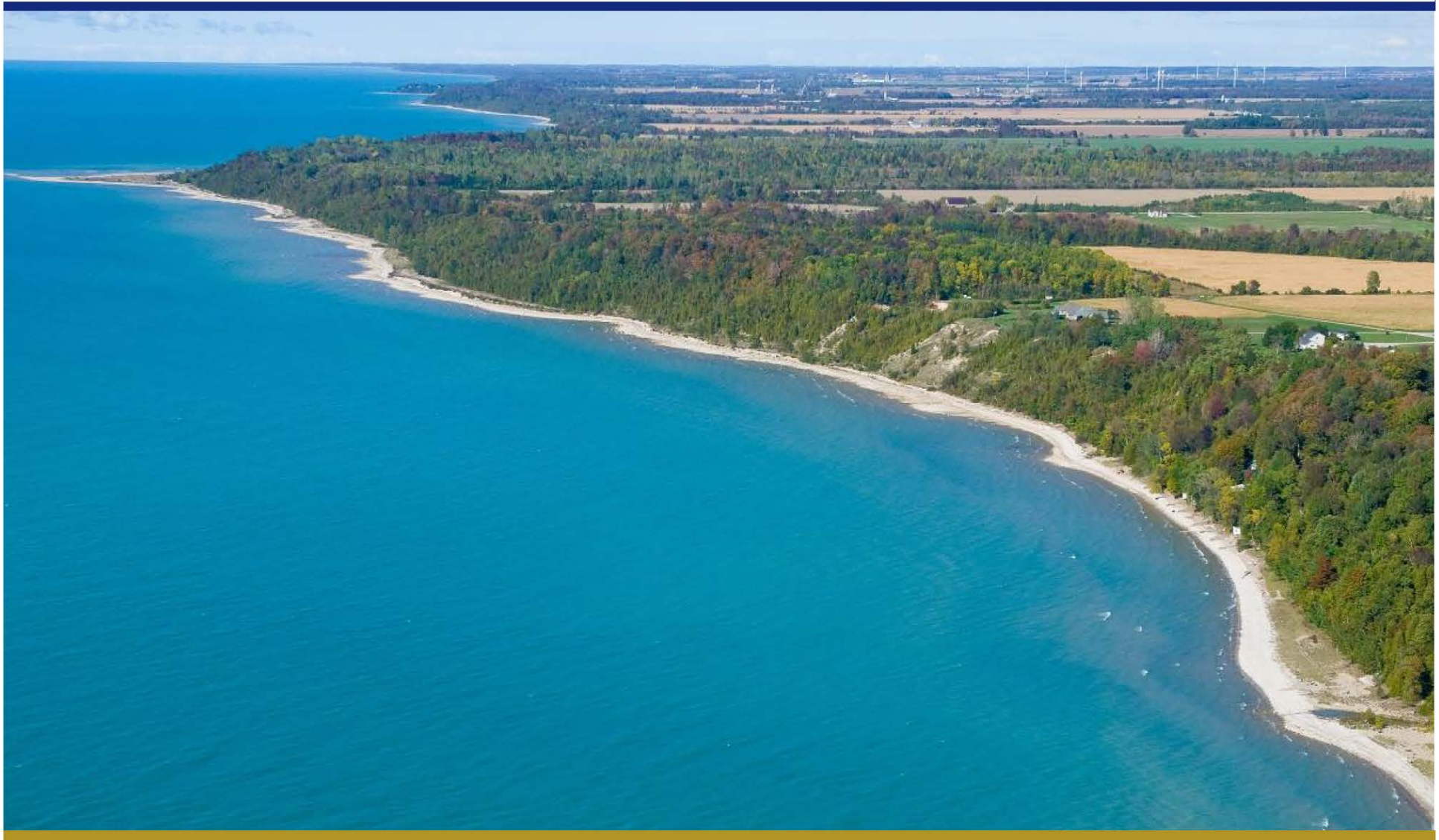
# Lake Huron
# Bluff Stewardship Guide



## Lake Huron's Coastal Bluff Ecosystems

**Coastal property owners have watched, cared for, and enjoyed their coastal properties for many years. They see the changes that happen over the course of a year, over many years, and after a sudden dramatic storm. The joys of living by the coast are tempered by certain risks and costs. These include property loss resulting from lake-effect erosion, surface water runoff, groundwater related erosion, and storms. Changes in our weather are increasing these risks every year.**

**It's important to** understand **the behaviour of coastal bluff ecosystems, so that changes can be anticipated and addressed realistically.**

**This Stewardship Guide is written to provide background information, bluff facts, and ideas to wisely manage your coastal bluff property located within Huron County.**

## How it all Began - Are We on Solid Footing?

When glaciers receded about 10,000 years ago, mixtures of clay, silt, sand and rocks were left behind as layers of "glacial till" exposed in eroding bluffs and lakebeds. Within the till are layers of sand and gravel. There are also layers of sand, silt and clay, deposited on the lake bottom when lake levels were several metres higher than they are today.

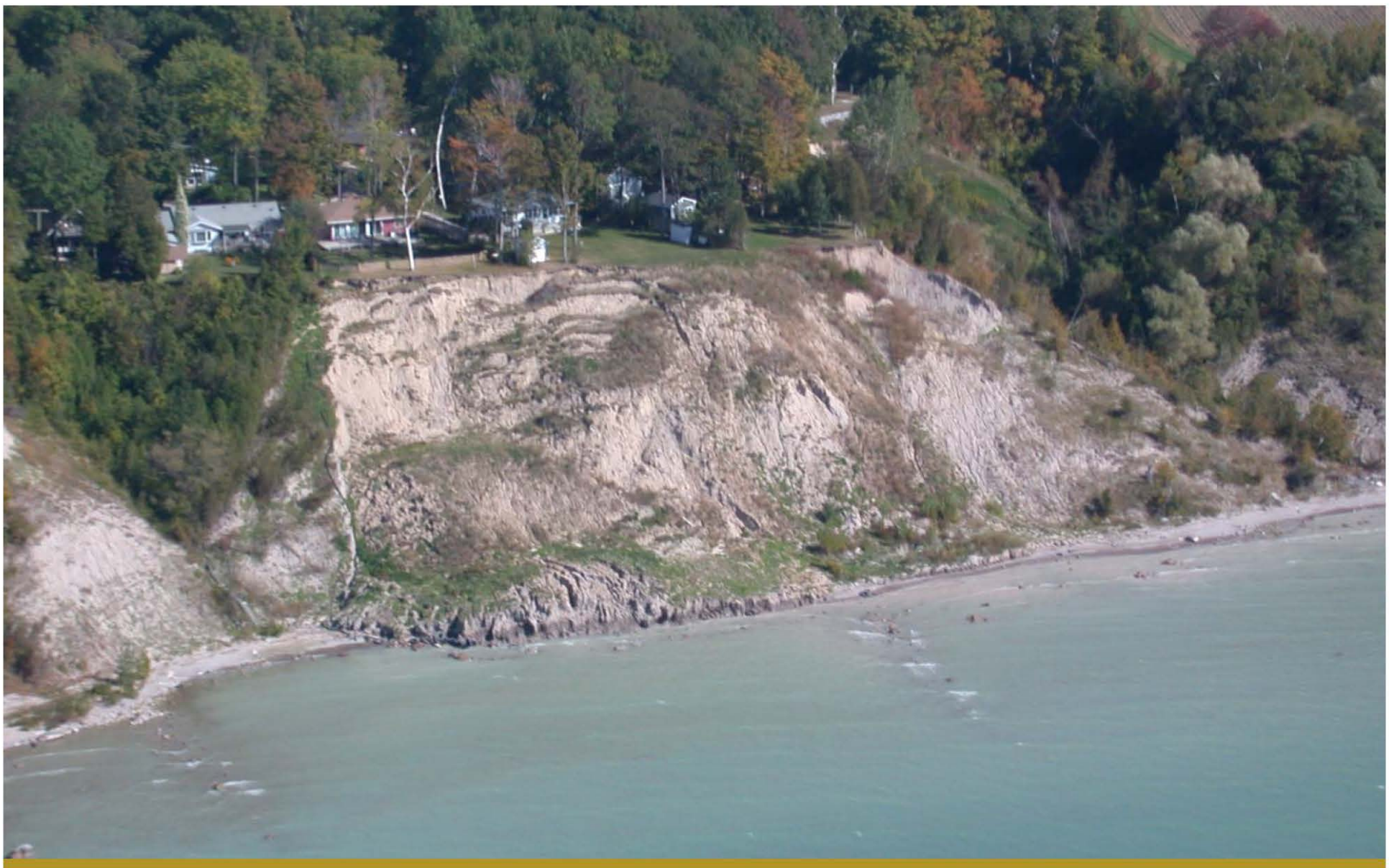
Soil types have different properties and differing resistance to erosion. Clay can stand as very steep slopes, when dry, only to fail as large landslides when wet or severely undercut. Sand is easily eroded but holds a gentler slope and rarely fails catastrophically. Exposed bedrock is more resistant than clay or sand to erosion, but eventually succumbs to the force of freezing and expanding of water within cracks, joints and porous layers, and the relentless attack of waves.

The geological legacy is also important because of the presence or absence of natural defenses (e.g., beaches, etc.), against storm waves. Some properties have visible defenses such as beaches (like Amberley and Oakwood Park Beaches), or bedrock outcrops along the shore (like Sheppardton), and invisible defenses, including rock-armoured lakebed bars, shoals of sand, gravel, or rock (like at Huron Sands, Lakeland Estates).

The **Huron County shoreline** from **Amberley** to **Grand Bend,** is primarily made up of 'clay' bluffs. Some bluffs are more prone to erosion than others.. Historical erosion risk mapping for this area shows that there are certain areas of the shoreline that are continually eroding, other areas that erode more slowly, and still others that have wide sandy beaches, stable for many decades. Of course, stability is relative, and how we care for these coastal lands can determine their future stability.

Geological factors that contribute to erosion include:

- *the continuing flow of surface water and groundwater from the lands,*
- *variable lake levels an d storm activity on the lakes*



## Lake-side Erosion

**Lake erosion** is a natural process**. Bluff erosion** is an important source of sand to supply our beaches. It all comes down to coastal processes.

When storm waves crash along the shoreline, it can cause erosion at the bottom of bluffs. Lake Huron's bluffs are composed of glacial till, made up of 10-15% sand. As the base of the bluff is eroded by waves, it causes the slope to become unstable, and in certain situations, can lead to massive slope failures, known as slumps. In a slope failure, large portions of the bluff slide down ending up on the beach or in the lake. Waves then filter this material. Lighter soil particles eventually get deposited offshore. The sand, however, being, heavier, will drop out of the water and form our beaches.

Waves carry sand along the shoreline by currents. When waves come out of the northwest (direction of the strongest waves), they cause sand to be carried from north to south. Conversely, when waves come out of the southwest, the sand is carried from south to north. Overall on Lake Huron, sand is carried from north to south and ends up in deposited in areas such as the Pinery and Ipperwash). Then, dunes will form where beach grasses and other specialized coastal vegetation develop.

Our beach and dune systems rely on bluff erosion and other shoreline processes in order to exist. They, in turn, protect the shoreline from storm waves and erosion.

Having a cottage in an eroding area can be worry-some, to say the least. Unfortunately, when cottage development first started along Lake Huron, information wasn't readily available to help people locate their building safely. As a result, a number of cottages along the lakeshore were built in high risk zones.

Coastal change is an ongoing natural process. You've seen it all your life, as have your parents and grandparents. The beaches you love (Amberley, Port Albert, Bayfield, Grand Bend) are created and maintained by erosion and the transport and deposition of sand along the coast.

Fortunately, information now exists to help landowners build in safer locations along the shoreline. It's the least costly method of cottage protection.

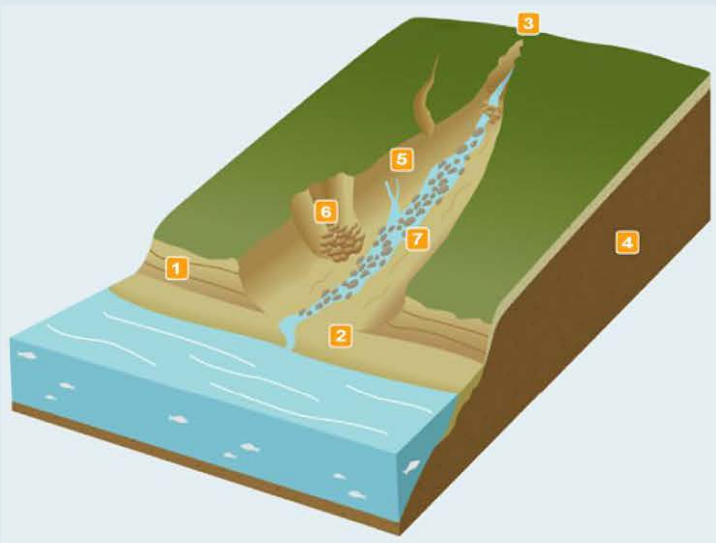
## The "Invisible" Erosion

Erosion of the lakebed (invisible erosion to us) is common along clay till banks and bluffs throughout the Great Lakes. In locations along Lake Huron such as Horizon View, Bluewater Beach south of Goderich, Poplar Beach, invisible erosion plays a major role in their formations. Where lakebed erosion occurs, or, again, invisible erosion, it allows ever-larger waves to reach the toe of slopes. Invisible erosion and slope recession proceed in unison.

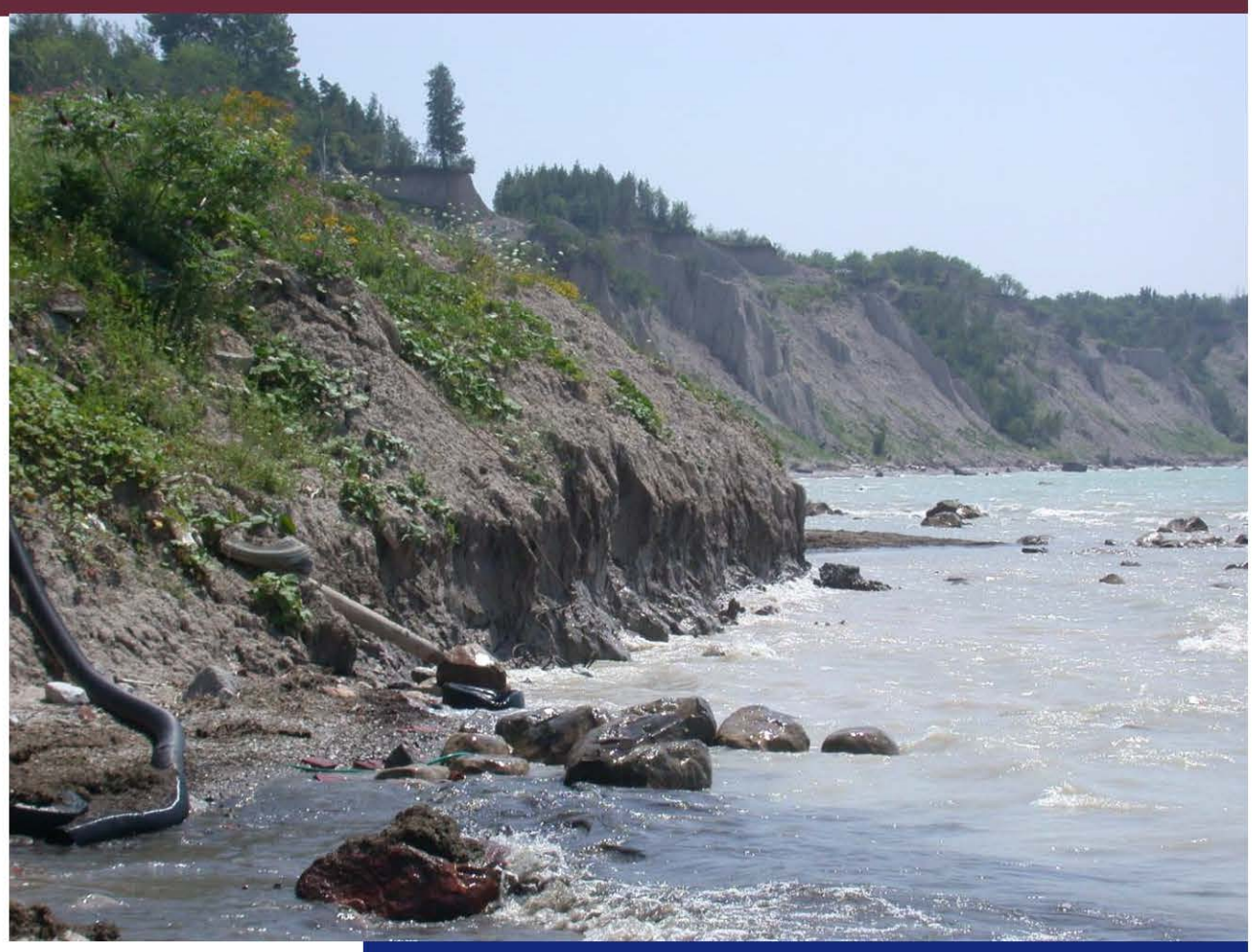
Do lower lake levels slow bluff erosion along the lake? Perhaps at first, but waves will gradually re-adjust the shoreline by eroding and deepening the lakebed, and erosion rates may resume as before.

During periods of low lake levels, the lakebed is subjected to higher currents due to wave motion, and the zone of 'wave breaking' is where erosion is highest. When high water levels return, however, wave impact results in more erosion along cliffs and bluffs.

1. **Bluff:** A steep exposure of unconsolidated sediment (as opposed to a cliff, which is a steep exposure of rock).
2. **Gully:** An erosional feature cut into the bluff; V-shaped when young, U-shaped with age.
3. **Headward Erosion:** The process of stream channel building that erodes the soil at the upper end of the ravine.
4. **Glacial Till:** The unsorted clay, sand and gravel sediment left behind by the last gcier. Along Lake Huron, the till type is often referred to as St. Joseph's Till.
5. **Seep:** A small spring where groundwater exits the slope between layers of sediment.
6. **Slump:** The falling away of large sections of a bluff or gully's sides often caused as waterlogged slopes weaken after winter freeze-thaw cycles and spring rains.
7. **Streambed Armour:** Eroded stones and boulders left in the base of the gully, ranging from a few centimetres to more than a metre across.



# Land-Side!



Water moves off the land as either **surface water** runoff or as underground water called **groundwater**.

***Did You Know...***that the change in elevation between the top of the bluff and the beach can range from 15 to 25 metres along Huron County's shore. As a result, water flowing down to the lake can pick up a lot of erosive energy.

**Q. What do you mean by surface water runoff?**
**A.** Surface water runoff can occur as a result of rainwater, snow melt, groundwater seeps or springs, and lawn or garden sprinkling systems. It may come from roofs through down spouts or from driveways, parking lots and roads.

***Did you know...***that surface runoff over the face of a cliff or slope can result in up to half of the loss of the slope? (Note: the sheer 'volume' of water can have a large influence on rate of erosion.)

**Q. What exactly is groundwater?**
**A.** Groundwater is water that infiltrates into the soil. The hidden activity of groundwater can be more of an issue than the visible effects of surface water runoff because it can trigger large, deep landslides that sometimes have catastrophic consequences.

***Note:*** Expect a bluff to be least stable during extended periods of precipitation or thawing of significant snow cover. Water tables can rise temporarily by several metres in a few days to a few weeks!

**Landslide-triggering mechanisms on slopes include:**

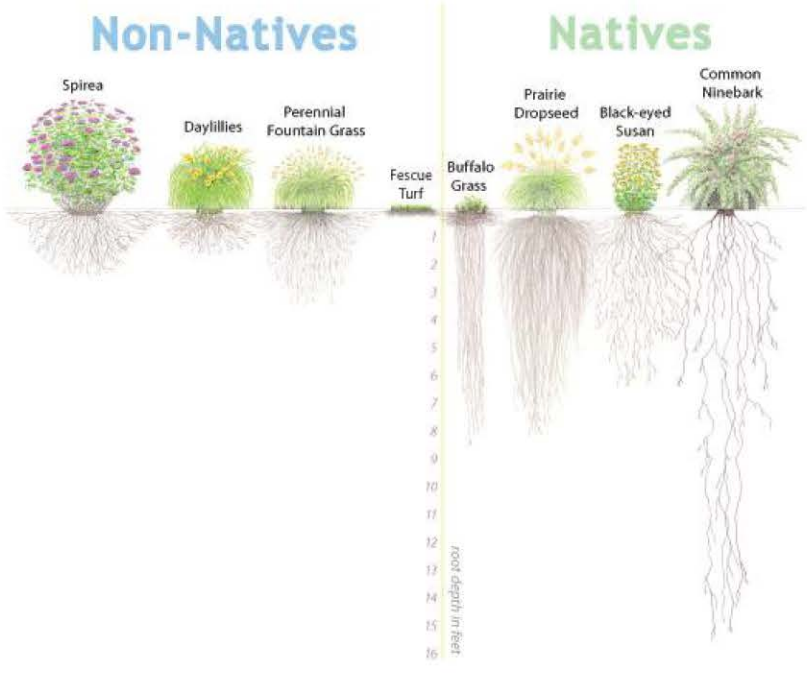
- Extended periods of rainfall
- Rapid snowmelt
- Freeze-thaw cycles
- Wave erosion of the lower parts of the slope and in the lakebed
- Development close to the top of the slope causing increased weight on the slope and resulting in slope instability
- Overly steepened slopes, groundwater that rises behind a slope and seeps out, and soaking of the soils by rainwater, all change the balance of forces and may lead to slope failure.

# Where Are the Trees?

Generally, the influence of a tree's roots on a given site will be related to the tree's age and size. Typically, of course, larger trees will have more extensive, deeper and better developed root systems.

Before cutting a tree, consider the positive effects of that tree's root system on the surrounding environment. If it is cut down, its roots will decay and the stabilizing influence diminished. Where trees and other vegetation has been removed, even stable slopes can fail several years afterwards.

In addition to the above, the removal of tree canopy results in the loss of interception of raindrops which can increase the rate of surface erosion. Since plants absorb and transpire great amounts of water, loss of vegetation tends to promote wetter and less secure slopes.




# The Benefits of Vegetation

Once you read this, you may want to go out and hug your trees!

***Did you Know...***that bluffs along Lake Huron owe much of their stability to the vegetation that acts to bind the soil, making it more resistant to erosion. Woody vegetation (trees & shrubs) in particular enhance the stability of slopes.

**Q.** So, how exactly do plants protect slopes from eroding?
**A.** 1) Plants catch and slow rainfall and draw water up into the air by transpiration (exhaling water), removing water from the soil.

2) Plant roots, especially smaller feeder roots, provide a fibrous web that stabilizes and anchors soil. They function much like reinforcing steel in concrete structures. The roots of many shrub and tree species penetrate deeply, increasing the soil's strength and reducing the risk of shallow slope failures.

3) Vegetation can be valuable in sustaining slope stability! Many bluff sites along Lake Huron are marginally stable and the removal of vegetation can lead to a fresh slope failure or reactivate an old one.

4) Vegetation also helps to protect water quality by filtering out nutrients and pesticides that could otherwise, reach the lake and cause algal blooms.

Trees and shrubs, of course, also improve air quality by taking in carbon dioxide and giving off oxygen. They also provide shade, helping to moderate weather extremes and reduce wind. Trees and shrubs help to provide wildlife habitat and act as a screen to adjacent properties.

Note: An un-vegetated bluff face generally suggests a site is either too steep to support vegetation or that recurring erosion makes the establishment of plants unlikely. Bare areas may also be indicative of a recent or active slope failure.

# Being a Good Neighbour!

What your neighbors do on their property can impact slope stability on yours and increase the potential for erosion. The clearing of trees, for example, can alter groundwater levels and drainage characteristics. It can also eliminate wind protection or change wind patterns.

Think before you act! Most of us do not live alone on islands. Actions on one property may very well have an impact on others.

***A word of caution:*** Thick piles of lawn clippings and other yard waste can smother vegetation that stabilizes slopes and banks. Decaying piles of vegetation can absorb a lot of water, the weight of which can destabilize a bank.
Use a composter rather than dumping your yard waste down the bank. In addition, locate your composter a distance from the top of a slope.

## Protect Your Trees

- During construction, protect bark, limbs, and roots; tie planks around trees to protect them from equipment; do not drive or park equipment over the root area
- Safeguard roots. This means avoid filling, compacting, or removing soil from the root area. *Note:* the root area is at least as large as the area under the crown of a tree
- Trim dead and dying limbs and remove diseased growth, but never trim oaks between April 15 and July 1, due to the risk of oak wilt; properly dispose of diseased limbs and bark to avoid providing an opportunity for the disease to spread
- Scout for pests and diseases; treat early to avoid widespread damage.
- Contact your local municipality for restrictions related to thinning trees in the shoreland area

## Planting Trees

- Use native species because they are hardier, more resistant to disease and pests and provide natural habitat for wildlife
- Include a variety of native trees and shrubs; emphasize diversity of species, heights, and their life expectancy
- Plant in the spring or fall, not in the summer when heat and dry conditions prevail
- When planting, dig a hole 30 to 60 cm (1' to 2') wider than the root system and backfill with original soil; water root area thoroughly, add a 10 to 15 cm layer of mulch, stake only if necessary
- Water regularly and deeply; avoid short, frequent watering which promotes shallow root systems; fertilize and prune as necessary; provide winter protection until established

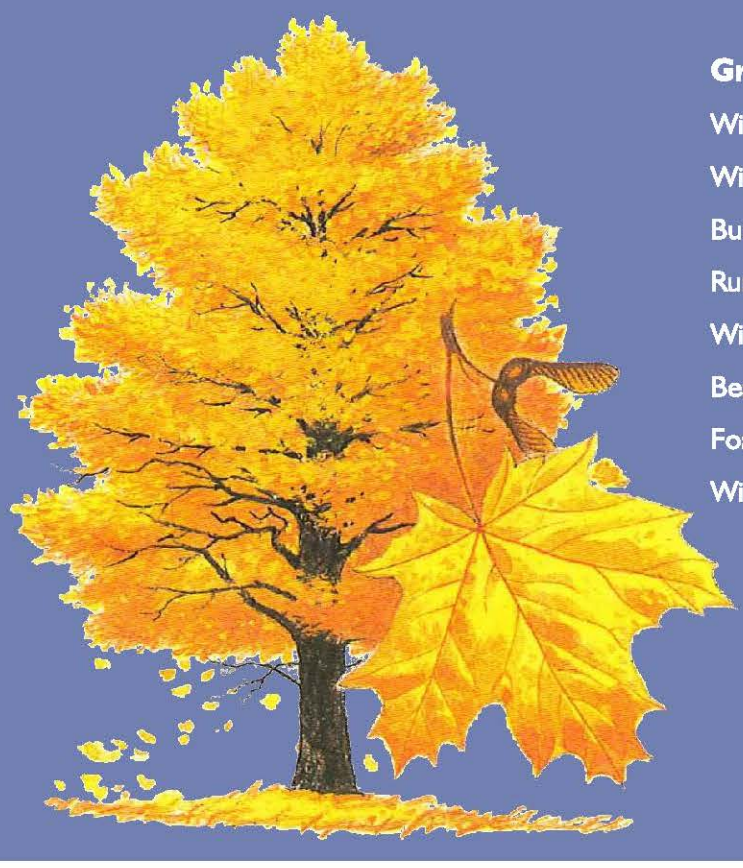
## Buffer Strips

- Buffer strips are vegetated areas of land adjacent to shorelines that help minimize direct runoff to a lake or stream. The most effective buffer strips include a variety of low plants, shrubs, and trees, preferably native or existing vegetation
- Research indicates that all nitrate was removed from groundwater flowing through 30 metres of wooded area. 80% of phosphorus and nitrate was removed from surface runoff. You may only have room on your property for a buffer 3-4 metres wide, but even that can help with erosion control, *and* in helping clean the water before it reaches the lake
- Plant as wide a buffer as you can. The wider, the greater the benefit of slowing runoff *and* removing pollutants from the water

## Recommended Native Species

**Trees & Shrubs**

Eastern White Cedar (Thunja occidentalis)
White Birch (Betula papyrifera)
White Ash (Fraxinus Americana)
Basswood (Tilia Americana)
Sugar Maple (Acer saccharum)
Big-Toothed Aspen (Populus deltoids)
Trembling Aspen (Populus tremloides)
Hop Hornbeam (Ostrya virginiana)
Choke Cherry (Prunus virginiana)
Common Juniper (Juniperus communis)
Red Osier Dogwood (Cornus stolonifera)
Staghorn Sumac (Rhus typhina)



**Groundcovers**

Wild Strawberry (Fragaria Vesca)
Wintergreen (Gaultheria procumbens)
Bunchberry (Cornus canadensis)
Running Euonymus (Euonymus obovatus Nutt.)
Wild Geranium (Geranium maculatum)
Bearberry (Arctostaphylos uva-ursi)
Foamflower (Tiarella cordifolia)
Wild Ginger (Asarum canadense)

# Oh Gullie Gee!

About 200 ravines, or gullies, have formed along the Huron County coastline of Lake Huron. Some have occurred naturally, and others have man-made in an attempt to manage the runoff or stormwater.

Ever since forests were cleared in the 1800's, erosion has increased. Forests and wetlands that acted like sponges to hold water on the land were, for the most part, removed. The lack of vegetation to regulate surface water flow meant that water was draining off the landscape more quickly. In essence, the 'sponge' was replaced with a 'tabletop'. With surface water flowing faster off the land, soil erosion has been accelerated. As water flowed over the lake bluff, channels were cut into the clay soil, forming gullies.

In more recent times, agricultural field tile drainage, increased drainage through municipal drains, and urbanized development (including intensified cottage development), has all contributed to increased erosion of shoreline gullies.

Gullies provide easy avenues for water movement, especially during storm events. In addition, these gullies or channels tend to widen and get deeper over time, due to increased flows.

Excessive groundwater and surface water runoff are leading causes of gully and bluff erosion. It's important to control runoff before erosion becomes extensive and unmanageable.

Stormwater or run-off should be directed properly to a "safe and adequate" outlet, to reduce or eliminate erosion problems. This might mean lining the outlet with cloth geotextile called 'filter fabric' and rock called 'rip rap' stone to allow water to flow properly, without causing further erosion of the gully or bluff.

Avoid creating large tilled gardens and flower beds near coastal slopes. They can easily become conduits for additional water to seep into eroded bluff areas.

Plant a buffer of trees, shrubs, or groundcover plants on land near coastal slopes. Surface water and shallow groundwater is removed from the soil by transpiration ("exhaling" moisture) through plants.

## Let's Get Practical!

- Slow down water: Stormwater runoff from tiled farm fields, roads, driveways and downspouts funnel water into gullies in great torrents when it rains, accelerating erosion. Consult a professional to address serious drainage problems, especially on your property!

- Don't throw yard waste into gullies, as it can smothers native plants and retains water (adding weight, de-stabilizing the slope). Use a composter located well away from slopes

- Do not over water your lawn

- Create and maintain a buffer area of natural vegetation along the shoreline. A buffer of native plants prevents coastal erosion by stabilizing and holding the soil in place more effectively than turf lawns

- Do not "clean up" your shoreline area by cutting back existing plants. Erosion can be magnified by removing shoreline vegetation and can increase the speed of stormwater. This runoff can quickly create gullies and washouts, undermining other landscaped areas and creating more problems than when you started

- Don't know what to do? Hire a qualified geotechnical engineer knowledgeable about coastal bluffs to design structural slope stabilization, such as a retaining wall or terracing

Surface-water runoff from seeps or springs on the slope should be diverted from the slope, collected and drained off through drain pipes. You'll need professional engineering advice on groundwater drainage to prevent landslides. Once vegetation becomes well established on the slope, this measure may become unnecessary except in extreme precipitation events.

Decrease the velocity of water flowing across the land in gullies to reduce the scour potential. Professional help may be required.

Check for seepage from septic systems. If connection to a municipal sewer system is not possible, septic systems should have leach fields located as far from the coastal slope as possible with discharge directed away from the coast. Potential contamination of water supply wells is an overriding concern in leach field location.

Practice water conservation. The more you put into your septic system, the more water you put into your slope. Become a water miser.

- Use low-flow shower heads and toilets;
- Limit shower times;
- Resist the urge to water lawns;
- Be aware of how much water you use.

We've provided some low cost ways of managing runoff before problems become complicated. Seek qualified professional advice if your drainage and/or erosion problem is beyond the scale of the suggestions in this resource guide.

Slow it down, soak it up and keep it clean.

# Size Does Matter with Respect to Drainage Projects

What about large scale erosion that has produced actively eroding slopes? These are typically not manageable by individuals, and require community cooperation. Drainage can become legally complicated, so do your homework and consult with your lawyer if you plan to get involved in a drainage agreement.

First, is the feature a municipal drain? If not, then it is likely a natural stream or watercourse, ravine, gully, private ditch/channel, or simply surface drainage water. It could also consist of features that can be part of a municipal drain but that are privately owned.

If it is one of these systems, it will likely fall into the legal area of 'Common Law'. If landowners can not mutually agree how to resolve the problem, a final solution can be determined through the courts. However, there are options available to landowners to resolve drainage matters which fall under the Common Law:

## Option 1

**Don't do anything.** This may require that structures on your property be moved back a safe distance from an eroding bank. Check with your municipality and local Conservation Authority about safe setback distances.

## Option 2

**Fix it yourself.** Under this scenario you would be responsible for any costs unless you can solicit other landowners to financially assist you or you obtain assistance through a funding program. You may also be limited to work on your own property only, unless you receive permission from another involved property owner to work on that property as well.

## Option 3

**Mutual Agreement Drains.** Allow landowners to work together to develop a drainage scheme. Mutual Agreement Drains are set up under Section 2 of the Drainage Act.

**Advantages:**

- There is no limit regarding the cost or extent of the work as in Section 3, requisition drains.
- Agreement Drains are usually cheaper to construct.
- Repairs and maintenance do not depend on a public body.
- Drains are constructed quickly, there are few delays.

**Disadvantages:**

- Impractical when major roads or utilities are involved.
- No prescribed way to decide on the actual cost.
- Not properly engineered, owners must assume liability.
- Legal fees and filing fee for agreement.

Note: No grants are payable under The Drainage Act for construction or maintenance of Agreement Drains.

## Option 4

**Petition Drain:** The Drainage Act provides a procedure whereby a group of landowners may 'petition' the municipality for a municipal drain. They do this by submitting a complete "Petition for Drainage Works by Owners" for a Municipal Drain in accordance with Section 4 of the Drainage Act. The Municipal Council would appoint an engineer. At the on-site meeting it is the duty of the engineer to determine if the petition is valid. If the petition is valid, a process under the Drainage Act would commence to, in the end, create a new Municipal Drain and a "communally accepted" project. The new drain could consist of all or portions of any existing natural watercourse, gully, drainage system or any other natural features that are deemed by the engineer as appropriate to be included as part of the drainage works as well as the construction of any new features such as piping, structures, etc. Once a Municipal Drain has been created under the Act, the Municipality is responsible for maintaining it but at the expense of all of the lands and roads assessed and in accordance with the manner determined by the engineer in the Report which has been adopted by By-Law.

If the Petition Drain work is done under an Engineers' report, it may be eligible for a 33 1/3% grant from the Province. Contact your local municipality for more information about Municipal Drains.

Contact your local Conservation Authority to determine if there are programs to help offset the cost of the work or if there is any assistance since it is assumed that the drainage system is not part of a Municipal Drain. Please note that Conservation Authorities may require the work to be "engineered". If it involves a gully or an unstable slope, it is strongly recommended that a qualified geotechnical engineering firm with expertise in such matters also be consulted.

# Looking Ahead

Scientists have identified that climate trends are changing our local environment, and that we will need to adapt to a new range of conditions. Changes in temperature, precipitation and water levels affect our living along the coast. Be prepared to adapt to their impacts.

Regional studies by Environment Canada and the US Environmental Protection Agency have identified future trends based on computer modeling. The **Maitland Valley Conservation Authority** has conducted an evaluation of historic temperature and precipitation trends in the Maitland River watershed over the past 50 years. The trends observed in the data indicate that these changes are taking place, consistent with the conclusions reached in regional studies.

# What Can We Expect?

## Precipitation

Trends indicate total annual precipitation and intensity is increasing in the fall, winter and spring seasons. Extreme precipitation is likely to become more frequent and intense, particularly in summer.

Small streams and gullies which drain directly into Lake Huron are particularly vulnerable to increased precipitation. Clay-rich soils are prone to erosion, especially where vegetation has been removed or the slopes have had a history of erosion.

The landscape in Huron County also tends to be extensively drained, and straightened channels can further accentuate potential erosion issues by increasing overall flow of surface water runoff. Flood forecasting systems do not have adequate coverage to accurately predict and measure short duration convective rainfall events, so it may be likely that public agencies will not be able to provide sufficient advance warning.

Areas within the traditional snowbelt area, east of Lake Huron, will likely see an increase in lake-effect snowfall due to warmer lake temperatures and less ice cover on Lake Huron.

## Temperature

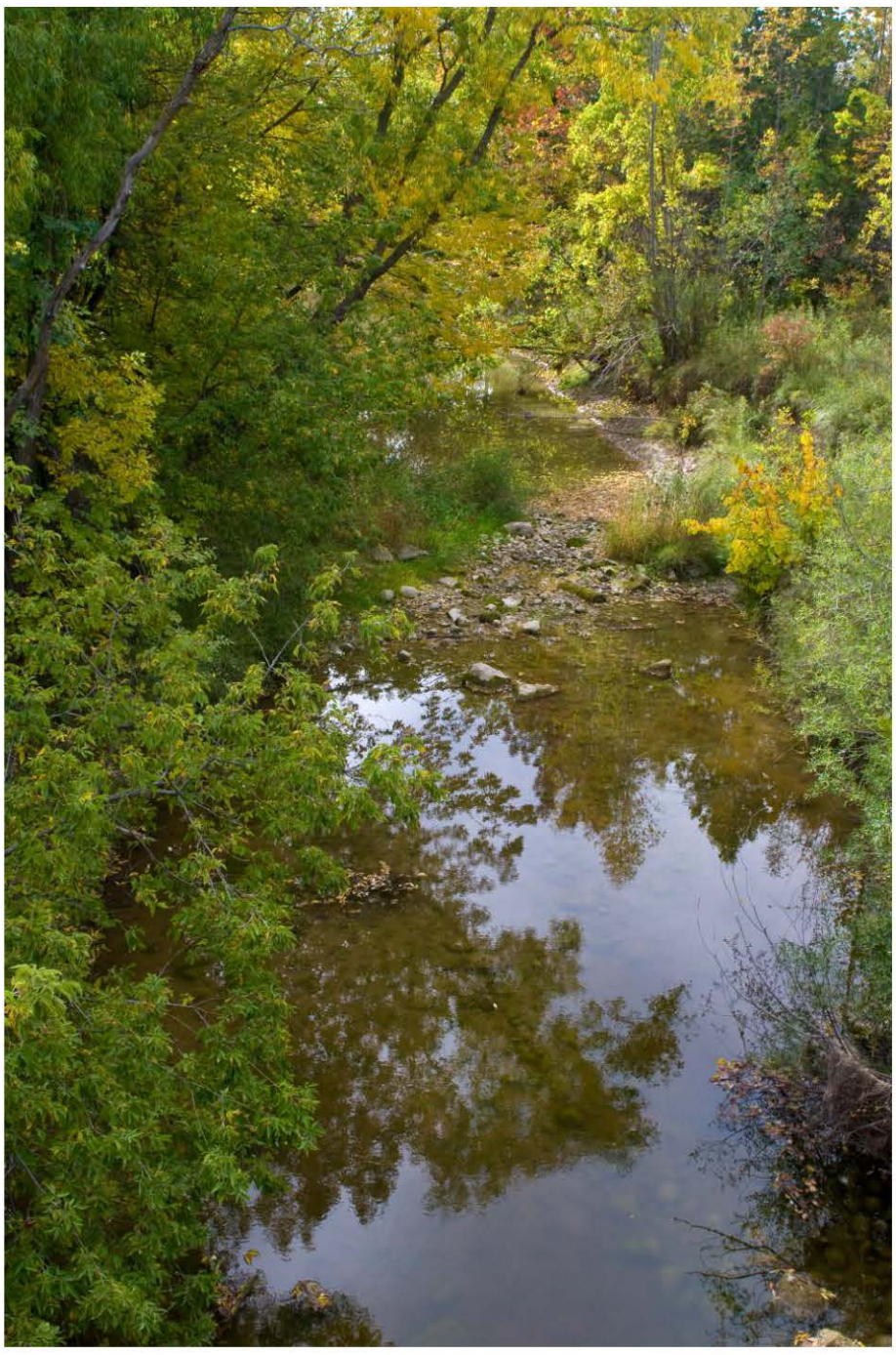
Temperatures have also been increasing locally. Heat units are up across local watersheds. The number of days where maximum temperatures exceed 30°C has increased, which identifies a trend toward warmer summer seasons. As a result, expect an increased risk of drought and more hot days (over 30°C) during summer.

The most profound trend documented in the MVCA study related to winter months, where the data showed a decrease in the number of days temperatures stayed below 0°C. Shorter winters and frequent, longer duration winter thaw events will become more common and will increase the probability of unstable and eroding bluffs. As the snow pack melts, water infiltrates quickly into the soils and both groundwater and surface runoff can promote slope failure.

As air temperatures increase, so will water temperatures. Waterborne pathogens will present an increasing risk to public health because many pathogens thrive in warmer conditions. Beach postings and algae blooms may become more frequent.

## Lake Levels

There has also been a decrease in lake ice on the Great Lakes which increases evaporation in winter, contributing to water levels decline. With that, we could see a reduction in lake-effect bluff erosion. However, in historically erosion prone parts of Lake Huron, this could be a temporary situation, as the shoreline re-adjusts. As lakebed erosion continues and deepens the nearshore, more wave energy will reach the shore, and bluff erosion would eventually re-activate.



## Effects of a Changing Climate:

- Increased temperatures may reduce the survival rate of trees planted in shoreline environments
- The increased number of hot days could result in conditions conducive to a higher incidence of poor air quality days. Some of the poorest air quality in Ontario occurs along the eastern Lake Huron shore, affected by lake-land breeze circulations
- Increased rainfall will increase flow rates of streams and rivers, causing scouring and sediment deposits
- Increased rainfall may cause gully erosion and unstable side slopes especially if the water flow is striving to a lower lake water level
- A longer growing season for aquatic algae may lead to greater algal problems, depending on nutrient availability. Warmer temperatures will also increase frequency and extent of algae washing up on shore which will reduce water use for swimming and increase water treatment costs for municipal water supplies
- Warmer lake temperature will generate stronger winds across the lake. This will affect the movement of sand in beach and dune areas, requiring effective dune conservation strategies. Winds could also affect the freeze-thaw cycle in bluff areas

# Shoreline Regulations

It's important if you're planning a drainage project, doing any alteration to the slope, beach or constructing within the 100 Year Erosion Limit, that you contact your local Conservation Authority. They can help with permits, suggest options or put you in touch with experts to help with technical details or requirements.

Conservation Authorities are agencies that have the responsibility for administering an Ontario regulation dealing with development, interference with wetlands and alterations to shorelines and watercourses. This regulation is something cottage and home owners will need to consider when planning to renovate or build.

The regulation prevents or restricts development in areas where the control of flooding, erosion, dynamic beaches, pollution or the conservation of land may be affected by development. The regulation assists Conservation Authorities to fulfill their mandate to prevent the loss of life and property due to flooding and erosion, and to conserve and enhance natural resources. The regulation applies to the Lake Huron shoreline including bluffs, gullies and beaches.

If a landowner is planning to do work near the shoreline they may require a permit from their local Conservation Authority. A municipal building permit does not replace a Conservation Authority permit. Before undertaking a project contact your local Conservation Authority:

**Ausable Bayfield Conservation Authority:** 519-235-2610, 1-888-286-2610 or info@abca.on.ca

**Maitland Valley Conservation Authority:** 519-335-3557 or maitland@mvca.on.ca

**St. Clair Region Conservation Authority:** 519-245-3710 or stclair@scrca.on.ca

# Adapting to a Changing Environment Means...

...people adjusting to natural coastal processes by staying out of nature's way. It is our responsibility to construct new buildings far enough from the edge of coastal slopes and high enough above the water that erosion and flooding won't affect them;

...relocating existing buildings inland of erosion hazard areas and designing new buildings that can easily be relocated if erosion is more rapid, or water levels higher, than anticipated;

...recognizing the important role of vegetation in coastal areas and anticipating how best to help your vegetation adapt to a changing climate. Healthy, resilient, native vegetation will adapt more successfully to climate change than vegetation that is already stressed from over-trimming, root damage, or suffering from other poor growing conditions;

Adaptation does not mean moving building sites lakeward as lake levels drop and shorelines advance lake-ward. In some situations, it means passing up an opportunity to buy property where a building is threatened from erosion, or not constructing a permanent structure on threatened land.

Professional advice and judgment is needed to anticipate the severity of future precipitation events and conditions and how best to manage surface water and groundwater on a coastal property. In many cases, a neighbourhood or community-wide approach to adaptation will be more successful, more cost-effective and easier to implement.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