



Instrumenting wells already drilled

A scalable groundwater network for the Great Lakes basin

Presented by

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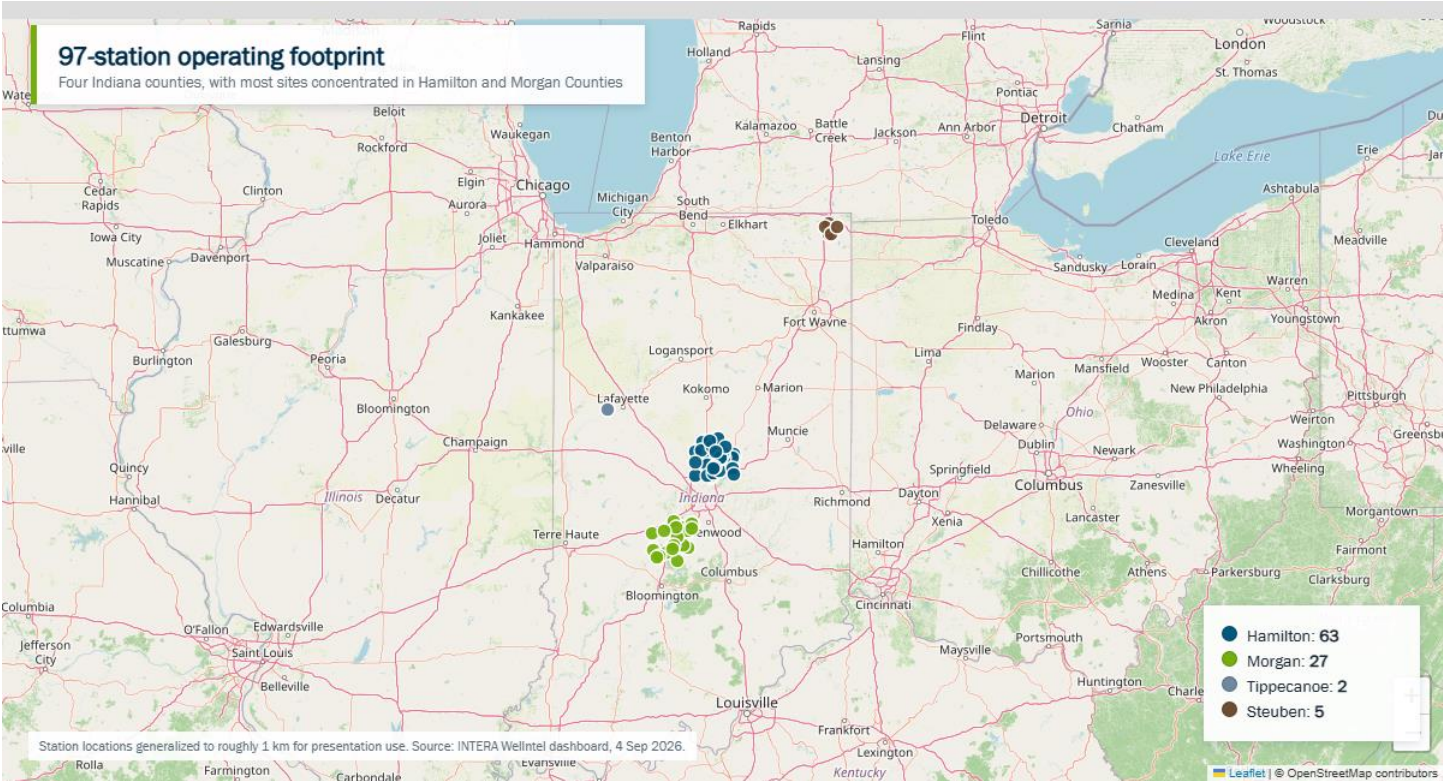
The practical gap is not a shortage of wells

- 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.**

Central Indiana is the working proof, not the study boundary



89

Stations

Hamilton + Morgan

97

In inventory

63 Hamilton · 27 Morgan ·
5 Steuben · 2 Tippecanoe

367,196

Water levels

4-hour cycle since Feb 2022

208,602

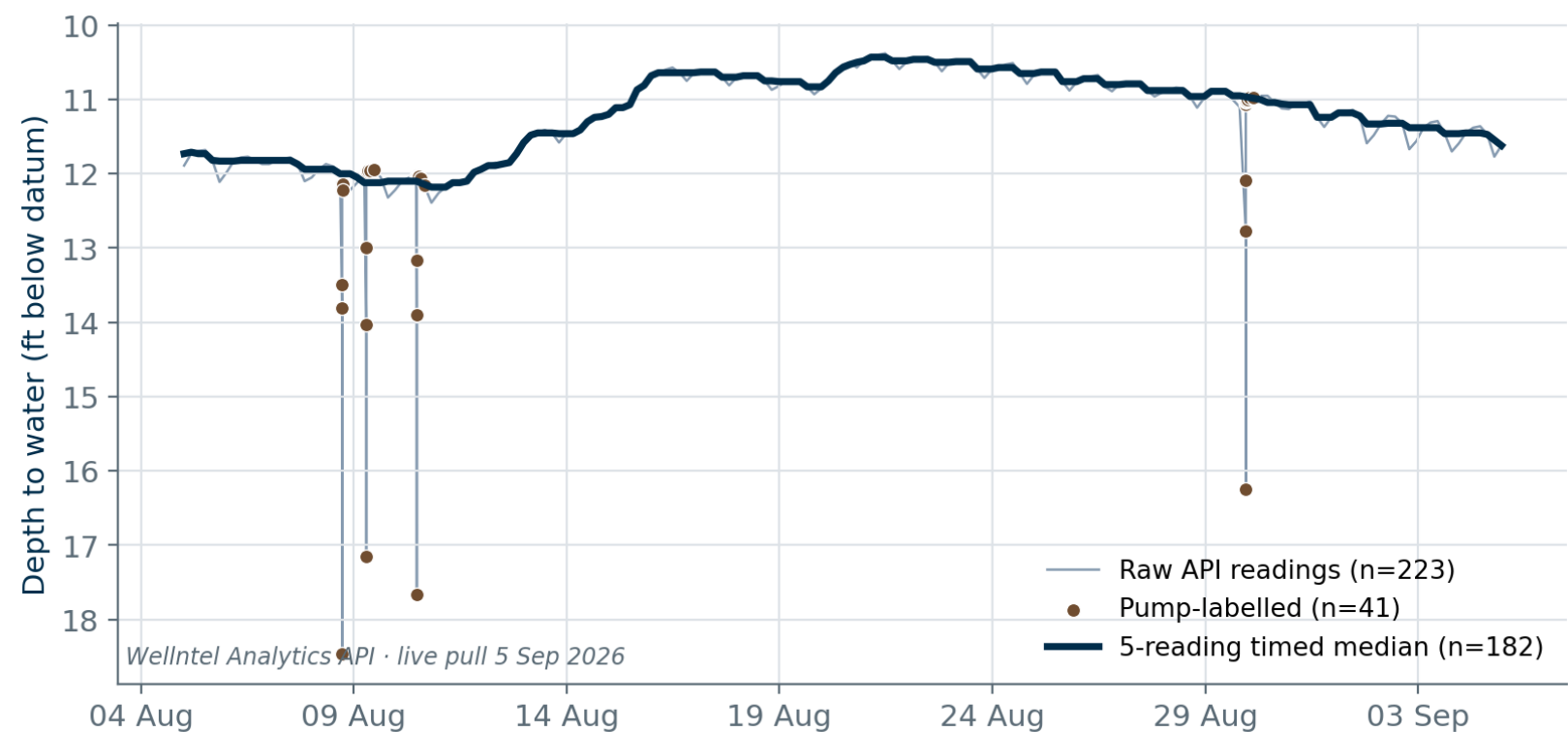
Pump cycles

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.

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

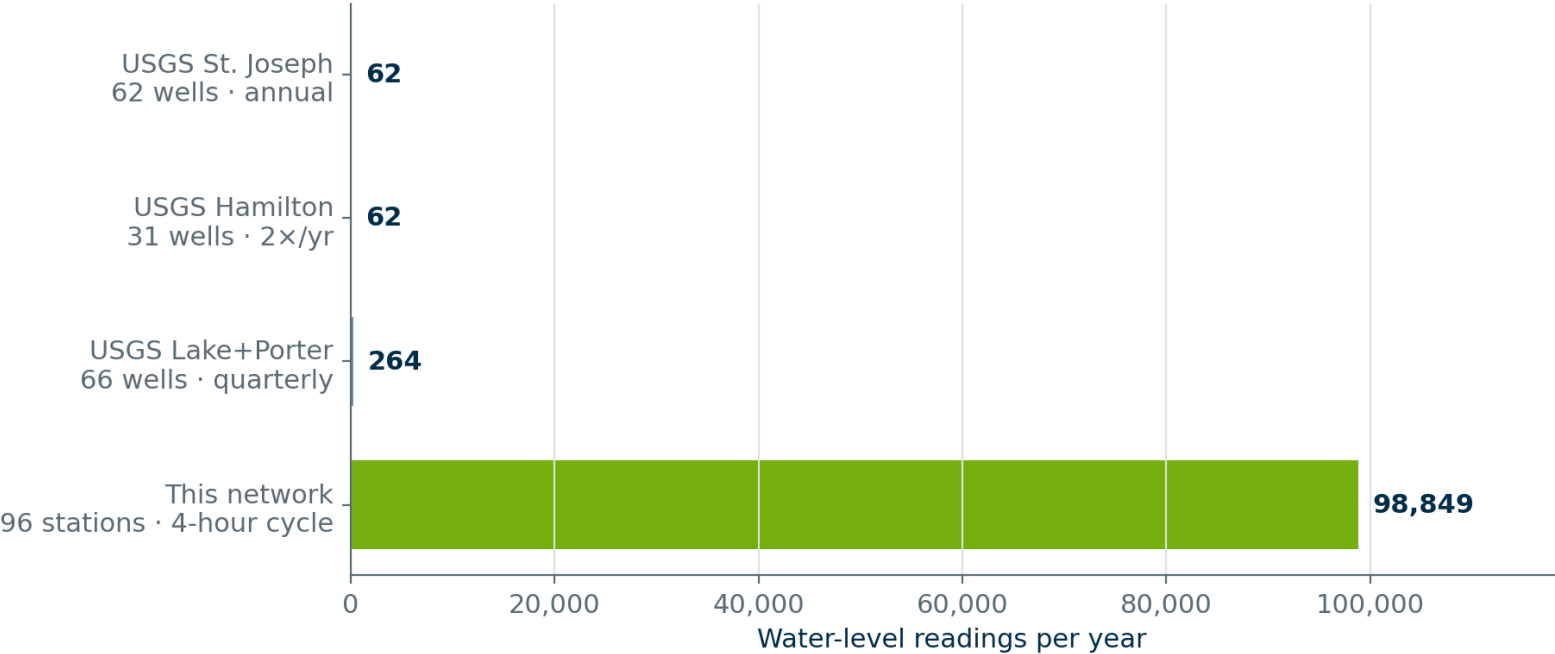
Start, stop, and recovery

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.



The gap is temporal resolution, not just well count



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

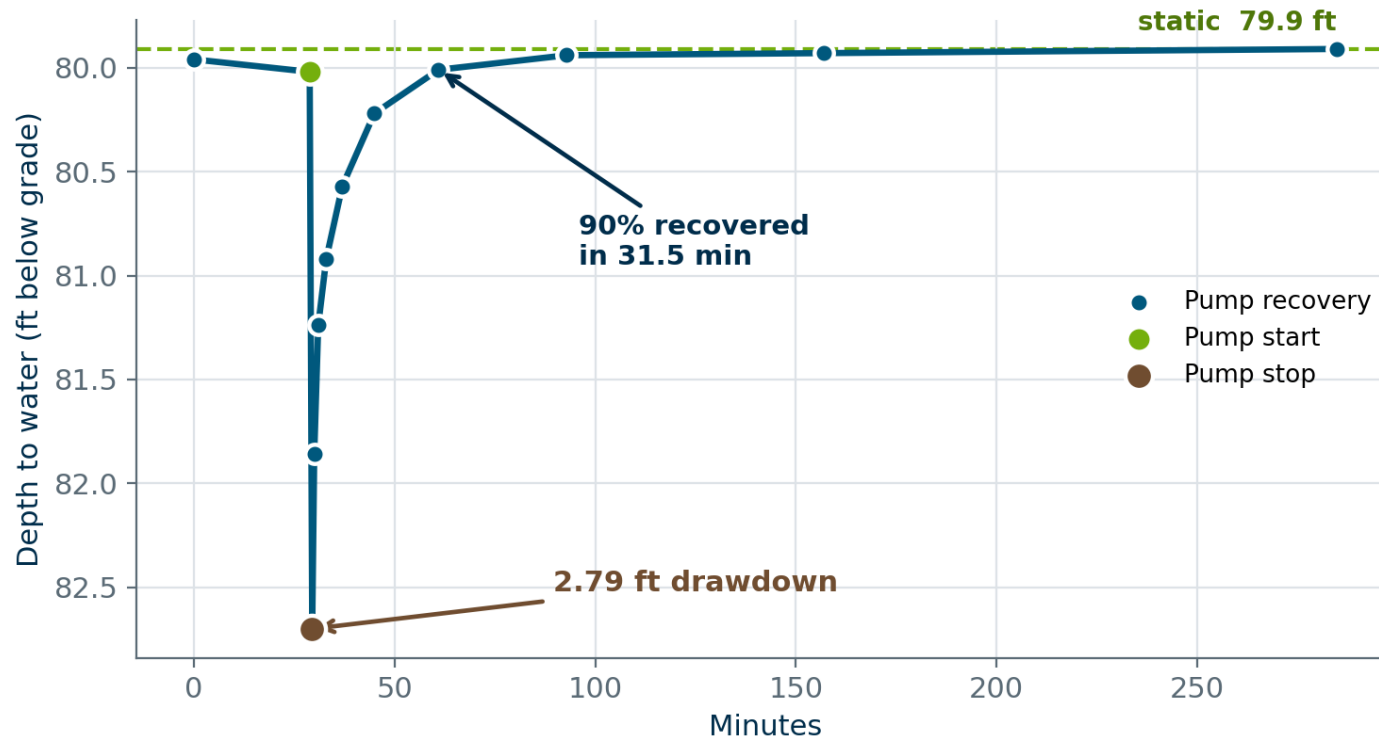
374x

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.

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

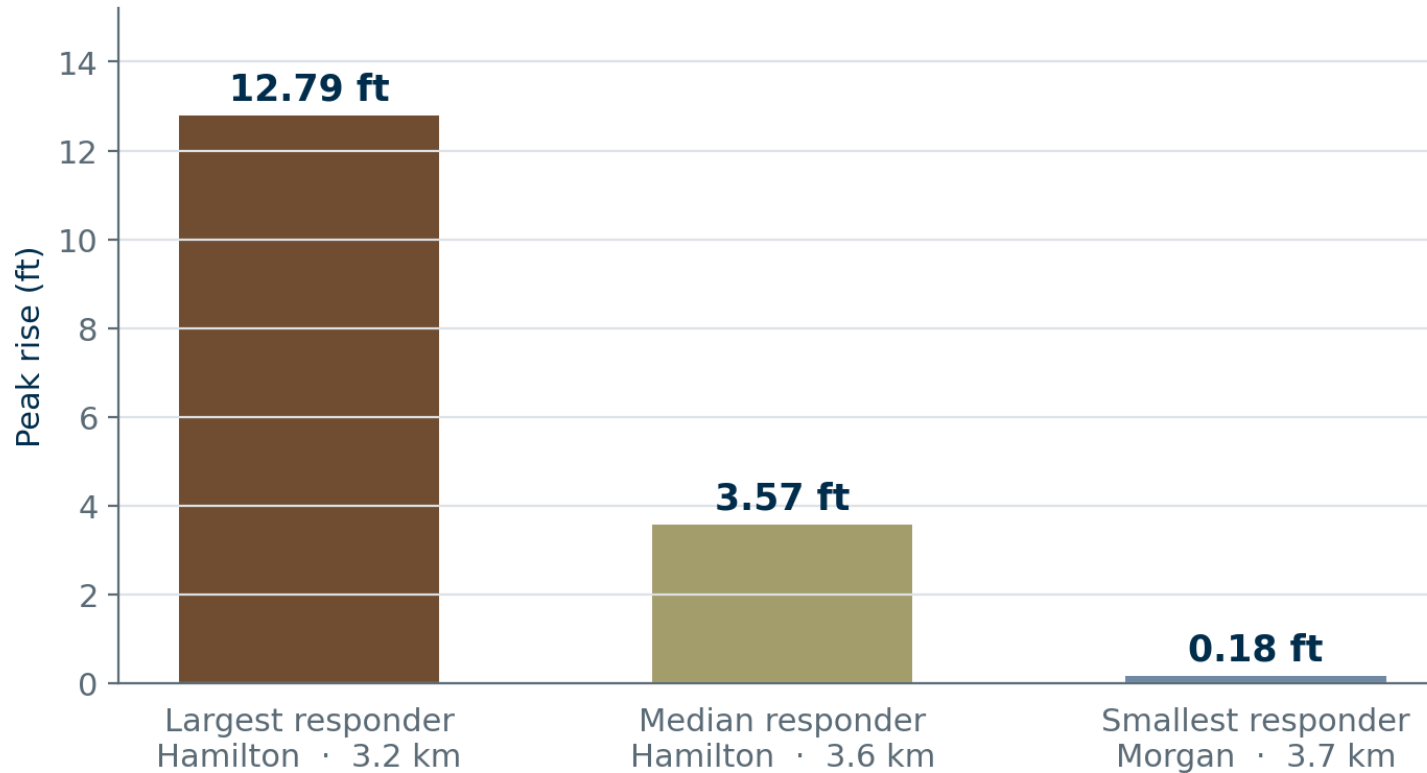
- Recovery shape → local transmissivity
- Specific capacity trend → screen fouling
- Timestamps → static level, cleanly separated

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.

Why density, and not a spacing rule?

Hydraulic connection matters



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

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

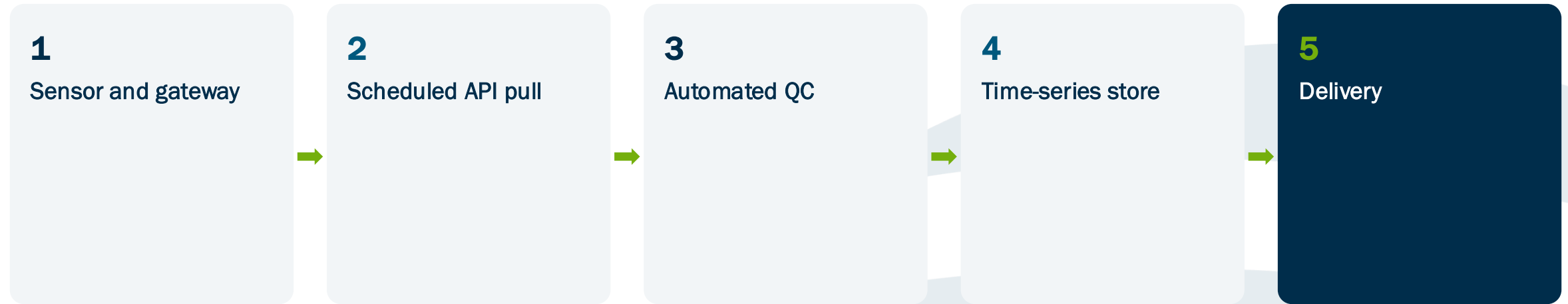
What controls amplitude is hydraulic connection, not proximity — and connection is exactly what a fixed spacing rule cannot see.

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

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

The network has to be a feed, not a folder



Why this is the scaling argument

The 200th well costs almost nothing in analyst time.

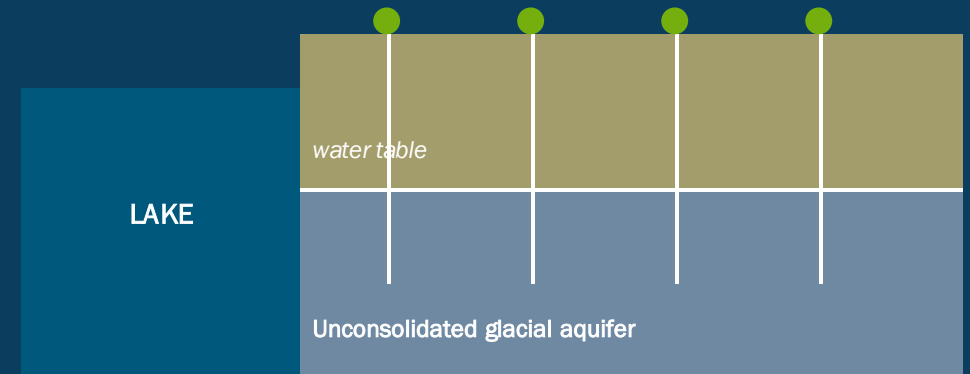
A WORKING DASHBOARD, NOT A PROPOSAL

Already running. Refreshes every three hours.

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

CONCEPTUAL NEARSHORE CROSS-SECTION



existing private wells — already drilled, currently unmeasured

→ High lake stage: lake-to-aquifer flow may occur

← Low lake stage: aquifer-to-lake flow may dominate

Schematic, not to scale.

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

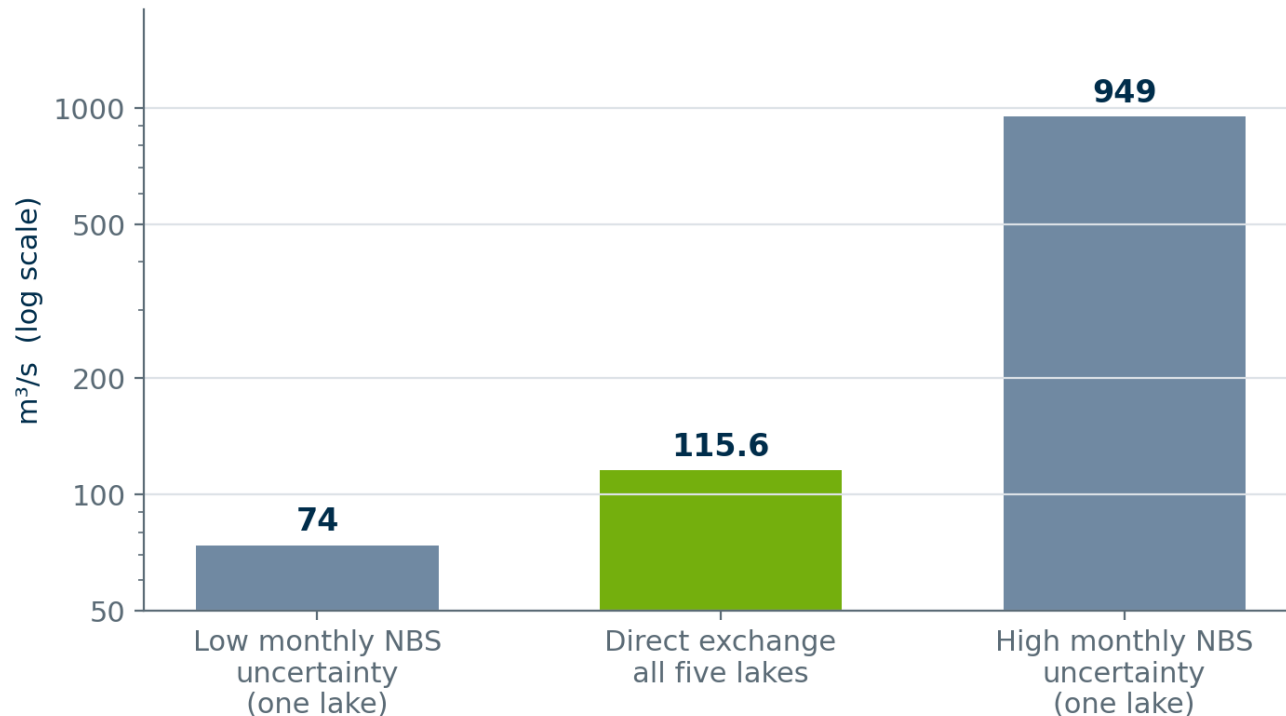
0.8% of average basin supply (Xu et al. 2021)

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.

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

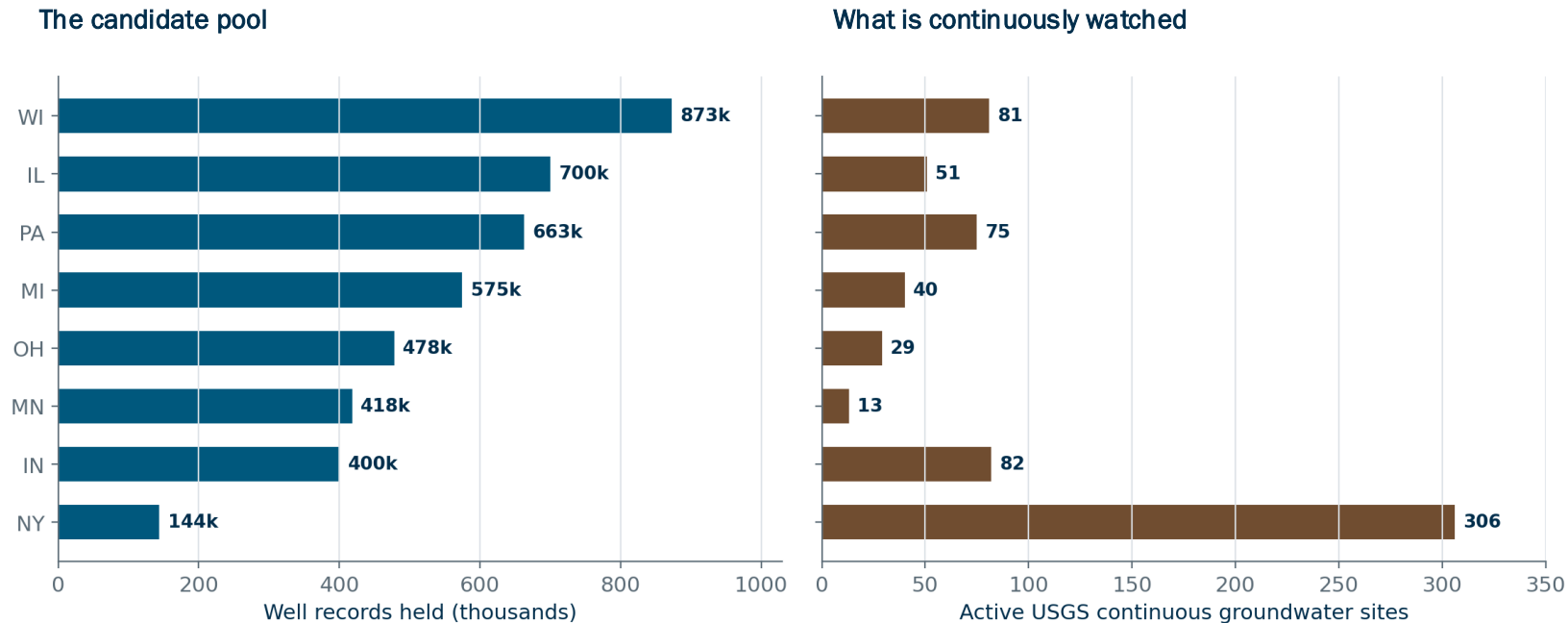
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Lakes assigned a GW status by SOLEC

Of five

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

Eight state databases already provide the candidate pool



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.

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

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.

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.

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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