Climate Wisconsin 2050

Wisconsin's climate is changing, and our lakes will continue to experience direct and indirect impacts from these changes.

This publication provides guidance on how **climate changes will alter our lake ecosystems,** and how **lake managers can prepare for and adapt to** those changes.

Scenarios of a State of Change: Lakes

Wisconsin has 15,074 documented lakes, ranging in size from one acre lakes to the 137,708-acre Lake Winnebago. Almost 3 percent of Wisconsin - nearly a million acres - is lakes. These lakes are integral to the cultural identity of our state.

However, Wisconsin's climate is changing, and warmer temperatures and changes in precipitation will drastically impact our lakes.

Look inside for a snapshot of what we can expect from Wisconsin's climate and weather by the year 2050, and how lake managers can adapt to these changing conditions.

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Scenarios of a State of Change

TEMPERATURE – 2050

Annual **average** temperature will have **increased by 3-9°F.**

Number of days with **>90°F** temperature **will triple.**

Future warming is projected to be greatest during the winter with **increases of 5-11°F.**

PRECIPITATION – 2050

Annual average precipitation will **increase by approximately 2" per year.**

Rainfall **frequency and intensity will increase,** including **more extreme rainfall events** (more than 6" in 24 hours).

Increased precipitation in winter and spring will result in **higher groundwater levels.**

Temperature and precipitation scenarios courtesy of the UW-Center for Climatic Research. Contact: Dan Vimont.

PHOTO CREDITS
Front cover: paddle boating – Madeline Magee; fish – Gretchen Hansen; Canoe – Clean Lakes Alliance; sunset – Clean Lakes Alliance; lake swimming – Carol Warden. Page 2: temperature display – Flickr, F. Delventhal; lightning–Flickr, N8foo. Page 3: flying – Madeline Magee. Page 4: algae – Madeline Magee; sunbathers – Sarah Collins; duck in algae – Aaron Carlson; city bloom – Ann Schell. Page 5: flooding – Katie Hein; dry dock – Tim Asplund; Lake Delton house – Ready Wisconsin; low lake level – Katie Hein. Page 6: zebra mussels – Clean Lakes Alliance; starry stonewort – Monika Lawrence; spiny water flea – Jake Walsh; water hyacinth – David Sutton. Page 7: northern pike – Gretchen Hansen; sunset fishing – Gretchen Hansen; bluegill – Gretchen Hansen; catch of the day – Carol Warden. Back cover: lake sunset – Carol Warden.

Adaptation Framework

Responses to climate change, adaptation options, and societal support vary across the landscape of Wisconsin lakes, so "one size fits all" adaptation strategies will likely be ineffective. Wisconsin's climate adaptation strategy must take a multi-faceted approach that is resistant, resilient, and responsive to the effects of climate change.

"Some adaptation efforts will be reactive, handling situations as they arise. But WICCI strives to be proactive, anticipating challenges and preparing for them ahead of time. Effective planning and preparation could help save wildlife, property, money and even lives."

– WICCI

Resistance - protecting high value lakes against climate changes

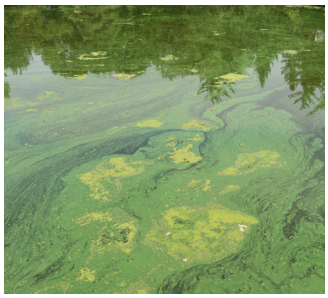
Resilience - improve capacity of lakes to return to prior conditions by reducing stress and minimizing vulnerabilities

Response - develop actions that intentionally accommodate change and minimize undesired outcomes

Water Quality

Climate Impacts

- Warmer summer water temperatures and higher nutrient runoff will increase **harmful algal blooms (HABs)** in lakes creating **health risk for humans and pets**.
- Precipitation increases will lead to **higher E.coli concentrations**, a health risk for humans, and **increase recreational beach closures**.
- Warmer temperatures and increased nutrient runoff from extreme precipitation events will reduce cold- and cool- water fish habitat, **increasing likelihood of summer fish kills**.



Adaptation Strategies

1. Increase communication with stakeholders about drivers of water quality and how climate change may worsen water quality issues. Address disconnect between stakeholders who value high water quality, but dislike management and regulation.
2. Incentivize companies and farmers to reduce nutrient runoff in the watershed.
3. Continue implementation of total maximum daily load (TMDL) programs.
4. Use best management practices for nutrient reductions such as grazing and pasture management, creating riparian and buffer zones, and installing saturated buffers to reduce nutrient loads.
5. Protect and restore wetlands.
6. Improve water quality through constructed wetlands and detention ponds, dredging of legacy phosphorus, and artificial aeration to prevent anoxic conditions.
7. Maintain beach usage through enclosed swimming and treatment systems.

Lake Levels

Climate Impacts

- In some lakes, increased precipitation will lead to **higher than normal lake levels** causing **flooding and property damage** when lakes are flooded.
- In areas with long-term drought conditions, **low lake levels** will **limit boat launch and dock usage**.
- Fluctuating lake levels influence water clarity, water temperature, and nutrient cycling, which could **exacerbate algal bloom conditions** in at-risk lakes.
- Low lake levels will **reduce fish and macroinvertebrate habitat**, potentially impacting the quality of lake fisheries.

Adaptation Strategies

1. Educate the public about natural lake level fluctuations, and set expectations for more variability in the future. Shift cultural norms regarding idyllic lake shorelines to include natural vegetation and minimize structures.

2. Incentivize agricultural and urban development practices that minimize water use and encourage water infiltration such as limiting groundwater extraction around at-risk lakes and setting zoning regulations that protect the riparian area from development.
3. Protect and restore wetlands and lake habitat in riparian and littoral zones.

4. Add woody and other habitat to deep water so it is available when lake levels are low and protect woody and other habitat stranded above water so it is available when lake levels rise.
5. Encourage dam management that is resilient to high and low water levels, and build adaptable structures that function under high and low water levels.

Aquatic Invasive Species

Climate Impacts

- **Southern species will expand northward** as warming air and water temperatures make lakes more suitable for warm adapted species.
- Changes in precipitation patterns may **increase establishment, dispersal, and spreading rate of aquatic invasive species**.
- Warmer water temperatures and decreases in ice cover can increase likelihood that invasive species can **overwinter in lakes and become established** in lakes that were previously unable to support populations.

- Warmer water temperatures and increased carbon dioxide will make control of invasive species more difficult. **Mechanical, chemical, and biological controls will become less effective** for some invasive species.

Adaptation Strategies

1. Continue outreach efforts to maintain 100% compliance with invasive species prevention efforts. Develop simple and consistent messaging.
2. Develop regulations and new technologies that close existing and potential future transport vectors such as:
    - balast water regulations and treatment
    - require boat manufacturers to design for treatment and decontamination
    - recreational boat and shipping vessel decontamination
    - aquatic invasive species passage barriers between systems
3. Develop biological control programs for common invasive species
4. Develop local-scale prediction and prevention strategies and provide funding and resources for communities to implement aquatic invasive species control at the local level.

Fisheries

Climate Impacts

- Warmer air temperatures and associated increases in water temperatures and stratification duration will decrease cold-water fish habitat, **causing local extinction of cold-water species** in many lakes.
- Warmer temperatures and earlier springs will result in **earlier spawning** for many fish and could **decrease recruitment success**.
- Warmer air and water temperatures will **allow warm-water species to expand** into northern lakes in the state.
- **Shoreline spawning and nursery habitat will be inaccessible** during droughts and can be destroyed during flooding .

Adaptation Strategies

1. Set realistic expectations and goals for fish communities based on projected lake conditions and increase transparency in scientific and management basis for regulations
2. Increase protection of forested watersheds to preserve high-quality habitat that is at risk from dual threats of water quality decreases and climate changes.
3. Stock genetic strains that are resilient to warmer temperatures.
4. Alter harvest regulations to reduce exploitation of vulnerable populations.

5. Add structural habitat that is resilient to water level fluctuations.
6. Reduce nutrient loading in watersheds to reduce anoxic conditions and maintain available cold- and cool-water fish habitat.
7. Artificially aerate low dissolved oxygen lakes to provide refugia for cold-water fish species.

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"Climate change is a game-changing issue for Wisconsin's lakes, and we all have a stake in maintaining their health and sustainability. The WICCI Water Resources Working Group helps put information into action by helping lake managers adapt and prepare for future change."

– WICCI

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Please contact:

Wisconsin Initiative on Climate Change Impacts (WICCI) for more information. (https://www.wicci.wisc.edu/)

Visit **wicci.wisc.edu/water-resources-working-group.php** for details on climate change impacts for Wisconsin's waters.

WISCONSIN UNIVERSITY OF WISCONSIN–MADISON

Author: Madeline Magee,
University of Wisconsin-Madison
Graphic design by Jeffrey J. Strobel, UW Environmental Resources Center
and Madeline Magee, University of Wisconsin-Madison

ENVIRONMENTAL RESOURCES CENTER