

GREEN

shorelines

Bulkhead alternatives
for a healthier
Lake Washington



Lake Washington embodies the best of Western Washington: clean water, bountiful recreational opportunities, striking mountain views, and access to thriving cities. These qualities have inspired thousands of people to make their homes on the shores of the lake, transforming a forested waterfront to a residential one over the past 100 years. This change has led to a variety of problems, including loss of important wildlife habitat and some of the area’s natural charm, but lakefront homeowners are finding new ways to protect the lake.

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This guidebook is about alternatives to the use of bulkheads and other shoreline armoring. Hard engineering is currently the standard approach for erosion control around the lake, but it has several negative impacts on nearshore habitats as well as the fish and wildlife that depend on them. More sustainable practices, referred to in this guidebook as green shorelines, use plants, beaches, and other natural materials to protect private property and the environment.

Green shorelines provide three types of benefits for homeowners:

- 1 they substantially improve habitat for Chinook salmon and other wildlife while maintaining shoreline stability;
- 2 they allow improved water access for homeowners and guests, making swimming and shoreline enjoyment easier;
- 3 they offer a softer, more natural aesthetic that can enhance views by adding variety and seasonal interest.

While homeowners often find green shorelines attractive, many have concerns about effectiveness, reliability, building and maintenance costs, the permitting process, and the potential loss of lawn. This guidebook specifically addresses these and other concerns by assembling technical information from a wide range of sources and providing local examples.

Although the guidebook was written by the City of Seattle, the principles described here can be applied to homes all around Lake Washington. Additionally, most of the information provided here is relevant to Lake Sammamish. Technical advice in these pages is offered as guidance; it is not building code. In the case of any discrepancies, defer to local, state, and federal regulations for shoreline development.

Green shorelines are attractive, reliable, and sustainable. The idea of having your own beach is a major motivator for many people to buy waterfront property – why give up your beach for a bulkhead?



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Introduction

The water's edge

People love to live in places where water and land meet. Shorelines provide work and recreation opportunities, mild climates, and tranquil views. Rapid growth in the communities around Lake Washington and Lake Sammamish is a clear demonstration of our desire to live near water.

People are not the only ones drawn to shorelines, however. Due to the diverse resources and habitats that occur along lakeshores, they tend to be biologically rich and productive places. Again, Lake Washington is no exception—numerous plant, bird, fish, mammal, and insect species call the lake's shorelines home.

Problems with “business as usual”

Unfortunately, some of the natural elements that attract people to waterfront properties are often casualties of development. Trees, shrubs, and wildflowers are cleared to make way for houses, lawns, and open views. Bulkheads built to control bank erosion displace beaches and cause erosion below the water line. Removal of vegetation along the shore allows contaminants to flow directly into the lake. As beaches and vegetation are replaced by lawn and concrete, prime wildlife habitat disappears, taking with it birds, beneficial insects, and fish.

Residential development on Lake Washington has taken a particularly heavy toll on Chinook salmon. These iconic fish of the Pacific Northwest hatch in the Cedar River, Issaquah Creek, and Bear Creek. Many rear in the lake for several months. Once they become smolts, Chinook swim through Lake Washington and Seattle's Ship Canal to reach the ocean. As they migrate through the lake, juveniles follow the shoreline, staying close to the shallow-water areas that help them to escape from predators and safely forage for food.

Bulkheads and docks have altered or eliminated much of the shallow-water habitat around the lake. A 2001 study found that 70% of Lake Washington's shoreline was armored with concrete, riprap, sheetpile, or another type of bulkhead. By reflecting wave energy back into the lake, these structures tend to wash away nearshore sediment, causing deeper water over time. Lawns have replaced much of the diverse vegetation that provided cover for young fish. While many factors are contributing to the decline of Puget Sound's endangered Chinook salmon populations, loss of rearing and refuge habitat is among the most serious problems.

Bulkheads also can compromise homeowners' access to the water and negatively affect views. Entering the water from a bulkhead can be awkward or even dangerous; shoreline armoring accelerates nearshore erosion, deepening the water and making wading difficult. Further, the widespread use of shoreline armoring is bad for waterfront aesthetics—while homeowners typically prefer greener, natural-looking lakeshores, armoring creates a more heavily developed look along the shoreline.

Attractive alternatives

The good news is that people are finding new strategies for protecting their property while also protecting and restoring habitat. Instead of concrete and sheetpile, these practices use a combination of plantings, gravel, stone, logs, and slope modification to protect against shoreline erosion.

The ideal is to set structures back far enough to preserve the natural shoreline and vegetation. However, given that the majority of Lake Washington is already developed, this guidebook focuses on positive steps that can be taken to reduce the impact of existing waterfront homes. Whether your site can accommodate a full beach restoration or only incremental improvements, a wide range of options is available, including:

- Full beaches
- Beach coves
- Setting back bulkheads
- Log installation
- Vegetated buffers
- Slope bioengineering

The following sections explain and illustrate how these approaches work, where they might be used, and what they look like. Although described separately, keep in mind that in most cases, these strategies are typically used in combination with one another. While the concepts outlined here will give you a broader understanding of the options for improving your shoreline, it is advisable for you to seek professional assistance to get your project designed and built. Suggestions for selecting designers and contractors are provided in the section titled “Choosing a Shoreline Professional.”

When this guidebook uses the term “restoration,” it does not mean returning Lake Washington to its pre-development condition. Rather, it refers to restoring specific ecological processes. The shorelines shown in this publication look different than they did 150 years ago, but they still can protect fish, wildlife, and water quality in many of the same ways.

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Together with design and construction advice, this guidebook also provides suggestions to help you get through your permitting process more quickly. Because Lake Washington is home to multiple species on the Endangered Species list, lakeshore construction has to be approved by local, state, and federal agencies. While specifics vary, the growing trend across regulatory agencies is to encourage projects that improve shoreline habitat quality through requirements, incentives, and streamlined permitting. Following the principles in this guidebook can help you avoid unnecessary permitting hurdles (see “Getting Permits”).

Photos of restored shorelines throughout the guidebook help demonstrate specific green shoreline techniques, and they also display the aesthetic benefits of natural beaches and plantings. Further, they provide samples of the diverse shoreline restoration projects that already exist around Lake Washington.





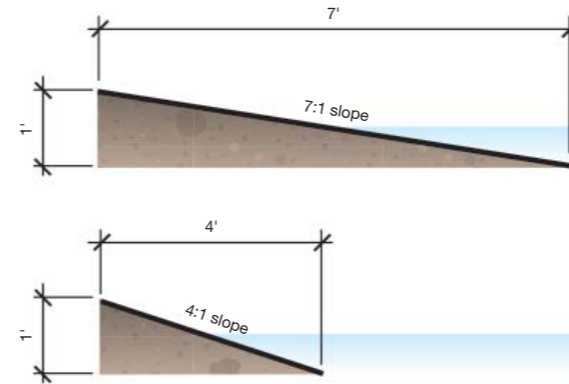
Green shoreline practices

Full beaches

Restoring a beach along your entire lakeshore frontage is the ideal Green Shoreline improvement. On the right site, beach restoration can be straightforward: after removing your bulkhead, lay back the slope to a stable angle, and add appropriate gravel and plants. A few guidelines apply to most beach restoration projects.



Slopes of 7:1 or less are ideal for restored beaches, although slopes up to 4:1 can be stable.



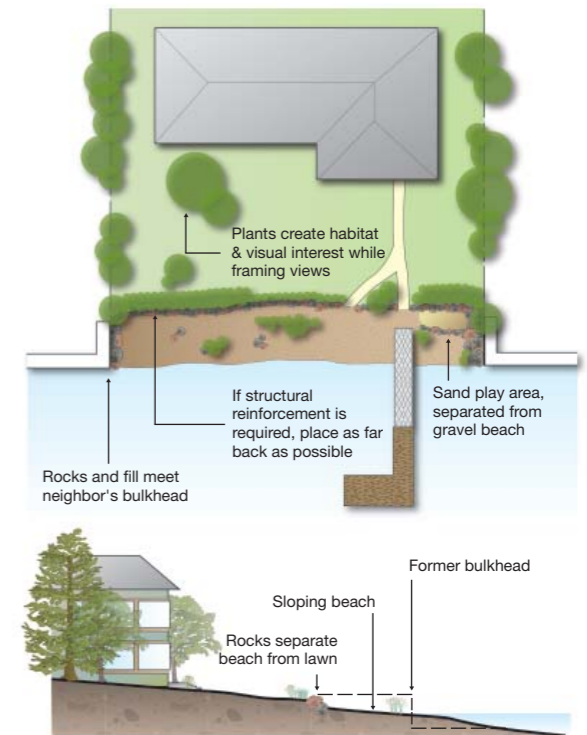
Beach slope is a critical component of a successful restoration project. A well-designed slope provides resistance to erosion, reducing the need for maintenance. Slopes of 7:1 or flatter are ideal (seven horizontal feet for each vertical foot), but slopes up to 4:1 can be stable in some circumstances.

New beaches should be made of an appropriate gravel material. Although people tend to think of sand when they think of shorelines, sand erodes quickly in most parts of Lake Washington. Instead, use clean, well-rounded gravel 1/8" to 2" size – specifics will depend on wave energy and your proximity to known sockeye spawning grounds. Contact the Washington State Department of Fish and Wildlife to learn about requirements in your area (see "Contacts"). If sand is desired it should either be placed well above the water line or physically separated from the gravel beach using stone or wood.

Additionally, a successful design for a restored beach must address how the beach will meet neighboring properties. This is not a concern if your neighbors already have or are restoring their own beaches, but it is necessary to plan how the edges of a beach will meet any neighboring bulkheads.

There are two strategies for meeting adjacent bulkheads:

- 1 Install rocks, wood, plantings, or concrete walls at the edges of your beach to reinforce the transition area from beach to bulkhead – these areas will be subject to greater erosive forces.
- 2 Add extra fill below the water line at the edges of your property – this protects your beach from the erosive forces of neighboring bulkheads and protects the bulkheads from undercutting. For shoreline restoration purposes, 25 cubic yards of fill are allowed outright in the water so long as they do not create dry land. More may be approved depending on site conditions.



Some erosion to beaches is normal over time. This can be offset by beach nourishment, the periodic addition of gravel. When a project is designed and installed properly, some nourishment is likely to be necessary every five to ten years.

To make beach nourishment easier, it is ideal to include periodic fill as part of the maintenance plan in your initial construction permit. This can help you avoid needing to obtain a local permit to add gravel to your beach in the future. If nourishment is not covered in your initial permit, you will need to obtain a shoreline exemption for each instance of beach nourishment. Time and costs for this process depends on your local jurisdiction.

Regardless of whether a local permit is necessary, beach nourishment projects need permits from the Washington State Department of Fish and Wildlife and Army Corps of Engineers. Both have relatively simple application processes so long as your nourishment project will be adding 25 cubic yards of fill or less. Total wait time for both agencies is likely to be 10 to 30 days, and neither permit requires a fee (see "Getting Permits").



Beach coves

Beach coves or “pocket beaches” are currently the most common type of green shoreline installed around Lake Washington. A beach cove is a beach along a portion of a property’s waterfront, flanked on both sides with hard structural elements. This is a useful strategy to improve habitat quality and water access while keeping armoring if it is necessary. While recommended slope, width, and depth of beach coves vary depending on site conditions, several features are advisable for most beach cove projects.

Like full beaches, beach coves should use appropriately sized gravel, and typically not sand. Beach nourishment will be needed with about the same frequency as with a full beach restoration (every 5-10 years), but less fill is needed since the beach area is smaller.

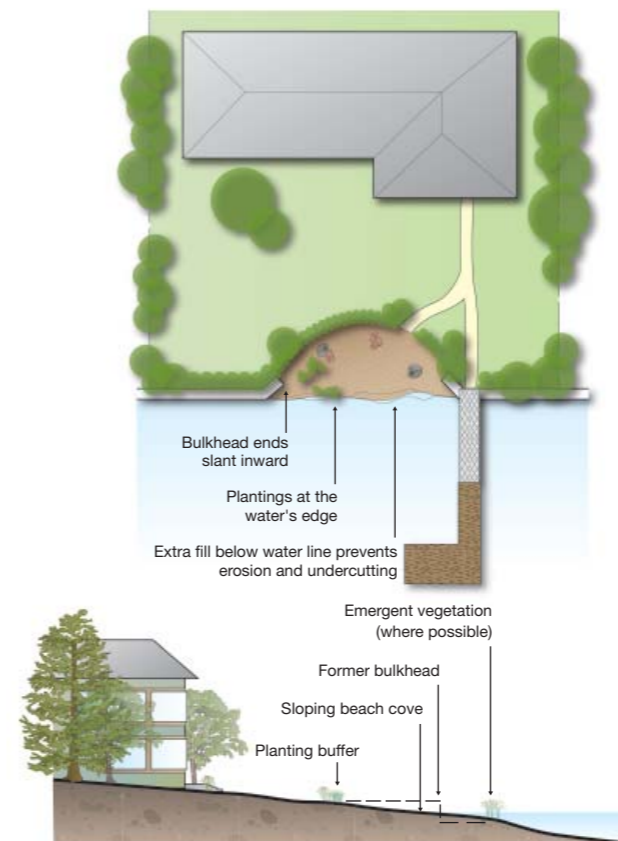
Localized erosion can occur where the bulkhead meets the beach on either side of the cove. Two techniques that help prevent this from happening include:

- 1 Angling the ends of the bulkhead away from the water to dissipate wave energy and decrease erosion.
- 2 Adding extra gravel fill below the water line to help prevent undercutting of the bulkhead.

As with full beaches, beach cove slopes should typically be no steeper than 4:1, i.e., four horizontal feet to one vertical foot. Again, 7:1 is a good goal, but steeper slopes can be stable when appropriate materials are used.

Beach coves should not be the first choice if your property can accommodate full beach restoration. They provide less shoreline for wading and other beach activities, and they do less to improve habitat. While fish biologists have observed juvenile salmon using pocket beaches around Lake Washington, research suggests that the fish gravitate to larger beaches and plantings when they are available.

Specific criteria to help you consider the practicality of a cove versus a full beach are discussed in “Selecting the Right Approach.”



“I like beaches, but my property is worth too much to give up any land.”

Some homeowners are reluctant to consider partial or full beach restoration because they are concerned about losing property. Although it is true that green shorelines sometimes result in smaller lawns, the square footage of dry land remains the same since these projects add beach and planting areas. Essentially, you are converting parts of your property from one use to another. A good design will maintain the ordinary high water line such that there is no loss of dry land.

Further, most homeowners do not actively use the full extent of their lawns. Green shorelines property owners often find that they use their beaches more than they did their lawns, and that plant diversity and visiting wildlife improve their yard’s aesthetics by adding visual variety. One homeowner reported that a beach cove installed by previous owners had become his favorite place to entertain company. “I wasn’t the one that had the foresight to build it, but I like to claim credit for it,” he admitted. “Guests love sitting out there in the evening.”

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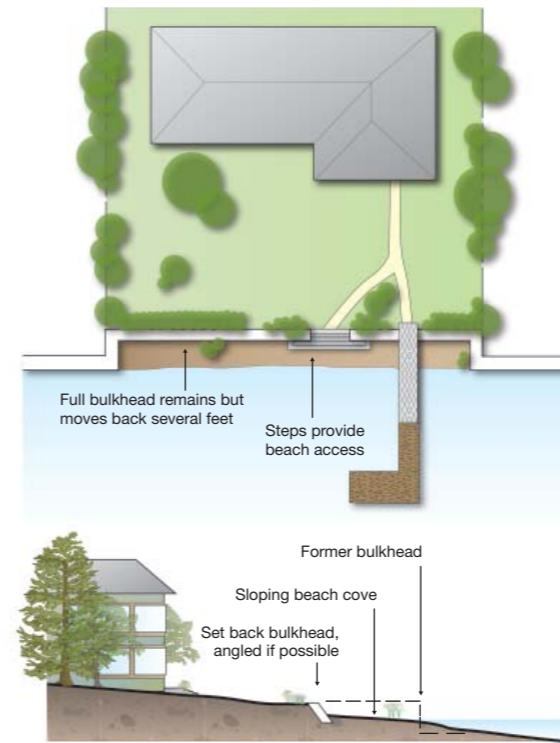
Setting back bulkheads

When houses have been built too close to the water, fewer options for shoreline management remain. If there is not an adequate setback between the water line and the house, a bulkhead really may be necessary to protect houses or other structures. In many cases, however, the bulkhead can at least be moved back from the high water mark, providing benefits to the homeowner and the lake ecosystem.

It is a simple concept but one that can make a big difference for access and ecological function. By moving a bulkhead back several feet from the water line, homeowners gain a beach and many of its advantages: safe wading and swimming access, an easy way to launch hand-carried boats, and waterfront play areas. The bulkhead is still there to help accommodate the grade change from house to water or to provide protection during large storms.

Part of the bulkhead can be set back to create a reinforced beach cove, or the whole thing can be set back to create new a new beach all across the shoreline.

If you need to keep a bulkhead because of how the site was developed, setting the bulkhead back from the water can simplify your permitting process. The Army Corps of Engineers does not claim jurisdiction above the ordinary high water line, so no federal permit is likely to be required for the new bulkhead provided that it is built before the existing bulkhead is removed. If the old bulkhead you are removing is located at high water, that part of the construction will still require an Army Corps permit.



As with beach coves, a project that sets back a bulkhead need not result in any loss of property. As long as beach fill is properly installed, the high water mark will remain the same distance away from your house as it was before renovation. You may displace some lawn or other upland planting area, but that area will be converted to usable beach. Like other beaches, a beach created by setting back a bulkhead will need periodic additions of gravel fill (see “Full Beaches”).

Whether you are setting a bulkhead back or replacing it in the same location, angling back the batter (the slope of the bulkhead) is generally a good idea. With every wave that hits it, a vertical bulkhead reflects most of the wave energy back into the lake. This leads to turbulence and erosion, which results in deeper water at the bulkhead’s base. A sloped bulkhead does a better job of absorbing and dissipating energy, creating less erosion and lengthening the service life of your investment. For Lake Washington, engineers generally recommend a bulkhead slope of 3:1 where site constraints will allow it.

“Won’t a beach attract more geese to my yard?”

While wildlife sightings are a major benefit of living on the water, all creatures are not greeted with equal enthusiasm; the noise, aggressive behavior, and messy habits of Canada geese frequently make them unwelcome guests. Although many worry that creating a new beach may draw more geese into their yard, a more natural shoreline can actually decrease the number of visiting geese. A lawn extending to the lakeshore is a goose’s equivalent of a 24-hour salad bar – geese eat turf grass and snails, and they prefer open areas with no shrubs and trees for predators to hide behind.

Two strategies, used separately or together, act as effective deterrents to geese. First, separating the beach from your yard by a few steps makes the ascent too much of a hassle for most geese. Second, plantings of native vegetation between your yard and the water can act as a visual and physical barrier, separating the geese from your grass. Even with a path through the plantings to allow beach access, geese are reluctant to walk through taller vegetation.

“Our old yard was a landing strip for geese. Since we shrank the lawn area and added plants, the geese almost never come here anymore,” reports a Bellevue homeowner. In addition to discouraging Canada geese, diverse plantings are likely to increase visits by songbirds and other desirable wildlife.



note



Logs must be anchored securely in place. Although the dense, weathered wood used for these projects does not float easily, a little buoyancy can be enough to pull a log loose during a storm. A loose log can be hazardous to people, structures, or boats. There are several ways to secure a log, but it is most commonly done using duckbill anchors and cables or by partially burying the log.

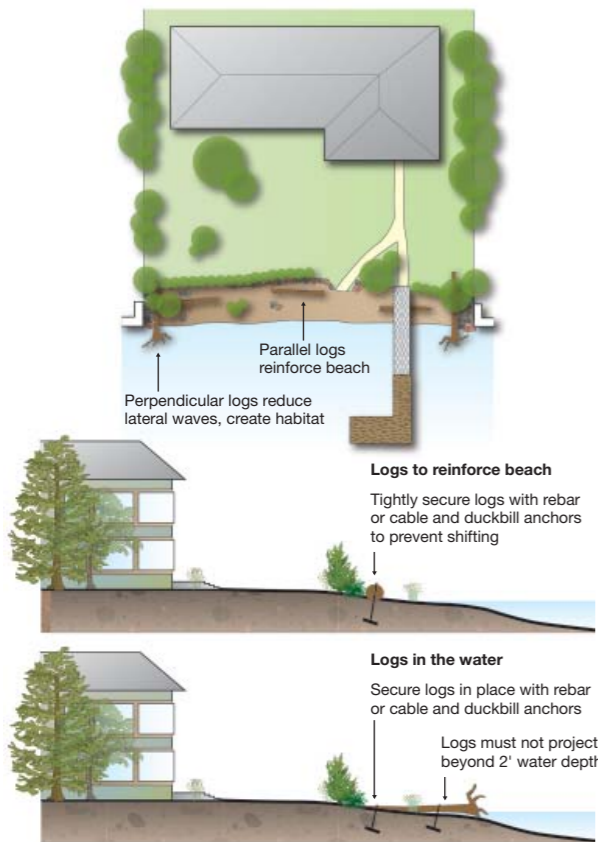
While logs in the water can improve nearshore habitat by creating salmon refuge areas, they should not extend beyond a depth of 2' below ordinary high water. Anything beyond this is thought to create habitat for predator fish species that prey on salmon. In some cases, logs are not allowed to extend beyond the water line, since they can interfere with natural movement of sediments.

Also, shorelines that place logs below or partially below the water line must be designed with particular care. Some restoration efforts around the lake have installed logs perpendicular to the shoreline to enhance fish habitat.

If logs are used for habitat enhancement, they should be as complex as possible, with root wads and some branches still attached.

Log installation

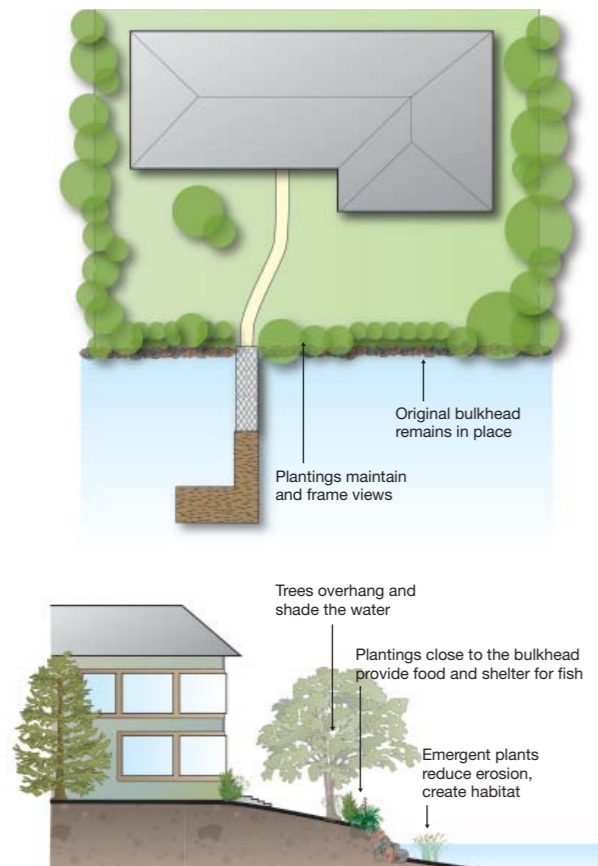
Logs are useful construction materials for green shorelines projects. They can provide strategically placed “hard engineering” structural reinforcement while complementing the aesthetic of a more natural beach project and, in some cases, enhancing ecological function. A few key principles increase the effectiveness of logs.



Shoreline plantings

The use of trees, shrubs, and perennials is a key characteristic that distinguishes green shorelines from conventional shoreline management. When homeowners see examples of green shorelines, the plants are typically what make the biggest impression; instead of a monotonous swath of lawn and bulkhead, these shorelines use a rich variety of plantings to provide visual interest, create and protect habitat, and help stabilize the lakeshore.

In this guidebook, two categories of plantings are discussed: vegetated buffers and slope bioengineering. Vegetated buffers primarily contribute to a shoreline by adding beauty, improving habitat value, and protecting water quality. Slope bioengineering strategically uses plants as an engineering element to hold soil in place.



GREEN SHORELINES:

Vegetated Buffers

Vegetated buffers at the water's edge add visual interest to residential landscapes. A mix of textures, flowers, fruit, and colors brings a dynamic quality to your yard throughout the year. Native plants are ideal, not only because they have lower water and maintenance needs, but also because they help draw birds and beneficial insects to your yard. Vegetated buffers are great options for any lakefront property, whether you have a bulkhead, a beach or a combination of the two.

Diverse shoreline plantings contribute to aquatic habitat in four important ways. First, vegetation provides diffuse shade to the water's edge, creating conditions that help juvenile fish blend in with their surroundings. Second, they restore natural food web processes to the shoreline – plants are home to insects and other small organisms, which become fish food when they fall into the water. Third, they provide twigs, branches and leaves, which create important refuges from birds and bigger fish. Finally, planted strips protect water quality by filtering excess nutrients and other contaminants from stormwater. Rainwater flowing over lawns carries fertilizer, pet feces, gasoline, paint, and pesticides into the lake, but shrubs and perennials can help stop and neutralize these contaminants.

How wide should your buffer be? This depends on what your lot can accommodate. While bigger is better, even a few feet can provide benefits. For most new residences along Lake Washington, Seattle requires at least a 25' building setback. This means a 5-10' vegetated buffer can easily fit on most sites, and 15-20' is often feasible. An additional benefit of vegetated buffers: replacing turf with low-maintenance perennials and shrubs can cut down on yard work by shrinking the area that needs mowing.

Ideally, shrubs and perennials should be directly adjacent to the water's edge, overhanging the lake wherever possible. When a property has a bulkhead, however, trees and large shrubs need to be sited carefully to prevent damage to shoreline armoring. Black cottonwood, for example, is an ideal tree to plant next to beach areas, but its vigorous root system could cause problems for a riprap bulkhead.

Emergent plants provide excellent habitat and erosion control, but they often struggle on Lake Washington due to the lake's unusual hydrological conditions – the lake's water level is managed at the Ballard Locks such that high water occurs in the summer and low water occurs in the winter. Emergent plants may work well in protected parts of Lake Washington, or areas with shallow nearshore slopes.

As long as all plants are placed above the high water mark, no permits are necessary to plant shoreline vegetation.



“Sure, I like plants, but maintaining my view of the water is a higher priority.”

Many homeowners favor large expanses of lawn because they see it as the best way to protect their view. The truth is that diverse plantings can accent and improve views.

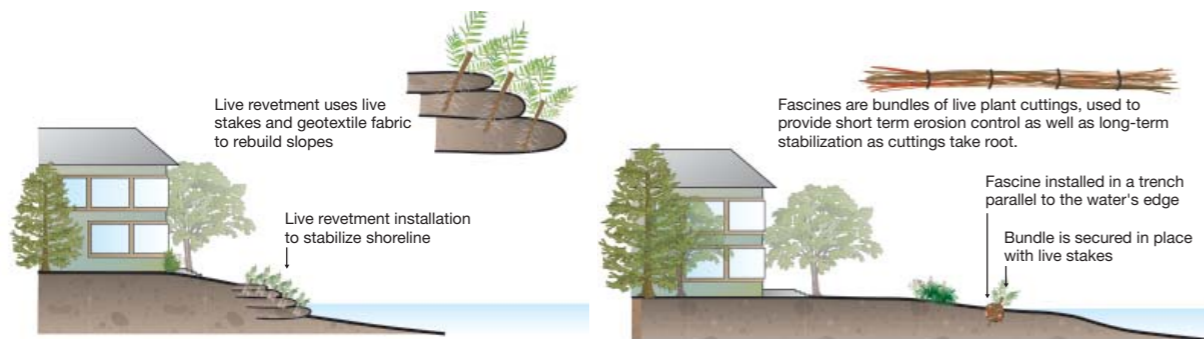
Framing views is an important principle of garden and landscape design. Identify which views you want to keep and enhance, and which views would be better screened. Strategic plant placement can help block or soften undesirable views (such as a neighbor's shed or boat house) while maintaining views of the water.

Since houses are always sited above the high water line, it's usually easy to keep views of the water over perennials and low shrubs. Most sites can also accommodate trees without losing views, so long as the trees are maintained properly; limbing them up (trimming out the lower branches to allow views under or through the canopy) may sometimes be desirable. Trees contribute to a sense of privacy, bring birds and other wildlife to your yard, absorb runoff, and can even reduce energy costs by shading your house in the summer.

Looking at the examples throughout this guidebook will give you more specific ideas of how plantings can preserve and enhance views while reducing your impact on the environment.



Photo Above: Joanna A. Buehler
Photo Left: The Berger Partnership



Slope Bioengineering

Slope bioengineering is a term used for an array of different techniques that share an elegant principle. Instead of using concrete or sheetpile, bioengineering uses plant material as a self-renewing, ecologically sustainable way to hold soil and gravel in place. These “soft engineering” techniques are commonly used in parks and natural areas for ecological restoration projects, but they may also be used on residential properties.

Each of the dozens of slope bioengineering techniques has its own advantages specific to different situations. A few examples are listed below:

- 1 Live stakes are a key element of almost all bioengineering projects. These are cuttings from plants that will grow roots when inserted into moist ground. Willows, dogwoods, and other shoreline species adapted to reproduce through cuttings are all viable candidates. Live stakes can be a simple and cost-effective way to bind soil in place and provide plant cover.
- 2 Fascines are long bundles of thin branches, tightly bound with twine. They are partially buried in trenches parallel to incoming waves and “nailed” into place with live stakes. These thick masses of branches provide immediate structural support, catch sediment coming from upslope, and can establish their own roots and new growth. Since they are usually composed of several different species, the resultant growth comes in as a thicket of mixed plants. For this reason, fascines should be placed carefully to avoid blocking views.
- 3 Live revetment is used to stabilize steep banks. Geotextile fabric holds earth-filled terraces in place. Further structural support is provided by live stakes driven through the fabric.

Be sure that cuttings are collected from an approved site – contact your city’s parks department or the Washington Department of Natural Resources to find out where harvesting is allowed (see “Contacts”). Permits are required for any slope bioengineering installations at or below ordinary high water.

“How might climate change affect Lake Washington, and how can plantings help?”

Fortunately for homeowners on Lake Washington, climate change will not cause the lake to rise. Because the lake’s level is managed at the Ballard Locks, the ordinary high water line should stay essentially the same.

The bad news is that a temperature change of just a few degrees can dramatically alter ecological relationships in the lake. University of Washington researchers have measured rising temperatures in the lake over the past 40 years. They suspect that the warmer water is linked to declining numbers of *Daphnia*, a tiny aquatic organism that provides a food source to Chinook, sockeye, and other fish.

As this food source diminishes, native vegetation along the shoreline becomes even more important as a source of insects, insect larvae, and other fish food. By increasing your waterfront vegetation, you are increasing habitat for beneficial insects, thereby providing an alternative food source for salmon.

Trees and shrubs also increase the amount of partial shade on the lake’s surface, helping to moderate temperatures in shallow water.

note





Plant List

Native plants offer many advantages for green shorelines and residential landscaping in general. Because they are adapted to local conditions, they rarely require irrigation. They are surprisingly diverse, offering a wide palette of shapes, textures, and colors to work with. They can be attractively mixed with many nonnative ornamental plants. Also importantly, they offer substantial habitat benefits for birds, beneficial insects, and fish. Finally, native plants do

not need fertilizer and pesticide treatments that can put harmful chemicals in the lake.

Many of the plants on this list, like Oregon grape and mock-orange, can be found at any nursery. Others will only be available through nurseries that specialize in native plants. For an up-to-date list of native plant retailers, please contact the Washington Native Plant Society (www.wnps.org).

Latin name	common name	exposure	moisture	height (ft.)
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TREES

<i>Abies procera</i>	noble fir	sun/part shade	dry/moist	200
<i>Acer circinatum</i>	vine maple	part shade/shade	dry/moist	25
<i>Acer macrophyllum</i>	bigleaf maple	sun/part shade	dry/moist	105
<i>Alnus rubra</i>	red alder	sun/part shade	moist/wet	70
<i>Betula papyrifera</i>	paper birch	sun	moist	80
<i>Crataegus douglasii</i>	black hawthorn	sun/part shade	dry/moist	25
<i>Crataegus suksdorfii</i>	Suksdorf's hawthorn	sun/part shade	dry/moist	20
<i>Fraxinus latifolia</i>	Oregon ash	sun/part shade	moist/wet	70
<i>Malus fusca</i>	Pacific crabapple	sun/part shade	dry/moist	40
<i>Picea sitchensis</i>	Sitka spruce	sun/part shade	dry/moist	200
<i>Populus balsamifera</i>	black cottonwood	sun	moist	100
<i>Populus tremuloides</i>	trembling aspen	sun	dry/moist	75
<i>Pseudotsuga menziesii</i>	Douglas fir	sun/part shade	dry/moist	200
<i>Rhamnus purshiana</i>	casacara	sun/part shade	dry/moist	30
<i>Salix spp.</i>	willow	sun/part shade	moist/wet	6-40
<i>Thuja plicata</i>	Western redcedar	part shade/shade	moist/wet	200
<i>Tsuga heterophylla</i>	Western hemlock	sun/part shade	dry/moist	180

GROUNDCOVER

<i>Achlys triphylla</i>	vanilla leaf	part shade/shade	moist	1
<i>Allium cernuum</i>	nodding onion	sun	dry/moist	1
<i>Asarum caudatum</i>	wild ginger	part shade/shade	moist	0.5
<i>Camassia quamash</i>	common camas	sun/part shade	dry/moist	1
<i>Cornus canadensis</i>	bunchberry	part shade/shade	moist	0.5
<i>Fragaria chiloensis</i>	beach strawberry	sun/part shade	dry	1
<i>Mahonia nervosa</i>	low Oregon grape	sun/shade	dry/moist	2
<i>Maianthemum dilatatum</i>	false lily-of-the-valley	part shade/shade	dry/moist	1
<i>Vancouveria hexandra</i>	inside-out flower	part shade/shade	moist	1

Latin name	common name	exposure	moisture	height (ft.)
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SHRUBS

<i>Amelanchier alnifolia</i>	Saskatoon serviceberry	sun/shade	dry/moist	20
<i>Andromeda polifolia</i>	bog rosemary	sun/part shade	wet	1.5
<i>Cornus stolonifera</i>	red-osier dogwood	sun/shade	moist/wet	15
<i>Corylus californica</i>	beaked hazelnut	sun/shade	dry/moist	20
<i>Gaultheria shallon</i>	salal	part shade/shade	dry/moist	5
<i>Holodiscus discolor</i>	oceanspray	sun/shade	dry	15
<i>Lonicera involucrata</i>	black twinberry	sun/part shade	dry/wet	8
<i>Mahonia aquifolium</i>	tall Oregon grape	sun/shade	dry/moist	8
<i>Philadelphus lewisii</i>	mock-orange	sun/part shade	dry/moist	9
<i>Physocarpus capitatus</i>	Pacific ninebark	sun/shade	moist/wet	13
<i>Rhododendron macrophyllum</i>	Pacific rhododendron	part shade/shade	dry/moist	20
<i>Ribes sanguineum</i>	red-flowering currant	sun/part shade	dry/moist	6
<i>Rosa gymnocarpa</i>	bald-hip rose	sun/part shade	dry/moist	5
<i>Rosa pisocarpa</i>	cluster rose	sun/part shade	moist/wet	6
<i>Rosa nutkana</i>	nootka rose	sun/part shade	moist/wet	10
<i>Rubus spectabilis</i>	salmonberry	sun/shade	moist/wet	10
<i>Salix scouleriana</i>	Scouler willow	sun/part shade	moist/wet	25
<i>Sambucus racemosa</i>	red elderberry	sun/part shade	moist/wet	20
<i>Sorbus sitchensis</i>	Sitka mountain-ash	sun/part shade	moist	10
<i>Spiraea douglasii*</i>	spiraea	sun/part shade	moist/wet	12
<i>Symphoricarpos albus</i>	snowberry	sun/shade	dry/moist	5
<i>Vaccinium ovatum</i>	evergreen huckleberry	part shade	dry	12
<i>Viburnum edule</i>	highbush cranberry	sun/part shade	moist/wet	12

PERENNIALS

<i>Aruncus sylvestris</i>	goat's beard	sun/part shade	moist/wet	5
<i>Aster subspicatus</i>	Douglas' aster	sun/part shade	moist	2
<i>Athyrium filix-femina</i>	lady fern	sun/shade	moist/wet	4
<i>Aquilegia formosa</i>	Western columbine	sun/part shade	moist	2
<i>Blechnum spicant</i>	deer fern	part shade/shade	moist/wet	3
<i>Carex canescens</i>	grey sedge	sun/part shade	moist/wet	2
<i>Dicentra formosa</i>	Pacific bleeding heart	sun/part shade	moist/wet	1
<i>Iris tenax</i>	Oregon iris	sun/part shade	moist/wet	1
<i>Lupinus polyphyllus</i>	large-leaved lupine	sun	moist/wet	4
<i>Mimulus guttatus</i>	yellow monkey-flower	sun/shade	moist/wet	2
<i>Polystichum munitum</i>	sword fern	part shade/shade	moist	4
<i>Sisyrinchium californicum</i>	golden-eyed-grass	sun/part shade	moist/wet	1
<i>Sisyrinchium idahoense</i>	Idaho blue-eyed-grass	sun/part shade	moist/wet	2
<i>Solidago canadensis</i>	goldenrod	sun/part shade	dry/moist	4
<i>Trillium ovatum</i>	Western trillium	part shade/shade	moist/wet	1.5

EMERGENT AQUATIC PLANTS**

<i>Alisma plantago-aquatica</i>	water-plantain	sun-part shade	wet	3
<i>Carex kelloggii</i>	Kellogg's sedge	sun/part shade	moist/wet	2
<i>Carex obnupta</i>	slough sedge	sun/part shade	moist/wet	3
<i>Carex stipata</i>	sawbeak sedge	sun/part shade	moist/wet	2
<i>Sagittaria latifolia</i>	arrowhead	sun/part shade	wet	3
<i>Scirpus microcarpus</i>	small-fruited bulrush	sun/part shade	wet	3
<i>Scirpus acutus</i>	hardstem bulrush	sun	wet	9
<i>Typha latifolia*</i>	cattail	sun/part shade	wet	8

* Potentially aggressive growth and spreading – not suitable where spreading is undesirable.
 ** See information on emergent plants under "Vegetated Buffers."

Selecting the right approach



Not all of the practices discussed in this guidebook are appropriate for every waterfront parcel. Vegetated buffers and logs can be incorporated into just about any shoreline project, including those that require some form of bulkhead. Slope bioengineering and setting back bulkheads also can be used on most sites. While full beach restoration and beach coves are the most desirable options for shoreline management, they may not be effectively implemented on every site.

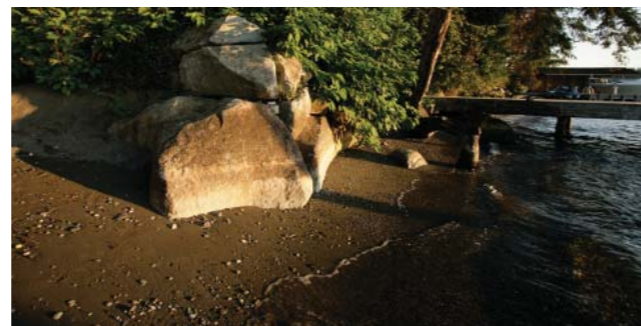
In cases where bulkheads serve only to maximize lawn area, they can typically be replaced by a beach with minimal grading and little additional reinforcement. Others cases, such as properties where houses are set back just a few feet from the water or are perched steeply above the shoreline, require some amount of armoring. How can you tell which practices might be the most appropriate for your property?

Your property's potential for green shoreline improvements is determined by a combination of four factors: building setback from the water, nearshore slope moving from your shoreline into the lake, yard slope leading from your house to the shoreline, and the intensity of waves in your area.

"High wave energy" on the decision tree does not include the typical waves experienced along Lake Washington, but rather refers to sites with one or more of the following conditions:

- 1 Site is adjacent to major boat traffic lane, such as the mouth of Union Bay.
- 2 Site receives waves that build up over a particularly long fetch (the distance over which waves pick up wind energy).
- 3 Site receives waves reflected off Highway 520 or Interstate 90.

The decision tree presented here helps evaluate options based on a site's characteristics, but it is not definitive – individual sites may have additional or special characteristics that increase or limit design options.



Green Shorelines Decision Tree

How do I know which options I can consider for my site?



Notes:

The use of plant buffers or logs is a viable option for any site, including those that employ hard engineering such as bulkheads.

Sites with less than a 10' setback are not included on this decision tree, because in most cases they will depend on concrete, sheetpile, or riprap. As noted above, plant buffers still may be appropriate.

- 1 full beach, beach coves, setting back bulkhead, bioengineering
- 2 beach coves, setting back bulkhead, bioengineering
- 3 setting back bulkhead, bioengineering
- 4 bioengineering

Building better docks



“What’s the goal—shade or no shade?”

Permitting agencies encourage plants that hang over the water, but discourage overwater structures because they shade the water. So what’s the difference?

Natural shorelines provide complex habitat: varied sediment sizes, dappled shade, leaves, twigs, branches, logs, and varying depths. All of these factors help juvenile fish by providing shelter and food sources. Shoreline development, especially bulkheads and docks, tend to simplify habitat. It creates large, homogenous swaths, with shallow-water areas alternating between full sun (between docks) and full shade (under docks). Essentially, speckled or patchy shade can be beneficial for salmon, but conventional docks are the equivalent of a dark alley.

More complex landscapes such as those promoted by green shoreline practices provide more habitat diversity, which in turn supports relatively high biological diversity. Simplified built landscapes provides homogenous habitat, and only support a few species.

People are often surprised to learn that docks can have a major impact on fish. While problems sometimes arise from toxic preservatives leaching off older docks, the bigger issue is that overwater structures change underwater light conditions, affecting the behavior of juvenile salmon and their predators. Regulators and the construction industry have worked together to address this problem, and new dock-building practices have dramatically decreased impacts on the nearshore environment.

Since water moves freely underneath docks, it seems logical that they are not barriers for fish. In fact, research shows that migrating smolts tend to swim around docks rather than underneath them. It is thought that this helps juvenile salmon avoid bass and other predators that hide in the dark shade under these structures. Taking this behavior into consideration, it is apparent that the 2,700+ docks around Lake Washington can add up to taxing and potentially dangerous detours for smolts. The docks add distance to a salmon’s migration to the Ship Canal, and they push much of that migration out into deeper water where small fish are more vulnerable to predation.

Research suggests certain modifications to docks that can improve conditions for salmon while maintaining access for people.

Making construction clean and green

Like any construction along the shoreline, building or renovating a dock presents a potential disturbance to sensitive shoreline habitat. However, taking the following steps can decrease the impact:

- 1 Work with a contractor who is conscientious about preventing spills and minimizing disturbance of sediments, following Best Management Practices.
- 2 Carefully select wood preservatives for any lumber that will have contact with the water, or use untreated wood. The worst preservatives, creosote and pentachlorophenol, are now banned, but most of the remaining options contain arsenic or copper, which also pose threats to aquatic organisms. Nontoxic alternatives can be difficult to find and are not yet approved under International Building Code. Fortunately, untreated Douglas fir and galvanized or epoxy-coated steel piles last a long time in freshwater.
- 3 Use decking materials that will not require toxic finishes and cleaning agents. No matter how careful you are in applying these chemicals, they end up in the lake. Metal, fiberglass or plastic grating, recycled plastic lumber, and naturally rot-resistant wood can help avoid the problem. For wood needing finishes, look for the least toxic product for the job. The signal word (“poison,” “warning,” “caution,” etc.) at the top of the label gives a general sense of the potential hazards. Avoid products labeled “poison” or “warning” if possible, as these indicate a relatively high hazard level.
- 4 Schedule construction within approved work windows to minimize disturbance to threatened species. These windows are determined based on the nesting season for bald eagles and the migration patterns of salmon. Work windows vary from one part of the lake to another. You will get information for your area during the application process for Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (see “Getting Permits”).



Let the sun shine in

Juvenile Chinook salmon have a complicated relationship with docks. As fry, Lake Washington salmon tend to congregate under docks during the day. This can protect them from bird predation, but may make it easier for larger fish to get them. Additionally, during their migration as smolts, docks present an obstacle for salmon to swim around. Allowing more light under docks is thought to help salmon during both the fry and smolt life stages. There are several ways to improve the light conditions under a dock:

- 1 Use grated decking with openings that allow light to pass through.
- 2 Make ramps and walkways narrower, ideally 4’ or less for walkways and 3’ or less for ramps.
- 3 Do not use “skirts,” i.e., boards on the sides of the dock that extend down to the water. Multiple agencies prohibit skirts because of their effect on light in the nearshore area.
- 4 Design the dock such that the bottom of the entire structure is at least 18” above ordinary high water.
- 5 Use structural beams such as glu-lams, which allow longer spans between piles.
- 6 Avoid overwater lights that will be on all night. Although salmon need light during the day, artificial light makes them more vulnerable to predation at night.

These guidelines are highlights of a regional general permit for dock construction issued by the Army Corps of Engineers. Complying with these guidelines can substantially speed up the federal review and permitting for your dock (see “Getting Permits”).

Photo and design: Anchor Environmental





Estimated costs & maintenance

A survey conducted by Seattle Public Utilities found that most lakefront homeowners prefer vegetation and beaches over bulkheads, but they assume that green shorelines are more expensive than armoring. So what do these projects really cost? It varies, but in general, green shorelines cost about the same as conventional bulkheads. Up-front design, permitting, and construction costs tend to be slightly lower, but maintenance costs make up the difference.

There is an enormous range of costs for shoreline construction. The price for any given renovation depends on site characteristics, the professionals that design and build your project, and, to a large extent, your preferences. Also, cost estimates presented here are based on 2008 rates – actual costs fluctuate.

Bulkhead removal

If your site has an existing bulkhead, the cost to remove it is the same whether you are replacing it with a new bulkhead or an alternative. Costs typically range from about \$30 to \$125 per linear foot, depending on bulkhead material and site access.

Design and Construction

Green shorelines project tend to cost slightly less for design and permitting, since they tend to require fewer revisions to meet regulatory conditions. “We’ve found that natural shoreline projects sail through the permitting process. We frequently get permits in three months or less, while bulkhead projects can take up to a year,” says one designer who specializes in residential beach restoration. A faster permitting process translates to less money spent sending your designer or contractor to government offices.

Once the old bulkhead has been removed to make way for construction, slope bioengineering or beach construction cost about the same as a new bulkhead, while riprap generally costs somewhat less.

Maintenance

Maintenance and long-term costs represent important differences between conventional approaches and green shorelines. While residential bulkheads typically require no maintenance over the course of their 25-50 year life spans, green shorelines may require periodic beach nourishment (see “Full Beaches”).

Although they require upkeep, beaches and bioengineered shorelines have an important long-term advantage: while bulkheads settle, weaken, and eventually fail, the alternatives can last indefinitely if maintained properly. Aside from supplementary gravel and any replacement plants needed during the establishment period, no large future investments are likely to be needed.

Several factors help determine whether your project is likely to fall at the low end or high end of the possible cost range:

- 1 Grading:** Projects that require large volumes of cut or fill are more expensive than those that do not require major excavation.
- 2 Access:** If your shoreline can be accessed by land, costs will be lower than they would be for sites that require equipment to be brought by water.
- 3 Planting plan:** Planting in the fall and using native plants can bring down costs. Both strategies decrease the need for irrigation and improve plant survival, reducing the need for replacement plantings in the first year.
- 4 Project size:** While larger projects cost more as a whole, they carry lower costs per unit. That is, cost per linear foot of a 70’ long beach will be less than that of a 25’ long beach. Along these lines, working with a neighbor to renovate both shorelines at the same time can substantially lower construction costs for each project.

note



Bulkhead removal costs			
SITE ACCESS	BULKHEAD MATERIAL (REMOVAL)		
	Wood	Riprap	Concrete
Accessible from land and water	\$30-40 per linear foot	\$45-60 per linear foot	\$95-110 per linear foot
Accessible from water only	\$40-55 per linear foot	\$55-80 per linear foot	\$100-125 per linear foot

Shoreline construction costs (as of 2008)					
Cost Category	CONVENTIONAL TREATMENTS		GREEN SHORELINES		
	Solid bulkheads	Riprap	Beach Establishment	Slope bioengineering	Docks
Capital Costs	Average rock or concrete bulkhead is \$350 to \$400 per linear foot, sheetpile is \$800+ per linear foot	Average riprapped bank is \$125 to \$200 feet per linear foot	Average beach establishment is \$200 to \$500 per linear foot	Average bioengineering project is \$200 to \$500	Average new dock costs \$100 to \$130 per square foot
Design and Permitting	10-15% of capital costs for larger projects (greater than \$100K), 20-25% for smaller projects		7-12% of capital costs for larger projects (greater than \$100K), 15-20% for smaller projects		Similar to bulkheads
Maintenance	No maintenance is usually required for 25-50 year life span of projects		Sand replenishment at a 1-5 year frequency, gravel at a 5-10 years, both \$3 to \$6 per square foot of beach – with proper maintenance, project can last indefinitely		Similar to bulkheads

Choosing a shoreline professional



Design: The Watershed Company

Almost all shoreline projects, aside from minor landscaping above the water line, will require some hired help from one or more professionals. These individuals use their training and experience to help you navigate the technical details of designing, permitting, building, and maintaining a durable, attractive shoreline. The professionals that you hire help determine how smoothly your design and permitting processes will go, as well as the final outcome of your project. It is worth taking extra care at the outset to find the right professional for you.

Depending on your time, budget, and the specifics of your site, you may find yourself looking for a landscape architect, landscape designer, engineer, contractor, and/or permit specialist. Some companies do all of these things, and others specialize in one. Start by identifying your priorities for your new waterfront. Make a list of features or qualities that you like, either from this guidebook or from projects that you have seen around the lake.

Talk to friends and neighbors who have undertaken recent shoreline work. Their experiences can give you leads, or can help you cross candidates off your list. After identifying several candidates, ask to see photos of recent work or to visit any of their projects. Be sure to tell them that you are interested in a green shoreline or “soft engineering” approach for your project so they can show you the most relevant examples. Inquire specifically about the practices that each contractor uses to minimize impacts on the shoreline environment. Once you have narrowed the list down to three or four companies, invite representatives to your property to get personalized recommendations and estimates.

As you interview potential designers or contractors, assess their experience as well as their willingness to help you realize your vision for the project. Make sure that you are confident in their abilities and that you will be able to have a collaborative relationship.

note





Getting permits

The permitting process can be daunting for any shoreline project. Agencies at local, state, and federal levels review shoreline plans to ensure that development in and around shorelines will protect safety, the aquatic environment, endangered species, and water quality. The resulting multilayered regulatory process can seem confusing and overwhelming. Fortunately, help is available.

Staff from the agencies listed in “Contacts” can help you navigate through specific requirements. The Governor’s Office of Regulatory Assistance can also provide guidance: Call 1-800-917-0043 or visit www.ora.wa.gov for free support regarding environmental permits and permitting processes.

Additionally, jurisdictions at all levels are working to encourage the kinds of practices highlighted in this guidebook. Many of them already have some regulations that favor green shorelines, and most are working to make the process smoother for shoreline restoration. If you follow the recommendations in this guidebook, the permitting process is likely to be noticeably easier and faster. Good design and thorough documentation are always necessary for obtaining permits, but proposed projects that feature beaches and plantings will tend to be more successful than those that emphasize armoring.

Any project that involves work in, over, under, or adjacent to water requires review from three levels. Each project may be required to obtain the following permits from the following agencies:

1 Local jurisdiction (your city or King County)

- Shoreline substantial development permit or exemption
- Environmentally Critical Area permit
- State Environmental Policy Act (SEPA) permit or exemption
- General construction permits

2 State agencies

- Washington State Department of Fish and Wildlife
 - Hydraulic Project Approval (HPA)
- Washington Department of Ecology
 - Section 401 Water Quality Certification
 - Coastal Zone Management Certification
 - NPDES Stormwater General Permit

3 United States Army Corps of Engineers

- Discharge of Dredge or Fill Material, Section 404 Permit
- Work for Structures in Navigable Waters, Section 10 Permit

Application materials

In most cases, the permitting process will be handled by your project designer or contractor. Information that they will need to provide with the application includes:

- 1 Joint Aquatic Resources Permit Application (JARPA) form. In an effort to streamline permitting, multiple agencies have worked together to develop a single application form. The form is currently used by WDFW, Department of Ecology, and the Corps, and it may be used by some local jurisdictions in the future. Find the form and more information at <http://www.epermitting.org/default.aspx>.
- 2 Plans and, if applicable, surveys of existing conditions.
- 3 Plans for proposed construction, including plan (aerial) view and cross sections. The JARPA specifies an 8½”x 11” copy for fax and public notice purposes, but larger plans are required for most local reviews. Each municipality has its own standards for drawings, so be sure to research these before preparing your application packet.
- 4 Photos or aerial photos of existing conditions may be helpful.
- 5 Any additional studies or specifics you already have for your site—erring on the side of too much information will help your application get through the process faster. For example, if one agency requires you to conduct a geotechnical study or biological evaluation, include the results in all of your permit applications.

Many permit reviews are delayed while agencies wait for additional information from applicants. Remember to review application requirements, use the most current forms, provide all the required information, and obtain all the necessary signatures before attending a permit review meeting.

Permit application timeline

Permitting takes time. It is ideal to start the permit application process a full year before the desired work start date. While green shorelines projects are sometimes permitted in as little as three months, the process can be lengthy since several steps have to occur in a specific sequence.

Before you draw any plans, start by reviewing local permitting rules, Corps and WDFW design guidelines, and information requested on the JARPA form. Find out if there are any examples, conditions, or concerns for your specific type of project. Also understand what work windows are and how they might affect your project timeline (see “Building Better Docks”).

Once you and your designer complete a concept design for your project, meet with your local agency for early design guidance and review of your preliminary plans. Taking this step before completing plans will save time and money.

note

Since Corps permits are the most complex, consider submitting your applications to both the Corps and local jurisdiction at the same time. As part of its review process, the Corps is required to consult with other agencies such as the Washington State Department of Ecology (DOE), tribal agencies, NOAA Fisheries, and the United States Department of Fish and Wildlife. Except for the DOE, you probably will not work directly with these other agencies. DOE will begin formal review of your application once it receives official notification from the Corps.

Tips to facilitate the Army Corps permit process

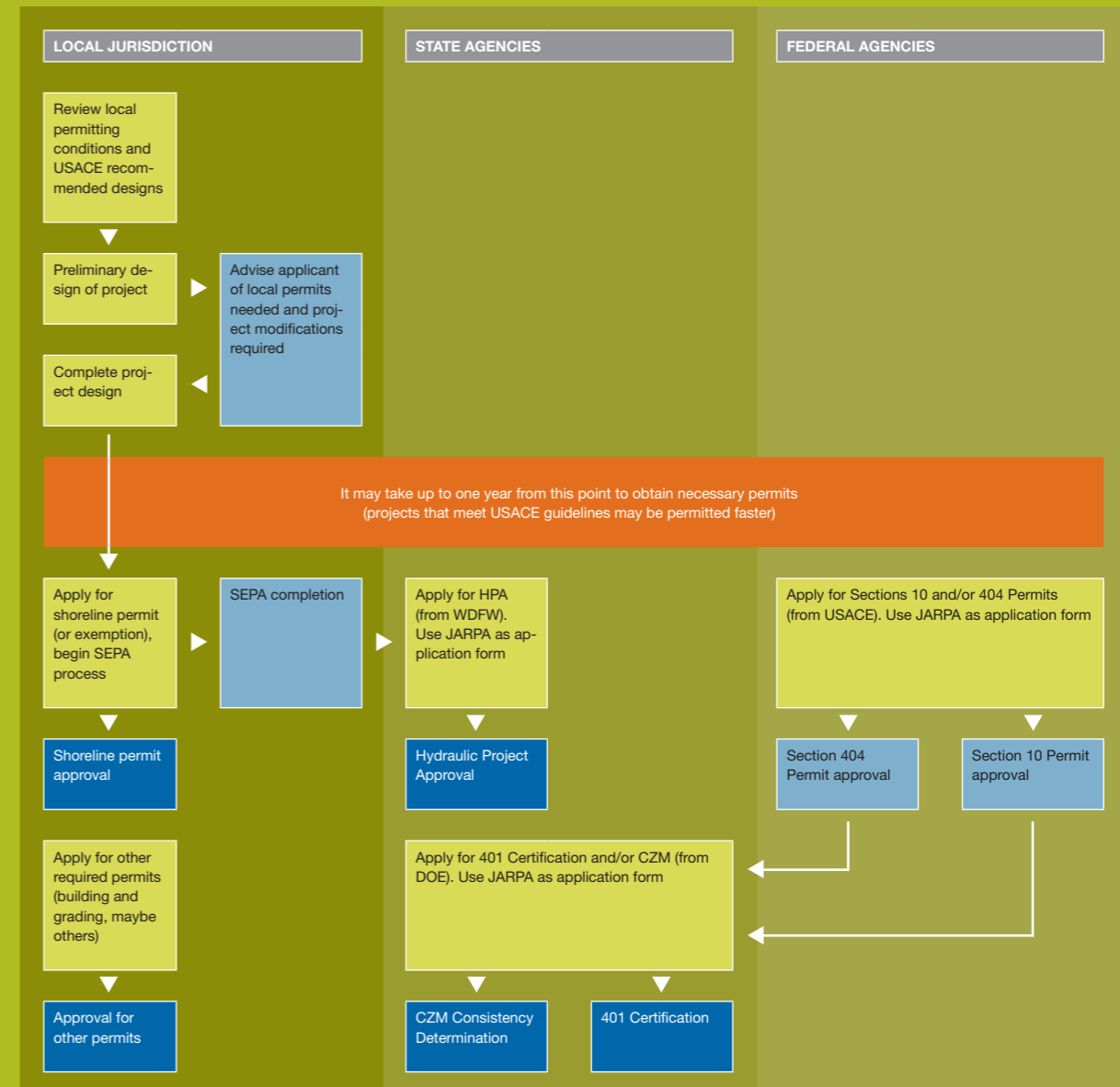
The Corps has written several documents that can accelerate the process of getting federal permits. Most significant for green shoreline projects is a “Programmatic Biological Evaluation” for shoreline restoration that the Army Corps wrote in collaboration with NOAA Fisheries and the U.S. Fish and Wildlife Service. It includes criteria for cut beaches, fill beaches, and bulkhead plantings. If your project meets the conditions listed, you will be able to forgo the site-specific Endangered Species Act analysis, which is typically the most involved part of getting federal permits. To determine whether your project meets the programmatic conditions, visit: <http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=Programmatics>

Also, a Regional General Permit (RGP3) provides clear guidelines for docks on Lake Washington and Lake Sammamish, most of which are outlined in “Building Better Docks.” If you can demonstrate that your proposed project meets the conditions of RGP3, it will greatly simplify the Corps review. To download RGP3, visit: http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=mainpage_RGPs

The Corps has a series of general permits known as Nationwide Permits for activities that have minimal environmental impact. If your project does not meet the criteria of RGP3, Nationwide Permits 3, 13, and 27 may help streamline permitting. For more information, visit: http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=What_is_NWP

The flow chart provided here represents the process for a typical residential shoreline project. It does not cover every possible variation that can arise for specific projects.

Schematic of the permitting process for residential shoreline projects on Lake Washington



Design and Photo: J.A. Brennan Associates



Resources

The following publications and websites served as sources for this guidebook. They include additional information based on shoreline restoration efforts around the country. For links to these sites and more, please visit the Green Shorelines website, www.seattle.gov/dpd/GreenShorelines.

Lakeside Living (King County)

www.govlink.org/watersheds/8/action/lakeside-living

Salmon-Friendly Gardening (City of Seattle)

www.seattle.gov/util/Services/Yard/Natural_Lawn_&_Garden_Care/Salmon_Friendly_Gardening/index.asp

Lakescaping for Water Quality and Wildlife (Minnesota Department of Natural Resources),

by Carrol Henderson, Carolyn Dindorf, and Fred Rozumalski. May be purchased online at www.comm.media.state.mn.us/bookstore/bookstore.asp

Slope Stabilization and Erosion Control (Washington State Department of Ecology)

www.ecy.wa.gov/programs/sea/pubs/93-30/index.html

Alternative Bank Protection Methods for Puget Sound Shorelines (Department of Ecology)

www.ecy.wa.gov/biblio/0006012a.html

Native Plant Resources Directory (King County)

green.kingcounty.gov/GoNative

Puget Sound Shoreline Stewardship Guidebook (Puget Sound Action Team)

www.kingcounty.gov/environment/watersheds/central-puget-sound/shoreline-stewardship-guidebook.aspx

The Shoreline Stabilization Handbook: Lake Champlain and Other Inland Lakes (Northwest Regional Planning Commission)

www.nrpcvt.com/nrpcvt/shoreline.html

Green Home Remodel series (City of Seattle)

In particular, see “Landscape Materials” and “Hiring a Pro.” www.seattle.gov/dpd/GreenBuilding/SingleFamilyResidential/Resources/RemodelingGuides/default.asp

The Water’s Edge: Helping fish and wildlife on your waterfront property (Wisconsin Department of Natural Resources)

www.dnr.wi.gov/fish/pubs/thewatersedge.pdf

Governor’s Office of Regulatory Assistance,

including documents such as a Aquatic Permitting Fact Sheet, a Permit Handbook, permit schematics, and an on-line permit questionnaire, www.ora.wa.gov

Army Corps of Engineers permit process overview

www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=mainpage_Permit_Applicant_Info

Contacts

United States Army Corps of Engineers, Seattle District Office

Mailing Address:
P.O. Box 3755
Seattle, WA 98124

Street Address:
4735 E. Marginal Way South
Seattle, WA 98134
(206) 764-3742
www.nws.usace.army.mil

Washington Department of Fish and Wildlife, Region 4

1775 12th Ave NW
Issaquah, WA 98027
(425) 313-5660
www.wdfw.wa.gov/reg/region4.htm

Department of Ecology, Northwest Regional Office

3190 160th Ave SE
Bellevue, WA 98008
(425) 649-7000
www.ecy.wa.gov

Governor’s Office of Regulatory Assistance

1-800-917-0043
www.ora.wa.gov

City of Seattle, Department of Planning and Development

700 5th Ave., Suite 2000
Seattle, WA 98124
(206) 684-8600
www.seattle.gov/dpd/Permits/default.asp

City of Mercer Island, Development Services

9611 SE 36th St.
Mercer Island, WA 98040
(206) 275-7605
www.ci.mercer-island.wa.us/SectionIndex.asp?SectionID=43

City of Bellevue, Development Services

450 110th Ave. NE
P.O. Box 90012
Bellevue, WA 98009
(425) 452-6800
www.ci.bellevue.wa.us/development_services_center_intro.htm

City of Renton, Development Services

Renton City Hall
1055 S. Grady Way
Renton, WA 98057
(425) 430-7200
www.rentonwa.gov/government/default.aspx?id=1112

City of Kirkland, Planning Department

123 5th Ave
Kirkland, WA 98033
(425) 587-2225
www.ci.kirkland.wa.us/depart/Planning.htm

City of Redmond, Department of Planning and Community Development

PO Box 97010
Redmond, WA 98073
(425) 556-2473
www.ci.redmond.wa.us/insidecityhall/planning/planning.asp

City of Sammamish, Community Development Department

801 228th Ave SE
Sammamish, WA 98075
(425) 295-0500
www.ci.sammamish.wa.us/CommunityDevelopment.aspx

City of Lake Forest Park, Planning and Building Department

17425 Ballinger Way NE
Lake Forest Park, WA 98155
(206) 368-5440
<http://www.cityofflp.com/city/planning.html>

City of Kenmore, Community Development

6700 NE 181st Street
P.O. Box 82607
Kenmore, WA 98028
(425) 398-8900
<http://www.cityofkenmore.com/dept/cd/cdindex.html>

King County, Department of Development and Environmental Services

Black River Corporate Park
900 Oakesdale Avenue SW
Renton, WA 98057
(206) 296-6600
www.kingcounty.gov/permits

Glossary

Armoring: Any hard engineering approach to shoreline protection. This includes structures made of concrete, riprap, and sheetpile. While needed on some properties, armoring is often unnecessary, and causes negative impacts on fish habitat, water quality, and access to the water.

Beach nourishment: Adding appropriate gravel to the shoreline in order to offset gradual erosion. Typically needed every five to ten years for beaches on Lake Washington.

Emergent plants: Plants that thrive while partially submerged. In addition to having striking visual qualities, emergent plantings are an effective way to enhance near-shore habitat and provide reinforcement against erosion. Often difficult to establish in Lake Washington, given the lake's unusual hydrology (see "Plant List").

JARPA: Joint Aquatic Resources Permit Application, a form developed by multiple regulatory agencies to streamline the environmental permitting process (see "Getting Permits").

Nearshore habitat: Shallow areas waterward of the shoreline, which make up the most biologically active part of the lake. Aquatic plants, juvenile salmon, shore birds, and numerous other organisms depend on this habitat. Nearshore slope can be a key factor in determining which kinds of restoration work on a given site (see "Selecting the Right Approach").

Ordinary high water line: The elevation where high water meets the shore. Water level in Lake Washington, which peaks in the summer at 21.85 feet above sea level, is regulated at the Ballard Locks. In most cases, local, state, and federal permitting processes are triggered when development occurs at or below the ordinary high water line.

Riprap: Stone commonly used for bulkheads or other bank stabilization efforts; ranging from about 4" to 2' in diameter. Also known as rip-rap, rubble, revetment, or rock armoring.

SEPA: State Environmental Policy Act, a state process that requires state and local agencies to consider the environmental consequences of a proposal before approving or denying the proposal.

Sheetpile: A type of wall used as a bulkhead on sites with shallow setbacks. Typically made of steel, vinyl, fiberglass, or treated wood, sheetpile walls have all the negative effects of concrete and typically cost more.

Shoreline exemption: A determination that a proposed project does not require a shoreline substantial development permit. Shoreline substantial development permits are required by state law for many development activities in shoreline areas, but most single-family residential projects are exempt (see "Getting Permits").

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