Citizen Lake Monitoring Network
Do-It-Yourself Lake Level Monitoring: Overview

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WISCONSIN DEPT. OF NATURAL RESOURCES

Introduction

Lake levels naturally fluctuate over time. These fluctuations are important for maintaining healthy populations of many aquatic plants and other organisms, but extreme highs and lows can also present challenges. Low water levels can strand dead branches above water, reducing important cover for fish. They can also leave piers far from shore and render boat launches and public beaches unusable. Conversely, high water levels can erode the shore and flood homes. To address the growing concern of changing lake levels brought on by climate and groundwater withdrawals, the Wisconsin Department of Natural Resources (WDNR) and the University of Wisconsin - Extension have created a statewide lake-level monitoring that relies on volunteers.

This data can be used to:

1) Establish baseline lake level fluctuations to characterize lake levels during a normal year versus an especially dry or wet year, and eventually reveal long-term trends.
2) Investigate trends in groundwater levels. Seepage lakes have no surface inlets or outlets, so lake levels are determined by precipitation, evaporation, and groundwater levels.
3) Investigate relationships between lake level and other variables, such as water clarity, water quality, aquatic plants, and fish.
4) Compare lake level fluctuations across the state to evaluate the influence of large-scale climatic drivers on lake levels.

Although long-term water level records exist, current monitoring efforts do not cover all areas of Wisconsin. With over 15,000 lakes across the state, partnerships with local volunteers, nonprofit groups, and county staff are crucial for filling gaps in the current water level records. Because of limited budgets and staff availability, WDNR is not able to financially support lake level monitoring on all lakes. Lake level monitoring falls under the supervision of regional Citizen Lake Monitoring Network (CLMN) coordinators, who must prioritize lake level monitoring according to the following criteria:

1) Seepage lakes
2) Regions with little to no existing lake level data
3) Regions vulnerable to groundwater withdrawal
4) Lakes currently monitored for water quality or game fish by volunteers and/or WDNR

This document, along with the accompanying volunteer and surveyor protocols, is intended to guide lake users who wish to gather accurate lake level data on their own. Central Office and regional staff may still be able to assist with data management and provide advice as time allows.

Volunteers or groups interested in initiating lake level monitoring will build staff gauges, choose appropriate installation sites, and hire a surveyor to establish the elevation of the staff gauge twice a year. Volunteers will then monitor lake levels by visually reading a staff gauge placed in the lake bed. The staff gauge installation and survey should not be undertaken by volunteers unless they are trained. All project consultants will need to be trained using the WDNR surveyor protocol. Finally, lake level and survey data should be submitted online to the Surface Water Integrated Monitoring System (SWIMS), making high quality lake level data available to researchers and the public.

Lake Level Monitoring Task Overview and Timeline

Season	Task	Responsibility
Early Spring	Review this document, the Volunteer Protocol, and the Surveyor Protocol and make a lake level monitoring plan	lake group
	Discuss new lake level monitoring project with CLMN regional coordinator	lake group
	Choose appropriate site for staff gauge and reference marks	lake group
	Find and train volunteer to record lake level observations	lake group
	Build staff gauge	lake group
	Create SWIMS project and station, grant access to volunteer and/or surveyor who will enter lake level and survey data	WDNR Central Office SWIMS support staff
	Hire professional surveyor to create reference marks and survey staff gauge	lake group
Spring	Establish permanent reference marks on land (only in year 1)	surveyor
	Install staff gauge	surveyor/ volunteer
	Survey staff gauge	surveyor
	Enter spring survey information into SWIMS	surveyor/ volunteer
Spring, Summer, and early Fall	Record water levels, upload data to SWIMS	volunteer
	Check gauge to be sure it has not been bumped or moved. Notify professional surveyor if it has.	volunteer
	Re-survey gauge if it has been moved	surveyor
Fall	Survey staff gauge at end of monitoring season (before ice-on)	surveyor
	Enter fall survey information into SWIMS	surveyor/ volunteer
	Remove staff gauge and store indoors over the winter	surveyor/ volunteer
	Enter lake level data and review full season of data in SWIMS	volunteer

Beginning Lake Level Monitoring

Before you begin monitoring lake levels, first consider whether your lake is a good candidate for lake level monitoring. Initiating a lake level monitoring program comes with some expenses and requires planning and regular time commitments. The questions below may help you decide if lake level monitoring is appropriate.

- **Is the lake level currently monitored?** USGS, WDNR, and local government sometimes monitor lake levels. You can view a compilation of these data sources here: http://dnrmaps.wi.gov/H5/?viewer=Water_Use_Viewer. Open the viewer, zoom to your lake, and click on the surface water quantity layers to find out if there are current and/or historical lake level records available. You may also contact the municipality or county to see if lake level monitoring has been conducted in the past or is ongoing. Your regional CLMN coordinator will be aware of other monitoring activities occurring on the lake. You can find your regional coordinator by visiting dnr.wi.gov/lakes/contacts/contacts.aspx?role=CLMN_START.
- **Is the lake level regulated by a dam or other structure?** If so, the lake level may be determined by law, and recording the lake level may not provide additional insight. The dam operator may also be charged with regularly checking the lake level. If you choose to initiate monitoring, you may be able to permanently affix the staff gauge to the dam or permanent structure, eliminating the need for yearly surveys. This would require obtaining permission from the dam operator.
- **Is the lake connected to other surface waters by an inlet or an outlet?** WDNR prioritizes lake level monitoring on seepage lakes without inlets or outlets because these lakes respond more dramatically to changes in precipitation and groundwater and have simplified hydrologic budgets (water in minus water out). If the lake in question has an inlet or outlet, stream flow may have the greatest influence on the lake level. It may be worth checking if a USGS stream gauge exists above or below the lake by visiting https://nwis.waterdata.usgs.gov/nwis.
- **Is there community support for the monitoring program?** A successful lake monitoring program will gather data for many years, but requires commitments of money, time and energy. Review the sample project budget and gather support from riparian owners, lake associations, fishing clubs, and others who use the lake. Volunteers will be needed to build the staff gauge, install it, take water level readings, and submit or manage the data. Make sure that the placement of the staff gauge and reference marks will not inhibit others' enjoyment of the lake. This is also a good time to identify those who would be interested in knowing the lake level measurements you record.
- **Do good locations for the staff gauge and reference marks exist?** The staff gauge must be placed so that the lake can fluctuate while remaining within the range of the staff gauge. It should also be visible from shore (some volunteers use binoculars), but not an obstacle to navigation or swimmers. Also consider the location of the permanent reference marks. These must be immovable, easily identifiable points, such as the tip of a large rock, edge of a concrete structure, or rebar driven several feet into the ground. The surveyor will be comparing the elevation of the reference marks to the bottom of the staff gauge, so the benchmarks should be within ~10 vertical feet of the bottom of the staff gauge. They should also be on public land.
- **Is a professional surveyor able to establish the elevation of the staff gauge in spring and fall?** After reviewing the surveyor protocol, you can search for a professional surveyor to complete the work. The protocol takes two hours to complete, possibly more if benchmarks must be established. The Wisconsin Society of Land Surveyors is a good resource for finding potential surveyors in your area (http://www.wsls.org/).

- **Have you created a plan to record, store, use and distribute the lake level data?** While the lake level data will be stored in SWIMS, it is always best to have additional copies of the data in paper and electronic form. A volunteer with experience in Microsoft Excel can also produce a graph of lake levels over time to share with interested parties.

Lake Level Monitoring Expenses

The largest expenses for lake level monitoring are the surveyor's fee and the materials to build the staff gauge. The staff gauge will last many years once built, but the surveyor will need to establish the elevation of the staff gauge twice a year, and will need to create permanent reference marks on shore the first year of lake level monitoring. The surveyor's fee will vary depending on the hourly rate. If the staff gauge is moved or bumped mid-season, the surveyor will have to reestablish the elevation of the staff gauge, incurring further costs not detailed below.

Sample Project Budget

Budget Item	Cost Estimate
Hire a surveyor to install and remove one staff gauge, and survey to reference marks on shore twice a year (spring and fall). Estimated 4 hours at $40 - $80 hourly rate.	$160 - $320 *(per year)*
Buy materials for building a staff gauge	$100 *(one-time)*
Buy materials for establishing reference marks	$20 *(one-time)*
Total	$280 - $440 *(first year)* $160 - $320 *(additional years)*

Lake Level Monitoring Protocols

The volunteer and surveyor protocols were written to help assure the collection of accurate data, and they include many safeguards and double-check procedures. WDNR asks that lake groups interested in submitting their data to SWIMS follow the protocols closely and maintain good records of the reference marks and the survey data.

The following protocols accompany this document:

- *"DIY_Staff Gauge Building 2017"* - Lists materials and gives instructions for building a staff gauge.
- *"Volunteer Protocol 2017"* – Details how to read the staff gauge and submit data to SWIMS.
- *"Surveyor Protocol 2017"* – Details how to install reference marks, survey in the staff gauge, and submit survey data to SWIMS. Review this protocol before discussing the project with a professional surveyor, so you generally know what they will be doing. It may in practice be easier for the volunteer or member of the lake group to enter the survey data into SWIMS (think about specifying this in your contract with the surveyor). This should not present a problem as long as the surveyor keeps detailed field notes using the data sheet provided in the surveyor protocol.