Understanding Coastal Erosion: A Guide for Landowners

Overview of Landowner Workshop presented by FreshWater Engineering with Cook and Lake County Soil & Water Conservation District

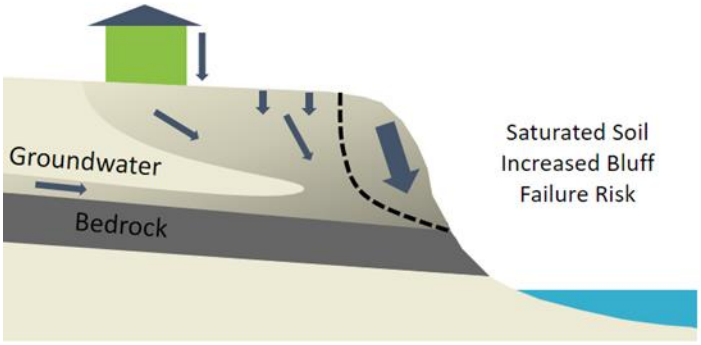
What Causes Lake Superior Coastal Erosion?

Main Causes

1. **Wind:** Creates waves. In addition, strong winds can erode bluffs and land without established vegetation.
2. **Waves:** Force that repeatedly eats away at the bluffs and shorelines. Biggest when wind comes from the east.
3. **Fluctuating Water Levels:** Determines how much of your land is affected by water.
   - **Seasonal Variation:** Highest water levels in Spring and Summer, lowest in the Winter.
   - **Storm Surge:** Precipitation and increased inflow from rivers increases water levels.
   - **Wave Height**
   - **Wave Runup:** Waves crash on the shore and run up the shoreline. Depends on slope of shore.

Additional Causes

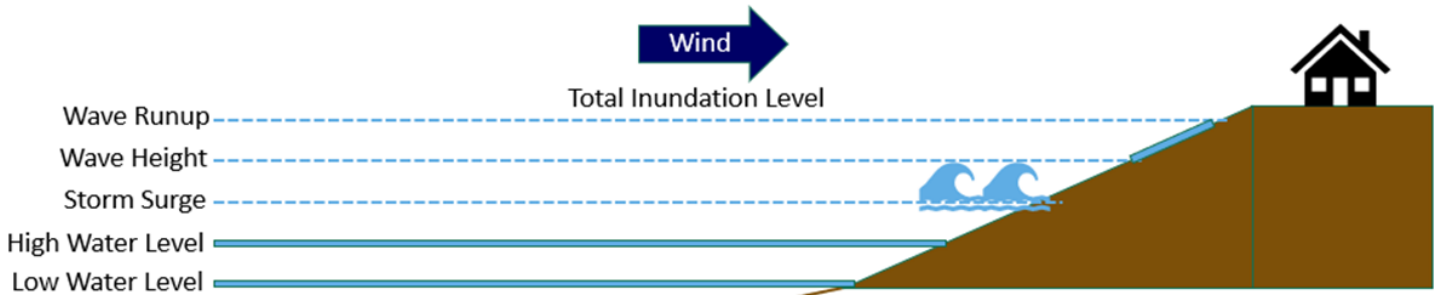
- Surface Water Runoff
- Lack of Vegetation
- Removal of Vegetation
- Groundwater Saturation
- Ice Forces
- Freeze-Thaw Cycles



Ordinary High Water Level (OHWL)

Elevation of the highest water level that leaves evidence upon the landscape. Commonly the point where natural vegetation changes from aquatic to land based. This is also the landward extent of DNR jurisdiction.

Any alterations below this level must be first permitted by the DNR and U.S. Army Corps of Engineers, as required. Contact the local DNR Area Hydrologist to determine this elevation.



Water Levels

Great Lakes Water Levels: https://www.lre.usace.army.mil/Missions/Great-Lakes-Information/Great-Lakes-Information-2/Water-Level-Data/

Great Lakes Dashboard: https://www.glerl.noaa.gov/data/wlevels/

Understanding Erosion on Your Property

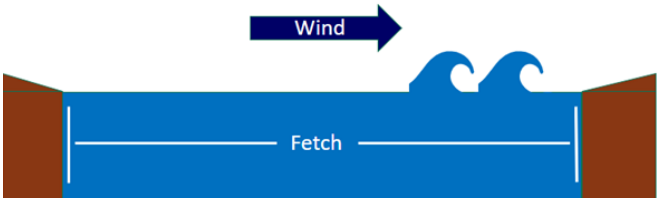
Every Property is Different

Erosion is dependent on:

1. **Site Conditions**
   - Soil/rock type
   - Bluff slope angle
   - Bedrock extent
   - Bedrock condition
   - Stormwater management
   - Vegetative cover
   - Neighboring hard armor
2. **Wave Environment**

Understanding Wave Environment

Fetch: Length of lake surface over which the wind blows in an essentially constant direction, generating waves.



Low Wave Energy: Limited fetch in a sheltered, shallow, or small water body (bay)

High Wave Energy: large fetch (deep, open water)

North Shore Coastal Erosion Hazard Map

The North Shore Coastal Erosion Hazard Map is a web-based mapping tool that is easily accessible to landowners, contractors, realtors, and local officials. The tool can also be used to identify the suitability for development and can be used to guide decisions related to conservation concerns and hazardous erosion areas.

Link: ardc.org/CEHM/

North Shore Erosion Rates

(note: erosion is not constant)

	Average	Maximum
High Erosion Potential ▪ Organic deposits ▪ Sand and gravel ▪ Clay and silt ▪ Unsorted glacial deposits	0.46	1.09
Low Erosion Potential ▪ Bedrock	0.16	0.64

Table shows average and maximum recession rates measured, 1930s-75, ft/yr. (University of Minnesota, Minnesota Sea Grant, 1990)

What Solutions are Available?

Grey Infrastructure

What is it? Uses harder features like rocks and concrete.

When to use it? High energy environments

Green Shorelines

What is it? Uses nature-based features like vegetation and geotextiles

When to use it? Low energy environments

Hybrid Shorelines

What is it? Combination of both vegetation and rocks

When to use it? Low – High energy environments

Gray Infrastructure

1. **Seawalls:** Vertical or sloped wall aimed to stabilize shoreland and prevent from flooding and overtopping of waves.

Advantages
- Long lifespan
- Shoreline stabilization behind structure
- Low maintenance cost if built properly

Maintenance Issues
- Deterioration
- Loss of toe stability
- Cracking
- Settlement behind wall
- Erosion near the flank can lead to failure

Disadvantages
- Can be expensive
- Wave reflection causes: erosion of adjacent unreinforced sites and toe erosion
- Prevents upland from being sediment source
- Can fail during large events
- Rising water levels decrease effectiveness
- Low visual appeal

Costs
- Extremely variable ($300-$2,000/ft)

2. **Rip Rap Revetments:** A sloping wall usually made with angular quarry stone with the goal of protecting the toe of a bluff or piece of shoreland.

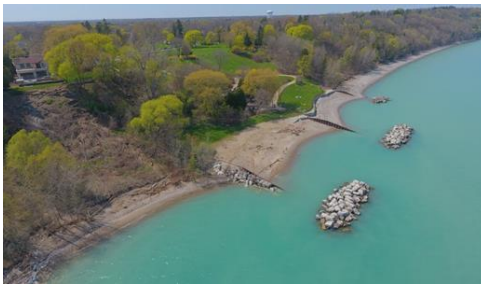
Advantages
- Dissipates wave energy
- Little maintenance
- Long lifespan

Maintenance Issues
- Stone Deterioration and cracking
- Toe stability
- Erosion near the flank can lead to failure

Disadvantages
- Erosion of adjacent unreinforced sites
- Prevents upland from being sediment source
- Gets rid of shoreline habitat
- Waterfront access can be difficult

Costs
- Extremely variable ($300-$625/ft)

3. **Breakwaters:** Offshore structure intended to break waves and reduce the force of wave action on the shoreline.



Advantages
- Reduces wave force and height
- Economical in shallow areas

Maintenance Issues
- Stone deterioration
- Toe stability

Costs
- Extremely variable ($1,000-$5,000/ft)

Disadvantages
- Expensive in deep water
- Reduces water circulation
- Navigational hazard
- Toe erosion
- Disrupts sediment transport
- Wave reflection
- Low visual appeal
- Needs USACE permit

Why is Cost so Variable?

Depends on:
- Site needs & energy environment
- Engineering requirements
- Contractor
- Distance to quarry/material pits
- Access to site (barges, cranes, pump trucks, hand-carrying, etc.)
- Length of shoreline
- Height of structure

The Impacts of Grey Infrastructure and Human Coastal Development

Erosion becomes more severe down-drift of structures because of:

1. Increased wave reflection
2. Disrupted sediment budgets
3. Impacts to wave breaking processes

Also,

4. Gets rid of shoreline habitat
5. Freeze/thaw can be more severe
6. Waterfront access becomes more difficult

Resources

Coastal Bluff Evolution Adjacent to Shoreline Protection Structures: https://coastalbluffevolution.weebly.com/

In wake of Concordia University Project, beaches and bluffs fade away: https://archive.jsonline.com/news/ozwash/in-wake-of-concordia-university-project-beaches-and-bluffs-fade-away-b99424792z1-289255751.html/

Green Shorelines

Roots of native plants hold soil in place to reduce erosion. Creates a buffer to upland areas.

Advantages
- Improves habitats and biodiversity
- Visually appealing
- Lessens downdrift impacts
- Shoreline sustainability
- Improves water and air quality
- Low maintenance and cost

Maintenance Issues
- Condition of vegetation
- Invasive species

Disadvantages
- High energy wave environments pose challenges
- Affected by high water levels
- Cold climates/ice can damage vegetation
- Situationally limited

Costs
- Variable (up to $1,000/ft)

Hybrid Shorelines

1. **Sills:** Combination of either a small breakwater or revetment along with vegetative stabilization.

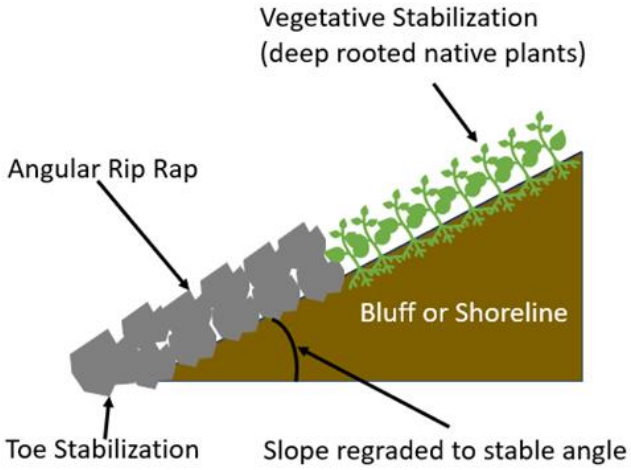
Advantages
- Provides habitats and ecosystem services
- Dissipates wave energy
- Slows inland water transfer

Maintenance Issues
- Condition of vegetation
- Invasive species
- Toe stability and erosion
- Cracking of stone

Disadvantages
- Not entirely effective in high energy wave environments
- Uncertainty of vegetative growth
- Erosion at the tow of the structure

Costs
- Extremely Variable ($300-$1,500/ft)

2. **Regrading, Toe Protection, and Vegetative Stabilization:** Regrades a bluff or shoreline to a more stable angle, which makes it easier for vegetation to establish. This is usually combined with toe protection through use of a rip rap revetment or seawall. Rip rap does not need to extend all the way up the slope, and the extent should be determined by a professional.



Advantages
- Provides habitats and ecosystem services
- Dissipates wave energy
- Improves water and air quality
- Slope stabilization

Disadvantages
- Erosion of adjacent unreinforced sites
- Prevents upland from being a sediment source
- Gets rid of shoreline habitat

Maintenance Issues
- Condition of vegetation
- Invasive species
- Toe stability and erosion
- Cracking of stone

Costs
- Extremely Variable ($700-$2,200/ft)

Other Options – Moving your House

Advantages
- Potentially increase value of home
- Potentially less expensive than shore protection/bluff stabilization
- Avoids damaging ecosystems/neighboring properties
- Preserves sediment input to the lake

Costs
- Extremely variable
- Depends on square footage, location, weight, nearest contractor, site access

Disadvantages
- Relocation cost could potentially exceed the value of home
- May not be enough space to relocate
- Your land is still eroding

Potential Contacts
- H J Mc Gregor House Moving - Mountain Iron, MN
- Building Relocators – Duluth, MN
- Iron Range Moving Inc – Virginia, MN

Setback by County and Hazard Area

Vegetation line: Point where water prevents growth of permanent or woody vegetation.

	Non-Erosion Hazard Areas	Erosion Hazard Areas
Cook County	**40 feet** from vegetation line Additional setback: **30 feet** from top of bluff	Structures and Soil Absorption Area Setbacks **(Annual Erosion Rate x 50) +** **25 feet** from bluff **OR** (if no erosion rate) **125 feet** from eroding bluff
Lake County	Whichever sets you furthest back between: **40 feet** from vegetation line **OR** **75 feet** from the mean water level (601.5 ft above sea level) Additional setback: **30 feet** from top of bluff	

Permitting

Contact your local SWCD to learn more about all required permits for your site-specific project.

What is needed from the DNR for shoreline projects?

1. Plans and Designs
   (best if done by a capable engineer)
2. Aquatic Plant Management Permit if planting below the Ordinary High Water Level (OHWL)

How do I apply for a permit?

1. In search engine, type "MPARS" (Minnesota DNR Permitting and Reporting System)
2. Create an account and password
3. Fill out the online application
4. **Apply Early** – DNR requires up to 6 months to process permit applications

How can we make our property more resilient?

Start from the Top Down

1. **Manage stormwater with green practices**
   Why? Directing water from your roofs and driveways to green practices decreases surface water runoff by increasing the infiltration of water into the ground. In addition, practices like rain gardens and permeable pavement help maintain water quality by filtering pollutants collected from lawns, driveways, and roofs.

2. **Redirect stormwater away from bluff or shoreline**
   Why? Runoff directed towards the face of a bluff can erode surface material. Instead, direct the water near the front of your properties away from the shoreline or bluff.

in

(rain garden, rain barrel, permeable pavement)

3. **Minimize your footprint to the lake**
   Why? Compacting trails to the lake lead to increased surface water runoff down the face of a bluff or shoreline, which can lead to gully erosion.

4. **Plant native vegetation**
   Why? Plant roots strengthen soil. Avoid using turf grass, as it does not have deep roots and offers little addition to soil strength. Plants also offer ecosystem services, including enhanced air quality and offering habitat for creatures.

5. **Avoid removing vegetation (Do not mow near your shore!)**
   Why? Try to leave native vegetation in place on at least half the length of your property to the lake. Native plant roots strengthen soil and remove water through root uptake and transpiration. They also slow runoff and trap sediment. Since plant roots help hold soil in place, removing vegetation will weaken the soil and make bluff or shoreline stability and surface water erosion worse.

Vegetation Selection

Shrubs

Shrubs are shorter and have deep root systems. Along with native grasses such as switchgrass, they should be considered first for bluff and shoreline stabilization.

Native Species:

- Serviceberry
- Red Berried Elderberry
- Dogwood
- Wild Rose
- Red Raspberry
- Currants
- Beaked Hazel
- Grey Alder
- Prickly gooseberry
- Sand Cherry
- Ninebark
- Black Chokeberry
- Chokecherry
- Staghorn Sumac
- Mountain Ash
- Hazelnut
- Willows
- Northern Bush Honeysuckle
- Mountain Maple
- Downy Arrow-wood

Trees

Trees should not be the first choice when planting native vegetation near the lake. A significant amount of soil can be lost with one tree falling. Also, wind and the weight of a tree can increase risk of falling.

Native Species:

- Paper Birch
- White Spruce
- Quaking Aspen
- Pine (Red, White, Jack)
- Basswood
- Balsam Fir
- Red Maple
- Red Oak
- Yellow Birch
- Sugar Maple
- Burr Oak

MN DNR Resources for Vegetation Selection

Native Plant Suppliers, Landscapers, and Restoration Consultants:
https://files.dnr.state.mn.us/assistance/backyard/gardens/native_plant/suppliers_northeast.pdf

Consulting Contractors and Engineers

We highly recommend that you seek professional help and assistance when hard armoring or altering your shorelines. These projects can become extremely complex and can have a huge impact on the environment and on neighboring properties.

Key Steps in the Decision-Making Process

1. **Set Project Goals:** Keep in mind the effects your project could have on the environment and on neighboring properties.
2. **Talk with Your Neighbors:** Seek out neighbors who have had structures built on their properties to learn more about standard costs and procedures. Also, you may be able to reduce costs by teaming up with neighbors who also want to protect their land.
3. **Research Your Options:** Do not settle on the first quote or armoring solution that you receive from a firm or contractor. Make sure to research all available options.
4. **Seek Advice:** Talk to local professionals and contact the DNR. In addition, contact your local SWCD. They can provide guidance on land management strategies.

Resources

Extra resources are available on the SWCD websites, including resources developed to help landowners understand coastal erosion, the permit process, shoreland stewardship, and many other related topics. Additionally, there are Minnesota DNR contacts below that were highlighted in the workshop.

Cook County Soil & Water Conservation District
411 W. 2nd Street, Grand Marais, MN 55604
Phone: (218)387-3647
Website: cookswcd.org

Lake County Soil & Water Conservation District
408 First Ave., Two Harbors, MN 55616
Phone: (218)834-8370
Website: lakecountyswcd.org

Marcia Nieman
MN DNR Area Hydrologist
Phone: (218)834-1440
Email: marcia.nieman@state.mn.us

Brooke Haworth
MN DNR Northeast Plant Ecologist
Phone: (218)302-3248
Email: brooke.haworth@state.mn.us

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