Your Marine Waterfront

A guide to protecting your property while promoting healthy shorelines

Enjoy the beach. Protect your home. Improve shoreline habitat.

Washington Department of FISH and WILDLIFE

Overview

Puget Sound is a beautiful waterway with over 2,500 miles of shoreline including the Strait of Juan de Fuca and Hood Canal, stretching north to the international border and south to Olympia. It offers stunning views, an incredible diversity of recreational opportunities, and supports a vast array of fish, shellfish, and wildlife that are iconic to the Pacific Northwest.

The actions you take to manage and protect your waterfront property are essential for preserving the Sound as a special place for future generations. By offering choices to homeowners, this booklet shifts the focus from bulkheads, or hard techniques, toward natural and restorative approaches to protect and enhance marine waterfront properties.

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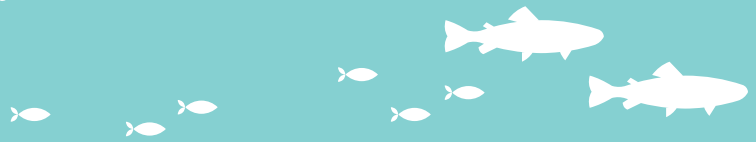
Sustainable choices for your waterfront are a good investment in your property and in the health of Puget Sound.



Introduction

Benjamin Benschneider

With iconic views and easy access to recreation, owning a waterfront property is a dream-come-true for many. But a property's greatest asset—its waterfront location—may come with concerns about erosion, flooding, and exposure to the elements. As a marine waterfront property owner you undoubtedly want to protect your investment and its unique shoreline environment.

Many alternatives to hard armoring provide protection to a waterfront property while supporting healthy beach habitat. In many locations, hard vertical structures like bulkheads can be replaced with elements that are functional, attractive, and better for the environment.

If you are thinking of replacing, repairing, or constructing a bulkhead on your shoreline or you are interested in how to best manage your shoreline, consider the following:

ONE SIZE DOESN'T FIT ALL

Hard armoring of the shoreline (bulkheads) may be appropriate in select circumstances. However, in many locations, using techniques that preserve or mimic natural shoreline characteristics can be equally effective at protecting property.

LOCATION MATTERS

Locating residences and infrastructure away from the shoreline is the most effective way to reduce the need for shoreline protection. When needed, shoreline armor should be installed as high up the beach as possible.

ATTRACTIVE BEACHES ADD VALUE

Natural-looking waterfronts can make a home more appealing and cost less to maintain. Many buyers of waterfront property envision family and friends playing in the water and relaxing on the beach in a way that may be difficult and unsafe if obstructed by a bulkhead.

ARMORING CAN HAVE UNINTENDED CONSEQUENCES

Unfortunately, in some cases, hard armoring can change or eliminate beach habitat which reduces food and shelter for fish and wildlife. Hard armoring may also increase erosion risk to neighbors.

THE SIMPLER, THE BETTER

Projects that are over-designed for a particular site can negatively impact the beach environment with no added protection for the landowner. Often, allowing the shoreline to function naturally or with minor enhancements will protect property.

PROTECT WILDLIFE

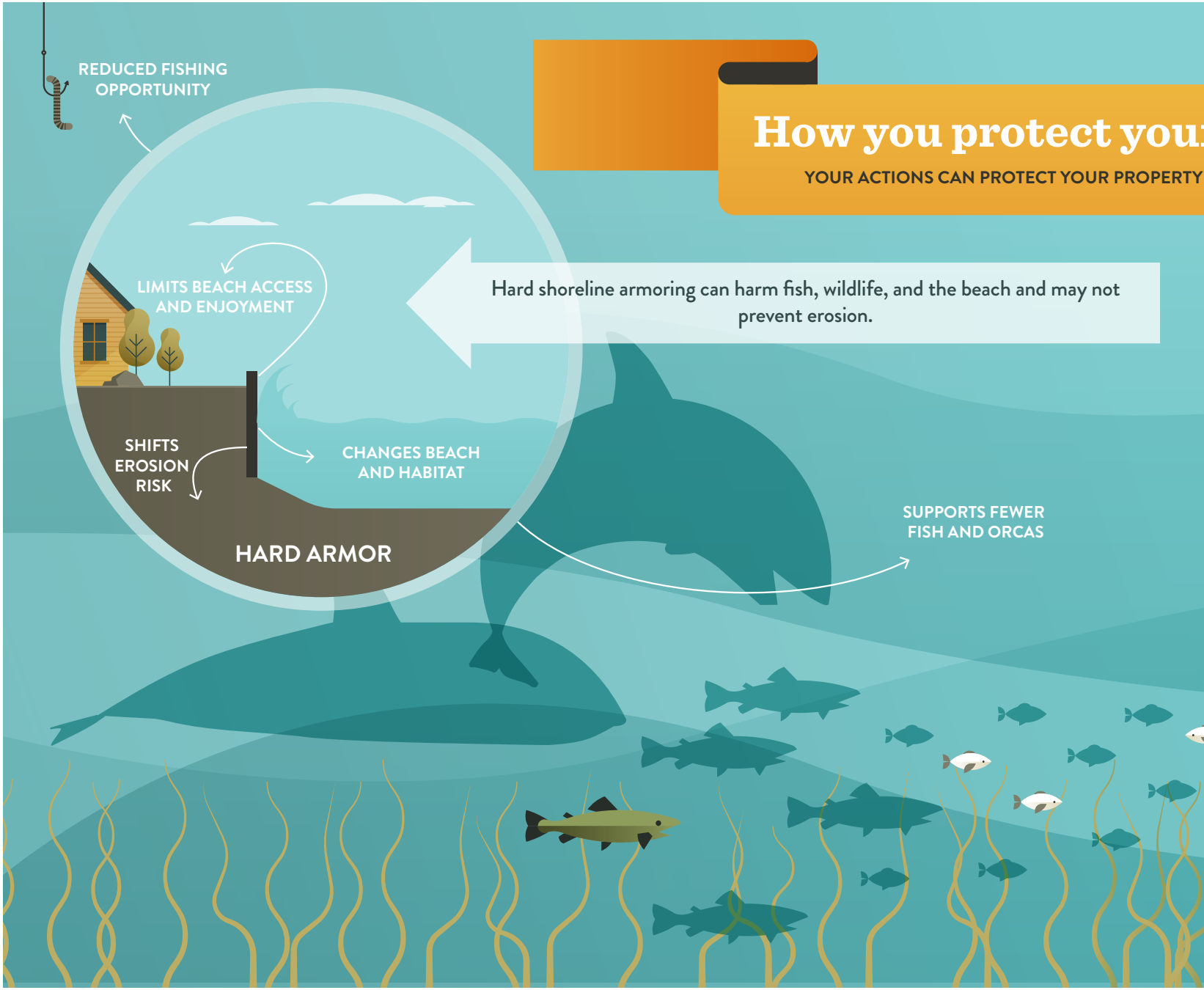
Bulkheads can change or eliminate upper beach areas that are used by some small fish to lay their eggs. Reduced area for these eggs can result in fewer small fish for larger fish to eat, such as salmon. Fewer large fish can reduce the food supply for both humans and orcas.

Your decisions matter. Hard armor already impacts over 650 miles of Puget Sound's shoreline. You can help by making informed decisions when considering how to manage your marine waterfront.

How you protect your

YOUR ACTIONS CAN PROTECT YOUR PROPERTY

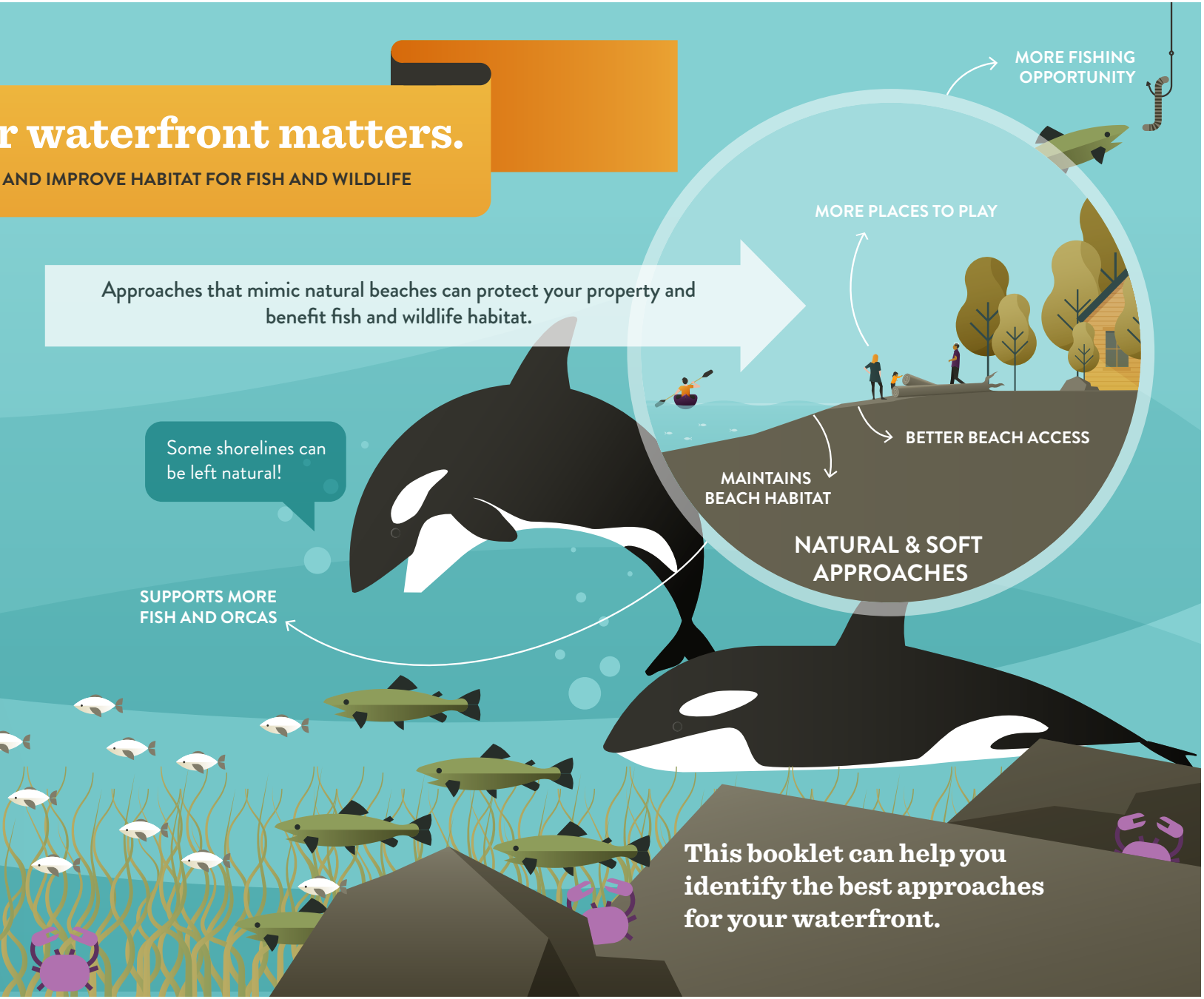
Hard shoreline armoring can harm fish, wildlife, and the beach and may not prevent erosion.



r waterfront matters.

AND IMPROVE HABITAT FOR FISH AND WILDLIFE

Approaches that mimic natural beaches can protect your property and benefit fish and wildlife habitat.

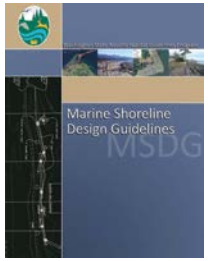


This booklet can help you identify the best approaches for your waterfront.

EXCITED ABOUT SMART APPROACHES FOR YOUR WATERFRONT?

This booklet describes the first three steps to protect your home, enhance your property, and enjoy your beach: 1) assessing your site, 2) evaluating design techniques that may best fit your situation, and 3) other helpful information. The shoreline is a complex ecological and regulatory environment, and you will likely require professional assistance to plan and implement your project. Your local planning office is a great resource and an early meeting with your county or city planner can help you learn about applicable regulations, approval time frames, and any required special studies.

Concepts presented in this booklet come from the *Marine Shoreline Design Guidelines* technical document. See page 41 for more details.



pages 7-15

ASSESS YOUR PROPERTY

Site Assessment introduces you to characteristics of waterfront property including:

- Geologic features
- Beach and wave characteristics
- Hydrologic features

pages 16- 33

SELECT DESIGN TECHNIQUE(S)

Design Techniques introduces you to a variety of design approaches, ranging from:

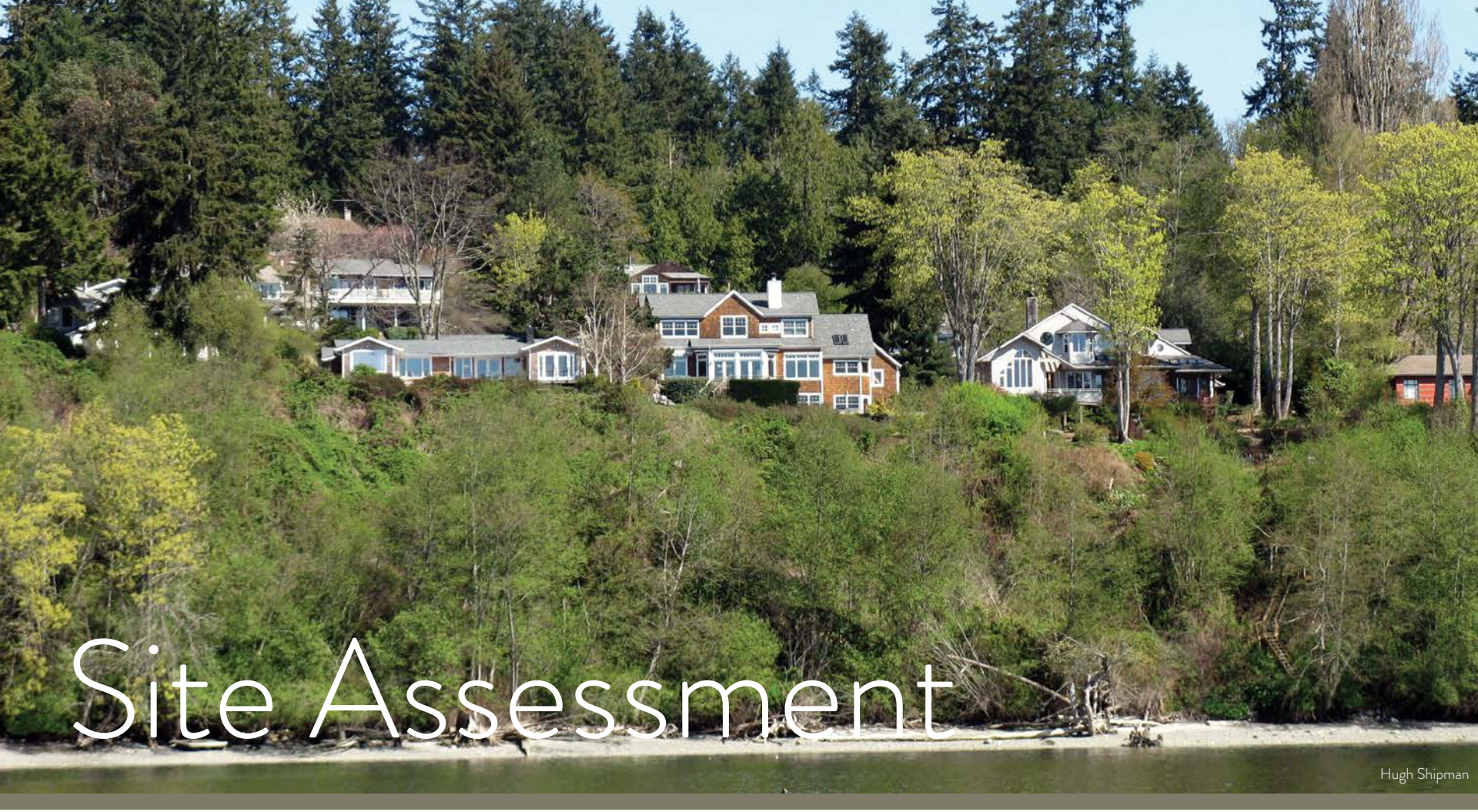
- Limited or no action
- Soft/restorative improvements
- Hard/structural improvements
- Structure removal

pages 34 - 44

OTHER HELPFUL INFO

Look here for useful information to help you get started:

- Choosing a professional
- Permitting
- Selecting native plants
- Finding additional resources



Site Assessment

Hugh Shipman

Characterizing your site starts with simply observing the conditions on and around your property. In many cases you will need the assistance of a professional, such as a geologist, to complete the assessment which will provide an understanding of the interactions between coastal, geologic, and ecological processes at a site.

A thorough assessment of your site is the first step towards protecting both your property and the environment and will allow you to better understand the opportunities and constraints at your site. This section introduces common types of information that are important to collect and consider when deciding how to proceed.

Getting Started

An assessment will help you identify the types, locations, and causes of erosion occurring at a site. This step allows you to determine if action is required, and if so, which approaches will be the most effective. Depending on site conditions, taking no action may be the best choice. An assessment should enable you and your design professionals to answer these types of questions:

- Is erosion occurring on your site? If so, where?
- How fast is the erosion occurring?
- How frequently, and under what conditions, does erosion occur?
- Does the erosion reflect cyclical/seasonal changes rather than a chronic problem?
- Is the erosion a risk? If so, to what?

Some types of erosion are not caused by marine-related factors and will not be solved by installing a bulkhead or other hard shoreline armor.

The two center properties are examples of retaining natural shoreline features to provide property protection while preserving valuable habitat on the backshore beach.

WA Department of Ecology

Site Assessment Checklist

In collaboration with design professionals, you will want to document important characteristics of your site. This checklist provides examples of the information that you will want to record.

GEOLOGY

- ☐ Slopes and bluffs
- ☐ Backshore characteristics (width, presence of large logs)
- ☐ Beach material and composition
- ☐ Evidence of landslide activity
- ☐ Presence of fill or excavated areas

COASTAL PROCESSES

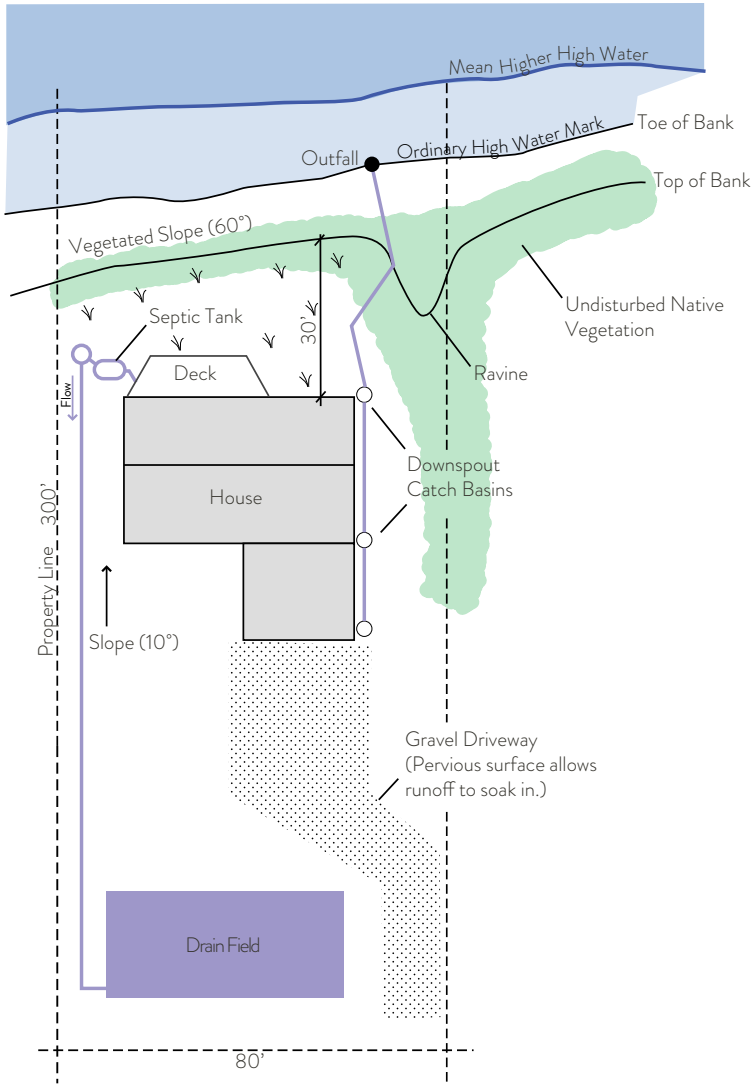
- ☐ Long term rate of erosion
- ☐ Landform (beach, bluff, stream mouth)
- ☐ Location in drift cell (beginning, middle, end, or no appreciable drift)
- ☐ Direction of net drift (sediment movement)
- ☐ Barriers to sediment movement (bulkheads, groins, fill) within the drift cell, especially updrift of the site

HYDROLOGY

- ☐ Seeps, springs, and streams
- ☐ Irrigation systems, water lines, drainfields
- ☐ Hydrophilic vegetation
- ☐ Drainage measures (discharges, impervious surfaces)

OTHER SITE CHARACTERISTICS

- ☐ Plant species present
- ☐ Structures and setback distances
- ☐ Presence of key wildlife and associated habitat
- ☐ Potential for cultural resources
- ☐ Past and present erosion control measures



You can start by drawing a simple diagram of key features on your property. The above site plan is an example.

Geology

The geologic composition of your site is a key factor in how your property responds to erosive forces. Some types of soils are more resistant to erosion while some geologic features can lead to instability. The geology of a site includes both the landform above ground and the composition and dynamics of the earth below.

Before identifying the characteristics of the property itself, it is useful to consider its larger context. The assessment should take into account site location such as on a sand spit, along a bluff, or at the mouth of a stream. A geologic assessment documents major features and existing upland and beach conditions. It also considers past uses of the site and looks for evidence of past instability or slides.

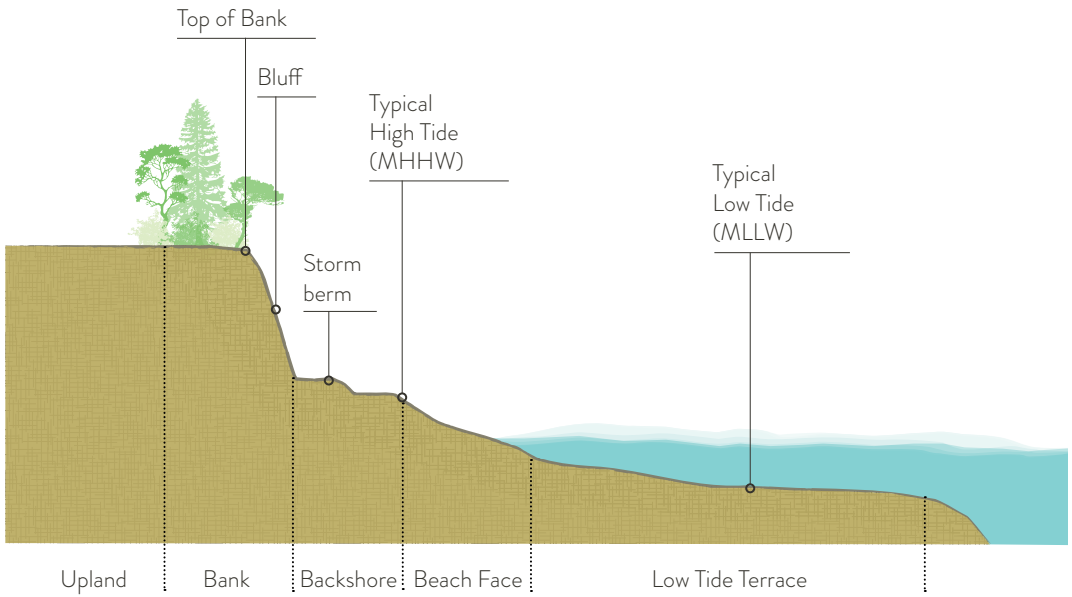
Beaches naturally change over time. Taking photographs seasonally and after major storms from the same location, perspective, and including a reference point, will help you distinguish short-term shifts from long-term erosion.

High bank shoreline with bluff

Low bank shoreline

The location, elevation, and composition of a beach will guide the design process for enhancements or erosion control measures. Note that some features are not always present.

Considering a site's backshore condition, including the presence of salt-tolerant vegetation, is particularly relevant to your assessment as it can provide clues to understanding tidal elevations at your site that will inform design options. Erosion control structures placed at incompatible elevations are at risk of early failure and damage to beach habitat.



Example beach profile features (MHHW = Mean Higher High Water, MLLW = Mean Lower Low Water)

What are the sections of your shoreline?

BANK

A steep slope rising behind the beach. A bank can range in height from a few feet to hundreds of feet. Higher, more distinct slopes are called bluffs. Banks and bluffs may or may not be vegetated. Bowed and tilted trees, distinct breaks (scarps or benches) in the slope, and piles of earth and debris at the base all indicate the potential for landslides.

BACKSHORE

Upper zone of a beach beyond the reach of normal waves and tides. A broad backshore can provide natural protection against wave induced erosion and storm events.

The width and character of the backshore varies naturally and is often heavily impacted by human modifications such as roadways, bulkheads, and other structures.

BEACH FACE

Sloping portion of the beach normally acted on by waves and tides. Beach steepness depends on wave energy and sediment size.

LOW TIDE TERRACE

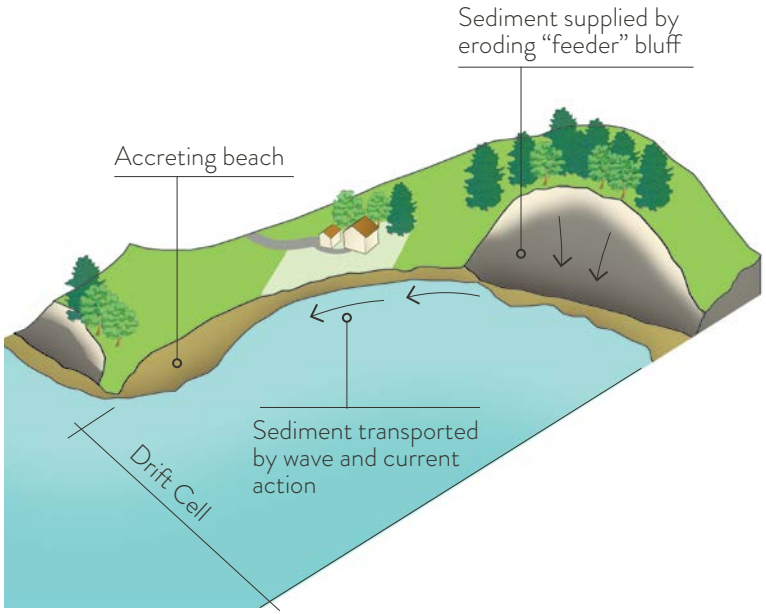
Broad, flat portion of the beach generally at the low tide elevation. Often, this area supports a diversity of aquatic vegetation such as eelgrass, kelps, and seaweed.

Coastal Processes

Your property is part of a larger system driven by wind, waves, and currents that continuously moves beach material (sand, gravel, logs) along the waterfront like a conveyor belt. In some places beach material may build up and in other places it may erode. Many factors combine to determine the rate and amount of material that moves along the beach.

DRIFT CELLS

Recognizing that beach material moves as part of a natural, healthy system is fundamental to understanding coastal processes. This movement is captured by the concept of drift cells. A drift cell includes a source of sediment input to the beach, a zone where wind and waves move sediment down drift, and a terminus where sediment either builds up on the beach (accretion) or moves offshore into deeper water. Altering the flow of sediment through the drift cell can cause downdrift beaches to receive less sediment and erode.



Elements of a drift cell

Knowing your place in a drift cell will help you and any professionals you hire design an approach for your site that allows coastal processes to continue as naturally as possible.

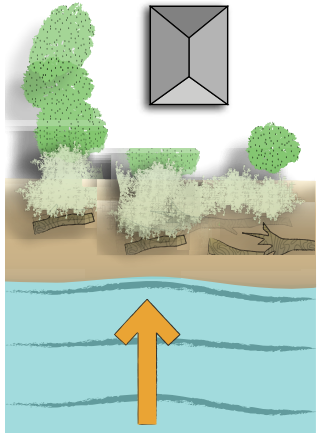
Sand and gravel erode from feeder bluffs (left) and travel a mile down the beach to form a broad spit (right).

WAVE CONDITIONS

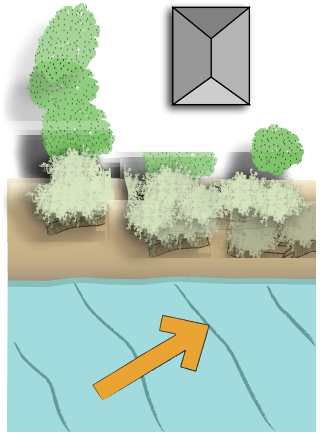
Wave conditions help determine the character of the beach and the erosion potential. Key elements are the orientation of the beach to predominant wind and waves and the intensity of the waves. Wave conditions at a site are a key factor in selecting a design technique. Lower energy sites are good candidates for soft armor or no intervention.

Beaches oriented parallel to predominant waves are called swash aligned beaches. They tend to erode slower and may even build up sediment over time. Beaches oriented at an angle to predominant waves are called drift aligned beaches and tend to experience more sediment movement and erosion.

Wave energy is largely dependent on fetch. Fetch is the distance across open water to an opposing shoreline. A longer fetch generally indicates greater relative wave energy. Winter storms in Puget Sound typically come from the south, thus, south facing beaches with a long fetch can expect strong wave energy.

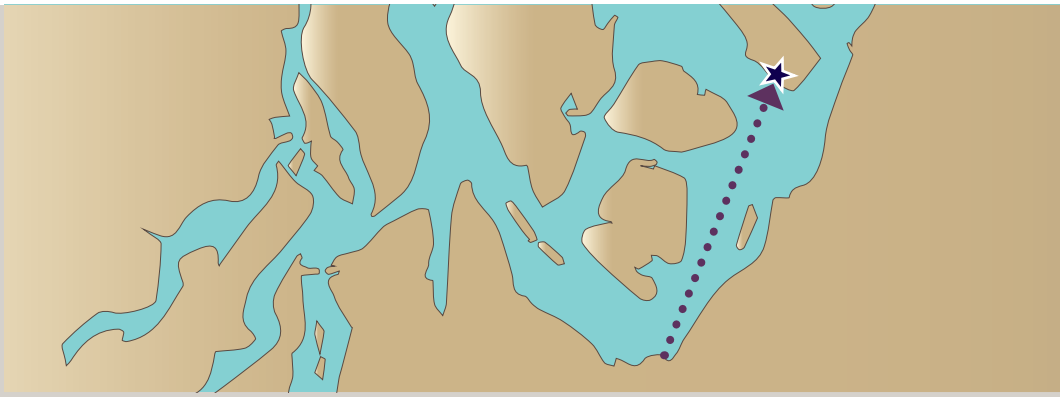


Swash aligned: Waves break *parallel* to the beach.



Drift aligned: Waves break at an *angle* to the beach.

Wave energy is an important factor in determining erosion patterns and depends greatly on fetch. The greater the distance, the larger the waves and the more energy they carry.

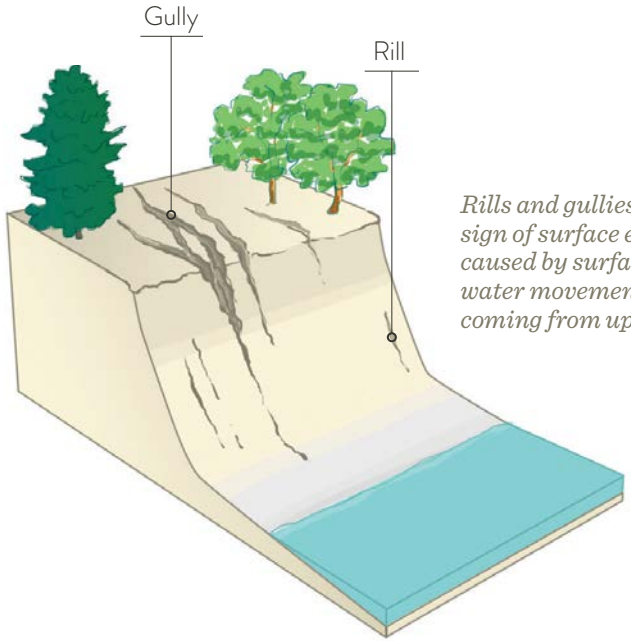


Maximum fetch (arrow) is the longest distance across open water to a site (star).

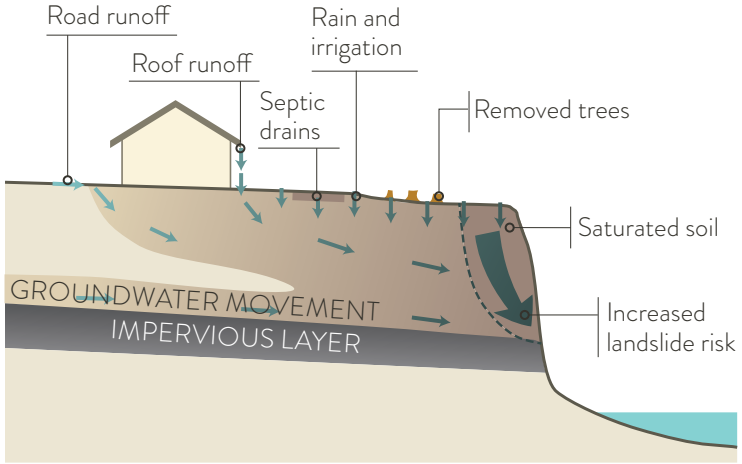
Hydrology

Hydrology describes how surface water and groundwater move throughout an area and how they may impact the stability of your site. A professional can identify streams, springs, and seeps and collect subsurface data from borings to fully understand the hydrology. All drainage control structures such as downspouts, French drains, and tightlines as well as pipe sizes and discharge points will need to be noted. Irrigation systems, ponds, and fountains will also need to be considered since these can add additional water to a site.

Landslides can occur when groundwater reaches an impervious layer and destabilizes the slope. In another scenario, rainfall does not soak into the soil, gathers on the surface, and runs downhill forming small channels of water called rills or larger ones called gullies. For sites where slope instability is caused by the dynamics between the geologic features and the hydrology, installation of bulkheads or other shore armor will do little to reduce the instability. Improvements to surface water management and site drainage are good approaches to these sites. The discussion about drainage on page 20 offers more information.



Rills and gullies are a sign of surface erosion caused by surface water movement coming from uphill.



Water-related causes of bluff instability

Other Site Characteristics

VEGETATION

Noting the general types, condition, and distribution of vegetation on each portion of your property will lead to better understanding of site stability. Look for the following: water-loving plants (alder, willow, salmonberry, etc.), which can indicate the presence of a seep that may weaken soil; bluff faces devoid of vegetation, which may indicate instability; vertical trees on a slope, which can be a sign of good soil stability; and dune grass and salt-tolerant vegetation, which indicate a lower energy environment less prone to erosion.

WILDLIFE AND HABITAT

Documenting protected and important animal species and habitat in the project area will be useful information as you plan your project. The Washington Department of Fish and Wildlife provides the Priority Habitats and Species (PHS) web-based mapping tool. Of particular importance are documented spawning areas for small fish called forage fish. In some areas these fish use the upper beach habitat to lay their tiny eggs. Both the fish and their eggs are an important food resource for larger fish and birds.

CULTURAL RESOURCES

Cultural resources are evidence of past human activities. It is not uncommon for waterfront areas to have items of cultural significance. If you suspect or know you have a culturally sensitive area, consider contacting the Department of Archaeology and Historic Preservation or an archaeologist to help you identify ways to design your project to avoid, minimize, or mitigate any disturbance to the resource. Archaeological materials found on private property remain the property of the landowner.

Dunegrass can grow in the backshore and provide protection against waves.

Surf smelt and sandlance (forage fish) use the upper beach to lay their eggs.

Discarded shells (midden) can be a sign of past human activity.

Design Techniques

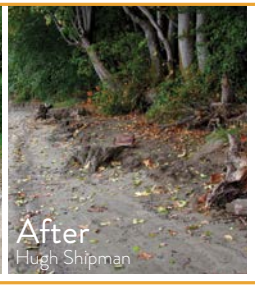
Theresa Mitchell

A broad spectrum of techniques can be applied to protect your property and manage the shoreline sustainably for you and future generations. The techniques range in complexity and cost; some projects may be simple and inexpensive while others may require lengthy permitting and design processes.

Leaving your site to function naturally is likely the best course of action for environmental health. However, if intervention is needed, **natural** techniques—vegetation, drainage, and locating structures—are best management practices that should be considered first.

Soft methods (e.g., log placement, beach nourishment, and reslope and revegetation) can provide erosion protection using strategically placed natural materials while allowing beach processes and habitat to remain intact.

Conventional, **hard** methods (e.g., bulkhead, seawall, revetment, and rockery) disrupt natural ecosystems and tend to be difficult to permit and expensive to install. Hard structures can often be replaced with soft methods or removed completely to restore natural processes.

DESIGN TECHNIQUE TYPE		DESIGN TECHNIQUE	COST	PROJECT COMPLEXITY
NATURAL Hugh Shipman	Natural	LEAVE NATURAL	N/A	N/A
		VEGETATION	$	
		DRAINAGE	$ - $$	
		LOCATING STRUCTURES	$ - $$$	
SOFT Hugh Shipman		LOG PLACEMENT	$	
		BEACH NOURISHMENT	$$	-
		RESLOPE AND REVEGETATION	$ - $$$	-
HARD Theresa Mitchell	Man-Made Structures	BULKHEAD INSTALLATION	$$$	
REMOVAL Before Saving Salmon  After Hugh Shipman	Remove Structures	BULKHEAD REMOVAL	$ - $$$	-

Each design technique can be used alone or in combination, depending on site characteristics and property owner objectives. The techniques are described on the following pages.

Icon Key

COST

$ Low

$$$ High

PROJECT COMPLEXITY

Less Complex

More Complex

Vegetation

Vegetation absorbs rainwater that can cause surface erosion. Roots, especially deep roots of trees and shrubs, bind soil together to strengthen and stabilize slopes. Having the right plants in place helps the overall coastal ecosystem by:

- Providing insects as food to animals on the beach and in shallow water (including fish);
- Slowing and filtering run-off before it reaches the beach;
- Supporting the small fish that salmon eat;
- Naturally supplying large wood to the beach (see log placement on page 24); and
- Increasing the presence of birds and other wildlife.

Native vegetation is exceptional in its ability to hold soils together, stabilize slopes, and absorb and filter rainwater. Lawns are less suited for providing these benefits.

Where might you consider this?

Adding and maintaining native vegetation is a good idea on any site. The native plant list (see page 37) is a good place to start. Erosion issues are best assessed by a trained professional, who will be able to determine the issues during the site assessment.

Vegetation is one of the easiest and most affordable techniques to install and maintain. It protects slopes by stabilizing soils and is good for fish and wildlife. Native flora is well adapted to our climate.

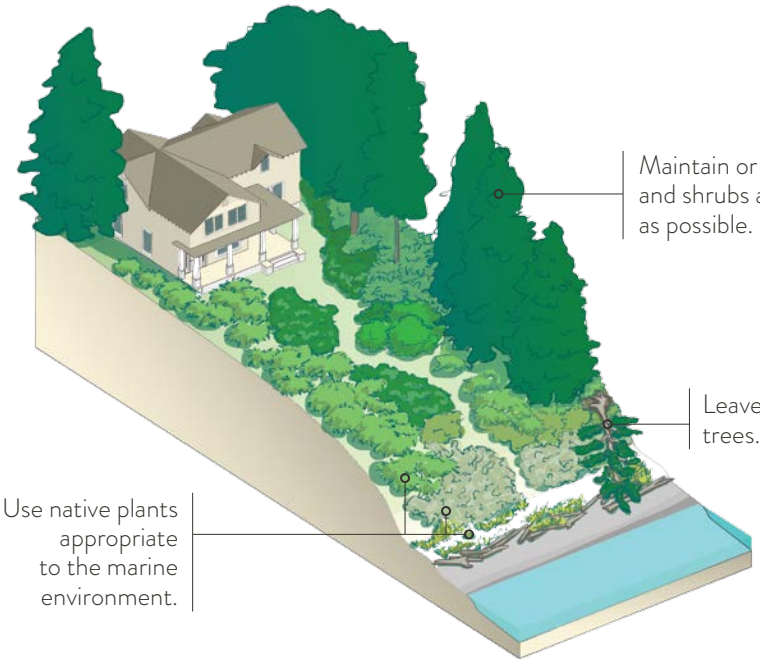
Dave Shreffler

Good Design Practices

Small-scale planting can often be done by homeowners without the need for permits or professional guidance. However, if erosion is a concern, or if significant changes to vegetation near bluffs is planned, a professional can help ensure there are no unforeseen impacts.

A geologist or geotechnical engineer can determine causes of erosion and a landscape architect or designer can develop a planting plan and oversee installation. See page 40 for more information.

Vegetation is often paired with drainage.



Use good quality native plants (see page 37) and those with deep roots like shrubs and trees. A planting plan should consider the bank exposure and steepness, soil type, hydrology, intensity of development, and an assessment of existing vegetation.

FRAME VIEWS

Arranging plants to accommodate and complement special views may help prevent removal of vegetation in the future when plants mature or a property is sold.

ENHANCE VEGETATION

Avoid removing, topping, and excessive pruning of existing trees, as their roots stabilize the soil. Keep existing native vegetation and plant new trees and shrubs to mimic a pre-development environment.

LEAVE LEANING AND FALLEN TREES

Leave leaning trees in-place unless an arborist determines they are hazardous. Allowing trees to fall naturally and the logs to decompose on-site provides no-cost erosion protection and important habitat for fish and wildlife.

CONSERVE AND RESTORE SOIL

Conserving topsoils during construction helps to retain the organic matter within existing soils. Some soil may need to be amended to better support plants.

ACCOMMODATE DRAINAGE

Placing plants and soils appropriately is important to ensure they fit into the overall drainage plan for rainwater and septic systems. This may include planting water-loving plants in lined swales and rain gardens.

USE EROSION CONTROL PRACTICES

Applying erosion control techniques (e.g., laying straw over soil) on recently laid or disturbed soil will help keep topsoil in place while plants establish and grow.

Drainage

Proper drainage manages on-site water flow to minimize erosion. Removing vegetation and adding impermeable surfaces like buildings, driveways, and patios can increase the flow of water toward the bluff and heighten the risks of erosion and landslides. Septic drainfields and irrigation can compound this problem.

Redirecting rainwater through drains or pipes to the bottom of the bluff can reduce these risks. Lined rain gardens, swales, and native vegetation are often used in conjunction with drainage structures to clean runoff before it enters the piped system.

Where might you consider this?

This technique is typically used where there is evidence of surface erosion or risk of landslide. Your professional can determine whether this technique is appropriate during site assessment.

Managing drainage is an effective way to protect your bluff or bank from rainwater-induced erosion.

Piping water over a steep slope (left) with a diffuser tee outfall (middle) can promote stable bluffs. Rain gardens (right) lined with a waterproof barrier can filter run-off as it flows into the drainage system.

Hugh Shipman

Hugh Shipman

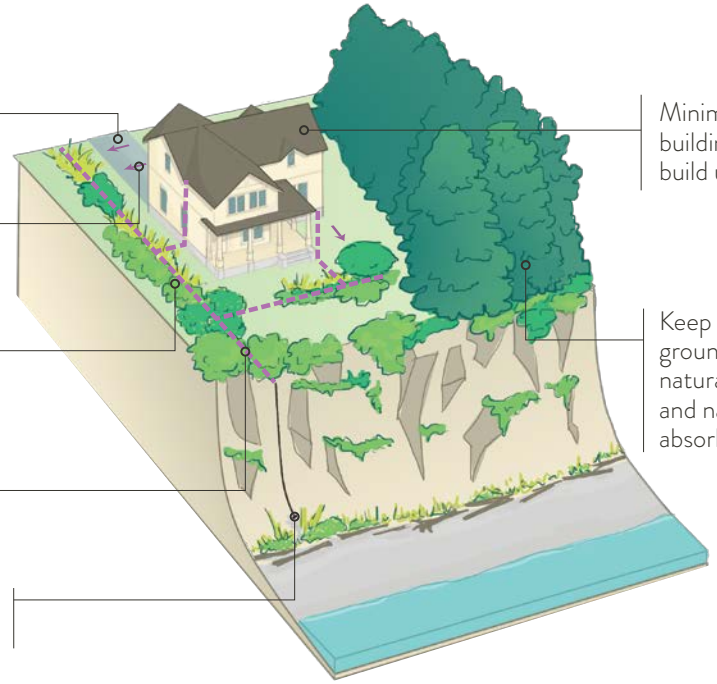
Kitsap Conservation District

Good Design Practices

Even small changes to drainage can have unforeseen impacts to bluffs and shorelines. Systems should be designed and installed with the help of a trained professional.

See the Washington Department of Ecology's *Managing Drainage on Coastal Bluffs* and *Stormwater Management Manual for Western Washington* for more information.

Drainage is often paired with vegetation.



Design drainage projects to reduce the volume of water that might: 1) erode slopes at the surface or 2) cause landslides (see diagrams on page 14). Specific practices will depend on site conditions like the property's geology, pattern of water movement, and erosion risks.

ENHANCE VEGETATION

Keeping existing vegetation and adding new plants, especially native vegetation, will help absorb water and stabilize the soil and slope.

MINIMIZE IMPERVIOUS SURFACES

Reducing driveway lengths and widths, and building up rather than out, will reduce surface water flow and allow rainwater to be absorbed by plants.

USE RAIN BARRELS

Collecting rainwater and reintroducing it over a large area that doesn't affect slope stability will reduce the amount of water saturating the bluff during heavy rains.

CLEAN RAINWATER RUNOFF

Directing rainwater flows to lined rain gardens will prevent water from seeping deeper underground and toward the bluff. Rain gardens also filter runoff. Combine this with an underground drainage system.

INSTALL A DRAINAGE SYSTEM

Installing a drainage system that carries water to the beach or to a professionally identified safe place (e.g., stormwater storage area) will reduce landslide and surface erosion risks.

SLOW WATER AT OUTFALL

The outfall is the last point on the piped system where the runoff discharges to the beach. Placing a diffuser tee or other water-slowing device at a proper height will help prevent erosion of the beach.

Locating Structures

When a structure is threatened by erosion or flooding, sometimes the wisest and most effective solution is to place the structure out of harm's way. In the case of erosion, this may mean locating a building farther from the shoreline. If the threat is flooding, the solution may be to locate the structure landward or elevate it to accommodate storms and floods.

Where might you consider this?

Your site assessment should evaluate long-term erosion patterns, the potential for landslides, and the risk from floods and storms to determine the safest places to build or relocate structures on your site. Also consider complicating factors such as earthquakes, development of nearby areas, and sea level rise.

Locating structures away from an eroding shoreline or bluff is the most effective action to ensure peace of mind and safety. It may also result in long-term cost savings.

Homes set back from the waterfront provide comfort in knowing shoreline erosion risks are minimal while still delivering stunning views.

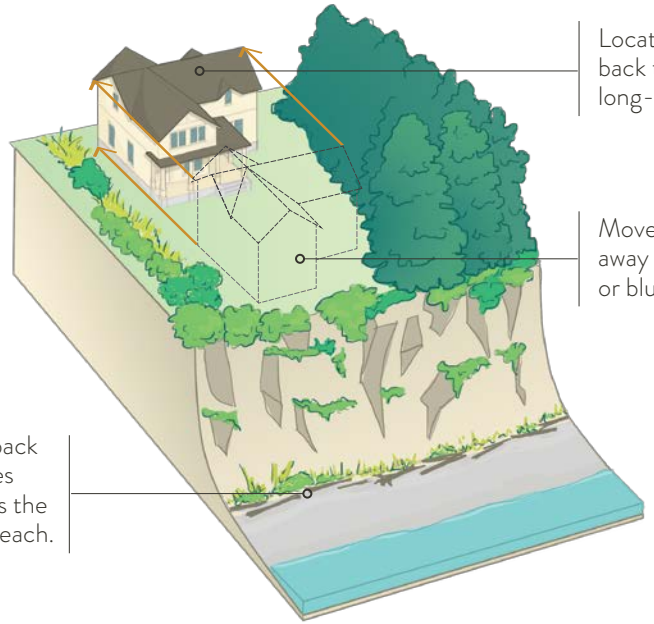
Hugh Shipman

Good Design Practices

Whether you are developing a site for the first time or rebuilding, a geologist familiar with coastal sites can help identify site stability issues and reduce your long-term risks. Ask for a design that minimizes the need for future structural stabilization.

An engineer can help design your home, site drainage, and necessary structural stabilization to assure safety and compliance with legal and technical standards. Make sure the designer understands your property's erosion rates, flood risks, and slope stability.

Locating structures is often paired with bulkhead removal.



Consider the locating structures technique before any construction, especially if the property is located on a feeder bluff.

NEW CONSTRUCTION

Siting structures away from the shoreline is always good practice and eliminates the added expense of constructing and maintaining shoreline protection.

New construction was set back for long-term safety.

FEEDER BLUFF

Relocation in lieu of a bulkhead is especially beneficial on feeder bluffs. It is safer for your home, allows for natural erosion of the bluff, and promotes a healthier ecosystem.

This bluff supplies sediment to nearby beaches and maintains habitat used by spawning forage fish, which salmon eat.

NO OR LOW BANK

Relocation can reestablish a backshore area that accommodates viewing and recreation areas, occasional flooding, a marsh, or higher sea levels.

The building on the right was moved back and the bulkhead removed.

Log Placement

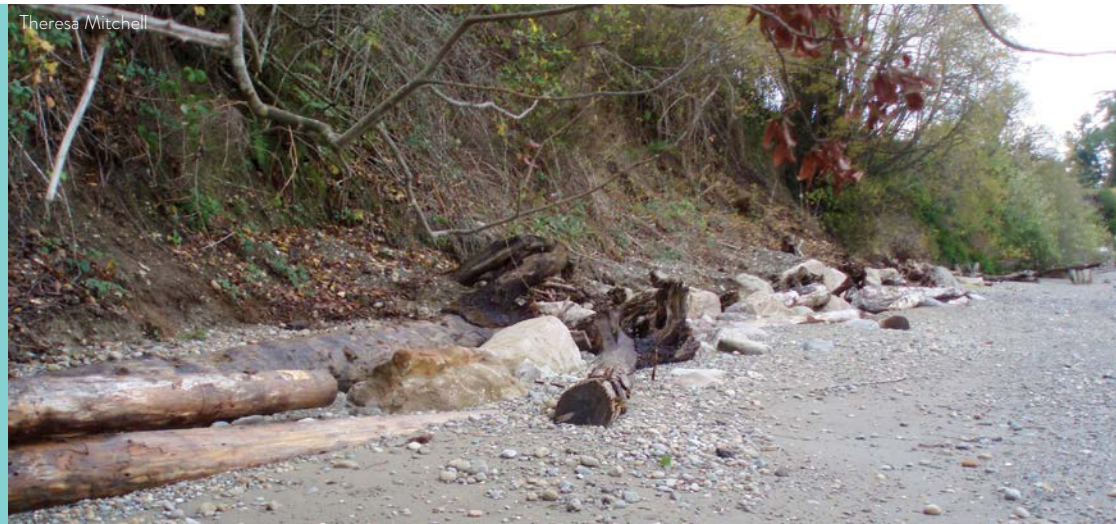
This technique places large logs and root wads (also known as large woody debris) along the upper beach to mimic natural driftwood accumulation. Logs disperse wave energy, trap and build up sand (which can provide additional erosion protection), and improve habitat. Log placement can be used in combination with beach nourishment and vegetation to protect your site from erosion.

Where might you consider this?

Log placement can be applied on many marine shores, but specific site conditions, like wave action, beach material, erosion rates and backshore width will influence the design and application of this technique. During the site assessment, your professional should evaluate the feasibility of using this technique on your property.

Log placement projects are typically low-cost, attractive, and offer natural erosion protection. They provide habitat and food sources for plants, animals, insects, and other shoreline species.

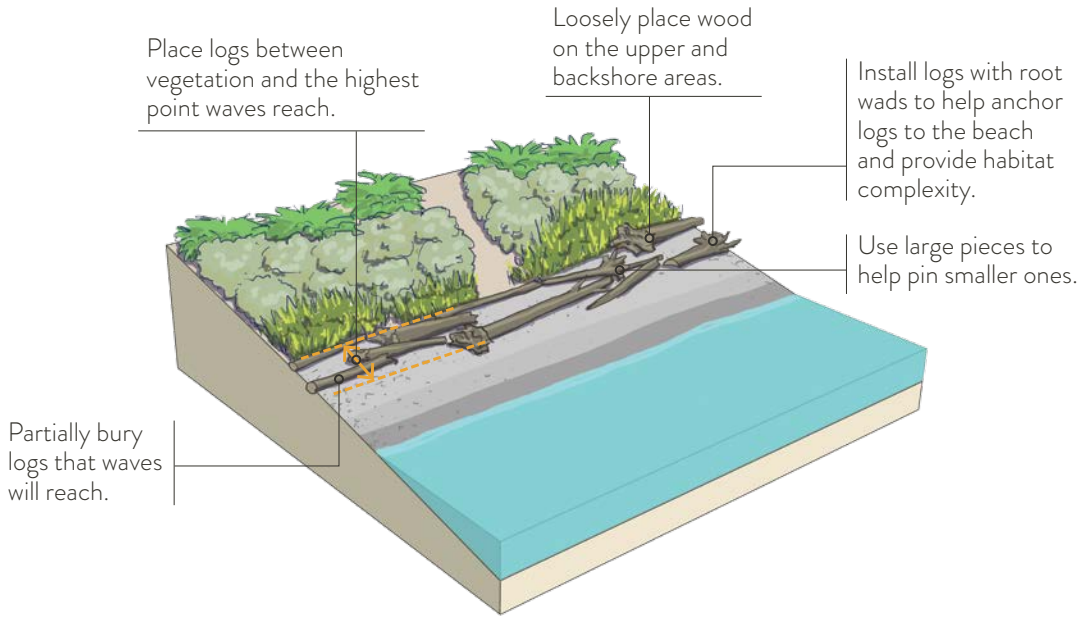
Fallen trees that land on the beach can build up beaches by trapping sediment behind them. Both the logs and sediment serve as natural erosion protection for the uplands. Placed logs like those pictured to the right mimic the role of naturally accumulated logs.


Theresa Mitchell

Good Design Practices

A qualified professional, like a landscape architect or a coastal engineer, can help you create healthy habitat and avoid hazards when installing large logs. Make sure your professional understands coastal processes and has experience with this technique.

Log placement is often paired with beach nourishment and vegetation.



Design log placement projects to last for many years, improve access to the waterfront, and benefit ecological processes.

PLACE LOGS PROPERLY

In most cases, large wood pieces are aligned parallel to the shoreline, but in some cases can be oriented at an angle to facilitate beach access or to trap additional large wood and beach sediment. If waves will reach them, partially bury logs to limit mobility. Otherwise, loosely place logs on upper and back beach areas. Large pieces can help pin other pieces in place.

CHOOSE LOCATION

Log placement should mimic wood that falls or is washed onto the shoreline. Logs are typically placed several feet landward of the highest point waves regularly reach and just waterward of upland vegetation or infrastructure. If placed too far down the beach, they will wash away.

SELECT LOGS PROPERLY

Selecting larger logs with root wads and/or branches is best. Western redcedar and Douglas fir provide longevity due to natural rot resistance and strength. Never use lumber or logs treated with chemicals.

ANCHORING

Anchoring logs may be appropriate depending on site conditions. Use durable materials appropriate for the marine environment to reduce the likelihood of failure and beach debris. Selective use of larger logs or boulders can help pin logs in place.

Beach Nourishment

Beach nourishment is an effective way to address erosion on some sites and restore previous beach conditions. Nourishment involves placing sand and rounded gravel on the beach to reestablish upper beach and backshore areas or create protective storm berms. This establishes a gradual beach grade that allows wave energy to dissipate and reduces erosion potential.

Where might you consider this?

Beach nourishment is a good option where buildings are at risk because beaches have eroded, either from natural causes or the effects of development. This technique works best on swash aligned beaches (see page 13) and on barrier beaches. Beaches mined for gravel in the past may also be good candidates.

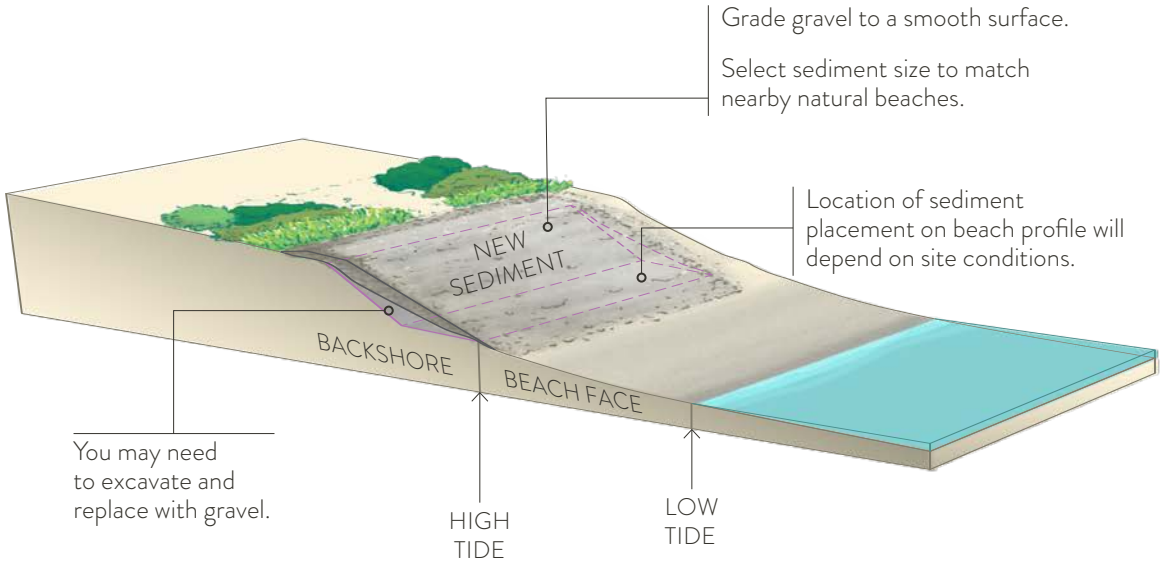
Beach nourishment slows beach erosion, provides wind and storm protection, mimics beneficial natural processes, provides areas for recreation, and is relatively inexpensive.

These property owners chose to remove a failing and ineffective rock bulkhead, used nourishment to create a stable beach, and improved their waterfront access.

Good Design Practices

Although beach nourishment is a relatively common practice in Puget Sound, design and permitting usually requires a trained professional. Make sure your designer understands beach dynamics and has project experience in this environment. A geotechnical engineer or coastal geologist can determine the causes of erosion and set design goals.

Beach nourishment is often paired with log placement and bulkhead removal.



Since beach nourishment design goals can range from erosion control to habitat enhancement, site-specific designs are needed.

ASSESS WAVE ENERGY

Beach nourishment is generally suitable for low to medium wave energy sites. Wave energy informs design features such as proper elevation of sediment placement, sediment volume, and grain size.

DETERMINE BERM ELEVATIONS

A professional experienced in this technique can help design a proper berm height. A berm that is too low or high will create management challenges. The design elevation will also depend on whether the backshore is natural or developed.

SELECT SEDIMENT SIZE

Choosing the right sediment is important. Sediment that is too small may wash away quickly; sediment that is too coarse will gravitate to the lower beach and provide little protection. Sediment size should generally match what is found on nearby beaches but slightly coarser material may be needed to provide additional protection.

PLACE SEDIMENT CAREFULLY

Placing sediment appropriately is critical to a project's success. The specific location will depend on the project scale and longevity. Gravel should generally be graded to a smooth surface, as large irregularities or low points in the backshore can cause localized erosion.

Reslope and Revegetation

Reslope and revegetation transforms a steep, unstable bluff or bank into a regraded, more stable slope. Native vegetation is then planted to protect the slope from eroding.

Where might you consider this?

This approach is most often used in response to an upper slope disturbance that has created steep, unstable slopes. If your site is generally stable or well-vegetated, weigh the benefits of this technique against the scale of disturbance it will cause. If erosion is occurring solely due to wave energy, resloping may not be appropriate.

Resloping stabilizes bluffs and banks and revegetation protects the slope from erosion and enhances aesthetics, water quality, and wildlife habitat.

A professional can help you develop a planting plan for your resloped site.

A porous natural fabric (geofabric) like burlap holds soil in place until a site is planted and roots establish.

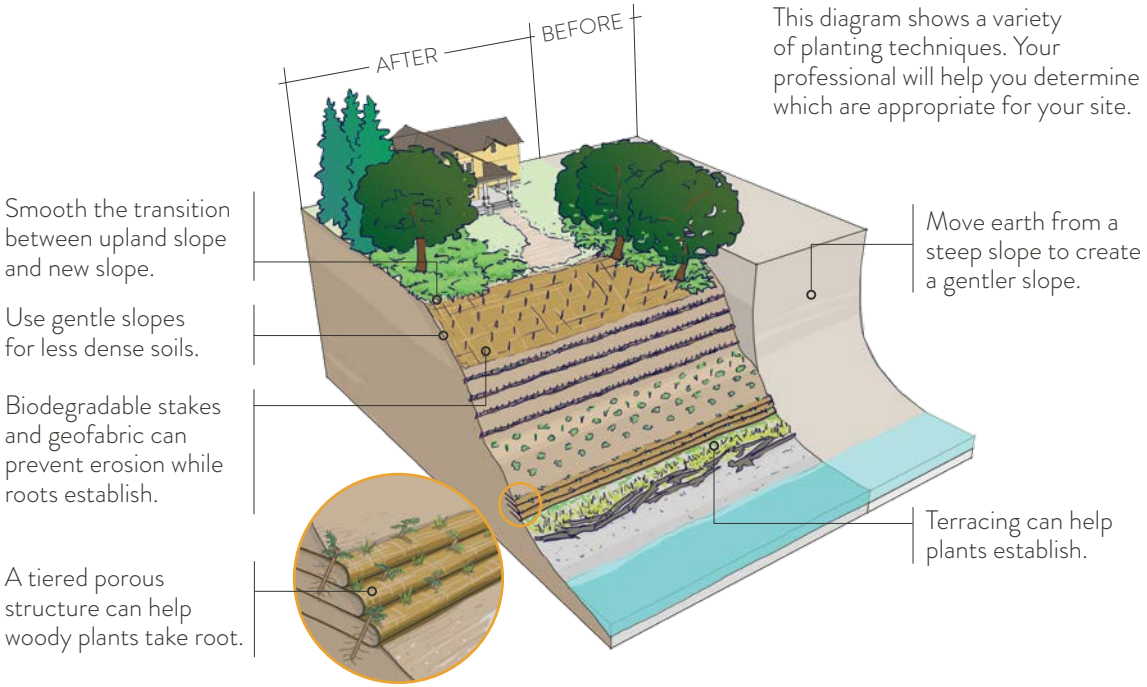
A vegetated retaining wall can provide the structural support of a traditional wall while mimicking natural systems.

Good Design Practices

Professional assistance is required to safely and permanently change a slope angle. Your property's geologic features including its sediment strength will be considered in design.

Addressing drainage on the site may eliminate the need for further action. If resloping is still necessary, proper surface and groundwater management will need to be a design component.

Reslope and revegetation is often paired with drainage, beach nourishment and log placement.



This diagram shows a variety of planting techniques. Your professional will help you determine which are appropriate for your site.

RESLOPE APPROPRIATELY

Consider soil types, planting goals, and structure location when determining the slope to promote a stable bluff or bank. Gentler slopes and terraces require more space but also provide better stability for topsoil and plants. Smoothing the transition between the new slope and the existing upland prevents instabilities.

PLANT FOR LONG-TERM SUCCESS

Revegetating provides soil strength through root systems. Plants and grasses with shallow root systems will not adequately strengthen steeper slopes. It may take time for deep-rooted plants and trees to establish, so temporary erosion control features like geofabric and wood stakes may be necessary. Always try to use native plants in designs (see page 37).

LIMIT IRRIGATION NEEDS

Establishing plants will require extra care and watering, though installing during the fall and winter will reduce irrigation needs. Plants that require long-term irrigation are not ideal; additional water inputs can destabilize the soil.

PROJECT TIMING

To limit erosion concerns, minimize the time bare soil is exposed. Grading is often done during dry months to avoid rain runoff. If possible, grade at the end of the dry season (see Limit Irrigation Needs above), or use irrigation if you must plant during dry months.

Bulkhead Installation

Bulkheads are rigid structures constructed on the beach to control erosion. They are used to protect upland property from wave attack or to hold back material eroding from the upper beach or bluff. Seawalls, revetments, and rockeries are types of bulkheads.

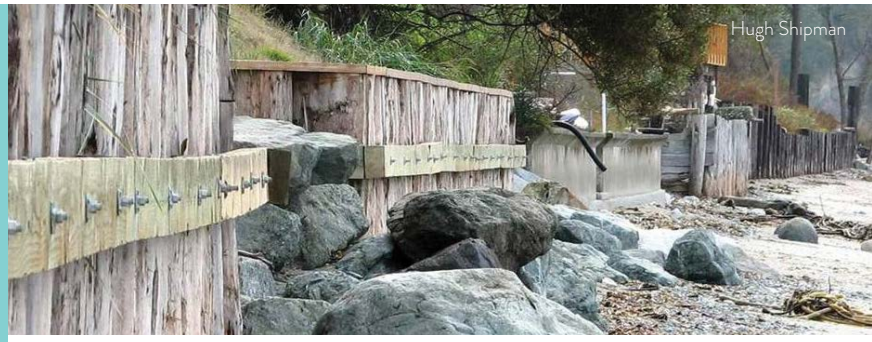
Though bulkheads can reduce erosion of the uplands at the site, they disrupt the natural supply of sediment into the drift cell, increase erosion potential on nearby beaches, and can lead to coarser, narrower beaches. Over time, this degrades important beach and shallow water habitat used by salmon, birds, and other fish and wildlife.

If a bulkhead is determined to be necessary, following proper design protocols is critical for minimizing negative impacts to beach habitat and neighboring properties.

Where might you consider this?

Bulkheads are now considered an option of last resort and most often built only where required by site conditions. Most jurisdictions prohibit bulkheads unless it is demonstrated that erosion will directly threaten a home in the near term.

All bulkheads require periodic inspection for signs of failure, as well as on-going maintenance, repair, or replacement. Failures can create a safety hazard or an unsightly mess if debris falls onto the beach. The associated costs and risks should be included when considering a bulkhead.

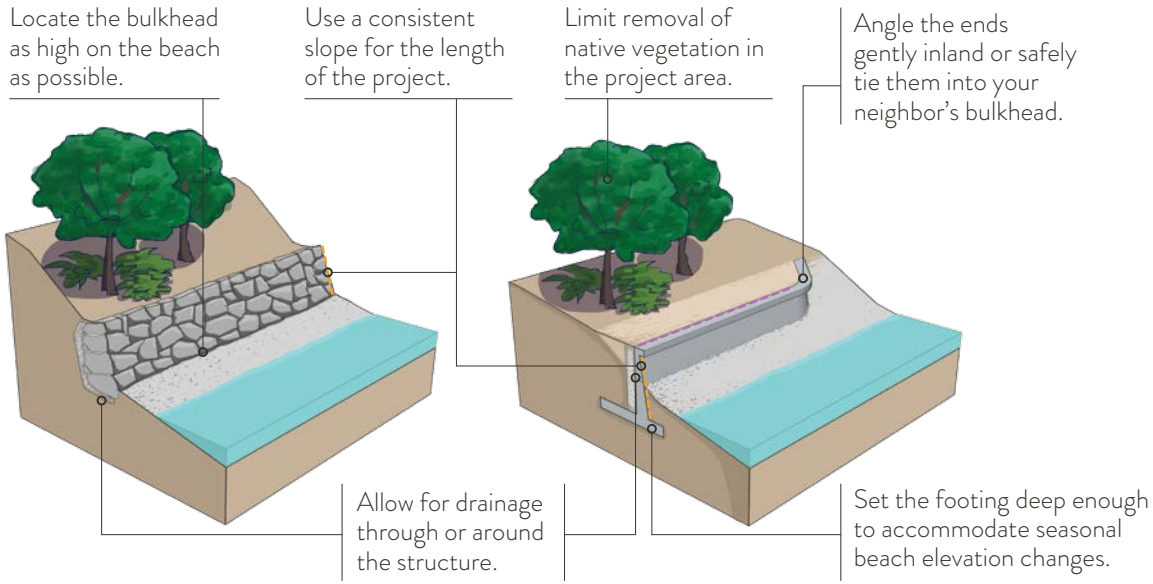


A bulkhead can increase erosion risk by deflecting wave energy onto the beach or adjacent properties.

Good Design Practices

Your team of professionals should assess your site and document why other techniques are not appropriate. If no other options exist, a bulkhead may be appropriate. A bulkhead can incorporate design elements that will minimize its environmental impact.

A standard approach in Puget Sound would be a vertical bulkhead made of concrete or wood, or a steep rock wall (rockery) constructed of stacked boulders. A less common option is the use of vinyl or metal sheet pile.



ROCK BULKHEAD

CONCRETE BULKHEAD

CHOOSE APPROPRIATE DESIGN

Locating a structure as high on the beach as possible and keeping its footprint small will reduce environmental impacts. Construct replacement bulkheads landward of an existing structure whenever possible. Your engineer will suggest bulkhead material based on your preference and site conditions.

ALLOW FOR DRAINAGE

Incorporating tightlines, weep holes, and backfill that allows drainage will reduce the likelihood of water pressure related failures.

ADEQUATELY SET FOOTING

The footing provides structural integrity and should be deep enough to prevent overturning. Consider scour effects and seasonal beach elevation changes when determining footing placement.

ALIGN TO LIMIT EROSION

Bulkheads are often built in a straight line, however rockery bulkheads have more flexibility to conform to the natural shape of the shoreline. Angle bulkhead ends gently inland to limit erosion on neighboring shorelines and retain fill behind the bulkhead.

SELECT APPROPRIATE MATERIALS

Use durable materials appropriate for the marine environment; avoid the use of treated wood to prevent leaching of chemicals into the environment. Design for site conditions to reduce the likelihood of failure and debris on the beach.

PRESERVE VEGETATION

Avoid construction-related impacts to vegetation and, if needed, replant native vegetation at project completion. Vegetation is an important part of the nearshore ecosystem providing food, shade, and shelter for fish, birds, and wildlife.

Bulkhead Removal

Many existing bulkheads were installed decades ago, long before we understood the value of the upper beach and backshore for fish and wildlife. Hard armor was often installed in areas where it is ineffective or unnecessary for erosion control. Reducing the size and impact of hard armor, or removing it completely, provides an opportunity to regain beach habitat and improve natural shoreline function.

Where might you consider this?

Removal is not feasible at every site and a full professional site assessment will be necessary. Locations with infrastructure set back from the waterfront or with no upland development are good places to consider this approach. If infrastructure is present, knowing the wave climate (see page 13) is important, as sites with lower wave energy and without persistent erosion are more suitable for this technique.

If your existing bulkhead is in need of repair or replacement, it is a good time to consider bulkhead removal. It may reduce costs, improve beach access, and benefit you and the environment.

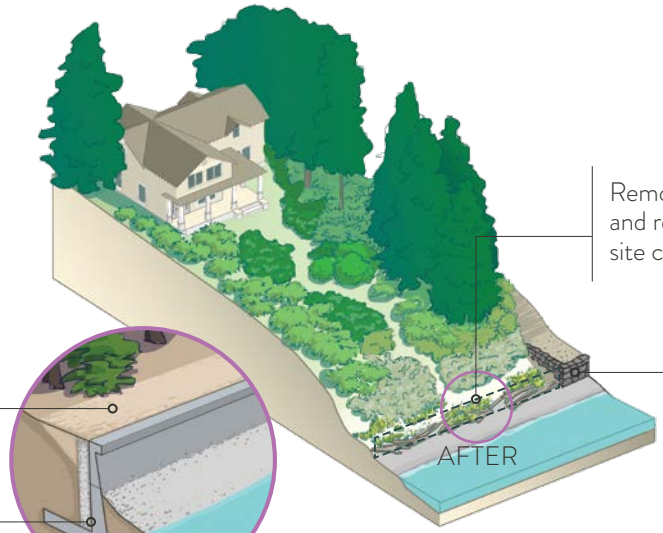
We now know that bulkheads are unnecessary in many places, can cause additional erosion concerns, and damage habitat for local species. Removal is increasingly becoming a favored option as appreciation for the value of natural shorelines grows.

Unnecessary hard armor on the left is scheduled for removal and will allow for a more natural beach setting like the one on the right.

Good Design Practices

The primary design goals of bulkhead removal are to maintain a safe home while enhancing recreational value and natural processes. To accomplish this, your designer will need to understand your site's conditions. The following are some issues your professional team will need to address.

Bulkhead removal is often paired with reslope and revegetation, beach nourishment, log placement, and locating structures.



ANTICIPATE INITIAL EROSION

After a bulkhead is removed, it is not uncommon to notice erosion of sediment and fill from behind the structure as the shoreline works to reach a new stable configuration. Your project consultants should assess the site and any as-built drawings for the structure in order to anticipate the extent of this response to bulkhead removal.

ADDRESS ADJACENT BULKHEADS

If bulkheads will remain on adjacent properties, additional design elements will be needed to protect your property from deflected wave energy and erosion from those structures.

CONSIDER SLOPE STABILITY

To understand how the site will respond over time to bulkhead removal, a complete analysis of slope stability through a geologic and geotechnical assessment should be done by a professional.

REMOVE NON-NATIVE MATERIALS

Remove non-native soil, treated wood, and rocks to help the beach return to a natural condition more quickly. Look to the original design drawings or test holes to anticipate the amount of material that may be underground and use proper disposal methods. Any on-site native materials such as logs, boulders, and sand and gravel can be incorporated into the project design.

Other Helpful Info

This section contains additional useful information, including guidance on choosing a design professional, getting a permit, and selecting appropriate vegetation for your shoreline. If you would like to learn more, additional resources are summarized at the end of the section.

Choosing a Professional

In many cases, selection and proper implementation of the design techniques illustrated in this manual will require the involvement of a trained professional. The range of professionals with expertise in shoreline environments includes:

- Arborists and botanists
- Archaeologists
- Biologists
- Coastal engineers
- Engineering geologists
- Geologists and geomorphologists
- Geotechnical engineers
- Hydrologists
- Landscape architects and landscape designers
- Shoreline planners and permitting specialists
- Structural engineers

If your site is straightforward and your project is limited to simple interventions, minimal involvement from a single professional may be all that is needed. However, if more complex work is planned, or if there are steep slopes with evidence of erosion or drainage issues, additional professionals will likely be needed to assess conditions and determine the appropriate solution. Firms that specialize in shoreline projects may have multiple disciplines in-house, but it is also common for sole practitioners to work together as part of a design team.

What type of professional do I need?

The unique characteristics of your site, the design techniques that you consider, and your timeline and budget will all help determine which professional is best suited to guide your project. While a professional can assist at many different stages of the project, often you will encounter a need for more information and guidance early in the planning process. Local planners and permitting specialists, if contacted early, can help you avoid costly and time-consuming redesigns. To conduct a thorough site assessment, you will need someone who has a broad understanding of the interaction of coastal and upland ecological processes and has a working understanding of the local regulatory framework and permit processes.

Friends or neighbors who have integrated soft shoreline design techniques into their property can also be an essential resource to help you get started. Ultimately, the best professional for your project is someone you trust who can provide the skill set needed to successfully accomplish your project.

Permitting

Shoreline development in Washington state is regulated, which means installation of most shoreline protection techniques will require one or more permits. Taking steps outlined in this booklet to properly assess a site and using publications like the Washington Department of Fish and Wildlife's *Marine Shoreline Design Guidelines* to properly design a structure may minimize review time for permits.

Installation, repair, or replacement of shoreline protection will normally require a permit from a local jurisdiction (such as a city or county) that is responsible for the local Shoreline Master Program (SMP). A Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife will also typically be required. The HPA ensures that the design and construction of the project include proper protection for fish. Some projects will also require a permit from the U.S. Army Corps of Engineers which protects many of the nation's aquatic environments under authority from the Rivers and Harbors Act (Section 10) and the Clean Water Act (Section 404). These agencies should be engaged early in your design process through a pre-application meeting which will reduce the need for major redesign later in the process.

Many property owners find it simpler to hire a professional that will guide them through the permitting process. Homeowners may also contact the Washington state Governor's Office for Regulatory Innovation and Assistance (ORIA) to receive free guidance on regulations and permits.

Additional Permit Information

- ORIA Information Center provides free permit support for Washington state residents.
  www.oria.wa.gov
- Washington Department of Fish and Wildlife provides Hydraulic Project Approval (HPA) information.
  www.**wdfw.wa.gov/licensing/hpa**
- Washington Department of Ecology provides a Shoreline Master Program (SMP) informational handbook.
  www.ecy.wa.gov/programs/sea/shorelines/smp/handbook/chapter15.pdf
- U.S. Army Corps of Engineers (Seattle District) provides local regulatory information.
  www.nws.usace.army.mil/Missions/CivilWorks/Regulatory.aspx

Selecting Native Plants

Washington state has many native plant species that are well-adapted to the unique conditions of the marine shoreline environment. Existing native vegetation should be preserved wherever possible, as these plants provide habitat for local wildlife and help stabilize soil. To find plants best-suited to the unique conditions of your site, work with a local professional and/or native plant nursery.

Shore pine

Vine maple

Western redcedar

Trees

Common Name	Scientific Name	Exposure Needs	Moisture Needs	Max. Height (ft)	Growing Ease
Big-leaf maple	*Acer macrophyllum*	sun - shade	dry - moist	100	High
Douglas fir	*Pseudotsuga menziesii*	sun - partial shade	dry - moist	250	Medium
Grand fir	*Abies grandis*	sun - shade	dry - moist	250	Medium
Hookers willow	*Salix hookeriana*	sun	moist - wet	20	High
Madrone	*Arbutus menziesii*	sun - partial shade	dry	90	Low
Pacific crabapple	*Malus fusca*	sun - partial shade	moist - wet	40	Medium
Red alder	*Alnus rubra*	sun - partial shade	dry - wet	120	High
Shore pine	*Pinus contorta var. contorta*	sun - partial shade	dry - wet	50	High
Sitka spruce	*Picea sitchensis*	sun - partial shade	moist -wet	200	Medium
Vine maple	*Acer circinatum*	partial shade - shade	dry - moist	25	High
Western hemlock	*Tsuga heterophylla*	partial shade - shade	moist - wet	225	Medium
Western redcedar	*Thuja plicata*	partial shade - shade	moist - wet	200	Medium

Serviceberry

Dwarf Oregon grape

Sweet gale

Nootka rose

Salal

Shrubs

Common Name	Scientific Name	Exposure Needs	Moisture Needs	Max. Height (ft)	Growing Ease
Bald hip rose	*Rosa gymnocarpa*	sun - shade	dry - wet	4	High
Beaked hazelnut	*Corylus cornuta var. californica*	sun - shade	dry - moist	20	Medium
Dwarf Oregon grape	*Mahonia nervosa*	partial shade - shade	dry - moist	3	Medium
Evergreen huckleberry	*Vaccinium ovatum*	partial shade - shade	dry - moist	6	Medium
Indian plum; Osoberry	*Oemlaria cerasiformis*	partial shade - shade	dry - moist	15	Medium
Nootka rose	*Rosa nutkana*	sun - partial shade	moist - wet	10	High
Oceanspray	*Holodiscus discolor*	sun - shade	dry - moist	15	High
Salal	*Gaultheria shallon*	partial shade - shade	dry - moist	5	Medium
Salmonberry	*Rubus spectabilis*	sun - shade	moist - wet	10	High
Serviceberry; Juneberry	*Amelanchier alnifolia*	sun - shade	dry - moist	20	High
Snowberry	*Symphoricarpos albus*	sun - shade	dry - moist	5	High
Sweet gale	*Myrica gale*	sun - partial shade	moist - wet	4.5	Medium
Sword fern	*Polystichum munitum*	partial shade - shade	dry - moist	3	High
Thimbleberry	*Rubus parviflorus*	sun - shade	dry - moist	8	Medium

Western columbine

Tufted hairgrass

Golden-eyed grass

Yarrow

Pickleweed

Perennial/Grass-like

Common Name	Scientific Name	Exposure Needs	Moisture Needs	Max. Height (ft)	Growing Ease
Common spikerush	*Eleocharis palustris*	full sun	wet	3	Medium
Douglas aster	*Aster subspicatus*	sun - partial shade	dry - moist	3	High
Dunegrass	*Elymus mollis*	sun	wet	3	High
Fleshy jaumea	*Jaumea carnosa*	sun - partial shade	wet	0.5	High
Golden-eyed grass	*Sisyrinchium californicum*	sun - partial shade	moist - wet	1.5	Medium
Large-leaved lupine	*Lupinus polyphyllus*	sun - partial shade	moist - dry	5	High
Lyngbye's sedge	*Carex lyngbyei*	sun - partial shade	wet	3	Medium
Pickleweed	*Salicornia pacifica*	sun	moist - wet	1	High
Puget Sound gumweed	*Grindelia integrifolia*	sun	dry - moist	3	Medium
Seacoast bulrush	*Bolboschoenus robustus*	full sun	wet	2	Low
Sea-watch	*Angelica lucida*	sun - partial shade	moist - wet	5	Medium
Slough sedge	*Carex obnupta*	sun - partial shade	moist - wet	3	High
Tufted hairgrass	*Dechampsia cespitosa*	sun - partial shade	dry - wet	3	High
Western columbine	*Aquilegia formosa*	sun - partial shade	moist	2	Medium
Yarrow	*Achillea millefolium*	sun - partial shade	dry - moist	0.5	High

H. checker mallow

Kinnikinnick

Beach strawberry

Thrift

Broad-leaved stonecrop

Groundcovers

Common Name	Scientific Name	Exposure Needs	Moisture Needs	Max. Height (ft)	Growing Ease
Beach/Coastal strawberry	*Fragaria chiloensis*	sun - partial shade	dry	1	High
Broad-leaved stonecrop	*Sedum spathulifolium*	sun	dry	0.5	High
Graceful cinquefoil	*Potentilla gracilis*	sun	moist	2	Medium
Henderson's checker mallow	*Sidalcea hendersonii*	sun	moist - wet	5	Medium
Kinnikinnick	*Arctostaphylos uva-ursi*	sun - partial shade	dry	1	Medium
Silverweed	*Potentilla anserina var.pacifica*	sun - partial shade	moist - wet	1.5	High
Thrift; Sea pink	*Armeria maritima*	sun	dry - moist	1	High

For additional information on native plants and nurseries that can help with proper plant selection, visit the following resources:

- King County Native Plant Guide: **https://green2.kingcounty.gov/gonative/Index.aspx**
- Washington Native Plant Society, Saltwater Shoreline Plants: **http://www.wnps.org/landscaping/herbarium/saltwaterlist.html**
- Plant Native: **http://www.plantnative.org/nd_wa.htm**

For additional information on vegetation management, visit the following link:

- Washington Department of Ecology, *Vegetation Management: Guide for Puget Sound Bluff Property Owners*: **http://www.ecy.wa.gov/programs/sea/pubs/93-31/intro.html**

Additional Resources

Marine Shoreline Design Guidelines (MSDG)

Washington Dept. of Fish and Wildlife
www.wdfw.wa.gov/publications/01583
If this booklet intrigued you, get more information from the source! The MSDG is a technical publication developed as part of the Aquatic Habitat Guidelines series. It provides additional detail and technical information on assessing your shoreline as well as how to select and design a technique for your site. Case studies of 25 sites evaluate the effectiveness and impacts of the various design techniques.

Shore Friendly

Washington Dept. of Fish and Wildlife & Washington Dept. of Natural Resources
www.shorefriendly.org
If you appreciate the content in this booklet, visit the Shore Friendly website. Get more information about options for your Puget Sound waterfront property and resources in your area. You can also share the link with your friends and neighbors.

Green Shores for Homes

Multiple Agencies
www.greenshoresforhomes.org
Green Shores for Homes is a voluntary incentives program to promote sustainable use of coastal ecosystems through planning and design.

Green Shorelines

City of Seattle
www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/dpdp025742.pdf
This helpful booklet, focused on property owners on Lake Washington and Lake Sammamish, offers a guide to understanding and implementing green shoreline practices and green dock designs, estimating costs and maintenance, and getting through the permitting process.

Shore Stewards: Guide for Shoreline Living (2015)

Washington State University
www.shorestewards.wsu.edu
A guide based on 10 steps to being a good steward of the shoreline. Many of the sections are directly relevant to managing the shoreline and working with nature.

Shorelands and Environmental Assistance

Washington Dept. of Ecology
www.ecy.wa.gov/programs/sea/shorelan.html
The Washington Department of Ecology offers access to many marine waterfront resources through its Shorelands and Environmental Assistance page. Access to map data from the Washington State Coastal Atlas, planning resources, technical information and permit assistance are all available.

Priority Habitats and Species (PHS)

Washington Dept. of Fish and Wildlife
www.wdfw.wa.gov/conservation/phs/
This is a web-based, interactive map for people looking for basic information about the known location of Priority Habitats and Species in Washington.

City and County Shoreline Characterizations

Many cities and counties in Washington produce Shoreline Master Programs that contain characterization reports documenting existing shoreline conditions. Check your jurisdictions' websites and/or visit your local planner to learn more.

This Cornet Bay restoration project removed a bulkhead and added logs and natural vegetation to transform the park into a beautiful, usable, safe, and healthy environment. The same techniques can be used on residential properties.

Benjamin Benschneider

After

Peter Kilpatrick

Before

The owners of this home replaced a bulkhead with a more natural shoreline. Their approach involved resloping the beach, nourishing with sand and gravel, and strategically placing boulders and logs.

Landowners on Orcas Island installed a gravel beach with logs and native vegetation in place of a rock berm. This new beach enhances storm protection, improves beach access, and provides habitat for fish and wildlife.

Acknowledgments

Steering Committee

Laura Arber, WA Dept. of Fish and Wildlife
Joe Burcar, WA Dept. of Ecology
Randy Carman, WA Dept. of Fish and Wildlife
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Project Consultants

MAKERS
Killer Infographics

Front cover photo provided courtesy of Dave Shreffler.
Back cover photo provided courtesy of Theresa Mitchell.

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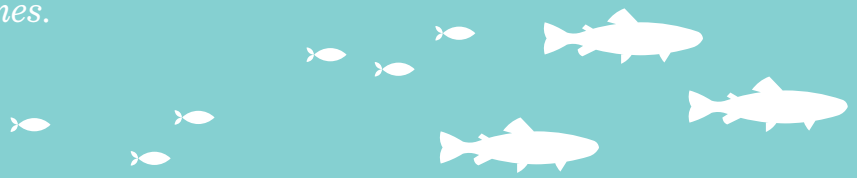
This booklet is based on the work of Coastal Geologic Services, Qwg Applied Geology, and partners as presented in the *Marine Shoreline Design Guidelines*.



Waterfront living provides a lifetime of memories.

Recognizing your role in caring for the shoreline ensures that you—as well as future generations—will be able to enjoy our shared marine resource.

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