Adaptive Monitoring of the Winnipeg River Watershed

- Jeff Simpson[a], S Simpson[a], C Riach[a], M Stanley[b], T Saleh[c], J Simoes[b], P Gerrard[c]
- a *Aquatic Life Ltd.*
- b *International Institute for Sustainable Development*
- c *IISD-Experimental Lakes Area*

Agenda

Background

Discussion of the Winnipeg River project

Catchment monitoring challenges and installations

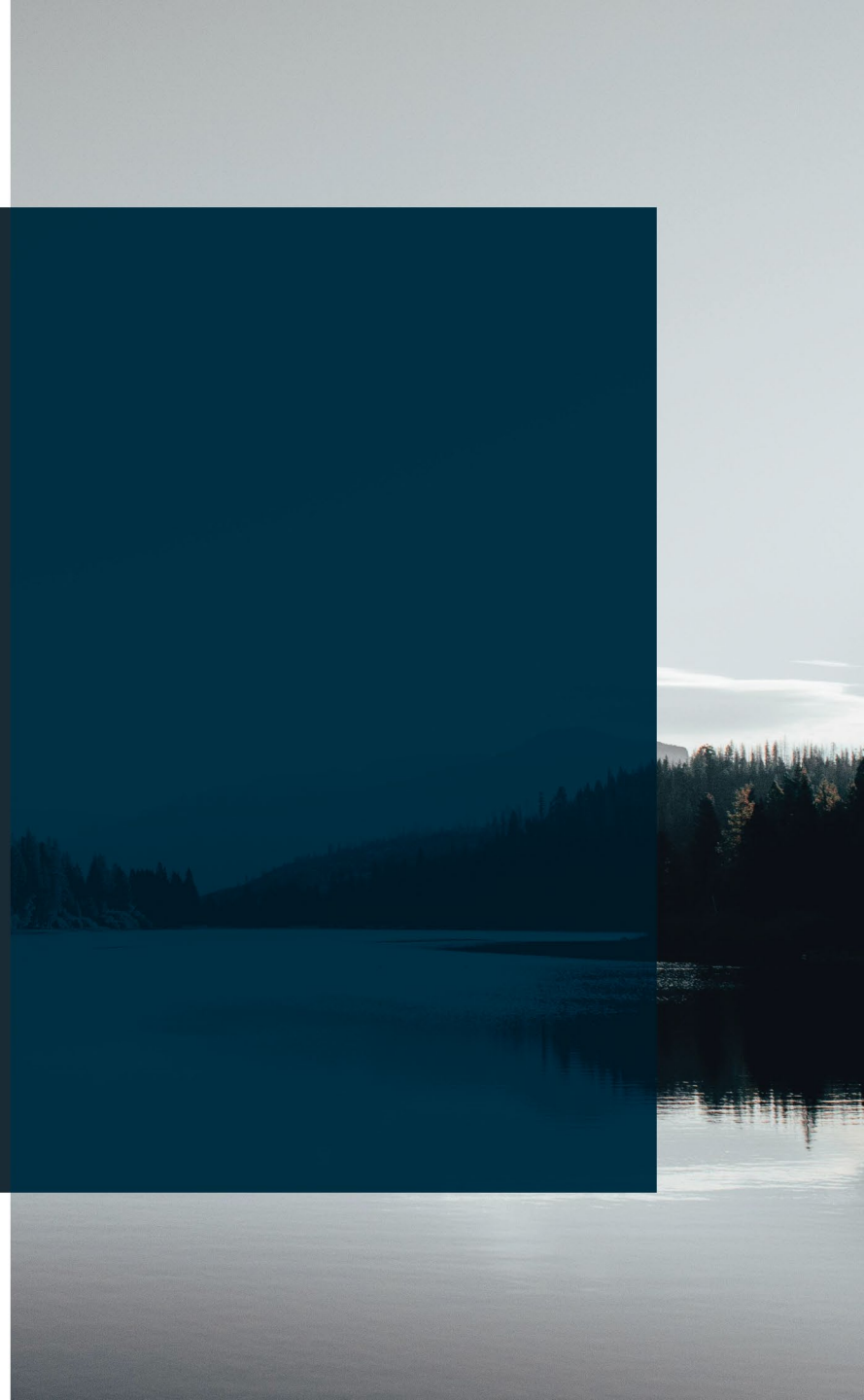
Municipal Water Application

Research Collaborators

Aquatic Life Ltd - For more than 39 years, Aquatic Life Ltd. has remained committed to the field of water monitoring, earning recognition for our experience and research contributions. Aquatic Life prides itself in delivering expert water consulting services and solutions. https://aquaticlife.ca/

International Institute for Sustainable Development (IISD) is an award-winning independent think tank working to accelerate solutions for a stable climate, sustainable resource management and fair economies. https://www.iisd.org/

IISD Experimental Lakes Area (IISD-ELA) is an exceptional natural laboratory comprised of 58 small lakes and their watersheds set aside for scientific research. https://www.iisd.org/ela/



ESG Focused Municipal Water Management

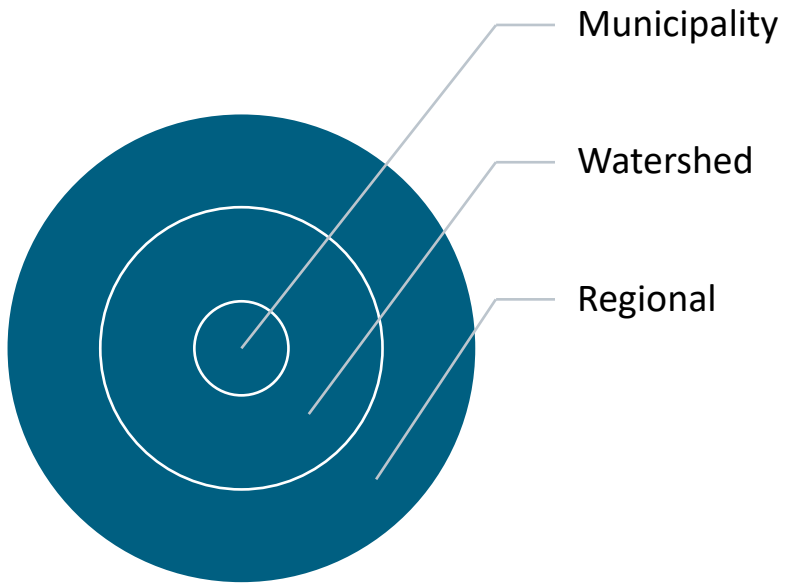
Water flows in and out of watersheds

Municipalities exist within watersheds and greater regions of interest

Growing number of stakeholders

MOVING FORWARD:

- Monitoring strategies encompass municipality, watershed and greater region of interest
- Enhanced transparency and awareness for stakeholders
- Improved engagement with the communities



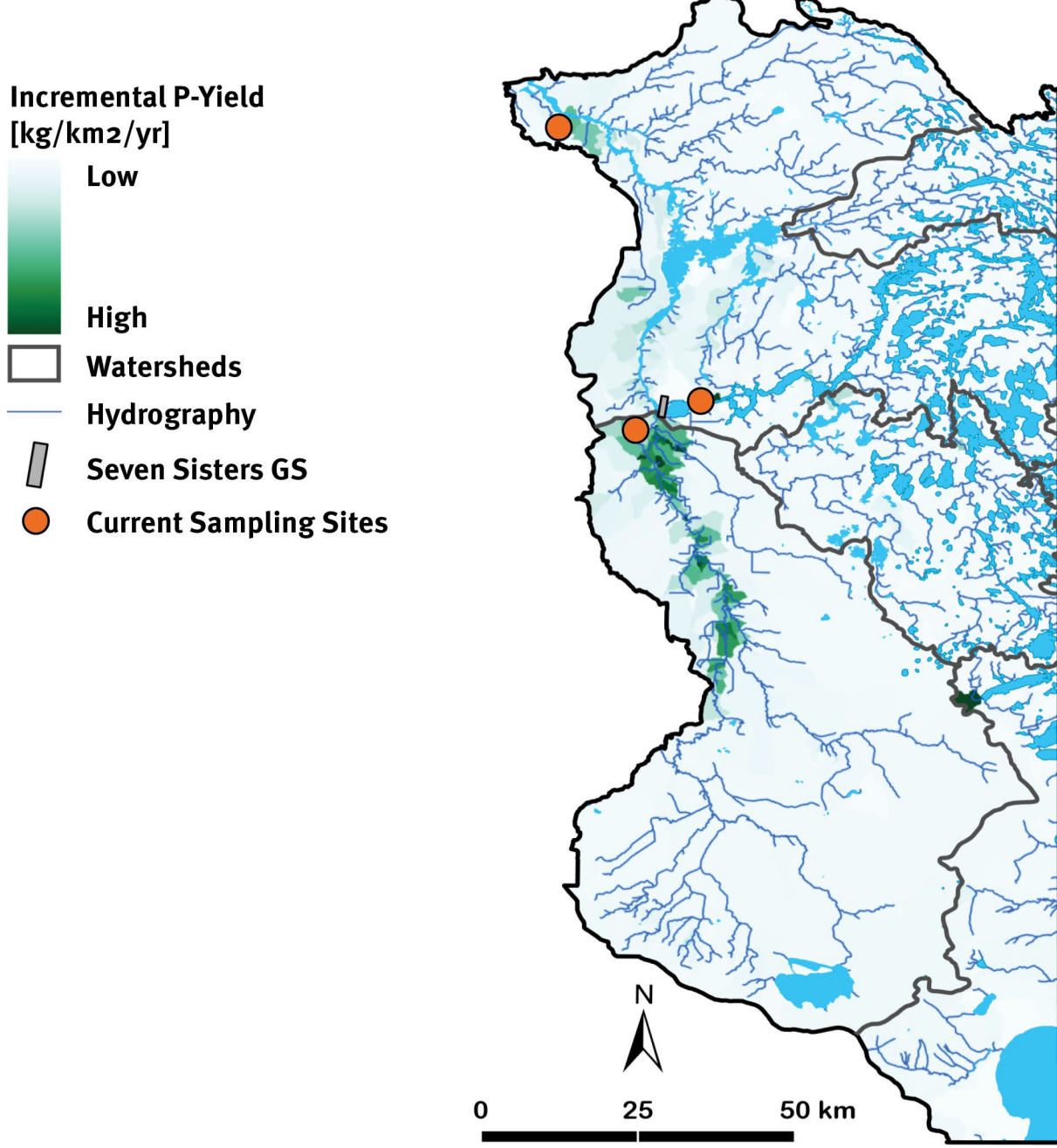
WATERSHED RESEARCH

WINNIPEG RIVER ADAPTIVE MONITORING PROJECT

An example of regional monitoring is our collaborative pilot-scale project of Adaptive Monitoring in the Winnipeg River Basin.

Developed based on the ecological and socioeconomic characterization efforts on the lower Winnipeg River basin.

Developing advanced analytics and early warning



Initial Research Questions

1. Can high-frequency water quality stations influence water management on the Winnipeg River—including by improving drinking water treatment systems; informing community leaders about the state of the river; and, along with existing programs, contributing to a shared understanding of the state of the river?

2. Does changing the frequency of monitoring from quarterly or monthly to hourly build a useful dataset to develop surrogate models for complex and important chemical or biological parameters?

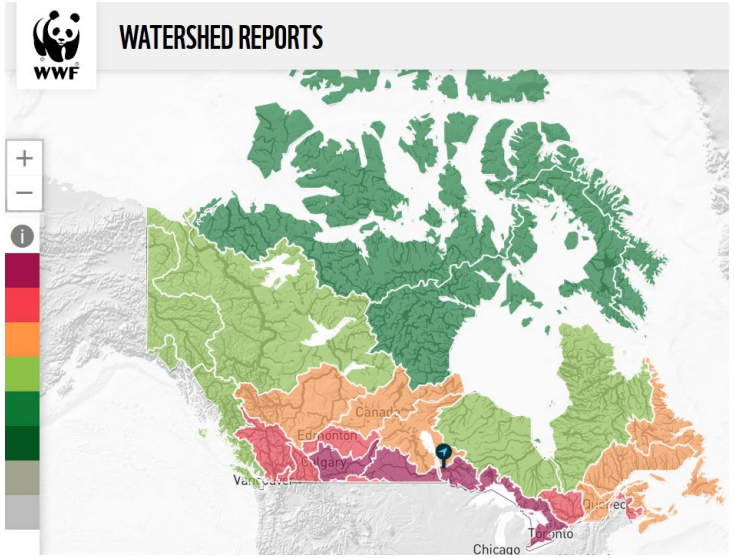
3. After one season, will there be sufficient data to train a data-driven model to generate near-term forecasts of river water quality?

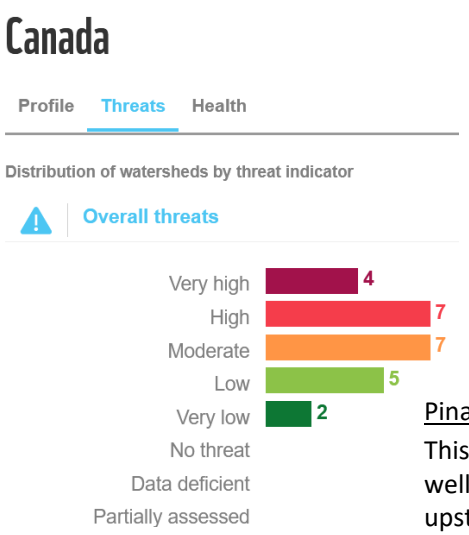
4. Can we isolate the spectral response of phosphorus and nitrogen in Manitoba's surface waters?

Research into Watershed Monitoring

Watershed Scale Monitoring and its Application in Municipal Water Management

Lower Winnipeg River Watershed





Optimized Station Locations

<u>Pinawa</u>

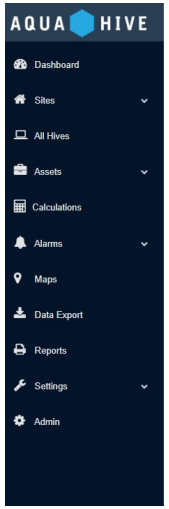
This site contains Boreal forest landcover as well as mining and recreational influence upstream.

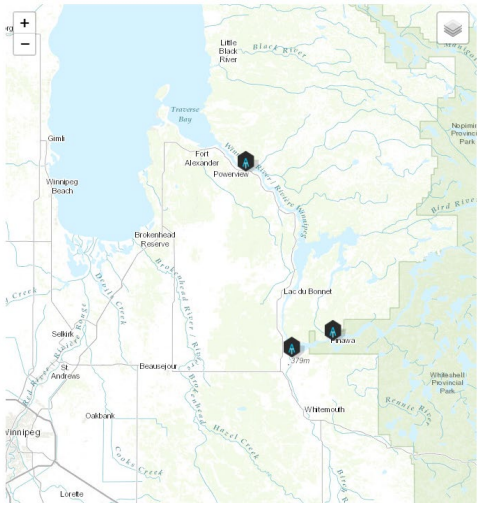
<u>Whitemouth</u>

The site was seen as a candidate high nutrient load tributary due to upstream agricultural land use.

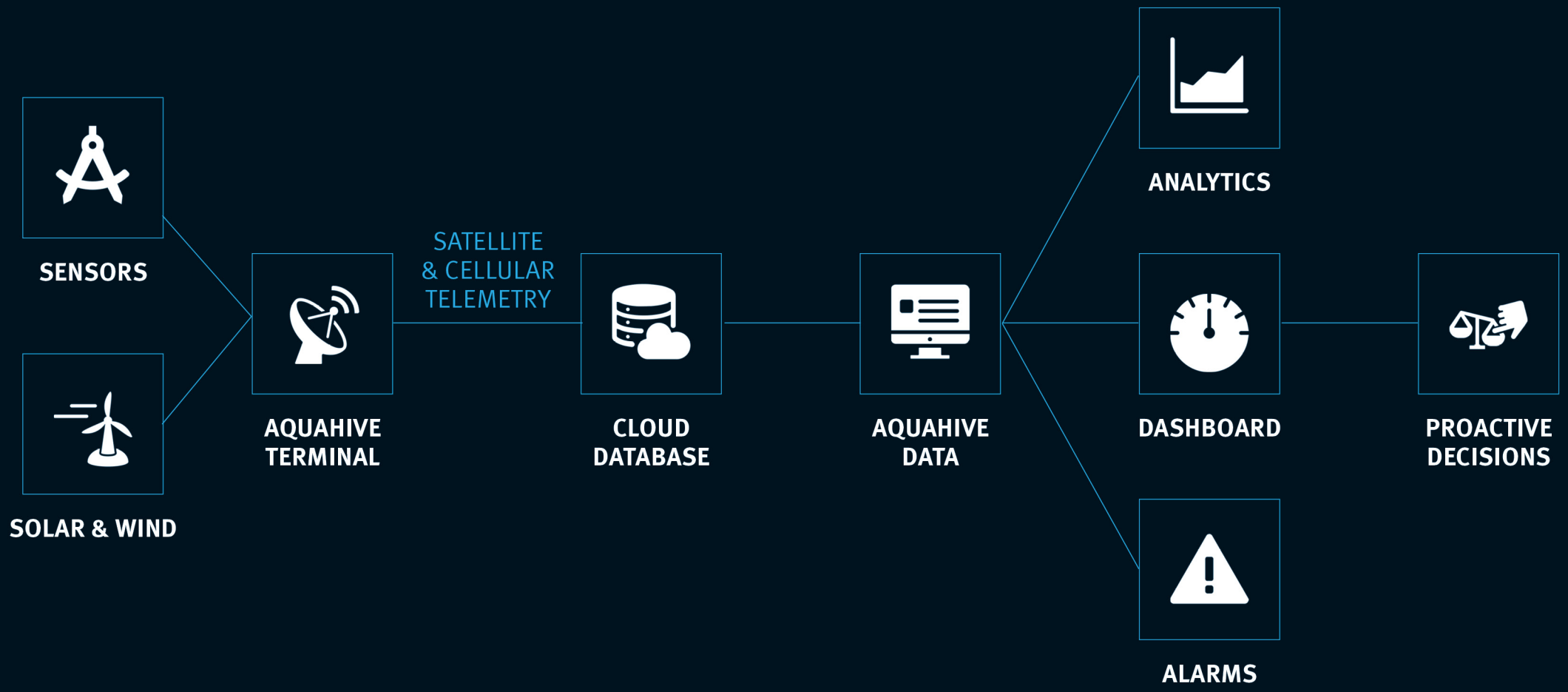
<u>Powerview-Pine Falls</u>

This site is close to Lake Winnipeg and contains the sum of the other 2 sites as well as all other upstream tributaries in the watershed.





AQUAHIVE PLATFORM



Winnipeg River Watershed Research Data Flow

Pinawa Station

Remote Terminal Unit (RTU) with Cellular rollover to Satellite

Connected Sensors:

UV Vis Spectrometer

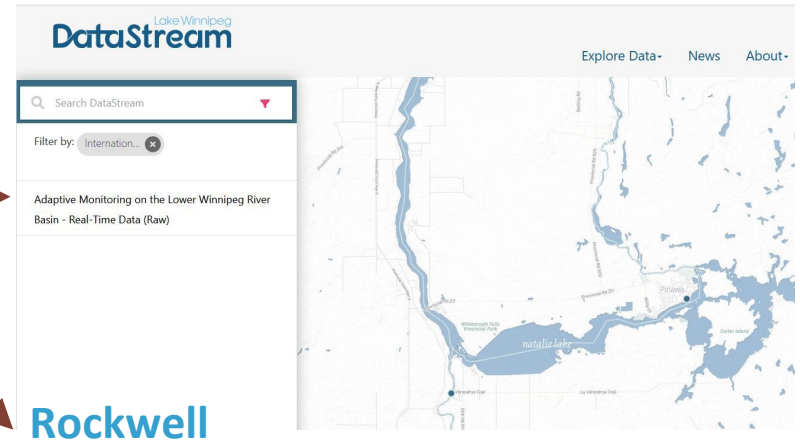
Multiparameter Sonde

Parameters:

DOC, TOC, NO3, NTU, Color, UV254, pH, Cond, ORP, TDS, NH4, NH3, DO, Resistivity, salinity, temp.

Aquahive Dashboard

- Visualization of multiple remote stations data
- Alerts and early warning
- Calculation parameters/loading values
- Automated reports



Rockwell Automation

Example Centralized Database

- Data pulled from API to Centralized data management
- Transparency of data
- Opportunity for advanced analytics and centralized data management

Whitemouth River Site

Remote Terminal Unit (RTU)

- Aquahive with satellite/cellular comms

Sensors

- s::can spectro::lyser V3
- In-Situ Aqua TROLL 600 Multiparameter Sonde

Parameters

- DOC, TOC, NO3, NTU, Color, Chl-A, pH, Cond, ORP, TDS, DO, Resistivity, salinity, temp, depth

Measurement Interval

- 1 hour

Install 2022

Install 2023

Powerview-Pine Falls Site

Terminal unit

- s::can con::cube with cellular modem

Sensors

- s::can spectro::lyser V2
- s::can pH sensor
- s::can ORP sensor
- s::can Conductivity sensor

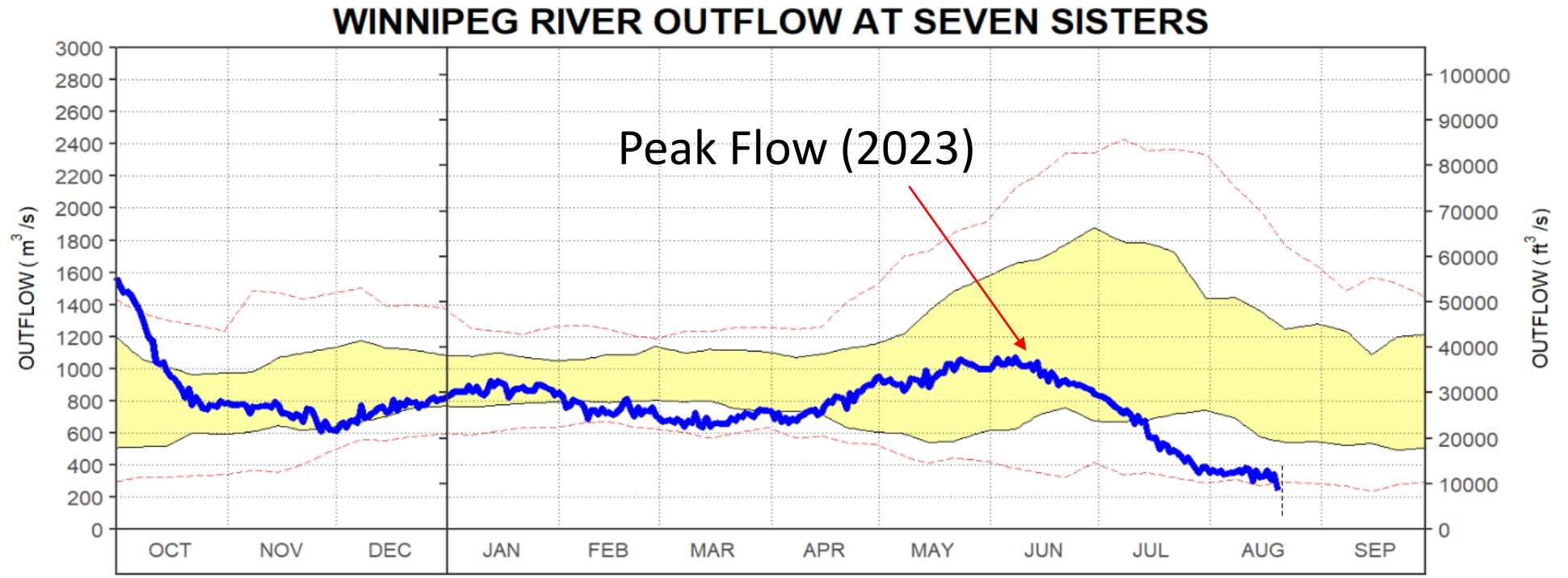
Parameters

- pH, Cond, ORP, temp, DOC, TOC, NTU, Color, Chl-A, NO3, UV254, UVT, Salinity

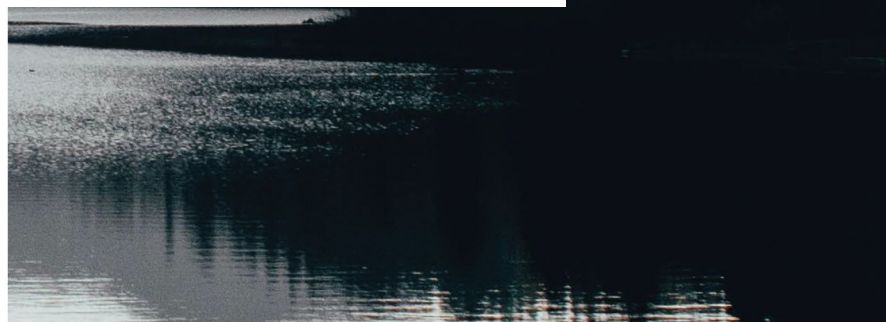
Measurement Interval

- 2 minutes

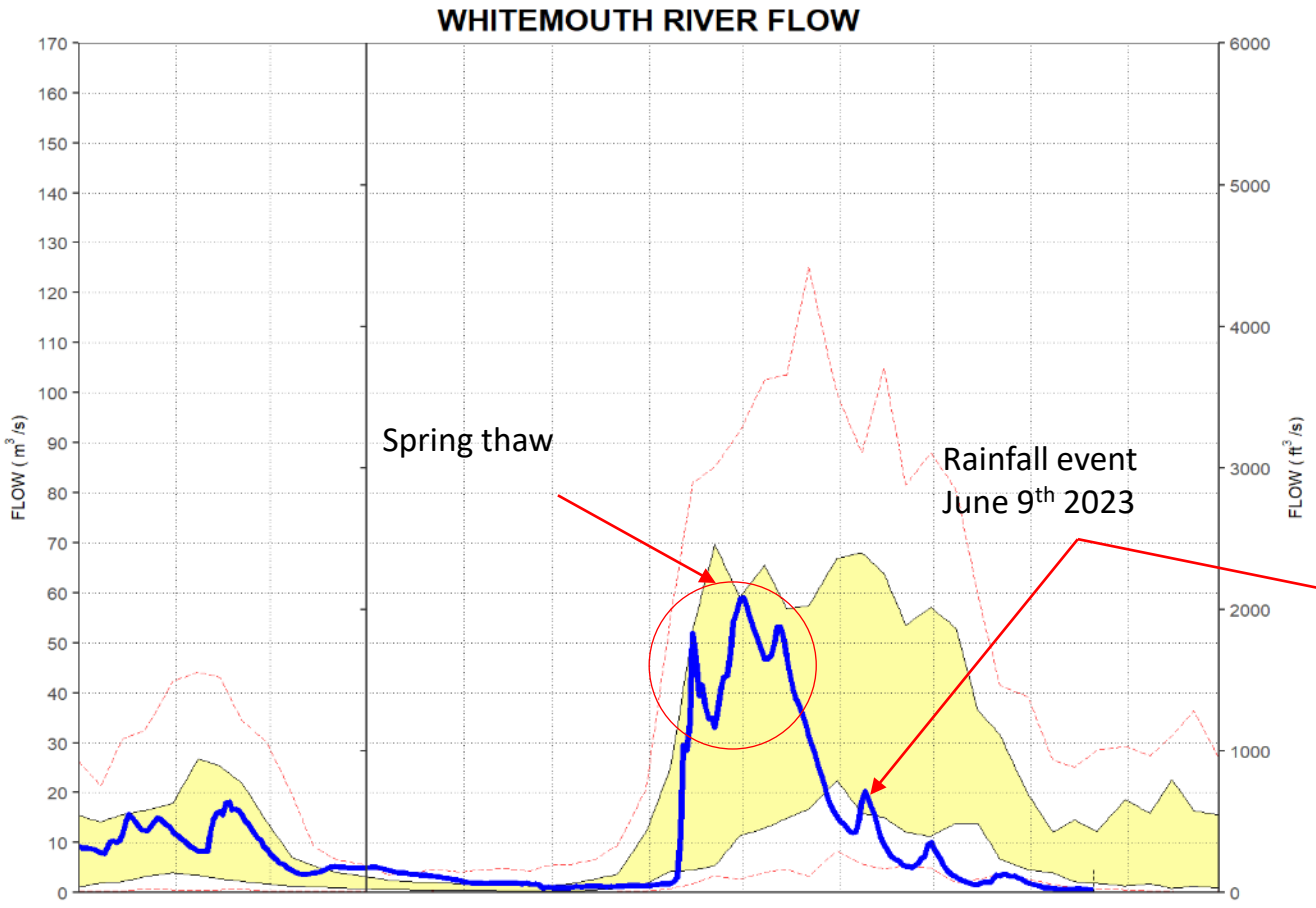
Flow Estimates 2023

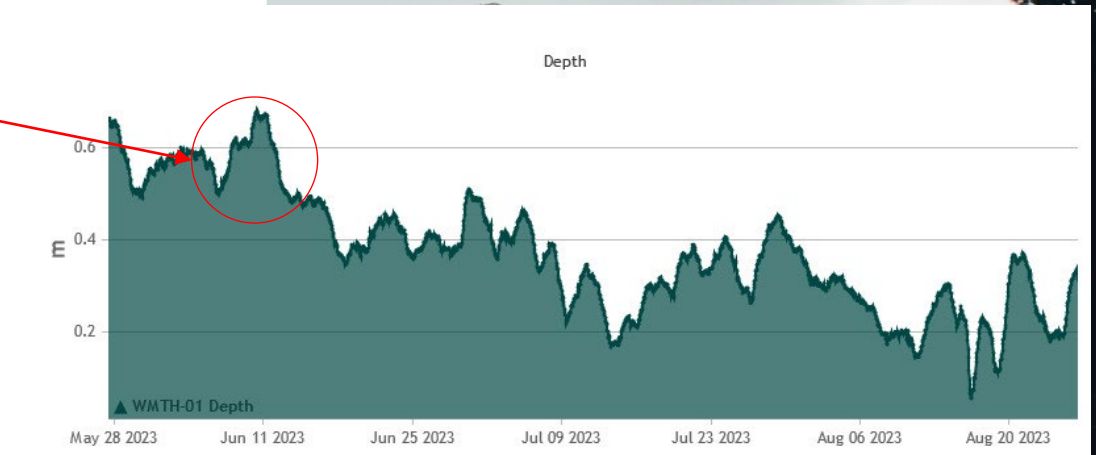


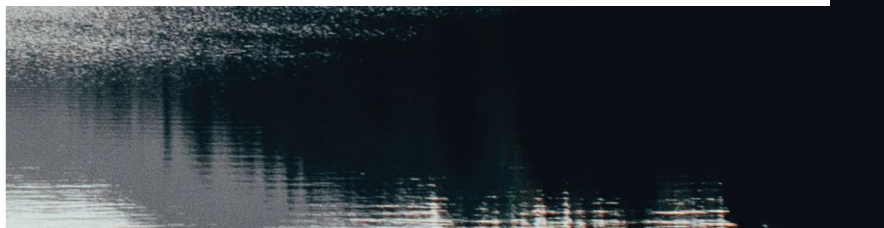
Lake of the Woods Control Board



Regional Flow Estimates 2023



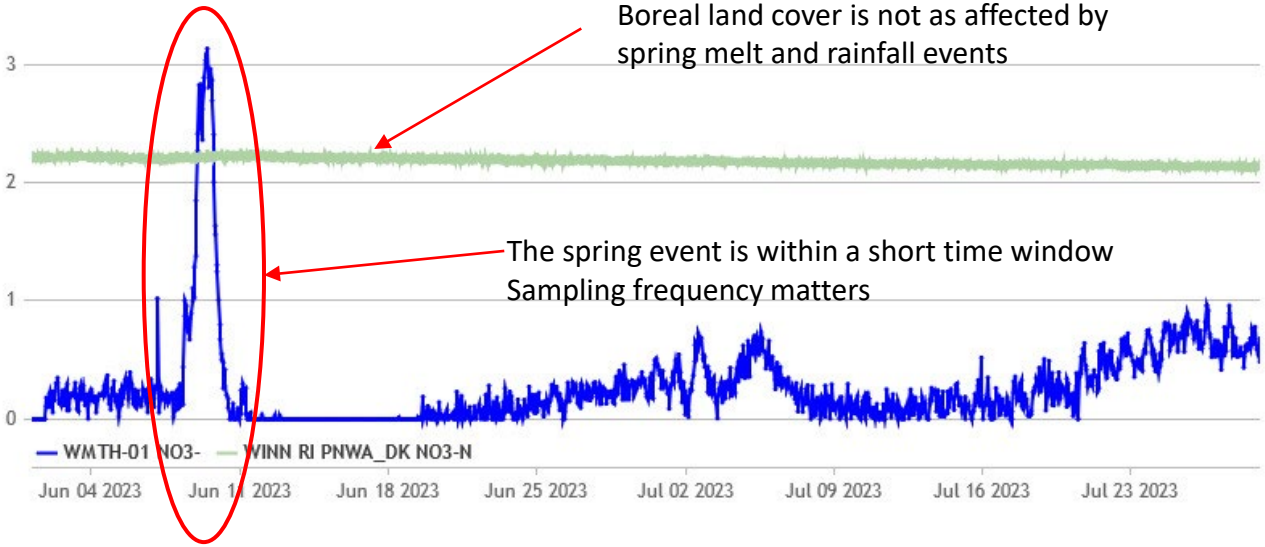




Watershed Research Data

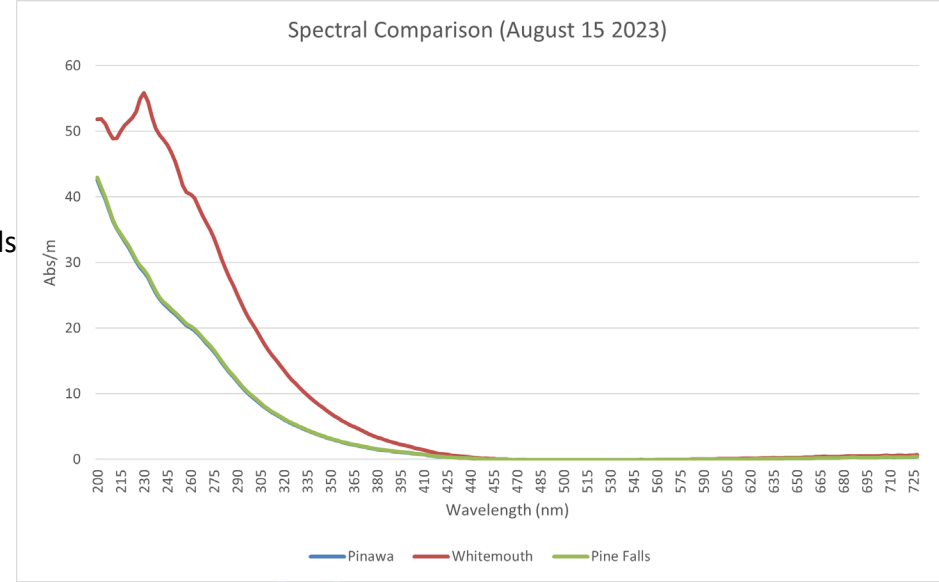
Early Warning and Sampling Frequency Matters

Nutrient Loading Example



- Near-overlap of Pinawa and Powerview-Pine Falls spectra seen in green.
- Significant difference with Whitemouth in red
- Deviations from normalized spectra
- Rapid indication of water quality changes.
- Used for early warning of changes

UV – Vis Spectral Data Comparison



Surface Water Challenges

- Source contamination Events/Alerts
- Spring freshet and flooding
- Watershed Data Gaps
- Lack of real time monitoring systems
- Highly variable water turbidity and organic loads

“sustainable access on a watershed basis to adequate quantities of water, of acceptable quality, to ensure human and ecosystem health” Strengthening the Resilience of the Canadian Water Sector: Final Report 2017, Dalhousie Report

Value of Real-Time Watershed Monitoring

- Important of monitoring highly variable source water
- Advanced warning of loading values – Leading to enhanced coagulation and control.
- Grab sampling for monitoring these types of events has been shown to be insufficient.
- Potential cost savings through coagulation dose optimization

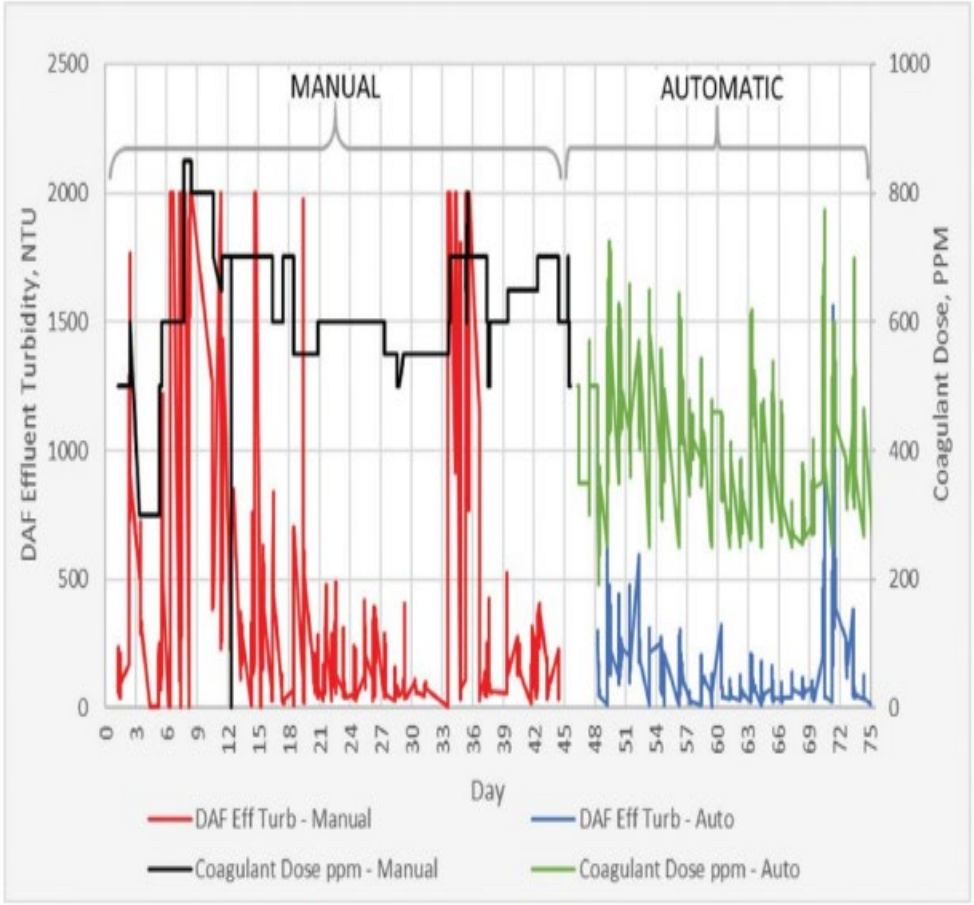


Figure 2: DAF operation before and after coagulant dosing automation.

Aquatic Life® Ltd.

QUESTIONS & NEXT STEPS?

JEFF SIMPSON

CEO & Founder • Aquatic Life

www.aquaticlife.ca

www.aquatest.ca

jsimpson@aquaticlife.ca

AQUATEST™
water technology solutions