

WATER LEVELS IA – PHASE 2 FINAL REPORT – REVISED

December 5, 2016

Project Title

Implementing Adaptation: Developing Land Use Regulations and Infrastructure Policies to Implement Great Lakes Shoreland Area Management Plans

Investigators

Richard K. Norton, Principal Investigator
Urban and Regional Planning Program
University of Michigan
rknorton@umich.edu / 734.936.0197

Guy A. Meadows, Co-Investigator Great
Lakes Research Center Michigan
Technological University
gmeadows@mtu.edu / 906.487.1106

Harry Burkholder, Co-Investigator
Executive Director, LIAA
Traverse City, MI
burkholder@liaa.org / 231.929.3696

Principal Investigator Contact Information

Richard K. Norton
Urban and Regional Planning Program
Taubman College of Architecture and Urban Planning
University of Michigan
2000 Bonisteel Blvd.
Ann Arbor, MI 48109-2069
rknorton@umich.edu / 734.936.0197

EXECUTIVE SUMMARY

This project builds on previous work to incorporate information regarding Great Lakes shoreline dynamics into the community master plans of the City of Grand Haven and Grand Haven Charter Township. This step advances prior efforts by developing methods for implementing those newly adopted planning ideas into the Great Lakes coastal communities' regulatory and infrastructure policies.

Given the unique challenges that Great Lakes coastal localities face in their planning efforts, this continued work with the City of Grand Haven and Grand Haven Charter Township confronts issues that arise at the water/land interface in Great Lakes shorelands settings at large. These issues include environmental concerns, economic concerns, the desire to accommodate near-shore residential living, and the need to protect near-shore public and private property from coastal hazards.

There are a number of common regulatory and non-regulatory options that address managing Great Lakes coastal shorelands, but applying an abstract policy prescribed in a general plan to a particular place, and ensuring that it can yield the desired outcome, is difficult—especially considering potential political and legal implications.

The project team has been conferring with the community planners from the City of Grand Haven and Grand Haven Charter Township to better understand their perceived issues related to planning for community resiliency given fluctuating lake water levels. In doing so, we are taking special note of the kinds of issues that are not clearly or strictly related to coastal area management, but that local citizens and officials believe should be addressed concurrently with coastal management concerns as part of a larger regulatory/policy reform effort (e.g., natural area protection, etc.).

Based on feedback provided by the communities, we have focused on developing policies to address more protective land management in high risk flood areas, improved stormwater management, and more protective management of development within shoreline coastal hazard zones (both city and township), along with modified land management within state-designated Critical Dune Areas for the sake of addressing fire hazards (township). For each of these policy areas, we identify and evaluate a range of options that each community might adopt, including most notably the adoption of low impact development regulations, policies, and programs for stormwater management; the establishment of setbacks and corresponding development regulations and policies within high risk coastal zones; and the development of land management and service delivery policies and regulations within Critical Dune Areas to better address wildfire and structural fire hazards within dune settings that are especially inaccessible and/or at high risk.

INTRODUCTION

This research leverages work from the Planning Grant and other prior work conducted under the direction of the co-investigators. That prior work developed planning techniques to improve efforts by Great Lakes coastal localities in Michigan to analyze and incorporate information regarding Great Lakes shoreline dynamics into their local master plans and shoreland area management plans. The work addressed the topics of Great Lakes shoreline dynamics (focusing on dynamics related to lake level variation), near-shore environmental/natural resources analysis, near-shore land use and critical facilities analysis, fiscal impact analysis, and methods for visualizing shoreline dynamics. The focus of this follow-on Integrated Assessment project is to take the next step and develop methods for implementing local master plans or shoreland area management plans through regulation and infrastructure policy.

We continue our collaboration with the City of Grand Haven and Grand Haven Charter Township to assess the issues and needs related to the development and adoption of regulations and policies that are necessary to implement their local plans in order to improve shoreland area management in the face of dynamic Great Lakes water levels.

The City of Grand Haven and Grand Haven Charter Township are located on the western coast the State of Michigan, on the shores of Lake Michigan. Given its location, the Grand Haven community is home to a number of sensitive natural resources, including critical sand dune areas and coastal wetlands. The city has some 600 acres of state-designated Critical Dune Areas, while the township encompasses a little over 1,000 acres.¹ The township contains almost 3,300 acres of wetlands, and the city contains 270 acres.² Sand dunes provide unique habitats for rare and endangered species, hold enormous environmental and recreational value, and also provide an important coastal flood buffer for Great Lakes littoral communities.³ Similarly, wetlands are critical flood-management resources that regulate the movement of water within watersheds. Their habitats are also home to a number of Michigan's sensitive wildlife populations. These important features shape the larger Grand Haven community's identity and economy. This incentivizes the community's desire to both protect and capitalize on its coastal setting, which often pits competing interests against each other. As such, a better understanding of the many impacts of dynamic water levels can help local officials and citizens in Grand Haven make more informed planning and coastal area management decisions.

The city-township relationship is a common governance structure found within the state. This structure often puts two or more different types of communities in similar natural environments. This is especially true of Grand Haven. Even so, while the City of Grand Haven and Grand Haven Charter Township share many of the same benefits and potential burdens of the natural resources that accompany their location, they look and operate differently from a management perspective. The City of Grand Haven is much smaller and more urban than Grand Haven Charter Township, and as a result

¹ Grand Haven Township Master Plan, 2016.

http://www.resilientmichigan.org/downloads/2016_resilient_grand_haven_master_plan_compressed.pdf and

City of Grand Haven Master Plan, 2016.

http://www.resilientmichigan.org/downloads/city_of_grand_haven_master_plan_compressed.pdf

² Ibid.

³ Michigan Conservation Districts, 2010. Michigan's Critical Dunes. <http://macd.org/critical-dunes.html>

is almost fully developed (or built out). This influences the potential management options that the city can employ to protect and grow around their natural features—for example, positioning them to contemplate wetland restoration instead of wetland protection (reactive vs. proactive). Grand Haven Charter Township, in contrast, is still rapidly growing and evolving from its roots as an agriculture community. The township gained an additional 1,200 housing units between 2000 and 2014, and its population is projected to grow by 46% over a 20-year period.⁴ Because large portions of the township have not yet been developed, it has an opportunity to employ more protective and proactive management options than the city through initiatives such as clustering residential development to conserve open space, wetlands, or tree canopy.

Despite the clear differences between the City of Grand Haven and Grand Haven Charter Township from a structural and management perspective, their collaboration in the resilient master planning process, and now the Integrated Assessment, affords the Grand Haven community a cohesive future plan for its shared natural features.

IDENTIFICATION OF POLICIES AND ADAPTIVE ACTIONS

The project team has worked with several sets of stakeholders from both the City of Grand Haven and Grand Haven Charter Township to review community goals and identify key shoreland management issues. These stakeholders include the city and township planning commissions, city and township planning staff, Ottawa County water resources officials, city and township engineers, and the township's fire chief.

As noted, the two Grand Haven communities have clear structural and management differences. In order to think through their various shoreland management issues, and provide each community with a tailored set of policies and adaptive actions, we have been working through implementation options with the City of Grand Haven and Grand Haven Charter Township separately. To do this, we have identified for both the city and the township – with the help of the stakeholders – a set of coastal assets and coastal concerns. From these lists, we are using model ordinances and other best management practices as guides to produce ranges of potential adaptive actions of increasing intensity for both the city and the township to consider. The goal is to provide an array of policy options with corresponding pros and cons analyses for the communities to deliberate on and potentially adopt in order to enhance their shoreland management efforts as they deem appropriate, rather than providing our own recommendations to them on how best to proceed.

City of Grand Haven

The City of Grand Haven enjoys a number of coastal assets – both natural and manmade. The natural assets include State of Michigan designated Critical Dune Areas, public access to healthy beaches – including Grand Haven State Park, and a number of unique viewsheds of Lake Michigan. Additionally, a thoughtfully developed built environment affords the City of Grand Haven a walkable downtown and a plethora of public spaces and tourist attractions.

⁴ Grand Haven Township Master Plan, 2016.

http://www.resilientmichigan.org/downloads/2016_resilient_grand_haven_master_plan_compressed.pdf

These coastal assets make the City of Grand Haven a highly desirable place not only to live and do business, but also to recreate and sightsee. When mapped, it is clear that these natural and manmade assets, for the most part, overlap spatially in the City of Grand Haven. See Figure 1 for maps showing this relationship. What this elucidates is that development interests often create a conflict between fiscal opportunity and maintenance of natural features. In fact, many of the Critical Dune Areas in the City of Grand Haven have already been developed, a number of the city's wetlands have been filled, shoreline development is encroaching on Lake Michigan, and high levels of imperviousness exposes the city to stormwater runoff that can negatively impact water quality and the health of sensitive natural features. Specifically, the City of Grand Haven stakeholders have expressed concerns with their stormwater management throughout the community, the encroachment of shoreline development in their "North Shore" zoning district, the health of their Critical Dune Areas (and other sensitive habitats), and potential development vulnerabilities in high-risk flood areas.

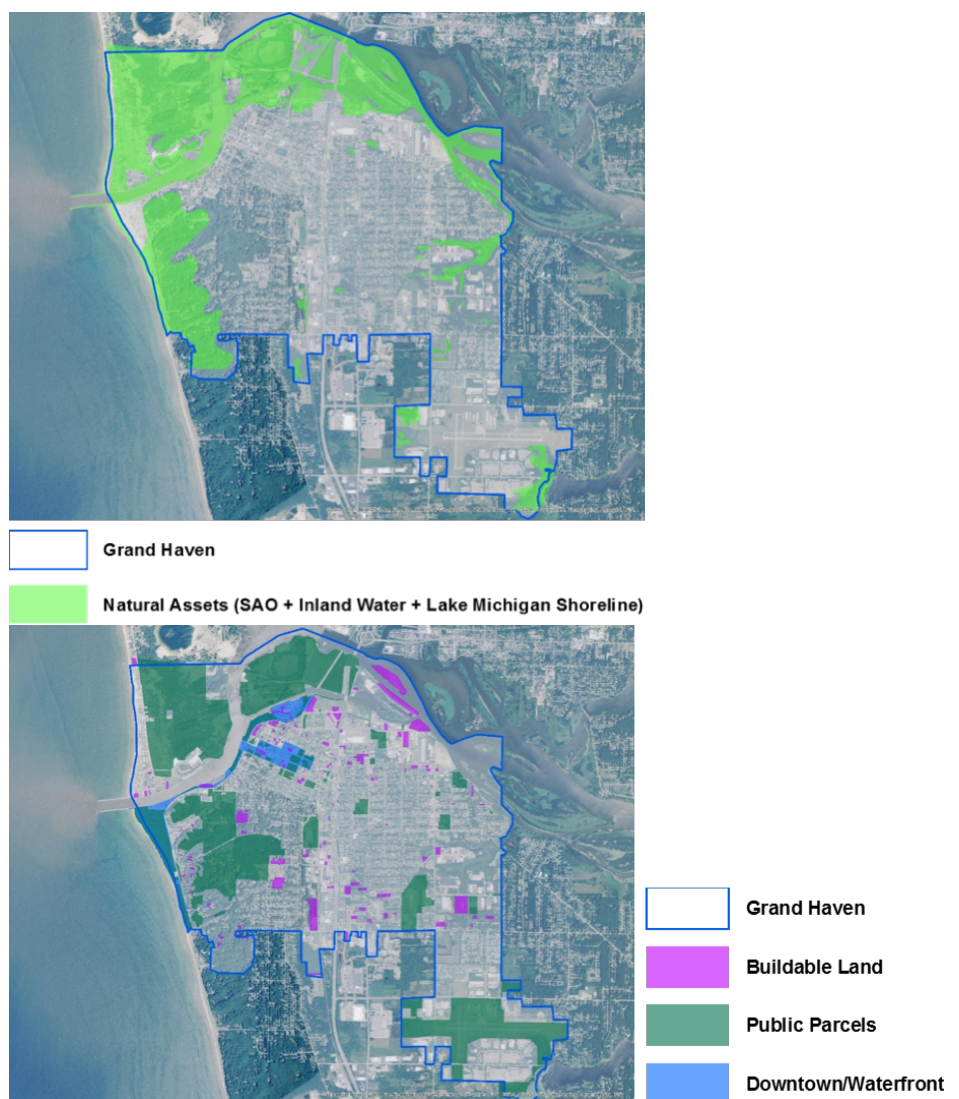


Figure 1. City of Grand Haven natural areas and built environment.

There are a number of potential adaptive actions that the City of Grand Haven can implement either through infrastructure policy or through revisions to its zoning code to address these specific concerns. In order to explore these adaptive actions in full, it helps to separate the coastal concerns identified previously and address them individually.

Stormwater Management

Stormwater runoff and associated water quality concerns due to the city's imperviousness can be addressed through improved stormwater management practices, including the use of Low Impact Development (LID). According to the Southeast Michigan Council of Government, LID is "[T]he cornerstone of stormwater management. LID uses the basic principle that is modeled after nature: manage rainfall where it lands."⁵ It is predicated on "design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source.... They [LID practices] can be integrated into the existing infrastructure."⁶ Consequently, implementing LID can also lead to improved protection and health of sensitive habitats in the City of Grand Haven, as well as potentially reduce build-out in high-risk flood areas with certain LID actions. The reason for this is that there are a number of LID best management practices, both structural and non-structural, that can yield more than one beneficial outcome post-implementation (i.e. improved water quality and preservation of natural vegetation).

Structural best management practices include, for example, bioretention areas (rain gardens), capture reuse structures (rain barrels), and detention basins (dry or wet ponds). Some non-structural best management practices include, for example, stormwater disconnection (directing stormwater runoff to areas of existing vegetation), riparian buffer areas, sensitive areas zoning overlay, and reduction in impervious surfaces. A more thorough analysis of options through which the City of Grand Haven might implement LID is provided below.

High-Risk Lake Michigan Shoreline Development

The City of Grand Haven's concern about encroaching shoreline development in their North Shore zoning district might be addressed with the establishment of a clear, equitable, and protective development setback line from Lake Michigan based on the physical dynamics of a Great Lakes shore, coupled with policies designed to prevent new inappropriate development lakeward of that setback line and/or to ensure removal and cleanup of structures already lakeward of that line should they be damaged by a coastal storm. This actually represents a multi-dimensional approach, and there are multiple options for both elements of it.

In general, a setback line marks the furthest point lakeward that development on any given lot can occur. Currently, the North Shore zoning district permits encroachment up to twenty-five feet from parcel lot lines, and it allows property owners with structures situated landward of neighboring structures to shift their homes lakeward. Under this policy, structures on at least a few parcels are currently exposed to dangerous shoreline dynamics. Even more structures are likely to become exposed over time as homes are shifted lakeward while erosion continues to move the shoreline landward. The city has several options for adjusting this setback line to address these concerns.

⁵ SEMCOG. *Low Impact Development Manual for Michigan: A Design Guide for Implementors and Reviewers*. 2008.

⁶ Ibid.

The options developed further here, and discussed more below, include: 1) fixing all developing in its current location (i.e., retain the 25 foot setback but disallow any additional shifting of current structures lakeward); 2) adopting a setback premised on the 60-year shoreline erosion rate, consistent with the State of Michigan's High Risk Erosion program; and 3) adopting a setback that follows the 'Perfect Storm' high risk hazard line developed through this research program. The Perfect Storm high-risk erosion line represents the predicted landward extent along the shoreline of inundation and/or wash-over by high-energy waves during an extreme coastal storm event that occurs while Lake Michigan is at or near an all-time high water level.

Having adopted an appropriate setback line, the city also has multiple options for adopting policies tied to that setback. The options further developed here, again discussed more below, are not mutually exclusive, and they each speak to various aspects of risk and fairness (i.e., fairness to both individual property owners and the larger community) in terms of allowing development while not putting people and structures in harm's way and ensuring the adequate cleanup of structures once damaged. They include: 1) prohibiting the placement of any new structure lakeward of the setback line; 2) allowing only readily moveable structures lakeward of the setback line; 3) establishing that existing structures currently lakeward of the setback line (or structures that become lakeward of that line as the shoreline erodes over time) are nonconforming structures, such that they must be removed if substantially damaged by a coastal storm event; and 4) requiring that owners of structures currently lakeward of the setback line (or that become lakeward) post a surety bond sufficient to clean up and restore the shoreline should the structure need to be removed following a coastal storm event. All of these options are mapped and analyzed in more detail below.

High-Risk Flooding

Finally, although not developed further here, we have explored briefly options for enhancing the city's high-risk flood hazard policies and regulations, and will present an overview of options available to the city in our final report to city officials.

Grand Haven Charter Township

Given their proximity to each other, Grand Haven Charter Township's natural coastal assets are similar to those found in the City of Grand Haven. The township's greatest coastal asset, however, is land available for new development or redevelopment. There are 733 undeveloped parcels that are not publicly owned or zoned for agriculture in Grand Haven Charter Township. These undeveloped parcels account for almost 2,217 acres of land. This affords Grand Haven Charter Township the opportunity to take advantage of protective adaptive actions to avoid building in sensitive habitats (i.e., an opportunity the City of Grand Haven no longer enjoys) and to develop in sustainable and resilient ways with the use of Low Impact Development (LID).

Stakeholders from Grand Haven Charter Township have identified concerns related to development in state-designated Critical Dune Areas, wildfire hazard areas, and coastal wetlands, as well as the desire to improve stormwater management, maintain natural viewsheds, and improve public access to Lake Michigan. Similar to the city, the township could develop and implement a number of infrastructure or zoning code revisions to address these broad concerns. Therefore, as with the city, it is easiest to step

through potential adaptive actions for the township by separating the coastal concerns and addressing them individually.

Critical Dune Areas and Fire Risk

Grand Haven Township has 1,056 acres of state-designated Critical Dune Areas within its borders, or about 6% of its total land area. Development has occurred within the Critical Dune Areas for decades, but there is still considerable land that could be developed. Currently, many of the structures located within the Critical Dune Areas are built off of steep and narrow private roads that often make it difficult (and in some cases nearly impossible) to reach with emergency vehicles like township fire trucks, and that make timely access to structures especially difficult when residents are attempting to leave the dune areas. Additionally, according to wildfire risk maps created by both Michigan State University's Firewise program and the Michigan Department of Natural Resources, large portions of the Critical Dune Areas within Grand Haven Charter Township are either at a moderate or high risk of wildfire hazards.⁷ There are also portions that are classified as very high or extreme risk of wildfire hazards.⁸ These risks, along with constrained fire truck access, make the township's homes and other structures located within Critical Dune Areas highly vulnerable to fire hazards.

The township has already taken a number of steps to address these fire hazards within its coastal dunes, including the purchase of specialized (and smaller than typical) fire vehicles, and the development of contingency plans for laying fire hose lines quickly to remote areas. The option of maintaining these kinds of approaches alone is identified and discussed more below. A second and more proactive option might be to draw from a number of model wildfire protection regulations to craft and implement a township-wide fire protection policy that safeguards their development and other resources from wildfire and/or ensures that emergency vehicles can access structures quickly and safely. These potential solutions, however, which include most notably widening access roads and removing vegetation, are not necessarily appropriate for Critical Dune Areas, and indeed would likely be prohibited under the State of Michigan's Sand Dune Protection and Management Act (SDPMA).

While the SDPMA may prevent the township from removing vegetation or widening access roads to address fire safety, it also prohibits communities like Grand Haven Charter Township from crafting land use regulations that are more stringent than the state's standards for the sake of protecting critical dune systems (i.e., local regulation that might be used to reduce the amount of development occurring in high-risk settings). Given that conundrum, review of Michigan constitutional, statutory, and case law suggests that the township is not legally obligated to accommodate or promote growth and development in their Critical Dune Areas. This suggests, conversely, that the township could decide to not fully accommodate development in high-risk dune areas as a way to disincentive such development. A third approach the township might consider for addressing fire safety concerns in its coastal dunes, therefore, would be to declare that developments in high-risk areas throughout the township that are also too remote to reach quickly and safely will no longer be given full fire-safety or other related emergency service protection. The township might do this by delineating a fire hazard

⁷ MDNR (Michigan Department of Natural Resources). *Statewide Wildfire Risk*. http://firewise.msu.edu/uploads/files/fire_risk_statewide_cities.pdf & Michigan State University Remote Sensing & GIS Research and Outreach Services. *Fire Management – Communities at Risk: Ottawa County*. http://firewise.msu.edu/uploads/images/gis_maps/Analysis%20Map_Ottawa%20County.jpg

⁸ Ibid.

overlay district for all areas within the township that are at high-risk for fires and are also too remote to reach quickly and safely. Doing so would put current residents and future residents on notice by stating clearly that they are unable to provide emergency services due to access issues that limit sufficient response times and/or subject emergency responders to safety risks. As an additional step, the township could require that fire suppression devices be installed in all new development and recommend that they be installed in all current development. This kind of action might potentially prompt political pushback within the community, and that analysis is fully developed below, but it would directly addresses issues related to fire safety without promoting potentially damaging development in their Critical Dune Areas.

Stormwater Management, High-Risk Shoreline Development, and High-Risk Flooding

Many of the other noted concerns in Grand Haven Township can be addressed with LID for the same reasons previously laid out for the City of Grand Haven. The analysis of LID options that work for the township is fully developed below.

Similarly, the township faces development issues with regard to its high-risk shoreline areas as presented above with regard to the city, with one notable exception. While the township's entire shoreline is within a state-designated High Risk Erosion area, it is also characterized entirely by steep dunes. As a result, it is not reasonable or feasible to identify a setback line based on a Perfect Storm high-risk hazard line because it is not possible to predict when or how much coastal bluff might collapse into the lake during a storm event. The options with regard to establishing a setback line for the township given these conditions, therefore, would be to either not set such a line at all, or to use an estimated erosion line. All of the policy options discussed above (i.e., having established a setback line) would be the same.

Finally, township stakeholders similarly expressed interest in expanding their efforts to address land management within high-risk flood zones. As with the city, and again although not developed further here, we have explored briefly options for enhancing the township's high-risk flood hazard policies and regulations and will present an overview of options available to the city in our final report to township officials.

ANALYSIS OF POLICIES AND ADAPTIVE ACTIONS

As previously noted, there are a number of policies and adaptive actions that both the City of Grand Haven and Grand Haven Charter Township can implement to address their coastal concerns. The best way to analyze these options is to discuss these concerns for the city and the township separately.

For each of the coastal concerns identified by the city and township, we have developed a range of policy options that the city and the township could implement. In doing this, we have answered for both the city and the township:

1. What adaptive actions or policies could the community implement?
2. What benefit could each action or policy provide?
3. What challenges might each action or policy present?

In our efforts to better understand the concerns and potential adaptive actions that each Grand Haven community might take, we not only met with community stakeholders but have also reached out to and received feedback from two outside groups whose work is relevant to our research. One is the City of Grand Haven's engineering firm, Abonmarche, which just completed a review of the city's zoning and stormwater ordinances in response to the new Municipal Separate Storm Sewer System (MS4) standards being put forward by Ottawa County. We discuss this more below but note here that our analysis of stormwater management for the City of Grand Haven builds from and incorporates their recommendations. The second group we have reached out to and heard back from is the Lower Grand River Organization of Watersheds (LGROW). LGROW is working in Grand Haven to develop a comprehensive design manual that includes a design calculator tool with built-in model ordinances to help the communities comply with the new MS4 standards and meet post-construction requirements. They have let us know that they are using SEMCOG's LID manual as a guide for the built-in model ordinances, and we have utilized the same manual to recommend similar LID options to the two communities.

City of Grand Haven

The City of Grand Haven stakeholders expressed concerns with stormwater management throughout the community, the encroachment of shoreline development in their North Shore zoning district, the health of their Critical Dune Areas (and other sensitive habitats), as well as potential development vulnerabilities in high-risk flood areas. There are wide arrays of best management practices that can be used to address each of these coastal concerns. Our analysis of each of these expressed concerns follows.

Stormwater Management

As previously noted, stormwater runoff and associated water quality concerns due to the city's imperviousness can be most adequately addressed through improved stormwater management practices, including the use of Low Impact Development (LID). LID also has the added benefit of helping protect sensitive habitats such as Critical Dune Areas, coastal wetlands, and other natural features.

In response to the US Environmental Protection Agency's (EPA) updated municipal separate storm sewer systems (MS4) standards to treat polluted stormwater runoff, the Michigan Department of Environmental Quality (MDEQ) has updated its MS4 program standards to better account for nonpoint source pollution. The Ottawa County Drain Commission (OCDC) is subject to the minimums set forth by MDEQ's updated MS4 program, but can also adopt standards that are more stringent than those established by MDEQ. OCDC has worked with the Macatawa Area Coordinating Council (MACC) to develop standards in compliance with these updates, and in some cases standards that are more stringent than the MDEQ baseline. The City of Grand Haven's stormwater ordinance must comply with these requirements. Since the city was aware of these changes, they requested a review of their stormwater ordinance by their engineering consultant, Abonmarche, to better understand exactly what they needed to address in order to comply with the MDEQ MS4 program and OCDC's new requirements. Abonmarche's review of the City of Grand Haven's stormwater ordinance concluded that the city must do the following things:

1. Identify sensitive areas and require nonstructural [best management practices] BMPs (Low Impact Design/Development) for those areas
2. Amend its stormwater ordinance to include new language regarding:
 - a. Pretreatment
 - b. Hot spots
 - c. Cold water streams

The first of these requirements is significant for the City of Grand Haven because identifying sensitive areas within the community, and requiring nonstructural BMPs for those areas prompts the city to start introducing LID elements into its land management policies and regulations. Since the City of Grand Haven has to comply with the MDEQ MS4 program and OCDC's new requirements, this option can be thought of as "Level 0". Adoption of the Level 0 approach would help not only with stormwater runoff, but also would help protect sensitive areas. Yet, the City of Grand Haven could do more to address their stormwater management concerns. The OCDC manual notes that they referenced SEMCOG's LID manual as a guide for developing their new BMPs and other standards. We used SEMCOG's LID manual to develop additional stormwater management options for the City of Grand Haven.

A potential "Level 1" approach for the City of Grand Haven involves adopting more stringent standards within their stormwater ordinance than OCDC. Standards that are not required by the updated OCDC stormwater regulations, but that SEMCOG includes in their model stormwater ordinance include:

- Planning commission review of stormwater plans submitted by developers. This is not something that is listed in state law as a responsibility of the planning commission, but input from the planning commission would be consistent with other local review processes. Additionally, any recommendations for action on the stormwater plan could be part of the recommendation for action on a site plan or subdivision plat.
- Offering development incentives only to those that employ BMPs that "enhance the response of a piece of land to a storm event rather than treat the runoff that is generated."⁹

⁹ SEMCOG. *Low Impact Development Manual for Michigan: A Design Guide for Implementors and Reviewers*. 2008.

- Examples: Minimize soil compaction or soil restoration; protect existing trees; restore or enhance native vegetation and riparian buffers

Adoption of this approach would have the benefit of making the city a leader in stormwater management in the State of Michigan. Challenges that would need to be overcome in order to adopt more stringent standards than the OCDC regulations include potential political pushback and the requirement for the city to demonstrate need for as well as benefits of those standards. A demonstration of needs and benefits is feasible, but needs to be carefully developed.

A “Level 2” approach that the City of Grand Haven could adopt is to develop a more coordinated effort between the planning commission and public works department to advocate for and enable Low Impact Development (LID) within the City of Grand Haven. Ways to develop a more coordinated effort might include:

- Establishing standing meetings between the planning staff and public works staff
- Enabling LID in zoning regulations:
 - Examples: Integrating LID elements into off-street parking landscaping zoning regulations; allowing for shared parking/driveways in residential districts
- Incentivizing participation in LID:
 - Examples: Introducing a recognition program for sites employing LID/creative stormwater management; accelerate plan review for site plans implementing LID techniques; reducing fees charged to the applicant (e.g. plan review fees) for site plans implementing LID techniques

If this approach were adopted by the city, some of the benefits they might enjoy include: a unified city message that LID efforts are positive and obtainable stormwater management goals; encouraged community participation in LID efforts driven by incentive programs; and a tailored implementation approach that could fit with its current development and stormwater infrastructure. There are challenges, however, that the city might confront while attempting to adopt this approach, including the burden of additional standing meetings and developing a communication process and incentives program that properly encourages community participation.

The most involved option – the “Level 3” approach – that the City of Grand Haven could adopt is the development of a stormwater utility program. A stormwater utility program is used by many cities across the United States, including Ann Arbor, MI. It offers a legally permissible way for municipalities to assess stormwater fees on residents and business owners proportional to the necessary costs of service. In order for the program to be legally permissible in the State of Michigan, the fees must serve a regulatory and not a revenue-generating purpose, and property owners must also be able to refuse or limit their use of service (i.e., by reducing impervious area on their property). As an example, Ann Arbor achieves these criteria by using the program to fulfill National Pollutant Discharge Elimination System (NPDES) and National Flood Insurance Program (NFIP) obligations, and by allowing owners to reduce their imperviousness in order to reduce their use of service fees (which are directly proportionate to their imperviousness).¹⁰

¹⁰ MML (Michigan Municipal League). *Michigan Green Communities: Ann Arbor Stormwater Utility Case Study*. http://www.mml.org/green/pdf/MGC_A2_StormwaterUtility_Case.pdf

Although the development of a stormwater utility presents many challenges, including the initiation of the program, establishing guidelines, and the development of oversight procedures (not to mention the potential political pushback), there are corresponding benefits. Most notably, it could encourage and provide incentives to residents and business owners to participate in LID. It also has the potential to help fund improved stormwater management practices, even though it would not be revenue generating.

High-Risk Lake Michigan Shoreline Development

The City of Grand Haven's concern about encroaching shoreline development in their North Shore zoning district might be addressed with the establishment of a clear, equitable, and protective development setback line from Lake Michigan based on the physical dynamics of a Great Lakes shore, coupled with policies designed to prevent new inappropriate development lakeward of that setback line and/or to ensure removal and cleanup of structures already lakeward of that line should they be damaged by a coastal storm. As noted above, this actually represents a multi-dimensional approach, and there are multiple options for both elements, including different potential setback lines and different, but not mutually exclusive, policy options.

Currently, the North Shore zoning district permits encroachment of structures lakeward up to twenty-five feet from parcel lot lines, and it allows property owners with structures situated landward of neighboring structures to shift their homes lakeward. Under this policy, structures on at least a few parcels are currently exposed to dangerous shoreline dynamics. Even more structures are likely to become exposed over time as homes are shifted lakeward while erosion continues to move the shoreline landward. Several figures help to highlight this exposure to dangerous shoreline dynamics.

Figure 2 displays updated high-risk coastal hazards zones under low-risk (lucky), moderate-risk (expected) and high-risk (perfect storm) combinations of lake water level and storminess for the city's North Shore district. Initial flood forecasts were developed for the master planning initiative undertaken with the City of Grand Haven. We subsequently updated and remapped these high-risk zones for this Integrated Assessment. We did so by using observed storm elevation numbers recorded at gauges along the shores of Lake Michigan. Use of these observed storm elevation numbers lowered our predicted storm surge elevation numbers for the expected and perfect storm flood forecasts, which, when remapped, show less land coverage. Despite this, the remapped flood forecasts still project some impact to current structures along the coast of the City of Grand Haven, most significantly along the North Shore.

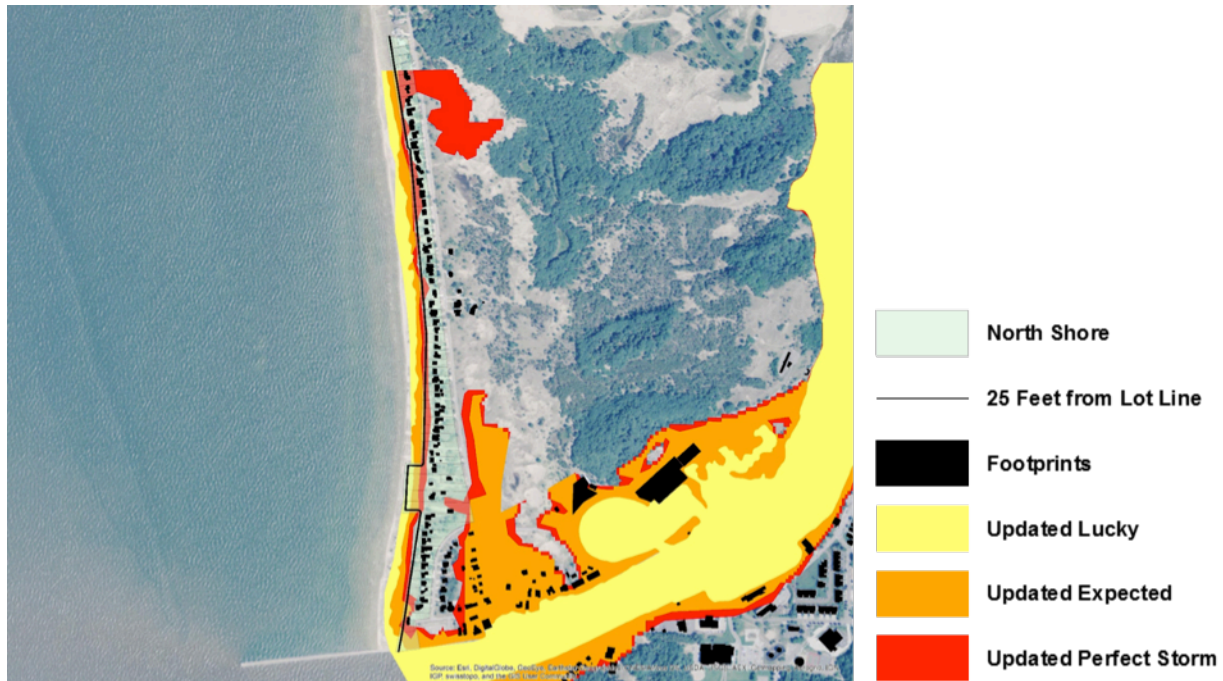


Figure 2. Updated extent of potential flooding and/or high-energy waves under “Lucky,” “Expected,” and “Perfect Storm” climate future conditions for the City of Grand Haven North Shore district.

Figure 3 shows historic aerial images of the North Shore under varying standing water conditions with the current setback line mapped along the shoreline. It is clear from these maps that given the lakeward extent of some parcels, new or redeveloped structures could move much closer to Lake Michigan. Closer structures could be at increased risk of inundation especially during high standing water conditions. We also estimate that three of the 70 structures located on the North Shore are abutting the current setback line. This means that a majority of property owners could feasibly continue moving structures closer to Lake Michigan, which again, would likely increase their exposure to potentially damaging shoreline dynamics.

Low Standing Water

Average Standing Water

High Standing Water

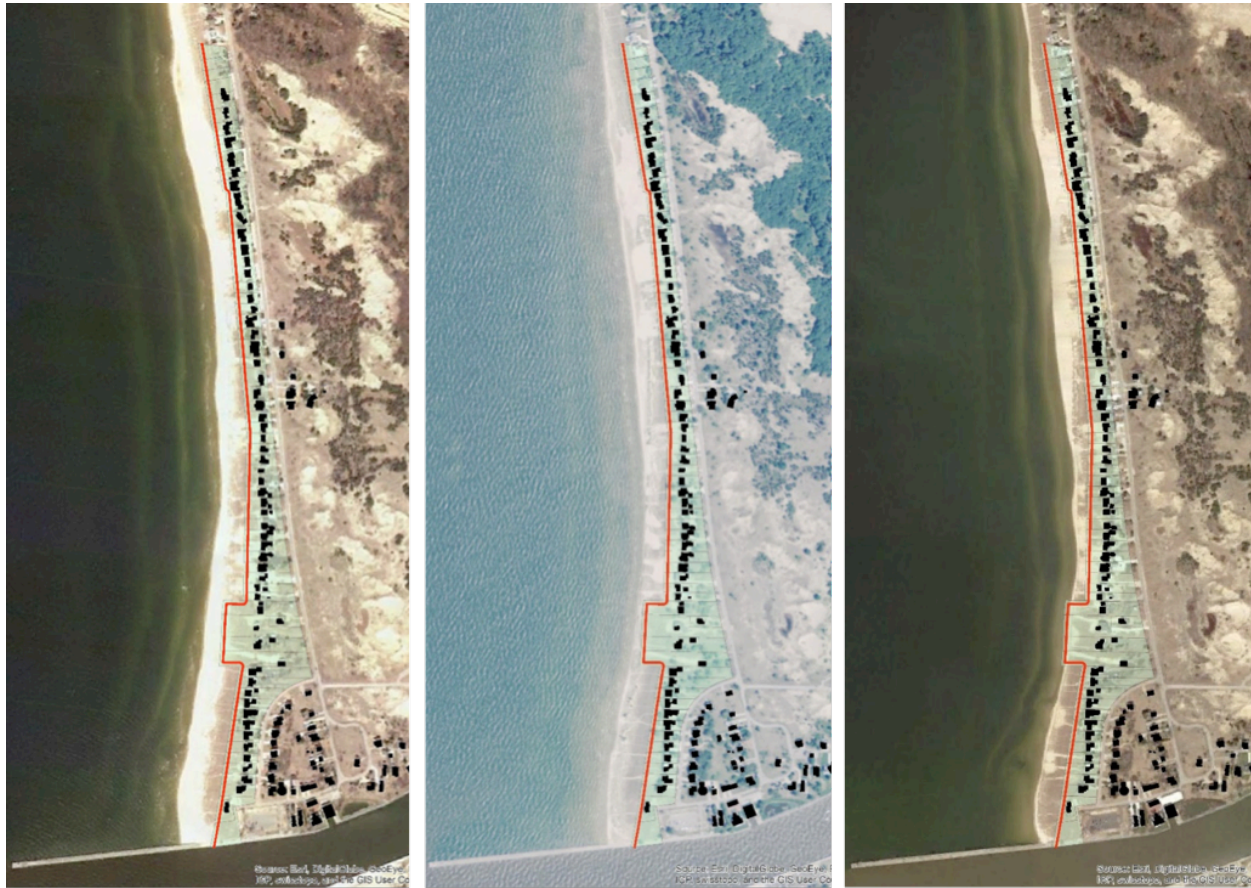


Figure 3. Current setback line and existing structures along the City of Gran Haven’s North Shore district under varying Lake Michigan water levels.

Again as noted above, the city has several options for adjusting this setback line to address their concerns about lakeward encroachment and potential property damage in the North Shore. These options include: 1) fixing all developing in its current location (i.e., retain the 25 foot setback but disallow any additional shifting of current structures lakeward); 2) adopting a setback premised on the 60-year shoreline erosion rate, consistent with the State of Michigan’s High Risk Erosion program; and 3) adopting a setback that follows the ‘Perfect Storm’ high risk hazard line developed through this research program. The Perfect Storm high-risk hazard line represents the landward extent along the shoreline of inundation and/or wash-over by high-energy waves during an extreme coastal storm event that occurs while Lake Michigan is at or near an all-time high water level.

Figure 4 illustrates the 60-year erosion line under high standing water conditions, and Figure 5 illustrates the Perfect Storm hazard line under average standing water conditions. Approximately 23 of the 70 total properties on the North Shore either abut or are lakeward of the 60-year erosion line, while approximately 16 properties either abut or are lakeward of the Perfect Storm hazard line. As such, either line represents a more stringent setback option than what the City of Grand Haven currently is using for its North Shore properties.

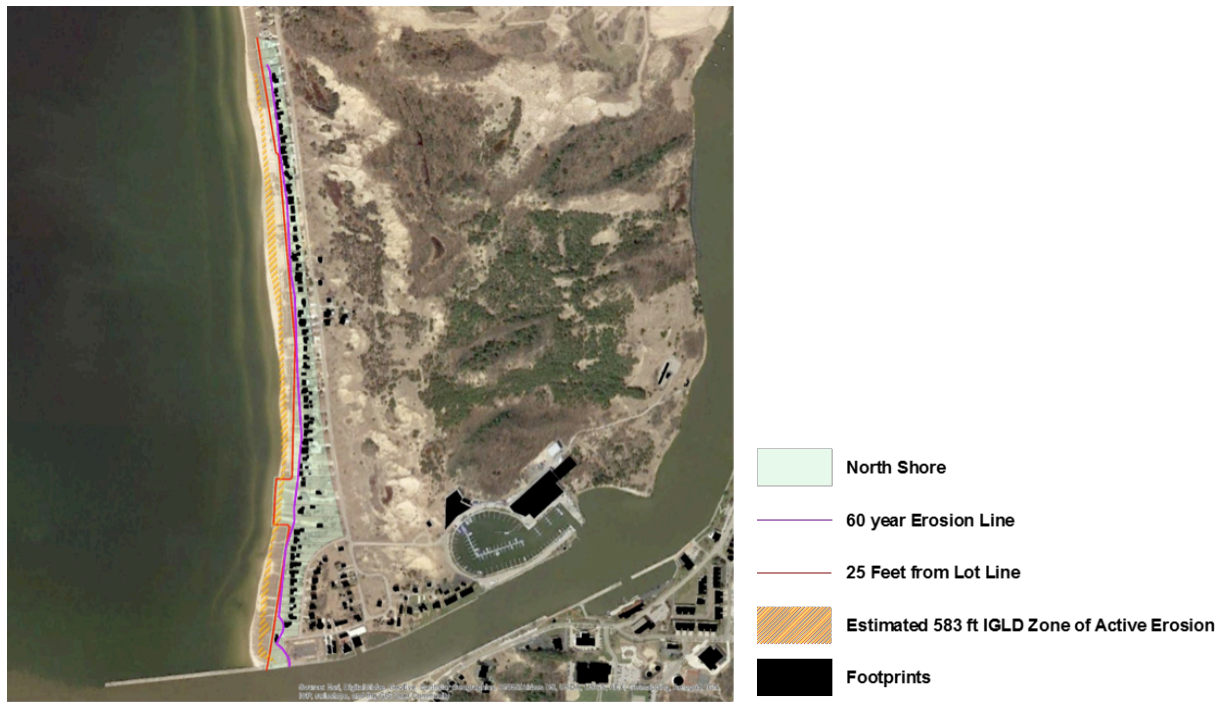


Figure 4. North Shore district showing

approximate location of a 60-year erosion line.



Figure 5. North Shore district showing approximate location of a Perfect Storm high-hazard line.

Adjusting the setback line would benefit the City of Grand Haven because it would limit lakeward encroachment, thus protecting properties from increased exposure to dangerous shoreline dynamics. An additional benefit of adopting either the 60-year erosion line, or the Perfect Storm hazard line would be using a line or restriction that is grounded in reasonable and appropriate technical methodologies for determining the spatial reach of erosion and flood risk. There would also be challenges for the City of Grand Haven. Chief among these challenges is that these lines may be difficult to apply on the ground, and that given the number of structures potentially affected, there might be political pushback to the adoption of either adjusted setback line.

Having adopted an appropriate setback line, the city also has multiple options for adopting policies tied to that setback. These options are not mutually exclusive and they each speak to various aspects of risk and fairness (i.e., to property owners and the larger community) in terms of allowing development while not putting people and structures in harm's way and ensuring the adequate cleanup of structures once damaged. As noted above, they include: 1) prohibit the placement of any new structure lakeward of the setback line; 2) allow only readily moveable structures lakeward of the setback line; 3) establish that existed structures currently lakeward of the setback line (or that become lakeward of that line as the shoreline erodes over time) are nonconforming structures, such that they must be removed if substantially damaged by a coastal storm event; and 4) require that owners of structures currently lakeward of the setback line (or that become lakeward) post a surety bond sufficient to clean up and restore the shoreline should the structure need to be removed following a coastal storm event.

If the City of Grand Haven chose to adopt these policies, there would be benefits and challenges of similar to those of adjusting the setback line. If adopted, these policies could prevent continued lakeward encroachment of development if a storm destroys structures. These policies, as noted, would also be premised on risk and fairness, which means that unless a structure that is nonconforming is destroyed, the property owner could continue to enjoy their development. The biggest potential challenge in adopting any of these policies would be political pushback from homeowners potentially impacted. Note that we are currently reviewing the legal implications of a surety bond option and will have that analysis completed by the time we present our final report to city officials.

Grand Haven Charter Township

Stakeholders from Grand Haven Charter Township have identified concerns related to development in state-designated Critical Dune Areas, wildfire hazard areas, and coastal wetlands, as well as the desire to improve stormwater management, maintain natural viewsheds, and improve public access to Lake Michigan. Similar to the city, the township could develop and implement a number of infrastructure or zoning code revisions to address these concerns. Therefore, it is easiest to step through potential adaptive actions by addressing the township's coastal concerns individually.

Critical Dune Areas and Fire Risk

The tale of Grand Haven Charter Township's Critical Dune Areas is one of both opportunity for development and of current development exposed to risk. As noted, the township has 1,056 acres of state-designated Critical Dune Areas within its borders, or about 6% of its total land area. Development has occurred within the Critical Dune Areas for decades, but there is still considerable land area that could be developed. In fact, there are 126 undeveloped parcels within the township's

Critical Dune Areas. These undeveloped parcels encompass a little over 156 acres of land. Put another way, undeveloped parcels represent almost 15 % of the total Critical Dune Area within the township. Moreover, these figures are probably conservative because a significant number of parcels that currently have developed structures are very large parcels that could easily be sold and/or split for new development. Beyond undeveloped (or potential split) parcels, about 396 non-publicly owned structures are already built within these dune areas on about 558 acres of land. As noted above, many of these existing structures, and much of the land that could potential be developed, within these Critical Dune Areas are built off of steep and narrow private roads, all within areas that are both ecologically vital natural resources and at high risk of wildfire.

Dune systems are dynamic natural habitats that are reliant on the ability to move with changes to their environment, like changing water levels. Restrictions to this movement diminish the future health of the dune system. For example, when the sands that comprise the dune systems are restricted from moving because of development or imperviousness, or when the native vegetation is removed from the dune systems, the future health of dunes is put into jeopardy. This is a negative for communities like Grand Haven Charter Township because dunes are not only natural flood buffers, but also sustain habitats important for “millions of plants, [and] animals” like the monarch butterfly, eastern box turtle, and the piping plover.¹¹

The attributes that make these dune systems ecological vital also make them highly susceptible to wildfire—a land management problem primarily when structures are built in harm’s way. Model wildfire hazard zoning regulations designed to minimize the potential for damage to structures and risk to human safety in high hazard areas essentially seek to increase emergency access ability through the widening of roads and driveways, and to remove vegetation that easily catches and spreads fire.¹² Because of the harmful ecological impacts these modifications would engender, efforts to protect residents and emergency responders seeking to enjoy the township’s Critical Dune Areas from fire hazards through such approaches could do substantial harm to these very same vital dune systems that so define the character of the community.

Nonetheless, one option the township might adopt to address fire risk in its coastal dune areas would be to seek permission from the State of Michigan through its sand dune management program to widen at least the most dangerous access roads and remove vegetation near structures that could put multiple structures at risk during a conflagration. The primary benefit of this option is that it would provide more robust fire safety protection for high-risk dune areas. The primary challenges are that each modification of a dune feature would require permission from the state, that it would undermine the ecological health of the dune systems, and that it might prompt push-back from dune system residents wishing to keep their neighborhoods in a “wilderness”-like condition. It could be too that providing additional fire safety protection might incentivize yet more residential development within the coastal dune system that is currently taking place.

To further complicate matters, the state’s sand dune management program also makes it difficult for communities like Grand Haven Charter Township to craft land use regulations that are more stringent

¹¹ MDEQ’s Coastal Management Program. *dune systems*.

http://www.michigan.gov/documents/deq/lwm_cda_dune_systems_267266_7.pdf

¹² Michigan State University Extension. 2013. *Land Use Series: Sample Wildfire Hazard Zoning*. <http://msue.anr.msu.edu/uploads/resources/pdfs/S6r.pdf>

than the state's standards. "In the summer of 2012, a proposal to amend the Sand Dune Protection and Management Act was presented, citing among other things the takings risk they contended was facing the state. The amendments were adopted as Public Act 297 of 2012. The legislation included: Removal of the ability of local governmental jurisdictions to adopt stricter critical dune regulations than the state."¹³ The township faces the conundrum, therefore, of not being able to discourage new development in high-risk coastal dune settings while also not being able to fully address new fire hazard risks that comes along with that development, let alone risks faced by already existing development.

Short of widening access roads and/or removing vegetation, therefore, the options left to the township to better manage these dunes would be to either continue its ongoing efforts to plan for and practice emergency response efforts as best as possible, or to adopt a wild fire high hazard overlay district. As noted above, review of Michigan constitutional, statutory, and case law suggests that the township has no legal obligation to provide services such as fire protection to properties located within high-risk fire zones. Therefore, the township could delineate a fire hazard overlay district for all areas within the township that are high-risk for fires and are also too remote to reach quickly and safely. Within these areas the township could put current residents and future residents on notice by stating clearly that they are unable to provide emergency services due to access issues that limit sufficient response times and/or subject emergency responders to safety risks. As an additional step, the township could require that fire suppression devices be installed in all new development and recommend that they be installed in all current development.

If adopted, a benefit of this approach would be that it protects the township staff and equipment from excessively risky operations without degrading the very dune environment that the township and residents desire to protect. It would strike a balance between dune protection and public safety. Requiring new residents to install fire suppression devices would provide an alternative form of protection given the inability of fire crews to respond quickly and safely.

Nonetheless, this approach would face some real challenges. Beyond the potential political pushback, the initial designation of high-risk fire areas, and mapping these areas, would require time and funding support not readily available. Also, despite our legal analysis suggesting that Grand Haven Charter Township would likely have the authority to develop a fire hazard overlay district and decline to provide emergency response services within that district, this approach has not yet been litigated, suggesting some uncertainty about its long-term legal (and political) viability.

Stormwater Management

The township's greatest coastal asset is land available for new development or redevelopment. There are 733 undeveloped parcels that are not publicly owned or zoned for agriculture in Grand Haven Charter Township. These undeveloped parcels account for almost 2,217 acres of land. As noted, this affords Grand Haven Charter Township the opportunity to take advantage of protective adaptive actions to thwart building in sensitive habitats and to develop in sustainable and resilient ways with the use of Low Impact Development (LID).

¹³ Michigan Environmental Council. 2015. *Bringing the Latest Science to the Management of Michigan's Coastal Dunes* (citation omitted) http://www.environmentalcouncil.org/mecReports/Latest_Science-Michigan_Coastal_Dunes.pdf

Similar to the City of Grand Haven, Grand Haven Charter Township is subject to the same updated Ottawa County Drain Commission (OCDC) standards that occurred when the Michigan Department of Environmental Quality (MDEQ) updated their MS4 program. We have not obtained an official engineering review of Grand Haven Charter Township's current stormwater ordinance, but with the documentation we have from the City of Grand Haven, we believe that the township would likely have to at least update their stormwater ordinance to include the very same things that the city has to include. Therefore, we believe the township must at least do the following:

1. Identify sensitive areas and require nonstructural [best management practices] BMPs (Low Impact Design/Development) for those areas
2. Amend its stormwater ordinance to include new language regarding:
 - a. Pretreatment
 - b. Hot spots
 - c. Cold water streams

Grand Haven Charter Township also has the ability to more comprehensively use LID as a way to not only manage stormwater, but also to protect sensitive features, protect water quality, and protect viewsheds. Specifically, there are a number of nonstructural LID best management practices (BMPs) that could either enhance or prevent the degradation of the natural landscape's ability to perform stormwater management through infiltration (a natural runoff reducer).

A potential "Level 1" approach for Grand Haven Charter Township would be to offer development incentives only to those who employ BMPs that specifically advance the goal of enhancing the responsiveness of land to a storm event instead of treating runoff post-construction. Examples of this include: minimizing soil compaction or soil restoration; protecting existing trees; and using native vegetation and riparian buffering. The township could also offer density bonuses or transfers for all new development, which would allow for greater density in a given district or site in exchange for more contiguous green space. This could potentially reduce impervious surfaces, and thus help address runoff concerns, while also allowing for clustering of development away from natural viewsheds.

Adoption of this approach could benefit the township by more comprehensively allowing LID to help protect its sensitive areas, water quality, and prevent runoff. In fact, it may even make sense for the township to also proactively delineate its sensitive areas through this enhance approach, which it may have to do under the new OCDC standards in any event. This would help facilitate the LID process for the protection of these features and also jumpstart its stormwater management goals. The challenges of adopting this approach include potential political pushback, and the requirement for the township to demonstrate need for as well as benefits of increased standards. A demonstration of needs and benefits is feasible, but needs to be carefully developed.

A potential "Level 2" approach that Grand Haven Charter Township could adopt would be to develop a more coordinated effort between the planning commission and public works staff to advocate for and enable Low Impact Development within the township. The township's planning and public works staff already meet regularly, but other coordinated efforts could include:

- Planning commission review of stormwater plans submitted by developers. This is not something that is listed in state law as a responsibility of the planning commission, but input from the planning commission would be consistent with other local review

processes. Additionally, any recommendations for action on the stormwater plan could be part of the recommendation for action on a site plan or subdivision plat.

- Incentivizing participation in LID:
 - Examples: Introducing a recognition program for sites employing LID/creative stormwater management; accelerating plan review for site plans implementing LID techniques; reducing fees charged to the applicant (e.g. plan review fees) for site plans implementing LID techniques

The potential benefits of Grand Haven Township adopting a more coordinated planning commission and public works effort to advocate for and enable LID are: a unified township message that LID efforts are positive and obtainable stormwater management goals; encouraged community participation in LID efforts driven by incentive programs; and a tailored implementation approach that could fit with its vision for future development and stormwater infrastructure. Notable challenges that the township might confront while attempting to adopt this approach would include the added burden of expanding the communication and coordination process, along with the development of an incentives program that properly encourages community participation.

Near Shore Coastal Hazards

As noted above, given that the township's entire shoreline is composed of high bluffs, it is not reasonable or feasible to identify a setback line based on a Perfect Storm high risk hazard line because it is not possible to predict when or how much coastal bluff might collapse into the lake during a storm event. However, the entirety of the township's shoreline also falls under the State of Michigan's High Risk Erosion Area (HREA) program. Its shoreline is segmented into five different HREAs, each representing different 30 and 60-year erosion rates, as determined by the Michigan Department of Environmental Quality (MDEQ). Because it is subject to state regulation, all of the structures currently built should have been permitted by the state (although we have not been able to confirm whether this is the case). Even so, we estimated where the 60-year erosion line falls landward of MDEQ's Zone of Active Erosion (583 ft on the Lake Michigan shoreline and determined that there are about 70 structures that are either lakeward or directly abutting the 60-year erosion line. From this analysis, we conclude that the township's current lack of a locally defined setback for these waterfront properties might not be sufficiently protective.

Given the fact that structures are currently at risk and that additional structures could be placed at risk in the future, and given the physical form of the shoreline itself, the options with regard to establishing a setback line would be to either not set such a line or to use an estimated erosion line. All of the policy options discussed above (i.e., having established a setback line) would be the same.

MDEQ's HREA program regulates those structures that may be at risk of being destroyed by erosion without needing additional township oversight or regulation. As such, while a more stringent setback may provide additional protection from erosion, it might not be worth the potential political pushback. It also might be hard for Grand Haven Charter Township to establish need for the regulation. Additionally, if a building is lost due to erosion, something like a nonconforming use provision within the township's zoning code would likely be moot, given the fact that once a bluff is gone, there would likely be no way for a property owner to rebuild.

There may be some benefit to establishing a surety bond requirement, as discussed with regard to the city above, which we will explore further before completing our report for township officials.

ADDITIONAL CONSIDERATIONS

Finally, we provide a few additional thoughts regarding the scope of our work and its transferability. Our potential adaptive actions can be applied to most if not all Great Lakes coastal community grappling with similar coastal concerns, particularly with those enjoying shorelines similar physically to those of Grand Haven (sandy beaches and high bluffs with little rocky substrate). Even so, an aspect of coastal community resiliency highlighted throughout this Integrated Assessment process has been that coastal concerns implicate more than just planning staffs and planning commissions. In fact, many different municipal departments interface with the management of coastal-related issues. As such, coordination and communication between municipal departments will be crucial to successful implementation of adaptive policies. Similarly, another key to successful implementation will be adopting measurable policies (i.e. set a clear setback line) and enforcing those policies. Finally, potential limitations to adopting adaptive actions include primarily political pushback and the potential for legal challenges, as well as the need for quality data to support potential policies. None of these observations is new or innovative, but their importance is readily apparent through our work.

LITERATURE CITED

Ardizzone, Katherine A., and Mark A. Wyckoff. 2010. *Filling the Gaps: Environmental Protection Options for Local Governments* (2nd ed.). Lansing, MI: Michigan Department of Natural Resources and Environment.

City of Grand Haven Master Plan, 2016.

http://www.resilientmichigan.org/downloads/city_of_grand_haven_master_plan_compressed.pdf

Citizens Research Council (CRC) (1999). *A bird's eye view of Michigan local government at the end of the twentieth century*. Livonia, MI.

EPA (U.S. Environmental Protection Agency). 2014. *The Great Lakes: An Environmental Atlas and Resource Book*. <http://epa.gov/greatlakes/atlas/index.html>.

GLERL (U.S. Great Lakes Environmental Research Laboratory). 2014. *About Our Great Lakes: Great Lakes Basin Facts*. <http://www.glerl.noaa.gov/pr/ourlakes/facts.html>.

Grand Haven Township Master Plan, 2016.

http://www.resilientmichigan.org/downloads/2016_resilient_grand_haven_master_plan_compressed.pdf

Gronewold, Andrew D., et al. 2013. Coasts, water levels, and climate change: A Great Lakes perspective. *Climatic Change* 120:697-711.

International Joint Commission. 1993. *Lake Levels Reference Study: Great Lakes---St. Lawrence River Basin, Annex 2 (Land Use and Management)*. Working Committee 2 Final Report submitted to the Levels Reference Study Board, March 31, 1993. ISBN 1---895085---46-2.

Michigan Conservation Districts, 2010. Michigan's Critical Dunes. <http://macd.org/critical-dunes.html>

Michigan Environmental Council. 2015. *Bringing the Latest Science to the Management of Michigan's Coastal Dunes*.
http://www.environmentalcouncil.org/mecReports/Latest_Science-Michigan_Coastal_Dunes.pdf

MDEQ (Michigan Department of Environmental Quality). 2014. *Shorelines of the Great Lakes*.
http://www.michigan.gov/deq/0,4561,7-135-3313_3677-15959--,00.html.

MDEQ's Coastal Management Program. *dune systems*.
http://www.michigan.gov/documents/deq/lwm_cda_dune_systems_267266_7.pdf

MDNR (Michigan Department of Natural Resources). *Statewide Wildfire Risk*.
http://firewise.msu.edu/uploads/files/fire_risk_statewide_cities.pdf

MML (Michigan Municipal League). *Michigan Green Communities: Ann Arbor Stormwater Utility Case Study*. http://www.mml.org/green/pdf/MGC_A2_StormwaterUtility_Case.pdf

Michigan State University Extension. 2013. *Land Use Series: Sample Wildfire Hazard Zoning*.
<http://msue.anr.msu.edu/uploads/resources/pdfs/S6r.pdf>

Michigan State University Remote Sensing & GIS Research and Outreach Services. *Fire Management – Communities at Risk: Ottawa County*.
http://firewise.msu.edu/uploads/images/gis_maps/Analysis%20Map_Ottawa%20County.jpg

Norton, Richard K. 2011. Who decides, How and Why? Planning for the Judicial Review of Local Legislative Zoning Decisions. *Urban Lawyer* 43(4):1085-1105.

Norton, Richard K. and Guy A. Meadows. 2014. Land and water governance on the shores of the Laurentian Great Lakes. *Water International* 39(6):901-920.

Norton, Richard K., Guy A. Meadows, and Lorelle A. Meadows. 2013. The deceptively complicated 'elevation ordinary high water mark' and the problem with using it on a Great Lakes shore. *Journal of Great Lakes Research* 39(2013):527-535.

Norton, Richard K., Lorelle A. Meadows, and Guy A. Meadows. 2011. Drawing lines in law books and on sandy beaches: Marking ordinary high water on Michigan's Great Lakes shorelines under the public trust doctrine. *Coastal Management* 39(2):133-157.

SEMCOG. *Low Impact Development Manual for Michigan: A Design Guide for Implementors and Reviewers*. 2008.

US Army Corps of Engineers, Detroit District, and Great Lakes Commission. 1999. *Living with the Lakes: Understanding and Adapting to Great Lakes Water Level Change*. ISBN 0-9676123-0-6.

APPENDICES

List of Events and Participants

- January 25, 2016 – First project meeting with community planners
 - Richard Norton – University of Michigan
 - Harry Burkholder – LIAA
 - Katie Sieb – LIAA
 - Zach Rable – University of Michigan
 - Jennifer Howland – City of Grand Haven
 - Stacey Fedewa – Grand Haven Charter Township
- February 16, 2016 – Project check-in phone call
 - Katie Sieb
 - Zach Rable
- March 15, 2016 – Public Hearing for City of Grand Haven Master Plan
 - Katie Sieb
- May 10, 2016 – Introduction of IA project to City of Grand Haven Planning Commission
 - Richard Norton
 - Zach Rable
 - Jennifer Howland
 - City of Grand Haven Planning Commission
- May 16, 2016 – Scoping meeting with community planners, and photo documentation of issues
 - Katie Sieb
 - Zach Rable
 - Jennifer Howland
 - Stacey Fedewa
- June 6, 2016 – Introduction of IA project to Grand Haven Township Planning Commission
 - Richard Norton
 - Stacey Fedewa
 - Grand Haven Township Planning Commission
- July 18, 2016 – IA project discussion with Grand Haven Township stakeholders
 - Richard Norton
 - Zach Rable
 - Katie Sieb
 - Stacey Fedewa
 - Dennis Cole – Ottawa County Office of Water Resources
 - Kevin Kieft – Prein & Newhof Engineers
 - Mark VerBerkmoes – Public Services Director
 - Grand Haven Township Fire & Rescue Staff
- July 18, 2016 – IA project discussion with City of Grand Haven stakeholders
 - Richard Norton
 - Zach Rable
 - Katie Sieb
 - Jennifer Howland
 - Tony McGhee – Abonmarche Engineers

- Mike Morphey – Abonmarche Engineers
- July 18, 2016 – IA project update and policy options discuss with Grand Haven Township Planning Commission
 - Richard Norton
 - Zach Rable
 - Katie Sieb
 - Stacey Fedewa
 - Grand Haven Township Planning Commission
- July 19, 2016 - IA project update and policy options discuss with City of Grand Haven Planning Commission
 - Richard Norton
 - Zach Rable
 - Katie Sieb
 - Jennifer Howland
 - City of Grand Haven Planning Commission
- August 10, 2016 – Meeting with and guided Critical Dune Areas tour with Grand Haven Township Fire & Rescue Chief
 - Richard Norton
 - Zach Rable
 - Katie Sieb
 - Stacey Fedewa
 - Rom Gerencer – Fire & Rescue Chief
- November 9, 2016 – City of Grand Haven Presentation on updated findings of potential policy options. Received feedback to refine research pursuit.
 - Richard Norton
 - Zach Rable
 - Katie Sieb
 - Jennifer Howland
 - City of Grand Haven Planning Commission
- November 21, 2016 – Grand Haven Charter Township Final Presentation on updated findings of potential policy options. Received feedback to refine research pursuit.
 - Richard Norton
 - Zach Rable
 - Katie Sieb
 - Stacey Fedewa
 - Grand Haven Township Planning Commission
- January 2017 – Final reports and presentations to both the City of Grand Haven and Grand Haven Charter Township

Model Ordinance Links

High FQI:

- http://www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/FQA_text.pdf
- <http://www.sustainourgreatlakes.org/wp-content/uploads/Properties-and-Performance-of-the-Floristic-Quality-Index-in-Great-Lakes-Coastal-Wetlands.pdf>

- https://www.municode.com/library/mi/spring_lake_township_ottawa_co/codes/code_of_ordinances?nodeId=COOR_CH14EN_ARTVWEPR_S14-107FIFA
- <http://quod.lib.umich.edu/cgi/p/pod/dod-idx/use-of-floristic-quality-assessment-as-a-tool-for-monitoring.pdf?c=mbot;idno=0497763.0050.402>
- <http://dnr.wi.gov/topic/wetlands/documents/fqamethodwithacknowledgements.pdf>

Wetlands Buffer:

- http://www.aswm.org/pdf_lib/model_ordinance_1209.pdf
- <http://dnr.wi.gov/topic/ShorelandZoning/documents/NR117model.pdf>
- <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.319.6568&rep=rep1&type=pdf>
- https://www.scdhec.gov/HomeAndEnvironment/Docs/CLBO_Manual.pdf

Riparian Buffer:

- http://www.hrwc.org/wp-content/uploads/2009/11/HRWC_riparianbuffer_model_ordinance.pdf
- http://www.epa.gov/sites/production/files/2015-12/documents/2002_09_19_nps_ordinanceuments_buffer_model_ordinance1.pdf
- <http://superiorwatersheds.org/images/riparianbufferreportnew.pdf>

Ag Buffers:

- http://www.dca.state.ga.us/intra_nonpub/Toolkit/ModelOrdinances/AltZ/4_3.pdf

Maximum % lot coverage (limiting impervious surfaces):

- <http://www.oregon.gov/lcd/docs/publications/wqgbchapter4zon.pdf>
- <http://www.ncwrpc.org/countyftp/NR115/Chapter2.pdf>
- <http://www.dem.ri.gov/programs/bpoladm/suswshed/pdfs/imperv.pdf>
- http://www.fws.gov/southwest/es/Documents/R2ES/LitCited/4TX_Sal/Arnold_and_Gibbons_1996_Impervious_cover.pdf

Smart Growth parking schedules:

- http://contextsensitivesolutions.org/content/reading/parking_md/resources/parking_paper_md/

Fencing Regulations for Waterfront properties (viewshed protection):

- <http://www.preservationnation.org/information-center/law-and-policy/legal-resources/preservation-law-101/resources/Viewshed-Protection.pdf>

General Model Ordinance Information:

- <http://dnr.wi.gov/topic/ShorelandZoning/documents/NR115ModelOrdinance.pdf>
- http://seagrant.noaa.gov/Portals/0/Documents/what_we_do/social_science/ss_tools_report/resilient-planning_web.pdf
- <http://coastalsmartgrowth.noaa.gov/elements/design.html>
- <http://dnr.wi.gov/topic/ShorelandZoning/LocalGovResources/local.html>
- <http://www.miseagrant.umich.edu/wp-content/blogs.dir/1/files/2013/08/13-720-Best-Practices-Working-Waterfronts-Case-Study.pdf>
- <http://dnr.wi.gov/topic/ShorelandZoning/documents/annotatedordinance.pdf>
- <http://www.jstor.org/stable/3147260>
- <https://coast.noaa.gov/czm/enhancement/media/mi3092011.pdf>
- <http://coastal.ohiodnr.gov/ocmp>
- <http://www.semcog.org/reports/lid/index.html#>
- http://landpolicy.msu.edu/resources/rural_water_quality_protection_a_planning_zoning_guidebook_for_local_offici