8 Shoreline Erosion

- Losing Your Land

The springfed lake we live on is so small that we rarely even see whitecaps. Perhaps we have become a wee bit complacent thinking that erosion will never be at the top of our issue list. But just over the hill, on the "big lake", and in the valley beside the river, and further down the river, beside the ocean, it's a different story. Countless times we have seen, and heard about, erosion nightmares... grassy banks collapsing into streams, or shorewalls which begin crumbling after only a few years. Even small events like boat traffic during high water can cause grief. A friend loses a bit of her bank every year during high water from boat wake.

Questions about preventing or correcting erosion problems are among those most frequently asked by shoreline residents. Whether you live by a small stream that becomes a raging torrent after a heavy rainfall, a tranquil lake that picks up big waves when the wind is right, at the top of a bluff which slumps a little more every year, or next to some "bruiser" ocean waves, erosion is a fact of life. Throughout this chapter, when we talk about the "erosion zone", we especially mean the tops of bluffs, banks, or ravines, as well as the place where water meets land, your true shore line. These are the places where your property is most susceptible to erosive forces.

Erosion Blues

Did you know . . .

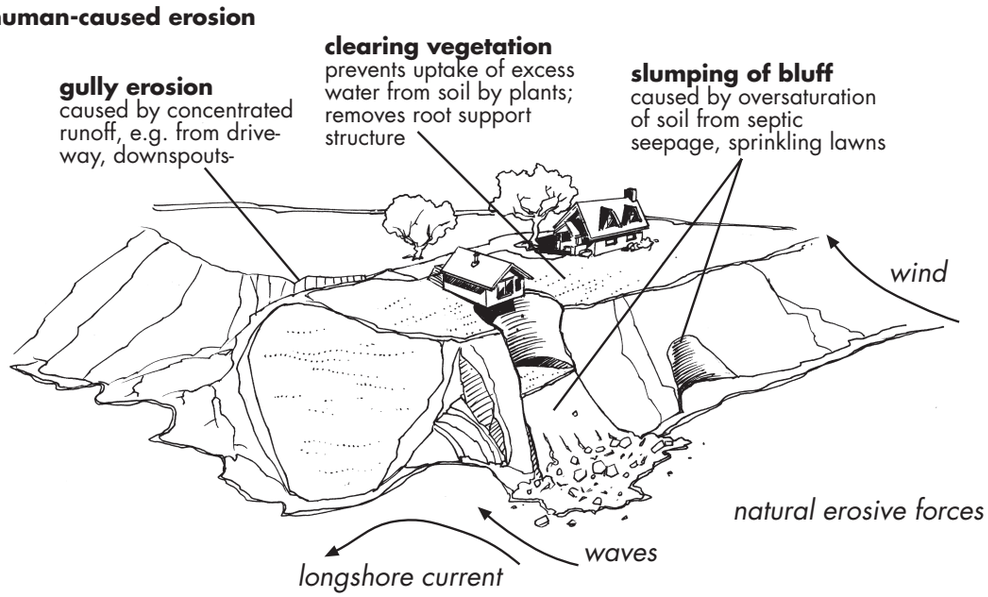
Over 90,000 coastal homeowners in the US are forecast to lose their homes as a result of rising sea levels over the next 60 years, according to a study by the Heinz Centre for Science, Economics and the Environment in Washington.

CAUTION

When you buy property along a shoreline or in a flood plain, be aware of the risks of erosion and runoff associated with your location.

"When I bought, there was a chicken coop six feet from the stream's bank. That's where the erosion is – the only place along the bank that's been cleared!"

Dave, Englishman River

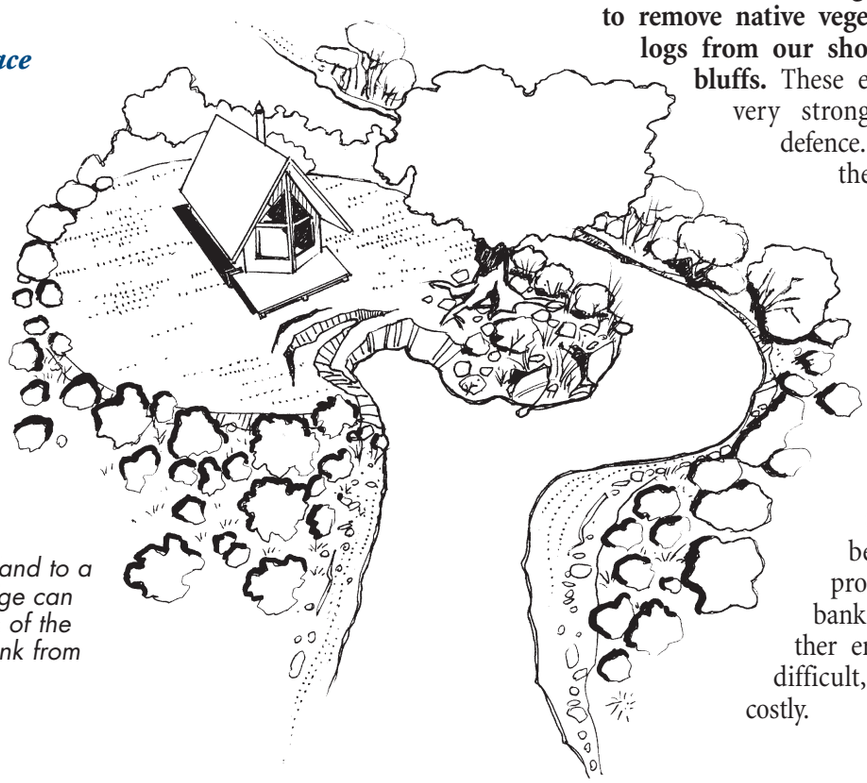


Erosion can translate into substantial losses by reducing the value and productivity of our properties. Some of us know unlucky folks who have lost property to the power of water, or whose homes have been threatened by a rapidly eroding bluff or bank.

The gradual wearing away of land surfaces due to factors such as water (or ice) and wind is a natural process; erosion creates the beaches, bluffs and estuaries that we love. However, we can accelerate erosion and create problems for ourselves and our neighbours with some of the things we do on our land, along our shorelines, and below the high water mark.

By being aware of erosion risks and taking appropriate action, you will be better armed to help safeguard your property and protect your pocketbook.

One of the most damaging things we do is to remove native vegetation, rocks and logs from our shorelines, banks or bluffs. These elements provide a very strong natural line of defence. Once they're gone, the land is exposed and becomes more vulnerable to becoming an erosion zone. Remember, the secret of success is keeping it natural – the beauty of the buffer! Once erosion has begun, planting to protect the shoreline, bank or bluff from further erosion can become difficult, and sometimes costly.



Clearing land to a stream edge can cause loss of the stream bank from erosion.

Assessing Potential Erosion

By assessing the erosion potential of your property, you may be able to prevent erosion problems before they occur.

Setbacks. The further buildings are from the water's edge, the more protected they will be from erosion. If a building is too close to the edge of a bluff or bank, it may be cheaper in the long run to move the building back, than to attempt to stop erosion with structures like shore walls. Then you can explore alternative ways of managing erosion (such as improving drainage or planting vegetation along the bluff's crest).

CAUTION: ***If you have any concerns about a receding shoreline, consult with a geotechnical engineer.***

Slope. Unless you have a solid rock bluff, the steeper the grade, the more likely the slope will suffer from erosion.

Soil. Rocky shores are unlikely to erode very quickly; but if a clay or silt shoreline has started to erode, it can be a challenge to reverse the process.

Shoreline features. If there are signs of past instability, such as slumping or landslides, you may face similar problems in the future.

Vegetation. Is the shoreline well covered with substantial natural vegetation such as mature trees, shrubs and grasses that help stabilize slopes?

Neighbours. Do neighbouring properties have shorewalls, signs of eroded banks or slumpage such as exceptionally bare tree roots, bare areas without vegetation, gullies? Their problems could be passed on to you.

Location. If the prevailing wind blows waves into the shoreline or bluff, you may find increased erosion potential from wave action, especially during stormy weather.

Water levels. What are current water levels in relation to the historical range of water levels? Consider the implications of potential rising sea levels forecasted as a result of climate change. Changes in water level have an impact on the water table and can destabilize banks.

Natural Beach. Where is the beach in relation to the high water mark? Is it a natural beach? Beaches made of imported sand will, in most cases, eventually be carried away by the water.

Drainage. Can you see water seeping from the side of the slope, or evidence of drainage and runoff over the surface of the property? Slumping and erosion are more likely in soil that is saturated with moisture.

Bluffs. Is the toe of the bluff subject to wave attack? If so, what is the nature and frequency of wave action? Small waves acting over time can potentially do as much damage as one severe storm.

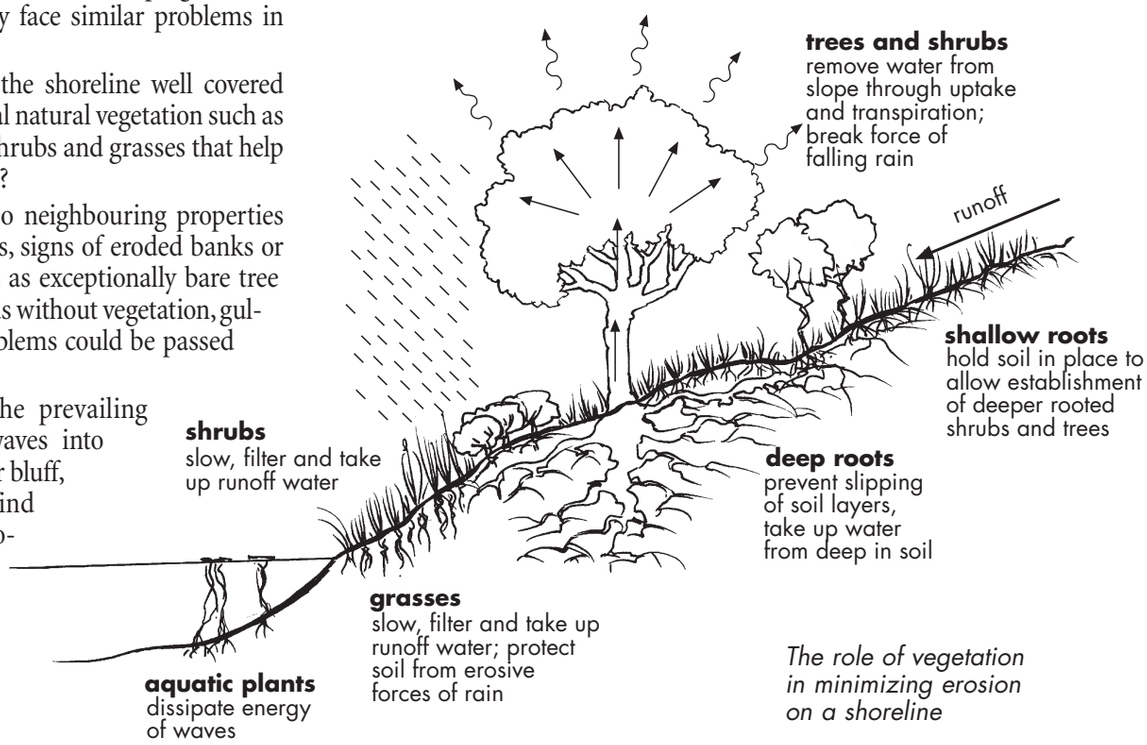
Did you know . . .

A setback of 60 m (200 ft) plus the height of the slope may be suggested in areas where the shoreline is receding by 50 cm (20 in) per year.

Did you know . . .

The silt that enters surface water from runoff and erosion can:

- *destroy plant habitat for aquatic creatures by blocking sunlight*
- *increase costs of drinking water treatment*
- *make swimming less enjoyable*
- *cover fish spawning beds*



The role of vegetation in minimizing erosion on a shoreline

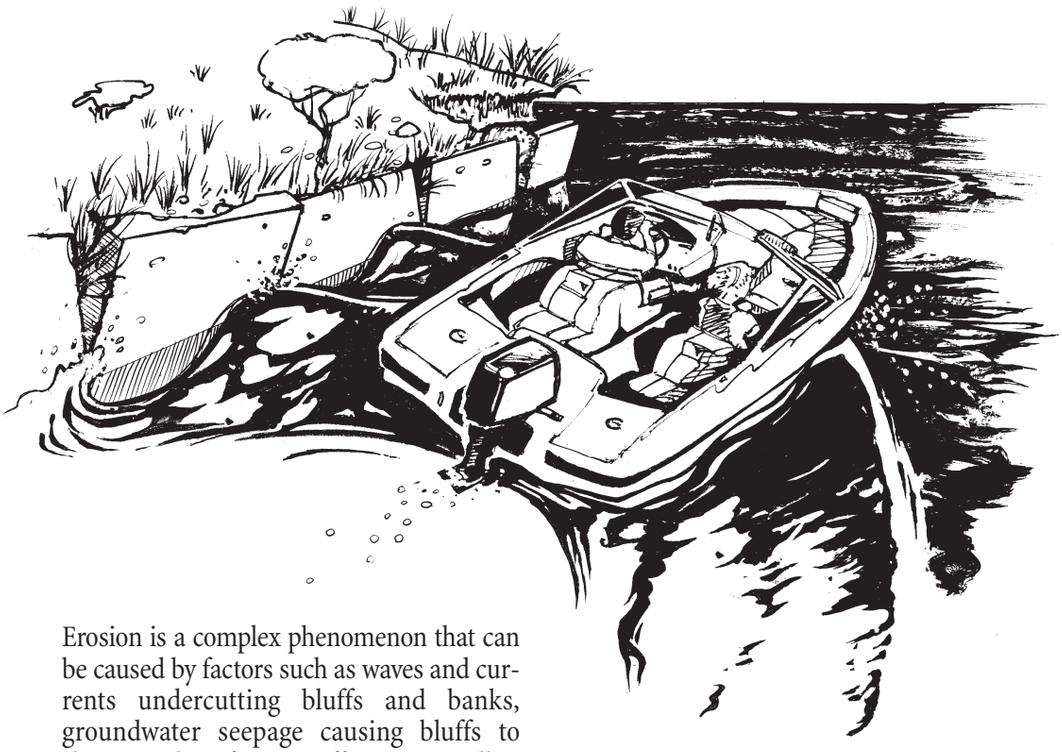
Preventing Erosion

Did you know . . .

A retaining wall reduces the total surface area of a shoreline, making it less able to absorb the erosive energy of water. Instead of slowing the force of water, a retaining wall often deflects it further down the shore and can interfere with natural currents and processes.

Did you know . .

Over time, even small ripples from passing boats can gradually erode banks, bluffs or beaches that have had their protective vegetation removed.



CAUTION

Watch out for heavy fines! Under the Federal Fisheries Act you may have to pay fines of up to $300,000, pay to have any shoreline damage repaired or even take a trip to jail for damaging fish habitat.

Erosion is a complex phenomenon that can be caused by factors such as waves and currents undercutting bluffs and banks, groundwater seepage causing bluffs to slump, and surface runoff creating gullies down slopes. Before you take action to deal with an erosion problem, examine these interrelated forces at work on your property. Looking at the big picture will give you a better idea of how to proceed and increase your chances of success.

Similarly, before clearing your land and starting construction, evaluate what impact your project will have on drainage and runoff. Remember, the best (and least expensive!) defence against future erosion is to leave shorelines, banks and the tops of bluffs in their natural state.

- Retain vegetation. It helps absorb potential runoff and excess moisture within the soil.
- Avoid adding weight (buildings, parking areas) close to the edge of bluffs and banks; it may cause slumping.
- Manage site drainage. *Review the tips in Chapter 4.* Many erosion problems can be traced to improper drainage as a result of construction.
- Be cautious when employing heavy equipment; an excavator or backhoe can destroy a shoreline in just a few minutes of work. To restore its intricate ecosystem may take years.
- Evaluate - before you build - whether a shoreline access trail might cause erosion or instability in a slope. *See Chapter 9.*
- Build a dock which will allow the free flow of currents along the shoreline. *See Chapter 9.*
- Avoid building seawalls, bulkheads and groins (fingers that penetrate out into the water). They interfere with currents along the shore and can often cause erosion elsewhere.

CAUTION: ***Before you consider making any changes to the shoreline or to existing shore protection installations, obtain professional advice and check with DFO.***

First Aid for Erosion Problems

Erosion problems can vary from small amounts of soil being washed away during a rainstorm, to disastrously slumping banks or disappearing shoreline frontage. Assessing the severity and cause of your problem can be complicated. Sometimes factors upstream, or along the shore, play a significant role. If you are in any doubt about what is contributing to your problem, we recommend a consultation with a specialist who focusses on shoreline erosion. Geotechnical, civil or soil bio-engineers may be able to assist.

For solutions to your problems, choose a professional who is familiar with "soft shore protection", also called "soft armouring" or "soil bioengineering". Even if your problem appears to be fairly minor, for peace of mind, it is likely worth the cost of a consultation with someone who is knowledgeable. Choosing the wrong approach can be an expensive, time-consuming and sometimes damaging mistake!

This section contains a brief explanation of some of the more commonly used approaches to erosion control. It will give you somewhere to begin discussions with the various professionals you contact, and provide you with knowledge for informed decision-making. It will also help you get started on some small do-it-yourself erosion control projects that can have positive results.

Remember, methods for protecting shorelines usually require some maintenance. Include these maintenance costs in your budget.

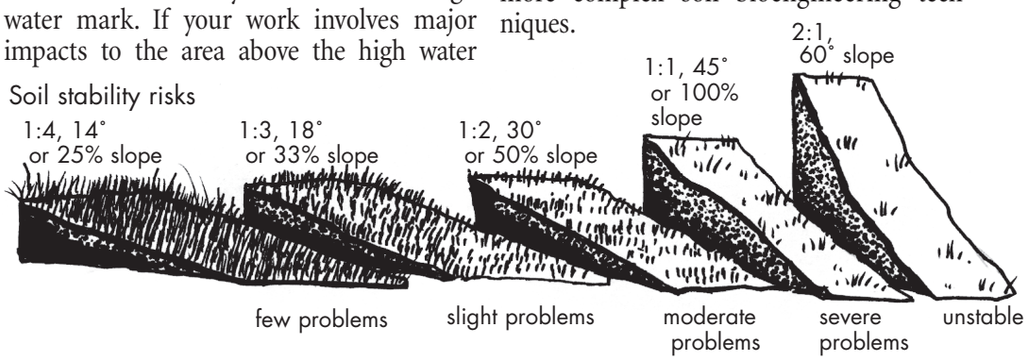
Plan ahead

In addition to obtaining professional advice, you will need to consult with, and obtain permits from, Fisheries and Oceans Canada (DFO) and the Ministry of Water, Land and Air Protection for any work below the high water mark. If your work involves major impacts to the area above the high water mark, you may also need to consult with these agencies, and possibly your local municipality, or any designated covenant holder.

The more information that you provide about your project, the easier it will be for officials to review it. Give yourself – and government officials – lots of planning and review time. You will need to plan construction work to avoid sensitive times for fish and other wildlife.

The best windows of opportunity for construction vary from location to location, depending on factors such as what fish species and other wildlife use your shore, seasonal cycles, runoff patterns, etc. If there is a citizen's group or non-government organization in your area involved in shoreline restoration projects, you may want to contact them as well for assistance.

If you have steep, bare slopes along your shoreline, you may need to cut them back to flatter angles, before you can install erosion prevention measures and achieve slopes suitable for planting. Most erosion control methods work best with a maximum slope of 50%, or 1:2 (vertical: horizontal). However, you may still be able to plant a steeper slope using more complex soil bioengineering techniques.



Estimating the slope of your shoreline

Choose a stretch of slope that is representative of your shoreline.

- Pound in a short stake at the top of the slope and a long stake (1.5 m high) roughly 8 to 10 m downhill; string the line between the two to form a 90 degree angle, as shown. (Use a carpenter's level on the line.)
- Measure the vertical distance up the long stake to the point at which the line comes in on the perpendicular, and measure the horizontal distance crossed by the line.
- Use the following calculation to calculate the slope:

$$\frac{\text{vertical distance}}{\text{horizonal distance}} \times 100\% = \text{slope}$$

For example:

$$\frac{1.5 \text{ metres}}{10 \text{ metres}} \times 100\% = 15\% \text{ slope}$$

CAUTION

While you have the right as a waterfront landowner to construct works on your property to protect it from erosion, any construction in or adjacent to the water will likely require approvals by a variety of agencies.

See Chapter 17.

Soft Shore Protection

"We had an estimate of the cost to protect our eroding shoreline. Riprap would have cost about $500,000, while a bio-engineering solution was estimated at about $10,000."

Dave, Parksville

tip ***Check with local conservation groups that do shoreline restoration work. You may be able to get help with your shoreline stabilization project.***

Seeding

good for:

- Areas with mild erosion problems.
- Stabilizing until shrubs or trees can take root.
- Can be used in combination with other techniques.

advantages:

- Relatively easy, quick and inexpensive.
- Technique is compatible with many slope situations.

disadvantages:

- Not adequate for highly eroded areas.
- Vegetation can take longer to become established than when seedlings or cuttings are used.

In the last few years, as soil bioengineering research and restoration work have expanded, erosion experts are learning that the most successful and least costly approaches to dealing with erosion problems involve mimicking nature's own designs, and using native vegetation as much as possible. Soft shore protection, or soil bioengineering, uses plants, often in combination with other materials (rocks, logs), to create a "living barrier" of protection. This barrier controls erosion and runoff, increases the stability of slopes, and at the same time helps to maintain and improve habitat for wildlife. And it blends into the surroundings, creating a natural look.

Soft shore techniques rely on the binding action of plant roots; plants adapt to changing shoreline conditions and become stronger as they mature. The roots of species used in soil bioengineering often strengthen after stems are damaged (by a storm, for example). Traditional erosion control techniques that involve building barriers of concrete or stone sometimes suffer damage very quickly from waves and wind, become weakened or undermined, and eventually collapse.

Many of the materials used in soil bioengineering can be obtained locally and installed with light equipment, saving you the cost and potential damage by heavy machines.

If you want to carry out some small erosion control projects yourself, we recommend combining seeding with planting live stakes, container and bare root plants. In steeper locations, consider using live palisades *(see Pg 73)* in combination with rocks and logs for practical and aesthetic purposes.

Choose native species

Trees, shrubs and perennials that are adapted for the climate and growing conditions of your area are essential to making soft shore protection work. Native plants appropriate for the site (e.g. willows for wet shoreline areas or snowberry on drier upland slopes) will root easily, grow well and require little maintenance once they're established. They will also ready the site for other native plants which tend to move in after a few years, as happens in nature. For example, Douglas fir might gradually move into an area where native grasses and shrubs have been growing.

Interest in native plants has grown substantially over recent years, and there are now many places to find information. *See Chapter 7 and Appendix 2 for some tips about selecting and growing native plants.* For sources of plants suitable for your area and site conditions, ask at your local nursery, your local Ministry of Forests office, or see our website for listings.

Seeding

Seeding involves the hand planting of native grasses and perennials whose quick growing roots help bind surface soils and protect them from runoff, wind and other erosive forces. Use it for temporary protection while other methods take hold, and in conjunction with larger shrubs and trees. Your planting may need the extra protection of biodegradable landscape fabric or matting, especially if it extends down a slope. It may also need a regular supply of water, especially in the vulnerable first year.

Hand Sowing

Uniformly scatter seeds by hand, making sure your seeds stay near the soil surface. (Planting depth is determined by type of seed.) Mulch immediately with straw, newspaper, jute netting or similar material to help retain moisture, and to prevent soil and seed from being washed away or eaten by birds and wildlife.

For a large area that may be subject to erosion, consider hydroseeding. This involves spraying a combination of seed, water, a "sticking" agent and mulch onto the soil. Avoid chemical fertilizers in the mix. Be sure to check that the source of seed is appropriate for your location, and monitor contractors to ensure there is no overspray into the water.

"Drilling" Holes

This method is best used on shallow slopes, smaller areas, and for woody plant stock. It is essentially the same technique you would use when planting a garden. Make holes to a depth required by the particular seed type and ensure that the soil surrounding each hole is loosened so that root systems can develop. Place several seeds in each hole and water.

Container and bare root planting

This method involves placing container grown or bare root (for example, transplanted) native plants into dug holes.

Finding plants

You can obtain plants by rescuing them from sites under development, starting them from seeds or cuttings, or buying from a local native plant nursery. Nursery stock is convenient and gives quicker results than growing from seed or cuttings, but may cost more.

CAUTION: ***Never dig up native species from the wild unless the area is about to be cleared or treated with pesticide (for example, under power lines).*** Always check with the property owner first.

- Choose healthy plants that are at least two years old, native to your area and elevation, and of species appropriate for your site. *Check the species listing in Appendix 2.*
- Trees and bushes leaving the nursery can suffer transplant shock, so be ready to baby them.
- Store your plants in a cool, shady place before planting, and keep the roots moist.

Ten easy steps to planting

Plant bare root seedlings before leaf buds appear in the spring or after the leaves have dropped in the fall. Container grown plants can be planted up to early summer or in the autumn before the leaves fall. Planting in spring is often the best choice because it helps give the roots a full season to become established.

1. Pick a cool, damp day with little wind or plant in the evening; the plants will be less stressed.
2. Plant shrubs in clusters with other shrubs or trees, between 60-100 cm (24-40 in) apart on all sides. Planting in groups improves survival rates.
3. For each planting, dig a hole that is two to three times larger than the size of the roots. Loosen 20 cm (8 in) of soil at the bottom and the sides of the hole, and mix in a little bone meal and some organic material like compost.
4. When working with container plants, gently untangle the roots. If the roots are pot-bound and encircling the pot, snip some of them.
5. Mound some soil in the middle of the hole for roots to form around.
6. Place the plant upright in the middle of the hole, making sure the roots are not bent upwards. Bury the plant so the top of the rootball is flush with the soil.
7. Fill in two-thirds of the hole. Carefully pack down the soil. Finish filling the hole and press firmly to ensure that there are no air pockets. Build a berm (a dirt wall) around the plant to hold water, unless the tree or shrub is one that tolerates dry conditions. This is critical on slopes.
8. Water (unless your soil is saturated).
9. Cut off any dead or broken branches.
10. Mulch with straw, newspaper, or comparable material. Do not mulch right up to the main stem of the shrub or tree. *For tips on maintaining shrubs and trees after planting, refer to Pg 60.*

Live staking and live palisades

Live staking involves putting live stakes (pointed cuttings of native woody plants) into the ground to root and grow. Live palisades are living fences of thick stakes (often balsam poplar) planted deep into the ground to help stabilize an eroding bank. The easiest plants to propagate from cuttings are willows, dogwoods and poplars.

Container and bare root planting

good for:

- Areas that need immediate assistance. Deeper roots provide more stabilization than grasses.

advantages:

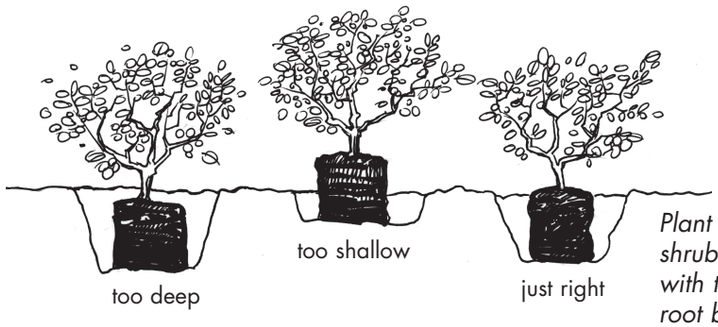
- Planting rooted plant materials gives you a head start; makes for faster stabilization; has a higher plant success rate.
- Easy to put into place.

disadvantages:

- Can be expensive.
- Takes some planning, and more long-term care.

tip ***To prevent erosion when watering new plants on slopes:***

- ***Mulch.***
- ***Build berms (small dams of soil) around plants to hold water.***
- ***Use a fine spray when watering.***



Plant any seedling, shrub or tree flush with the top of its root ball.

Live stake and palisade planting

good for:

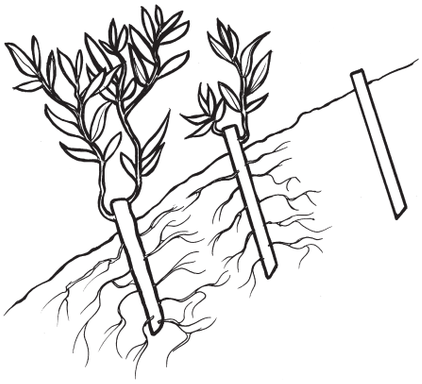
- Gentle slopes and flat areas; live palisades may be suitable for steeper sites.
- Small eroded areas and wet areas with slumps.
- Can be used alone or with other planting techniques.

advantages:

- Easy, inexpensive, and can be planted with minimal surface preparation or disturbance.
- Helps reduce slope soil moisture and stabilize slopes by creating a root system that holds soil and extracts moisture.
- Requires little maintenance once installed.

disadvantages:

- Ineffective on deep erosion problems and slope instabilities, except live palisades can be used beside steeper banks as a back armour or secondary defence.



As a live stake of native willow, dogwood or poplar grows, its roots act like rebar in concrete to help to stabilize an eroding shoreline.

Obtaining cuttings

Take cuttings from fully dormant plants on sites that are similar to yours. If you are collecting many cuttings, collect them from over a wide area to ensure genetic variety in your stock and avoid stressing any one plant. For cuttings to be planted in areas where they will have to compete with weeds or grasses, or which become dry in summer, use thick branches about the diameter of fence posts. Otherwise, cut your stakes 70-100 cm (2-3 ft) long, and at least 2.5 cm (1 in) in diameter. For palisades cut stakes at least 2 m (6 ft) long and up to 15 cm (6 in) in diameter, depending on the difficulty of the erosion control task.

Cutting the bottom at an angle makes it easier to push or drive the live stake into the ground and also helps mark the bottoms; however, the cut exposes a larger area, so it will tend to dry out faster. You can also mark the tops with latex paint diluted in water, or by bundling them in one direction and flagging.

Store the cuttings in plastic bags (with ventilation to prevent mould growth) in a refrigerator or a snow bank until you are ready to plant them. Soak cuttings in water for one to ten days before planting to help them survive dry conditions.

Planting

The best time to plant is during the spring while the plant material is still dormant. Consult your local nursery, or obtain assistance from a local conservation group, to find out the recommended spacing and other planting requirements for each species.

The planting pattern you choose for live staking will likely depend on the number of cuttings you have, the size of the area you are planting, and the severity of the erosion problem. Plant your cuttings 30 - 90 cm (12 - 36 in) from each other. Keep willows closer together than poplars. If too many cuttings survive and start crowding each other, or shade the water too much, thin some out.

To plant a cutting, make a hole the correct diameter using a hammer or mallet to pound a stake (such as a piece of rebar or a pry bar) into the ground. Then, push or use a rubber mallet to gently tap your live cutting into the hole. You can place a piece of wood or a metal cap across the top of the cutting to prevent splitting. Bury cuttings three-quarters of their length on wet sites and seven-eighths of their length on drier sites, leaving the rest exposed. Sufficient depth is very important, to encourage the cutting to produce more roots.

When constructing a live palisade fence, dig a trench 2-3 m (6-9 ft) below the top of the eroding slope. The trench must be deep enough so the cuttings extend down to the water level (they need a water source) and stick out at least 1 m (3 ft) above ground. As you fill in the trench, plant cuttings from a variety of species to provide diversity.

If you have an actively eroding shoreline, you may need to use erosion control blankets, mulches, and landscape fabrics to help retain your soil while your plantings are taking root. Consult with experts to ensure you take advantage of the most up-to-date information. There are many specialized materials being developed.

Using rocks and logs

Rocks and logs are an integral part of a soil bioengineering approach – an approach that's really about following Mother Nature's example. When a tree falls onto a bank and into the water, it acts as a nursery for many plant and wildlife species as it decays. It also stabilizes the shoreline and bank by obstructing the movement of runoff and the action of waves on the shore. By placing logs (anchoring them if necessary) in strategic locations we can take a page from nature's book - protect the shoreline and make it look beautiful too.

Cleverly placed rocks can save banks at drainage outfalls or in gullies, break the force of waves and provide a place for fish and other wildlife to take shelter and feed. Rocks and logs can help to anchor plantings, speeding up the naturalization of your shoreline and giving you more green, more quickly.

Extreme Erosion Problems

There may be cases where standard soil bioengineering techniques alone are not enough to handle the erosion on your site. If the erosion is already severe, or the wear is ongoing, soil bioengineering techniques may need the support of some "harder" solutions.

Hard armour using human-made structures alone such as solid concrete or heavy rocks or rock in wire cages (called gabions) used to be the erosion control method of choice. Experience has shown that hard armouring is difficult to implement successfully, and if poorly designed or improperly constructed, may be worse than leaving the problem alone! This approach is generally more expensive than soft shore techniques - it often requires the use of heavy equipment - and is more likely to damage the surrounding environment. It is also more difficult to obtain approvals.

If you are considering the hard armour option, it is essential to have your project designed and carried out by an engineer or someone with considerable expertise in the area. Without a competent engineer, hard armouring carries with it the risk of making costly, hard-to-reverse mistakes. Consult with the Association of Professional Engineers and Geoscientists for a suitable experienced professional. If your project causes problems for your neighbour, you could be on the receiving end of legal action! *See the tips in Chapter 4 for hiring a contractor.*

If you and your engineer decide to go with hard armouring, you can still have a green, habitat-friendly shoreline. There are many techniques for planting in and over a hard structure that may even increase its effectiveness. For example, there are now "green gabion" techniques that mix a "hard" approach with live plantings. *See Pg 65 for ideas.*

If you already have a retaining wall or other form of hardened shoreline, consider "retiring" it, to help improve habitat and restore shoreline function. *See sidebar.*

If you have an erosion situation, some of the steps you might consider, to help assess it and develop a solution, include the following:

- Check the Living by Water website for references: www.livingbywater.ca
- Call the Planning Department in your municipality and talk to an Environmental Planner.
- Talk to a habitat biologist at your local WLAP or DFO office.
- On fish-bearing streams, talk to your local Streamkeepers group.
- Talk to a geotechnical engineer. They often have the expertise to determine the underlying cause of your erosion problem.
- Talk to a soil bioengineering specialist. They can help with finding a cost-effective and shore-friendly solution.
- If you have a very challenging problem that involves a possible threat to your safety or to your property, call a civil engineer. Ask if they have shoreline erosion experience and if they would be prepared to work with you and look at a soil bioengineering approach. As with hiring any contractor, check out qualifications and get more than one opinion.
- In an emergency that involves threat to human life or property call Emergency Measures. *See Appendix 1.*

Note: This chapter is intended as a general guide to help you make better decisions and to assist you in talking to the right professionals. It is not intended as advice on any specific erosion situation.

***tip* To remove a retaining wall:**

- ***Obtain professional advice and permits.***
- ***Dig out the supporting backfill behind wall.***
- ***Regrade the slope to 1:2 (vertical to horizontal) and cover with erosion control fabric.***
- ***Break up and either haul away the concrete wall or place small pieces on the new slope.***
- ***Plant native grasses and shrubs in the spaces.***

Resources

Soil Bioengineering
www.on.ec.gc.ca/doc/cuf_factsheets/soil-bioeng-e.html

Slope Stabilization and Erosion Control Using Vegetation. 1993. 93-30
www.ecy.wa.gov/programs/sea/pubs/93-30/

Vegetation Management: A Guide for Puget Sound Bluff Property Owners. 1993. 93-31
www.ecy.wa.gov/programs/sea/pubs/93-31/intro.html

Surface Water and Groundwater on Coastal Bluffs. 1995. 95-107
www.ecy.wa.gov/programs/sea/pubs/95-107/intro.html

Understanding, Living with, and Controlling Shoreline Erosion. A Guidebook for Shoreline Property Owners. 1997. Douglas Fuller. Tip of the Mitt Watershed Council. Conway, Michigan www.watershedcouncil.org/shore.htm

Marine Guide to Preventing Shoreline Erosion.
www-heb.pac.dfo-mpo.gc.ca/english/publications/PDF/erosion.pdf

See Appendix 1 for complete Resources.