Hydrology, carbon storage, and water and soil quality in wetlands along the Lake Michigan shore in Illinois

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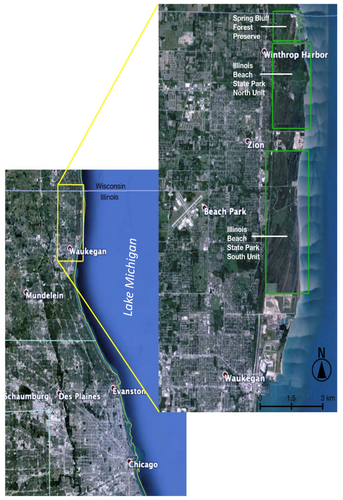
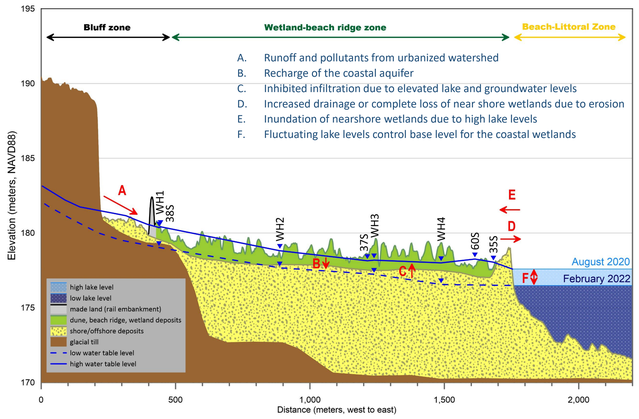
Background

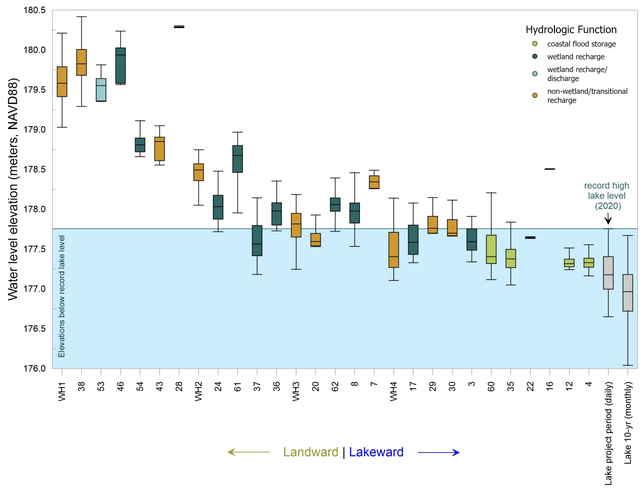
- Great Lakes coastal wetlands are critical for maintaining community water supplies, lake-system fisheries, and migratory bird and endangered species populations.
- Coastal wetlands are vulnerable to development, water pollution, flooding, erosion, and desiccation associated with lake level change.
- Evaluating wetland hydrologic function is key to developing effective wetland management strategies.
- The study area: Illinois Beach State Park and Spring Bluff Nature Preserve represent most of the remaining coastal wetlands in Illinois and are part of a designated a RAMSAR Wetland of International Importance.
- Water levels and water quality were monitored starting in March 2020 to identify hydrologic connections of coastal wetlands to Lake Michigan and the groundwater system in the coastal aquifer.
- Results provide hydrologic characteristics to support the assessment of wetland function and hydrologic context for prioritizing wetland restoration and management in the Illinois Coastal Zone.

Lake Michigan beach overwash deposits encroaching on near-shore coastal wetlands at Illinois Beach State Park.



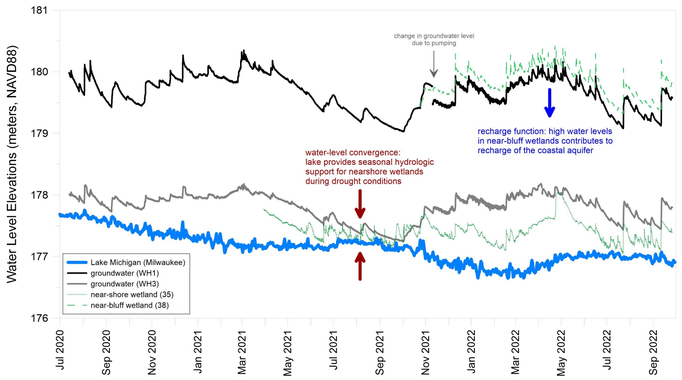
Coastal geologist Robin Mattheus (left) and wetland geologist Nicolette Sheffield (right) setting up vibracores at Well 38.





Groundwater-Wetland-Lake Interactions

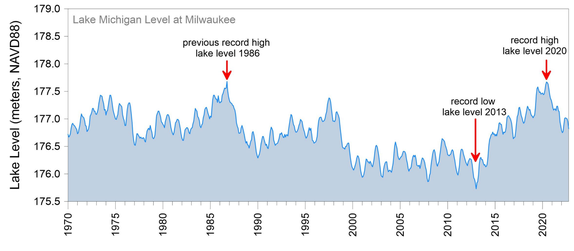
Left: Hydrogeologic profile showing water table during lake level high and low and hydrologic processes (A-F). *Right:* Overall, observations show wetland water level has a strong correspondence with groundwater level and a weak correspondence with lake levels. However, nearshore wetland water levels briefly showed convergence with lake levels during late Summer 2021, indicating that during locally drier periods the lake provides base-level support for wetland water levels.

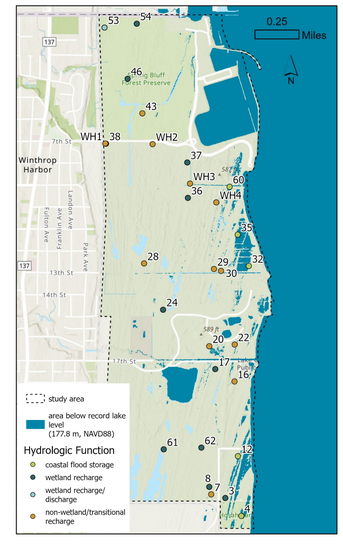


Linking Hydrologic Characteristics to Wetland Function

Wetland water level depth, duration, and variability as well as level relative to the lake (left) were used to assign hydrologic function categories per each monitoring location (right).

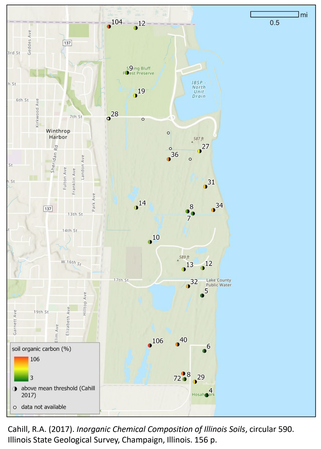
This characterization of functions is based on a time period that does not cover the full range of hydrology. The functions shown here are not static—function changes with the season, lake level phase, and drought and deluge cycles (see below). Continued monitoring will provide data to characterize a more complete range of variability and shifts in functions at each location over time.



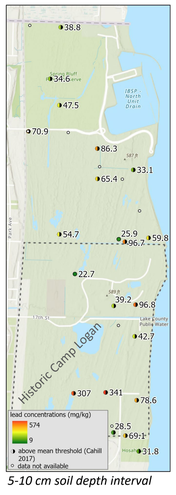


Soil Quality: Carbon and Legacy Pollutants

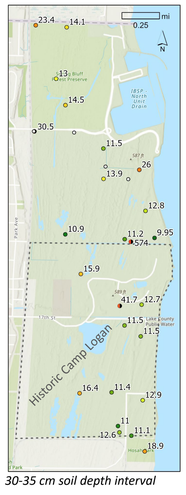
Soil organic carbon in the upper 15 cm of the soil indicates the highest carbon storage function in deep marsh and fen settings (below left). Elevated lead concentrations in the soil correspond with the location of the former Camp Logan which included a rifle range training facility (below right).



Cahill, R.A. (2017). *Inorganic Chemical Composition of Illinois Soils*, circular 590. Illinois State Geological Survey, Champaign, Illinois. 156 p.



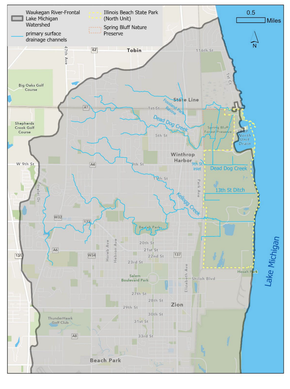
5-10 cm soil depth interval

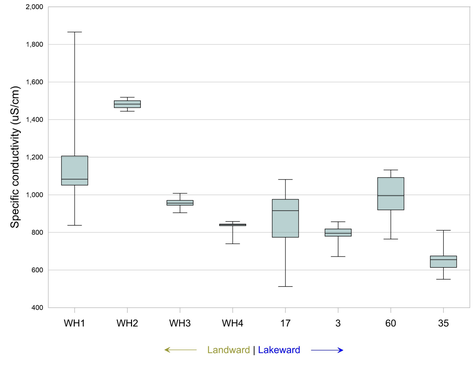


30-35 cm soil depth interval

Water Quality: Assessing Effects from Watershed Sources

Specific conductivity observations show relatively low levels and variability in near-shore wetlands, suggesting low exposure to pollutant sources. Higher conductivity values were observed in deeper groundwater nearer to inputs from urban areas on the bluff. Panels below show the streams and watersheds that contribute to the wetlands in the study area (below left) and the range of conductivity (below right).





Wetland Management Scenarios and Functional Tradeoffs

Results from this project provide insight into *where* and *when* wetland functions occur in the context of hydrologic cycles and processes. Providing this context can aid the assessment of potential tradeoffs in wetland ecosystem services that could result from management decisions.

Goals	*Scenarios*	*Tradeoffs*
Restore degraded wetlands to improve habitat quality	Disconnect wetlands from urban stormwater sources	Shorter duration inundation reduces carbon storage capacity
Increase carbon/nutrient storage	Increase duration of inundation and residence time	Increasing period of inundation may favor invasive plant species
Improve lake nearshore water quality	Increase the connection of already degraded wetland to stormwater	Increased exposure to pollutants precludes high quality habitat restoration

Acknowledgments
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