

Instrumenting wells already drilled

A scalable groundwater network for the Great Lakes basin

Presented by Garrett Marietta

INTERA Incorporated · Bloomington, Indiana

Great Lakes Groundwater
Conference · 10 September 2026

INTERA

The practical gap is not a shortage of wells

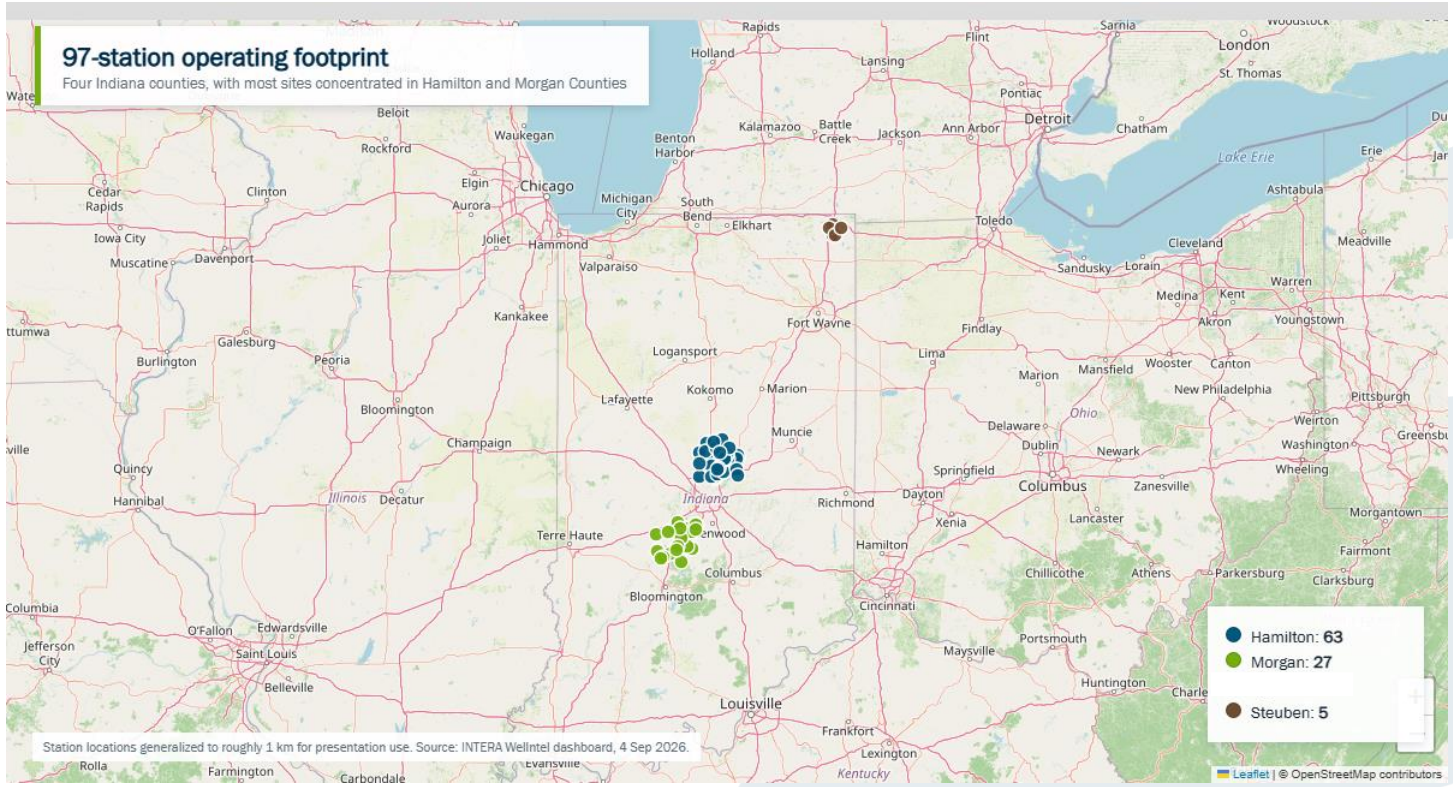
- The U.S. Great Lakes watershed crosses eight states — Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania and New York.
- Groundwater supports tributary baseflow, wetlands, nearshore exchange, water supply, and the movement of nutrients and contaminants.
- The IJC identifies an urgent need for better basin-scale groundwater monitoring, water budgets, pressure heads, and forecasts.
- Every basin state already maintains a large well-record system that can be screened for candidate sites.

THE THESIS

The practical gap is not the absence of wells. It is the small number converted into sustained, comparable time series.

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Central Indiana is the working proof, not the study boundary



89

Stations

Hamilton + Morgan

95

In inventory

63 Hamilton · 27 Morgan · 5 Steuben

367,196

Water levels

4-hour cycle since Feb 2022

208,602

Pump cycles

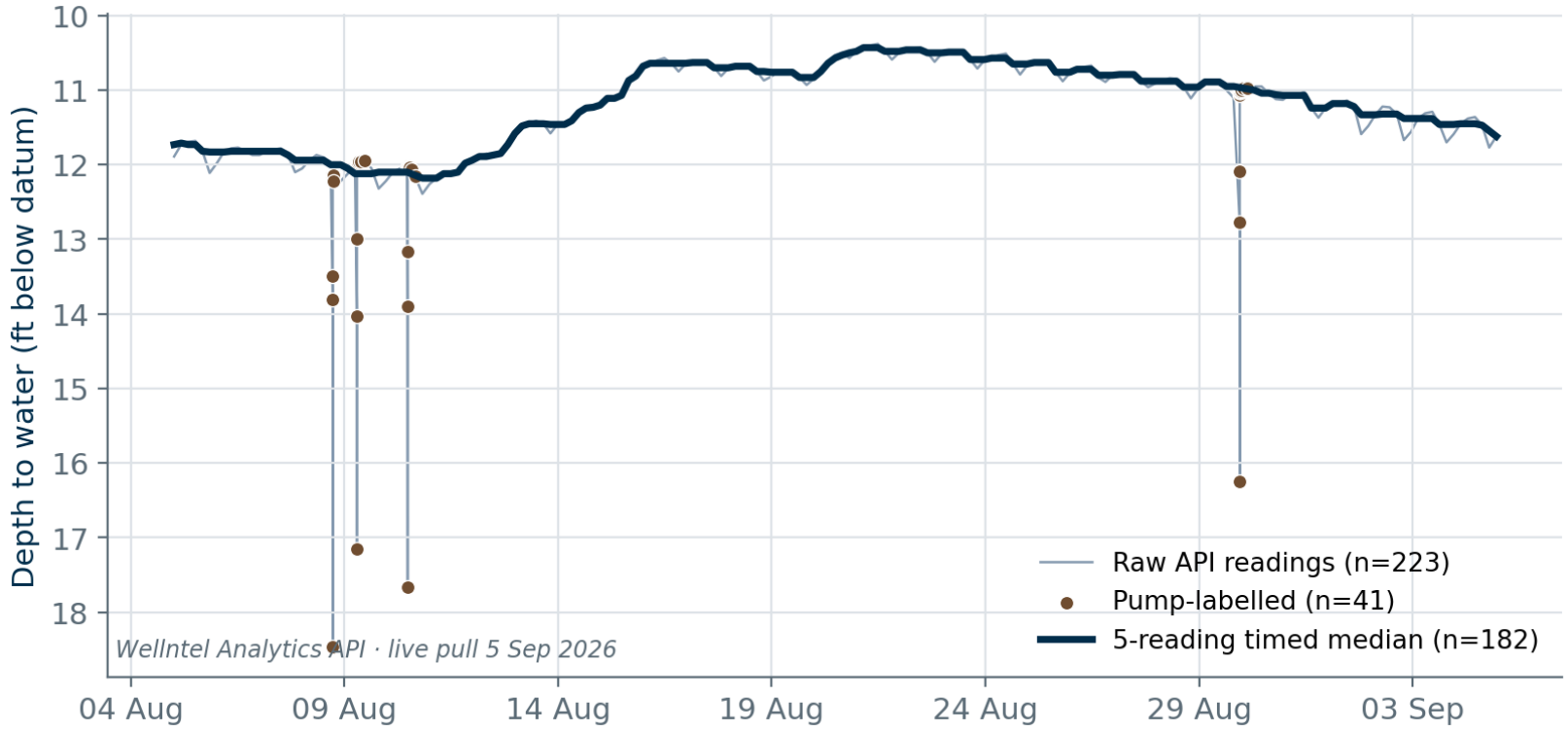
Each a drawdown + recovery

WHAT THIS IS NOT

Not a research pilot. Not a special deployment. Homeowner wellheads, one field crew, one pipeline — shared across several client programs.

WellIntel Analytics API /reservoirs, live pull 5 Sep 2026 — 97 stations; basemap © OpenStreetMap contributors.

A cleaner record separates ambient depth from pumping response



223

Raw API readings

5 Aug – 4 Sep 2026, one well

182

Timed readings

Feed the smoothing line only

41

Pump-labeled

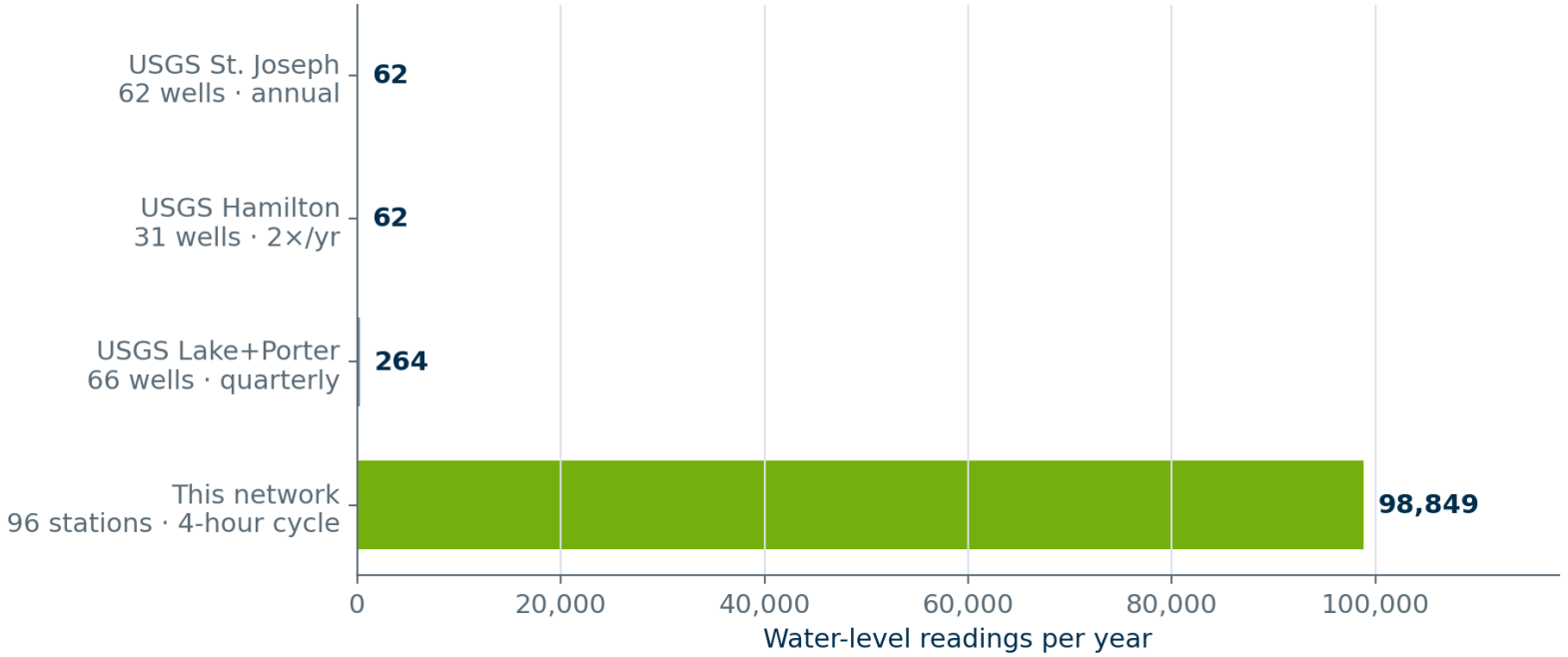
Start, stop, and recovery

Each record carries exactly one label, so the two counts sum to 223.

WellIntel Analytics API, reservoir 1271 (Homeowner, HMLCO-025). Live pull 5 Sep 2026. Event labels are the API's own.

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The gap is temporal resolution, not just well count



Linear scale. All three public networks are on this chart.

374×

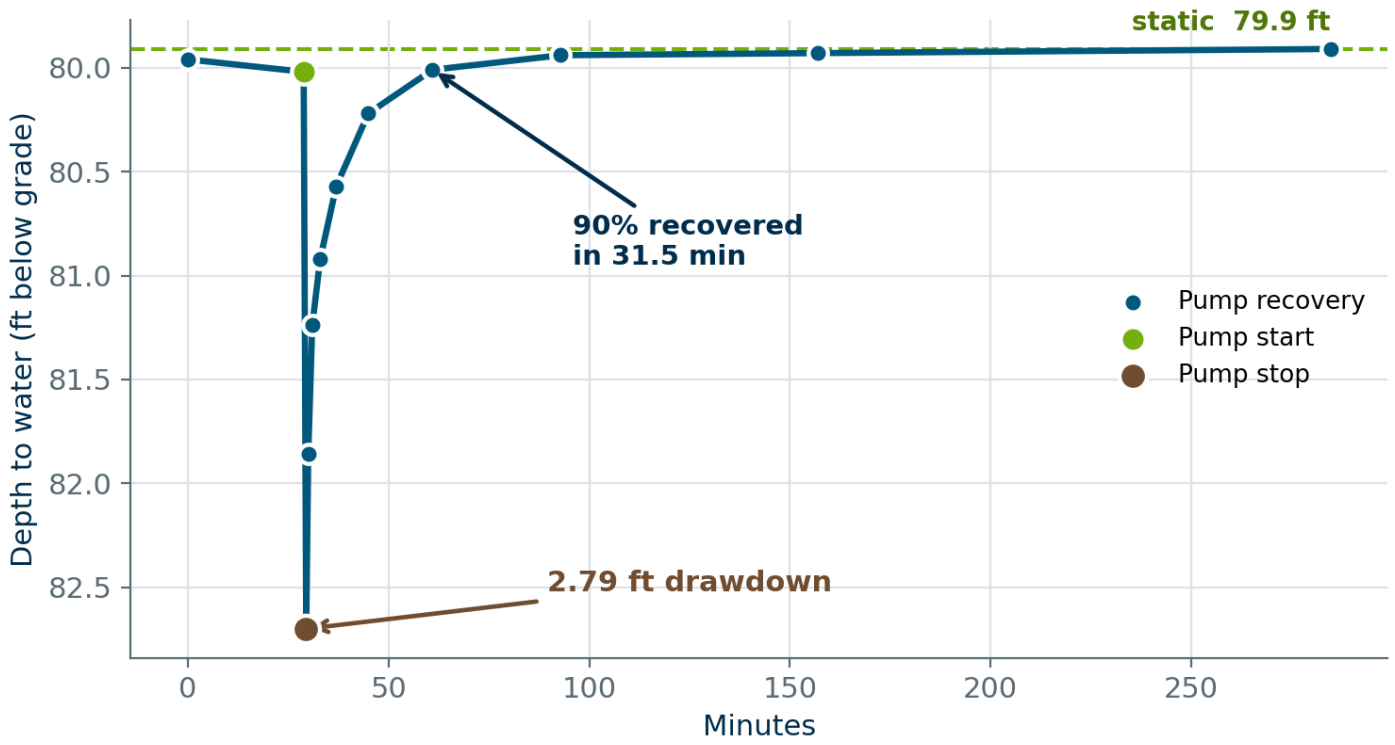
more water-level observations per year than the entire Indiana lakefront public record.

Passed in 24 hours

66 wells × 4 visits = 264 readings a year for the whole north-west Indiana lakefront. This network passed that in its first day.

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Every pump cycle is a free aquifer test



Homeowner well, Morgan County · 26 Aug 2026

The pump event is logged with the level.

So drawdown and recovery are labeled, not inferred — a static level plus a repeated hydraulic test.

What it supports

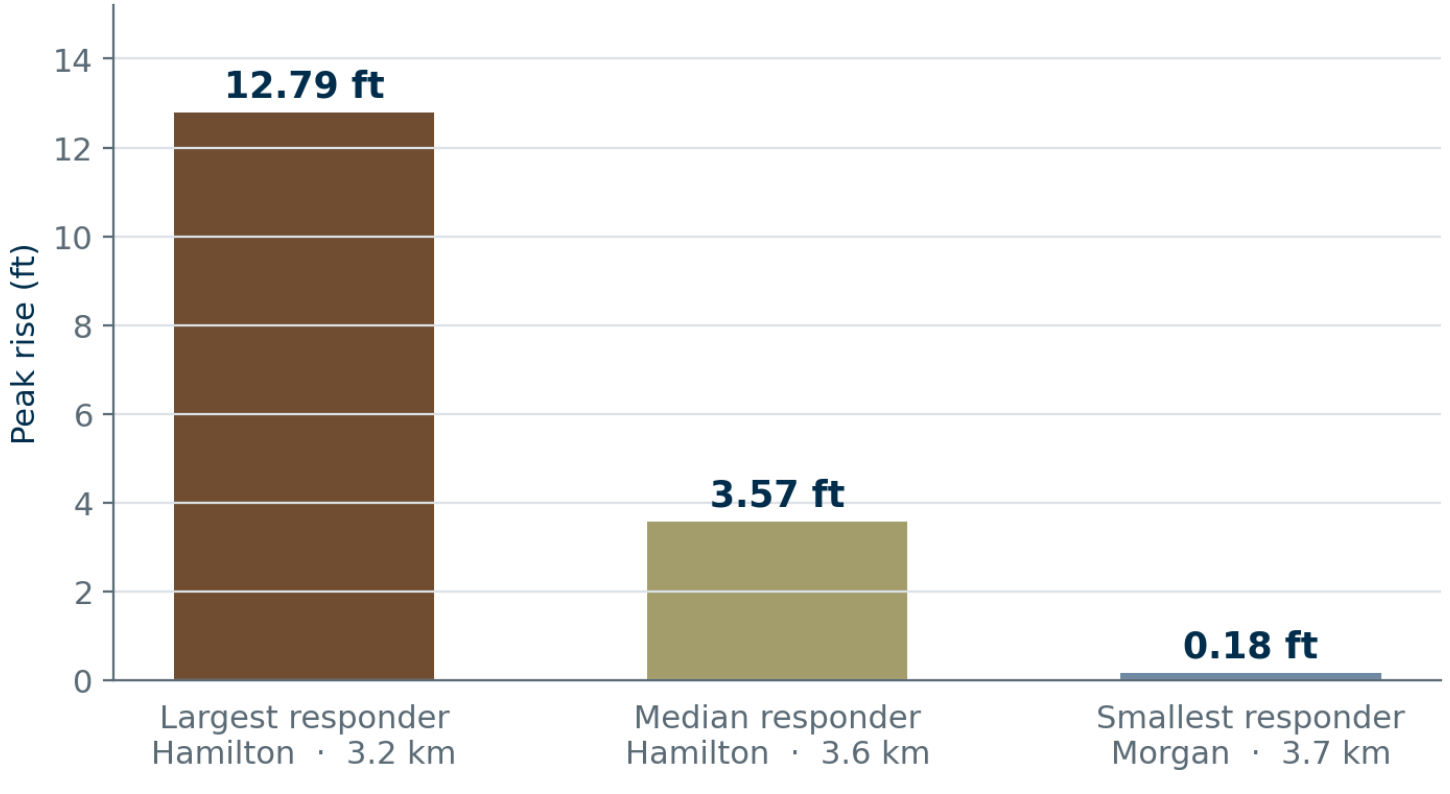
- Recovery shape → local transmissivity
- Specific capacity trend → screen fouling
- Timestamps → static level, cleanly separated

77 pump cycles at this one well in 72 hours.

WellIntel Analytics API, reservoir 1431 (Homeowner Well). Live pull 5 Sep 2026. Supports response screening, not an absolute aquifer parameter without discharge and well geometry.

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Why density, and not a spacing rule



Distance explains 2% of the variance. Elevation explains none.

n = 39 wells, August 2026 White River record crest.

What controls amplitude is hydraulic connection, not proximity — and connection is exactly what a fixed spacing rule cannot see.

Live dashboard snapshot, 4 Sep 2026. Peak rise measured against pre-event baseline.

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Distributed networks fail on logistics, not on technology

- Reaching the well is its own dataset
- The homeowner is the asset
- Track the components separately
- Verify against a tape
- Route, do not react

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The network has to be a feed, not a folder

1
Sensor and gateway

2
Scheduled API pull

3
Automated QC

4
Time-series store

5
Delivery

Why this is the scaling argument

The 200th well costs almost nothing in analyst time.

A WORKING DASHBOARD, NOT A PROPOSAL

Already running. Refreshes every three hours.

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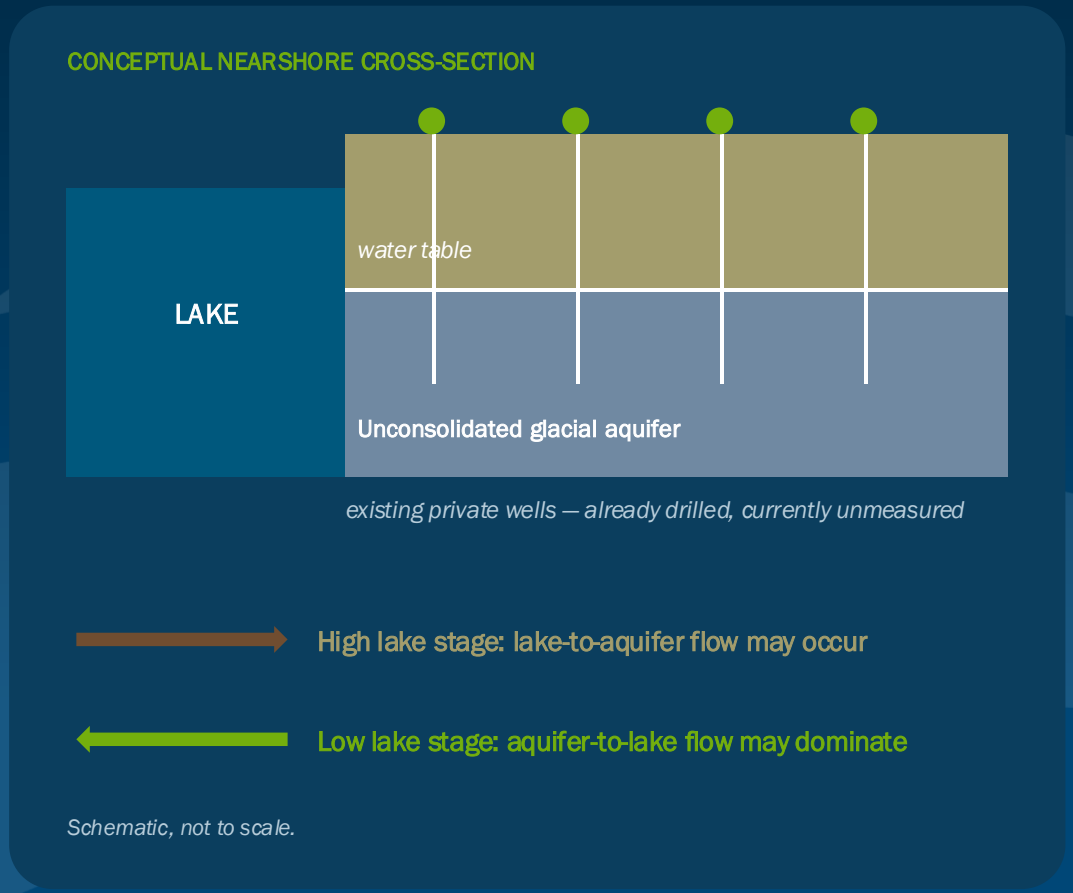
Now the harder boundary: a lake instead of a river

1. **The gradient reverses**

2. **The boundary is exogenous**
   117,000 km² of over-lake precipitation and evaporation

3. **Timescales span hours to years**
   Seiches · 0.3 m seasonal cycle · 1.9 m since 2013

4. **High consequence**
   Baseflow · contaminant transport · shoreline-well yield



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Two different quantities are often called groundwater's share

INDIRECT — VIA TRIBUTARY BASEFLOW

67% of streamflow, mean of 195 basin streams

25–96% range across studied basin streams

22–42% of basin water supply, by lake

5,735 station-years behind those separations

Large, and reasonably well constrained. Holtschlag & Nicholas 1998.

DIRECT — LAKEBED SEEPAGE

115.6 m³/s modeled net flow, all five lakes

0.8% of average basin supply (Xu et al. 2021)

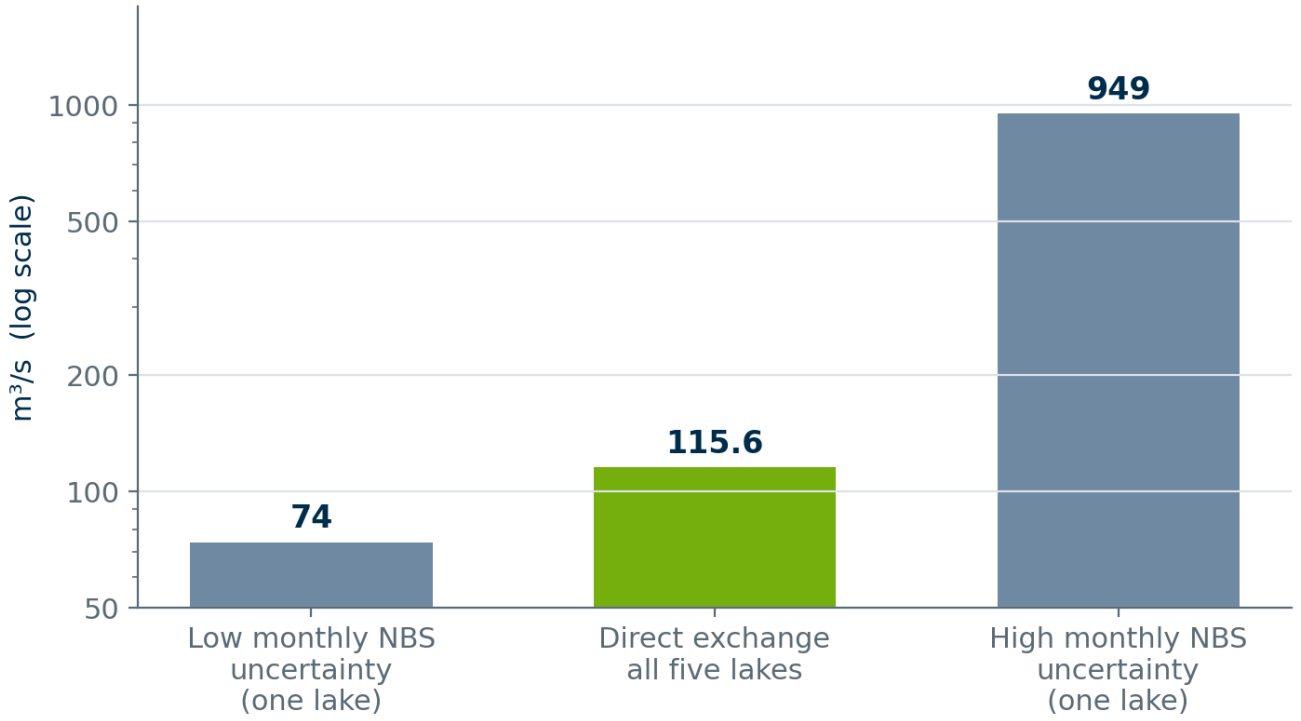
23–190 m³/s — Lake Michigan alone, same lake

4 km nearshore strip dominates the exchange

Small, and genuinely unconstrained. Not interchangeable with the left column.

INTERA

Bookkeeping cannot substitute for measurement



116 m³/s

Direct discharge, five lakes

Xu et al. 2021

74–949 m³/s

Monthly NBS uncertainty, one lake

Neff & Nicholas 2005

0

Lakes assigned a GW status by SOLEC

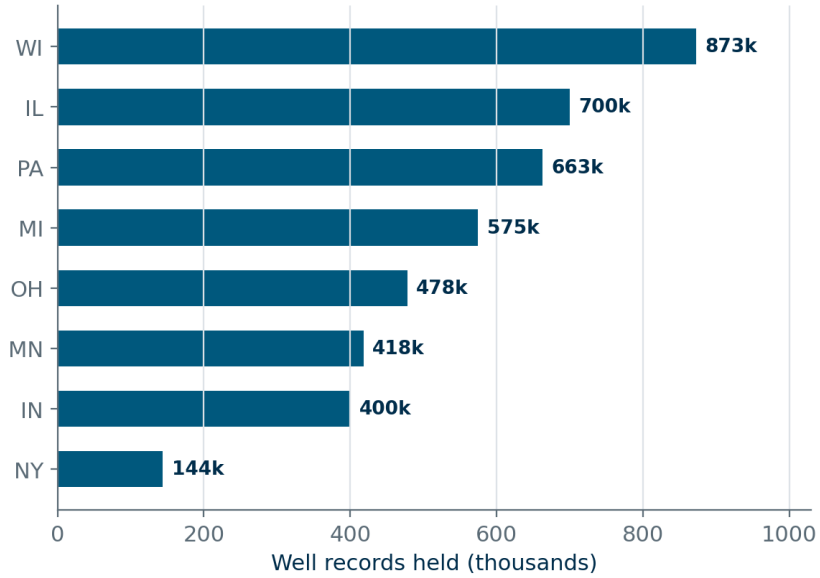
Of five

"Without adequate estimation of uncertainties associated with each component, the accumulated error ends up in the calculated net groundwater changes." — IJC, 2018

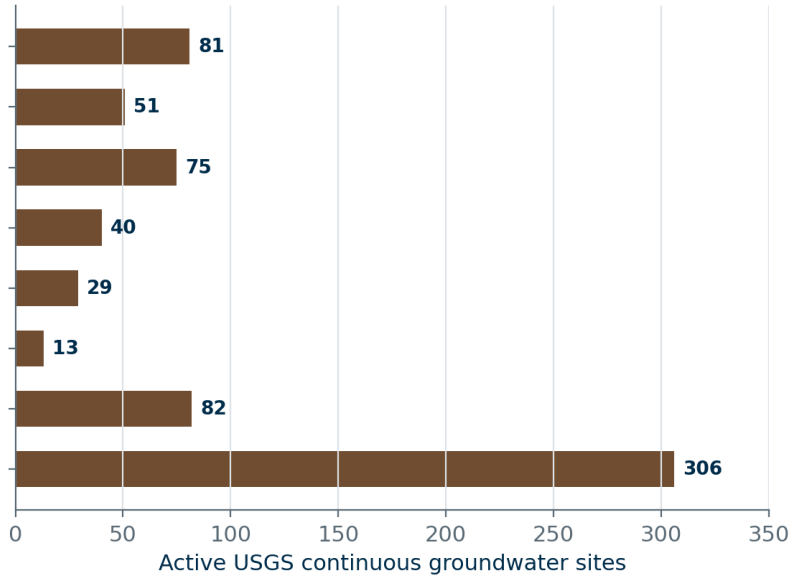
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Eight state databases already provide the candidate pool

The candidate pool



What is continuously watched



4.25M

state screening records, conservative sum across eight state systems

677

active USGS continuous groundwater sites, whole-state counts, one consistent national service

Statewide screening inventories, not accessibility claims. USGS Site Service, active GW sites with instantaneous values, retrieved 4 Sep 2026.

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The nearest step north: Lake and Porter Counties

A densely developed, heavily industrialized shoreline sitting above 21,341 documented IDNR well records — almost none of them doing any monitoring work.

21,341
Well records
Lake + Porter combined

11,169
Lake County
IDNR records

10,172
Porter County
IDNR records

The question a network here could answer: how far inland does Lake Michigan stage propagate, through which aquifer systems, and how does that interact with pumping stress?

- Straddles the basin divide
- A quarterly network to build on
- Five mapped aquifer systems
- A reversal already observed
- Findings transfer

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Repeat one defensible design in several basin settings

Tier	Distance from shore	What it resolves	Density
1	0–2 miles	Lake-stage propagation and direction of exchange	Highest
2	2–10 miles	Attenuation, and interference from pumping	Moderate
3	Beyond propagation	Recharge baseline — the attribution control	Sparse, essential

Well selection criteria

- An IDNR well record exists — construction, depth and screen interval, which also places it in a mapped aquifer system
- Reliable household internet and an engaged, likely long-term owner
- A one-time measuring-point elevation survey after selection — routine, but required before heads enter a model

THE CONTROL SET IS NOT OPTIONAL

Wisconsin's water table peaked the same years Lake Michigan did — one wet period drove both. Without an inland control, the network overstates the link.

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Four phases, beginning with all eight state databases

01

Basin inventory

3 to 6 months

Clip all eight state systems to the basin. Rank candidate areas.

02

Multi-lake demonstrations

12 to 18 months

Three to five contrasting clusters, each with an inland control.

03

Basin build-out

Years 2 to 3

Extend to missing aquifers and states. Connect to regional models.

04

Institutionalize

Ongoing

Share with agency, tribal and utility partners. Maintain calibration.

Each phase is a decision gate. The first deliverable is a defensible basin-wide candidate map, before field deployment.

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The wells are already drilled.

At least 4.25 million searchable or mapped records already exist across the eight U.S. Great Lakes states — a screening pool, not a claim that every well is accessible or suitable.

4.5 YEARS, CENTRAL INDIANA

89
stations

367,196
water levels

208,602
pump cycles

- Sensors on existing wells remove the capital barrier to spatial density
- Timestamped pump events turn household noise into repeated aquifer tests
- Direct groundwater flux is too small to calculate from a water budget — it has to be measured

WHAT WOULD HELP

A basin consortium willing to complete the eight-state GIS screen and co-design three to five contrasting demonstration areas.

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