any waters of the state including beds of rivers, estuaries, lakes and ocean lands up to 3 miles offshore. Ownership of all submerged and submersible lands in the state is monitored by this agency. Management of state-owned beds and banks of navigable waterways including leasing for special long-term use of submerged and submersible lands, such as marinas, docks, and commercial development is handled through this office.

Oregon Soil and Water Conservation Commission
Identifies areas of streams that are subject to erosion. Interested in control and prevention of soil erosion.

Washington Department of Ecology, Office of Water Programs
Issues both surface and groundwater rights permits. Examination and licensing of well drillers and enforcement relating to the actual construction of wells. Advises on problems of saltwater intrusion in wells, especially for those providing drinking water. Provides analyses on problems of groundwater supplies. Administration and program management of municipal sewage treatment facilities. Water quality planning and management. Prepares resource damage assessments for oil spills, fish kills, and other significant projects or problems.

WASHINGTON STATE AGENCIES
Washington Department of Ecology, Office of Land Programs

Administers the shoreline and coastal zone planning and management acts, solid waste and resources recovery, and flood insurance. Conducts data studies and surveys that aid in the maintenance of water quality standards. Issues flood zone permits for any works, structures and improvements which adversely influence the regimen of the stream or might adversely affect the security of life, health, and property against damage by flood waters. Assists cities and counties in implementation of State Environmental Protection Act guidelines and regulations.

Washington Department of Emergency Services

Provides disaster relief services needed as a result of flooding, earthquakes, severe storms, and other emergencies. Disaster preparedness planning by identifying hazard agents; outlining the nature, location and occurrence interval for each hazard agent; analyzing and synthesizing existing hazard data in the form of mitigation reports, maps, publications; and developing preparedness plans and programs at the state level. Coordination of search and rescue missions in the coastal zone.

Washington Department of Fisheries

Must approve projects which divert the natural flow or utilize the waters of any stream of the state and which might impact fish and fish habitats.

Washington Department of Game

Reviews permit applications concerned with pollution, development and construction on tideland marshes and other factors affecting the survival of fish and wildlife.

Washington Department of Natural Resources

Major proprietor and manager of marine and upland property including tidelands, harbor areas, and marine beds. Regulates the operation of a log collection and patrol program in coastal waters. Provides information and research background for private industry and individuals such as resource inventories, and road engineering and design studies. Leases tidelands for purposes of aquaculture, small boat moorage buoys adjacent to residential property, and other marine-related uses. Prepares policies and guidelines for marine land management. Cooperates with coastal counties in preparation of maps and data relating to potential geologic hazards such as landslides, slope stability, solid waste disposal site suitability, settleline of lands, and location of construction materials. Publishes public documents relating to marine lands and maintains a resource inventory utilizing maps, aerial photography and remote sensing data. Issues dredging permits for removal of rock, gravel, sand and silt from state-owned beds of navigable waters, tidelands and shorelands.
<table>
<thead>
<tr>
<th>Agency</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington Department of Social and Health Services, Water Supply and Waste Section</td>
<td>Regulatory and non-regulatory responsibility to protect public water supplies, control solid and liquid waste disposal, prevent public health hazards related to recreational facilities, and provide sanitary control of shellfish taken for human consumption. Regulates design, construction and maintenance of on-site sewage disposal systems. Monitors contamination of groundwater from sewage disposal systems.</td>
</tr>
<tr>
<td>Washington Department of Transportation</td>
<td>Maintains highways and bridges and has data on hazards which interfere with highway construction and maintenance.</td>
</tr>
<tr>
<td>Oceanographic Commission of Washington</td>
<td>Non-regulatory agency which studies, advises, and informs relative to matters of marine science. The Commission and its non-profit research and educational corporation, the Oceanographic Institute of Washington, perform marine research in response to legislative and agency needs and serves as a source of public information on oceanographic affairs.</td>
</tr>
<tr>
<td>Shoreline Hearings Board</td>
<td>Final administrative arbiter relative to decisions made under the state's Shoreline Management Act.</td>
</tr>
</tbody>
</table>

**LOCAL AGENCIES**

<table>
<thead>
<tr>
<th>Agency</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>County Planning Commissions or Departments</td>
<td>Each county must inventory hazards and hazard areas within its boundaries. The form and presentation of data may vary from county to county. Land use planning and zoning ordinance information is available. Flood plain management regulations in the coastal and all riverine flood plains of the coastal zone counties are the responsibility of local governments.</td>
</tr>
<tr>
<td>City Planning Departments</td>
<td>Within city boundaries specific zoning ordinances and land use regulations exist. Land use planning and zoning ordinance information is available.</td>
</tr>
<tr>
<td>County Building Departments</td>
<td>Responsible for administering the building codes for construction within county boundaries. Speciality codes may exist for electrical, mechanical, plumbing, and structural specifications.</td>
</tr>
<tr>
<td>City Building Departments</td>
<td>Responsible for adopting any or all sections of the building codes for construction within city boundaries.</td>
</tr>
</tbody>
</table>
AGENCY ADDRESSES

FEDERAL AGENCIES

U.S. Army Corps of Engineers

Portland District
P.O. Box 2946
Portland, OR 97208
(503) 221-6021

Seattle District
P.O. Box C-3755
Federal Center South
Seattle, WA 98124
(206) 764-3728

U.S. Bureau of Land Management

Oregon State Office
729 N.E. Oregon Street
P.O. Box 2965
Portland, OR 97208
(503) 231-5251

Coos Bay District
333 South Fourth Street
P.O. Box 1139
Coos Bay, OR 97420
(503) 269-5880

(Eastern Douglas, Coos, Curry)

Eugene District
1255 Pearl Street
P.O. Box 10226
Eugene, OR 97401
(503) 687-6650

(Lane)

Salem District
3550 Liberty Road South
P.O. Box 3227
Salem, OR 97302
(503) 399-5646

(Tillamook, Lincoln, Clatsop, Columbia)

Tillamook Resource Area
Naval Air Station
P.O. Box 152
Tillamook, OR 97141
(503) 842-7546
Spokane District
West 920 Riverside
Spokane, WA 99201
(509) 456-2570

U.S. Department of Housing and Urban Development

Region 10
520 S.W. 6th Ave.
Portland, OR 97204
(503) 221-2558

Region 10
1321 2nd Ave.
Seattle, WA 98101
(206) 442-7456

U.S. Environmental Protection Agency

Oregon Operations Office
Yeon Bldg., 2nd Floor
522 S.W. 5th Ave.
Portland, OR 97204
(503) 221-3250

Region 10
1200 Sixth Ave.
Seattle, WA 98101
(206) 442-5810

U.S. Fish and Wildlife Service

Region 1 Headquarters
Lloyd 500 Bldg., Suite 1692
500 N.E. Multnomah St.
Portland, OR 97232
(503) 231-6154

Olympia Area Office
2625 Parkmont Lane
Olympia, WA 98504
(206) 753-9578

Fisheries Assistance Office
3207 N.E. 78th
Vancouver, WA 98660
(206) 695-7605

U.S. Geological Survey

Water Resources Division
830 N.E. Holladay
P.O. Box 3202
Portland, OR 97208
(503) 231-2008
Water Resources Division
1201 Pacific, Suite 600
Tacoma, WA 98402
(206) 593-6510

Geologic Division
1107 N.E. 45th St.
Seattle, WA 98105
(206) 442-1995

Public Inquiries Office
West 920 Riverside Ave.
Spokane, WA 99201
(509) 456-2524

U.S. Soil Conservation Service

Federal Building
1220 S.W. 3rd Ave., 16th Floor
Portland, OR 97204
(503) 221-2755

Clatsop County SWCD
P.O. Box 716
Post Office Bldg.
Astoria, OR 97103
(503) 325-4571

Tillamook County SWCD
1503 Third Street
P.O. Box 187
Tillamook, OR 97141
(503) 842-2231

Coos County SWCD
238 N. Collier Courthouse
Coquille, OR 97423
(503) 396-3121

Lincoln County SWCD
29 S.E. Second Street
P.O. Box 156
Newport, OR 97365
(503) 265-2631

Umpqua SWCD
269 North Fourth Street
P.O. Box 295
Reedsport, OR 97467
(503) 271-2611
Curry County SWCD
360 N. Ellensburg Ave.
P.O. Box 666
Gold Beach, OR 97444
(503) 247-6825

Area Office
Evergreen Plaza Bldg.
Olympia, WA 98504
(206) 753-9454

Field Office
816 E. 5th
Olympia, WA 98504
(206) 753-9448

Area Office
STE 214, 300 120th N.E.
Seattle, WA
(206) 442-5449

Field Office
STE2-H, 510 W. Mill Plain Blvd.
Vancouver, WA 98660
(206) 696-7631

State Office
Rm. 360, U.S. Courthouse
920 West Riverside Ave.
Spokane, WA 99201
(509) 456-3711

OREGON STATE AGENCIES

Oregon Department of Emergency Services
43 State Capitol Bldg.
Salem, OR 97310
(503) 378-4411

Oregon Department of Environmental Quality

Subsurface Sewage Disposal Section
522 S.W. 5th
Portland, OR 97204
(503) 229-6218

Water Quality Control Division
522 S.W. 5th
Portland, OR 97204
(503) 229-6474
Clatsop County Branch
818 Commercial
Astoria, OR 97103
(503) 325-2611

North Coast Branch
3600 East Third St.
Tillamook, OR 97141
(503) 842-6637

Southwest Region
1937 W. Harvard Blvd.
Roseburg, OR 97470
(503) 440-3338

Coos Bay Branch
490 N. Second
Coos Bay, OR 97420
(503) 269-2721

Oregon Department of Fish and Wildlife
Main Office
506 S.W. Mill St.
Portland, OR 97201
(503) 229-5551

Marine Region
Marine Science Dr. Bldg. #3
Newport, OR 97365
(503) 867-4741

Oregon Department of Geology and Mineral Industries
1069 State Office Bldg.
Portland, OR 97201
(503) 229-5580

Oregon Department of Human Resources
Health Division
1400 S.W. Fifth Ave.
Portland, OR 97201
(503) 229-5861

Oregon Department of Land Conservation and Development
Main Office
1175 Court St., N.E.
Salem, OR 97310
(503) 378-4926

Newport Office
313 S.W. 2nd Suite B
Newport, OR 97365
(503) 265-8869
Oregon Department of Transportation

Highway Division
Transportation Bldg.
Salem, OR 97310
(503) 378-6570

Parks & Recreation Branch
525 Trade St., S.E.
Salem, OR 97310
(503) 378-6305

Parks & Recreation Branch
Region 2
607 Main Ave.
Tillamook, OR 97141
(503) 842-5501

Parks & Recreation Branch
Region 3
P.O. Box 1265
Coos Bay, OR 97420
(503) 269-9410

Oregon Department of Water Resources

Mill Creek Office Park
555 13th Street, N.E.
Salem, OR 97310
(503) 378-3739

Oregon Division of State Lands

1445 State Street
Salem, OR 97310
(503) 378-3805

Oregon Soil and Water Conservation Commission

1015 13th Street, S.E.
Salem, OR 97310
(503) 378-3810

County Planning Departments

Clatsop County Planning Commission
P.O. Box 179
Astoria, OR 97103
(503) 325-7441
Coos County Planning Department  
County Courthouse  
290 N. Central  
Coquille, OR 97423  
(503) 396-3121

Curry County Planning Department  
P.O. Box 1123  
Gold Beach, OR 97444  
(503) 247-7011

Douglas County Planning Commission  
Douglas County Courthouse  
Roseburg, OR 97470  
1-800-452-0991

Lane County Planning Division  
125 E. 8th  
Eugene, OR 97401  
(503) 687-4186

Lincoln County Planning Department  
County Courthouse  
Newport, OR 97365  
(503) 265-6611

Tillamook County Planning Department  
Room 7, County Courthouse  
Tillamook, OR 97141  
(503) 842-5511

WASHINGTON STATE AGENCIES

Washington Department of Ecology

Office of Water Programs  
Olympia, WA 98504  
(206) 753-3893

Office of Land Programs  
Olympia, WA 98504  
(206) 753-6874

Southwest Regional Office  
7272 Cleanwater Lane  
Olympia, WA 98504  
(206) 753-0132  
(Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom)

Northwest Regional Office  
4350 - 150th Ave.  
Redmond, WA 98052  
(206) 885-1900  
(Clallam, Grays Harbor, Jefferson, Mason, Pacific, Pierce, Thurston, Wahkiakum)
Washington Department of Emergency Services

4220 East Martin Way
Olympia, WA 98504
(206) 753-5255

Washington Department of Fisheries

115 General Administration Building
Olympia, WA 98504
(206) 753-6600

Washington Department of Game

600 No. Capitol Way
Olympia, WA 98504
(206) 753-5700

Washington Department of Natural Resources

Division of Marine Land Management
Public Lands Bldg.
Olympia, WA 98504
(206) 753-5327

Washington Department of Social & Health Services

Health Services Division
Office of Environmental Health Programs
Olympia, WA 98504
(206) 753-5955

Washington Department of Transportation

Highway Administration Building
Olympia, WA 98504
(206) 753-6005

Oceanographic Commission of Washington

Oceanographic Institute of Washington
152 Denny Way
Seattle, WA 98109
(206) 464-6272

Shorelines Hearing Board

Number One South Sound Center
Lacey, WA 98504
(206) 753-3025
LOCAL AGENCIES

County Planning Commissions (Oregon)

Clatsop County Planning Commission
P.O. Box 179
Astoria, OR 97103
(503) 325-7441

Coos County Planning Department
County Courthouse
290 N. Central
Coquille, OR 97423
(503) 396-3121

Curry County Planning Department
P.O. Box 1123
Gold Beach, OR 97444
(503) 247-7011

Douglas County Planning Commission
Douglas County Courthouse
Roseburg, OR 97470
1-800-452-0991

Lane County Planning Division
125 E. 8th
Eugene, OR 97401
(503) 687-4186

Lincoln County Planning Department
County Courthouse
Newport, OR 97366
(503) 265-6611

Tillamook County Planning Department
Room 7, County Courthouse
Tillamook, OR 97141
(503) 842-5511

County Planning Commissions (Washington)

Clallam County
P.O. Box 430
Port Angeles, WA 98362
(206) 457-4562

Grays Harbor County
207 1/2 E. Market
Aberdeen, WA 98520
(206) 532-8812
Island County
P.O. Box 698
Coupeville, WA 98239
(206) 678-5111

Jefferson County
Jefferson County Courthouse
Port Townsend, WA 98368
(206) 385-1427

King County
Administration Bldg., Rm. 430
5th and James
Seattle, WA 98104
(206) 344-4213

Kitsap County
916 Division Street
Port Orchard, WA 98366
(206) 876-7152

Mason County
P.O. Box 186
Shelton, WA 98584
(206) 426-5593

Pacific County
County Courthouse
P.O. Box 66
South Bend, WA 98586
(206) 875-5591

Pierce County
742 County-City Bldg.
Tacoma, WA 98402
(206) 593-4570

San Juan County
P.O. Box 947
Friday Harbor, WA 98250
(206) 378-2354

Skagit County
City Administration Bldg., Rm. 218
Mt. Vernon, WA 98273
(206) 336-2188

Snohomish County
Snohomish County Administration Bldg.
Everett, WA 98201
(206) 259-9311
Thurston County
Courthouse Annex
Olympia, WA 98501
(206) 753-8131

Wahkiakum County
Courthouse Annex
Cathlamet, WA 98612
(206) 577-3041

Whatcom County
401 Grand Ave.
County Courthouse
Bellingham, WA 98225
(206) 676-6750
REFERENCES


ADDITIONAL READINGS ON COASTAL HAZARDS

The following list of readings contains citations relating to coastal hazards. Many of the cited documents and reprints are on file at the Northwest Coastal Information Center. Further information regarding these documents can be obtained from the Northwest Coastal Information Center in Newport, Oregon.

Beaches/Beach Erosion


Sand Dunes/Dune Migration


Sand Dune Stabilization


Shore Protection/Bank Protection


Geology/Geologic Hazards


Landslides


Tsunamis/Coastal Storms


Flooding


Groundwater/Hydrology


Design/Development Guidelines


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Ternyik, N.E. 1979. Beach and dune implementation techniques: Site investigation reports. Oregon Coastal Zone Management Assoc., Inc.: Newport, Oregon. 27 pp. NCIC #1164.


Management


Bauer, W. n.d. Management policies within the shore-process corridor. (No bibliographic information). NCIC #1026.


Bibliographies/Information


Oregon Executive Department, Intergovernmental Relations Division. 1978. 1978 permit inventory of state requirements for developers or activities on specific sites. Salem, Oregon. 18 pp. NCIC #534.


