

Reinforcing our Waterfronts

Increased Resilience at Marinas and Harbors

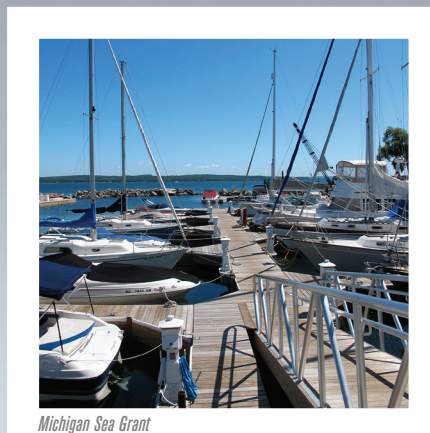
More intense storms, fluctuating lake levels and shifts in average temperatures are all indications of climate variability — and are increasingly frequent.

While our knowledge of natural systems and climate trends is improving over time, we will continue to be challenged by the uncertainty of nature.

Included here is a summary of risks and impacts for marina and harbor operators and a variety of best practices to assist marinas in preparing for these risks. As an introduction to environmental variability, *Part 1: Assessing Risks and Impacts* provides an overview of the primary climate-related issues marinas and harbors may face.

Part 2: Best Practices to Consider for Your Facility provides guidelines for how to prepare for an uncertain future. Specific recommendations are included for infrastructure, dredging, planning and financing.

Part 3: Resources and Tools provides information to help you learn more.



Michigan Sea Grant



Levi Read, U.S. Coast Guard



PART 1: ASSESSING RISKS AND IMPACTS

When considering the impact of changing environmental conditions for your facility, it may be helpful to assess your current goals, strategies and operating procedures in the context of increasingly variable environmental conditions. What impacts do you need to prepare for?

The major environmental and climate-related changes most relevant to ports, harbors and marinas include:

- Fluctuating water levels
- Storm frequency and intensity
- Changing precipitation
- Changing temperature

After reviewing risks and impacts for your facility and the introductions to environmental change, refer to *Part 3: Resources and Tools* for more information.

FLUCTUATING WATER LEVELS

Water levels directly affect marinas and harbors in the Great Lakes. Access to boat slips, navigation channels and harbors of refuge may be compromised. Fluctuating water levels influence a facility’s ability to operate, and in turn, affect finances and patronage.

UNDERSTANDING WATER LEVELS

Significant changes in Great Lakes water levels require prolonged periods of wet or dry conditions. Lake levels are determined by three main factors related to inputs and outputs (i.e., the water budget):

1. Evaporation off the lakes and evapotranspiration from land.
2. Precipitation onto land and lakes.
3. Runoff from the land and rivers into the lakes.

These factors are influenced by the climate. For example, air and water temperature plus ice cover influence evaporation rates. We are unsure if anticipated increases in evaporation will be offset by an increase in precipitation.

HOW WATER LEVELS AFFECT MARINAS AND HARBORS

Fluctuating water levels — both high and low — will affect your facility. Some impacts from drastically different water levels will be experienced regardless of whether levels are higher or lower; additional impacts are specific to whether levels are high or low. The following table provides an overview of potential impacts.

ENVIRONMENTAL CHANGE	POTENTIAL IMPACT
FLUCTUATING WATER LEVELS	<ul style="list-style-type: none">• Dockage: Reduced stability and strength; increased rate of deterioration.• Dredging: Increased need for ensuring access to harbor navigation channels and interior slips.• Beaches: More or less beach area exposed; related aesthetic issues.• Native vegetation: Variation in nearshore areas impacts fish spawning and vulnerability to invasive species.• Costs: Additional dredging, structural changes and operational changes increase costs.
LOWER WATER LEVELS	<ul style="list-style-type: none">• Wood infrastructure exposed to oxygen, increasing rate of decay.• Potential safety concerns (e.g., increased vertical distance between fixed dock and vessel, vessels running aground or striking bottom).• Stranded dock or harbor in extreme lows.• Bottleneck at access channel and boater wait time.• Reduced access to slips (e.g., limits on size of vessel entering basin, reassignment of berths to match draft depths).• Reduced access to boat launch due to limited paved area.• Increase in costs including dredging, adaptations, accepting only smaller boats with a loss of revenues from slip fees and other purchases (e.g., fuel and groceries).
HIGHER WATER LEVELS	<ul style="list-style-type: none">• Stability and strength of infrastructure compromised.• Structures may become unusable in extreme conditions.• Widespread shoreline erosion and flooding.• Greater potential for flooding of critical land areas and operational structures.• Reduced beach access, limiting recreational activities.• Changes to ecology of beach and offshore habitat, affecting aesthetics and fisheries.

Sources: *Climate Change and Wisconsin’s Great Lakes Coastal Communities*, Wisconsin Initiative on Climate Change Impacts; *Great Lakes Water Levels Briefing*; Nov. 20, 2013, NOAA; *Recreational Boating and Tourism Contextual Narrative*, International Upper Great Lakes Study.

RANGE OF FLUCTUATION

The U.S. Army Corps of Engineers reports differences between record high and low monthly mean lake levels as:

- Superior: 3.9 feet (1.2 meters)
- Erie: 6.1 feet (1.8 meters)
- Michigan/Huron: 6.3 feet (1.9 meters)
- Ontario: 6.6 feet (2.0 meters)

Source: *USACE Long-term Averages for Great Lakes Water Levels*, 2013.



Hurricane Sandy damage at a Lake Erie marina. (Source: ODNR, Office of Coastal Management.)



Wind-generated waves breach the harbor structure along Lake Michigan. (Source: Michigan Sea Grant.)

INCREASED STORM FREQUENCY AND INTENSITY WITH INCREASED PRECIPITATION

Storms are becoming more frequent and more intense, escalating risk for damage at marinas and harbors.

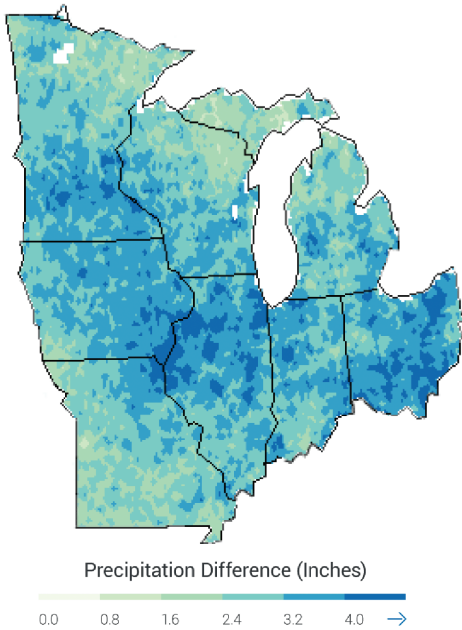
In 2012, Hurricane Sandy delivered gale force winds over 45 miles per hour, causing damage to marinas and breakwaters along Great Lakes shorelines. Federal navigation structures in the Great Lakes sustained about \$17.7 million in damage, according to a U.S. Army Corps estimate. The storm also increased sediment loads to harbors and channels. In some marinas, damage to patrons’ vessels was extensive, and operators and owners spent months determining legal responsibilities and

conducting clean-up. Future storms will pose similar operational considerations.

UNDERSTANDING STORMS AND PRECIPITATION

Extreme rainfall and flooding have increased in frequency during the last century, and these trends are expected to continue. In the Midwest, the 10 rainiest days can contribute as much as 40 percent

of the total precipitation in a given year. Generally, annual precipitation increased during the past century — by up to 20 percent in some locations — with much of the increase driven by intensification of the heaviest rainfalls (2014 National Climate Assessment). Flooding also causes major human and economic hardships, including damage to roads, buildings and personal property.



Projected Precipitation Changes in the Midwest: Interactive Map. (Source: U.S. Global Change Research Program - Midwest Report.)

HOW STORMS AND PRECIPITATION AFFECT MARINAS AND HARBORS	
The following table provides an overview of potential impacts.	
ENVIRONMENTAL CHANGE	POTENTIAL IMPACT
INCREASED STORM FREQUENCY AND INTENSITY	<ul style="list-style-type: none"> • Larger waves, higher seiches and greater storm surges can damage port and harbor infrastructure. • Increased potential for shoreline erosion and damage to existing property due to erosion from storm runoff and flooding. • Increased need for scour protection at the base of fixed docks, piles and walls. • Damage to dockage and boats while moored. • Reduced vessel maneuverability and speeds affect safety. • Increased channel sedimentation and potential for resuspension of contaminated sediments.
INCREASED PRECIPITATION	<ul style="list-style-type: none"> • Increased rainfall amounts may overwhelm onsite stormwater management system, resulting in flooding. • Impaired water quality and beach closures if increased runoff deposits excess nutrients and pathogens on beach. • Degraded water quality from factors such as combined sewer overflows from increased stormwater volumes can lead to economic loss in the form of lost tourism and lower quality of life. • Prolonged dry periods can lead to major slope failures in heavy rainfall events.
Sources: <i>Climate Change Implications and Adaptation Strategies</i> , Wisconsin Sea Grant; <i>Climate Change and Wisconsin's Great Lakes Coastal Communities</i> , Wisconsin Initiative on Climate Change Impacts; <i>Midwest Climate Impacts</i> , ICLEI.	

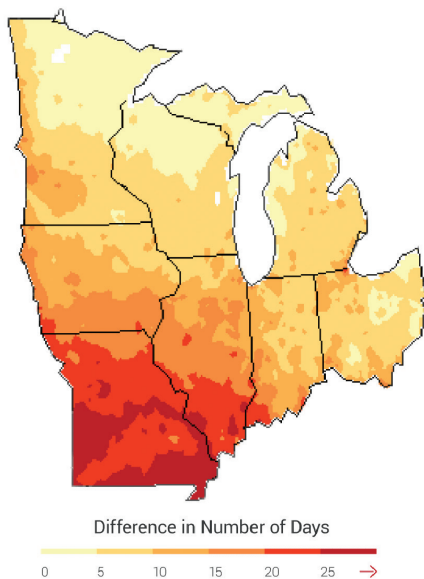
HOW TEMPERATURE AFFECTS MARINAS AND HARBORS

The following table provides an overview of potential impacts.

ENVIRONMENTAL CHANGE	POTENTIAL IMPACT
TEMPERATURE CHANGES	<ul style="list-style-type: none">• Increased wear on buildings from heat and weather extremes.• Increased energy cost for additional air conditioning during longer, hotter summer.• Variable seasons extend boating and change operations (e.g., earlier start dates for seasonal staff, varying dates launch/storage of vessels).• Late spring freezes may impact boats dewinterized and launched in an early warm period.• Increased heat wave intensity and frequency, plus humidity, could bring more people to the waterfront.• Changes in freeze-thaw cycles may adversely affect bluffs and increase erosion.
Sources: <i>Climate Change Implications and Adaptation Strategies</i> , Wisconsin Sea Grant; <i>Climate Change and Wisconsin's Great Lakes Coastal Communities</i> , Wisconsin Initiative on Climate Change Impacts; <i>Midwest Climate Impacts</i> , ICLEI.	

TEMPERATURE CHANGES

Changes in our region's average temperatures will affect recreational boating and facilities operation in several ways. It's not all bad news — the boating season may be extended if temperatures warm. At the same time, operators will need to be aware of other concerns, such as what could happen after launching boats in an early warm period followed by a late spring freeze.



Projected Mid-Century Temperature Changes in the Midwest: Interactive Map. (Source: U.S. Global Change Research Program - Midwest Report)

UNDERSTANDING TEMPERATURE

Key temperature changes anticipated for our region include increased number and intensity of heat waves and increased humidity. Variations in when these temperature changes happen are also expected, including more late spring freezes and decreased ice cover.

The Midwest, which includes much of the Great Lakes, has experienced an increased pace of warming since 1900. Generally, a changing climate will exacerbate a range of risks to the Great Lakes, including changes in the range and distribution of certain fish species, increased populations of invasive species, more harmful algal blooms and declining beach health (2014 National Climate Assessment).

PART 2: BEST PRACTICES TO CONSIDER FOR YOUR FACILITY

Now that you're familiar with the potential risks and impacts to marinas and harbors, this section explores what you can do to build your facility's resilience to changing conditions. In other words, how can you be prepared? This overview of best practices provides guidance specifically to help marina and harbor operators adapt to a variety of environmental conditions. The following topics are covered:

- Infrastructure and Grounds
- Dredging
- Planning and Financing

INFRASTRUCTURE BEST PRACTICES

More severe and frequent storms, shoreline erosion and fluctuating water levels will likely increase wear and tear on your facility's infrastructure, much of which may have been designed and built to withstand a different set of environmental challenges than those we're experiencing now and expect to see in the future. Harsher weather events like more frequent heat waves, floods and rapidly changing water levels may accelerate deterioration of aging infrastructure.

EVALUATE RISKS:

Evaluating the potential risks and weak points of infrastructure and grounds is a best practice and a first step in being prepared for and building resilience against uncertainty — meaning no matter what happens, high or low water levels for example, your facility will be fortified to withstand a variety of conditions. In addition to the potential impacts previously listed, also consider the shoreline (e.g., coastal erosion from



Coastal bluff failure. Erosion from waves, lakebed erosion and rainfall are the most common contributors to bluff failure or collapse. (Source: Michigan Sea Grant.)



(L to R): Timber structure rot, timber crib repair and protective jacket for piling. Wood infrastructure is especially vulnerable to low water levels, which expose timber to oxygen that hastens deterioration. (Source: Gene Clark, Wisconsin Sea Grant.)

Floating docks provide uniform distance between dock and vessel regardless of water level. (Source: Michigan Sea Grant.)

increased storm surges, permanent erosion of nearshore lakebed) and sensitive areas (e.g., impacts to dunes, wetlands, coastal bluffs).

- Evaluate how the maintenance and operations of your buildings perform under extreme conditions (e.g., high temperatures, heavy downpours).
- As needed, consider options for stabilizing shorelines or relocation of facilities.
- Periodically monitor your facility, the surrounding area and lakebed for signs of erosion and related impacts to infrastructure or shore protection structures (e.g., wood or rock foundations).

INVEST IN LONG-TERM ADAPTATIONS:

As many marina and harbor structures in the Great Lakes reach or exceed their design life, there are opportunities to invest in repairs or long-term adaptations.

- As needed, repair or replace components of your stormwater management system, buildings, wood infrastructure, pilings or shoreline protection structures.
- Consider installing a floating dock that will adjust to fluctuating water levels and will keep the distance a person has to step up or down from a boat to the dock uniform, regardless of water level change.
- If required, enlarge breakwaters, reinforce walls and improve scour protection. Where possible, use soft engineering or natural shorelines.

DREDGING BEST PRACTICES

Dredging — the excavation and removal of sediments and debris from the bottom of a water body — is often necessary to ensure safe passage for ships and to maintain recreational access for boaters. Storms often deliver a great volume of sediment to a basin; this, paired with changing water levels, will continue to influence the demand for dredging to clear access for boaters.

IDENTIFY JURISDICTION FOR DREDGING:

The U.S. Army Corps of Engineers (USACE) regulates dredging in the Great Lakes and may delegate some responsibility for permitting to state agencies. Before you can apply for a permit for dredging work, you must determine the responsible agency.

COLLECT REQUIRED INFORMATION:

Next, compile required permit materials; this usually includes:

- Information about the quantity of materials to be dredged.
- Survey or dredging plan to show area to be dredged.
- The location and condition of the proposed disposal site.
- Names and addresses of nearby landowners who may be affected.
- Likely environmental impacts.

If there is reason to believe sediments may be contaminated, sediment testing will be required. It may be wise to have these materials prepared in order to respond to future funding assistance programs or budget allocations.

EXPLORE FUNDING OPTIONS:

The federal government, through the Army Corps' Operation and Maintenance (O&M) budget — funded by the Harbor Maintenance Tax — funds dredging in the designated Great Lakes navigation system. As federal funding has become less consistent, states and communities have been increasingly responsible for supporting local projects. The following best practices may help your facility move forward with dredging when funding is difficult to secure.

- Support allocation of Harbor Maintenance Trust funds for their intended purpose.
- Pursue grants or low interest loans supported through local or state general fund revenue, bonds or indirectly through taxes.
- Determine if project falls within a designated Great Lakes Area of Concern; federal funding may be available.
- Also evaluate options to identify more cost-effective strategies to ensure harbor viability; for example, dredge channels only in priority areas.

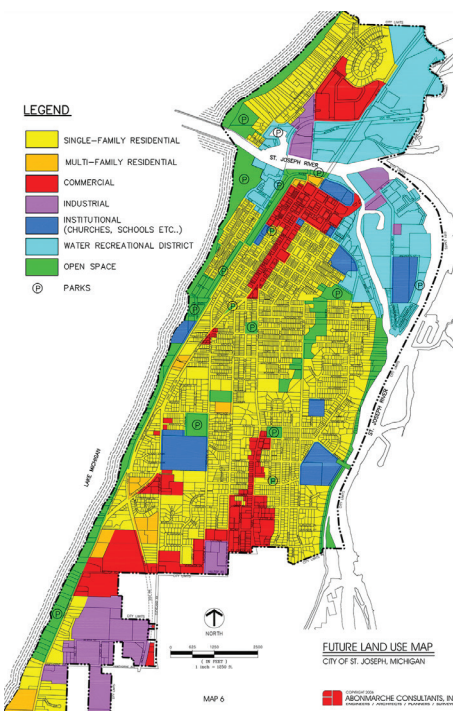
PLANNING AND FINANCING

Being prepared — through adaptation planning — can reduce your facility's exposure to risks and hazards. Planning can help you get ready for an uncertain future, and will help your business remain flexible when faced with environmental, economic and social changes.

GET INVOLVED IN COMMUNITY PLANNING:

Comprehensive planning and climate adaptation planning are types of community planning that garner support for a shared vision, safeguard economic interests and increase community preparedness. By engaging in these planning exercises you can show local decision-makers that your facility is an important part of the waterfront.

- Participate in community planning exercises, as available. Identify and voice needed measures (e.g., design standards, zoning ordinance) to improve resilience to increased storm intensity, fluctuating lake levels and other environmental changes.
- Pursue development of harbor management plans and master plans that anticipate climate change as well as update old infrastructure.



Land use plan designating a water recreational district, shown in light blue. (Source: City of St. Joseph.)

DEVELOP A PLAN TO REDUCE RISK:

Plans developed specifically for your marina will ensure you are prepared to protect your investments and those of your patrons. Developing a disaster preparedness or hazard mitigation plan provides an opportunity to develop potential responses specific to your marina or harbor should a hazardous situation arise (e.g., beach erosion, damage to infrastructure).

- Consider ways to reduce risk and plan for how to recover after hazardous events (e.g., storm surge, flooding) when making long-term infrastructure and land use decisions.
- Review your facility and operations through the lens of increased exposure to climate-related hazards. How do variable environmental conditions affect your facility's goals, objectives and strategies?

ESTIMATE COSTS OF ADAPTATION:

Typical operating costs for marinas and harbors will likely increase when dealing with extreme water level variability and increased storm frequency and intensity.

Costs of adaptation can vary depending on many factors. A survey of 125 marinas showed a 3-foot drop below long-term averages in water levels could cost a marina \$53,000 to \$83,000 each year, including lost revenues from reduced access to the facility (e.g., foregone slip rentals, incidental spending, fuel sales). According to this analysis, these costs could put about half of the marinas on Lake Erie, Lake Michigan and Lake Huron out of business, and all of the surveyed marinas on Lake Superior (International Upper Great Lakes Study).

When considering costs, it is helpful to look beyond just the expense of adaptations or pre-emptive maintenance. Running a cost analysis on potential damage repairs, infrastructure updates and increased dredging needs provides a more accurate financial picture when considering the variability likely to occur in the future.

EXPLORE FINANCING OPTIONS:

To fund adaptation and sustainability efforts for waterfront operations, explore financing opportunities from local, state or federal government including grants or loans supported through general fund revenue, bonds or indirectly through taxes.

Recommendations to fund replacement of failing infrastructure include establishing a Water Resource Improvement Tax Increment Finance Authority or a marine investment fund, wherein non-marine users pay to help offset infrastructure improvements. Also, find allies to improve access to funding sources. Explore or establish public-private partnerships and support from a waterfront non-profit or trade association. Use innovative approaches for cost savings that may qualify for tax benefits (e.g., energy reduction through increased efficiency).

MOVING TOWARD AN UNCERTAIN FUTURE

We don't know exactly what the future will bring, but we do know that climate variability and associated impacts pose risks to waterfront businesses. By treating these risks as operational issues, you will increase your facility's preparedness for an uncertain future. The suggestions and best practices featured throughout this publication are aimed at preparing marinas and harbors for the future and ensuring our Great Lakes coastal businesses thrive when faced with such variability.

PART 3: TOOLS AND RESOURCES

Now you have an overview of the primary risks and impacts facing marinas and harbors. Learn more about the best practices outlined here, by visiting the *Resources* section of the Great Lakes Clean Marina Network website (www.glcleanmarina.org) or the Clean Marina Classroom website (www.cleanmarinaclassroom.org). Also, explore the tools and resources listed below.

WATER LEVELS

- Great Lakes Water Level Dashboard — NOAA: View current, historical and projected water levels. glrl.noaa.gov/data/wldb
- Great Lakes Hydro-Climate Dashboard — NOAA: Includes data on drivers behind water level. glrl.noaa.gov/data/hcdb

- Great Lakes Lake Level Viewer — NOAA: A visualization tool about changing lake levels. www.coast.noaa.gov/digitalcoast/tools/llv
- Water Level Bulletins and Forecasts — U.S. Army Corps of Engineers: Historic, current and predicted water levels. www.lre.usace.army.mil/Missions/GreatLakesInformation/GreatLakesWaterLevels.aspx
- CoastWatch: Great Lakes — NOAA: Near real-time observation and tracking of a number of physical characteristics in the Great Lakes. coastwatch.glerl.noaa.gov

STORM INTENSITY AND FREQUENCY

- Flood Map Service Center — Federal Emergency Management Agency: Provides access to your official flood map, flood hazard products and tools to better understand flood risks. msc.fema.gov/portal
- National Flood Insurance Program: Flood Hazard Mapping — FEMA: Identifies flood hazards, assesses flood risks and partners with states and communities to provide accurate flood hazard and risk data to guide to mitigation actions. www.fema.gov/national-flood-insurance-program-flood-hazard-mapping

TEMPERATURE AND PRECIPITATION

- Climate Wizard — The Nature Conservancy: An interactive tool for users to explore specific regional climate scenarios. www.climatewizard.org
- Binational Climate Impacts and Outlook Reports — NOAA: Quarterly regional reports on climate trends and impacts on water quality, navigation, recreation, public health and infrastructure. www.drought.gov/drought/content/resources/reports
- Cities Impacts & Adaptation Tool — GLISA: Planning support tool including “climate peers” – your city’s projected climate compared to a climate that currently exists elsewhere. graham-maps.miserver.it.umich.edu/ciat

INFRASTRUCTURE AND DREDGING

- Great Lakes Port & Harbor: Infrastructure Matrix & Dredging Cost Estimate Tool — Great Lakes Climate: Resources to identify the current value of navigational and port infrastructure; aids in estimation of potential maintenance costs in context of climate variation. climategreatlakes.com/great-lakes-port-harbor-infrastructure-matrix
- Great Lakes Coastal Infrastructure Brochure — U.S. Army Corps of Engineers: Overview of how coastal infrastructure protects urban waterfronts. www.lre.usace.army.mil/Portals/69/docs/Navigation/RiskCom-GLCI-CPR_Brochure_Jan_2012.pdf
- Failing Wood Infrastructure in the Great Lakes — Wisconsin Sea Grant: Overview of potential failures and repairs. www.seagrant.wisc.edu/home/Portals/0/Files/PortsHarborsandMarinas/SGfact_WoodInfrastructures7_2.pdf
- Ports, Harbors and Marinas: Harbor Dredging (Wisconsin Sea Grant) — Information on dredging (e.g., portable dredges, beneficial use, contaminated sediment cleanup and a list of Great Lakes dredging contractors). www.seagrant.wisc.edu/home/Topics/PortsHarborsandMarinas.aspx

PLANNING

- Adapting to Climate Change: A Planning Guide for State Coastal Managers — NOAA: Guidance for climate adaptation planning process, assessing vulnerability, devising a strategy and implementing the plan. A Great Lakes Supplement is also available. coastalmanagement.noaa.gov/climate/docs/adaptationguide.pdf
- Great Lakes Coastal Resilience Planning Guide — NOAA: Resources for mapping, analyzing, reporting and visualizing specific coastal hazards. www.greatlakesresilience.org
- Multi-Hazard Mitigation Planning — FEMA: Resources for hazard mitigation planning, including recommended process, related laws and regulations, resources, training opportunities and contacts for additional assistance. www.fema.gov/multi-hazard-mitigation-planning

FINANCING

- Climate Funding Opportunities — NOAA: Snapshot of currently available climate-related funding opportunities. adapt.nd.edu/resources/1322
- Sustainable Working Waterfronts Toolkit: Financing Section — National Working Waterfronts Network: An inventory of financing tools. www.wateraccessus.com/financing.cfm
- Adapting to Climate Change: A Planning Guide for State Coastal Managers Appendix A: Potential Federal Funding Sources — NOAA: Summary of federal funding sources and programs that support climate change adaptation. www.regions.noaa.gov/great-lakes/wp-content/uploads/2012/09/04a-AppendixA_FundingSources.pdf
- Great Lakes Coastal Resilience Planning Guide: Funding Opportunities — NOAA: Events and funding sources related to coastal resilience and natural hazard issues throughout the Great Lakes Basin. www.greatlakesresilience.org/events-and-funding

GENERAL CLIMATE

- Great Lakes Integrated Assessments and Sciences: Center to facilitate research and collaboration on climate change. glisa.umich.edu
- Sea Grant Webpages
 - Michigan Sea Grant Climate and Weather. www.miseagrant.umich.edu/explore/climate-weather-and-the-great-lakes
 - Ohio Sea Grant Climate Webinar Series. www.changingclimate.osu.edu
 - Wisconsin Sea Grant Climate Change. www.seagrant.wisc.edu/home/Topics/ClimateChange.aspx
- Great Lakes Climate — Ohio State University: Climate resources for the Great Lakes region. www.climategreatlakes.com
- Climate Adaptation Collaboratory — University of Notre Dame: Interactive resource where you can share information, tools, ideas and experiences for collaborative research and decision-making. adapt.nd.edu/resources/1322



Michigan Sea Grant College Program
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The Clean Marina Classroom is a self-paced, convenient way for marina operators to complete training requirements for certification. The online Classroom includes information on laws, regulations and best management practices focusing on issues such as petroleum control, waste disposal and marina management. The Classroom includes resources relevant to all freshwater marinas.

There are 10 units in the course:

- | | |
|--|---|
| 1. Siting Considerations and Marina Design | 6. Sewage Handling |
| 2. Marina Facilities and Habitat | 7. Waste Management and Recycling |
| 3. Stormwater Management | 8. Marina Management and Boater Education |
| 4. Boat Maintenance and Repair | 9. Aquatic Invasive Species Education |
| 5. Petroleum Control | 10. Increasing Resilience |

The best practices included in this booklet are described in additional detail in the Clean Marina Classroom, *Unit 10: Increasing Resilience*.

See: cleanmarinaclassroom.org

The Great Lakes Clean Marina Network is a group of Great Lakes marina and boatyard stakeholders brought together by a common goal: share knowledge and resources that promote environmentally sound, economically feasible practices that protect the Great Lakes.

Network activities support and improve existing Clean Marina programs. The network supports educational opportunities that lead to certification.

RESOURCES

A variety of resources were developed to increase information sharing and efficiency across the Great Lakes Clean Marina programs.

See: www.glcleanmarina.org



ACKNOWLEDGEMENTS

This work was supported in part by the Great Lakes Integrated Sciences and Assessments program (GLISA), a NOAA-funded partnership of the University of Michigan and Michigan State University. For more information on these topics, please see the *Resources* section of the Great Lakes Clean Marina Network website (www.glcleanmarina.org) or the Clean Marina Classroom website (www.cleanmarinaclassroom.org).

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Sources: 2014 National Climate Assessment, Great Lakes Integrated Sciences and Assessments Center, International Upper Great Lakes Study, NOAA Great Lakes Environmental Research Laboratory, University of Wisconsin Sea Grant Institute, Michigan Clean Marina Program, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, National Working Waterfronts Network, The Nature Conservancy and others.