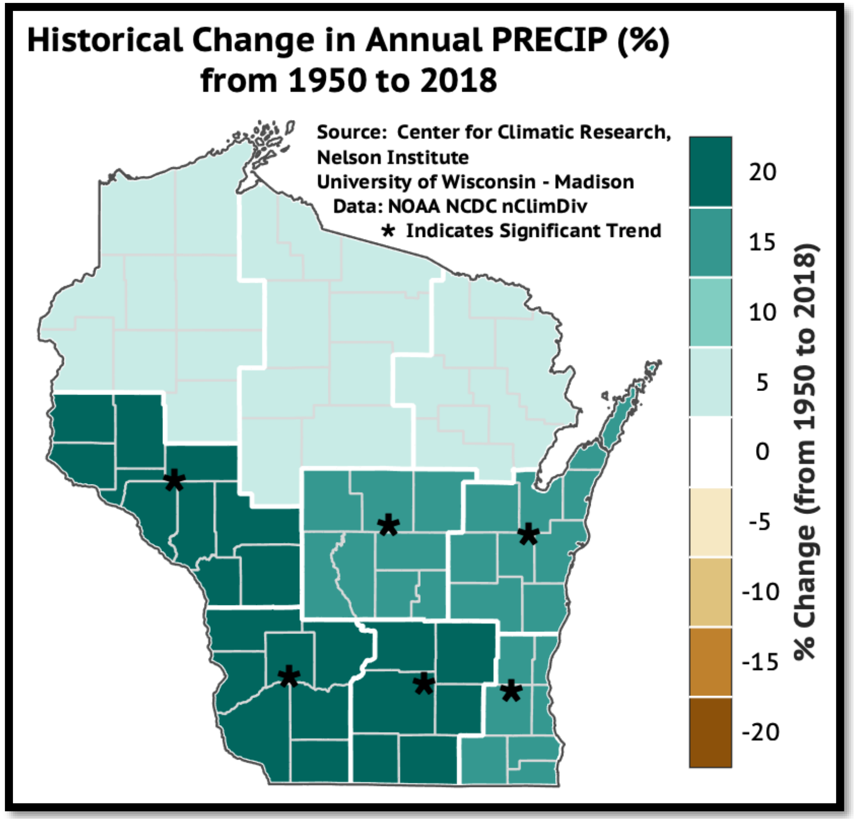
# Climate Change: Incorporating Climate Change Considerations into TMDLs





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**Water Quality Bureau**


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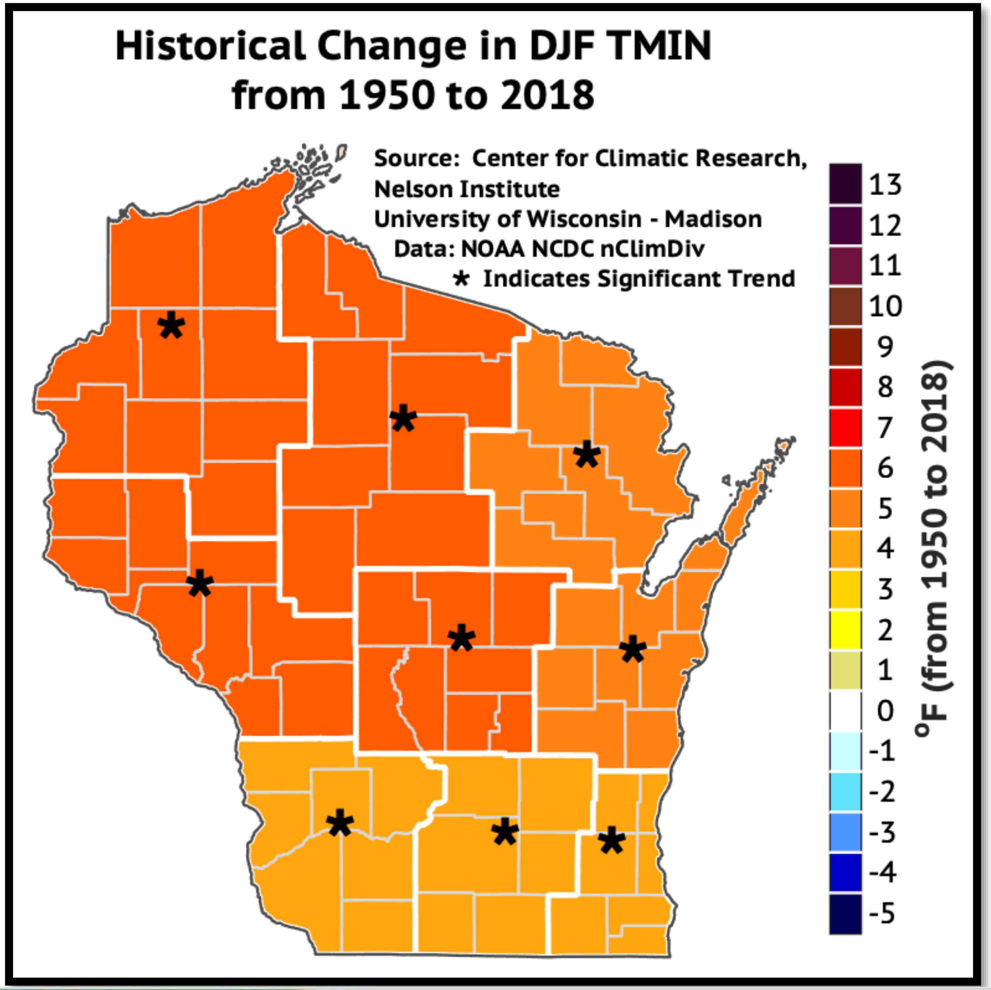
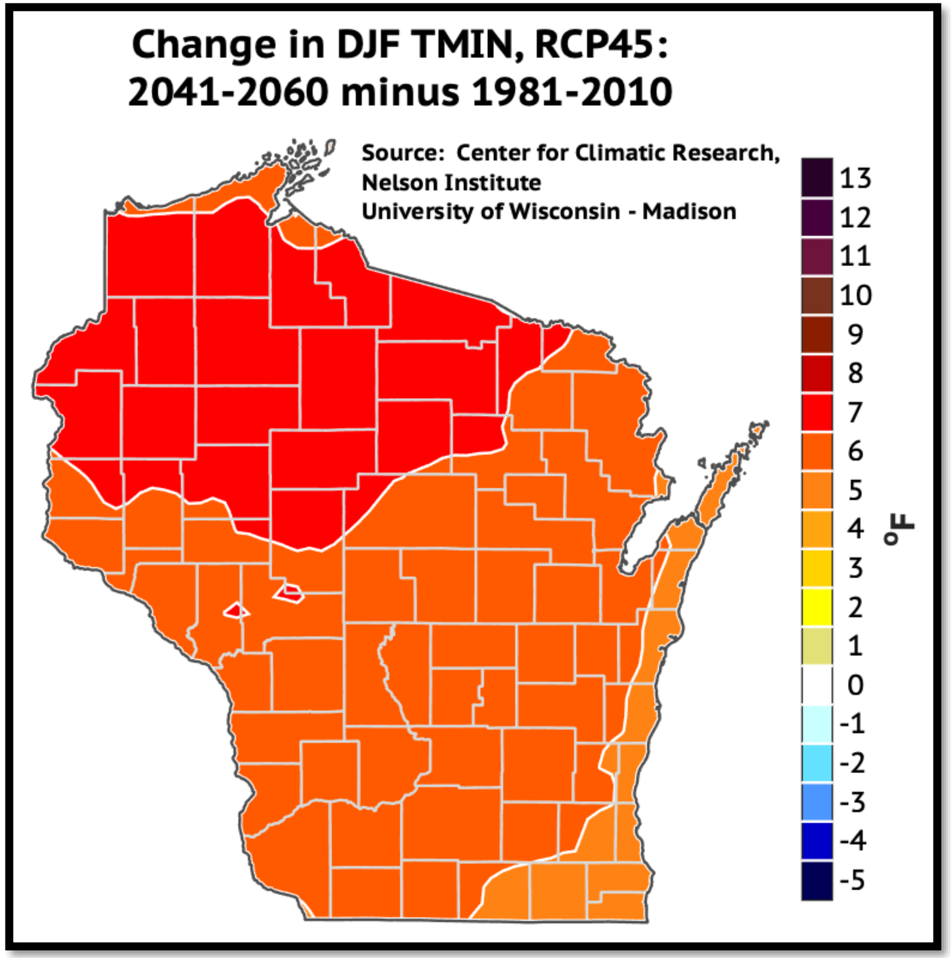
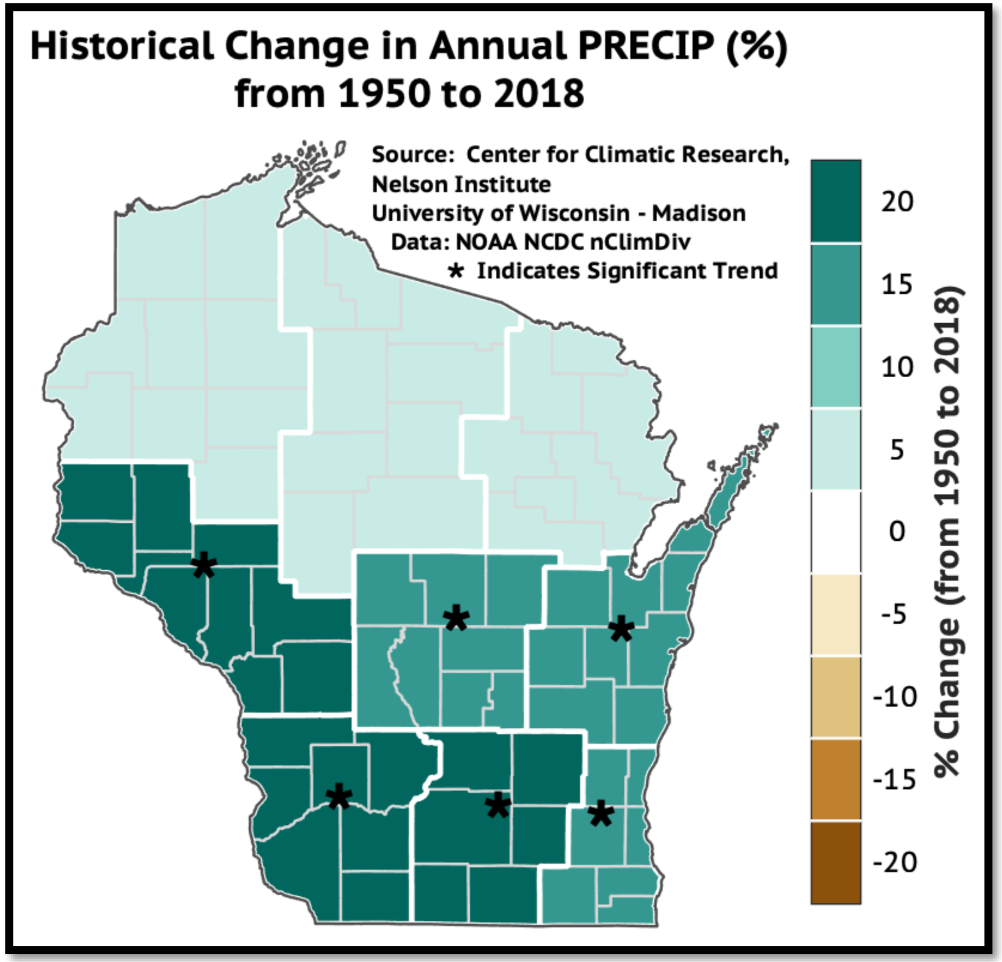
# What Climate Change Looks Like in Wisconsin



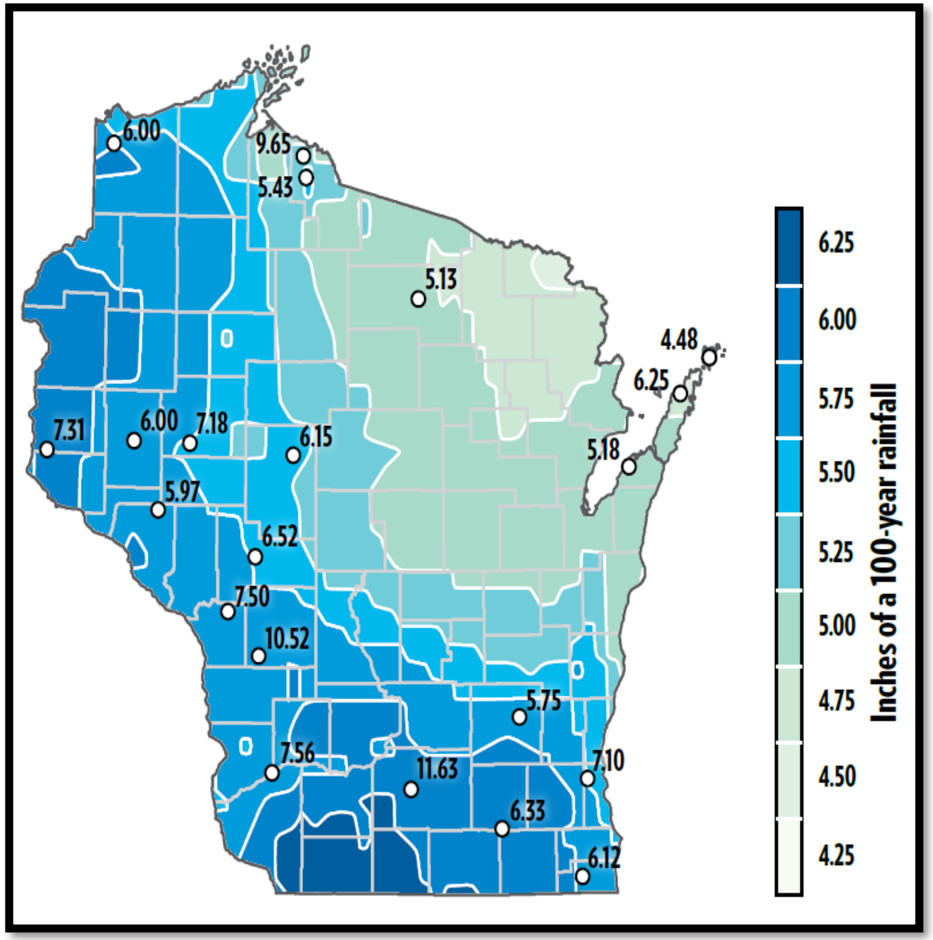

- Winter warms more than summer
- WI winters will warm by 3-10°F by 2050



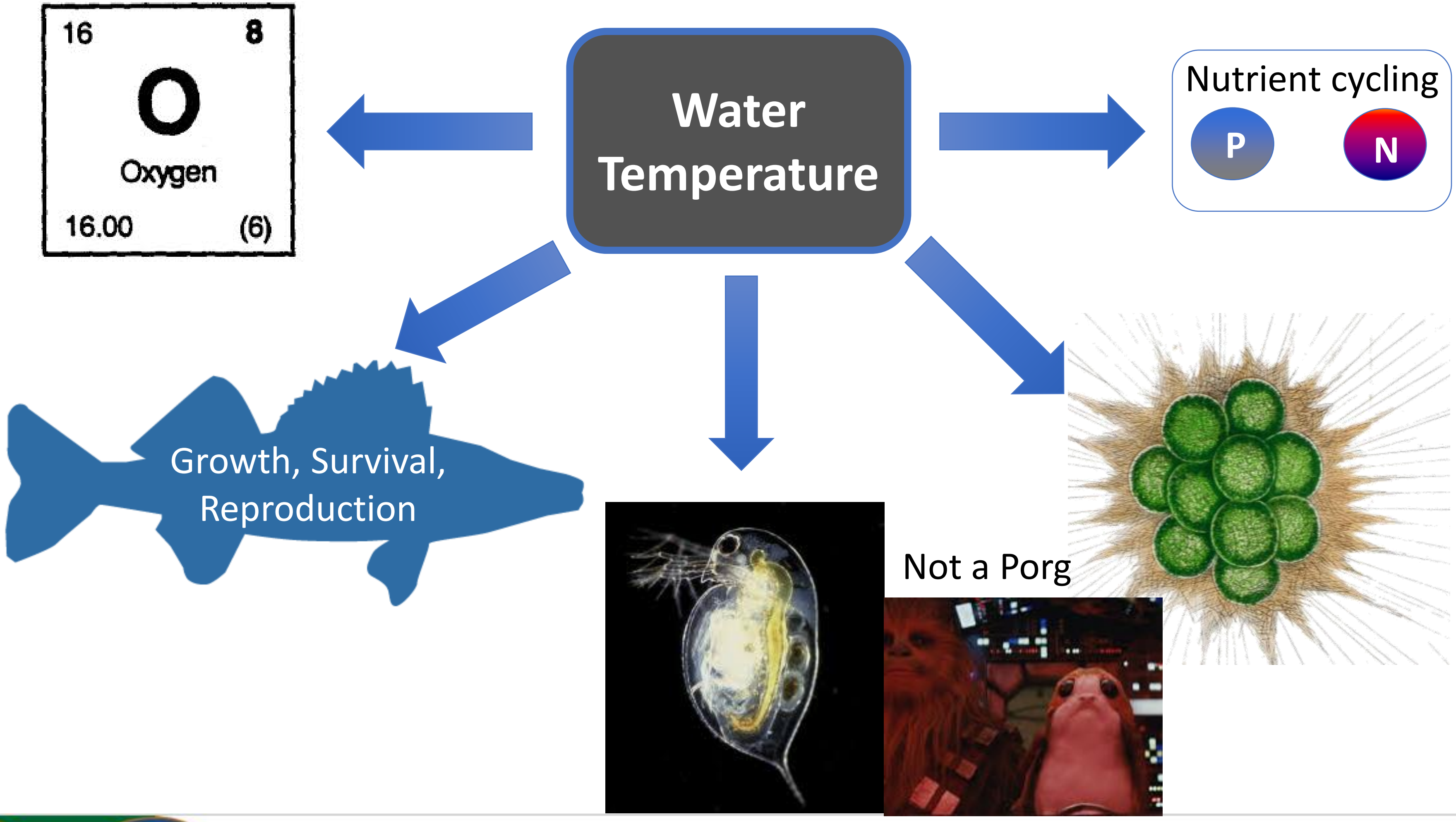
# Changes in Wisconsin's Precipitation




1. 5 -20% wetter since 1950.
2. Likely continued increase in average annual precipitation. Drier summers and wetter winters/springs.
3. Increase in extreme events



# Climate Change Impacts - Temperature




- Water temperature is a master factor for aquatic ecosystems. Temperature impacts metabolic cycling rates, and controls the growth, survival, and reproduction of fish.

- Understanding temperature dynamics is foundational to untangling changes to biology and water chemistry.

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# Climate Change Impacts: Water level fluctuations and Invasive Species

## Water Clarity


## Mercury Bioaccumulation


UW Zoology Museum

## Woody Habitat & Fisheries



## Invasive Species: Range Expansion or Local Introductions

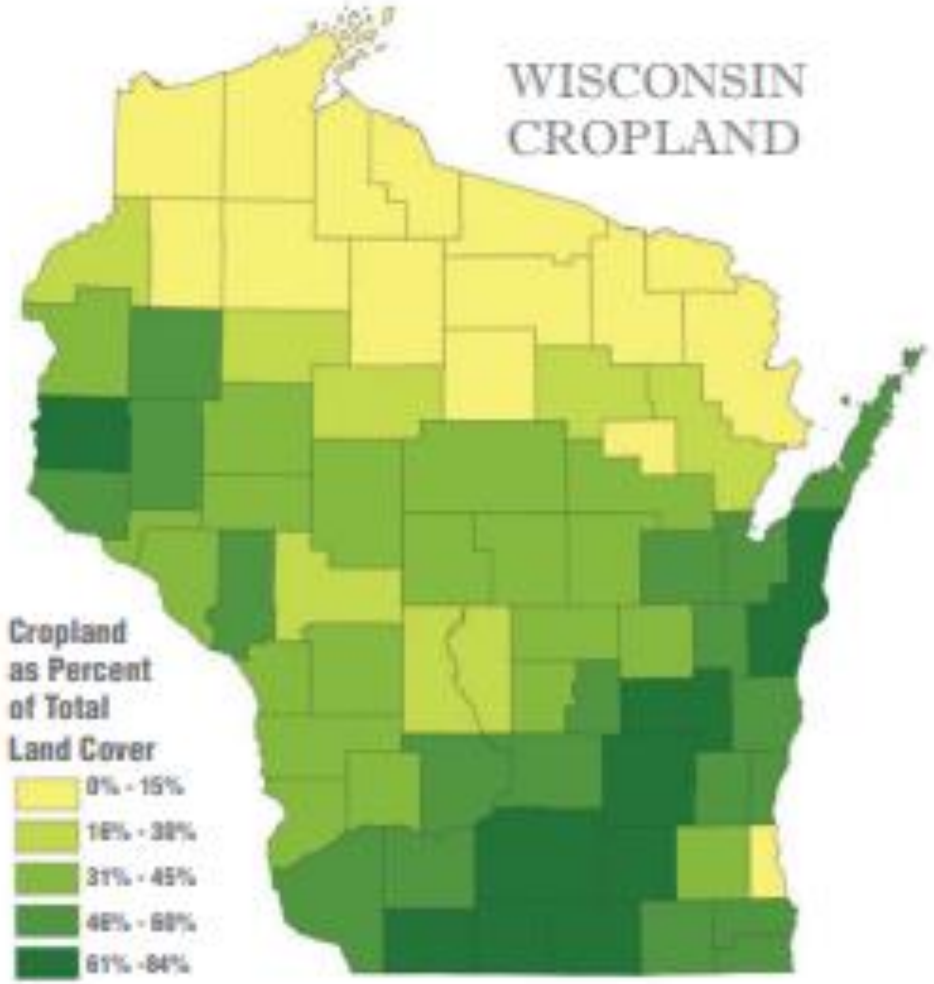
# Climate Change: Agricultural Impacts
## Uncertainty: There is a combination of competing positive and negative factors.

- Negative Impacts to Water Quality:

  1. Increased erosion due to increased precipitation intensities and amounts
  2. Faster decay of crop residues due to higher temperatures
  3. Reduced windows for manure applications in the spring and fall
  4. Increased runoff carry pollutants to receiving waters
  5. Delayed planting due to waterlogged soils in the spring
  6. Possible increase in summer droughts reducing plant cover

- Adaptation Strategies:

  1. Adoption of management practices can mitigate negative impacts; however, it is more important than ever to invest in these management practices and utilize systems of management practices that keeps the soil covered.
  2. Technology advances in manure treatment and precision agricultural provide opportunities to mitigate nutrient losses.
  3. The adaptation strategies provide an intersection of climate resilience, increase profitability, and provide water quality protection.

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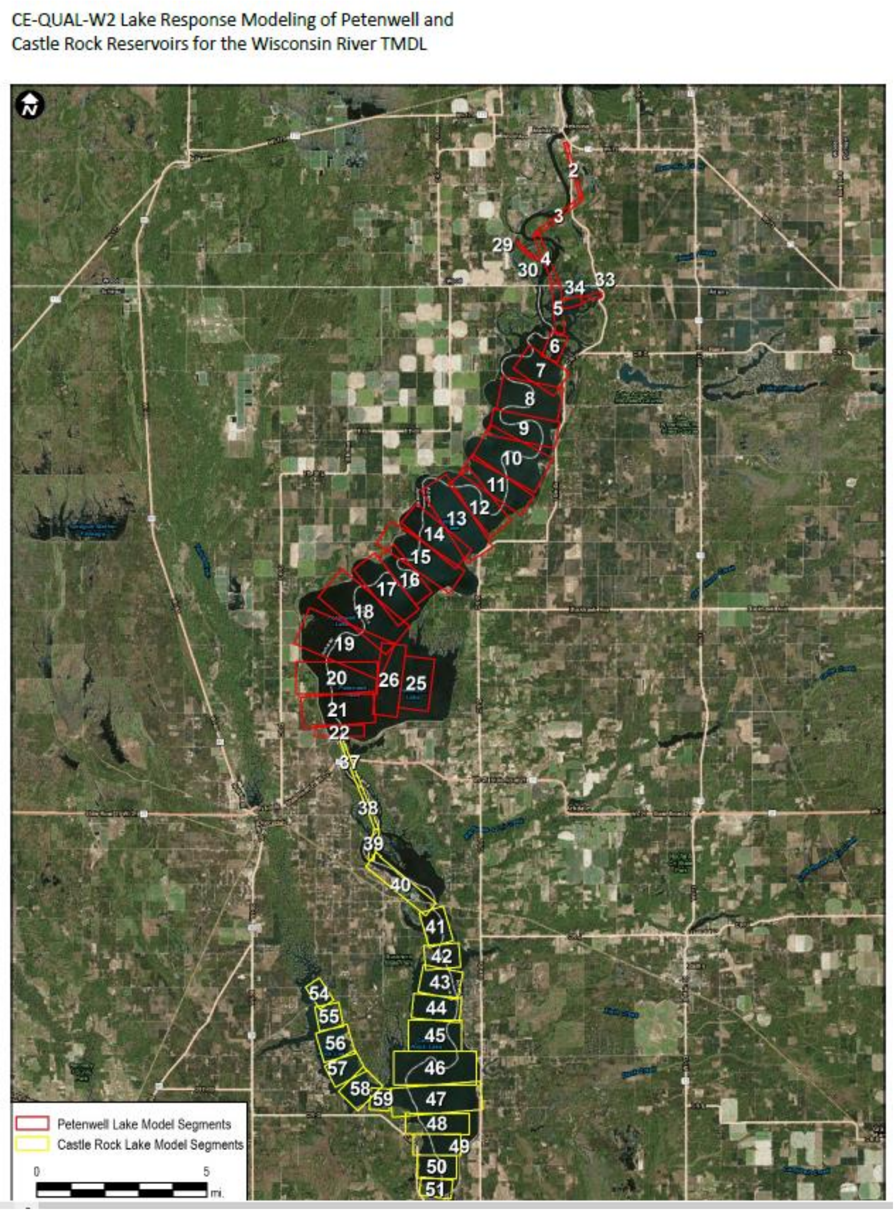
# Climate Change: Urban and Infrastructure
# More complicated and costly than agricultural runoff

- Negative Impacts to Water Quality:
  1. Increase flooding and habitat destruction
  2. Overwhelming of stormwater management practices
  3. Increased SSOs and CSOs
  4. Increase delivery of pollutants to receiving waters

- Adaptation Strategies:
  1. Use updated climate data for design and modeling
  2. Use dispersed infiltration and green infrastructure to complement regional stormwater practices
  3. Larger practices to address flooding but still scaled to handle water quality

# Climate Change Challenges in TMDL Development

- More uncertainty and challenging to simulate with models.
  - *Use current and representative climate data to address critical conditions (wet, dry, and average years).*
- Can require use of more complicated mechanistic models that can be data intensive but may not provide better results.
  - *Run different scenarios under current climate data to ensure that model parameters are correctly simulating processes.*
- Models calibrated and validated with existing data may no longer provide accurate simulations using future climate scenarios.
  - *See bullet above. If model not properly calibrated and validated, results under future climate projections are likely not representative nor predictive.*




CE-QUAL-W2 Lake Response Modeling for Wisconsin River Basin TMDL

# Climate Change in TMDL Development
## More uncertainty and challenging to simulate with models

"We are unsure of the impacts of changing temperatures and precipitation coupled with the impact of invasive species, but one thing is certain, you need to reduce the amount of phosphorus entering Lake Winnebago"

- UW-System Researcher Commenting on Lake Winnebago

- The Upper Fox - Wolf Basin TMDL requires an 83% reduction in phosphorus loads to meet water quality criteria in Lake Winnebago.
- Factoring projected climate change into the percent reductions may only complicate messaging. Modeling to calculate allocations already uses a combination of critical conditions including wet, dry, and average rainfall years obtained from the current climate normal.

# Accounting for Climate Change in TMDL Implementation Analysis: Agriculture

- For TMDLs, Wisconsin has chosen to primarily address climate change impacts in the implementation phase.

- For agricultural sources, TMDL allocations are expressed as edge of field targets (lbs./ac./yr.) consistent with SnapPlus and RUSLE2 which are used to assess nutrient management compliance.

| TMDL Subbasin | TP | | | TSS | | |
|---|---|---|---|---|---|---|
| | Baseline (lbs./ac/yr) | % Reduction | Target (lbs./ac/yr) | Baseline (tons/ac/yr) | % Reduction | Target (tons/ac/yr) |
| 1 | 1.68 | 88% | 0.20 | 1.71 | 47% | 0.91 |
| 2 | 2.74 | 79% | 0.57 | 2.72 | 47% | 1.45 |
| 3 | 3.41 | 79% | 0.71 | 3.29 | 79% | 0.69 |
| 4 | 2.10 | 88% | 0.25 | 1.80 | 47% | 0.96 |
| 5 | 3.14 | 74% | 0.83 | 2.64 | 64% | 0.96 |

# Accounting for Climate Change in Implementation Analysis: Agriculture

- Compliance with edge of field targets evaluated using SnapPlus (https://snapplus.wisc.edu/ )
- SnapPlus is a mechanistic model that runs on a daily timestep and simulates the impact of temperature, precipitation, residue, tillage, nutrient applications, crop yield, and management practices on sediment and phosphorus losses.
- Model's climate data updated with new normals (30-year records).

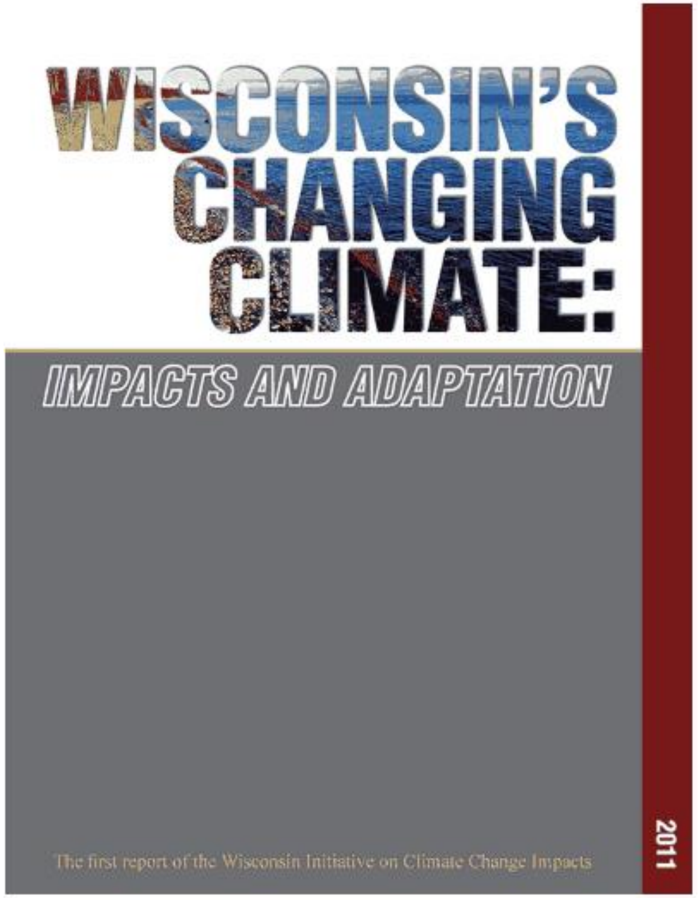
# WI Climate Change Resources

Website:

https://wicci.wisc.edu/

WICCI Releases Report to Governor's Task Force on Climate Change

Read the story »




**WICCI in the News:** Climate Change Report Details Current and Future Impacts in Wisconsin

## Wisconsin Initiative on Climate Change Impacts

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