

11. Hazard Alleviation Techniques (HATs)

The preceding description of coastal erosion hazards and vulnerabilities leads to an obvious question: what can we do about them? That is, what measures can we take to reduce or eliminate impacts of hazardous events like beach erosion or flooding? Such measures are referred to as *hazard alleviation techniques* or HATs. Think of them as the tools that make up our toolkit for adapting to coastal hazards.

Outlined below are the main hazard alleviation techniques known to have been used in various places around the US and elsewhere. The list is long, but not all these would necessarily be effective or even possible to use in Tillamook County. For example, sand bypass systems are used on the east coast to move sand past inlets, which are common on barrier islands there. The much more rugged Oregon coast has no barrier islands and few inlets, so sand bypass is not likely to be useful for most conditions in Tillamook County.

Category 1: Hard (Structural) HATs

Structures parallel to shore:

Bulkhead – A vertical retaining wall to impound sand or soil thus prevent sloughing or erosion of coastal property. See <http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;186&g=41>

Revetment (including *riprap*) – A sloping rock face to protect beachfront property. See <http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;141&g=41>

Sand bypass – A hydraulic or mechanical system to move sand around some obstacle, typically an inlet, from an accreting area to an eroding area.

Seawall – A vertical wall, often concrete, primarily to protect property against wave attack. See <http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;140&g=41>

Sill – A low nearshore wall similar to a breakwater; it enables sand to build up behind it, creating a “perched beach.” See <http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;189&g=41>

Structures perpendicular to shore:

Groin – A short wall, usually one in a series, extending seaward from shore, intended to trap sand and reduce beach erosion. See <http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;188&g=41>

Jetty – A stone or concrete wall extending from the shore seaward at the mouth of river. See <http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;514&g=41>

“A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to climate change.”

Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report* (A Summary of IPCC’s Fourth Assessment Report (AR4)), p. 14. On-line at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

Structures offshore:

Artificial reef – An offshore underwater mound or ridge intended to reduce or redirect wave impact. A variety of materials including derelict ships intentionally sunk offshore have been used to create such reefs.

Breakwater – A nearshore rock or concrete wall extending above the water’s surface to reduce or redirect wave impact. See

<http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES;187&g=41>

Reef breakwater – A nearshore underwater mound or ridge intended to reduce or redirect wave impact. The most common type is made of rubble, but a variety of materials have been employed, including sand, thereby creating an artificial offshore sandbar. A variation on this theme is to enclose the sand in long geo-textile tubes called *sea bags*.

Category 2: Soft (Nonstructural) HATs

Beach nourishment – The replenishment of sand eroded from a beach by importing sand from some other location. Usually, the imported sand is pumped onto the beach from a barge anchored above an offshore source of sand known as a *borrow pit*. See NOAA’s *Beach Nourishment: A Guide for Local Government Officials* at

<http://www.csc.noaa.gov/beachnourishment/html/human/law/history.htm>

Buffer dune – A low artificial dune created along an eroding beach to dissipate wave energy and thereby reduce beach erosion. See “Navarre Beach: Providing Protection for the Panhandle,” in *Coastal Voice*, the newsletter of the American Shore & Beach Preservation Association, September 2010, p. 13.

Dune management – The reshaping of a dune’s height and shape with heavy equipment for purposes of flood control, view protection, or sand inundation prevention. See DLCD’s *Dune Management Planning*.

Dune stabilization – The use of plantings (of European beach grass, for example) and, sometimes, dune fencing to reduce the effects of wind erosion. See “Invasion of New Beach Grass Could Weaken Shoreline Protect in *Science News*, September 26, 2007, at <http://www.sciencedaily.com/releases/2007/09/070923203558.htm>

Dynamic riprap (a.k.a. *cobble berm* or *rubble beach*) – A form of shore protection in which a cobble berm is placed on an eroding beach to dissipate wave impact. Cobble is essentially large gravel, with individual stones ranging from about 2 to 10 inches in diameter. See DOGAMI’S *Dynamic Revetment for Coastal Erosion in Oregon* at http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/DynamicRevetments.pdf

Category 3: Development HATs

Abandonment of building – To surrender a building to whatever damage or destruction may occur from a coastal hazard.

Increased elevation of building – To raise an existing building higher or to build a new structure to a specified height so as to avoid some hazard such as flooding or wave overtopping.

Making buildings movable – To design and build structures so that they can be moved to safer locations during times of increased risk from hazards such as ocean flooding.

Relocation of building – To move a building from a high-risk site to a site of lower risk.

Relocation of community – To move a community from a high-risk site to a site of lower risk.

Relocation of infrastructure – To move or re-route public facilities such as roads, sewers, water lines, and bridges to (a) make them less vulnerable to coastal hazards and (b) to ensure that critical facilities will be operable during hazard events.

Runoff and drainage controls – To design, build and manage coastal development so as to reduce runoff or drainage that contributes to coastal erosion.

Special building techniques – To design and build structures sited in higher-risk areas in such a way as to (a) increase the safety and integrity of the structure itself, and (b) to lessen risk that the structure's failure might cause harm or damage to others.

Category 4: Policy and Planning HATs

Compensatory mitigation – **Example:** A development permit applicant must pay fee to compensate for costs to public resulting from the development (typically, for costs of beach nourishment)

Conditions of development –

- *Floor elevation requirement:* Lowest habitable floor of development must be constructed at a specified elevation such as one foot above base flood elevation
- *Geological reconnaissance:* Development approval is contingent on a brief report from a qualified geologist who visits site and, based on observations, finds development to be appropriate
- *Geotechnical report:* Development approval is contingent on a detailed study from a qualified geologist who visits site and, based on scientific observations and field testing, finds development to be appropriate
- *Indemnification:* Applicant for a development permit must indemnify the government entity approving the development on a hazardous site – that is, hold the government harmless from any third-party litigation resulting from damage caused by the development
- *Land division standards* – **Example:** Land may not be partitioned or subdivided unless the newly created parcels or lots have building sites outside of active erosion or high risk areas
- *Liability waiver:* Applicant for a development permit must sign a waiver declaring that, in the event of any damage to that development resulting from a hazard event, he or she waives the right to sue the government entity that approved the development
- *Safe-site requirement:* Development may be approved only on that portion of a lot or parcel deemed suitable.

Conservation easement – **Example:** A property owner is paid by a public agency or nongovernmental organization to conserve land from certain types of use or development

Floodplain management – Development in flood-prone areas is regulated in accordance with FEMA floodplain management regulations

Hazard-area overlay zone – Areas at risk from hazards such as erosion or landslides are subject to hazard overlay zone, which sets standards and requirements based on type and degree of risk

Prohibition of development – New development is not allowed on sites determined to be at specified risk from hazard

Public education – Development officials prepare materials on coastal hazards and conduct programs to notify and inform key audiences

Public notification and review – Proposals for new development in specified areas must secure a coastal hazards permit through a review process that involves notification to interested persons and agencies, opportunity for public comment, notice of decision, and opportunity to appeal

Purchase of development rights (PDR) – Governments or nongovernmental organizations buy all rights to development of selected property for purposes of eliminating risk to development there or to facilitate hazard management of nearby property

Setback – Development is not permitted within a specified distance of some feature

Transfer of development rights (TDR) – A process in which the owner of a “receiving property” may buy development rights from a “sending property.” The owner of the sending property thus gets reimbursed for a lost right to develop, while the owner of the receiving property gains a right to develop more intensively on his or her property. **Example:** Under current zoning, the owner of a vacant farm parcel has the legal right to build one dwelling. She sells that right to the owner of a rural residential parcel that, without the transfer, has a right to build only one dwelling. The transfer thus leaves the farm parcel protected from development and doubles the development potential of the rural residential parcel, all at no cost to taxpayers.

11.1 Choosing the Right HAT

We have quite a variety of tools to choose from: the toolkit for dealing with coastal hazards is large. To determine which hazard alleviation technique (HAT) is best for a given situation, we need to consider a multitude of factors:

Effectiveness – To what extent will the HAT that’s being considered alleviate the coastal hazard?

Capital Cost – What will be the initial costs to build or put into effect the HAT?

Maintenance Costs – How much will the HAT cost to maintain over time?

Funding Availability – Does a reliable source of funding exist, both for the initial costs of the HAT and for its continued maintenance?

Materials Availability – Are essential materials such as suitable rock for riprap or sand for beach nourishment available at a reasonable price?

Durability (a.k.a. “design life”) – To what extent is the HAT an enduring long-term solution to the problems presented by the hazard?

Environmental Impact – Are the likely effects of this HAT on environmental systems and natural resources consistent with local, state and federal standards and proportionate to the benefits of the HAT to development?

Public Access – Will the HAT ensure adequate public access to coastal resources?

Public Safety – Will the HAT ensure adequate safety for citizens residing or working in hazardous areas and for visitors to such areas?

Legality – Is the HAT consistent with local, state and federal laws regarding coastal hazards, coastal resources, and coastal zone management?

Design – If the HAT alters the built environment or natural environment, are such alterations consistent with local standards for design, appearance and visual impact?

Unfortunately, despite the significance of the eleven factors described above, many of them are given short shrift when it comes to deciding which HAT to use in a given situation. That’s because such decisions often are made only when a catastrophic event such as an extreme winter storm suddenly reminds us about the hazards of coastal erosion. At that moment, short-term effectiveness tends to trump everything else. The result is likely to be selection of a “hard” structural HAT that may quickly reduce the immediate threat to beachfront properties but also creates long-term problems for entire community.

This tendency for most responses to coastal erosion to be short-term, reactive decisions is one of the key reasons to have an adaptation plan. Such a plan provide a forum in which we can consider all the factors listed above and thereby take long-term pro-active measures for dealing with coastal erosion – before the next big storm.

The table on the next page summarizes the main hazard alleviation techniques available and the key factors that should be considered when deciding which HAT to use.

Factors To Consider in Choosing Erosion Hazard Alleviation Techniques (HATs)

	Effective-ness	Capital Costs	Maint. Costs	Funding Availability	Materials Availability	Durability	Environ. Impact	Public Access	Public Safety	Legality	Design
1. Hard (Structural) HATs											
Bulkhead											
Revetment											
Sand bypass											
Seawall											
Sill (for "perched beach")											
Groin											
Jetty											
Artificial reef											
Breakwater											
Reef breakwater											
2. Soft (Nonstructural) HATs											
Beach nourishment											
Buffer dune											
Dune management											
Dune stabilization											
Dynamic riprap											
3. Development HATs											
Abandon structure											
Elevate structure											
Make structure movable											
Relocate structure											
Relocate community											
Modify or relocate infrastructure											
Control runoff and drainage											
Modify structure											
4. Policy and Planning HATs											
Compensatory mitigation											
Conservation easement											
Floor elevation COD (<i>Condition of Development</i>)											
Require geologic reconnaissance (COD)											
Require geotech report (COD)											
Indemnification (COD)											
Land div. standards (COD)											
Liability waiver (COD)											
Safe-site requirement (COD)											
Floodplain management											
Hazard-area overlay zone											
Prohibition of development											
Public notice and review											
Public education											
Purchase of developmt rights											
Setback											
Transfer of developmt rights											