Coastal Solutions **Compendium**

August 2025

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COASTAL SOLUTIONS COMPENDIUM
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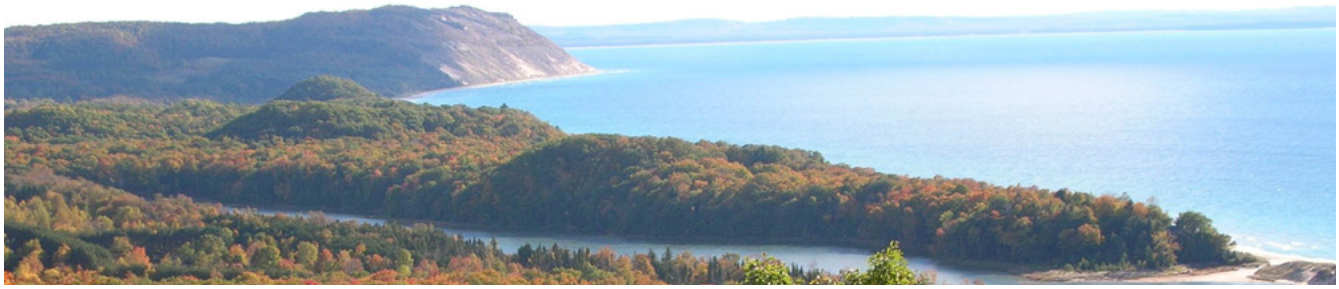


North Bar Lake Overlook Trail (NOAA/OAR/GLERL, National Park Service)

This resource is designed to help land use decision-makers in the 387 Michigan jurisdictions that touch a Great Lakes coast to wisely manage their portion of our statewide treasure. As a Compendium, it collects and summarizes work done in a particular field of knowledge–in this case, Great Lakes coastal management. Throughout the Compendium, links and acknowledgements point to other resources with deeper information on specific planning and zoning subjects.

For those new to this role, or for those just embarking on a coastal management endeavor, begin with the Coastal Conundrum in Section I to get a broad understanding of the fundamental challenge of Great Lakes coastal management.

For those who have a grasp of the central tensions, Sections II and III provide a tour of the two basic, complementary approaches that land use decision-makers can use to support the health of both the water and the community: giving the water space to move, and providing a natural border between the water and the built environment.

This is where many communities get stuck. The next question is the hard one: Which of these tools is right *for us*? No community will (or should!) implement all of them, so how do we know which ones to spend our precious capacity developing? Now is the time to move on to the Coastal Solutions Guide in Section IV. This Guide recommends a set of specific zoning changes for your community to consider based on the answer to a series of questions about your coast's physical characteristics, your regulatory capacity and conditions, the existing and likely future development on your coast, and your community values. Section V offers a detailed compendium of zoning and regulatory tools that support each approach, including potential obstacles to implementation and successful examples.

Once a package of zoning changes has been developed for your individual community to consider in its quest to support wise coastal management, the Getting It Done section offers advice and direction for moving from idea to implementation. This process begins with introducing it to the public and stakeholders, includes formal adoption processes, and continues into the future with periodic review, regular communication, and a readiness to adjust as conditions change...which they certainly will.

I. THE COASTAL CONUNDRUM

The problem, the solution, and why this isn't already done.

US Lake Survery facilities at Detroit, Michigan (NOAA Digital Collections)

Framing the Problem

Just about everyone loves a coast. Walking the beach, listening to the surf, wading and splashing—people are so strongly attracted to the water's edge that we can't stay away and can't get enough.[1] We, as communities, have placed every kind of development as close to the water as we can get; commercial downtowns to take advantage of tourism and recreation; industrial facilities to use its transportation and energy resources; and most of all, residential development to just experience it. Nearly every lake, river, and coast in Michigan finds itself lined with buildings and the infrastructure to support them.

Our 3288 miles of majestic Great Lakes freshwater coast is no different in this respect, yet it is completely unique in other respects. The enormity of each Great Lake fuels crashing waves that deliver an energy burden to its shores that is incomparable to any inland lake. Its volume gives it a similarly incomparable reach when wet seasons and cyclical fluctuations raise the water levels. This coast commands individualized attention, which is what this Compendium provides.

Box 1.1. Is This Problem New? Hint: No (Click here for the full article)
"One Billion Dollars Damage: Heavy Rainfall Raises Level of Great Lakes" by Arlene Bell (The Michigan Daily, 1952)

PAGE SIX THE MICHIGAN DAILY

ONE BILLION DOLLARS DAMAGE:

Heavy Rainfall Raises Level of Great Lakes

By ARLENE BELL

One way to name the problem is to call it "flooding and erosion"

The reward of being near the coastal shore comes with risk. Water is dynamic, both its movement and in its inherent chemical nature. Plenty of disaster lies at the intersection of water and development: rot, corrosion, erosion, instability. Achieving both closeness and safety has always been a conundrum.

Flooding happens when the surface of the waterbody expands into an area where development exists. It's useful to remember that the development is a critical part of the definition of a "flood"; where the surface expands but doesn't adversely affect a human investment, it's just called a natural hydrologic process. The Great Lakes water levels rise and fall of their own accord, with a span of variation that is increasing over time. These changes, and the science behind them, are described in detail in Chapter 2 and 3 of the Resilient Coastal Communities Planning Guide[2] produced by the Michigan Coastal Management Program (MCMP). In times of low water levels, there is a tempting mirage of opportunity to extend our own habitat out to meet it, only to later face the lake's punctual return and reclamation. This is unpredictable only on a short timeframe. When we expand our time horizon to consider all we know about the lakes, we can see that this is a mistake we need not keep repeating.

1 Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. Journal of Environmental Psychology, Volume 30, Issue 4, December 2010, Pages 482-493. https://www.sciencedirect.com/science/article/abs/pii/S0272494410000496?via%3Dihub

2 MCMP. https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Programs/WRD/Coastal-Management/Resilient-Coastal-Communities-Planning-Guide.pdf

Erosion refers to the force of the water wearing away the surface of the earth. This wearing away destabilizes any structure that the earth was supporting, and eventually the force of the water washes that away too. Unlike flooding, we call erosion by the same name regardless of whether the process affects our development, but we generally only address it when development is at risk. "Managing" erosion often starts by trying to manage the water's action, since that is the driving force.

But our efforts to get closer to the water's edge are not just *subject* to erosion—they can also create and facilitate it. When we remove coastal plants that are blocking our view of the water or forming obstacles to reaching it, we also remove allies that hold the ground in place with their roots and absorb the kinetic energy of the water. A coast is not a static line on a map; it is a complex ecosystem that developed its own checks and balances long before humans arrived on the scene. Here, too, we may be suffering from a bit of myopia by focusing so intently on ourselves. When we expand our considerations to include the coastal habitat more generally, we can see opportunities to align ourselves with existing processes.

Another way to name the problem is to call it "existing development"

For at least the whole history of the United States, communities large and small have valiantly built their way out of this conundrum. We've prioritized proximity to water, willing to trade uncertainty and perpetual investment to preserve and enjoy our access to it. Levees, seawalls, dams, breakwaters, jetties, groins, riprap, sandbags—we accept that all of these traditionally hardened structures, commonly known as "armoring," just come with the territory.

It's taken some time to see just how expensive it all is. There's the cost of installation, which can be eye-popping all by itself. Eventually, the cost of maintenance emerges as the cumulative effort needed to supply an opposing force that can keep pace with tireless and capricious hydrodynamics. Then there is the inevitable cost of the failures and losses, because we certainly don't win all the battles we pick with nature. More recently, a new cost is coming into focus: the system-wide harms and casualties of these battles. Seawalls distribute the water's force onto neighboring properties. Groins disrupt regenerative sand transport. Water quality suffers without protective wetlands. Ever-longer stretches of coastline are taken out of the public trust. The evidence suggests that our tradeoffs need rebalancing.

Rather than being perpetually at arms with our state's most awesome natural feature, we can look to an approach that carefully considers and deeply respects the reality of how that feature behaves. Prioritizing safety and health—of both the human-made development and the aquatic system—means some measure of deprioritizing our proximity to the water's edge.

The concept of a tradeoff is key to this change in approach. All existing development that is at risk of flooding and erosion represents an investment, and each type of development has its own delicate, intricate challenges when considering how best to protect it. There is the sheer number of residences, each in its own unique physical circumstance. There is the public economic impact of commercial development, tourism and infrastructure. And there are the environmental and pollution concerns with industrial development. In all of these instances, both change and the status quo pose possible perils.

The shift from coastal management to coastal resilience

Historically, communities have taken a reactive approach to flooding, erosion, and other issues, only mounting action once these issues are urgent and then forgetting about them again once lake levels drop. There has been a perception that coastal issues are manageable. But as coastal challenges increase in frequency, severity, and cost, this approach is increasingly inadequate.

The built environment is suffering. The rising costs of emergency repairs, disaster recovery, and infrastructure upgrades have formed a growing financial incentive for a more proactive approach. There is measurable value in planning for resilience in advance, investing in nature-based preventative measures, and using land use planning to reduce the need for emergency response.

The natural environment is suffering, too. Water quality deteriorates in the presence of things like impervious surfaces, septic tanks, roads, and lawn fertilizers. Civilization generates a collection of pollutants that damage habitats, drinkability, aesthetics, safety, and enjoyability when they make their way into a shared waterbody. Coastal features like vegetation and natural processes like groundwater filtration help mitigate these effects, but living close to the shoreline and altering it for our own purposes reduces those capabilities.

The end goal of coastal resilience is a sustainable coastline. The process includes mitigating hazards, creating healthy habitats, and supporting resilient planning.

Leading this shift rests at the feet of local decision-makers

Taking a general approach of moving development away from the water's edge is difficult for practical reasons, and it's also difficult to want to do: that coast is magnetic and alluring, and the status quo is almost always the easiest path. After all, in many cases the buildings are already there. And where they are proposed, the economic potential seems much more immediate and concrete than the risk.

For the most part, because land use decisions are made at the local or tribal level in Michigan, this responsibility is in the hands of almost 400 individual entities that line the Great Lakes coasts. It's a hard ask for that many separate entities to manage a single feature harmoniously. Yet, that is what the task requires: while land can be divided up with borders, water resists this imposed order. It moves under its own power, and it crosses our borders with impunity. Water quality somewhere is water quality everywhere.

Moreover, the line of responsibility between local leaders and safeguards of both public and private investment is often quite clear. We issue the permits that allow residents and businesses to build at the

Gilmore Township (Benzie County) , a coastal community affected by flooding. (Mark Breederland, Michigan Sea Grant)

shoreline. We invest public dollars in roads and marinas. We bear the costs of cleanup when disaster strikes. Local leaders are the only ones charged with the hard job of balancing immediate apparent gain with long-term considered risk.

Framing the Solution

The way to support both water quality and resilience to hazards is to give the lakes what they need: space to move, and a natural shoreline. By pulling our investments out of harm's way and reflecting a better understanding of coastal processes like sediment movement and wave energy, we allow the coast to produce, use, and benefit from its own resources. This benefits our communities, too, since we we won't need to be in continuous conflict with a jousting partner that never flags or makes a mistake. Planning and zoning are two powerful tools that can do that.

The tools in this Compendium are organized into the broad categories of giving the lake "space to move" and a "naturalized coastal shore." These are complementary concepts. When development is pulled away from the shoreline, natural and naturalized features like plants and sediment can carry out their natural costal functions. Conversely, the plants, habitats, and features that make up a naturalized coast can't exist without making space for them. We are really looking at the same desired end from two different perspectives.

Space to move

Regulatory approaches can move and keep private development investments out of the range of harm from the Great Lakes' natural processes. This section discusses how local regulations like zoning districts and development standards can be supported by data and planning to navigate the balance between permitting wise use of the coast and falling prey to the temptation to get too close to the water. We also consider the unique role of land divisions.

Naturalized coast

As the long-term difficulty posed by armored shorelines becomes clearer, we need to understand what should be done instead. The natural conditions that arise where the water meets the land—the configuration of sand, rock, vegetation, and slope—are the conditions that are more responsive to the lake's energy over time. This section of the Compendium discusses how to support and recreate those natural conditions through policy, and how to prescribe them through the zoning and development tools.

Why isn't this already done?

This Compendium certainly isn't the first effort to advocate for planning and zoning to support wiser coastal development, yet in many ways it seems that the implementation of change is moving at a much slower pace than the understanding of the need for it. Existing research has documented a few key reasons for this mismatch. These are worth acknowledging so that we can overcome, untangle, work out, and press forward on known impasses.

The nature of local government

A few-year elected term is not enough time to fully learn about a complex issue, lead a community to consensus, develop a technical solution, and shepherd it through an official process. But this is the system

we have. Local governments also face chronic limitations on staff capacity, funding, and specific expertise. And even just in the space of coastal management, issues ranging from disaster debris to invasive species compete for the same finite pool of attention. These are structural issues.

What can help? A thorough, well-documented planning process can help carry work from one term to another, so that new officials can get up to speed quickly. This will help them further the work of their predecessors rather than duplicate it. A good planning process is an investment, but like any good investment, it allows initial resources to stretch and multiply over time.

The nature of people

Political processes are meant to reflect the will of the people, and they often do a fairly good job. This is a double-edged sword. It's human nature to prefer short-term gain over long-term prudence; to look to allies for information rather than develop independent sources; to stop worrying about a danger once the immediate threat recedes; and to trail off on enforcement of a policy once it shows signs of success. This certainly makes the job of steady, responsible governance hard. It's also the human condition.

What can help? Consistent, measured, iterative community engagement builds trust between people and government. A dialogue that exchanges education and experience reveals the durable truths over time, and focuses attention on the opportunities to make progress on long-term problems. This should certainly be a part of a planning investment. It's also true that over the long term, leaders have to lead. They must use their influence in support of the longer view and the wiser course. That's what it's for.

The nature of change

The engineering approach to managing water, using tools like traditional hardened structures or armoring, has been in place a long time. There are deeply embedded systems that support it, and examples of it are everywhere—some of which reflect decisions made in public processes with public funds. When a resident or business is faced with making their own coastal investment, they are most likely to reach out to a contractor or engineer in the private sector, and that person will become the source of their education and expertise on the issue. Because the limitations to the current method are showing up in the longer term and the broader scale, there are few immediate incentives to adopt a new approach. The status quo is quite durable.

What can help? Engineers, contractors, and real estate agents are a few of the private sector professions that could be better included in ongoing dialogues about coastal management. Ultimately, regulation is the most direct form of communication here: its purpose is to guide their work, and they respond quite nimbly to changes. The example set by the public sector is also highly valuable. It can blaze a trail forward by demonstrating the possible, and conversely, it can also thoroughly discredit a community's "talk" when it fails to deliver the "walk."

The nature of the solution

Land use planning, policy, and regulation are powerful tools, but dry and technical subjects. There is often a wide gulf between the language of community desire and the legalese that implements it. "Consent of the governed" means that restrictions need buy-in, and there is a perpetual tension between regulation and flexibility. How is preference informed by data, and how do those work together when expressed in a local ordinance? This is the art and science of the work of governance.

What can help? Decisions that are grounded in data and made through transparent processes publicly connect the solutions to the problems they are intended to solve. So does measuring the effectiveness of decisions after they are made, and periodically revisiting regulations to review the conditions they are meant to manage.

The importance of community plans

While the focus of this Compendium is to provide a set of local regulatory tools to address each community's unique coastal conditions, it's important to remember that these tools should be grounded in the community's plans. This provides credibility to the solutions you select, helps communicate the need for changes to others in the community, and provides some legal protections. This is recognized in state law, which requires zoning regulations to be based on an adopted master plan.

There are a number of ways your community can plan for coastal hazards. A few of them are described here, with additional guidance provided in Appendix D.

Master / Comprehensive Plan

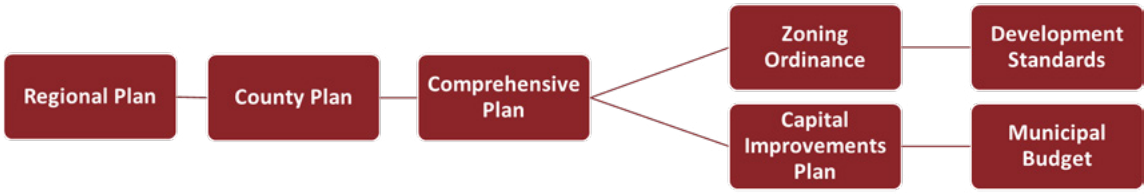
Almost every community has a comprehensive land use plan, often called the "master plan," which guides the municipality's efforts to accomplish its vision for the future. This plan is a community- wide effort which results in a description of how land within the jurisdiction should be used and developed, given that future vision. The plan typically contains policy and ordinance recommendations, a map showing desired future land use, and a zoning plan. The Michigan Planning Enabling Act (MPEA, Public Act 33 of 2008) requires that the plan be reviewed every five years to keep it current.

Box 1.2. Plan Integration

Communities typically rely on a "network" of plans that between them outline a community's vision, set goals, and guide local development and policy decisions. However, research has shown that these plans tend not to be coordinated, leading to inefficiencies or conflicting policies. For example, a hazard mitigation plan might recommend restricting development on shorelines, while an economic development plan might incentivize waterfront business expansion.

In working toward your coastal resilience goals, an early step would be to explore all of your community's plans to make sure they are in agreement.

Reference: Planning for Resilience in Michigan Handbook



Box 1.3. Definitions

Coast: A strip of land of indefinite width (may be several kilometers) that extends from the shoreline inland to the first major change in terrain features. The land regarded as near the shoreline.

Coastline: The boundary between coastal upland and the shore.

Shore: The narrow strip of land in immediate contact with the lake, including the zone between high and low water lines. A shore of unconsolidated material is usually called a beach.

Shoreline: The intersection of a lake with the shore or beach.

See the full Glossary in the Appendix.

The community-wide focus and statutory importance of the master plan / comprehensive plan makes it an important document for incorporating coastal resilience goals and recommendations. These may be included in a separate resiliency chapter or integrated throughout the plan.

Parks & Recreation Plan

Parks & recreation plans are documents that municipalities typically develop to apply for Michigan Department of Natural Resources (MDNR) grants. These plans must follow the MDNR template, that looks much like the format of master / comprehensive plans. To be eligible for project funding, the plan must be updated every five years. Parks & recreation plans offer a great opportunity to advance economic, social, and environmental resiliency, for example by incorporating nature-based tourism to support the local economy or acquiring land for coastal protection and green infrastructure goals.

Hazard Mitigation Plan

Hazard mitigation plans, also known as "all-hazards" plans, typically include risk assessments and scenario development to anticipate future hazards that could affect the community. The risk assessments often rely on information about past disasters and known hazards to look to the future, but more recently, they are incorporating climate forecasts. These plans are helpful in identifying coastal hazards that the community should understand, prepare for, and make a plan to recover from.

An adopted hazard mitigation plan is required for many types of Federal Emergency Management Agency (FEMA) grants. In most areas of Michigan, the hazard mitigation plan is created and updated at the county level, which ideally includes participation from each jurisdiction within the county. Localities may also produce their own plan.

Sustainability or Resilience Plan

Sustainability or resilience planning looks specifically toward the changes the community needs to make in order to manage its resources over the long term and to mitigate and prepare for the effects of a changing climate. These may be independent planning efforts, or they may be integrated into other plans. For example, the Land Information Access Association (LIAA) developed a Community Sustainability

Assessment Tool[3] that can be used to evaluate your master / comprehensive plan and zoning ordinance and identify potential areas of focus. Sustainability planning may include subjects not normally included in the land use planning process, such as greenhouse gas reductions, and it may focus more heavily on the health of the community's natural resources and green infrastructure, such as its water management practices and tree canopy. Resilience planning efforts may pair future climate projections with existing conditions to develop a vulnerability assessment that identifies geographic areas of concern. In order to have a legally binding influence on land use, this information, or at least the key takeaways, should be incorporated in the community's master / comprehensive plan.

Capital Improvements Plan

A capital improvements plan, or CIP, identifies and prioritizes a community's anticipated public infrastructure needs over the next 6 years. While the tendency is to treat the CIP narrowly as an asset management program or a budget document, it's an important tool to implement priority infrastructure goals from your master / comprehensive plan. Examples of the ways in which a CIP can be used to support resiliency objectives include relocating at-risk roads, acquiring land for flood protection, and incorporating green infrastructure into the municipal stormwater system.

Downtown Development/Corridor/Tourism Plan

Many communities have plans for special districts that focus on economic development. These plans can be a subplan of the master / comprehensive plan focused on improving job opportunities and strengthening businesses in the community or region, often through public investments in community facilities and infrastructure. Given coastal communities' unique draw for tourism, these plans can support marina and public beach development, as well as historic preservation of marine heritage sites, such as lighthouses.

3 LIAA, https://www.resilientmichigan.org/downloads/sustainability_tool_0402.pdf

II. SPACE TO MOVE

Why giving the lake space to move supports resilience.

Lake Huron coast near Presque Isle (NOAA Digital Collections)

What it is and why it supports coastal resilience

The key thing to remember about the natural systems along Great Lakes coasts is that they are dynamic, meaning they are constantly changing. Although specific shoreline conditions change between seasons and years, the results of these changes are fairly predictable: at some point, coastal buildings and infrastructure will experience erosion, flooding, wind, and wave damage.

The pressure to build along the privately owned lake edge, which accounts for about 80% of Michigan's coast, brings the built systems into conflict with the natural systems. Because of the water's dynamic and forceful nature, the tools for managing land use along the coast call for giving the shoreline space to move, rather than responding by using armoring to keep it as static as possible, which will fail over the long term.

This section highlights some resources that communities can use to learn about the unique characteristics of their coast, including how much room the lake needs to give it space to move in the future.

Why isn't this already done?

The short answer is: existing and potential economic value.

Because we love the water, we've already built things next to it. Those things are valuable because of the investment, and often they are even more valuable because they are next to the water. Even where we haven't built anything yet, we know from past experience that it would be valuable if we did. It's legally and politically tricky for regulation to interfere with economic value.

Especially in the case of existing investment, this is a compelling argument for doing nothing. Legal restrictions risk legal challenges. Individuals and communities alike are susceptible to defeatism, the idea that it is too difficult to change what already exists, when they feel that solutions are overwhelming or impractical. Yet a failure to act risks escalating costs and damages down the road, making it even harder to address issues and emergencies. It is a difficult tradeoff to quantify, and the competing interests are fierce.

Developing and adopting fair, thoughtful land use policy and regulation is a slow and challenging process, but the very foundation of land use management is to evenhandedly impose such regulations as are necessary to safeguard public health, safety, and welfare. A conscious shift toward a forward-thinking and solution-oriented mindset can help reframe the concept of "value" to better reflect these fundamental public benefits.

How much space does the lake need (for now)?

The first question to consider when contemplating regulations that allow the coastal shore space for its natural processes is: How much space does the lake need? This understanding will inform the type of regulation implemented as well as the specific distance from the water's edge that will provide an appropriate amount of protection for the built environment.

The Michigan Resilient Coastal Communities Planning Guide[1], created by the Michigan Coastal Management Program, provides a comprehensive description of the natural coastal processes that communities experience. For communities to effectively plan for coastal hazards, it's important to start by assessing the

1 MCMP. https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Programs/WRD/Coastal-Management/Resilient-Coastal-Communities-Planning-Guide.pdf

conditions that are unique to their coast. The Guide identifies a number of online tools and data sources that communities can access for this information free of charge, some of which are highlighted here.

It's critical to remember that not only does the location of the water's edge vary in a cyclical pattern, but also that the coastline in general is moving landward over time due to erosion (called "recession"). The rate of this landward movement varies from one place to the next, heavily influenced by the physical characteristics of the coast. For this reason, all of the tools in this Compendium need to include a regular review process that reassesses the adquacy of the tool and the structures at risk.

Great Lakes water levels

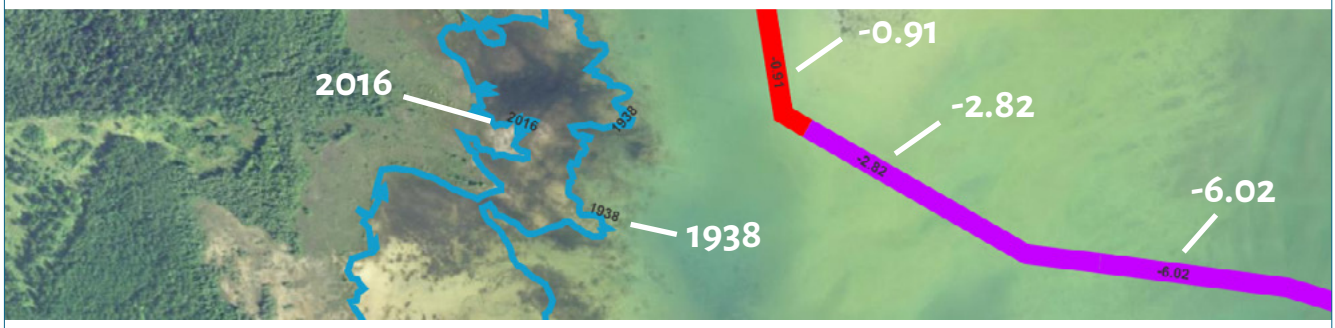
A recurring coastal management problem is the temptation to build near the water's edge when levels are low, only to have the investment threatened when levels swing back up again. Unfortunately, there is no long-term predictive tool for Great Lakes water levels. The National Oceanic and Atmospheric Association's Operational Forecast System[2] and the US Army Corps of Engineers' Water Level Forecasts[3] can venture only days or months into the future. However, the tools below can guide planning efforts by showing the range of lake level variation in the past.

The Great Lakes Lake Level Viewer[4] is an easy-to-use tool for visualizing potential coastal flooding through a range of water levels. The model is based on calm conditions, so it doesn't account for storms that would increase water levels or wave impacts. However, the tool can serve as a discussion-starter and inform planning for sections of the coast prone to flooding.

For an overview of the historical and natural processes at play in Great Lakes water level variation, explore NOAA's Water Levels in the Great Lakes StoryMap[5].

Box 2.1. How Has Erosion Affected Your Shoreline?

Try Michigan Tech University's Interactive Coastal Viewer



Erosion in Lake Huron (Near Thunder Bay River State Forest, Alpena). In the web viewer, the number on the thick line represents the lomg term rate-of-change between 1938-2020 (using meters divided by years). The blue lines represents the shoreline on the year it was recorded. The numbers are enlarged in this photo to show this.

2 NOAA. https://tidesandcurrents.noaa.gov/models.html

3 US Army Corps of Engineers. https://www.lrd.usace.army.mil/Water-Information/Water-Management/Great-Lakes-and-Harbors/Water-Level-Forecasts

4 NOAA. https://coast.noaa.gov/llv/

5 NOAA. https://storymaps.arcgis.com/stories/f60be9e50c6341d6b76e62f84de43dd6

Coastal flooding

Flood maps show how likely it is for an area to become inundated with water. Any place with a 1% chance or higher chance of experiencing a flood each year is considered to have a high risk. These maps can be used as visual tools to educate property owners about their flood risks and help local officials make decisions about capital improvements and future land use planning. Official flood maps may be found at the Federal Emergency Management Agency (FEMA) Flood Map Service Center[6]. An Introduction to FEMA Coastal Floodplain Mapping[7] provides additional information unique to coastal flooding.

Coastal erosion

Unlike water levels, which reach toward land and then recede, erosion is on a consistent landward march. Since the characteristics of the land play a determining factor in whether and how erosion occurs, knowing where it has occurred in the past can help predict where it may occur in the future.

One helpful resource is Michigan Coastlines Through Time[8], created by Michigan Technological University for EGLE. This web-based viewer allows users to view and compare aerial photography of shoreline and bluff line locations collected at intervals over the past 80 years. While this tool does not predict where the coastline will be in the future, it can powerfully illustrate to the community where it could be.

Portions of the Michigan coast identified as High Risk Erosion Areas (HREAs)[9], Critical Dune Areas[10], or Environmental Areas (EAs)[11] are regulated by the state of Michigan. Permits are required for construction in these areas. Local units of government may adopt a zoning ordinance to administer permits for state-designated lands within their municipality.

Coastal erosion affecting Whitefish Township, Lake Superior (Elliot Nelson, Michigan Sea Grant)

6 FEMA, https://msc.fema.gov/portal/home

7 FEMA, https://fema.maps.arcgis.com/apps/MapSeries/index.html?appid=89d2e393f2c64d7cae07264f4d00c19d

8 EGLE, https://portal1-geo.sabu.mtu.edu/mtuarcgis/apps/sites/#/czmp

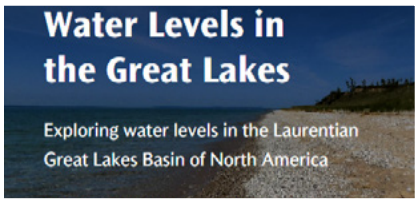
9 EGLE, https://gis-egle.hub.arcgis.com/datasets/egle::high-risk-erosion-zones/explore

10 EGLE, https://www.michigan.gov/egle/about/organization/water-resources/sand-dunes/critical-dunes/maps

11 EGLE, https://gis-egle.hub.arcgis.com/datasets/egle::environmental-areas/about

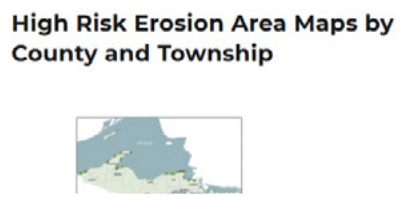
Box 2.2. Tools to Better Understand Your Community
Click to visit the pages

Great Lakes Level Viewer (NOAA)



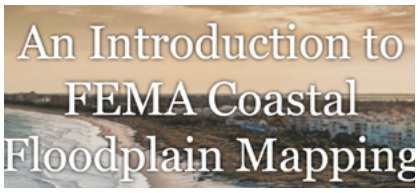
Water Levels in the Great Lakes StoryMap (NOAA)

Michigan's Coastlines Through Time Viewer (NOAA)

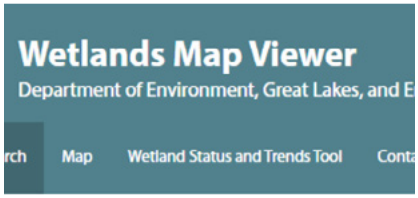


High-Risk Erosion Area Maps (EGLE)

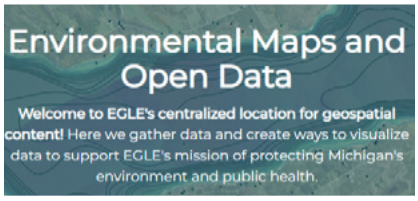
Flood Map Serivce Center (FEMA)



Introduction to Coastal Floodplain Mapping (FEMA)



Wetlands Map Viewer (EGLE)



Environmental Maps and Open Data (EGLE)

III. A NATURAL BORDER

Why natural coasts support resilience.

Lake Michigan, south of Sleeping Bear Dunes National Lakeshore (NOAA/OAR/Great Lakes Environmental Research Laboratory)

What it is and why it supports coastal resilience

The characteristics of a coast are formed by the interaction between the water's energy (force and motion), and the land's material (sand, pebbles, bedrock, vegetation) and arrangement (slope). These elements are constantly working together to reach an equilibrium that allows the material to best receive, absorb, and dissipate the energy of the water. Once again, change is the constant: the water's force and motion are dynamic, and the land's material and arrangement continually adapt to them, so this equilibrium is in an uninterrupted state of rebalance. A "natural border" between land and water refers to a coast where both the material and the arrangement are relatively free of human alteration.

Natural coasts support resilience by allowing the process of rebalance between the water's force and the land's accommodation of it to proceed unhindered. In a sense, the land is an active partner here, offering up responses that range from reconfiguring its shape to sprouting up vegetation, depending on conditions. The Resilient Coastal Communities Planning Guide and the Building Coastal Resilience video series (especially part 2) describe how waves and currents move beach sediments over time. Wetlands dissipate great quantities of energy while also providing unique habitats and improving water quality.[1] [2] [3]

Why isn't this already done?

The short answer is: a philosophical prioritization of engineered processes over natural ones.

People value being on the coast, and have gone to great lengths to reshape our environment as we've seen fit. This has largely been accomplished through an "engineering approach" that focuses on human inputs like research, design, feasibility, and implementation, and considers non-human inputs only to the extent that they constrain or assist the human efforts.

This approach is not intended to co-operate with natural processes but rather to overcome them as necessary to achieve our aims. In the coastal context, we have surmounted innumerable types of physical obstacles to attain access to water, a critical resource for settlement. However, the magnitude, dynamic unpredictability, and continuous nature of the water's force on coastal development has cast doubt on the affordability of maintaining this approach.

"Nature-based solutions"[4] and "green infrastructure" are two terms that refer to alignment of human goals with processes that are occurring in the natural world independently of human investment. A body of research beginning in the late 1990s demonstrates the effectiveness of this approach[5], and its applications have been increasing over time. As the benefits of conserving and restoring natural systems and designing new systems to mimic their processes are increasingly measured and quantified, it becomes possible to encourage or require a preference for this approach over the engineering approach.

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1 EGLE, "Coastal Wetlands: Essential to the Health of the Great Lakes." *State of the Great Lakes Report* pages 20-21, 2021. https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Reports/OGL/State-of-the-Great-Lakes/Report-2021.pdf. Retrieved April 2025.

2 EGLE, "What are wetlands and why are they important?" https://www.michigan.gov/egle/about/organization/water-resources/wetlands/what-are-wetlands-and-why-are-they-important. Retrieved April 2025

3 EGLE, "Introduction to Wetlands" video. https://youtu.be/bSfF6h7j1YU?si=Mhzpbp851RnvUCGD. Retrieved April 2025

4 NOAA Ocean Service, "What are nature-based solutions?" https://oceanservice.noaa.gov/facts/nature-based.html Retrieved March 25, 2025

5 NOAA Office for Coastal Management Digital Coast, "Green Infrastructure Effectiveness Database." https://coast.noaa.gov/gisearch/#/ Updated March 17, 2025; retrieved March 25, 2025

The pendulum is swinging ever so slightly away from exclusively recognizing and valuing human intervention. Mounting evidence of the successful outcomes resulting from protecting and restoring natural processes—designing with nature, rather than against it—offers legal support for a regulatory framework that requires it.

Box 3.1. Green Infrastructure

Impervious pavers: One of many green infrasture solutions to manage runoff (Bonnie Wilson, Michigan Sea Grant).

Green infrastructure enhances coastal resilience by using natural systems and processes to reduce the impacts of flooding and erosion. They also manage storm water and preserve natural habitats.

Examples include living shorelines, coastal wetlands, and riparian buffers. Coastal communities can also implement green storm water infrastructure such as rain gardens, bioswales, and permeable pavement to help manage runoff before it reaches the lakes.

What are the shoreline types along the Great Lakes?

The tools in this Compendium support the specific and varied geological characteristics that shape the unique coastal processes in your community, which in turn affect how to manage them. Here are the six typical Michigan shoreline types described in MCMP's Resilient Coastal Communities Planning Guide:

Elevated shorelines: bluffs and banks

Elevated shorelines have a steeply-sloped elevation between the water's edge and the adjacent land. The material consists of a range of sediment sizes left by deposits from the last glaciation, and the relatively low amount of sand means that the beach between the bottom ("toe") of the bluff and the water's edge is narrow. In these areas, the elevation change creates distance that protects buildings from flooding. However, the narrow beach means that wave energy is received primarily on the toe of the bluff. Erosion occurs from the bottom up, putting structures at the top of the bluff at risk.

Sandy beaches and dunes

Sandy beaches tend to have shallow slopes and are typically fed by sandbars close to shore. These shoreline types are especially responsive to water and wind energy, which means that they are especially unstable for building purposes. The shallow slope means that changes in the water level can affect dramatically large swaths of land, causing flooding concerns. Sand is light and mobile, making it an unsteady building surface that is susceptible to erosion. Because sandy soil drains well, any contamination on land is swiftly carried into the waterbody.

Coarse sediment beaches

Made up of gravel or cobble, these heavier materials mean that the beach remains relatively stable over time and is less susceptible to erosion than sandy beaches. These beaches are often steeply sloped, with relatively deep water near the shoreline. A steeper slope mitigates flooding by preventing rising water levels from traveling inland.

Bedrock

Bedrock coasts reflect wave energy, resisting erosion unless the rock type is soft. The elevation and slope are highly variable, depending on the shape of the rock. A shallow slope near the water's edge may still leave it susceptible to flooding.

Wetlands

Wetland shorelines are covered in mud, silt, and vegetation. They absorb and dissipate wave energy as the root structure of the plants holds the coastal material in place. These areas are wide and flat, making them exceptionally prone to flooding. The vegetation, which is adapted to periodic inundation, helps mitigate this flooding risk both by forming a physical barrier, and by soaking up water and releasing it into the air through the evapotranspiration process. The soft surface makes these areas unsuitable to build on without extensive mitigation, but they can form an excellent natural protective buffer between water and development.

Artificial / armored

These shorelines have been "hardened" with structures intended to prevent flooding and erosion, an investment that indicates development is in the direct path of one of these conditions. "Armoring" refers collectively to the installation of seawalls, revetments, bulkheads, riprap, and other traditional hardening structures that replace the natural shoreline. In the past, armoring was viewed as an effective strategy—perhaps the only effective strategy—for safeguarding coastal properties and infrastructure. Early technical guidance on coastal engineering provided by the US Army Corps of Engineers detailed methods and designs for constructing various armoring structures. They offer an immediate, visible result that provides a sense of security for concerned homeowners, businesses, and municipalities, and can still be appropriate in places where critical infrastructure is at risk and cannot feasibly be moved.

But artificial shorelines carry a continuous burden of maintenance and replacement. They are guaranteed to periodically fail and are likely to occasionally be inadequate. Hardened surfaces reflect wave energy back into the water rather than dissipating it. Armoring structures are generally installed on a property-by-property basis, so reflected energy reaches around the edges of the structure and erodes the unprotected areas. This causes the armoring to loosen and eventually detach. It also distributes the erosive effect onto neighboring property. Armoring creates a steep (often vertical) slope that prevents water from traveling landward, but only as long as the lake level remains below the top elevation of the structure.

Although armoring is sometimes referred to as "shoreline protection," this term is inaccurate. Rather than protecting, these artificial structures remove, disturb, and interrupt natural shorelines. They disrupt ongoing coastal processes in a piecemeal fashion, causing effects on not only adjacent properties, but throughout the coastal ecosystem. Often, they exacerbate on other properties the problems they purport to solve on the property where they are installed—the very outcome that planning and zoning are designed to prevent wherever possible. Armoring incurs a permanent cost by replacing existing coastal processes with a human management burden. This cost should be considered alongside the value of existing at-risk development, and certainly when considering the potential value of future development.

Box 3.2. Shoreline Types Around Michigan
Images Courtesy of NOAA Digital Collections

Elevated Shorelines

- Steep slopes or cliffs above the water
- Prone to erosion and landslides

Sandy Beach / Dunes

- Low-gradient sandy beaches
- Prone to shifts from wind/waves

Coarse Sediment Beaches

- Gravel, cobble, small boulders
- Common in Northern Michigan

Bedrock

- Exposed rock formation and cliffs
- Often steep and inaccessible

Wetlands

- Marshes, swamps, floodplains
- Low elevation, vital for habitat

Artificial Shoreline

- Seawalls, riprap, harbors, etc.
- Hardened with concrete, steel, stone

IV. COASTAL SOLUTIONS GUIDE

How zoning affects private property.

Kayaking in Lake Superior (NOAA/OAR/Great Lakes Environmental Research Laboratory; EPA)

How zoning affects private property

The Michigan Zoning Enabling Act (MZEA, Public Act 110 of 2006) gives municipalities the authority to regulate the development and use of land through the adoption of zoning ordinances (see below). This includes the regulation of land along the Great Lakes' coastlines to the Ordinary High Water Mark (OHWM). For lands lakeward of the OHWM, the State has regulatory authority through Part 325 of the Natural Resources and Environmental Protection Act (NREPA, Public Act 451 of 1994).

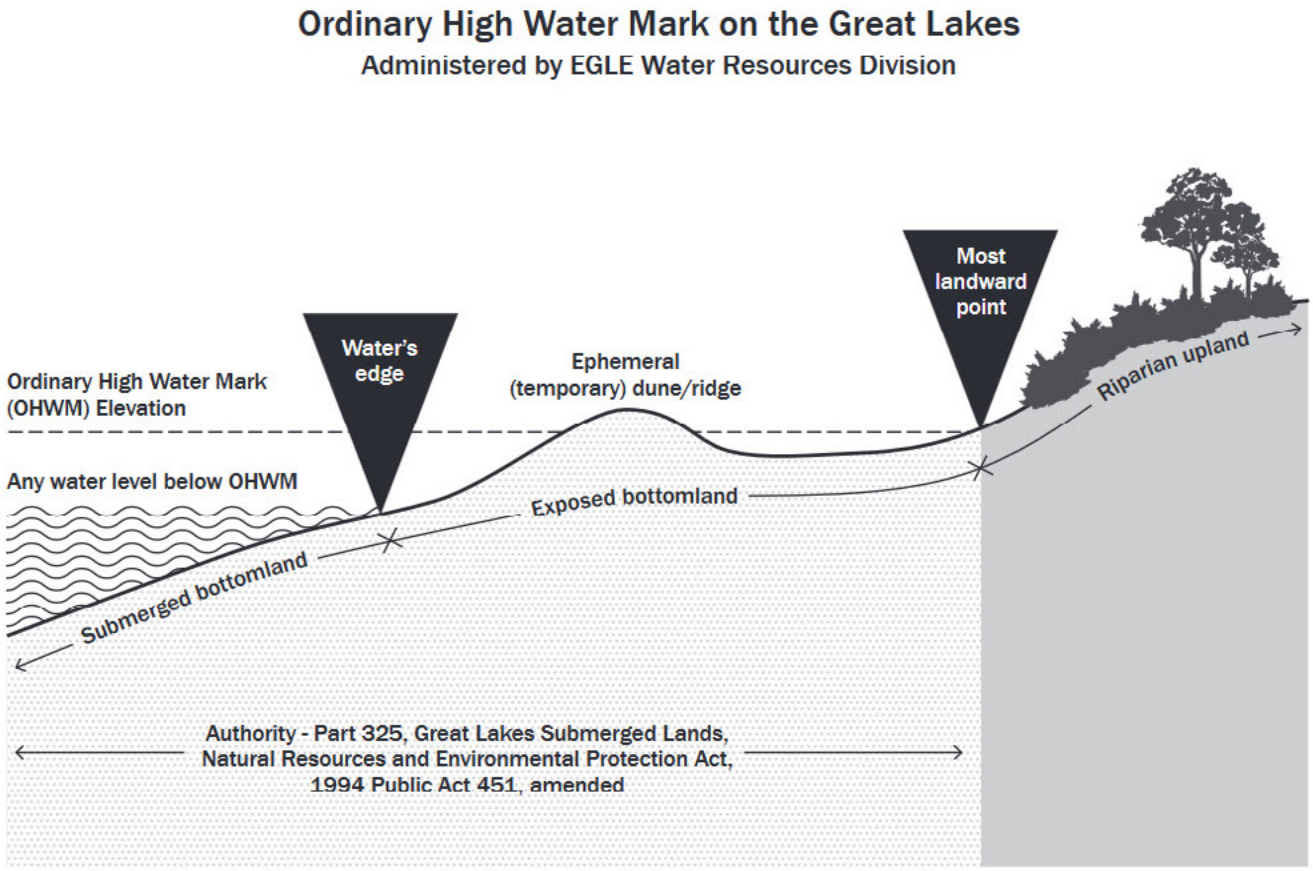


Figure 4.1. The "Most landward point" is the Natural Ordinary High Water Mark. Land below the Natural Ordinary High Water Mark (OHWM) along the Great Lakes is owned by the state and held in public trust for the benefit of all citizens.

A zoning ordinance contains standards for the development and use of private property within the jurisdiction. The MZEA says that all zoning regulations must be based upon a plan to guide the community's development. This plan, called a master plan or comprehensive plan, is authorized by the Michigan Planning and Enabling Act (MPEA, Public Act 33 of 2008) and created by the planning commission. The planning commission then has an advisory role in any changes that are proposed to be made to the zoning ordinance, which is adopted and amended by the municipality's legislative body, as all ordinances are.

All ordinances are uses of the government's police power: its fundamental ability to impose requirements that are necessary for the public's health, safety, and welfare. Zoning ordinances are a special case of this power dealing specifically with land use. They restrict the otherwise free use of property where such free use does not promote public health, safety, or welfare.

Government is always seeking to strike a balance between a person's "freedom to" do what they want and that person's "freedom from" being harmed by their neighbor doing the same. The purpose of zoning regulations is, in effect, to restrict the otherwise free use of property, so resistance from property owners who are focused on this "freedom to" is a common obstacle to implementing them. This is why ordinances are supported by data documenting the intended benefits to the public health, safety, and welfare. Public engagement processes make these tradeoffs widely known, broadening the conversation to include those who are helped by the "freedom from." However, restrictions can't be so severe that they result in a property where no reasonable use is available at all. In that case, a court may find that the municipality has "taken" the property and must pay compensation to the property owner.

Box 4.1. Michigan Zoning Enabling Act (Public Act 110 of 2006)

Section 125.3201 (3)

A local unit of government may provide under the zoning ordinance for the regulation of land development and the establishment of districts which apply only to land areas and activities involved in a special program to achieve specific land management objectives and **avert or solve specific land use problems, including the regulation of land development and the establishment of districts in areas subject to damage from flooding or beach erosion.**

Managing coastal development through zoning

For coastal communities, zoning ordinances are key to achieving coastal resilience goals in their master plans. A 2019 University of Michigan study[1] outlines several purposes for coastal communities to pursue shoreland management amendments to their zoning:

1. Hazard mitigation: changes to protect coastal property from storm-related flooding and high-energy wave damage.
2. Post-storm response and recovery: changes to help minimize the cost of response and recovery efforts.
3. Resource conservation and pollution control: changes to safeguard the coast, conserve coastal wetlands, minimize erosion and limit non-point source pollution from impervious surfaces and septic discharges.
4. Aesthetics / cultural preservation: changes to protect the views along the shore and conservation of historic structures and locally important cultural features.
5. Public access: changes to ensure access to public trust beaches for the purpose of walking and other appropriate recreational activities.

The study goes on to identify a series of questions for communities to consider when determining the approach they should take when drafting coastal shoreland management changes to their zoning ordinance.

1 Richard K. Norton et al, "Local Zoning in Michigan for Great Lakes Coastal Shoreland Management: Initial Findings and Guidance." https://gtbay.org/wp-content/uploads/2022/12/Norton_Local-Zoning-in-Michigan-for-Great-Lakes-Coastal-Shoreland.pdf Retrieved May 2025.

1. What are the primary goals of the ordinance, especially where goals may conflict? Most pointedly, when both objectives cannot be served simultaneously, has the community decided to save the naturally functioning beach even at the expense of a beach structure, or has it decided to allow a shoreland property owner to save the beach house even at the expense of the naturally functioning beach?

2. What is the appropriate method to be used in drawing boundaries and defining setbacks given the larger goals? For example:

    - Textual definitions and references only (especially if relying on a state-established boundary);
    - Textual descriptions and fixed/mapped locations made within the ordinance itself (i.e., established and fixed by the community in adopted the ordinance); or
    - A textual description of the boundary conceptually and an analytical siting process conducted by local officials or by the petitioner on an as-needed basis.

3. Given the characteristics of the shorelands at issue and the approach taken by the community through its existing code, does it make most sense for the community to adopt shoreland management provisions that are specific and fixed, providing increased certainty and requiring little discretion but reducing flexibility? Or does it make most sense to use an approach based on performance, providing more flexibility for the shoreland property owner but raising the potential for inappropriate or unwieldy discretionary decision-making by local officials?

4. Does the code specify monitoring and administration responsibilities? Is it credibly possible to adequately monitor and administer the new code provisions?

5. Is the code linked to, or at least not in conflict with, other regulatory provisions that apply to the development and use of coastal shorelands (e.g., other zoning, subdivision standards, building standards, requirements regarding septic systems)? Is it similarly linked to and in compliance with applicable state regulatory programs (e.g., the HREA program)?

6. Finally, does the code clearly specify an appropriate and fixed period for reviewing the boundaries of a shoreland district and/or setback, and does it clearly state the implications of adjusting those boundaries (specifically, potentially converting a permitted structure to a nonconforming use/structure status)?

Box 4.2. Public Trust Doctrine and Littoral Rights

According to the Public Trust Doctrine, the water in the Great Lakes is owned by the general public. The Public Trust Doctrine is an international legal theory, which means it applies to the entirety of the Great Lakes (Canada and the United States).

This Public Trust Doctrine allows for the public use of water and submerged land regardless of neighboring private property ownership, because the water and submerged land are held in the public trust. Neighboring property owners do not own the water or the land under the water.

However, they have unrestricted access to the water, a concept known as "Littoral Rights." Littroral Rights allows private property owners on the Great Lakes to construct structures that anchor to the submerged land (like docks) with a state permit.

What tools are the best fit for your community?

Every coastal community has its own unique combination of physical features and zoning requirements. The following charts provide some decision-making criteria for your community to consider when determining what type of tools to use to forward the coastal resilience goals in your master plan.

The **Effort/Impact Chart** at the end of this chapter organizes the 15 tools according to the relative organizational capacity and resources required to implement the tool on the X-axis, and the impact of the tool on the Y-axis. Communities with limited capacity or those that are at the beginning of their coastal resilience efforts may want to first consider the actions that represent a smaller lift and build on those achievements. Communities that are facing repeated or long-term issues may want to look immediately toward the highest impact activities.

The **Tool Options Chart,** also at the end of this chapter, contains a series of questions about your coast's physical character, zoning framework, development character, and community priorities. These questions are then cross referenced with the 15 coastal tools included in the Compendium. For each question that you answered "Yes" to, look at the tools marked with an X in the chart. These are likely good places to start your consideration, especially ones that come up more than once. As noted in the tool descriptions, many of these tools can be "bundled" into a customized approach.

Creating and adopting zoning regulations

To implement the coastal zoning tools highlighted in this document, there are common tasks necessary to create and adopt a zoning ordinance amendment. A zoning ordinance consists of text and a map, and either or both may need to be amended.

Text Amendments

Text amendments change the language of the zoning ordinance. They are necessary to add new zoning techniques, add new uses to zoning districts, bring standards up to date, or implement a change in procedure. For many of the zoning tools highlighted in this Compendium, a text amendment should include the following steps:

- *Check for supporting documentation in the Master / Comprehensive Plan*. Determine if the plan 1) identifies the protection of the coast in general or identifies specific coastal features as a priority, and 2) includes recommendations that would support the proposed zoning change. If not, the plan should be amended to add these priorities.
- *Draft a statement of intent.* Put in writing the reasoning for the ordinance change, keeping in mind that the proposed ordinance language should align with this justification. Ideally, the intent statement should reference goals or recommendations in the master / comprehensive plan, including those from the Zoning Plan. If amending an existing zoning district, check to make sure the district's intent statement aligns with the proposed changes.
- *Add definitions of any new or uncommon terms used in the text amendment to the Definitions section of the ordinance.* Clear definitions for terms are vital for users to interpret the requirements. They help apply requirements that are found in other parts of the ordinance, but should not include regulatory language.
- *Review the General Provisions of the ordinance.* The General Provisions are regulations that apply to all uses, buildings, and structures within districts. Examples include accessory buildings, fences, and decks. Some communities also include off-street parking, landscaping, access management,

and natural features regulations that apply to all zoning districts, although many cover these requirements in separate ordinances or a dedicated "site development standards" section in the zoning ordinance.

- *If new or revised uses are proposed for a zoning district, add these to the Permitted Principal Use or Special Land Use list.* Make sure that any uncommon terms are defined in the Definition section.
- *If setbacks or other dimensional standards are proposed for a zoning district, add these to the district's lot area and bulk requirements.* These are sometimes contained in a Schedule of Regulations chart that includes all zoning districts within the municipality. Typical requirements include lot size, height, setbacks, lot coverage, and density (e.g., allowable floor area or number of dwelling units).
- *If ordinance changes will make existing structures non-conforming, decide if there will be special provisions for adding to or rebuilding non-conforming structures.* Add these to the Nonconformities section of the ordinance.
- *Specify any permitting or review requirements.* If the requirements will be reviewed as part of a site plan or special land use application, make sure to identify the standards and procedures that will be applied.

Map Amendments

The zoning map illustrates the geographic location and boundaries of the districts included in the ordinance. Map amendments change the zoning designation of a parcel or parcels. For many of the zoning tools highlighted in this Compendium, the steps to amend a zoning map will include:

- *Check to see if the map change is included in the Zoning Plan of the master / comprehensive plan*. If not, consider amending the plan to support the proposed map changes(s).
- *If rezoning a parcel or parcels, collect legal descriptions for affected properties*. This information will be necessary for public notice of the zoning changes, as well as for a change to the official zoning map, if approved.
- *If creating an overlay district, identify all property to be included in the overlay district.* This should include a list of tax parcels and a legal description of the overlay area. This information will be necessary for public notice of the zoning changes, as well as for a change to the official zoning map, if approved.

Amendment Procedure

The MZEA stipulates hearing and notice requirements for the adoption of amendments to a zoning ordinance, including a change to the zoning map. An amendment may be initiated by the planning commission, by the elected legislative body, or by an applicant who has some interest in the property affected.

The planning commission makes a recommendation about the amendment, and the elected body officially enacts it. A typical process is:

- *Draft an ordinance transmittal*. This document describes the changes and provides a rationale for the amendment that references goals or recommendations in the master / comprehensive plan, including those from the Zoning Plan.
- *Request staff review and comment on the proposed zoning changes.* Include administering agencies and departments as well as municipal counsel.
- *Provide public notice of the proposed amendment and associated public hearing*. The MZEA requires this notice to be given at least 15 days before the scheduled public hearing.

- *Mail notice of map amendments.* For map amendments, notices must be mailed to property owners and occupants of all properties within a 300 foot radius of the of the subject property.
- *Hold a public hearing*. The planning commission holds a hearing in accordance with the Michigan Open Meetings Act to receive comments on the proposed change.
- *Planning commission recommendation*. Following the public hearing, the planning commission votes on whether to recommend the proposed change and submits a report to the legislative body with its recommendation. For townships, the proposal and recommendation must also be submitted to the county or regional planning commission for their review and advice, unless the county/regional planning commission has waived that requirement.
- *Legislative action*. The legislative body may decide to conduct a further hearing before it votes to adopt the amendment as submitted, amend the amendment, or reject it. In townships, once a zoning amendment has been enacted by the township board, it is potentially subject to a voter referendum.
- *Publication of the amendment.* This must be accomplished within 15 days following adoption. Published notices of amendments may be printed in their entirety, or simply contain a summary of the effect of the amendment. For a map amendment (rezoning), this must include a geographic description of the properties affected.

Using the Planning Process as a Review Opportunity

Coastal ordinances are unique in that they are used to manage a changing geography. Because coastlines move landward over time, tools like setbacks and buffers must be regularly compared to current conditions and amended as necessary. Structures which were outside these regulations when they were written will become within their reach, and eventually at risk. This is just the nature of coastal adjacency. The master plan process, which is required every five years, is an excellent opportunity to do this type of assessment.

Table 4.1. Tool Options Chart (for online viewing)
Click to view in Google Sheets

Tool		Physical Character								
	With your shoreline in mind, answer the following questions.	Is the shoreline elevated, such as by bluffs?	Is the shoreline sandy?	Are there dunes along the shoreline?	Are there coarse sediment beaches along the shoreline?	Is there bedrock along the shoreline?	Are there wetlands along the shoreline?	Is the shoreline armored (seawalls, riprap, etc.)?	Are there state-designated critical dunes, sensitive environmental areas, or high-risk erosion areas along the shoreline?	Are ther designa floodpla along th shorelin
	Coastal Setback		x		x	x		x		
	Coastal Buffer									
Primary Zoning Tools	Coastal Armoring Limitation		x	x	x		x	x		x
	Coastal District									
Zoning Districts	Planned Unit Development (PUD)									
	Coastal Overlay									
	Coastal Floodplain Overlay									x
	Bluff Protection Overlay	x								
	Dune Protection Overlay			x						
Overlay Zones	Natural Features/Sensitive Area Overlay	x	x	x			x			x
	Land Divisions									
	Non-Conformity and Variance Standards							x		
	Moveable Structure Requirements									
	Marinas and Special Waterfront Uses									
Other Tools	Permit Review of State-designated Lands								x	

	Zoning Framework				Development Character					Community Priorities		
re ated hins he?	Is the character of the shoreline similar across your community?	Do you have more than one zoning district along your shoreline?	Do you have capacity to implement and review discretionary standards in order to make zoning more flexible?	Do you have any land along your shoreline which may be platted or divided?	Does development already exist along the shoreline?	Do you anticipate new development or redevelopment along your shoreline?	Is there shoreline property which is experiencing erosion?	Is there shoreline property which is experiencing flooding?	Are there existing or desired shoreline-specific uses, such as marinas?	Is your community concerned about invasive plant or animal species?	Is your community concerned about water quality?	Is it a priority for your community to preserve or create public trust access to the shoreline?
		x				x	x	x				x
										x	x	
x					x	x	x	x				x
	x					x			x			
			x									
		x										
x												
x												
				x								
					x							
					x		x	x				
									x			

Table 4.2. Tool Options Chart (for printed versions)
Click to view in Google Sheets

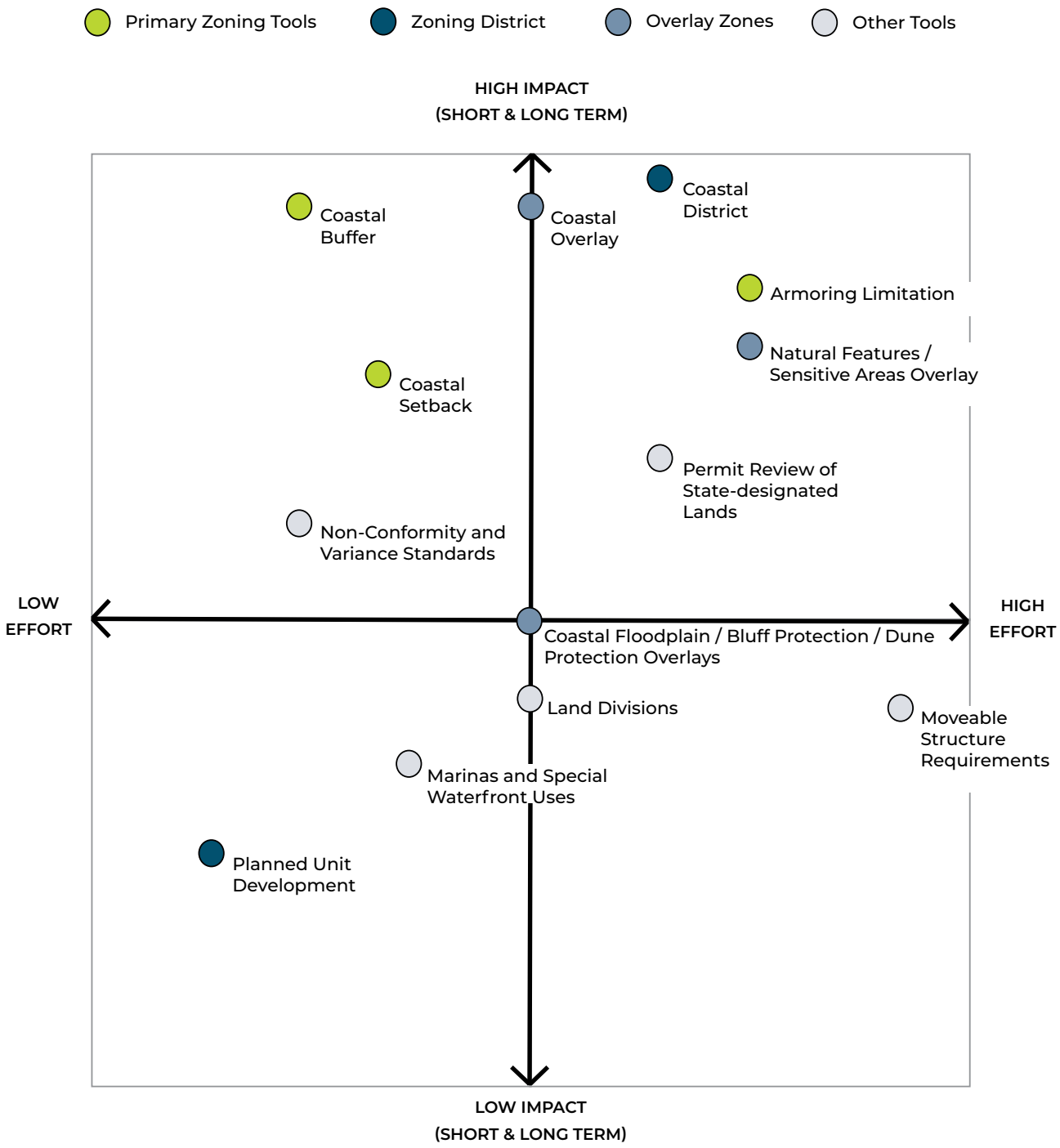
Tool		P			
	With your shoreline in mind, answer the following questions.	Is the shoreline elevated, such as by bluffs?	Is the shoreline sandy?	Are there dunes along the shoreline?	Are there coarse sediment beaches along the shoreline?
Primary Zoning Tools	Coastal Setback		x		x
	Coastal Buffer				
	Coastal Armoring Limitation		x	x	x
Zoning Districts	Coastal District				
	Planned Unit Development (PUD)				
Overlay Zones	Coastal Overlay				
	Coastal Floodplain Overlay				
	Bluff Protection Overlay	x			
	Dune Protection Overlay			x	
	Natural Features/Sensitive Area Overlay	x	x	x	
Other Tools	Land Divisions				
	Non-Conformity and Variance Standards				
	Moveable Structure Requirements				
	Marinas and Special Waterfront Uses				
	Permit Review of State-designated Lands				

Tool		Zoning Framework			
	With your shoreline in mind, answer the following questions.	Is the character of the shoreline similar across your community?	Do you have more than one zoning district along your shoreline?	Do you have capacity to implement and review discretionary standards in order to make zoning more flexible?	Do you have any land along your shoreline which may be platted or divided?
Primary Zoning Tools	Coastal Setback		x		
	Coastal Buffer				
	Coastal Armoring Limitation				
Zoning Districts	Coastal District	x			
	Planned Unit Development (PUD)			x	
Overlay Zones	Coastal Overlay		x		
	Coastal Floodplain Overlay				
	Bluff Protection Overlay				
	Dune Protection Overlay				
	Natural Features/Sensitive Area Overlay				
Other Tools	Land Divisions				x
	Non-Conformity and Variance Standards				
	Moveable Structure Requirements				
	Marinas and Special Waterfront Uses				
	Permit Review of State-designated Lands				

hysical Character					Community Priorities		
Is there bedrock along the shoreline?	Are there wetlands along the shoreline?	Is the shoreline armored (seawalls, riprap, etc.)?	Are there state-designated critical dunes, sensitive environmental areas, or high-risk erosion areas along the shoreline?	Are there designated floodplains along the shoreline?	Is your community concerned about invasive plant or animal species?	Is your community concerned about water quality?	Is it a priority for your community to preserve or create public trust access to the shoreline?
x		x					x
					x	x	
	x	x		x			x
				x			
	x			x			
		x					
			x				

Development Character				
Does development already exist along the shoreline?	Do you anticipate new development or redevelopment along your shoreline?	Is there shoreline property which is experiencing erosion?	Is there shoreline property which is experiencing flooding?	Are there existing or desired shoreline-specific uses, such as marinas?
	x	x	x	
x	x	x	x	
	x			x
x				
x		x	x	
				x

Chart 4.1. Tool Effort/Impact Chart



V. COMPENDIUM OF ZONING SOLUTIONS

Before you use the tools: Tasks necessary to create zoning regulations.

South entrance of Detroit River to the right and northeast corner of Lake Erie to the left. (NOAA/OAR/GLERL)

What tools does a community have to give the lake space to move and a natural coastal border?

This Compendium provides an array of zoning regulations that municipalities can use to protect development from damage by coastal hazards, as well as preserve the coast's character and ecology that are so integral to Michigan's economy. This section is broken into four parts:

1. Primary Zoning Tools are key tools which most directly accomplish the twin goals of giving the lake space to move and a natural coastal border.
2. Zoning Districts create a holistic set of regulations that address many aspects of land use at once.
3. Zoning Overlays apply to specific areas or features, and implement one or more targeted regulations.
4. The Other Tools section includes regulations, processes, and standards that are part of the suite of approaches that help accomplish coastal resilience.

Each tool includes a definition, an explanation of how it supports resilience, a description of how it is used and which other tools may be used in conjunction with it, and possible obstacles to implementation. It also names an example from a Michigan coastal community, and describes specific tasks required for implementing the tool in addition to the basic tasks described in the Coastal Solutions Guide chapter. Additional community examples and a map of coastal resilience tools used by communities in the state are included in Appendix C: Case Studies.

High waters in South Haven, April 2020. (J. Sandberg, Michigan Sea Grant)

1. Primary Zoning Tools

Communities considering the use of their zoning ordinance to address coastal hazards have a dizzying array of options to consider, many of which are outlined in this Compendium. Most of these tools incorporate one or more of the following Primary Zoning tools. These tools may be adopted individually, or may be included in a zoning district or overlay zone.

1.1 Coastal Setback

A coastal setback defines a minimum distance between the shoreline and development. It is established by a local unit of government through its zoning ordinance.

Why it supports resilience:

Setback requirements that are calibrated to the specific coastal conditions help to preserve the natural beach and protect development from the impacts of erosion and flooding. In addition to creating space that allows for natural coastal processes to occur, they serve to protect water quality and natural features along the coast by limiting disturbance from construction within the setback area.

How it is used:

Coastal setbacks require new buildings and additions to be a certain distance away from the shoreline or a fixed reference point, such as the bluff line or the Ordinary High Water Mark (OHWM). In addition to limiting the placement of occupied buildings, a coastal setback can apply to accessory structures, such as seawalls, decks, garages, and septic systems. Since every coast has unique characteristics, an engineering study may be necessary to identify a recommended setback line that takes into account likely lake levels, wave impacts, and erosion rate. Because this tool uses the changing shoreline as a reference, it is critical that a regular review process is established and implemented.

This tool may be incorporated into a Coastal District or Coastal Overlay, which includes other regulations in addition to a setback. It is most effective when paired with a Coastal Buffer that keeps the land within the setback in its natural condition.

Possible obstacles to implementation:

- Setbacks may be viewed as undesirable restrictions on development potential.
- Setback distances may need to be increased in the future to reflect changes in lake levels and erosion.
- In areas with existing development, a coastal setback may render buildings nonconforming, which may limit future improvements.
- The cost of a coastal engineering study may compete for scarce public resources.
- Exceptions may be needed to accommodate infrastructure such as stairs and boat launches.

Example:

City of Manistee R1 Low-Density Residential District

SECTION 803 DIMENSIONAL STANDARDS:

Within the R-1 District, the following dimensional standards shall apply:

C. Yard and Setback Requirements - The following requirements shall apply to every parcel, building or structure.

4. Waterfront Yard: The minimum setback shall not be less than one hundred (100) feet from the ordinary high water mark, provided such setback shall not apply to walkways, boat docks, boat slips, boat launches and boat houses. Provided, further that the waterfront setback shall not be less than the setbacks required by the Department of Natural Resources in a High Risk Erosion Control area.

Tasks for implementing this tool:

- Engage with the community about the potential change (see Community Engagement Approaches in Chapter VI).
- If possible, conduct an engineering study to determine the most appropriate minimum setback distance based on current and historical conditions of the shoreline and projected recession (i.e., erosion) rate. Otherwise, use GIS maps and historical data to identify an appropriate setback distance (see How much space does the lake need? in Chapter II for available data tools).
- Determine which definition of Ordinary High Water Mark to use for measurement of the coastal setback: Regulatory, Local or Natural (see Appendix A, Glossary of Coastal Terms).
- Determine whether to add the requirement as a general zoning provision that applies to all properties with coastal frontage, or as an overlay district (see Coastal Overlay Tool).
- Identify any special restrictions for the area between the shoreline and the minimum building setback distance, such as parking and driveway limitations, armoring limitation, septic tank placement, etc.
- Include a requirement to periodically review coastal conditions to determine if the setback distance should be adjusted, and establish a defined review period.
- Identify if there will be special provisions for additions onto structures that are non-conforming due to the addition of the coastal setback.
- Establish a regular review schedule and procedure to monitor the effect of coastal changes.

1.2 Coastal Buffer

Generally speaking, a buffer requirement mandates a strip of land that is not covered in impervious surface, often including requirements for specific types of vegetation. This may include native plants or designated tree and plant species, and it may also prohibit certain species that are invasive or otherwise undesirable. A coastal buffer, which may also be referred to as a shoreline buffer, is a specific requirement for a strip of land of fixed width from the edge of a water body that maintains the natural character of the coast.

Why it supports resilience:

The coast's natural features have evolved to accommodate the distinct conditions of wave action, water chemistry, soil makeup, geomorphology, and climate on that site. Allowing these features to remain

undisturbed offers the best opportunity for the natural system to function as it is intended. Native plants can stabilize soil and protect coasts from storm surges, which helps control erosion. Vegetation also absorbs rainwater and reduces runoff to maintain water quality.

Example of a coastal buffer (Tip of the Mitt Watershed Council)

How it is used:

The Zoning Enabling Act allows for local governments to implement landscaping and vegetation requirements on properties. Through zoning and land use regulations, municipalities can require property owners to preserve a percentage of natural vegetation or plant an area as necessary. Certain activities may be prohibited in the buffer, such as the application of pesticides, herbicides, and fertilizers; cutting or pruning vegetation; and beach sanding. A more general approach is to simply prohibit alteration within the buffer, granting an exception for access (such as a single path to the water). Because this tool uses the changing shoreline as a reference, it is critical that a regular review process is established and implemented.

This tool may be part of a Coastal District or Coastal Overlay, which would define other regulations in addition to keeping a strip of land in its natural condition. A Coastal Buffer adds great value to a setback by positively defining the character of the area between the setback and the water's edge.

Possible obstacles to implementation:

- In the eyes of developers and residents, vegetation requirements may be seen as a barrier to construction or recreation features.
- Property owners' preferences, which may include lawns, landscaping, a wide sandy beach, and unobstructed views of the water, may not align with the natural condition of the coast.

Examples:

Jurisdictions around Lake Charlevoix containing municipalities that border Lake Michigan

Although the level of protection varies, many jurisdictions around Lake Charlevoix have coastal buffer zoning standards. This 2016 plan prepared by the Land Information Access Association (LIAA), and funded by Tip of the Mitt Watershed Council and the Michigan Coastal Management Program, outlined the various coastal protections that communities have incorporated into their ordinances.

Evangeline Township Natural Vegetation Waterfront Buffer Strip

Section 3.06:

B. A Natural Vegetation Waterfront Buffer Strip shall meet the following specifications:

1. The Natural Vegetation Waterfront Buffer Strip shall be located between the water's edge and all structure(s), except docks, shoreline protection structures, and waterfront-viewing platforms as allowed in the district regulations.

2. The minimum depth shall be twenty-five (25) feet and shall extend across the full width of the waterfront portion of the lot, except that the depth shall be fifty (50) feet for lots with steep slopes as identified on the Evangeline Township Shoreline Steep Slopes Map (Figure 3-2). (effective April 21, 2010)

3. The Natural Vegetation Waterfront Buffer Strip shall be located upland from the High-Water Level Elevation as defined.

4. The Natural Vegetation Waterfront Buffer Strip shall be planted with a mixture of trees, which at maturity shall obtain a minimum height of 50 feet, and low-growing woody shrub species native to the area and suitable for the site. Trees shall be scattered throughout the strip, planted at a minimum of ten (10) trees per one hundred feet (100') of lake frontage, and sited in a manner that allows for "filtered" views of the water from the dwelling. Tree species shall be of a sufficient size and caliper (minimum 2") to compete with the surrounding vegetation, and shall provide coverage of 75% of the area within the Natural Vegetation Waterfront Buffer Strip as measured at the drip lines the trees are expected to have at maturity (for guidance, see Figure 1 in this Section). Shrubs shall be of sufficient size and planted at spacings that shall provide complete coverage of the ground within the Natural Vegetation Waterfront Buffer Strip, except as allowed in district regulations for a viewing platform and path, within a period of two (2) full growing seasons.

Tasks for implementing this tool:

- Determine if the buffer requirement is to be applied to all coastal properties through the ordinance's General Provisions, or as a requirement of certain districts or overlay zone(s).
- Inventory the coast to determine appropriate buffer depth and character of native vegetation.
- Determine which definition of Ordinary High Water Mark to use for measurement of the coastal buffer depth: Regulatory, Local or Natural (see Glossary of Coastal Terms).
- Using the inventory information, draft a provision that requires preserving native vegetation within a certain distance from the shoreline and limits unnecessary removal during construction. Specify acceptable native plant species and prohibited invasive species within the buffer area.
- Draft a provision requiring a permit or site plan application to include a vegetation preservation and landscaping plan that demonstrates compliance with the buffer standards.

- Draft review criteria to determine whether proposed developments sufficiently preserve vegetation.
- Identify if there will be special provisions for coastal areas that are non-conforming due to the lack of the buffer.
- Create enforcement measures and establish an inspection process to ensure compliance before, during, and after construction.
- Create materials for homeowners, developers, and landscapers on the benefits of native vegetation and the importance of implementing the requirements effectively.
- Establish a regular review schedule and procedure to monitor the effect of coastal changes.

Riprap: A form of coastal armoring (Mark Breederland, Michigan Sea Grant)

1.3 Coastal Armoring Limitation

A coastal armoring limitation prevents or restricts the installation and maintenance of artificial structures such as seawalls, rock revetments, or other "hard" stabilization methods to address erosion. Coastal armoring disrupts the movement of sediment from nearshore to the shoreline, interfering with natural erosion processes that replenish beaches and accelerating erosion on nearby coastal areas. Armoring can also hinder the public's ability to walk the public trust coast, impact the viewshed, and present a safety hazard.

Why it supports resilience:

A limitation on this type of structure, coupled with zoning tools that move development further landward from the shoreline, can protect and preserve the natural beach and the public trust access.

How it is used:

There are several ways a community can prevent coastal armoring. The Michigan Sea Grant publication "Best Practices in Great Lakes Shoreline Management: A Guide for Michigan Municipalities" walks through possible approaches based on the existing condition of the shoreline. A police power (general) ordinance would subject both new and existing structures to the limitation, whereas a zoning ordinance limitation would apply to new development only.

If armoring is limited through zoning, the existing armoring would be subject to nonconformity protections, and these would need to be evaluated as part of an ordinance amendment. A zoning limitation could be included in the ordinance's General Provisions section, or it could be incorporated into a Coastal District or a Coastal Overlay Zone.

Possible obstacles to implementation:

- Coastal property owners may express concerns about protecting their investment.
- Coastal property owners experiencing the effects of their neighbors' existing armoring may feel additional pressure to reduce these effects by armoring their own shoreline.
- The ecological impacts of armoring are not widely known, requiring an educational campaign.

Example:

Chikaming Township Shoreline Armoring Ordinance

Ordinance 147. An ordinance to secure the public health, safety, and general welfare of the property owners, residents, and visitors of Chikaming Township by prohibiting the installation and maintenance of hardened shoreline armoring that interfere with and degrade the natural and dynamic characteristics of the Lake Michigan shoreline and infringe on the public trust and thereby ensuring the use and enjoyment of private shoreland properties.

Section II Definitions

(1) "Shoreline armoring" means armoring comprised of concrete, boulders, stone, gravel, steel, iron, timber, or other similar materials that are designed and intended, either as the principal purpose or an incidental purpose, to interrupt the natural cross-shore or longshore movement of sand, gravel, and other sediments within or along a shoreline or watercourse. Shoreline armoring includes, but is not limited to, the placement of seawalls, bulkheads, riprap, revetments, groins, and breakwaters. Shoreline armoring does not include sandbags, Geotubes®, and sand fences as defined below.

Section III: Prohibition on Shoreline Armoring and Permitting Requirements for Sandbags and Geotubes

(1) It shall be unlawful to in any way commence installation of, actually install, or place shoreline armoring upon or within the ground anywhere within Chikaming Township.

Tasks for implementing this tool:

- Engage with the community about the potential change (see Community Engagement Approaches in Chapter VI).

- Conduct a shoreline analysis to assess wave information, lake levels, sediment transport rates, and wave run-up extents. This can help provide a scientific basis for an armoring limitation.
- Determine whether to add the limitation as a police power (general) ordinance that would subject both new and existing structures to the limitation, or a zoning ordinance limitation would apply to new development only.
- Identify any special considerations for the limitation, such as temporary or emergency armoring.
- If a zoning amendment, identify if there will be special provisions for existing non-conforming situations.

2. Zoning Districts

A specific zoning district is the most comprehensive approach to regulating property along the coast. It includes a set of regulations that define the use, intensity, and function of development in a defined geographic area, which is shown on the zoning map. This zoning district may "bundle" the Primary Zoning Tools, as well as incorporate approaches noted in the Other Tools section below.

2.1 Coastal District

A coastal district is a type of zoning district that regulates land use and development on properties that are adjacent to the water. This approach usually applies to a group of properties with similar uses and coastal characteristics and is structured like a residential or commercial zoning district. A coastal district is different from a coastal overlay zone, which provides an additional layer of regulations that span an existing zoning district or districts.

Why it supports resilience:

A coastal zoning district can include a comprehensive set of requirements for the unique needs of coastal properties, including protection from erosion, flooding, and rising lake levels. It also highlights the special character of properties along the coast.

How it is used:

This tool requires an amendment to the zoning ordinance to add a new zoning district, and an amendment to the map to include properties in the district. Coastal districts will typically include a list of allowable uses and special land uses as well as area, height and placement requirements, similar to other zoning districts. A coastal district may address specific natural features as well as view protections.

A coastal district ordinance may combine with other tools to implement a setback, impose buffer requirements, restrict coastal armoring, and include waterfront uses such as marinas and resorts. Where it establishes a setback or buffer requirements, a regular review schedule and procedure is necessary to address changing conditions.

Possible obstacles to implementation:

- Creating a new district is an intensive process that must be clearly linked to the Zoning Plan in the master / comprehensive plan
- Existing development within the new district may become nonconforming if the new zoning requirements are more restrictive than the previous district.

Example:

Garfield Township (Mackinac County) Great Lakes Shoreland District

Section 3.14: The Great Lakes Shoreland District is "intended to protect the fragile ecosystem in the coastal area, while at the same time permitting residential and recreational development and limiting other uses that are incompatible with the area. Any development in the Great Lakes Shoreland District must be accomplished in a manner that preserves the qualities found within the Lake Michigan shoreline as well as protecting any endangered species."

See also: Fruitland Township Lake Michigan Shoreline District

Tasks for implementing this tool:

- Engage the community about the potential change (see Community Engagement Approaches in Chapter VI).
- Use GIS and historical data to determine what parcels would benefit most from being included in a coastal zoning district.
- Review the principal and accessory uses allowed by right in the current zoning district and determine which of these should be included in the coastal district. If special land uses are proposed, list these and link to the related review standards and approval process (usually in a different section of the ordinance).
- Identify requirements for development in the district, such as a coastal setback, natural features protection, parking limitations, armoring limitation, septic tank placement, etc. If building form or viewshed restrictions are to be included, create diagrams to illustrate the regulations.

2.2 Planned Unit Development (PUD)

A planned unit development (PUD) provision in the zoning ordinance identifies conditions that must be met before a PUD zoning district or PUD site plan may be approved for a property. The requirements for PUDs are found in the Michigan Zoning Enabling Act (Sec. 125.3503).

Why it supports resilience:

The purpose of planned unit development, according to the MZEA, is to "achieve integration of the proposed land development project with the characteristics of the project area." PUDs allow for flexible site design that can address the unique characteristics and challenges of the coastal environment. They are often used to "cluster" or group buildings on a site to preserve natural features and open space.

How it is used:

The local unit's zoning ordinance identifies the standards and conditions for approval of a PUD, which could result in either a rezoning of a parcel to a special PUD zoning district or as an overlay zone that allows flexibility in site development if certain conditions are met. Many communities require applicants for PUDs to demonstrate that their development provides a substantial benefit to the community. These benefits are often defined by the community, and could include coastal health and resilience.

PUD provisions applying to coastal properties could implement a setback, impose buffer requirements, restrict coastal armoring, and include waterfront uses such as marinas and resorts. Where it establishes a setback or buffer requirements, a regular review schedule and procedure is necessary to address changing conditions.

Box 5.1. PUDs in the Michigan Zoning Enabling Act (Public Act 110 of 2006)

Section 125.3503

(2) The legislative body may establish planned unit development requirements in a zoning ordinance that permit **flexibility** in the regulation of land development, encourage **innovation in land use** and variety in design, layout, and type of structures constructed, achieve economy and e**fficiency in the use of land, natural resources**, energy, and the provision of public services and utilities, **encourage useful open space**...

(9) Final approval may be granted on each phase of a multiphased planned unit development if each phase contains the necessary components to insure protection of natural resources and the health, safety, and welfare of the users of the planned unit development and the residents of the surrounding area.

Possible obstacles to implementation:

- Communities may resist PUD developments due to concerns about changes in neighborhood character and incompatibility with adjoining uses.
- Planning and coordinating PUD cluster design standards can require significant capacity from the local unit to ensure that the public benefit is adequate to compensate for the zoning flexibility, and that the benefit is realized.
- Planned Unit Developments require significant upfront investment from the developer.

Example:

Casco Township Planned Unit Development

Section 16.01: The intent of this Chapter is to permit coordinated development on larger sites in order to achieve most or all of the following:

5. Protect and preserve natural resources, such as Lake Michigan, the Black River, and natural features, including but not limited to: soils, topography, wetlands, woodlands, steep slopes, dunes, natural habitat, streams, rivers, and lake views.

Tasks for implementing this tool:

- Identify benefits and/or conditions that support the creation of a PUD in the comprehensive plan and include the desired features in the Zoning Plan.
- Engage the community about the potential change (see Community Engagement Approaches in Chapter VI).
- If a new PUD ordinance is proposed to be added, determine whether it will be treated as a zoning district or an overlay zone.
- Identify any special requirements for the PUD, as well as any zoning requirements that are not subject to flexibility.
- Identify an appropriate review and approval process, either through rezoning (legislative) or site plan or permit (administrative) approval.

3. Overlay Zones

An overlay zone (or district) is a mapped area that introduces an additional standard or regulation over areas that may not align with zoning district boundaries. Overlay zones can help provide consistent management of land use and development along coasts that encompass multiple "base" zoning districts with different uses or characteristics. They may include one or more of the primary zoning tools, as well as incorporate approaches noted in the Other Tools section below.

Figure 5.1. Looking at the City of Grand Haven without the Sensitive Area Overlay (GIS data from Ottawa County).

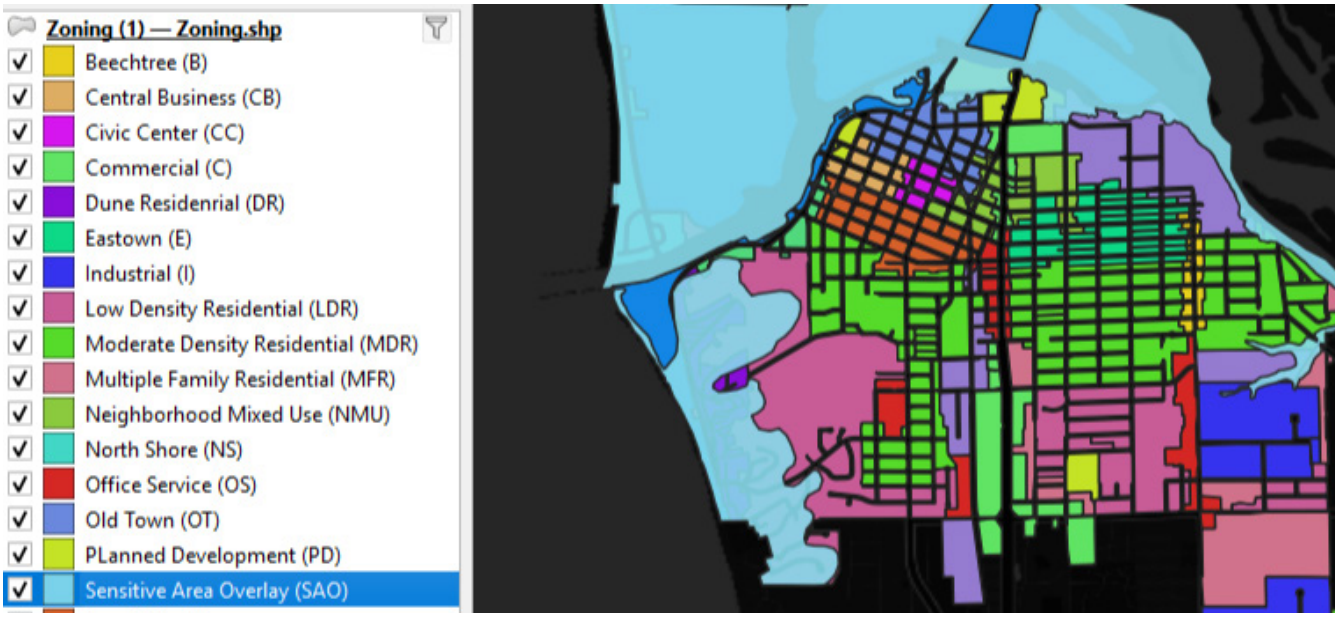


Figure 5.2. Looking at the City of Grand Haven with the Overlay, shown in light blue (GIS data from Ottawa County). Note how the overlay covers multiple "base" zoning districts.

3.1 Coastal Overlay

In the case where coastal properties are located in several zoning districts, an overlay zone can "layer" additional zoning requirements over these properties without changing the underlying zoning.

Why it supports resilience:

Similar to a coastal zoning district, a coastal overlay zone enables communities to include stricter regulations to protect coastal areas. An overlay zone minimizes disruption to overall land use patterns already in place.

How it is used:

Coastal overlays implement a few key regulations across more than one district. They are appropriate for coasts that host diverse uses and zoning classifications and therefore do not lend themselves to a single district.

A coastal overlay ordinance may implement a setback, impose buffer requirements, restrict coastal armoring, and include waterfront uses such as marinas and resorts. Where it establishes a setback or buffer requirements, a regular review schedule and procedure is necessary to address changing conditions.

Possible obstacles to implementation:

- The community may resist an additional layer of regulation on top of the existing zoning restrictions.
- Properties to be included in the overlay district must be mapped.
- The additional layer of regulation increases the complexity of zoning administration.

Examples:

City of Grand Haven Beach Overlay District

40-423. Beach Overlay District 40-423.01 Intent. The Beach Overlay District (B-OD) is an overlay district intended to prevent damage to private property along the shore of Lake Michigan, to prevent damage to public trust shorelands, and to preserve the character of those public trust shorelands, which constitute a valuable public resource and an important part of the identity of the community.

…These regulations are intended to prevent the construction of structures and implementation of other measures that would have deleterious effects on neighboring private properties and on public trust shorelands more broadly, to preserve the character of public trust shorelands along the Lake Michigan coast, and to protect vistas from neighboring public parks. These regulations are supported by the Master Plan.

Chocolay Township Lake Superior Shoreline / Dune Protection Overlay District

5.2 (A) Intent: The provisions of the Lake Superior Shoreline/Dune Protection Overlay District are intended to protect the lake shore adjacent to Lake Superior in Chocolay Township in order to insure property values are protected; existing and future structures and properties are protected from erosion and flooding; and that this special ecosystem is preserved.

In order to facilitate this purpose, this overlay zone has been established to overlap any existing zoning districts, and their respective regulations, along Lake Superior in a width from the erosion hazard line to

encompass the entire foredune, or to a maximum of 100 feet landward, whichever is less, where the natural conditions of the shoreline, specifically the foredune and/or associated vegetation, shall be preserved in its natural state.

Tasks for implementing this tool:

- Engage the community about the potential change (see Community Engagement Approaches in Chapter VI).
- Conduct an inventory of the coast using aerial photographs and coastal mapping tools (see section on How much space does the lake need? in Chapter II) to identify areas most at risk of development, in addition to the location of current structures and potential development parcels.
- Using data from the inventory, determine what types of regulations will be most protective of the coastal character.
- Identify all coastal parcels to be included in the overlay zone.
- Identify where in the zoning ordinance to add the coastal protection provisions. This may be in a chart, or it may warrant a separate section. The advantage of a separate section is that any special limitations between the shoreline and the setback distance, such as natural features protection, parking limitations, armoring limitation, septic tank placement, etc., may be listed.
- Determine the appropriate review process, either through a site plan or construction permitting.

3.2 Coastal Floodplain Overlay

Coastal floodplains are low-lying areas at risk of flooding from storm surge and high-velocity waves. Flood Insurance Rate Maps (FIRMs) developed by the Federal Emergency Management Agency (FEMA) help identify areas at risk of flooding and can be used as a tool for creating regulations that determine where and how development may occur in those areas.

Why it supports resilience:

Floodplain regulation is intended to reduce future damage to property and protect human safety, which reduces a community's vulnerability to coastal hazards.

How it is used:

Counties that border the Great Lakes have FIRMs created by FEMA that identify locations and elevations for Special Flood Hazard Areas (Zones V, VE and A). The Michigan Building Code allows local units of government to adopt regulations that are more stringent than the state minimums, meaning they can require higher freeboard or other measures to enhance flood protection. A floodplain overlay district adds these additional building restrictions on the location and elevation of new or substantially improved construction, while keeping the base zoning in place. Coastal floodplain provisions may be included in a natural features or sensitive area overlay district. They may also be used in conjunction with permit review of state-regulated lands. These designated areas change over time, and the community should plan on updating the regulation as new information becomes available.

Possible obstacles to implementation:

- Not all coastal communities have updated FIRM maps from FEMA.
- Maps may become inaccurate due to rapidly changing climate conditions.

Example:

City of St. Joseph Floodplain Overlay District - Article IX - Special Districts

9.6.1.Intent. Certain portions of the City of St. Joseph are subject to periodic or seasonal inundation which may result in flood damage to property; health and safety hazards of loss of life; disruption of commercial, industrial, and municipal and other economic activities; and adverse effects upon the general welfare of the community. It is the purpose of this section to significantly reduce hazards to Persons and damage to property as a result of flood conditions in St. Joseph, and to comply with the provisions and requirements of (1) the National Flood Insurance Program that are incorporated in 42 U.S.C. 4001-4128, and subsequent enactments and the rules and regulations promulgated in furtherance of this program by the Federal Emergency Management Agency, as published in the Federal Register, vol. 44 CFR, Part 59, October 1, 1995 and subsequent amendments, and (2) the relevant requirements of the Michigan Natural Resources and Environmental Protection Act, PA 451 of 1994, as amended. Further, the objectives of this section include:

A. The protection of human life, health and property from the dangerous and damaging effects of flood conditions.

B. The minimization of public expenditures for flood control of projects, rescue and relief efforts in the aftermath of flooding, repair of flood damaged public facilities and utilities, and the redevelopment of flood damaged homes and neighborhoods, commercial and industrial areas.

High water levels near Lake Michigan (Harbor Springs) (Mark Breederland, Michigan Sea Grant)

C. The prevention of private and public economic loss and social disruption as a result of flood conditions.

D. The maintenance of stable development patterns not subject to the blighting influence of flood damage.

E. To insure that the public has access to information indicating the location of land areas subject to periodic flooding.

F. To preserve the ability of floodplains to carry and discharge a base flood.

Tasks for implementing this tool:

- Engage the community about the potential change (see Community Engagement Approaches in Chapter VI).
- Conduct an inventory of the coast using FEMA FIRM maps, if available. Map out the Special Flood Hazard Area (SFHA), which will include Coastal High Hazard Area Zones V and VE.
- Identify all coastal parcels that would be subject to the floodplain development restrictions and determine whether to add these regulations as part of an overlay district or as a general zoning provision that applies to all properties with coastal frontage.
- To identify the extent of an overlay district, compare the mapped flood zones with existing zoning districts and parcel boundaries, and identify an overlay district boundary that encompasses the flood hazard zone(s).
- Using data from your inventory, determine what types of regulations will be most protective. These could include:
  - Limitation of buildings in a special flood hazard zone.
  - Require new construction located in a floodplain to have a Base Floor Elevation (BFE) of 2 feet of freeboard [or 1 foot above the 500-year flood elevation]
- Determine the appropriate review process, either through a site plan or construction permitting.
- Identify where in the ordinance to add the floodplain regulations. This may be in a chart, or it may warrant a separate section. The advantage of a separate section is that any special limitations, such as natural features protection, parking limitations, armoring limitation, septic tank placement, etc., may be listed.

Alternatives:

- Regulate the location and/or elevation of all property located in Special Flood Hazard Zones without creating an overlay district. These regulations would likely be contained in the "Special Provisions" section of the Zoning Ordinance.
- Identify any current use located in a Special Hazard Flood Zone as a Special Land Use that requires approval for proposed expansion or replacement.

3.3 Dune Protection Overlay

The Lake Michigan and Lake Superior coasts are characterized by extensive coastal dune systems, covering about 275,000 acres.[1] While more than 74,000 acres of dunes have been designated by the State of Michigan as Critical Dune Areas, where development, silviculture, and recreation activities are regulated and a permit

1 Michigan Sea Grant, "Coastal Habitats." https://www.michiganseagrant.org/topics/ecosystems-and-habitats/coastal-habitats/ Retrieved May 2025.

is required under Part 353, Sand Dunes Protection and Management, of the state Natural Resources and Environmental Protection Act (see Permit Review of State Regulated Lands), that leaves the majority of these spectacular Michigan resources entirely dependent on local protection. A dune protection overlay can preserve dune systems outside of the state-regulated areas.

Why it supports resilience:

A dune protection overlay can prevent disturbances that cause erosion and sedimentation of sand into the lake, wetlands, structures, and roads, as well as discourage fragmentation of a unique coastal ecosystem.

How it is used:

Regulations in a dune protection overlay focus on limiting construction disturbance and soil movement, stabilizing slopes, replanting/maintaining vegetation to limit erosion, and invasive species management. Because dunes naturally shift over time, even with regulation in place, regular review and monitoring is needed.

Box 5.3. Sand Dunes Protection and Management Act (Act 451 of 1994)

Section 324.35302

(a) The critical dune areas of Michigan are a **unique, irreplaceable, and fragile resource** that provide significant recreational, economic, scientific, geological, scenic, botanical, educational, agricultural and ecological benefits to the people of Michigan and to people from other states and countries who visit this resource.

Dune protection provisions may be included in a natural features or sensitive area overlay district. They may also be used in conjunction with permit review of state-regulated lands.

Possible obstacles to implementation:

- Potential economic interests, such as development and sand mining, may prioritize short-term gains over long-term resilience.

Example:

Pere Marquette Charter Township Critical Dune Overlay District

109-20.03 - AREA AFFECTED.

(a)The provisions of this Dune Overlay Zone apply to all lands so depicted on the zoning maps which are a part of this Ordinance. These lands include the entire critical dune area as designated by the Michigan Department of Environment, Great Lakes and Energy pursuant to part 353 of the Natural Resources and Environmental Protection Act (MCL 324.35301 et seq.), and to such other lands as locally designated and depicted thereon. Locally designated sand dunes together with dunes designated under such part shall be known as critical dune areas for the purpose of this Ordinance. Lands that are within 250 feet of a critical dune area, that are determined by the planning commission to be essential to the hydrology, ecology,

topography, or integrity of a critical dune area shall also receive all the protection afforded to critical dunes in this overlay zone, even if not so depicted on the Pere Marquette Charter Township Zoning Maps.

(b) This overlay zone establishes regulations which apply in addition to those of the underlying district. Lot size, density, and front and side setbacks shall be as established in the underlying district, except that lots created after the effective date of this section shall be at least 250 feet in width and shall have a ratio of lot width to lot depth of not less than 1:5. Where the provisions of this zone conflict with those of the underlying district, the provisions of the Dune Overlay Zone shall supersede.

Tasks for implementing this tool:

- Engage the community about the potential change (see Community Engagement Approaches in Chapter VI).
- Conduct an inventory of the coast using aerial photographs, Michigan Natural Resources Inventory and US Geological Survey Land Cover maps to identify dune systems most at risk of erosion and fragmentation, in addition to the status of current structures and potential development parcels. NOTE: The Michigan Department of Environment, Great Lakes and Energy embarked on a project in April 2025 to update sand dune maps in the state and assess critical dune areas.
- Using data from your inventory, determine what types of regulations will be most protective.
- Identify all coastal parcels to be subject to the dune protection provisions and determine whether to add the requirement as part of an overlay district or general zoning provision that applies to all properties with coastal frontage.
- Identify where to add the bluff protection provisions. This may be in a chart, or it may warrant a separate section. The advantage of doing a separate section is that any special limitations between the dune line and structures and restoration requirements may be listed out.
- Determine the appropriate review process, either through a site plan or construction permitting.

Resources for implementing this tool:

Valuing Michigan's Coastal Dunes: GIS Information and Economic Data to Support Management Partnerships (2018), Michigan Environmental Council

Building a Home in the Dunes (2012), Preserve the Dunes, Inc.

3.4 Bluff Protection Overlay

Bluffs are steep slopes, often adjacent to a body of water, that have been formed by erosion over time. Communities can protect bluffs from construction impacts by including special setback provisions in the zoning ordinance or including these areas in a natural features overlay zone (see Natural Features Overlay Tool). The state of Michigan regulates construction on bluffs which are in High Risk Erosion Areas. In those areas, the municipality may assume authority for regulating HREAs (see the Permit Review of State-designated Lands).

Why it supports resilience:

A bluff protection overlay can minimize the impacts of erosion, undermining, slumping, or collapse of the bluff on existing and proposed development and protect the adjacent water body from excess sedimentation.

How it is used:

Bluff protection overlays typically provide setback requirements for the top of the bluff, as well as limits on structures and activities on the face (slope) and at the toe of the bluff. These setbacks must be periodically reviewed to accommodate the landward movement of the coast.

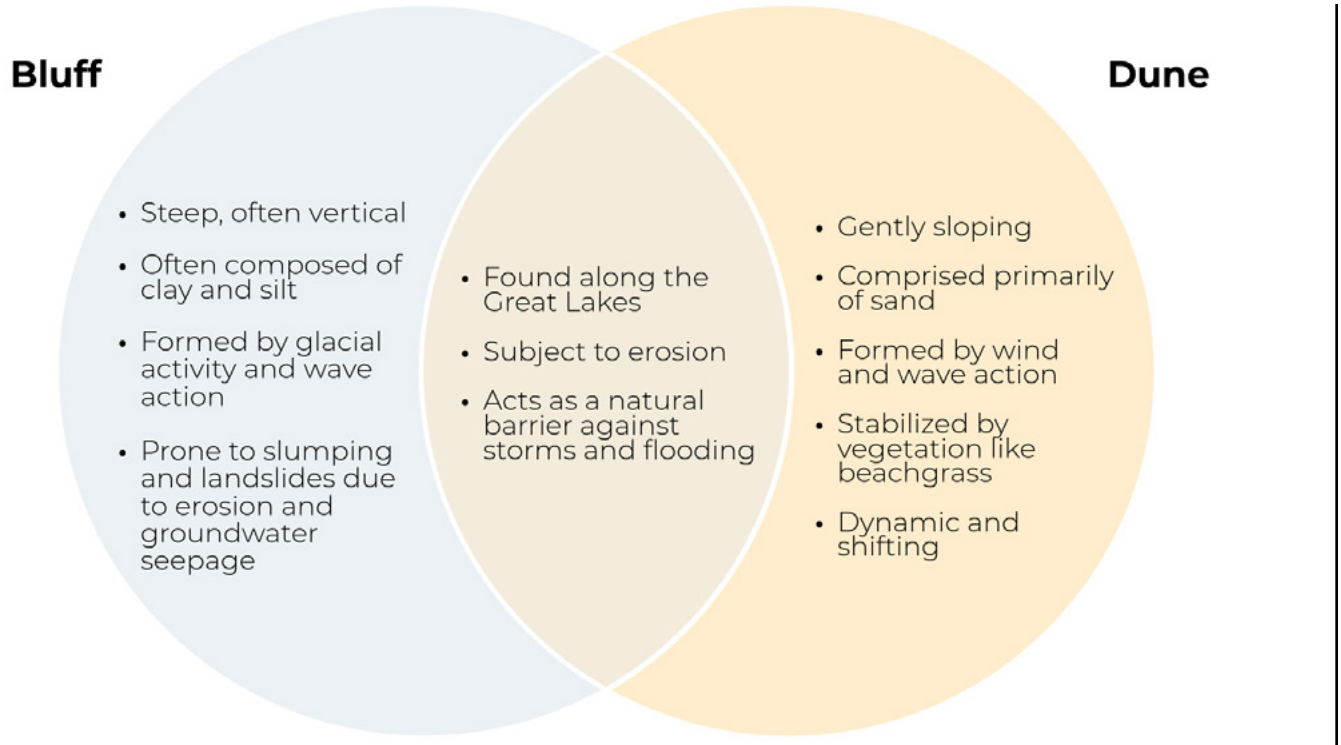


Figure 5.3. Venn diagram of a bluff versus a dune.

Bluff protection provisions may be included in a natural features or sensitive area overlay district. They may also be used in conjunction with permit review of state-designated lands.

Possible obstacles to implementation

- Not all bluff protections are good solutions (i.e., seawalls) so the regulations need to be carefully considered.

Example:

Emmet County Shoreline Bluff Protection Zone

Zoning Ordinance 15-1, 22.10.2 Regulation of Shoreline Bluff Protection Zone:

A. Except as otherwise provided in this Section, excavation or construction activity is prohibited within the Shoreline Bluff Protection Zone. The Shoreline Bluff Protection Zone includes an area within fifteen (15) feet

of the top of the bluff, the face of the Shoreline Bluff as it extends lakeward from the top of the bluff to the toe of the bluff and the area extending lakeward fifteen (15) feet from the toe of the bluff. For purposes of this Section, the following terms shall mean:

1. Top of the Bluff is the point where the slope toward Lake Michigan first exceeds a grade of 33%.

2. Toe of the Bluff is the point where the slope toward Lake Michigan first decreases to a grade of less than 33%.

B. This Section shall not apply to:

1. Stairways. The installation, repair and maintenance of open stairways, open landings of 200 square feet and under, pathways and trams, all intended to access the areas below the bluff.

2. Remodeling. Interior remodeling, changed floor plans, re-roofing, re-siding, replaced walls and the like, if no footing or foundation work within the Bluff Protection Zone is involved.

3. Existing driveways. The reconstruction of existing driveways including the replacement of existing surface materials and maintaining the existing driveway width or otherwise where no new excavation work would be needed.

4. Utilities. The repair, replacement or reconstruction of utility services to include all elements of sanitary sewage systems, wells and water services and other existing accessory service utilities.

Tasks for implementing this tool:

- Engage the community about the potential change (see Community Engagement Approaches in Chapter VI).
- Conduct an inventory of the coast using aerial photographs and US Geological Survey topographic maps to identify bluffs most at risk of erosion due to slope and underlying geology, in addition to the status of current structures and potential development parcels.
- Using data from your inventory, determine what types of regulations will be most protective.
- Identify all coastal parcels to be subject to the bluff protection provisions and determine whether to add the requirement as part of an overlay district or general zoning provision that applies to all properties with coastal frontage.
- Identify where to add the bluff protection provisions. This may be in a chart, or it may warrant a separate section. The advantage of a separate section is that any special limitations, such as natural features protection, parking limitations, armoring limitation, septic tank placement, etc., may be listed.
- Determine the appropriate review process, either through a site plan or construction permitting.

3.5 Natural Features/Sensitive Area Overlay

Coastal natural features such as wetlands, waterbodies, dunes, forests, steep slopes, animal habitats, and fragile ecosystems may be protected in a natural features or sensitive area overlay zone. Natural features overlay zones can include restrictions on activities and construction in sensitive natural areas to reduce

vulnerability to damage from human activities.

Why it supports resilience:

Natural features overlay zones help maintain native vegetation, geomorphic features, and soils that can absorb storm surges, reduce flood impacts, and protect development along the coast. Overlay zones can also protect habitat that allows for wildlife migration and connectivity of coastal ecosystems, which can support the long-term resilience of natural systems.

How it is used:

Natural features overlays typically include definitions of protected features, limits of disturbance, mitigation standards, the permitting process, and ongoing maintenance requirements. They may also require buffers of a certain size around protected features.

A natural features / sensitive areas overlay may combine specific protections for coastal floodplains, bluffs, dunes, and other features as designated by the community into a single ordinance. It may also be used in conjunction with permit review of state-designated lands. Where it establishes a setback or buffer requirements, a regular review schedule and procedure is necessary to address changing conditions.

Possible obstacles to implementation

- Property owners may express concerns about the added maintenance of preserving protected natural features.
- Property owners, and communities too, may have concerns about limiting development potential beyond traditional zoning requirements.
- Cultural preferences may include cultivated lawns or landscaping that does not align with the natural condition of the coast.

Examples:

City of Grand Haven Sensitive Area (SA) Overlay District

Section 40-422.01: The City of Grand Haven has a Sensitive Area (SA) Overlay District that covers floodplains, wetlands/streams, dunes/Lake Michigan shoreline, vegetation/habitat, species of concern, and slopes. Land development within a SA Overlay District requires compliance with strict conditions set to protect areas of environmental significance.

Tasks for implementing this tool:

- Engage the community about the potential change (see Community Engagement Approaches in Chapter VI).
- Conduct an inventory of the coast using aerial photographs and coastal mapping tools (see Chapter II on How much space does the lake need?) to identify areas most at risk of development, in addition to the location of current structures and potential development parcels.
- Identify and create definitions for the natural features to be protected.

- Using data from your inventory, determine what types of regulations will be most protective of the feature, such as required buffers or mitigation requirements.
- Identify all coastal parcels to be subject to the natural features protection provisions and determine whether to add the requirement as part of an overlay district or general zoning provision that applies to all properties within the municipality.
- Identify where to add the natural features protection provisions. This may be in a chart, or it may warrant a separate section. The advantage of a separate section is that any special requirements for natural features protection may be listed, such as buffer requirements, restoration and mitigation standards and long-term management plans.
- Determine the appropriate review process, either through a site plan or construction permitting.

4. Other Tools

A variety of other regulatory and planning approaches can be adopted by municipalities to support their coastal resilience goals.

4.1 Land Divisions

The Michigan Land Division Act governs how land may be subdivided into smaller parcels for development, sale, or other uses. It regulates the number and timing of **metes and bounds splits** (i.e., parcels) and the process for **platted subdivisions** (i.e., lots) of land. The Michigan Condominium Act provides the legal framework for establishing **site condominiums**, which many communities treat as a land division. For each of these land division methods, local units of government may adopt an ordinance to require compliance with zoning regulations or development standards and set up a process for review and approval.

Why it supports resilience:

Reviewing land divisions and developing standards specific to coastal concerns can help prevent overdevelopment in coastal areas and protect natural features such as dunes, wetlands, and vegetated zones. Deeper or "long" lots allow for development to be located further landward from the shoreline, reducing the risk of damage from erosion and flooding.

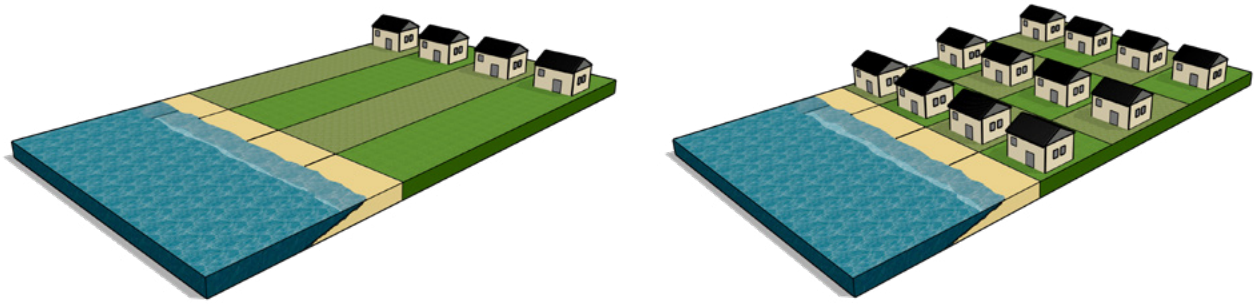


Figure 5.4. Diagram of a long lots (left) versus a typical lot (right). The longer lot allows for future retreat and coastal protection.

How it is used:

Local governments may adopt a review process for land undergoing a division and include development standards that align with zoning ordinances. The process can ensure that new lots/parcels/units meet requirements for size, shape, access, and compatibility with the surrounding area. Land division standards may be incorporated into a coastal district or coastal overlay.

Possible obstacles to implementation:

- Smaller communities or those lacking resources may find it difficult to track land divisions until after they have been completed.
- Land available to implement long lots may be limited by existing development, including roads.

Examples:

Hampton Township Land Division Ordinance

Ordinance No. 54: The purpose of this ordinance is to implement the provisions of the State Land Division Act (1967 PA 288, as amended, formerly known as the Subdivision Control Act), to prevent the creation of parcels of property which do not comply with the applicable ordinances and said Act, to minimize potential boundary disputes, to maintain orderly development of the community, and otherwise provide for the health, safety, and welfare of the residents and property owners of the Township by establishing reasonable standards for prior review and approval of land divisions within the Township.

Fruitland Township Lake Michigan Shoreline District

Section 6.01a, Lot Compliance standard: No waterfront lot or parcel shall be created unless said lot or parcel meets the minimum lot width, area, and dimensional standards and requirements of this district, in addition to the above-mentioned lake front requirements.

Tasks for implementing this tool:

- If a new land division ordinance is proposed to be created, determine the desired review and approval process that ensures compliance with zoning and development standards.
- Identify development standards that must be applied in addition to those required by the state Land Division Act. Examples could include greater width and depth for waterfront properties to allow for future building relocation and natural features protection and limitations on "flag" or "keyhole" lots that provide access to the waterfront.

4.2 Nonconformity and Variance Standards

Structures or uses that existed legally before current zoning ordinances were enacted, but no longer meet current zoning requirements, are considered to be "nonconforming." Legally established nonconforming uses or structures may continue to exist, as long as no change is proposed. If a property owner proposes an alteration or addition to a nonconforming structure or a change in use, the municipality's zoning ordinance provides a process for determining if the change is allowable. A variance is a legal exception to a zoning requirement that is granted by a local zoning board, allowing deviations such as from setback distances or building heights.

Why it supports resilience:

A review process and standards for nonconforming structures and uses that are tailored to coastal properties can provide protections from ill-advised additions into sensitive areas. Alternatively, variances that would facilitate the protection of the coast, such as reducing a setback requirement to allow a structure to be placed more landward or allowing a height exception to elevate buildings above flood levels, would allow for more resilient development.

How it is used:

To obtain a variance, property owners must demonstrate that strict adherence to zoning laws would cause practical difficulty in making a reasonable use of their land. Setting forth nonconformity/variance standards can eliminate variance requests that do not align with the community's long-term plan, or at least provide the community with legal justification for denying them.

Nonconformity and variance standards become especially relevant after new regulations are implemented, such as a coastal setback or armoring limitation. Existing development that does not meet the new standards will be regulated by the nonconformity provisions of the ordinance, and changes to it will be more likely to prompt variance requests.

Possible obstacles to implementation:

- The zoning appeal process can be bureaucratic and confusing to property owners.
- Appeal decisions are made by appointed citizen members of the Zoning Board of Appeals, which can be reluctant to make decisions that would impact their neighbors.

Example:

City of St. Joseph's "ED-OD" Edgewater Beach Overlay District's Standards:

9.7.3 E: In the event the provisions of the EB-OD render nonconforming any structure which is existing or which is the subject of a valid building permit and under construction on the effective date of this amendment, this shall not be deemed a voluntary action of the property owner and will not disqualify the parcel from receiving a hardship planned unit development under the procedures described in this ordinance for lands within the EB-OD or a hardship planned unit development or variance if on lands adjacent to the EB-OD.

F. Variances shall not be permitted within the EB-OD.

Tasks for implementing this tool:

- Conduct an inventory of existing development on coastal properties using aerial photographs and municipal records to determine the nature and extent of property conformance with zoning requirements.
- Using inventory results, determine if special provisions need to be developed to address changes to nonconforming properties.
- After identifying special provisions, determine whether to add these to the Nonconforming provisions in the Appeals section of the zoning ordinance, or instead include them in an existing or proposed coastal zoning district or overlay district.
- Provide training on the changes for members of the Zoning Board of Appeals.

4.3 Moveable Structure Requirements

Moveable structure standards are local regulations or guidelines that govern the relocation of structures at risk due to coastal erosion or other environmental factors. These standards may require, allow, or provide guidance on moving buildings away from vulnerable areas.

Continued erosion on a White River Township home along Lake Michigan, 2020 (Cory Morse, The Grand Rapids Press)

Why it supports resilience:

Relocating structures away from the coastline reduces their exposure to hazards like flooding, storm surges, and erosion.

How it is used:

One approach is to allow for "readily moveable structures" to be located in areas that are susceptible to future erosion so they may be moved by the property owner if that erosion occurs. Another approach is to allow for variances or special exceptions from zoning requirements to be granted if a building needs to be moved landward, such that it encroaches on other setback requirements.

Where there is a need for building moving standards, land division regulations should ensure that properties have enough area to move away from the hazard.

Possible obstacles to implementation:

- The costs associated with moving an entire structure can be significant.
- Finding a suitable space to relocate can be difficult, especially if the surrounding area is already developed.

Example:

Pere Marquette Township High Risk Erosion Overlay Zone

Section 109-19.09 Definitions (g): *Readily moveable structure* means a small permanent structure (with a total square footage greater than 225 square feet and with a first-floor foundation size less than 3,500 square feet) which is designed, sited and constructed to accomplish relocation at a reasonable cost relative to other structures of the same size and construction. Access to and from the site shall be of sufficient width and acceptable grade to permit the structure to be relocated.

(1) New construction and installations shall meet the following criteria to be considered readily moveable structures:

i. The buildings shall be on pilings, a basement or crawl space. Except as noted below, a slab-on-grade foundation does not meet this criterion.
ii. Above-grade walls shall be either stud wall or solid log construction. Above-grade walls that are constructed of masonry, including stone walls, and concrete poured or concrete block walls do not meet this criterion.

(2) Existing permanent structures shall be considered readily moveable structures if the cost of relocation landward of the required setback distance is not more than 25 percent of the replacement cost of the structure (including any added cost of land) or if the existing structure meets the criteria for new construction in this subsection. A one- or two-car garage which is bolted to a slab foundation, which does not have living space within the structure, and which does not have plumbing or interior walls shall be considered a readily moveable structure if it meets the remainder of the requirements specified in this subsection. Septic systems, tile fields, or other waste-handling facilities are not readily moveable structures.

Tasks for implementing this tool:

- Conduct an inventory of the coast using aerial photographs and coastal mapping tools (see "How much space does the lake need?" in Chapter II) to identify areas most at risk of erosion, in addition to the location of current structures and potential development parcels.
- Using inventory results, determine if there is an area landward of the coastal setback where structures could be at future risk, but could currently accommodate structures.
- Identify a dimension for the future risk area that is located landward of the setback and require that only readily moveable structures be located in this area.
- Draft the definition of a readily moveable structure and requirements for maximum size, allowable uses, escrow and related standards/limitations.
- Determine whether variances from the requirements are allowed. If so, identify any special provisions to be considered by the Zoning Board.
- Provide training on the changes for members of the Zoning Board of Appeals.

4.4 Marinas and Special Waterfront Uses

According to the Department of Natural Resources, there are over 80 harbors and marinas throughout the state of Michigan. Resorts are a common coastal feature in many coastal communities. Both offer valuable recreational and economic benefits, but poor design and management can contribute to coastal erosion, habitat disruption, and diminished water quality.

Why it supports resilience:

Properly planned and maintained marinas and resorts can provide access to and enjoyment of the Great Lakes for many Michigan residents, inspiring a relationship to them and a desire to care for them. Managing this intensity of use with environmental considerations in mind helps prevent resource degradation.

How it is used:

Zoning regulations for marinas, resorts, and working waterfronts can regulate land uses and building placement, in addition to provisions for docks, piers, and lifting devices. Special requirements, such as environmental mitigation measures and natural features protection, may be included as well.

Site standards for special coastal uses should include appropriate setbacks and buffer requirements. Armoring should be carefully considered, limiting it to the extent possible and designing any that is needed to minimize the impact on neighboring properties and the waterbody as a whole.

Possible obstacles to implementation:

- Resilient and environmentally-friendly infrastructure can be costly, particularly for smaller municipalities.
- Maintaining coastal uses in a way that minimizes impacts requires ongoing capacity and attention.

Example:

Grosse Ile Township Waterfront Provisions

Section 285-17: This ordinance regulates waterfront structures, dredging, and shoreline filling to protect public safety, environmental quality, and recreational use. It sets guidelines for structure placement and size while preventing ecological damage. A permitting process ensures compliance with regulations and public oversight.

Resources for implementing this tool:

- Water Resources Friendly Marina Development: Recommendations for Michigan - EGLE
- Sustainable Small Harbors Tools and Tactics Guidebook - Michigan Sea Grant
- Redevelopment Ready Communities Waterfront Planning Toolkit and Guidelines - Michigan Economic Development Corporation

Bioswales: An example of an environmental mitigation measure that can be included in marinas and special waterfront provisions. (Todd Marsee, Michigan Sea Grant)

4.5 Permit Review of State-designated Lands

The State of Michigan regulates property within mapped High Risk Erosion Areas (HREAs), Flood Risk Areas and Environmental Areas under Part 323, Shorelands Protection and Management of the Michigan Natural Resources and Environmental Protection Act. In addition, Critical Dunes are mapped and regulated under Part 353, Sand Dunes Protection And Management, of the Act. Both Part 323 and 353 allow a municipality to assume regulation of land use within these state-designated areas through their zoning ordinance. Approval of the municipality's zoning ordinance by the Department of Environment, Great Lakes and Energy (EGLE) is required to administer permitting in these areas.

Why it supports resilience:

Local review of permits for these sensitive coastal features can allow for better oversight and quicker enforcement response to prohibited activities.

How it is used:

The municipality adopts a zoning ordinance that matches the requirements of Parts 323 and 353 and establishes a permit process to confirm that covered activities in the state-regulated areas comply with these requirements. Activities where permit applications are typically required include the construction of a house or garage, building a road or driveway, installing a septic system, installing retaining walls, and sand removal in the case of Critical Dunes.

State-designated lands may be included in local natural features, dune protection, and coastal floodplain ordinances. The review process can then be tied to the district.

Possible obstacles to implementation:

- The process to gain approval from EGLE is not well-defined.
- Permit review, inspection, and enforcement require staff resources and capacity.

Example:

Pere Marquette Charter Township's Critical Dune Overlay District

Pere Marquette Charter Township's Critical Dune Overlay District outlines permitted and prohibited uses within the Critical Dune Overlay District (the area designated as a critical dune area by EGLE). Special standards regarding driveways, utilities, variances, and many more are included to protect dunes within the township.

Resources for implementing this tool:

- Critical Dunes Area Program, Department of Environment, Great Lakes, and Energy
- High Risk Erosion Areas, Department of Environment, Great Lakes, and Energy
- Environmental Areas, Department of Environment, Great Lakes, and Energy
- Floodplains, Department of Environment, Great Lakes, and Energy

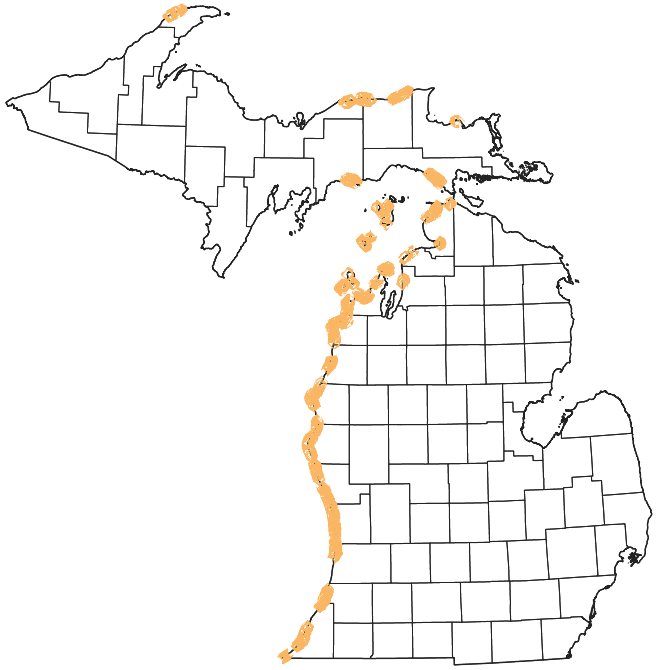


Figure 5.5. Critical Dune Areas (GIS data from EGLE)

Figure 5.6. High-Risk Erosion Areas (GIS data from EGLE)

Figure 5.7. Environmental Areas (GIS data from EGLE)

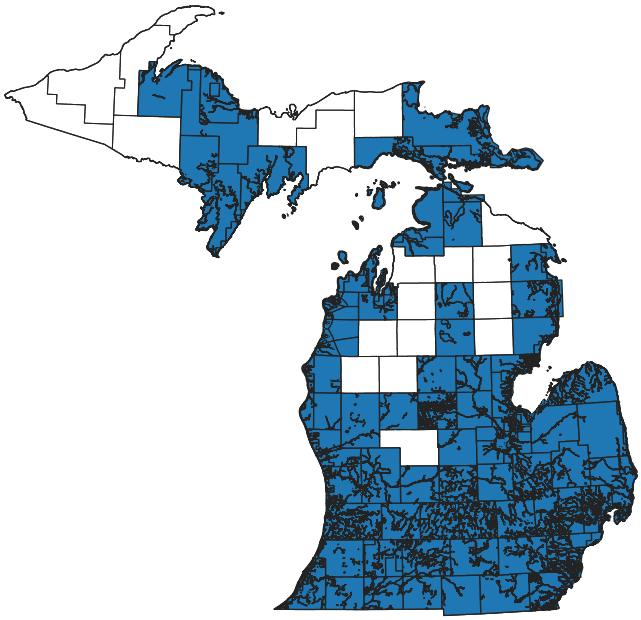


Figure 5.8. Counties with FEMA National Flood Hazard Layer (NFHL) data available. The NFHL database contains current flood hazard data (GIS data from FEMA MSC)

VI. GETTING IT DONE

This is hard, but it can be done: Approaches to coastal resilience and what it takes.

Miners Beach at Pictured Rocks National Lakeshore at sunset following passage of a thunderstorm (Marquette, Michigan Weather Service Forecast Office, Mark Stacey)

Changing a community's approach to its coastal lands is hard, but it can be done

For all the reasons mentioned in the first section, even the most comprehensive and innovative set of technical tools is not enough to solve the coastal conundrum. Relieving coastal flooding and erosion by shifting from a management approach to a resilience perspective is a long game with many players. Techniques only work if they're used. This section touches on the human and organizational context that supports the often simple but rarely easy act of implementing regulation designed to give the lakes space to move and a naturalized coast.

The case studies presented with each tool in the Appendix C show that it can certainly be done. One example of a particularly comprehensive approach is the Lake Huron Forever initiative. Using Lake Huron as a unifying force, the organization brings together advocates inside a community and connects communities by offering a common structure and a consistent message of a clean and healthy Lake. The communities then work through this alignment to establish a vision, goals, and tangible action steps—including developing plans and changing zoning, but also raising funding, dedicating time and attention, talking with the individuals and organizations, and accomplishing public projects. It's this rich and deep approach that helps overcome sticky obstacles like defeatism and resistance to change.

Community engagement approaches

Community engagement is the link that connects decision-makers' actions to the priorities of residents, businesses, visitors, and other stakeholders. In most cases, the formal activity is initiated by the decision-makers, because they are the ones with the official responsibility—community engagement is a request for help and advice in carrying out the leadership responsibilities that they have taken on.

Standard approaches to community engagement have often taken the following format: leaders invite "the public" to participate; they deliver information, usually about a problem, to the self-selected group; and then ask participants to state their preferences about what the leaders should do in response to that problem. This approach makes sense, but its effectiveness is limited. The leaders and staff who are tasked with these activities often report low participation, participation by the same few people across all issues and events, and receiving suggestions that are difficult to implement with the resources available.

The Watershed Game: A hands-on acitivty to illustrate the trade-offs with actions in watershed management.

Two strategies to break through these impasses of apathy and stagnation are storytelling and stewardship. Storytelling uses the brain's natural affinity for narrative to engage emotions as well as logic. By presenting decisions about the future as shaping the community's story, rather than as selecting a correct answer, there is more room for connection and cooperation. Moving out of the "agree/disagree" framework allows for co-creation. The idea of stewardship places the participants inside the story as a caretaker from the beginning. It puts to use research by environmental communicators showing that people want to know what they can do, how it will help, what others are doing, and how they are faring. In many cases, engagement asks "what should we do?" when that is already known; the real question is "how can we marshal our resources to do what we already know should be done?"

The following community engagement tools lend themselves to coastal decision-making.

Beach Walks

Beach walks are an engagement technique that takes place on the coast itself. Their content may vary, depending on the needs of the project or process the engagement is supporting: the key feature is the location.

Why it supports resilience:

Beach walks support resilience by connecting people physically with the resource that the event is intended to benefit. This connection helps spur positive action, and it increases people's familiarity with the resource so that they can offer more tailored feedback.

How it is used:

Beach walks can be used for a variety of purposes. For example, they may be educational in nature; they may be used to gather information about people's experiences on the coast; or they may be designed to take feedback on a proposed project. To ensure their effectiveness, it is important to identify an expert speaker who can lead the walk, provide accurate information, and guide meaningful discussion.

Possible obstacles to implementation:

Logistics and communications can present obstacles to a successful beach walk. Care should be taken to ensure that the activities are as physically accessible as possible. Communications should include written materials such as signs, since the lack of amplification may make it difficult to hear a speaker.

Another possible obstacle is identifying an expert speaker. Potential sources include EGLE, MSU Extension, local watershed councils, tribal natural resource departments, and regional planning agencies, among others. Regional partnerships such as Lake Huron Forever can also be valuable allies, helping to connect communities with knowledgeable experts and practical tools to support coastal resilience.

Example:

Lake Huron Summer Beach Walk with EGLE

The Michigan Coastal Management Program and the U.S. Army Corps of Engineers collaborated to conduct a series of Beach Walks on eight sites along Lake Michigan, Huron, and Superior coasts. According to the Michigan Coastal Management Program, "the events highlighted the dynamics and effects of the Great

Lakes water levels, storm intensities, coastal processes, and coastal hazards at each respective beach site. The intent of the Beach Walks is to increase knowledge of coastal hazards to increase community resilience and provide opportunity for the public to interface with state and federal coastal experts."

Coastal Resident Guides

Coastal Resident Guides compile management information in an easy-to-understand format that residential property owners can use. They may include official regulations like setbacks, as well as best practices like limiting fertilizer application.

Why it supports resilience:

Much of the actual, day-to-day management of the coast is done by residential property owners. This tool gets information directly into the hands of a group of people who have an enormous cumulative impact on coastal conditions.

How it is used:

A Coastal Resident Guide is most likely to be compiled by a group with particular knowledge about good coastal practices and an interest in promoting them, such as a local government, a county, or a special interest group. It can be mailed to property owners and made available online. It is also helpful to distribute a Coastal Resident Guide to private-sector interests such as real estate agents, landscapers, marine contractors, and lawn care professionals. These groups may integrate the practices into their own businesses and/or pass the resource and knowledge on to their clients.

Possible obstacles to implementation:

Getting a Coastal Resident Guide into the hands of every residential property owner is a big task, and one that has a maintenance component as property ownership changes hands. Since the non-regulatory practices in the guide are optional, achieving compliance may require additional education efforts and, possibly, some kind of incentive.

Example:

Living in Sensitive Areas: A Homeowners Guide for Residents of Grand Haven

This toolkit equips homeowners along the coast, in the dunes, in a floodplain, and near wetlands with best management practices for their home and lawn to minimize damage to these ecosystems. Maps are included to show which homes are in each sensitive area.

Tip of the Mitt Watershed Council Stewardship Guides

Tip of the Mitt Watershed Council has developed a series of "permit guides" to help residents navigate regulatory requirements, and they are currently working on a coastal homeowner guide. These materials can be valuable tools for communities and individuals looking to better understand and protect their coast.

Charrettes

Charrettes are a design-centered, multi-day meeting sequence with feedback loops that are designed to bring a community to enough consensus for action within an established timeframe.

Why it supports resilience:

The visual nature and multiple meeting format of charrettes support resilience by illustrating tradeoffs and the physical needs of various interests. Allowing everyone to develop, see, and comment on a proposed solution within a defined time frame helps manage the complexity that is inherent in coastal resilience initiatives.

How it is used:

Charrettes are especially suited to project design, because they result in a professionally created illustration. But they can be used to gather information and come to consensus on a variety of issues. A community determines the project goal, secures times and locations, and then brings together an extensive team of professionals and support staff (for example, watershed scientists, landscape architects, developers, graphics renderers, facilitators) to run the meetings and produce the design products.

Possible obstacles to implementation:

Charrettes require extensive preparation and intense management. The up-front costs generally appear to be greater than with other engagement techniques. However, they often represent the same amount that would otherwise be spread over a longer time-frame, and when the time savings are included, may in fact be a better value.

Example:

Sustainable Small Harbors Charrettes

Charrettes focused on the design of small harbors and their surrounding areas have been held in more than a half-dozen communities over the past ten years through Michigan Sea Grant. Over the course of three visits, the Sea Grant team collects information, hosts a series of public input opportunities, and presents a summary report with preferred alternatives to the status quo.

Pentwater Sustainable Small Harbor Design Charrette (Todd Marsee, Michigan Sea Grant)

Visualization

Virtual tools can help illustrate existing and projected damage due to flooding and erosion. These include data tools such as the coastline and lake level viewers; map-based analyses that show the relationship between future conditions and existing development; and frameworks like the ESRI StoryMaps that arrange narrative, images, and spatial data in a sequence for users to scroll through.

Why it supports resilience:

Visualization tools help overcome the difficulty of making changes to a system that appears to be working today by showing the harm that is in tomorrow's path.

How it is used:

Visualization tools are effectively used as part of educational materials. They can clarify and emphasize data findings. They are especially suited to showing possible futures.

Possible obstacles to implementation:

Some technical expertise is required to craft compelling and accurate visualizations.

Example:

Coastal Hazards of the Western Upper Peninsula StoryMap

The Western Upper Peninsula Planning and Development Region produced a comprehensive StoryMap with visual resources about coastal flooding and erosion alongside contextual information about Lake Superior and the culture and geology of the Keweenaw Peninsula. The tool embeds images, videos, and links to data tools to create a compelling invitation to learn.

Watershed Game

The Watershed Game is a hands-on simulation activity for up to 25 people, created by the Minnesota Sea Grant. It allows complex relationships between actions and conditions in a watershed to be shown in a compressed, experiential format.

Why it supports resilience:

The design of the game illustrates the tradeoffs and the effects of decisions made in watershed management. It allows players to consider a wide range of options and to see the results generated by different approaches, including coastal environments. The fun aspect of it supports ongoing engagement with watershed issues.

How it is used:

Any group with interest in or responsibility for watershed management decisions could play the Watershed Game in order to gain a baseline familiarity with the issues at hand, and to provide a common vocabulary among participants in future conversations.

Possible obstacles to implementation:

One trained facilitator is needed to successfully run the Watershed Game.

Example:

The Michigan Association of Planning (MAP) and the Michigan Coastal Management Program jointly sponsored a session of the Watershed Game at a Coastal Resilience Summit attended by planners, planning commissioners, and other land use decision-makers. The Game is now available to communities as an on-site workshop through MAP to educate community leaders and supplement their planning process.

Planning is the link between engagement and implementation

Community engagement is generally, and ideally, conducted as part of a planning process. Data determines the possible set of actions that a community can take, and engagement findings determine the preferred course. These recommended actions are described and formalized in the plan and then adopted by leadership. As described in Chapter I, this plan forms the required legal policy basis for regulation, and the purpose of that regulation is to shape investments, property, buildings, and systems so that they avoid harm to public health, safety, and welfare. This chain of processes is what translates community desires and experiences into the community they wish to see around them.

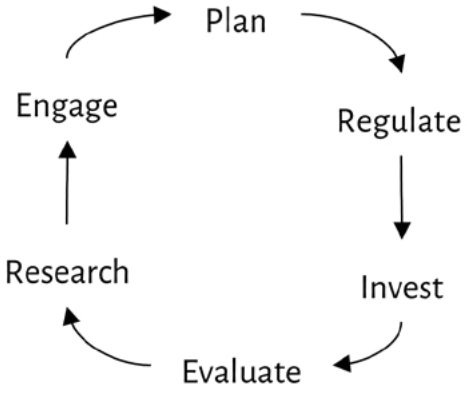


Figure 6.1. "Everything is iterative."

But it bears pointing out that the process doesn't have to start at the beginning, and in fact it rarely does. Often, it is only when something goes awry in the investment phase that we look to see how far upstream a change must be made in order to produce a different outcome. "That should have been regulated" means "we needed to plan for that." And that, in turn, means "we needed to research and engage." This is why the "planning process" is often depicted as a cycle. Everything is iterative.

Implementation resources

Every allocation contains a tradeoff. The equitable distribution of resources, especially scarce ones, are a distinct responsibility of the public sector. A dollar spent on a coastal study supporting a new setback is a dollar not spent on maintaining the public beach, and it's also hopefully a dollar that doesn't need to be spent on removing an abandoned property on the brink of immersion. Capacity and funding are perpetual challenges, and it seems unlikely that there will ever be enough of both to do everything. Acknowledging both the public responsibility and the fundamental limitations allows us to go straight to the next question: "OK then, what CAN we do?"

The Resilient Coastal Communities' Adaptation Strategies Toolkit

The Resilient Coastal Communities' Adaptation Strategies Toolkit (MCMP Toolkit) is a resource created by the Michigan Coastal Management Program (MCMP) to empower communities with knowledge of adaptation strategies to reduce the risks from coastal hazards (e.g., coastal erosion, flooding, and urban heat). The Toolkit provides technical guidance on adaptive approaches that local decision-makers can adopt within their local zoning ordinances and on-the-ground solutions to reduce coastal risks from erosion, flooding, and urban heat. The MCMP's Coastal Leadership Academy training workshop will assist local decision-makers gain an understanding of adaptation strategies that can help a community become more resilient to coastal hazards. A set of Best Practice fact sheets developed as part of the MCMP Toolkit will

provide examples and options to choose from to better respond and adapt to changing conditions on the coast. The Toolkit will be found at EGLE's Coastal Management webpage. Release date is TBD (this page will be updated later to include the direct link).

Existing planning processes

Master / comprehensive plans, zoning ordinances, hazard mitigation plans, and capital improvement plans are projects in every community, whether coastal or not; park and recreation plans, sustainability plans, and tax increment finance plans like DDA plans are also not necessarily connected to the presence of a coast. But a portion of the investment made in them can be shaped so that it directly benefits coastal management. Wherever land use, water quality, or infrastructure are discussed, specific and direct attention to coastal issues can be carved out for little to no extra cost.

Funding

Budget allocations; assessments

Budget allocation is an expression of the taxing authority of a unit of government. A special assessment is a budget allocated directly related to a special project, where the funds must be used in a highly specific way related to the request for the assessment.

Millages

Residents have the option of passing a millage to use the public funding process to achieve a specific aim. Parks, including parks containing coasts, are frequently supported by millages. A community could pass a millage to support a coastal project or to create coastal management capacity.

Crowdfunding

In some instances, an appeal has been made to collect funding directly, often to pay for a specific project. The Public Space, Community Places program is a partnership between the Michigan Economic Development Corporation and Patronicity that has used crowdfunding and a match to fund over 400 projects, including some along Great Lakes coasts. These can serve public access goals.

Box 6.1. Non-Traditional Partners

When thinking about who to involve in coastal resilience work, it's worth looking beyond the usual stakeholders. These partners might not always be on the radar, but they can bring useful perspectives and resources. Starting with a broader mix of voices can make the work feel less overwhelming and more connected to what's already happening locally. Engaging a wider network also builds long-term buy-in, making plans more durable and grounded in local capacity.

Non-traditional partners may include watershed groups, water utilities, DDAs, tribal leaders, chambers of commerce, drain commissioners, and hazard mitigation personnel (police, firefighters, etc.). Coastal resilience isn't the job of one sector alone; many roles intersect with the shoreline, each offering a piece of the solution. Bringing these voices to the table early can uncover opportunities, reduce conflict, and create more holistic strategies.

Grants

The Michigan Coastal Management Program (MCMP) disburses about $700,000 of funds annually to coastal units of government in partnership with the National Oceanic and Atmospheric Administration (NOAA). These funds assist in the development of vibrant and resilient coastal communities through the protection and restoration of our sensitive coastal resources and biologically diverse ecosystems. They support planning and projects that promote and protect healthy ecosystems, create coastal access, and encourage environmental stewardship. They must be matched by the recipient in cash, in-kind services, or donations. Some of the examples and educational materials in this document, such as the Grand Haven Beach District and the Tip of the Mitt permit guides, were funded with a grant by MCMP.

Michigan Sea Grant has made a dedicated effort to compile and maintain a comprehensive list of funding sources in its Coastal Resilience Resource Hub. The Funding landing page also points to other resource compilations.

Free money is, of course, never free. At a minimum, it must be found and secured, and often it must be carefully managed and extensively reported on. In this way, funding is closely tied to capacity.

Capacity

Watershed organizations

Known by a variety of names such as watershed councils, coalitions, and "friends of" a specific waterbody, these locally organized and nonregulatory groups generally bring together various stakeholders to protect water quality. They may be involved in watershed planning, permitting, project support, "citizen science" research, educating the public, and coordinating information across jurisdictions. Members and staff of these organizations can often provide access to detailed expertise with minimal direct cost.

Regions

Michigan's 14 Planning and Development Regions, known also as Councils of Government (COGs), are purposely designed to help address capacity challenges: they "help local governments resolve issues of overlapping services, help fill gaps in services through service sharing arrangements, and help find resources from the federal and state governments to address unmet needs."[1] Ten of the regions serve Michigan's coastal areas.

Michigan's COGs provide various services, which may range from administering federal programs to providing direct technical assistance to communities, and they vary widely in staff capacity themselves. However, these formal structures already exist as a mechanism for delivering support to individual municipalities, as well as to counties. Increasing resources to the regional COGs is a way to increase the capacity of many jurisdictions at once. A dedicated coastal planner at each COG could begin to truly move the needle on helping communities develop the plans, ordinances, and strategies that support wise coastal protection, restoration, and development.

Shared positions

Communities can also decide independently to consolidate capacity by sharing positions. Especially among adjacent communities that effectively function as a single market, these arrangements allow for greater consistency between jurisdictions. Cost savings and access to more specialized expertise are also benefits.

1 Michigan Association of Regions, "About Regions." https://www.miregions.com/aboutregions.asp, retrieved March 27, 2025.

MEDC technical assistance

The Michigan Economic Development Corporation provides funding that communities engaged in its Redevelopment Ready Communities program may use to contract for technical assistance services from the provider or consultant of their choice. The RRC program focuses on planning, zoning, economic development, and capacity building activities.

Where do we go from here?

Community of Coastal Practice

Coastal communities could come together to learn from each other, pool resources, and achieve economies of scale. More than that, such a "community of coastal practice" could increase effectiveness within individual municipalities by serving a goal outlined by environmental communicators: it helps people act in their own spheres when they know what others are doing and how they are faring. Regular events, communications, and education can help integrate coastal management into more community processes, easing the burden. Support is a soft input, and its benefits are often overlooked—but they can be quite substantial.

The next right thing

The basic requirement of pursuing any improvement is to keep moving toward it. Wherever your community is in its coastal management journey, the same question applies: what's the next right thing we can do? If you are moving toward a goal, keep swimming, and try to keep one eye on connecting this task to the next one. If your efforts have stalled, pick up a small piece of the plan or project to dislodge the stationary momentum without getting overwhelmed. If you've hit a roadblock, reach out—help, a new perspective, and encouragement all defuse barriers. And if you don't know where to start, look around for a problem to solve. There's never any shortage of those, and it puts a sharp focus on the effort.

Further out (for now)

There are coastal land use problems that the tools here will not solve. Planning and zoning are forward-looking tools, more in the realm of prevention than adaptation, but of course they intersect with existing conditions.

A major feature of zoning is that it applies primarily to new development, allowing what was done under previous regulations to stand relatively undisturbed. The Great Lakes, however, are not a party to this agreement and are not bound by it. They are their own regulating force, and what we build is subject to them on their own terms. Where we are in their right-of-way, they claim eminent domain thoroughly and without due compensation. We are welcome to attempt structures of resistance, for which the lakes exact continuous payment until the day they claim those structures, too.

None of this fits within our established legal and economic frameworks around development. This is why conversations about using regulation to cede land to natural coastal processes can be so uncomfortable, unappealing, and downright hostile: they represent a defeat under our own rules. Yet the truth that must be contended with is that the economic boon of the waterfront can, and does, turn to economic loss—both public and private. The less orderly our departure from lakes' right-of-way is, the costlier it will be. And the most orderly departure likely requires the enormous task of adjusting those legal and economic frameworks to account for reality. Over time, the force of the lakes will make this necessary.

APPENDIX

Additional information, suplemental resources, and reference materials

Lake Superior storms of November (NOAA Weather in Focus Photo Contest 2015, Paul Wickersham)

A. Glossary of Coastal Terms

All definitions are from Living on the Coast, US Army Corps of Engineers, Detroit Division, unless otherwise noted. For additional information and diagrams, visit the USACE Detroit Coastal Processes website.

Accretion: Buildup of a beach by waterborne and/or airborne material, usually sand, gravel, and larger stones.

Armoring: Manmade structures such as seawalls, revetments, bulkheads, geotubes, etc., intended to prevent damage to properties situated on the coast. (Mangor)

Beach: The zone of unconsolidated material (usually sand, gravel, or larger stones called "shingle") that extends landward from the low water line to the place where there is a marked change in material or to the line of permanent vegetation (usually the effective limit of storm waves).

Beach Nourishment or Beach Fill: The process of replenishing a beach with material (usually sand) obtained from another location.

Bluff: A slope with relatively complex soil structure or erosional processes, rising from the backshore of a beach with a crest elevation of 20 feet (6 meters) or more above the backshore elevation. Bluffs are sometimes defined as high, steep banks or cliffs.

Breakwater: A structure built to reduce wave activity in the waters at the leeside. It can be linked to the shore or positioned offshore. (Mangor)

Coast: A strip of land of indefinite width (may be several kilometers) that extends from the shoreline inland to the first major change in terrain features. The land regarded as near the shoreline.

Coastline: The boundary between coastal upland and the shore.

Coastal Development: Any activity likely to alter the physical nature of the coastal zone in any way, including construction of buildings, waste deposits, removal of natural vegetation, dredging, land reclamation, and mineral extraction (excluding fishing activities). (Mangor)

Coastal Special Flood Hazard Area: Special Flood Hazard Areas (SFHAs) along the coasts that have additional hazards due to wind and wave action. These areas are identified on Flood Insurance Rate Maps (FIRMs) as zones V, V1-V30, and VE. (FEMA)

Critical Dune Areas: Public lands and private properties where development, silvicultural, and recreational activities are regulated by Part 353, Sand Dunes Protection and Management, of the Michigan Natural Resources and Environmental Protection Act. (EGLE)

Downdrift: The direction of predominant movement of littoral materials.

Dunes: Ridges or mounds of loose, wind-blown material, usually sand.

Environmental Area: An area of the shoreland determined by the department on the basis of studies and surveys to be necessary for the preservation and maintenance of fish and wildlife. Regulated under Part 323 of the Michigan Natural Resources and Environmental Protection Act. (EGLE)

Erosion: The wearing away of land or a lakebed by natural forces, including wave action, currents, or wind.

Fetch: The area over which waves and wind setup (or surge) are generated by a wind having a fairly constant speed and direction.

Flood Risk Area: Any area which is within the 100-year floodplain of a Great Lake or a connecting waterway, as identified under Part 323 of the Michigan Natural Resources and Environmental Protection Act. (EGLE)

Freeboard: The additional height above the Base Flood Elevation (BFE) used as a safety margin in floodplain management. Constructing buildings with greater freeboard increases their elevation, making them less susceptible to flood damage. For FEMA levee accreditation, a freeboard of 3 feet is typically required.

Groin: A shore protection structure built (usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore.

High-Risk Erosion Areas: Shorelands of the Great Lakes where erosion has been occurring at a long-term average rate of one foot or more per year for at least 15 years. Regulated under Part 323 of the Michigan Natural Resources and Environmental Protection Act. (EGLE)

Littoral: Pertaining to the shore of a lake or sea.

Littoral Material: Sand and stones moved by waves and currents near the shore.

Littoral Transport or Littoral Drift: The movement of littoral material by waves and currents, including both longshore (parallel) and on-offshore (perpendicular) transport.

Littoral Zone: The area extending seaward from the shoreline to just beyond the breaker zone.

Longshore or Alongshore: Parallel to and near the shoreline.

Longshore Current: The littoral current in the breaker zone moving essentially parallel to the shore, usually generated by waves breaking at an angle to the shoreline.

Nearshore: A zone extending seaward from the shoreline beyond the breaker zone, typically to about 66 feet (20 meters) water depth.

Mitigation: Measures aimed at countering, alleviating, or partially obviating the adverse consequences of threatening developments or events with human or natural causes. (Mangor)

Ordinary High Water Mark (OHWM), Regulatory: The elevation along the shoreline where a construction permit is required for activities like dredging, seawalls, and permanent structures. Defined by the Michigan Natural Resources and Environmental Protection Act and referenced to the International Great Lakes Datum 1955 (IGLD 55).

- Lake Erie: 572.2’
- Lake St. Clair: 575.3’
- Lake Michigan/Huron: 580.5’
- Lake Superior: 602.6’

Ordinary High Water Mark (OHWM), Local: The elevation or line along the shoreline defined in the municipality's zoning ordinance for purposes of measuring a shoreline setback.

Ordinary High Water Mark (OHWM), Natural: A line on the shore where there is an indication that water is present. The Natural OHWM is used to identify where the public has the right to walk along the Great Lakes shoreline

Overtopping: The passing of water over the top of a beach berm, dike, or other shore protection structure due to wave runup or surge action.

Recession: The permanent landward movement of the shoreline, beach, or lakeward edge of a bank or bluff.

Revetment: A structure of stone, concrete, etc., built to protect a shore against erosion by wave action or currents. Often used for shore protection with sloping lakeward faces.

Riprap: Layers of stone, randomly placed to prevent erosion, scour, or sloughing of a slope. Also used to describe the stone itself.

Sediment: Loose fragments of rocks, minerals, or organic material transported by air, wind, ice, and water, and deposited. It also includes materials that precipitate from overlying water or chemically form in place.

Seiche: An oscillation of the water mass in a lake that continues after the originating force has stopped, typically caused by atmospheric forces in the Great Lakes.

Setback or Setback Distance: A selected (or required) space between a building (or other structure) and a boundary.

Shore: The narrow strip of land in immediate contact with the lake, including the zone between high and low water lines. A shore of unconsolidated material is usually called a beach.

Shoreline: The intersection of a lake with the shore or beach.

Storm Surge (Wind Setup, Storm Rise): A rise above normal water levels on the open coast due to wind stress on the water surface over a long distance (fetch).

Water Budget/Water Balance: An accounting of all the water that flows into and out of a project area, including wetlands, lakes, and other points of interest. Development can alter the natural supply of water, and a water budget helps evaluate possible impacts and mitigation actions. (EGLE)

Wave Runup (Swash): The rush of water up a structure or beach following the breaking of a wave, measured as the vertical height above still-water level to which the rush of water reaches.

Sources:

- US Army Corps of Engineers - Detroit District: Living on the Coast
- Mangor, Karsten (2021): Definitions of Coastal Terms
- EGLE - Michigan Department of Environment, Great Lakes, and Energy
- FEMA - Federal Emergency Management Administration (Glossary)

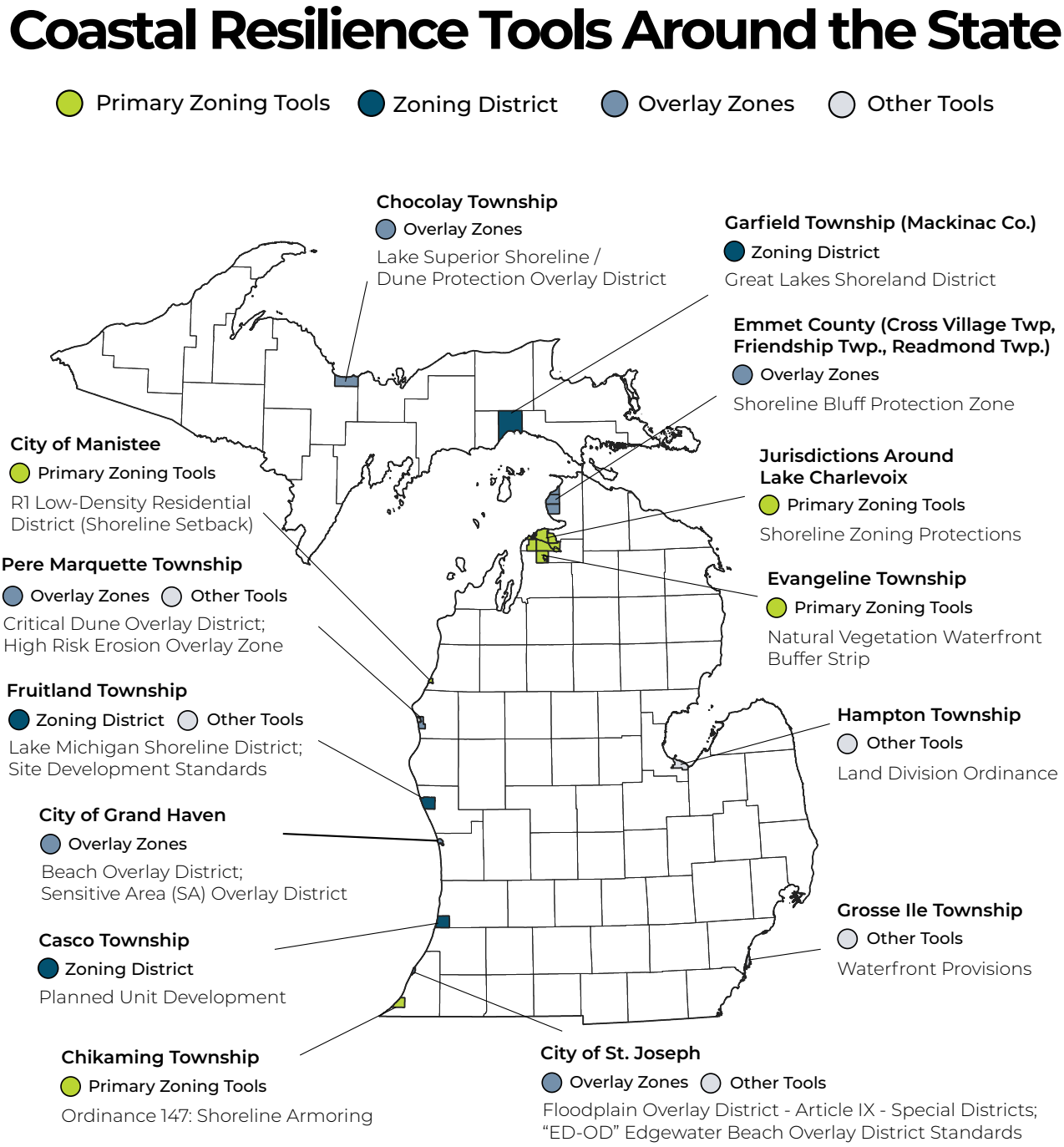
B. Typical Zoning Ordinance Outline

1. Purpose/Intent
    a. Amendment procedures
    b. Duties and responsibilities
    c. Purpose
    d. Other provisions
2. Definitions
3. General Provisions - apply to all uses, buildings, and structures within all districts, unless otherwise specified
    a. Accessory building and uses
    b. Waste facilities
    c. Fences
    d. Wireless communication
    e. Projections into yards/setbacks for architecture features
    f. Height exceptions (chimneys, silos, etc.)
    g. Home occupations

    NOTE: Off-street parking, landscaping, access management, floodplains and natural feature regulations MAY be included here, but may instead have their own respective chapters or be part of a "Site Development Standards" chapter
4. Zoning Districts
    a. Description and purpose
    b. Permitted uses
    c. Special land uses
5. Schedule of Regulations
    a. Lot size, width,
    b. Setbacks
    c. Coverage
    d. Height
    e. Density

6. Special Districts
    a. PUD
    b. Overlay district
7. Review Procedures
    a. Site plan review
    b. Special land uses
    c. Zoning ordinance amendments and rezonings
    d. Administrative rules and responsibilities
    e. Variances, appeals and interpretations
        i. Zoning Board of Appeals
8. Zoning Map

C. Case studies



Fort Gratiot Township: Shoreline setback permit for armoring, septic systems placement

Sec. 38-631 - High risk erosion area setbacks:

Pursuant to authority granted by Part 323 of Public Act No. 451 of 1994 (MCL 324.32301 et seq.), the state department of environmental quality has designated certain areas of Great Lakes Shoreline within the township as being "high risk erosion areas."

(1) *Lands designated*. These areas are delineated on maps provided to the township by the state department of environmental quality. More boundaries are indicated on aerial photographs on file with the state department of environmental quality.
(2) *Authority delegated to zoning administrator.* The township zoning administrator is hereby authorized to enforce the provisions of Part 323 of Public Act No. 451 of 1994 (MCL 324.32301 et seq.) with respect to the issuance of shoreline setback permits.

(3) *Permits required.* Prior to the construction of any permanent structures, septic systems, or modifications or additions to existing structures on parcels of property containing designated high risk erosion areas, a shoreline setback permit shall be obtained from the building inspector.

(4) *Minimum required setbacks.* No permit shall be issued unless such planned structures or improvements are in compliance with the minimum setback requirement from the bluff line as set forth by the state department of environmental quality on maps and other documents provided to the township.

(5) *Applicable setback.* In determining the proper setback from the bluff line, in cases where both a front yard, rear yard, side yard, or shoreline setbacks may apply, the greatest setback distance shall govern.

(6) *Dispute.* In cases where there is a dispute between the property owner or applicant and the zoning administrator as to the proper setback, or as to the applicability of shoreline setback regulations, such disputes must be submitted to the state department of environmental quality for a determination. The township zoning board of appeals shall not have jurisdiction in these matters.

City of Norton Shores: Seawall, revetments, and groin construction requires a building permit

Sec. 48-1054 - Seawalls, revetments and groins:

(a) **Building permits for seawalls, revetments and groins may be authorized** by the planning commission provided they are constructed of such materials and are of a height and color so as not to detract from the natural beauty of the shoreline.

(b) In regard to groins, an engineering determination shall be included in the building permit application establishing the effects of the proposed groins on adjacent beaches.

City of Manistee: Waterfront setback requirement extended to 100 ft in the low-density residential district (otherwise 30 ft. front, 10 ft. side, 10 ft. rear)

Sec. 803 - Dimensional standards:

C. 4: Waterfront Yard: The minimum setback shall not be less than one hundred (100) feet from the ordinary high water mark, provided such setback shall not apply to walkways, boat docks, boat slips, boat launches and boat houses. Provided, further that the waterfront setback shall not be less than the setbacks required by the Department of Natural Resources in a High Risk Erosion Control area.

South Haven Township: Shoreline protection overlay / setback requirements / long lots

Ordinance No. 144 Sec. 14B.01:

A. Purpose

The Shoreline Protection Overlay District includes all land located within 500 feet of the Historical High Water Mark, and as depicted on the Official Zoning Map for South Haven Charter Township. This boundary extends across all underlying zoning districts. This overlay zoning district is intended to be used in addition to any requirements of Article XIX Environmental Conservation Provisions.

C. Setback Requirements

1. For all earth removal or excavations within the Shoreline Protection Overlay Zone, a side setback of fifteen (15) feet from the nearest point of any earth change to the lot line shall be required.

2. All structures proposed to be built within the Shoreline Protection Overlay Zone shall be set back according to the requirements below, except for the following exempt structures: pump houses, recreational docks, stormwater and erosion control devices, picnic tables, benches, recreational watercraft, and stairways and walkways.

a) Within the Shoreline Protection Overlay boundary, the following setback requirements apply:

i) No structure, except those listed in subparagraph (2) above, shall be allowed within 50 feet of the Historical High Water Mark;

ii) All structures, except those specifically exempted in subparagraph (2) above, shall be set back 100 feet from the Historical High Water Mark.

iii) On lots with a steep bluff which begins within 100 feet of the Historical High Water Mark all structures, except those specifically exempted in subparagraph (2) above, shall be set back at least 50 feet from the top of the bluff;

b) If a greater setback is required under the provisions of any state or federal law than is required by this section, then such greater setback requirement shall apply. Where the imposition of the setbacks in the above table precludes the location of a dwelling or other primary structure, the applicant may request a variance. Any variance must be obtained from the Zoning Board of Appeals in accordance with Article XXIV. No variance shall be granted for any use or structure in violation of the intent and purpose of this Article or state law. Article 14B is also amended to add a subsection 14B.02(D) as follows:

D. Minimum Requirements for New Lots or Land Divisions Outside of Plats

1. For new lots or land divisions located outside of existing plats, the minimum lot depth shall be 300 feet.

2. The minimum lot width for new parcels shall be 75 feet. Lots deeper than 300 feet shall not exceed the length to width ratio of 4 to 1.

City of Charlevoix: Setback requirements

153.151 - Setback requirements:

(C) Setback from bodies of water. Notwithstanding other provisions of this subchapter, all principal uses located in the R1 and R4 Districts shall have a **setback of 50 feet from the ordinary high water mark** of Lake Michigan, Lake Charlevoix and Round Lake, as well as the Pine River Channel.

Torch Lake Township: Nothing besides stairways and ground-level walkways within 50 ft of the OHWM

Section 2.16 - General lot and yard area requirements for all zoning districts:

B. FRONT, SIDE, & REAR LOT LINE SETBACK AREA USES. Every part of every front, side and rear lot line setback area shall be open and unobstructed by structures from the ground up to the sky. **No structure may be located within 50 feet of the water's edge** of Torch Lake or within 50 feet of the Ordinary High-Water Mark of Lake Michigan. The following exceptions [stairways and ground-level walkways] apply to these setback requirements.

City of St. Joseph: Site plan review standards

Sec 12.6 - Standards for review of site plans:

Standards for Review of Site Plans. Prior to a recommendation or approval of any minor or major site plan by the planning commission, city commission or by the zoning administrator, conformance shall be ascertained with all the applicable standards of this ordinance, as well as with the following standards:

L. The site plan shall fully conform with this ordinance, and all applicable city, county, state and federal statutes, rules and regulations and any permits issued by agencies charged with administration of these statutes, rules or regulations, including, but not limited to, regulations pertaining to floodplains, wetlands, sand dunes, high risk erosion areas and water quality administered by the Michigan Department of Environmental Quality.

Saugatuck Township: Moving the bluff's edge by acquiring easements.

Lakeshore drive managed retreat project:

A major washout in 1988 has since led to consistent erosion of the roadway for Lakeshore Drive. The Allegan County Road Commission is assessing land availability and engineering solutions to reconnect the disconnected sections of Lakeshore Drive while ensuring long-term resilience against erosion. More details, including project updates and reports, can be found on the Saugatuck Township website under "projects."

Elk Rapids: Retaining walls require a permit and must meet design and placement standards to minimize adverse hydrological effects

Sec. 44-232 - Supplemental environment and wetland regulations:

(h) Retaining wall permit. **No shoreline retaining wall shall be erected without the issuance of a land use permit, and no such permit shall be issued except upon a showing that all federal and state approvals have been secured.** All such structures shall be designed and placed so as to minimize any adverse hydrological effects caused thereby to adjacent property owners.

Monroe Township: Construction or modification of dikes require a permit

Sec. 14-61 - Application for dike ordinance compliance permit.

Every person or other legal entity desiring to alter, replace, or modify existing dikes or to construct new dikes shall apply to the township enforcement officer for a dike ordinance compliance permit.

Chikaming Township: Beach overlay district that bans permanent private shoreline armoring but allows some temporary methods with a permit

Ordinance No. 147 Section III: Prohibition on shoreline armoring and permitting requirements for sandbags and geotubes:

(1) It shall be unlawful to in any way commence installation of, actually install, or place shoreline armoring upon or within the ground anywhere within Chikaming Township.

(2) A permit must be obtained for installation or placement of sandbags or Geotubes® on property in Chikaming Township.

City of Grand Haven: Shoreline protection measures

City of Grand Haven Sec. 40-423.03 - Shoreline protection measures:

For the reasons set forth in section 40-423.01, the installation, construction, and operation of shoreline protection measures, including but not limited to breakwater, groins, riprap, revetment, bulkhead, seawall, and sandbags, within the [Beach Overlay District (B-OD)] shall be subject to the following:

A.No shoreline protection measure shall be installed or constructed in the B-OD, except for temporary fencing not more than four (4) feet in height and with openly spaced slats or weaves, placed seasonally between October 1 and May 1 to influence the accumulation of sand and/or snow that does not prevent public passage across the public trust property, and except for temporary geotextile tubes or equivalent large sandbags placed at the toe of the slope during periods of extreme high water, which must be dismantled immediately when water levels recede to below the State of Michigan Ordinary High Water Mark (OHWM), and which are permitted by USACE and EGLE. All artificial materials must be completely removed from the site when the geotextile tubes are dismantled. This shall not be construed or used as support to install permanent armoring of the shoreline.

City of Petoskey: Replacing failing rock revetment with a nature-based, living shoreline at Bayfront East Living Shoreline

Bayfront East Living Shoreline and Trail Modification Project

The project replaces a failing rock revetment with a nature-based, living shoreline by softening the slope, creating a cobble beach and a backshore pond with native plantings and woody debris.

D. Resources

Resilient Planning

Coastal Resilience Resource Hub, Michigan Sea Grant

Local Zoning in Michigan for Great Lakes Coastal Shoreland Management Initial Findings and Guidance (2019), Norton, Salim, Friese, Secor

Planning for Coastal Resiliency in Northwest Michigan's Dunes: A Guidebook for Local Leaders (2017), Networks Northwest

Planning for Resilience in Michigan: A Comprehensive Guidebook (2020), Land Information Access Association

Resilient Coastal Communities Planning Guide (2023), Michigan Coastal Management Program

Survive and Thrive: Lessons from Michigan Coastal Communities Planning for Resiliency (2019), Michigan Association of Planning

Coastal Resident Guides

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