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High Risk: Michigan's Coastline in Danger

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High Risk

Michigan's Coastline in Danger

Beach erosion threatens Lake Michigan's many landmarks and treasures.

High Risk

Michigan's Coastline in Danger

Compiled & Designed by
Adira Weixlmann

This book is dedicated to the years of happiness that visits to the shores of Lake Michigan have brought me and my family.

The irony is that beach towns are extremely vulnerable to the very thing that makes them desirable, the sea.

Each summer I sit on the back porch
of the cottage and look out over the lake
and see a view like this.

1 MICHIGAN

My dad and brother walking along Lake Michigan, July 2011.

My Family Vacations

Practically every summer since I was 10-years-old, my family has been going to Lake Michigan. We go to a town along the eastern shore of the lake, Grand Haven, Michigan. Known as the official "Coast Guard City USA," the town holds an annual Coast Guard Festival which attracts about 300,000 people each year.

For all my life, when I reach a beach I become a beach bum — in the most positive sense of the phrase, of course. My personal "bum" behavior consists of soaking up the warm rays, savoring the relaxing sound of the waves hitting the shore, painting with watercolors, and occasionally building sand castles.

When my family returned to Grand Haven in July 2011, things were generally just as they were when we had left only one year earlier. In the mornings, we enjoy walking along the shoreline. The first one of those walks was filled with the expected elements — butterflies fluttering in the air, objects that had been washed up the shore, and the chill of the water untouched by the sun since the day before.

As we walked further down the beach, I started noticing places where the beach grass roots were extremely exposed. Over the years of visiting the lake, we had seen an ever changing shoreline, but it was definitely receding, and maybe more than I expected. All of this got me to thinking, just how much are the Michigan beaches eroding?

▶ The Grand Haven South Pier, July 2011. The lighthouse was built in 1839 due to the importance of the Grand Haven harbor.

The State

Agriculture

Second only to California in diversity of agriculture, Michigan produces a wide variety of crops, fruits, and vegetables.

High Tech Employment

Ranked fourth in the U.S. in high tech employment with 568,000 workers, these mostly include automotive jobs.

Beaches & Bodies of Water

When in the state of Michigan, a person is never more than six miles from a natural water source or more than 85 miles from a Great Lake shoreline.

◀ Michigan blueberries

"Big Three"

Detroit, Michigan is home to the "Big Three": Ford, General Motors, and Chrysler — the three major American automotive companies. These companies have increasingly become known as the "Detroit Three."

Universities

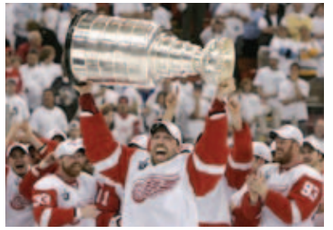
The state of Michigan has many public universities and private colleges. The three major research institutions are University of Michigan, Michigan State University, and Wayne State University.

Sports Teams

Detroit, the largest city in Michigan, also has four professional sports teams. These teams are the Detroit Tigers (MLB), Detroit Lions (NFL), Detroit Red Wings (NHL), and Detroit Pistons (NBA). It is one of twelve U.S. cities with teams from all four major North American sports.

▲ An assembly line of GM vehicles

▲ The graduate library at the University of Michigan



▲ The Detroit Red Wings winning the Stanley Cup in 2008

The facts tell us that beaches in Michigan
(and many other locations) are eroding

2 BEACHES ARE DISAPPEARING

Beachgrass with exposed roots along beach on coast of Ottawa County, July 2011.

Coastal Erosion

The Heinz Center's Evaluation of Erosion Hazards (April 2000) states: The Great Lakes coasts extend for 3,600 mi (Federal Emergency Management Agency, 1989), and are composed of a variety of shore types, ranging from high rock bluffs to low plains and wetlands.

Coastal erosion in the Great Lakes is affected by many factors, including cyclically changing lake levels, disruption of longshore transport of beach building material, and storms. Rates of bluff and dune erosion along the shores of the Great Lakes vary from near zero to tens of feet per year because of annual variability in wave climate and lake levels (National Research Council, 1990). The Great Lakes have experienced a series of high lake levels in the past two decades, with the highest peak occurring in 1987 (U.S. Army Corps of Engineers Detroit District, 1997). High lake levels increase bluff recession rates by increasing wave attack on the base of the bluff.

In many areas of the Great Lakes, bluff erosion produces beach-building sediments. However, both tributary and shoreland sources of sediment are depleted by navigational improvements and dredged material disposal practices, which remove these sediments from the littoral system.

Ice ridges that form and break up each winter along the shoreline also cause erosion by trapping sand in floating fragments of ice that are carried offshore into deep water. This continuing natural process is one of the principal mechanisms by which sand is lost from the nearshore system (U.S. Geological Survey, 1992). The hardening of the lakeshore with erosion control structures can also reduce sediment supply and adversely affect natural processes.

"High risk" erosion areas are those shorelands of the Great Lakes and connecting waters where recession of the zone of active erosion has been occurring at a long-term average rate of one foot or more per year. The erosion can be caused from one or several factors. High water levels, storms, wind, ground water seepage, surface water runoff, and frost are important factors causing erosion. Anthropogenic causes of erosion (e.g., disruption of littoral drift by placement of shore-protection structures) can also exacerbate shoreline erosion in a regional sense.

Approximately 300 miles of shoreline are classified as high-risk erosion areas. Many homes and other structures have been destroyed along areas of the Great Lakes subject to rapid shore erosion processes. This destruction has resulted in severe financial loss to property owners. Public losses to recreation facilities, roads, and other public works have also occurred.

The High Risk Erosion Areas have been identified through detailed recession-rate studies conducted by the Department of Environmental Quality. The recession rates are used to calculate the appropriate setback distances for coastal constructions.

The High Risk Erosion Areas are mapped on a County basis. The maps show 30-year setbacks, which apply to small readily-moveable structures and 60-year setbacks which apply to large or non-readily moveable structures.

Michigan law requires that the MDEQ conduct erosion studies to document the long-term rate of shoreline movement.

Initial, detailed erosion studies were completed in 1986, and updates of the recession rate studies are scheduled every ten years to reflect changing water levels and shore protection efforts. This data is used to identify hazard areas, and establish setbacks for new construction under state regulations.

These studies have examined the impacts of shore protection structures on erosion and bluff recession rates, increased the understanding of recession rates. These efforts include the periodic monitoring of survey profiles along the coastlines of Lake Michigan and Huron, which provide information on nearshore profile changes that accompany fluctuations in Great Lakes water levels.

The results of this work are culminating in the establishment of guidelines for the placement of shore protection structures on the Great Lakes and inland lakes of Michigan.

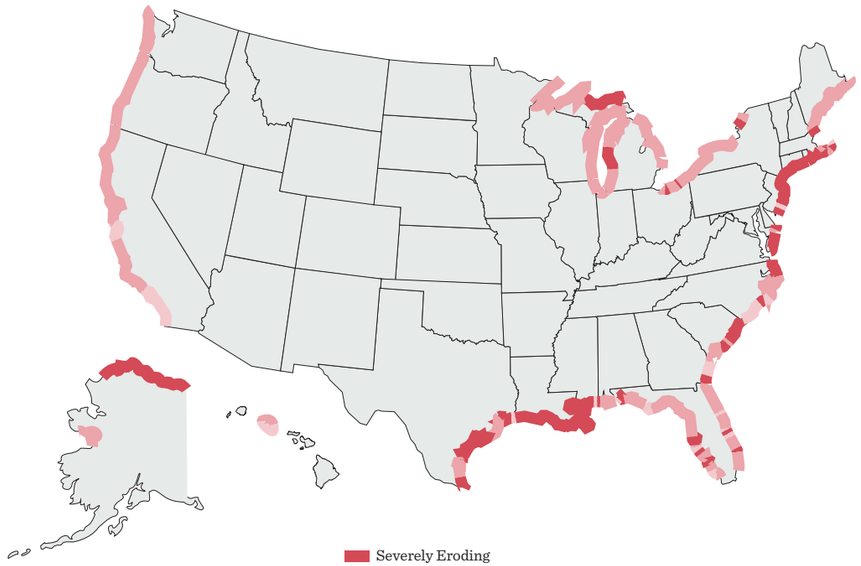
Michigan ranks second in the nation in the number of second homes, making its coastal region particularly vulnerable to the conversion of agricultural and forested land to residential development. The 2001 assessment gives a thorough and well-written analysis of regional characterization of the conversion of agricultural land to other uses for the southeast Lower Peninsula, central and southwest Michigan, northeast Lower Peninsula, and northern Lower Peninsula.

It reports a common pattern of 'hotspots' of increased development The Army Corps of Engineers also maintains a website on Great Lakes water levels.

An example of a lakeshore vacation home in Michigan.

"Michigan ranks second in the nation in the number of second homes, making its coastal region particularly vulnerable to the conversion of agricultural and forested land to residential development."

Location



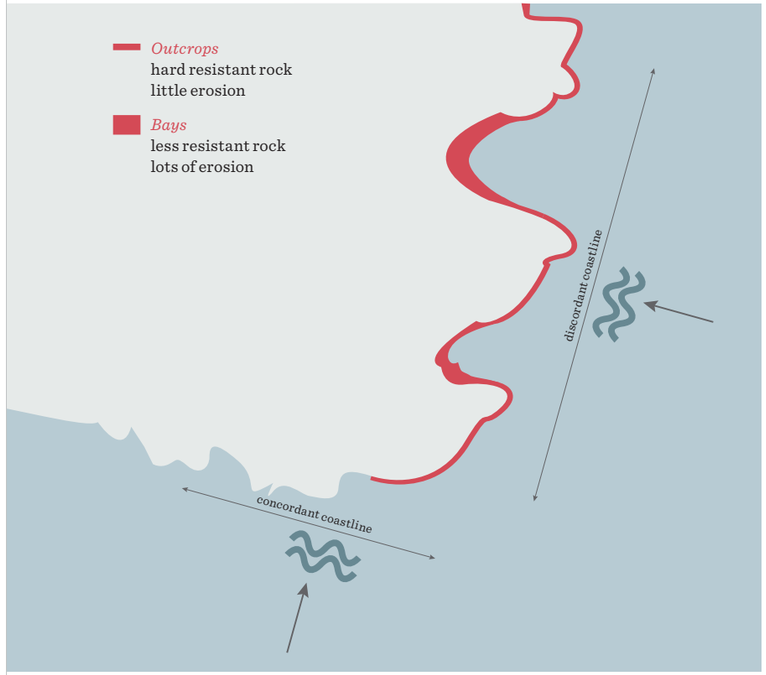
Beach erosion is a problem that affects all coastal regions. Though some may be more affected than others, all coasts are at risk.

From this map, one can see that some of the more severe areas are the edges of:

(Northern) Alaska
Connecticut
Delaware
Florida
Louisiana
Maryland
Massachusetts
New Jersey
New York
Rhode Island
South Carolina

Notice how almost all of Michigan is moderately to severely eroding.

Factors



▲ **Map illustrating concepts of rock type, rock structure, type of wave, and shape of coastline**

◀ **Map showing variety of erosion severity along all of the United States coastline**

Rock Type

Some rock is easily eroded (like clay and shale). These rocks tend to form wide beaches. Other rocks are very resistant to erosion (limestone and chalk, for example). These rocks tend to form steep cliffs or rocky outcrops.

Rock Structure

Where rocks are parallel to the coastline, the coastline is concordant and the amount of erosion will be determined by the resistance of the rock type forming the coastline. Where the rocks outcrop at right angles to the coast, the coastline is known as discordant and differential erosion may occur due to bands of hard and soft rock forming headlands and bays.

Shape of Coastline

Where there are rocky outcrops these are exposed to the full force of the seas energy. However headlands can protect surrounding bays which can be sheltered from erosion.

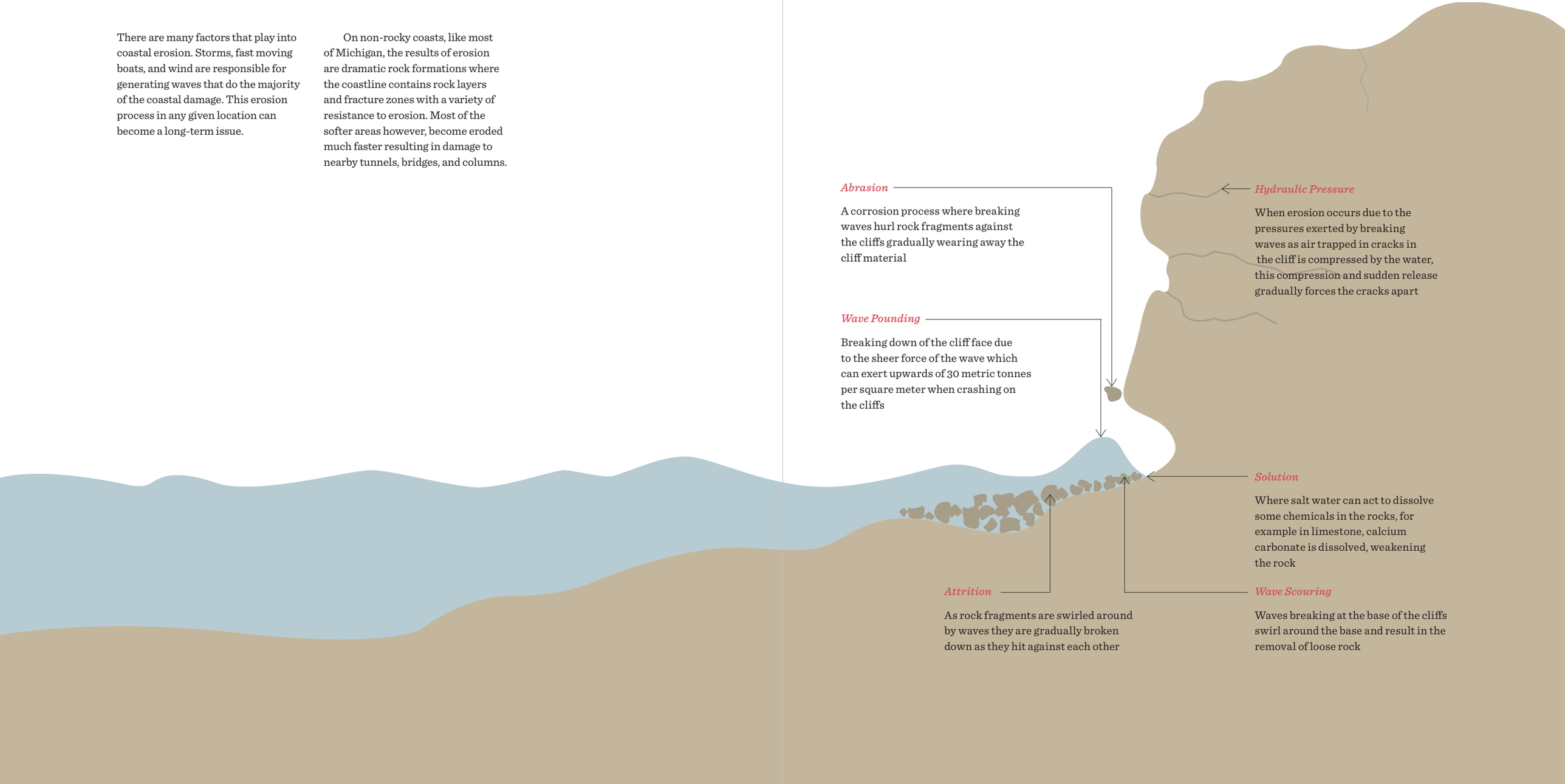
Type of Wave

The amount of energy a wave has will also determine the amount of erosion that will take place. Destructive waves have a steep angle of break and are high in energy. They degrade the beach due to the scouring action of the strong backwash.

Types of Coastal Erosion

There are many factors that play into coastal erosion. Storms, fast moving boats, and wind are responsible for generating waves that do the majority of the coastal damage. This erosion process in any given location can become a long-term issue.

On non-rocky coasts, like most of Michigan, the results of erosion are dramatic rock formations where the coastline contains rock layers and fracture zones with a variety of resistance to erosion. Most of the softer areas however, become eroded much faster resulting in damage to nearby tunnels, bridges, and columns.



Bluff Failures

In 2008, heavy rain triggered mudslides in Grant Park — with trees and chunks of land literally skidding down bluffs, across the beach, and into the lake — a sober reminder that coastal erosion poses a real threat along Lake Michigan.

Concordia University in Mequon knows all too well how important it is to protect against bluff failure. For more than 20 years, the 130-foot-high bluff that stood between the campus and the lake eroded about a foot per year. It took eight years to plan, design, and execute a bluff stabilization project to prevent more valuable property from tumbling into Lake Michigan.

The $10 million project, completed in 2007, "de-watered" a 2,800-foot-long section of bluff by building in drains to collect water and thus reduce saturated soil pressure. Contractors re-graded the slope, built a series of switchbacks down to the beach, added shoreline revetments, and created an artificial wetland, to protect the base of the bluff from wave action. What was once a liability is now an attractive amenity providing students with safer access to the lake.

Not every shoreline property owner along Lake Michigan has the means to reconstruct their land as dramatically as Concordia—and even their re-engineered bluff continues to erode—but each shares a common challenge in coastal erosion.

Mudslides defaced the bluffs of Grant Park after heavy rains in June 2008. There are two major types: shoreline erosion and coastal bluff failures due to instability. Both types of erosion can lead to loss of property, dwellings, and personal injury, but bluff erosion is particularly problematic on the western shore of Lake Michigan.

"Most of Lake Michigan bluffs are marginally stable at best," said Gene Clark, a coastal engineer with the University of Wisconsin Sea Grant Institute. "Some are still responding to high water of the 1980s, eroding at the bottom." The mixture of sandy and clay soils, rain, melting snow and groundwater flow, and the freezing and thawing cycles of ice during the winter months create instability.

Bluff erosion may happen abruptly with landowners losing as much as 50 feet of their backyard in a single landslide, as happened in one weekend storm in 1985.

In the tug-of-war between the force of gravity on soil masses and the resistance against it, gravity will always win, pulling a slope to a new equilibrium. The resistance occurs between tiny soil particles or along large soil surfaces called potential failure planes. When the particles or planes can no longer resist because of inflow of water or freezing or thawing of ice, they give way. The particle-scale movement may not be noticed, but movement along planes is what causes landslides, such as what occurred at Grant Park in 2008.

"It's like a teeter-totter where it doesn't take much to turn from stable to unstable," Clark explained. "All it takes is a severe storm, someone watering, someone cutting vegetation that was providing some stability, someone putting dead vegetation on the bluff front face—it just makes it worse."

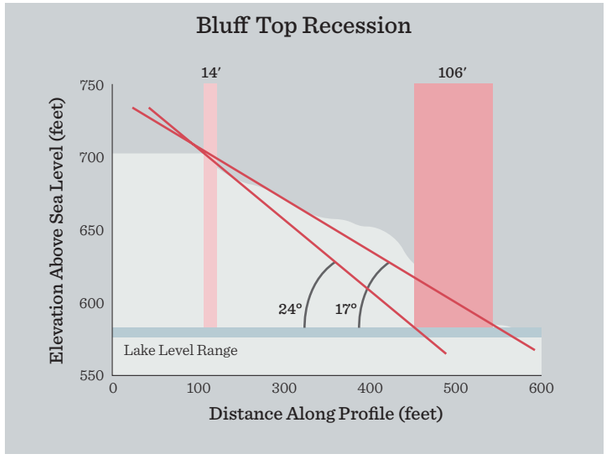
Property owners should get the advice of a coastal engineer or professional landscape architect to help stabilize coastal shorelines and bluffs, according to Clark, because not every beneficial approach is intuitive. Planting vegetation can stabilize the shore or the front of the bluff, but it can sometimes backfire. Planting grass or sod requires watering, and adding water may activate soil movement.

Bushes, on the other hand, have a deeper root structure, Clark said. Dogwoods and willows can add greater stability because they send out suckers and put down more roots when pruned.

Clark said stability is not acquired by adding things like old Christmas trees, dead leaves, or tree branches to the bluff face or an eroding path. These objects can actually make things worse by blocking sunlight from promoting natural live vegetation, channelizing flow around the objects when it does rain, or allowing water to pool or pond instead of infiltrating into the ground.

Since Mother Nature will always win in the end, coastal experts recommend placing structures far from the shoreline. Clark warns that even septic systems, especially mound systems, should also be sited far from the shore. Mound septic systems are continually dosing the ground with water, which can make the ground and bluff unstable and prone to erosion.

From 1956 to 2000, the Concordia University bluff top receded 14 feet and the bluff toe receded 106 feet. The bluff angle also got steeper, from 17 degrees to 24 degrees.



“If people are fighting setback limits, you can show them how the shoreline has changed over time. The regulations are in place to protect people and their property.”

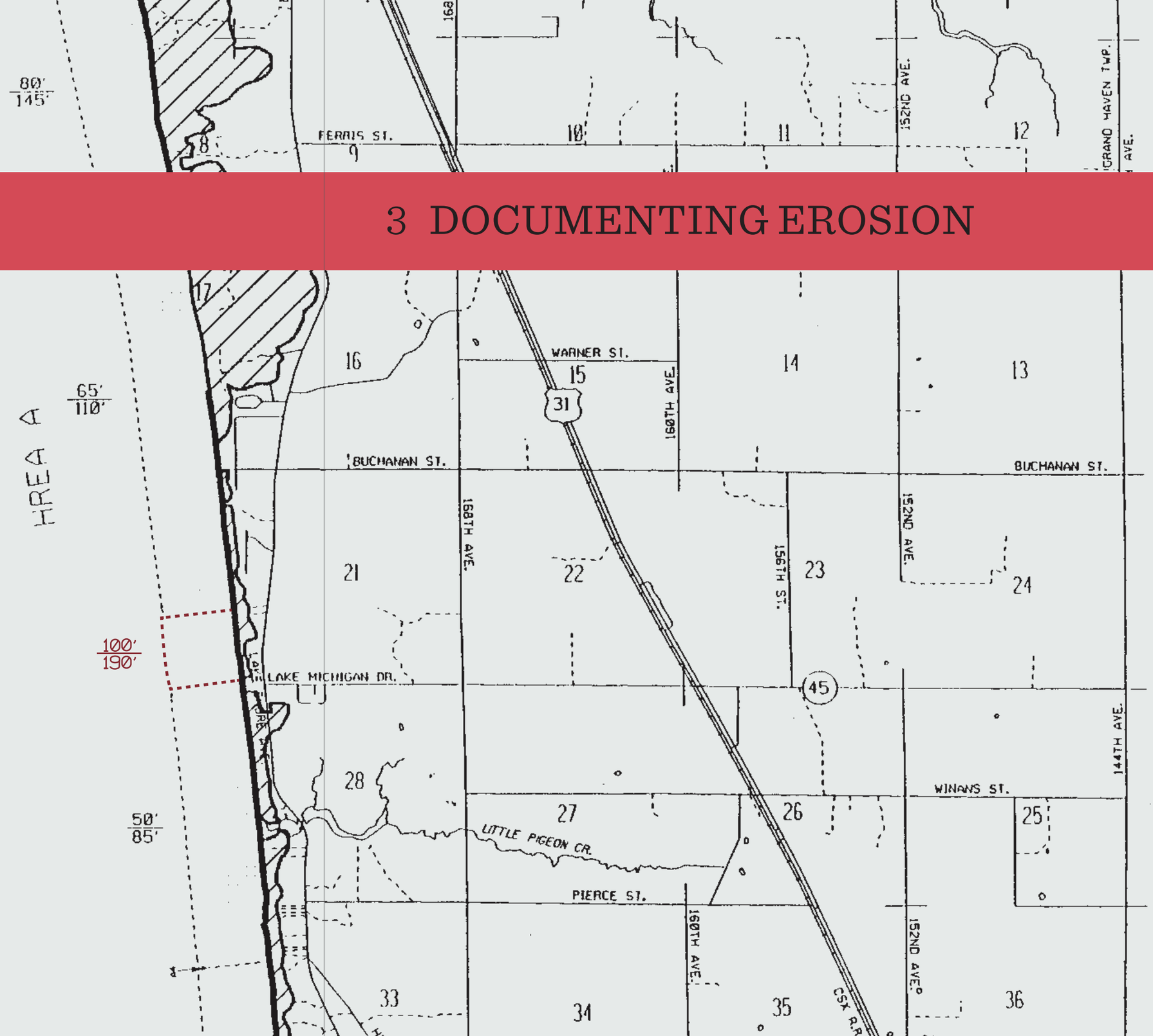
According to David Hart, a geographic information specialist at the University of Wisconsin, most coastal communities use shoreline zoning as a proactive development tool, Hart is developing an electronic toolbox full of aids to be used by coastal managers, including historical databases showing erosion over time. “If people are fighting setback limits, you can show them how the shoreline has changed over time,” said Kate Barrett with Wisconsin DNR’s Office of the Great Lakes. “The regulations are in place to protect people and their property.”

The delineation of building setbacks is traditionally based on the location of the Ordinary High Water Mark (OHWM), the place where the regular action of water against the bank leaves a distinct mark. That may not be easily seen, particularly on the Great Lakes. Currently, Lake Michigan is at a prolonged low, making the OHWM seem extremely far from the shore, tempting placement of dwellings much closer to the shoreline than would be allowed during a high-water period.

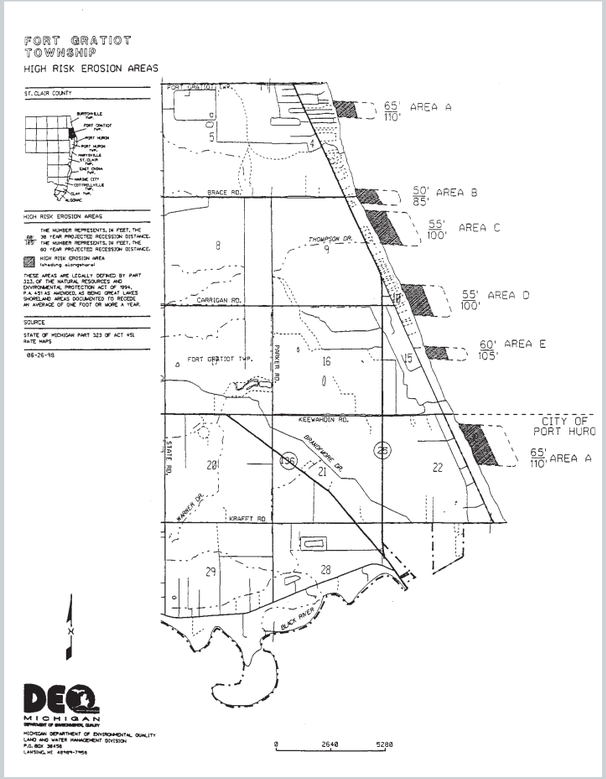
The Wisconsin Initiative on Climate Change Impacts predicts that increased storm events, with more precipitation, increased wind velocities, reduced ice cover, and increased nearshore wave height will occur as part of our changing climate. Dramatic events like the 2008 Grant Park mudslides are sure to continue, so coastal experts say we must be proactive in setting back our dwellings to accommodate coastal erosion, not only on the bluffs, but on the shoreline as well.

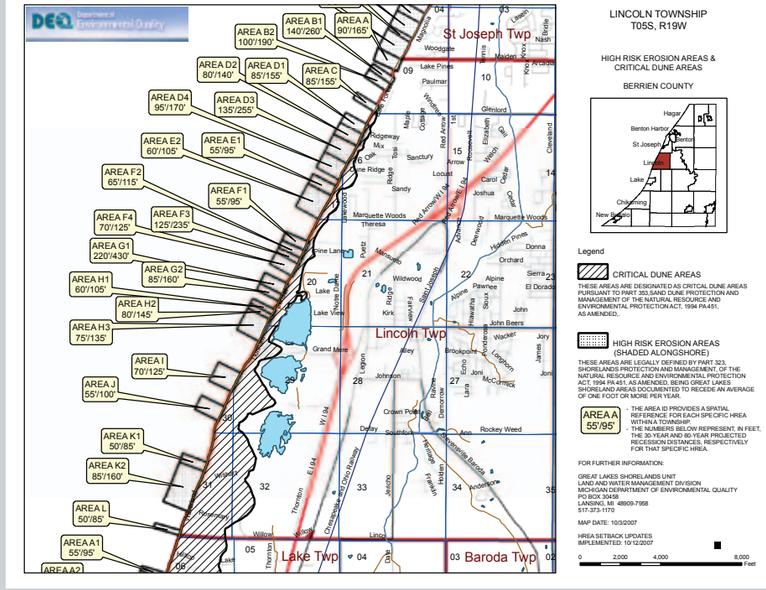
This map shows the predicted amount of erosion in feet over the course of 30 and 60 years, respectively.

3 DOCUMENTING EROSION



Original research for Fort Gratiot Township and updated research for Lincoln Township.

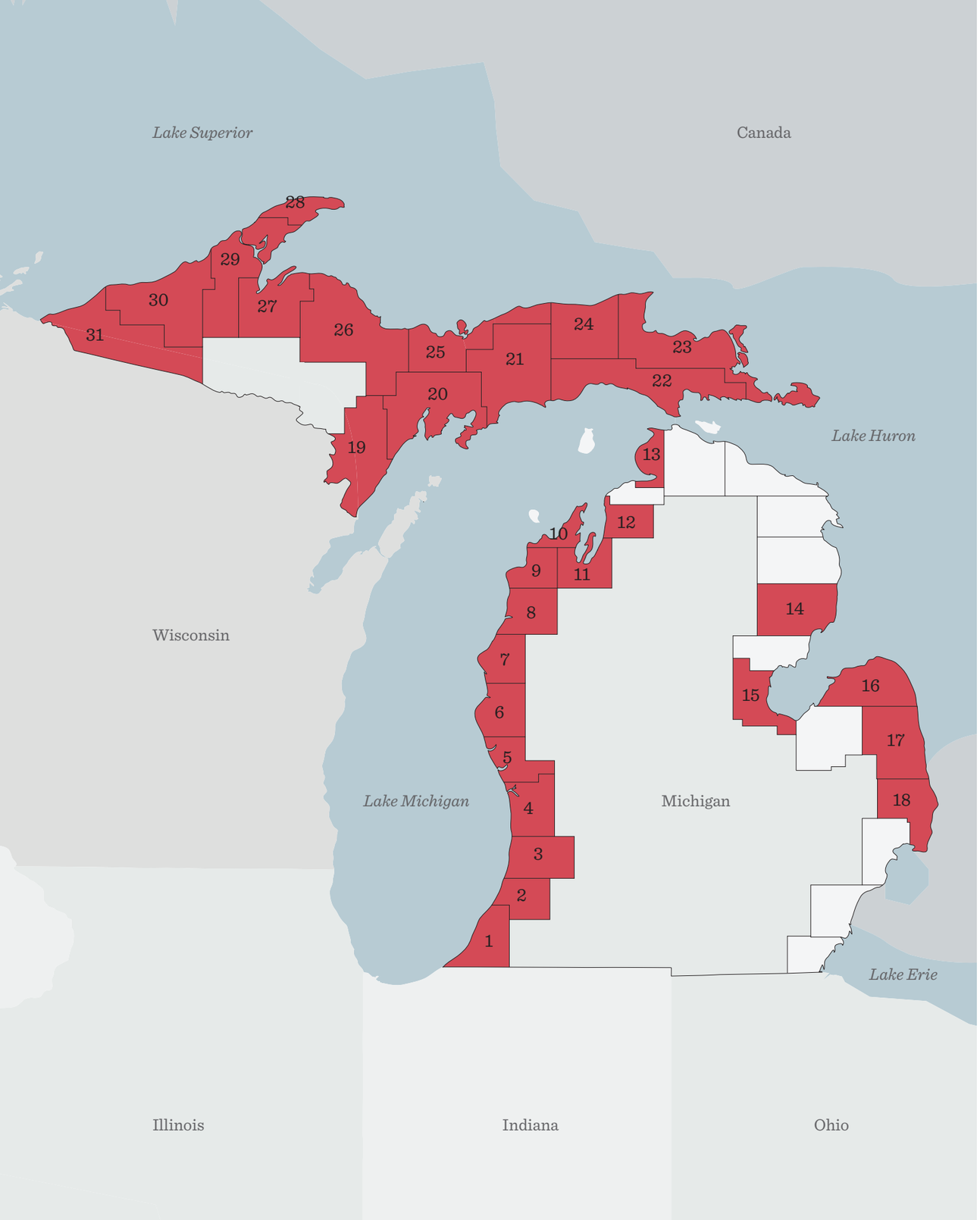




DEQ Maps

The Department of Environmental Quality (DEQ) for the state of Michigan declares that High Risk Erosion Areas (HREA) are the shorelands of the Great Lakes and connecting waters where recession of the zone of active erosion has been occurring at a long-term average rate of one foot or more per year, over a minimum period of 15 years.

The maps include the DEQ's findings from the initial research done between 1980 and 1986, done to identify and designate HREAs. Government staff have updated the recession rate studies on a county-by-county basis to incorporate the ever-changing coastal conditions.



31 OUT OF 41 COASTAL COUNTIES ARE CONSIDERED HIGH RISK EROSION AREAS

PERCENTAGE
OF TOWNSHIPS WITHIN A COUNTY CONSIDERED HIGH RISK EROSION AREAS

1 Berrien

2 Van Buren

3 Allegan

4 Ottawa

5 Muskegon

6 Oceana

7 Mason

8 Manistee

9 Benzie

10 Leelanau

11 Grand Traverse

12 Antrim

13 Emmet

14 Iosco

15 Bay

16 Huron

17 Sanilac

18 St. Clair

19 Menominee

20 Delta

21 Schoolcraft

22 Mackinac

28 Keweenaw

29 Houghton

30 Ontonagon

31 Gogebic

23 Chippewa

24 Luce

25 Alger

26 Marquette

27 Baraga

Each county is broken up into townships. If any number of townships are considered HREAs, even just one of four, the county entire county is still considered to be at high risk.

However, this graphic shows that much of the time the majority, if not all, of the townships in a given county are all considered HREAs.

Percentage of townships considered HREAs within each county.

For example, this chart shows that three-fourths of the townships in this county are high risk areas.

3 TOWNSHIPS IN THE GREATEST DANGER

As seen, the three townships with the fastest receding coastline are along Lake Superior and Lake Michigan. The township with the single largest point of recession is in Burt Township inside of Alger County. In 60 years, at a particular point on the beach, it is predicted to erode as much as 505 feet.

The township with the overall greatest predicted amount of erosion is Marquette, with an average expected recession of 140 feet in 30 years and 280 feet in 60 years.

Grand Haven is in Ottawa County, the eleventh fastest eroding county in the state. Each of the four townships are considered to be at high risk.

Just walking along the beach, one can see the effects of the erosion on the environment, including trees.

4 EFFECTS OF EROSION

Economy and Tourism

By this time in any other year, the 95-foot ferry Kristen D would be plying the waters of the Straits of Mackinac, the channel that joins Lake Huron and Lake Michigan.

But this year, even in the Great Lakes, there's not enough water. Several years of warm, dry weather caused primarily by La Niña, a phenomenon in which cool Pacific waters push the jet stream north — have taken a toll on America's largest waterways. Precipitation, particularly winter snow, has decreased. Evaporation, heightened by shallower, warmer lakes, has increased.

As a result, all five lakes have lost up to 3.5 feet of water in three years. By summer's end, they are expected to be at their lowest levels in the 120 years that records have been kept.

The drying of the Great Lakes poses a serious threat for nearly everyone working or playing in the waters between New York and Minnesota. It affects shipping, charter fishing, tourism, recreation and the environment.

Not to mention Ray Plaunt's family ferry business. For 68 years, April has marked the opening of Plaunt Transportation's 5-mile run to rustic Bois Blanc Island, which has 35 year-round residents and 500 summer homes. But lately, the water is barely knee-deep 200 feet from the shore — hardly enough to handle a ski boat, let alone a 95-foot ferry.

"We've had low water before, but not like this," says Plaunt, who was 12 when his father bought the family's first ferry in 1932. "It's the damnedest thing."

Plaunt's plight isn't unusual this year. For the first time, the National Weather Service last month issued a drought forecast for the nation, rather than its usual spring flood advisory.

For the Great Lakes, the problem is less water in, more water out.

Runoff from melting snow on the Canadian Plains can boost water levels in the lakes by a foot or more during May and June. But the past two winters have been the warmest and driest in the 105 years records have been kept. Fourteen northern states had their longest snow-free periods in history; their first snowfalls came later than ever.

As a result, satellite images taken by the National Oceanic and Atmospheric Administration in late March showed virtually no snow cover anywhere in the Great Lakes basin. Even above-average spring rainfall, experts say, would do little to elevate water levels.

The greatest loss of water, though, has been from evaporation. After the summer sun warms the lake water, cold autumn air settles on the surface and vaporizes as much as an inch of water a day. With shallower lakes, the water is warmer, and therefore the evaporation is greater.

This cycle of precipitation and evaporation normally causes lake water levels to fluctuate 12 to 18 inches a year. But the past three years have seen water levels drop steadily. The average water level in Lake Michigan plummeted from a near-record high of 582 feet in 1997 to a near-record low of 577 feet earlier this year. The total loss from all five lakes represents enough water to cover the continental USA about 9 inches deep.

"We are quickly getting to the crisis point," says Dave Schweiger of the U.S. Army Corps of Engineers in Detroit. "It's easy with high water to see the impact. Homes are flooded, and it takes out structures. This is so different. It creeps up on you."

The unprecedented drop in water levels comes just three years after near-historic highs — one of the most remarkable twists of nature the Midwest has ever seen. In 1997, there was so much water that lakes Huron and Michigan were swallowing up beachfront homes and provoking a panic over erosion.

Today, those hurt by the floods are helped by the drought. Receding water has left miles of wide, sandy beaches all along the shore.

That's fine for people like David Boone, who spent $50,000 during the mid-1980s building a seawall to keep Lake Michigan from swallowing his 6,000-square-foot beach home in Park Township. Now his only complaint is listening to his grandchildren worry that they'll burn their feet running across 180 feet of hot sand to reach the water this summer.

But Boone's relief is tempered. "It's too bad that what's good for me is bad for somebody else," he says. "It's too bad the lake can't find a happy medium."

The low water levels are threatening the livelihood of those who depend on the lakes: Eric Stuecher runs a charter fishing boat, Hooked, out of Port Austin on Lake Huron. May is the start of a four-month season for trout, steelhead and salmon that will make or break his business this year. But Stuecher, better known as Captain Eric, can't get his 30-foot cabin cruiser out of dry dock. "I'm starting to see my income dry up as fast as the lake," he says.

Harder hit are the 70 megatankers, known as "lakers," that move 180 million tons of cargo each season across the 94,000 square miles of the Great Lakes, an area nearly the size of Wyoming. The Detroit and St. Clair rivers, which connect Lake Erie to Lake Huron, are at their lowest levels in history. The perilously low water has forced the ships to carry lighter loads so they don't scrape bottom in the shallow rivers.

The most obvious immediate impact will be felt by summer tourists. Michigan's coastline, at 3,288 miles, is the longest in the continental USA. More boats are registered here than in any state in the nation. Tourism is as serious a business as the auto industry.

Now Robin Abshire, the harbor master in South Haven, worries that the water is too shallow for boaters. She has installed 18 ladders on the piers so boaters can climb up to the marina after docking their boats in the low water.

"But lately, the water is barely knee-deep 200 feet from the shore—hardly enough to handle a ski boat, let alone a 95-foot ferry."

"In our little town, the harbor is our bloodline, the major economic force," she says. "We completely depend on it."

For most lakefront towns, including South Haven, Port Austin and Cheboygan, the only solution seems to be dredging — deepening harbors, channels and marinas by digging into the soft lake bottom.

The state of Michigan this month set aside $14 million for dredging grants and loans to public and private marinas. But with a record 400 permit requests pending this year, permission to dredge might come too late for some.

Dredging also raises concerns from environmentalists. Though ebbing water levels allow some aquatic plants and wildlife to thrive, dredging up sediment from the lake bed poses hazards. The low water also could threaten towns' water-intake pipes, which extend only a few hundred feet into the lake.

Still, some environmentalists are not alarmed by the situation. "This is Mother Nature working at its best," says Cameron Davis of the Lake Michigan Federation, which monitors environmental issues. "Fluctuating lake levels are part of the beauty of nature."

Such a sanguine attitude is a hard sell in Cheboygan.

This is a scrappy little town with a population of 5,000 and an almost umbilical connection to Lake Huron, via the Cheboygan River.

Past the county marina and the Coast Guard station, beyond the yacht club and the BP/Amoco holding tanks rests the 95-foot Kristen D. She bumps gently against the lip of a new hydraulic ramp that can be raised or lowered to meet fluctuating water levels.

The real trouble for the Kristen D is across the channel. The ferry is the only way to get necessities to Bois Blanc Island, which has had electricity only since the mid-1980s. While small planes can carry people and luggage, anything else has to come by boat. The Plaunts have hauled virtually everything from furniture to building supplies to garbage trucks. For nearly seven decades, they've even delivered the mail.

So the town council, which presides over 35 full-time and 1,500 seasonal residents, has agreed to pay 25 percent of the $500,000 dredging cost. The state will pay the rest. But a work backlog at the local dredging company has delayed the project's completion.

That worries Curt Plaunt, who took over the business from his father, Ray, 20 years ago. Beginning today, every day the ferry doesn't run affects his bottom line. A month of lost income could ruin three generations of work.

He's not panicking — yet.

"The low water is not a problem until you can't fix things," Plaunt says. "We could get through another foot drop, maybe.

"After that, well . . . you can't control the lake."

▲ **The business done by Kristen D is just one of many businesses affected by the environmental and water struggles of Michigan lately.**

Environment

6,053 mi

+

750 mi

+

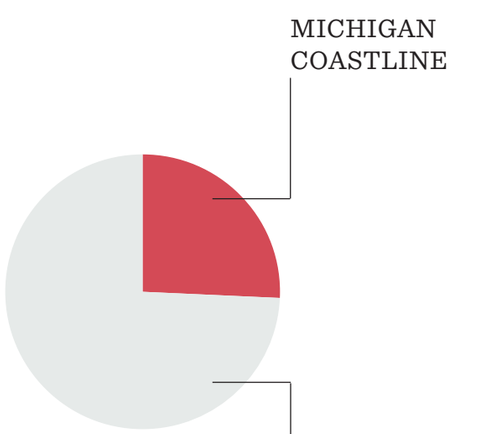
5,580 mi

=

TOTAL U.S. COASTLINE

12,383 mi

Michigan's coastline consists of 26.6% of the U.S. coastline distance. That is over a quarter of the shore for the entire country. If Michigan is not properly protected, that means that the rest of the country probably is not either. We could see the beaches disappear extremely quickly if proper care isn't taken.



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MICHIGAN COASTLINE

3,288 mi

$$\frac{\text{MICHIGAN COASTLINE}}{\text{TOTAL U.S. COASTLINE}} = \frac{3{,}288\text{ mi}}{12{,}383\text{ mi}} = 0.266$$

=

MICHIGAN'S COASTLINE IS

26.6%

OF THE ENTIRE U.S. COASTLINE

Hopefully help is available so that animals, like this seagull, will be able to continue living along thriving coasts.

5 IS HELP POSSIBLE?

An example of a large breakwater.

Breakwaters

Breakwaters are structures constructed on coasts as part of coastal defence or to protect an anchorage from the effects of weather and longshore drift.

Offshore breakwaters, also called bulkheads, reduce the intensity of wave action in inshore waters and thereby reduce coastal erosion or provide safe harborage. Breakwaters may also be small structures designed to protect a gently sloping beach and placed one to three hundred feet offshore in relatively shallow water.

A breakwater structure is designed to absorb the energy of the waves that hit it either by using mass or by using a revetment slope (with rock or concrete armour units).

Dredging

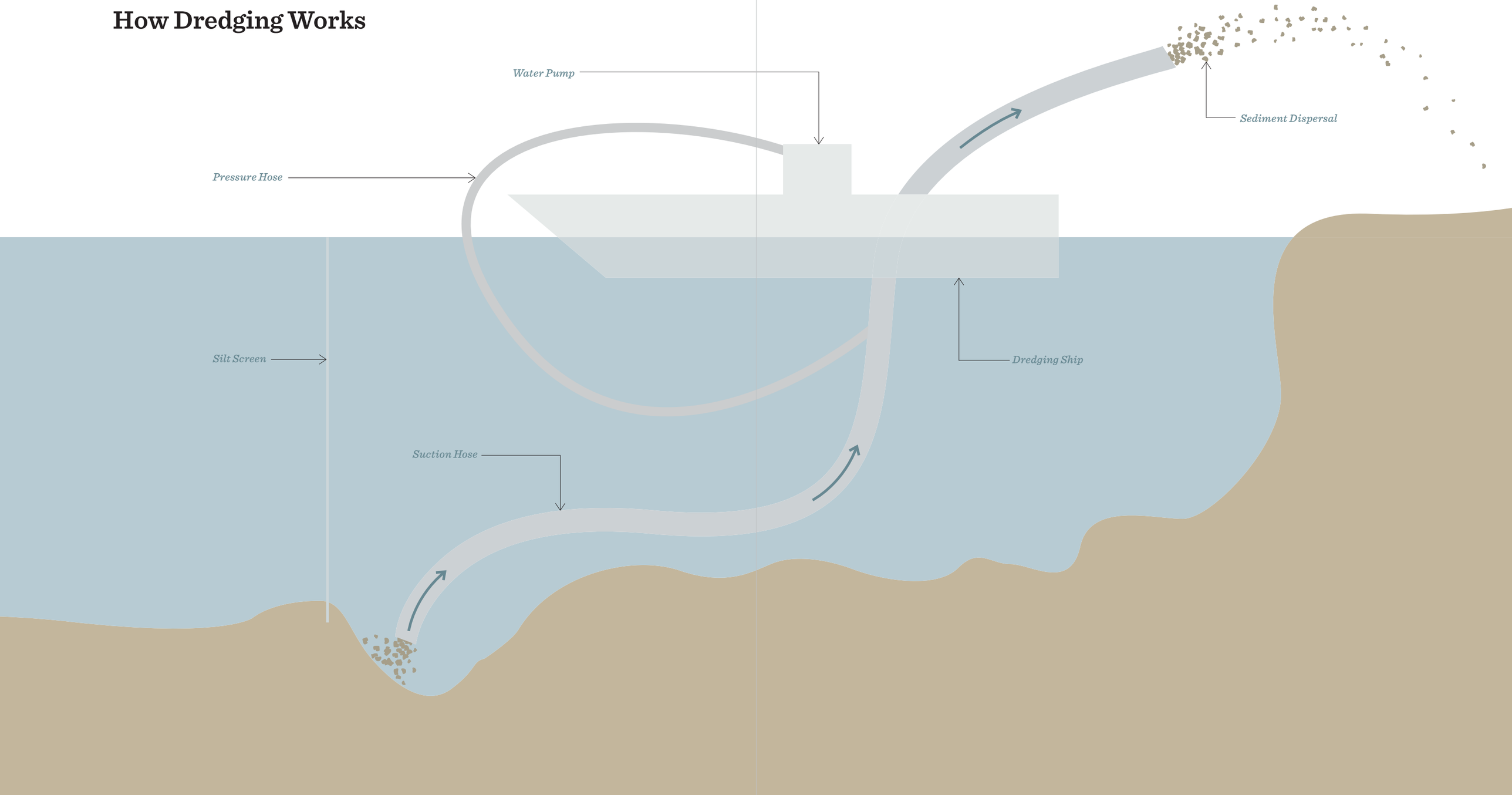
Dredging is an excavation activity or operation usually carried out at least partly underwater, in shallow seas or fresh water areas with the purpose of gathering up bottom sediments and disposing of them at a different location.

It is used as a way to replenish sand on some public beaches, where too much sand has been lost because of coastal erosion.

Though physically effective, dredging is expensive and can create disturbance in aquatic ecosystems.

An example of a dredging ship

How Dredging Works



Coastal Building

There is only so much coastal land in the world, making it extremely sought after. One would be very hard pressed to find land bordering a body of water that is not developed or already over developed.

Though these beachfront homes have amazing views and are generally grand marvels of architecture, the continuation to build even more along water is harmful to the beaches.

What can happen to coastal properties with much erosion

A standard example of a prized beachfront property that makes living on the coast so desirable

Campaigns

Pure Michigan Campaign

The nationally known brand of the State of Michigan, Pure Michigan, is administered by the state's marketing department, the Michigan Economic Development Corporation. Since 2006, Pure Michigan advertising has described the wonders of Michigan but in 2011 MEDC began bringing all of its activities under the popular brand, voted one of the 10 best destination brands ever by Forbes Magazine.

Great Lakes Restoration Initiative

The Great Lakes Restoration Initiative is the largest investment in the Great Lakes in two decades. A task force of 11 federal agencies developed a plan to put the president's historic initiative into action. This action plan covers fiscal years 2010 through 2014 and addresses five urgent focus areas: cleaning up toxins and areas of concern; combating invasive species; promoting nearshore health by protecting watersheds from polluted run-off; restoring wetlands and other habitats; working with partners on outreach.

The Alliance for the Great Lakes

The mission at the Alliance for the Great Lakes is to conserve and restore the world's largest freshwater resource using policy, education and local efforts, ensuring a healthy Great Lakes and clean water for generations of people and wildlife.

The vision is that, by working with the public, we can conserve and restore our Great Lakes for generations of people and wildlife. Public policy, education and local efforts are how to care for the lakes since 1970.

Where do you “sit” in the process of preventing more erosion?

6 WHO CAN HELP?

Volunteers helping with beach preservation efforts on St. Pete Beach in Florida.

Prevention Programs

Every state with a coastline along either a large lake (like the state of Michigan) or the ocean has a state government program to monitor the coastline. Though the name for the department and program is not always the same for each state, generally the programs include a similar focus on things like environmental protection, historic preservation, parks and recreation, wildlife resources, and sustainable programs, in addition to coastal resources.

The list below is the contact information of the environmental resources for each of the coastal states compiled into one. Some states have more developed departments than others, but overall, these programs are well-considered. The websites often include information on how to prevent further erosion, laws and permits about building on the coast, and general updates on the state's erosion status.

A **Alabama Department of Environmental Management**
Coastal Program
4171 Commanders Drive
Mobile, AL 36615
251.432.6533 // adem.alabama.gov

Alaska Department of Natural Resources
Division of Coastal and Ocean Management
550 W. 7th Ave
Suite 1260
Anchorage, AK 99501
907.269.8400 // alaskacoast.state.ak.us

C **California Coastal Commission California**
Coastal Zone Management
45 Fremont Street
Suite 2000
San Francisco, CA 94105
415.904.5400 // coastal.ca.gov

Connecticut Department of Environmental Protection
Office of Long Island Sound Program
79 Elm Street
Hartford, CT 06106
860.424.3000 // ct.gov/dep/cwp

D **Delaware National Estuarine Research Reserve**
Coastal Management Program
89 Kings Highway
Dover, DE 19901
302.739.9921 // dnrec.delaware.gov

F **Florida Department of Environmental Protection**
Coastal Management Program
3900 Commonwealth Boulevard M.S. 47
Tallahassee, FL 32399
850.245.2161 // dep.state.fl.us

G **Georgia Department of Natural Resources**
Coastal Resources Division
1 Conservation Way
Brunswick, GA 31520
912.264.7218 // coastalgadnr.org

H **Hawaii Office of Planning**
Coastal Zone Management Program
235 South Beretania Street
Suite 600
Honolulu, HI 96813
808.587.2846 // hawaii.gov/dbedt/czm

I

Illinois Department of Natural Resources
Coastal Management Program
2050 West Stearns Road
Bartlett, IL 60103
847.608.3100 // dnr.illinois.gov

Indiana Department of Natural Resources
Lake Michigan Coastal Program
402 West Washington Street
Room W267
Indianapolis, IN 46204
317.233.0132 // in.gov/dnr/lakemich

L

Louisiana Department of Natural Resources
Office of Coastal Management
617 North Third Street
Baton Rouge, LA 70802
225.342.4500 // dnr.louisiana.gov

M

Maine State Planning Office
Coastal Program
19 Union Street
38 State House Station
Augusta, ME 04333
207.624.7660 // maine.gov/spo/coastal

Maryland Department of Natural Resources
Chesapeake and Coastal Program
580 Taylor Avenue
Annapolis, MD 21401
877.620.8367 // dnr.state.md.us

Massachusetts Executive Office of Energy & Environment
Coastal Zone Management Office
251 Causeway Street
Suite 800
Boston, MA 02114
617.626.1240 // mass.gov/czm

Michigan Department of Environmental Quality
Coastal Zone Management Program
525 West Allegan Street
P.O. Box 30473
Lansing, MI 48909
517.373.7917 // michigan.gov/deq

Minnesota Department of Natural Resources
Lakes Superior Coastal Program
500 Lafayette Road
St. Paul, MN 55155
651.296.6157 // dnr.state.mn.us

Mississippi Department of Environmental Equality
Coastal Impact Assistance Program
P.O. Box 20305
Jackson, MS 39289
601.961.5277 // deq.state.ms.us

N

New Hampshire Department of Environmental Services
Coastal Program
29 Hazen Drive
P.O. Box 95
Concord, NH 03302
603.271.3503 // des.nh.gov

New Jersey Department of Environmental Protection
Coastal Management Program
401 East State Street
Trenton, NJ 08625
609.984.0058 // state.nj.us/dep/cmp

New York Department of Environmental Conservation
Coastal Zone Management Program
625 Broadway
Albany, NY 12233
518.402.8545 // dec.ny.gov

North Carolina Department of Natural Resources
Division of Coastal Management
400 Commerce Avenue
Morehead City, NC 28557
888.472.6278 // nccoastalmanagement.net

O

Ohio Department of Natural Resources
Office of Coastal Management
105 West Shoreline Drive
Sandusky, OH 44870
888.644.6267 // ohiodnr.com

Oregon Land Conservation & Development
Coastal Management Program
635 Capitol Street NE
Suite 150
Salem, OR 97301
503.373.0050 // egov.oregon.gov/lcd/ocmp

P

Pennsylvania Department of Environmental Protection
Coastal Management Program
400 Market Street
Harrisburg, PA 17105
717.772.4785 // dep.state.pa.us

R

Rhode Island Coastal Management Council
Coastal Zone Management Program
4808 Towel Hill Road
Suite 116
Wakefield, RI 02879
401.783.3370 // crmc.state.ri.us

S

South Carolina Department of Health & Environment
Ocean and Coastal Resource Management
2600 Bull Street
Columbia, SC 29201
803.898.3432 // scdhec.gov/environment/ocrm

T

Texas General Land Office
Caring for the Coast
1700 Congress Avenue
Austin, TX 78701
800.998.4456 // glo.texas.gov

V

Virginia Department of Environmental Quality
Coastal Zone Management Program
629 East Main Street
Richmond, VA 23218
804.698.4000 // deq.virginia.gov

W

Washington State Department of Ecology
Coastal Zone Management Program
300 Desmond Drive SE
Lacey, WA 98503
360.407.6000 // ecy.wa.gov

Wisconsin Department of Administration
Coastal Management Program
101 E Wilson Street
Madison, WI 53703
608.267.7982 // doa.state.wi.us

With some thought and care, the shores of Michigan beaches can continue to have waves roll in over your feet.

7 THE FUTURE

Sunset over Lake Michigan, July 2011.

What's Next?

In the last few years, Americans have come to recognize that humanity is changing the earth's atmosphere in ways that we will not be able to reverse over the next century. Some say we should immediately reduce our emissions, while others say we should wait. But there is a third, middle view, which is often overlooked. We must prepare now for rising sea level and other consequences of the continually changing climate.

Environmentalists concerned about the coastal environment and energy producers who oppose controlling emissions should both be able to agree that society should take measures to make our coastal development and ecosystems less vulnerable to a rise in sea level and coastal erosion.

A lack of awareness on the issue of coastal erosion, not the cost of prevention measures, appears to be impeding the speed at which these measures are adopted. However, people recently have responded more to the idea of adapting to climate change and not fighting it.

With a combination of more thoughtful care for the environment and willingness to accept the current climate change, beaches in Michigan and everywhere can continue to be a central part of people's lives.

Resource Texts

BEACHES ARE DISAPPEARING

Coastal Erosion
beachapedia.org // State of the Beach Reports // January 2012

Location
aegweb.org // Erosion Overview // January 2012

Factors
cgz.e2bn.net // Factors Affecting the Rate of Coastal Erosion // February 2012

Types of Coastal Erosion
cgz.e2bn.net // Coastal Erosion and Weathering Processes // February 2012

Bluff Failures
bayviewcompass.com // Lake Michigan Coastal Erosion and Bluff Failure // March 2012

DOCUMENTING EROSION

DEQ Maps
michigan.gov/deq // High Risk Erosion Areas Digital Maps // December 2011

EFFECTS OF EROSION

Economy and Tourism
USA Today // Shallow Waters Portend Deep Trouble // January 2012

IS HELP POSSIBLE?

Campaigns
michigan.org // Pure Michigan Campaign // December 2011
epa.gov/glnpo/glri // Great Lakes Restoration Initiative // April 2012
greatlakes.org // The Alliance for the Great Lakes // April 2012

WHO CAN HELP?

Prevention Programs
Respective state-run government websites // March 2012

Resource Images

MICHIGAN

The State
lolomag.com // Blueberries // April 2012
glassdoor.com // GM Assembly Line // March 2012
lib.umich.edu // University of Michigan Library // February 2012
prideofdetroit.com // Detroit Red Wings // February 2012

EFFECTS OF EROSION

Economy and Tourism
boatnerd.com // Kristen D ferry // February 2012

IS HELP POSSIBLE?

Breakwaters
delawarequilts.com // Breakwater // February 2012

Dredging
windmillsandmore.com // Dredging Ship // February 2012

Coastal Building
coastalcare.org // Poor Coastal Development // April 2012
homebuildanddesign.com // Modern Beach House // January 2012

WHO CAN HELP?

Prevention Programs
stpetebeachandhometowndemocracy.blogspot.com // Community Help // March 2012

THE FUTURE

What's Next?
papers.risingsea.net // Sea Level Rise Reports // April 2012

All other photos are taken by Adira Weixlmann, Joe Weixlmann, and Sharron Pollack on family trips to Lake Michigan

This informational book was created as the seminar project by Adira Weixlmann at Washington University in St. Louis' Sam Fox School of Design & Visual Arts in the Spring 2012. The entire book is compiled, designed, and bound by her.

Typefaces used are Sentinel and Scala Sans. Printer used is a Xerox Color 550.

The good news is
that beach towns can
continue to bring people
beautiful views and
memories for years to
come as long as people
are responsible.