Groundwater Quantity & High Capacity Wells in North Central Wisconsin

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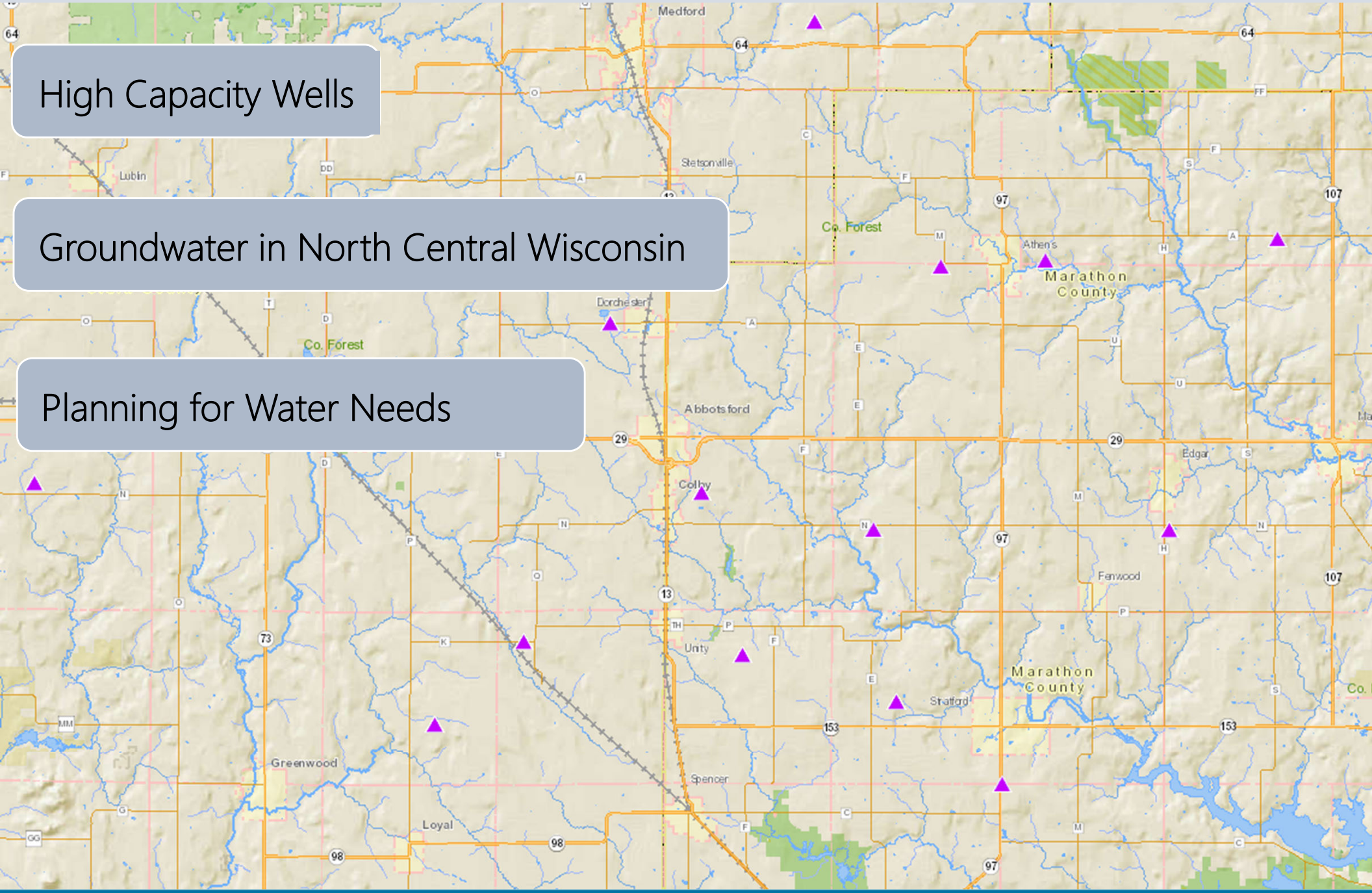
Madeline Gotkowitz
Wisconsin DNR Water Use Section
January 30, 2024

Agenda

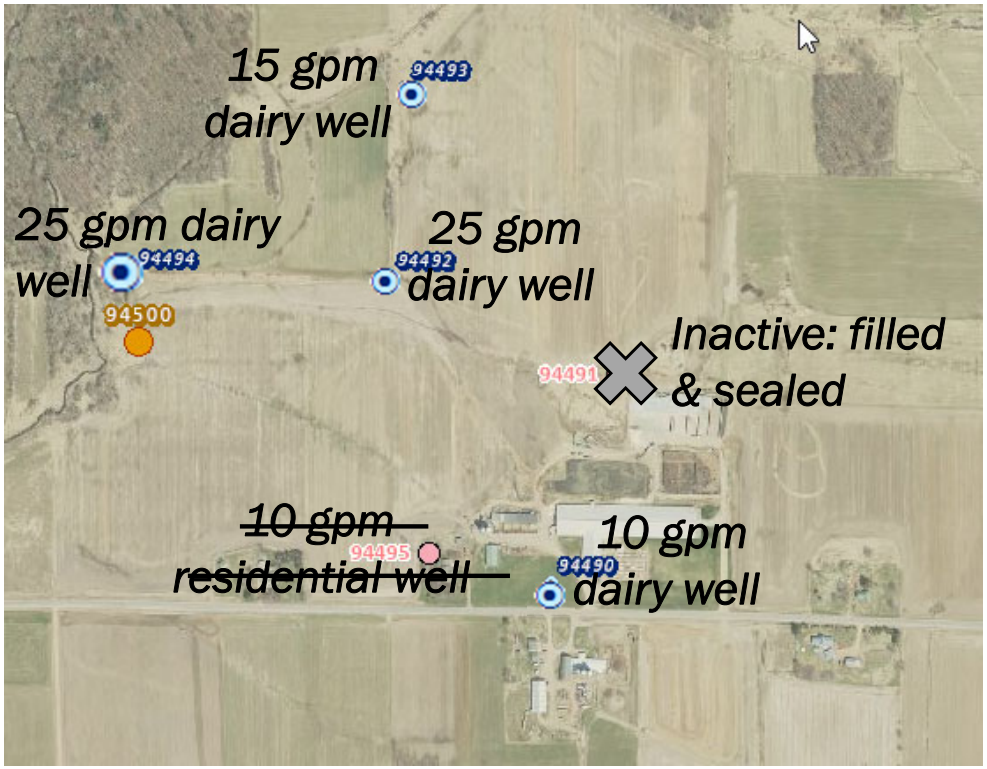
- High Capacity Wells
- Groundwater in North Central Wisconsin
- Planning for Water Needs



What is a high capacity well?

High capacity means a well, *except for a residential well or fire protection well*, that, **together with all other wells on the same property**, has a capacity of more than 100,000 gallons per day (**70 gpm**).

Wis. Stat. § 281.34(1)(b)



Systems may be plumbed together, with potable water delivered to the barn, milking parlor, and on-farm residences

High capacity well requirements

1. Obtain prior DNR approval to drill a new well or increase pump capacity of existing well. In some cases, you may also need approval to replace or reconstruct a high capacity well.

2. Register surface water and groundwater systems with pump capacity of 100,000 gallons per day (70 gpm)

3. Annual reporting of monthly water use

High capacity well review process

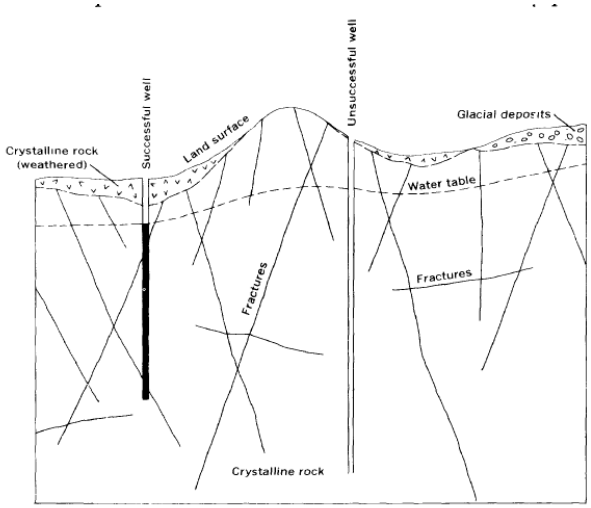
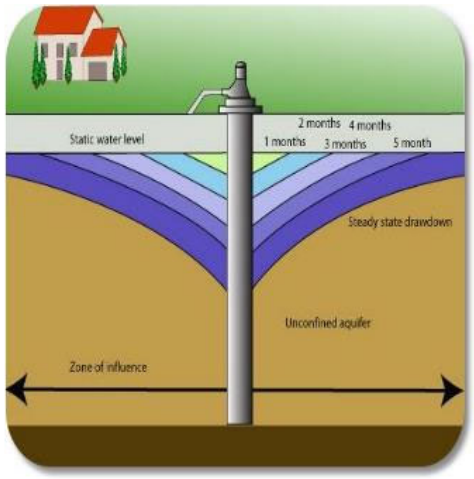


FIGURE 2.—Occurrence of ground water in crystalline rock.



Resource Inventory

- Lakes
- Springs (≥ 1 cfs)
- Streams
- Public Water Supply Wells

Conceptualization

- Geology
- Aquifer properties
- GW/SW Interaction
- Quality concerns

Quantify Impact

- Estimate potential drawdown at nearby private wells, streams etc.

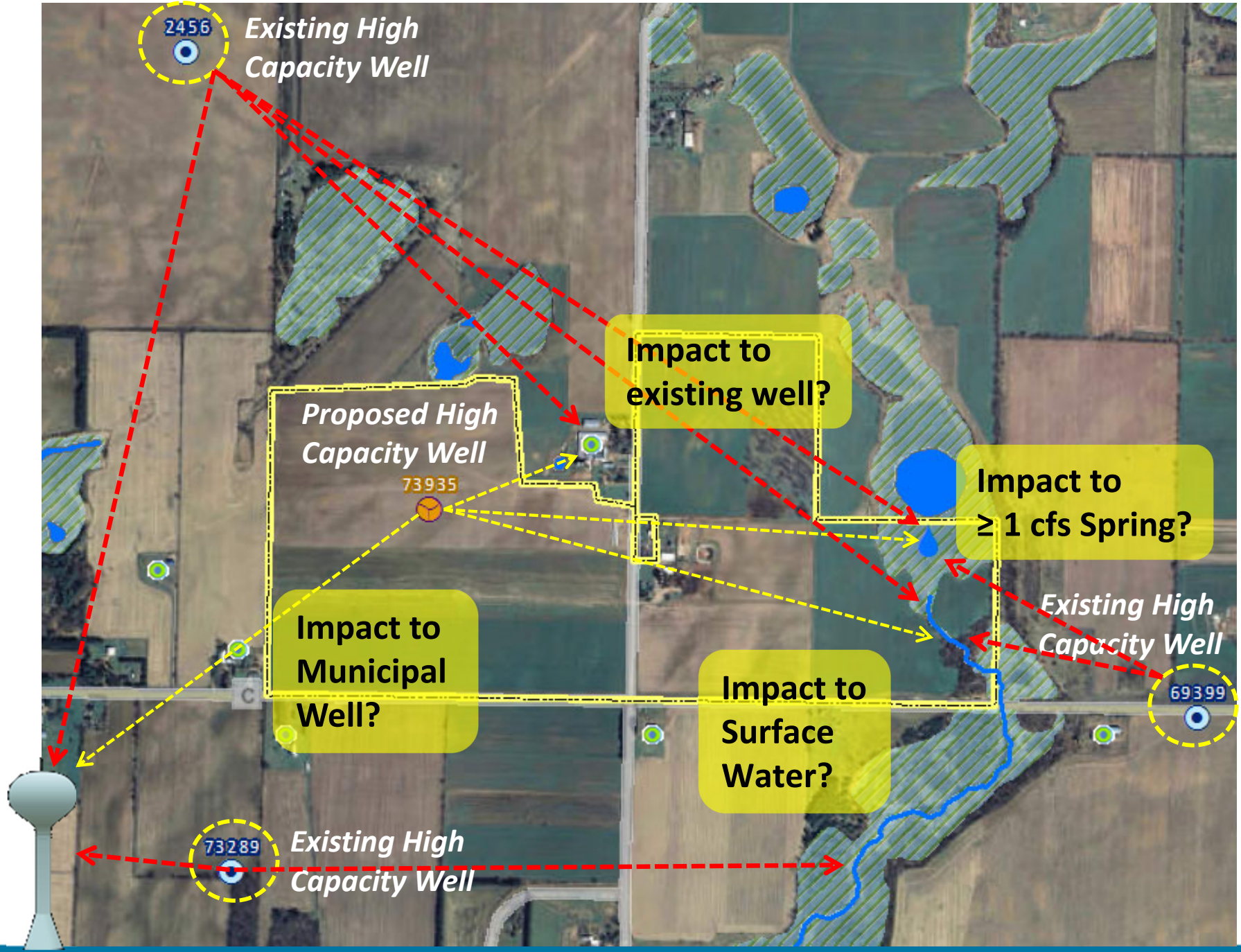
High capacity well review process

1. **Well Construction:** Does the proposed well meet current code requirements?

2. **Water Quality:** Does the construction of the proposed well degrade safe drinking water, degrade the groundwater resource, or impact public safety?

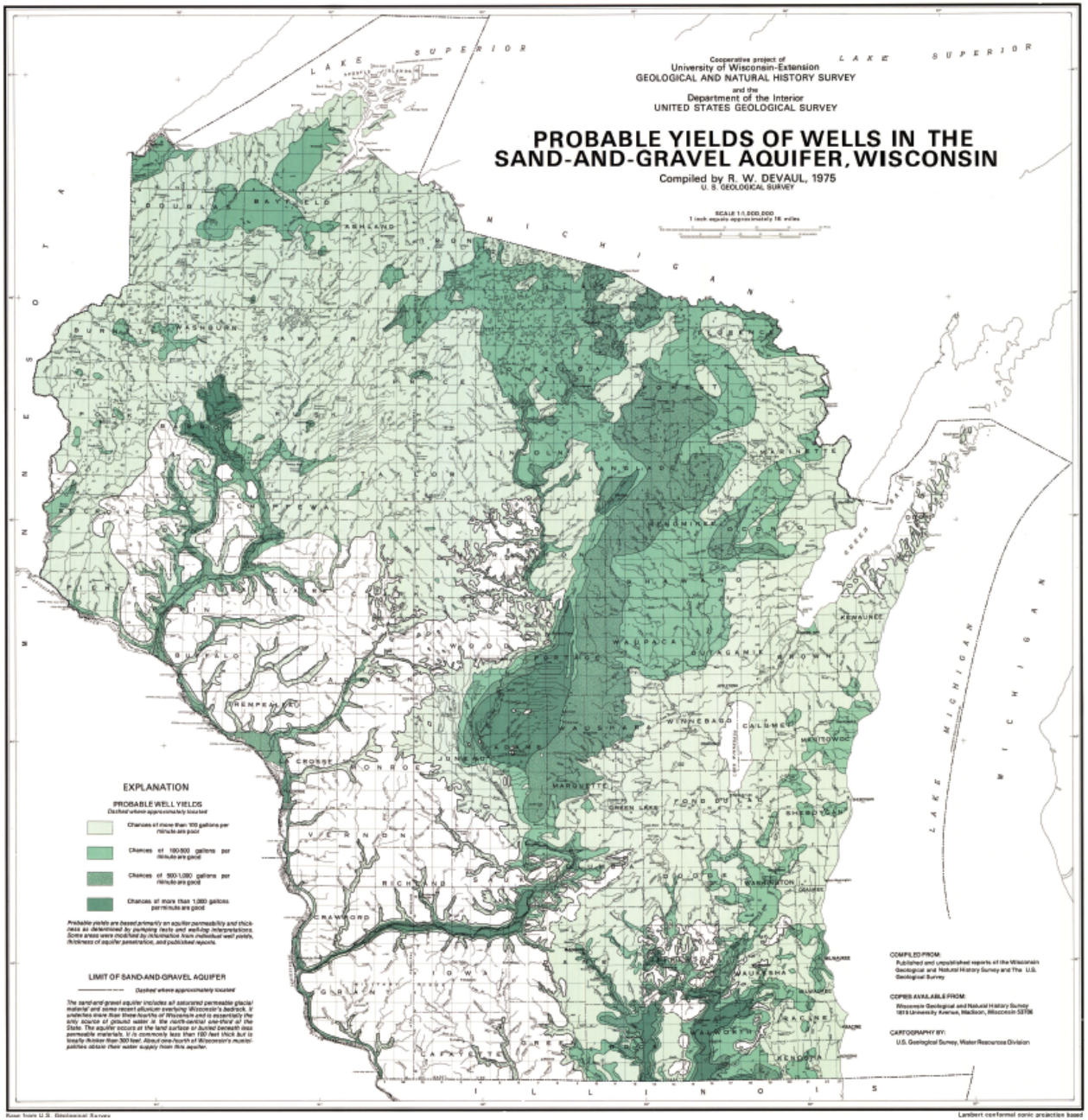
3. **Water Quantity:**
   - Is the proposed well in a groundwater protection area or near a >1 cfs spring?
   - Does the proposed well result in >95% water loss?
   - Does the proposed well, when combined with existing wells, result in potential harm to surface water resources?
   - Does the proposed high capacity well, when combined with existing wells, impair a public water system or neighboring residential wells?

Wisconsin's high capacity well review process



Wisconsin's hydrogeology

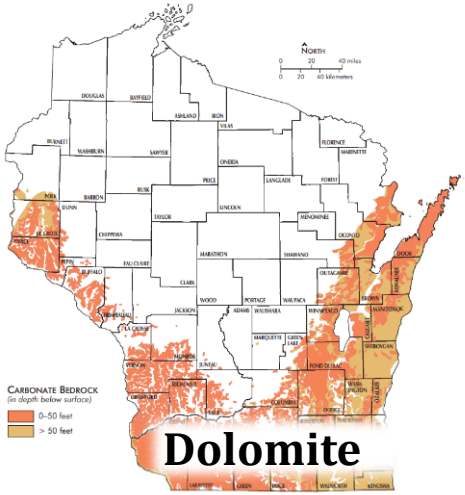
Well yields of the
sand & gravel aquifer…



GRMD1

Wisconsin's hydrogeology

Underneath the sand, gravel and clay…



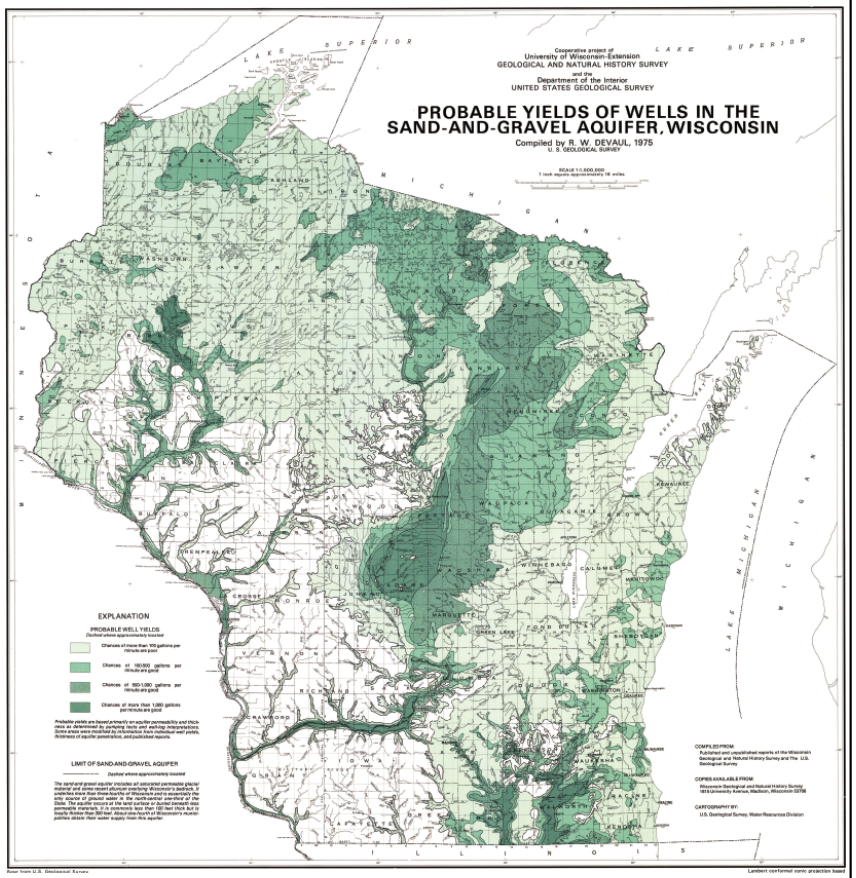
Slide 9

GRMD0 Switched out the quartzite photo for granite
Greve, Rachel M - DNR, 2024-01-22T16:41:31.875

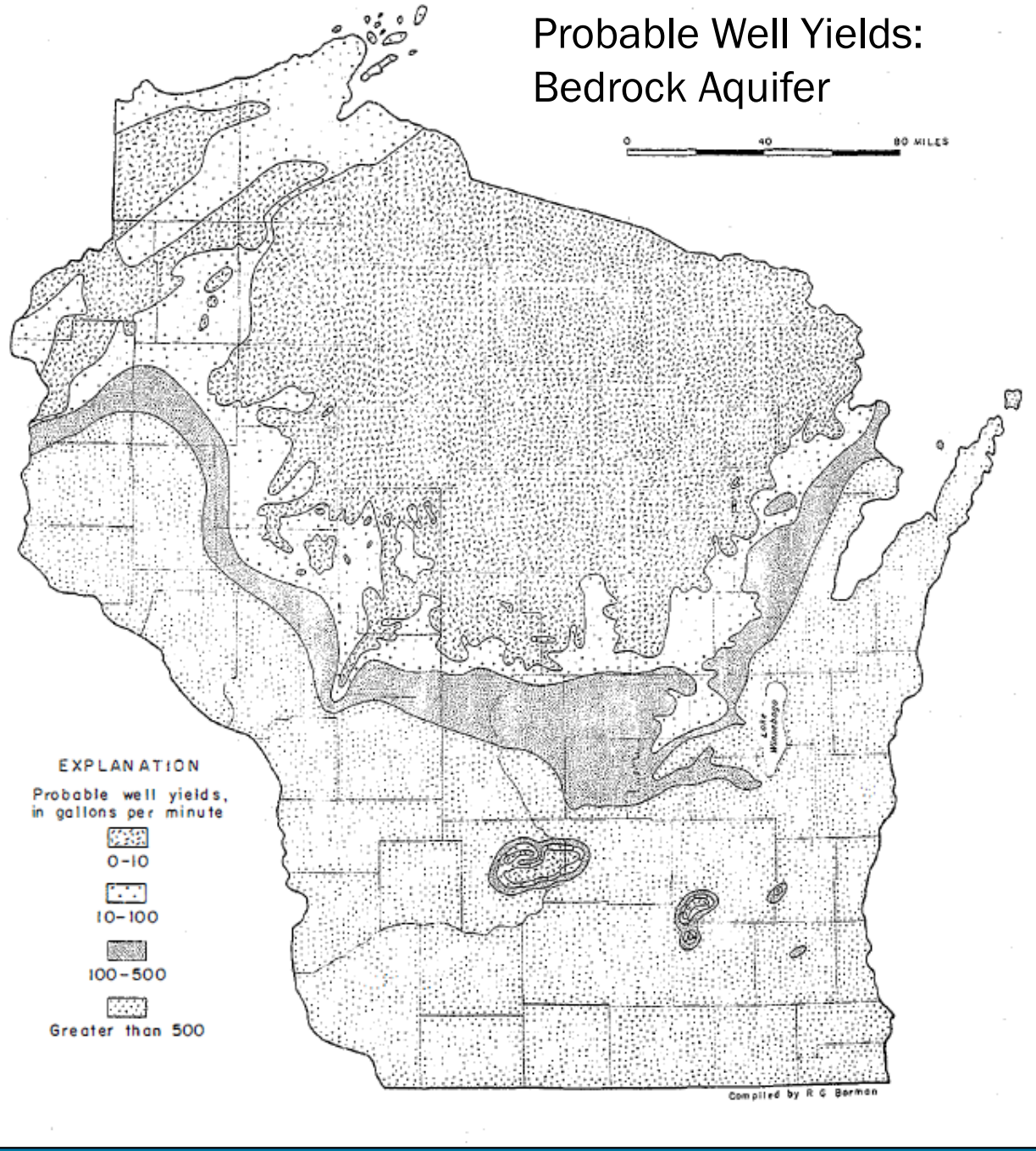
GRMD1 Switched figure to show the whole karst area i.o. just the Silurian
Greve, Rachel M - DNR, 2024-01-22T16:42:23.427

Wisconsin's hydrogeology

Water availability…

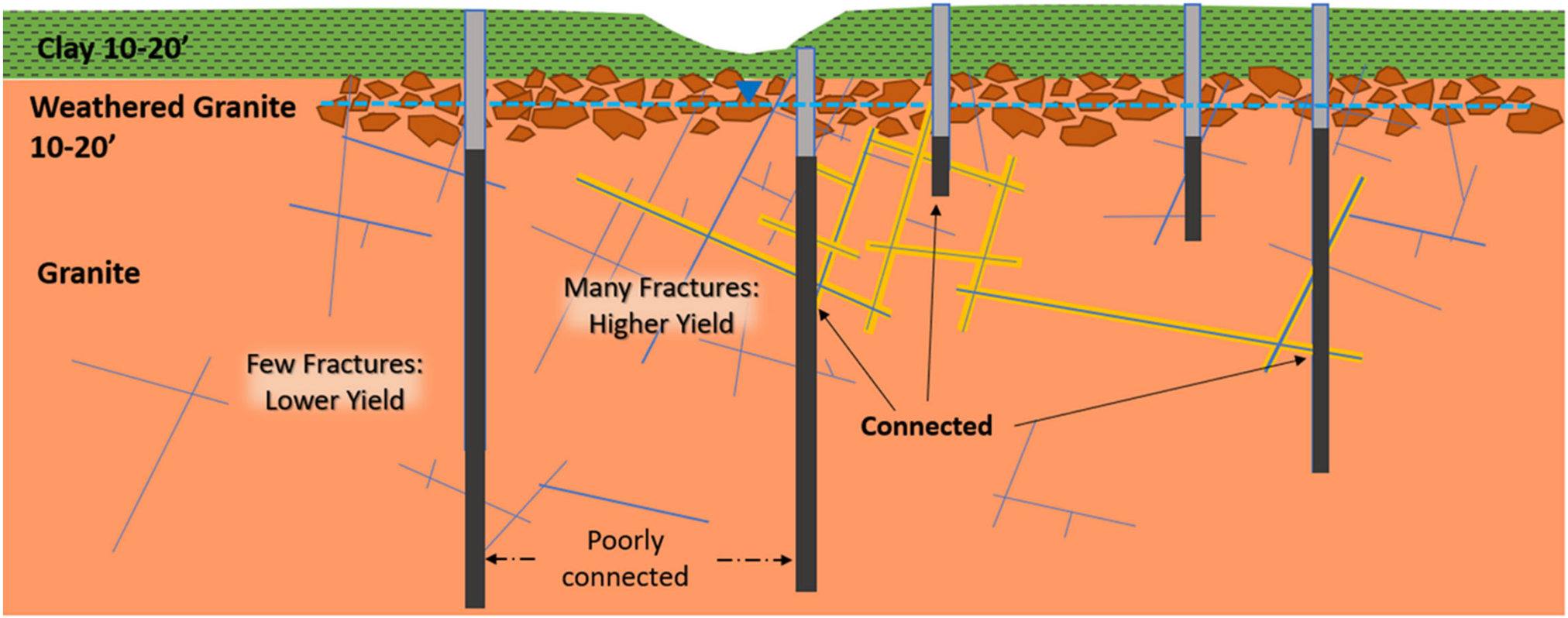


Probable Well Yields:
Bedrock Aquifer



Wisconsin's hydrogeology

Wells in fractured bedrock: challenges

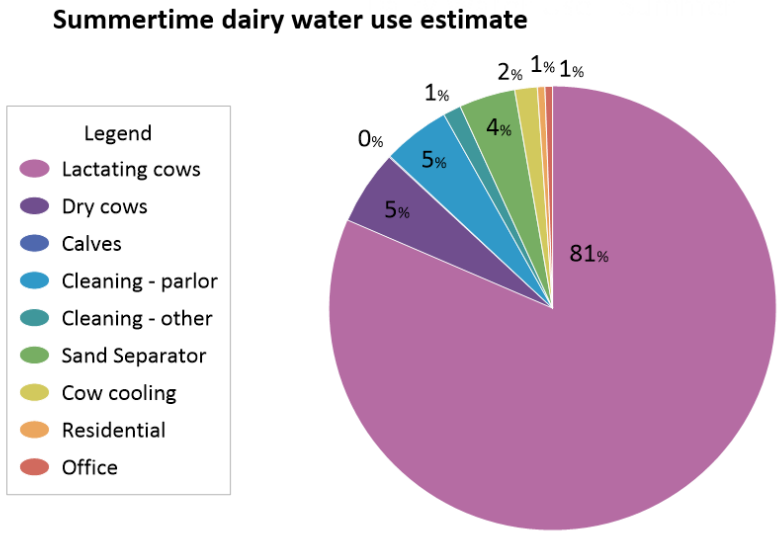


- Low well yields that often require multiple wells to meet dairy needs
- Fractures often connect wells, leading to "interference" and drawdown
- Some farms and villages may have sufficient sand and gravel overlying the fractured granite

Planning for current & future water needs

Consider water needs early in the expansion process

- Will current water supplies meet future demand?
- Is this a high capacity property? (total capacity >70 gpm?)
- Is this a low water-availability area?

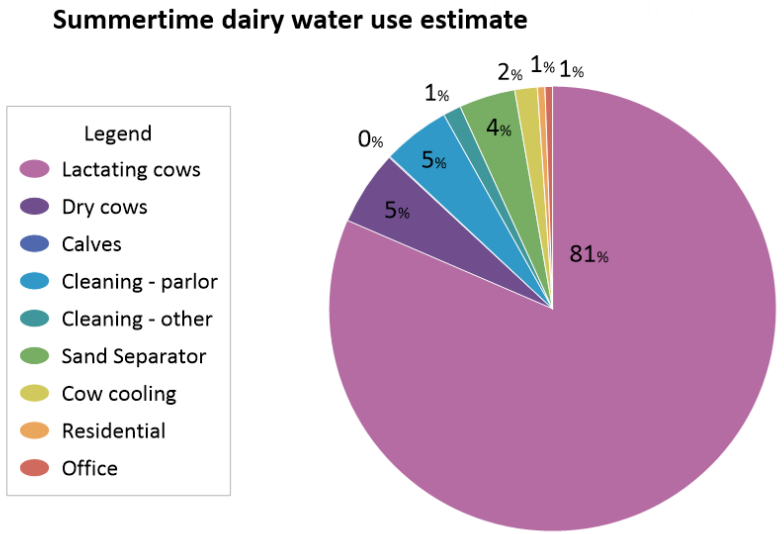


Planning for current & future water needs

1. How much water is currently used?
   - Measure (meters may be required by the high capacity well approval)
   - Estimate based on (herd size, cleaning, sprinkling, etc.)
   - Inventory existing wells – location, construction, capacity

2. Develop a water budget
   - Estimate future need

3. Apply for a new well or larger pump capacity



Questions?

CONNECT WITH US

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Madeline Gotkowitz.
Madeline.Gotkowitz@wisconsin.gov
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Water Use Line
(General Questions, Reporting)
608 266-2299

/WIDNR

@WIDNR

@WI_DNR

/WIDNRTV

"WILD WISCONSIN:
OFF THE RECORD"

Extra slides

2017 Wisconsin Act 10

Changes to existing high capacity wells

Action to Existing High Capacity Well	Statutory Requirements
Replacement	1. Fill and seal existing well 2. Meet one of the following • The replacement well's purpose is to prevent contamination; or • The replacement well is constructed to substantially the same depth as the existing well and either within a 75-foot radius of the existing well or farther away from the nearest groundwater protection area than the existing well. 3. Adhere to all other conditions of existing high capacity well approval 4. DNR must be notified within 90 days
Reconstruction	1. Maintain same depth and specifications of existing well 2. Adhere to all conditions of existing high capacity well approval 3. DNR must be notified within 90 days
Transfer	1. Adhere to all conditions of existing high capacity well approval 2. DNR must be notified within 90 days

The Wisconsin High Capacity Well Application Process

Denied

Approved with Modifications

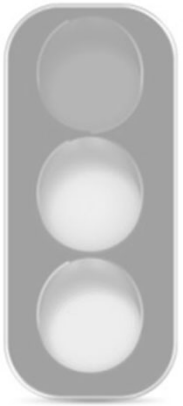
Approved

High Capacity Well Application Submitted to DNR

DNR conducts review of high capacity well application

DNR determines outcome of high capacity well application

The Wisconsin High Capacity Well Application Process



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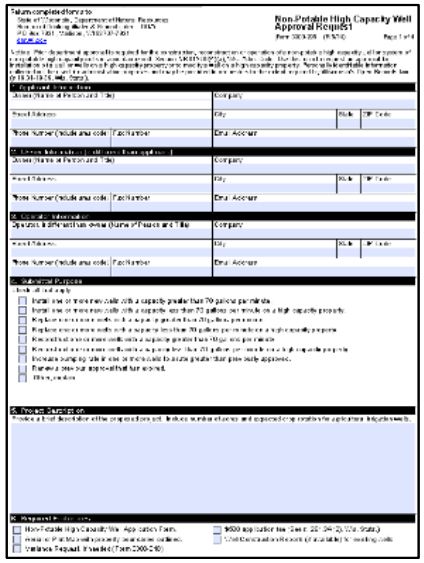
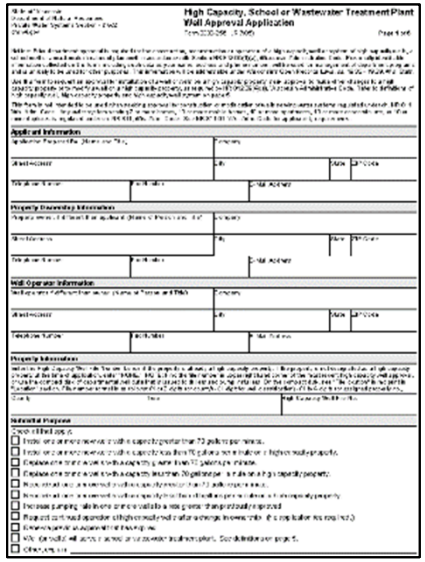
Submitting the Application

Prior department approval is necessary for the construction or operation of a high capacity well system*

* Prior department approval may not be needed for the repair, reconstruction, replacement or transfer of existing high capacity wells if certain criteria are met



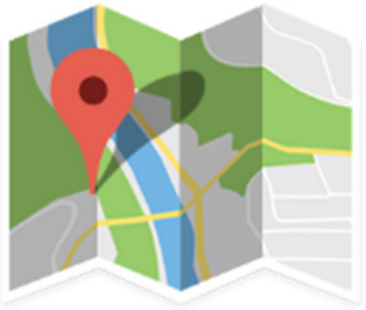
Non-Potable High Cap Well Application
WDNR Form 3300-295
4 page application
Submit application and $500 fee



Potable High Cap Well Application
WDNR Form 3300-256
6 page application
Submit application and $500 fee

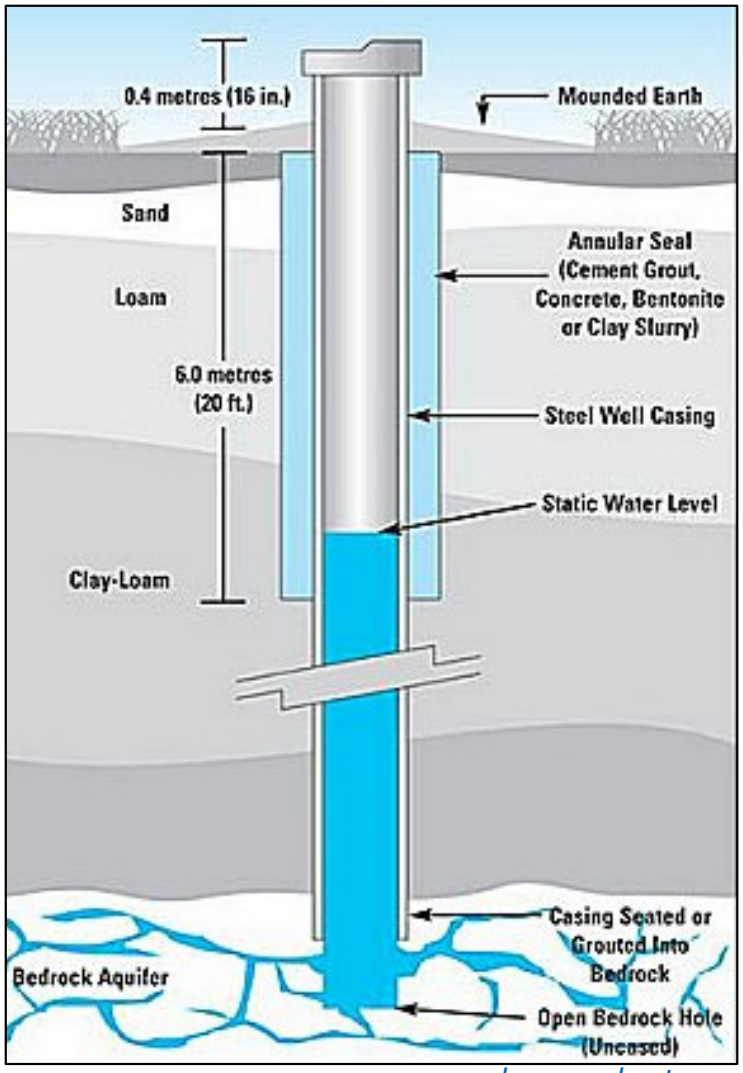
Instructions to complete the high capacity application can be found @ https://dnr.wisconsin.gov/topic/Wells/HighCap/Apply.html

Submitting the Application



Location

Water Use Type, Frequency, & Volume



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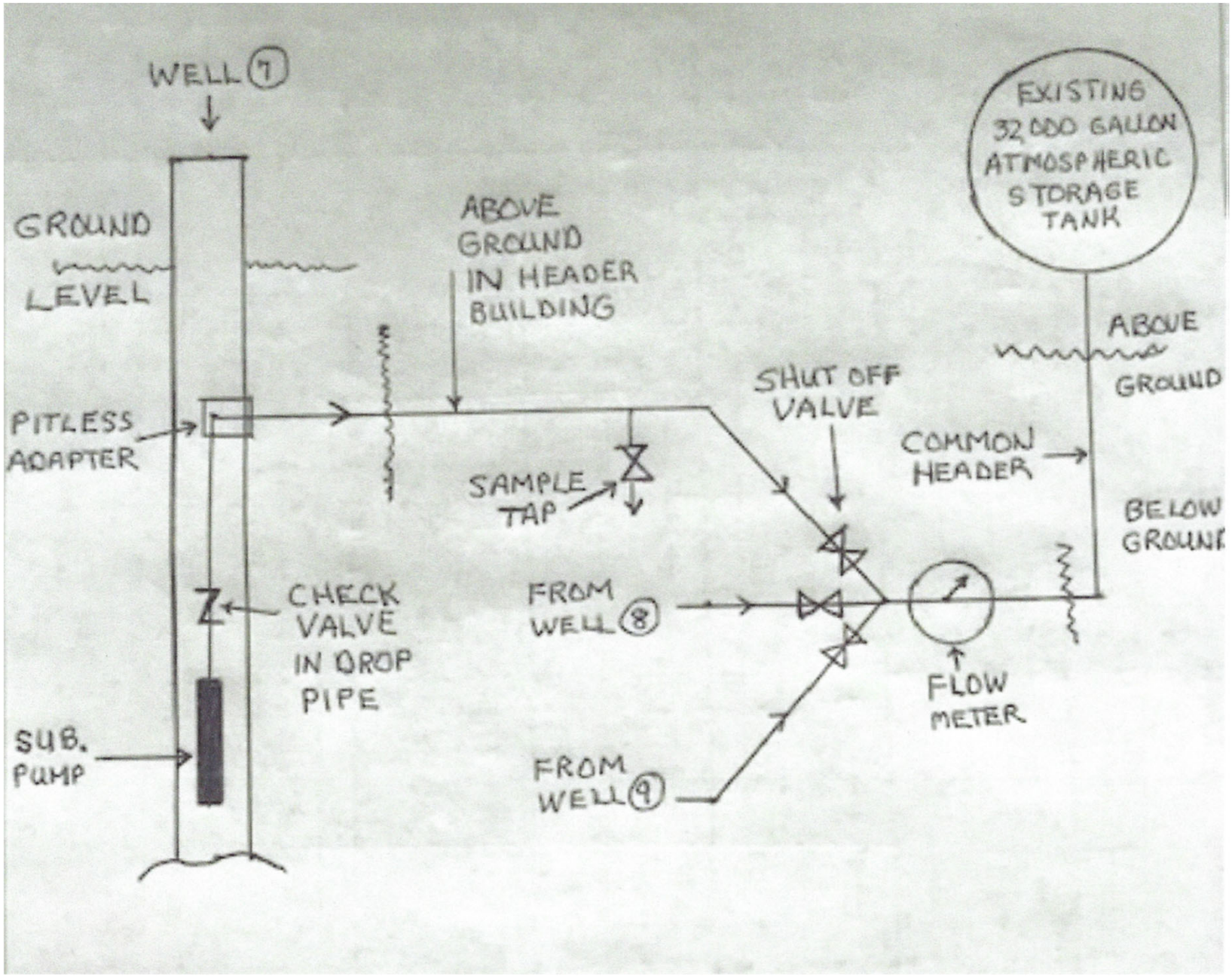
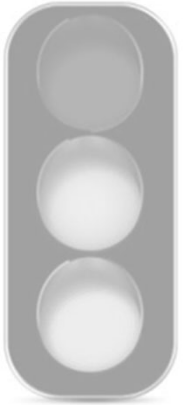
Well Construction

Submitting the Application



The Wisconsin High Capacity Well Application Process



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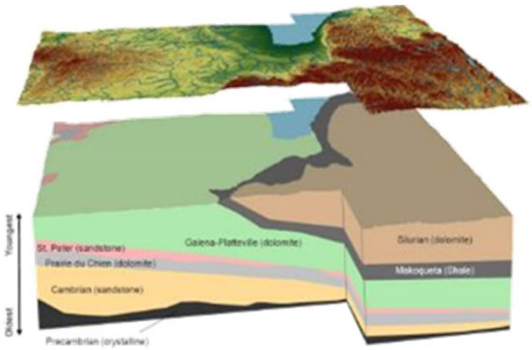
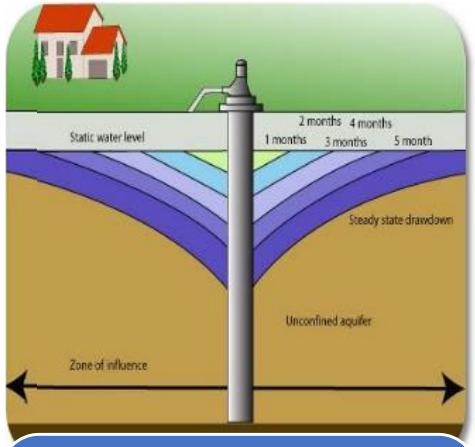
High Capacity Well Review Process





Resource Inventory
- Lakes
- Springs (≥ 1 cfs)
- Streams
- Public Water Supply Wells

Conceptualization
- Geology
- Aquifer properties
- GW/SW Interaction
- WQ concerns

Quantify Impact
- Analytic Methods
- Numeric Methods

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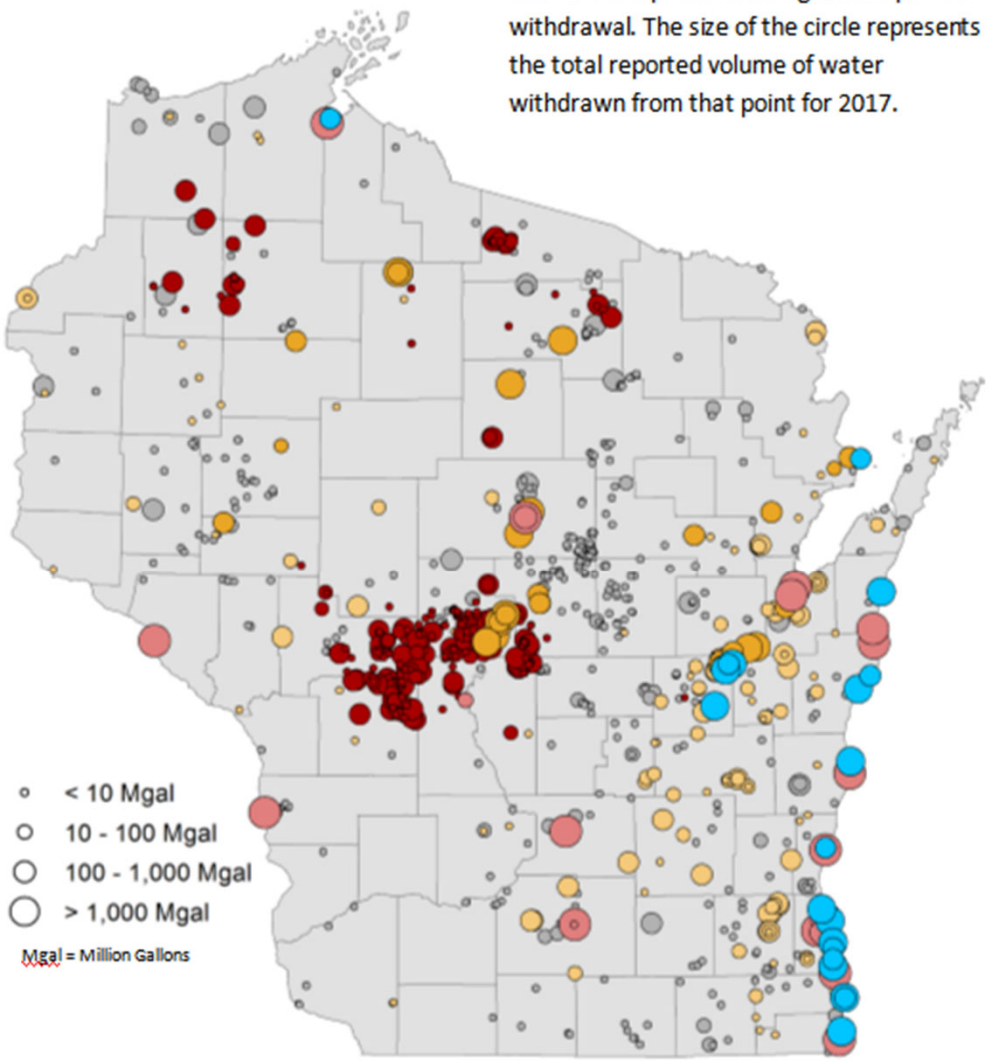
WI DNR determines outcome of high capacity well application

Wisconsin's Water Withdrawals

2017 Surface Water Annual Withdrawals

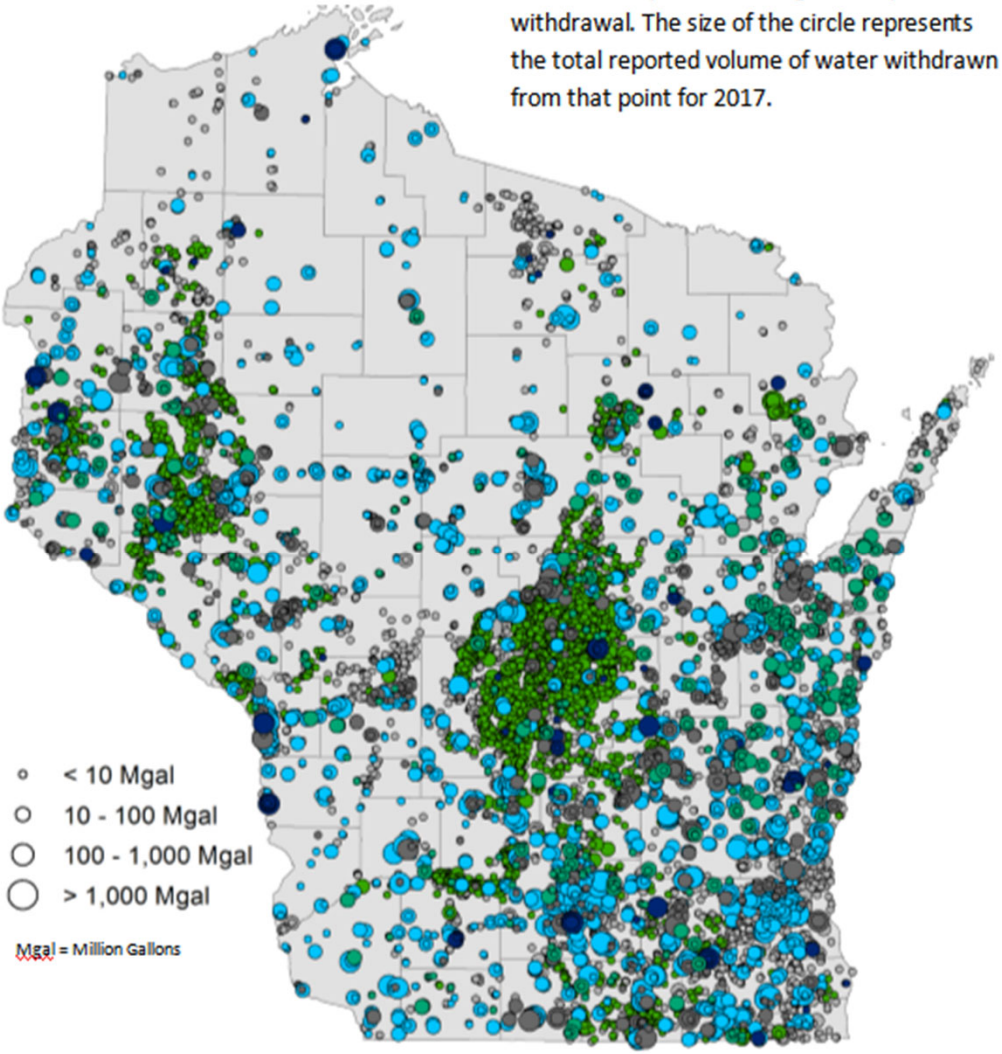
Each circle represents a single 2017 point of withdrawal. The size of the circle represents the total reported volume of water withdrawn from that point for 2017.



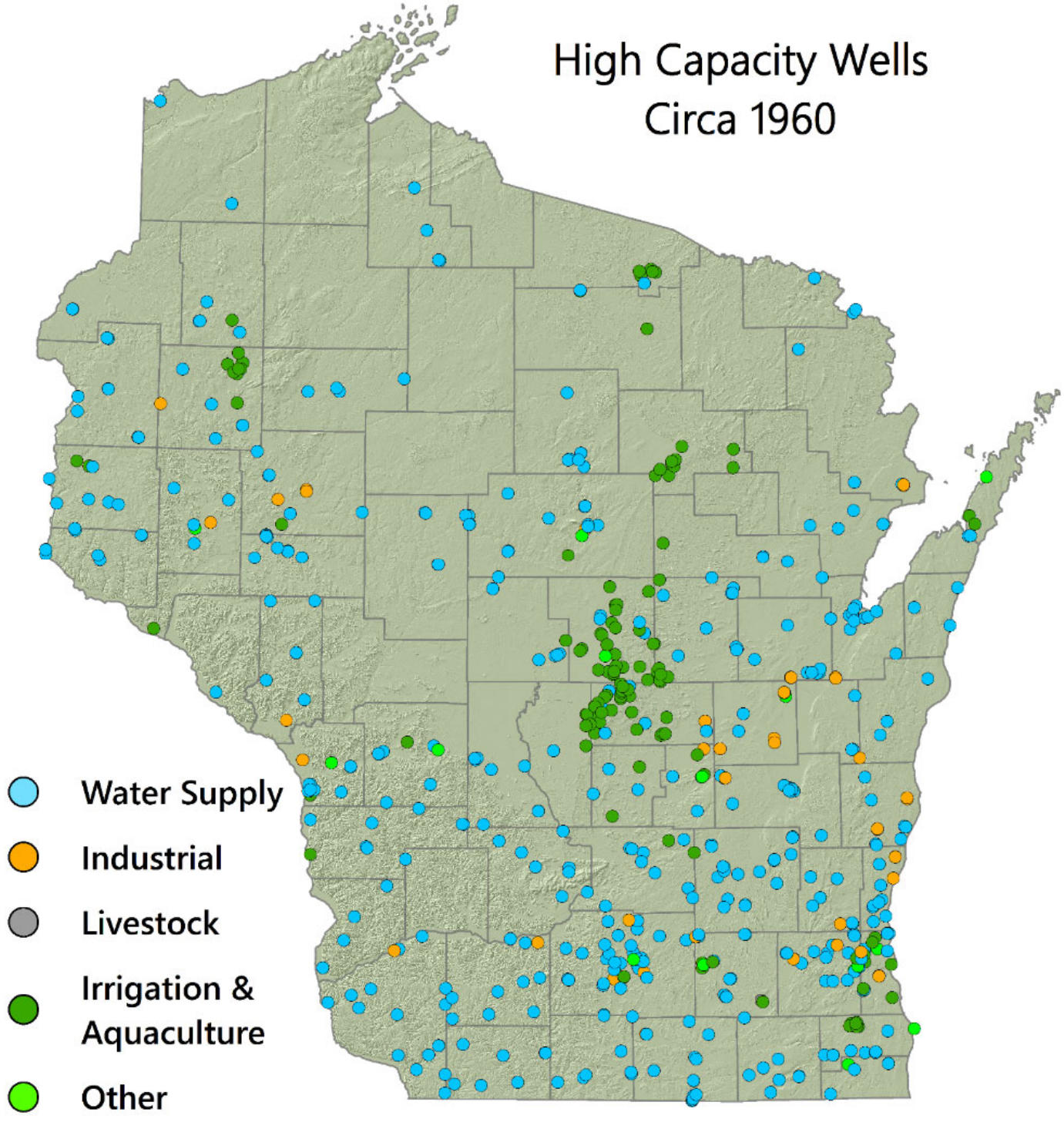
Power Generation
Municipal Water Supply
Mining
Paper Production
Cranberry Production
All Other Uses

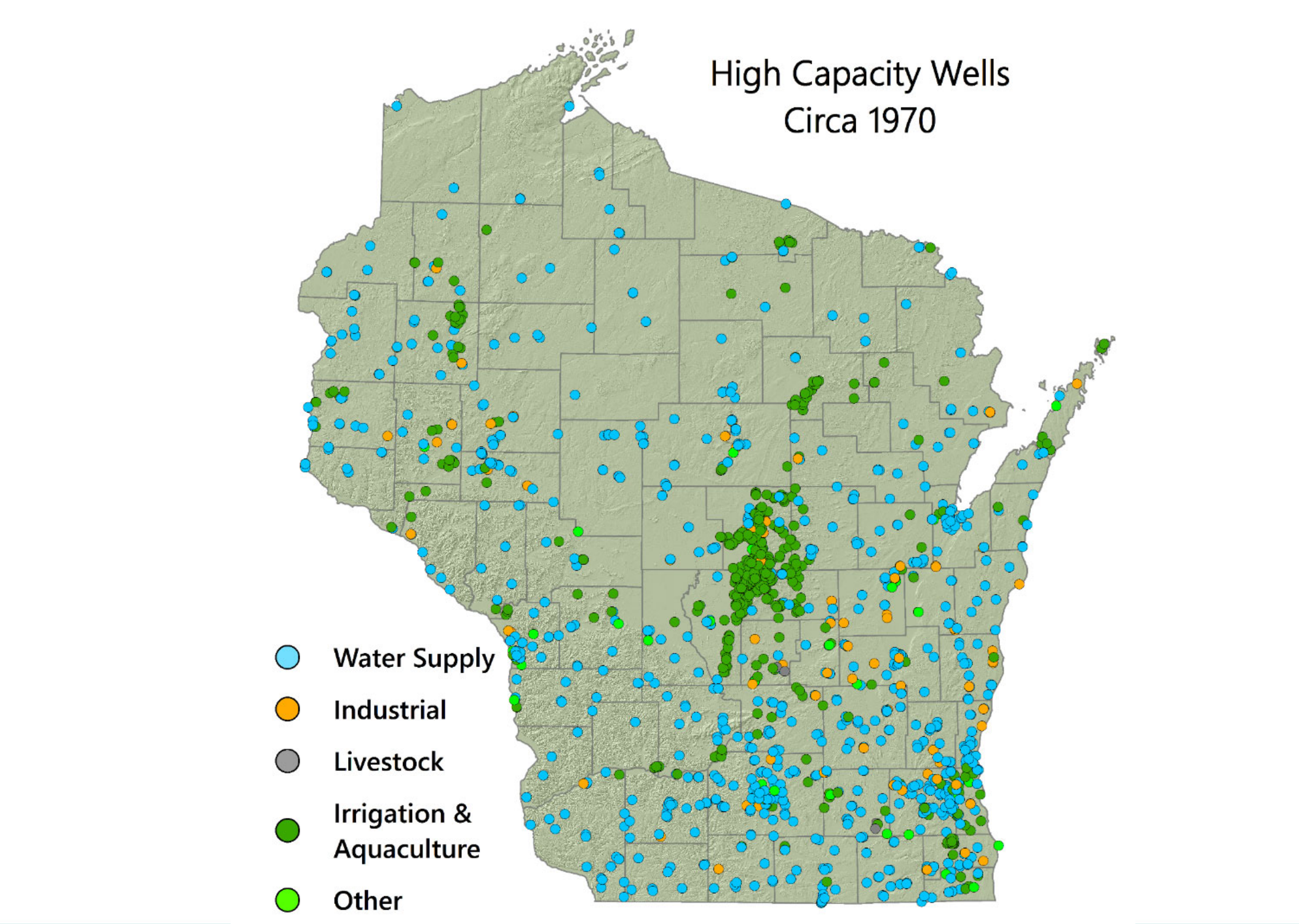
2017 Groundwater Annual Withdrawals

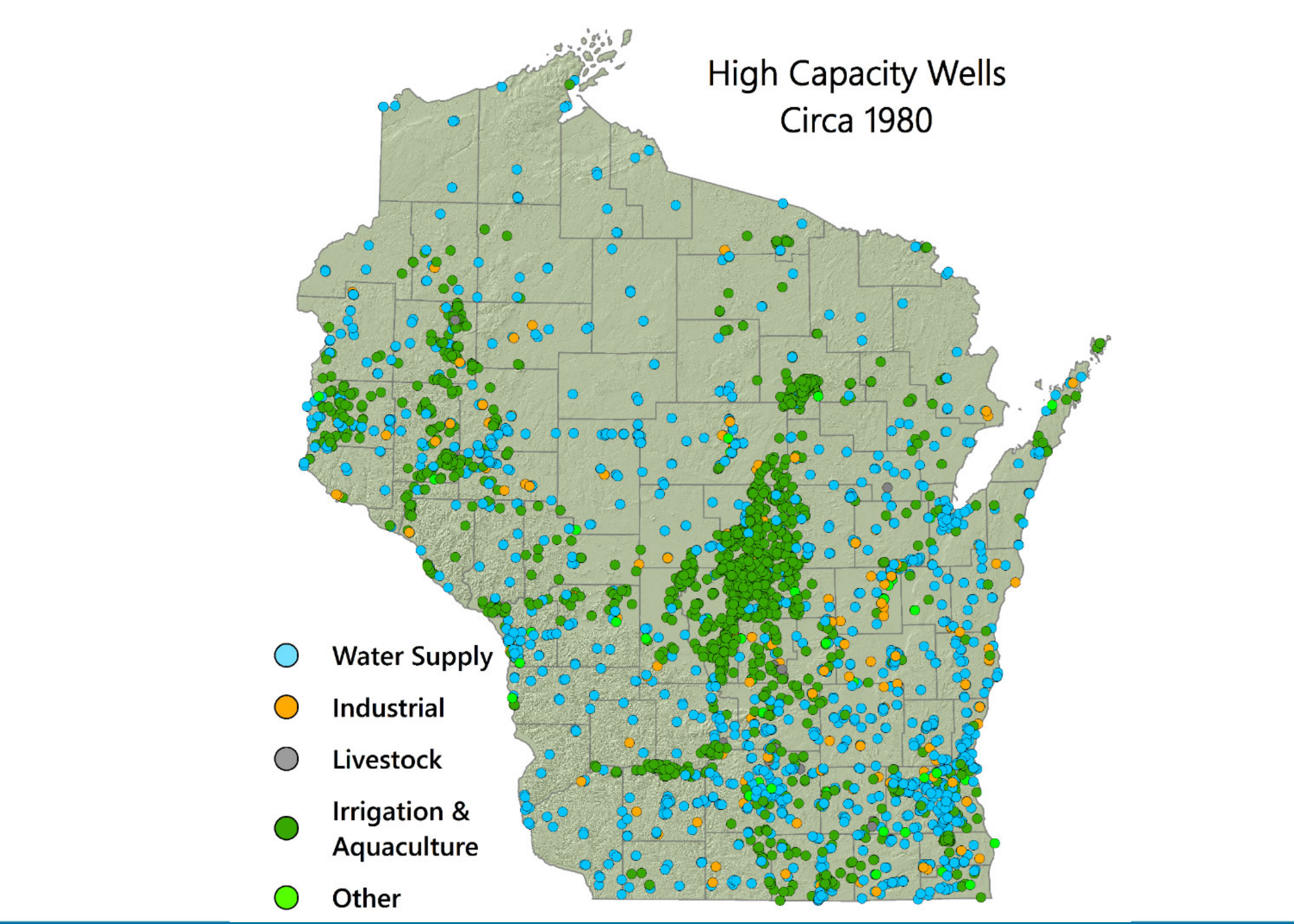
Each circle represents a single 2017 point of withdrawal. The size of the circle represents the total reported volume of water withdrawn from that point for 2017.

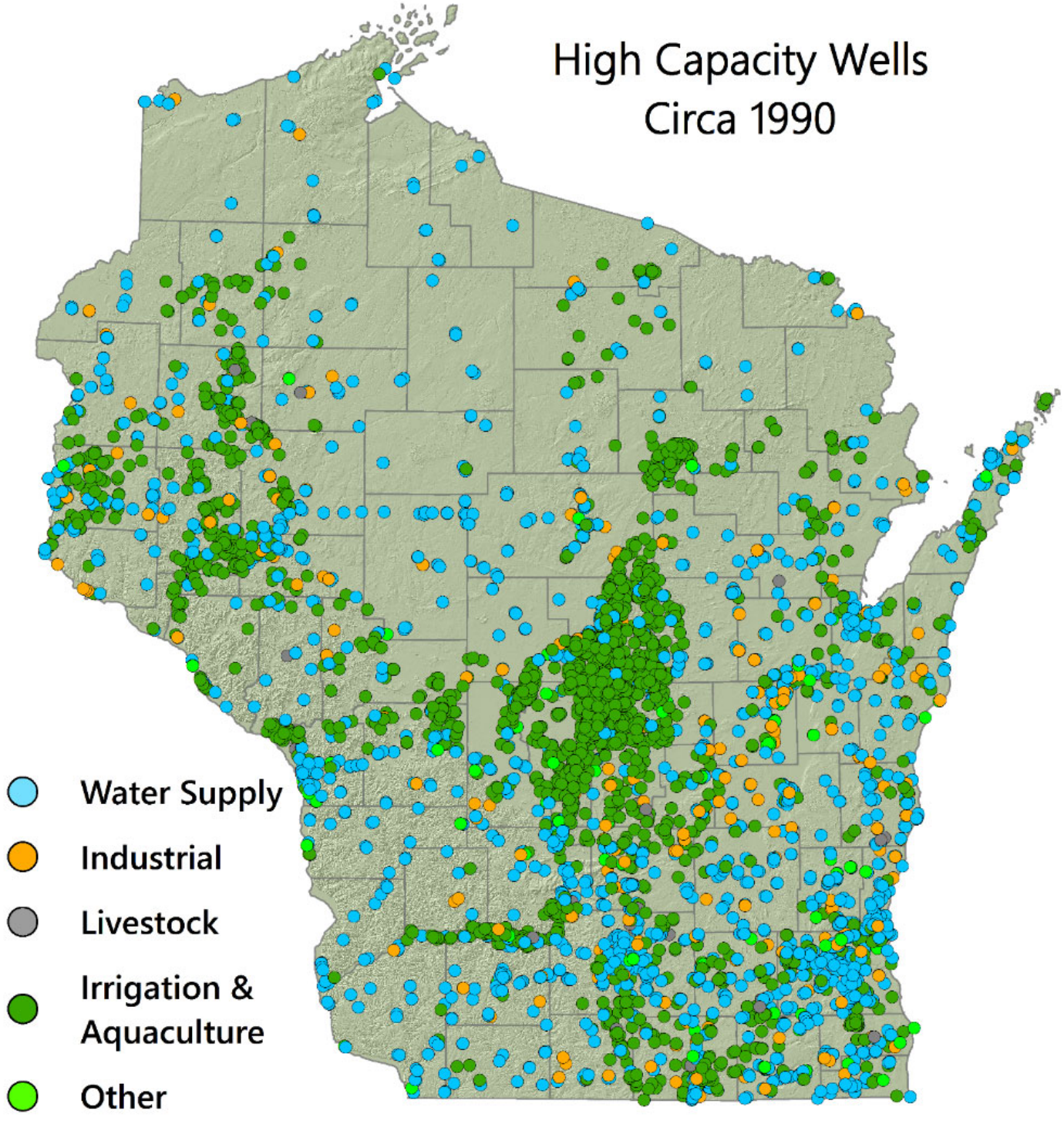


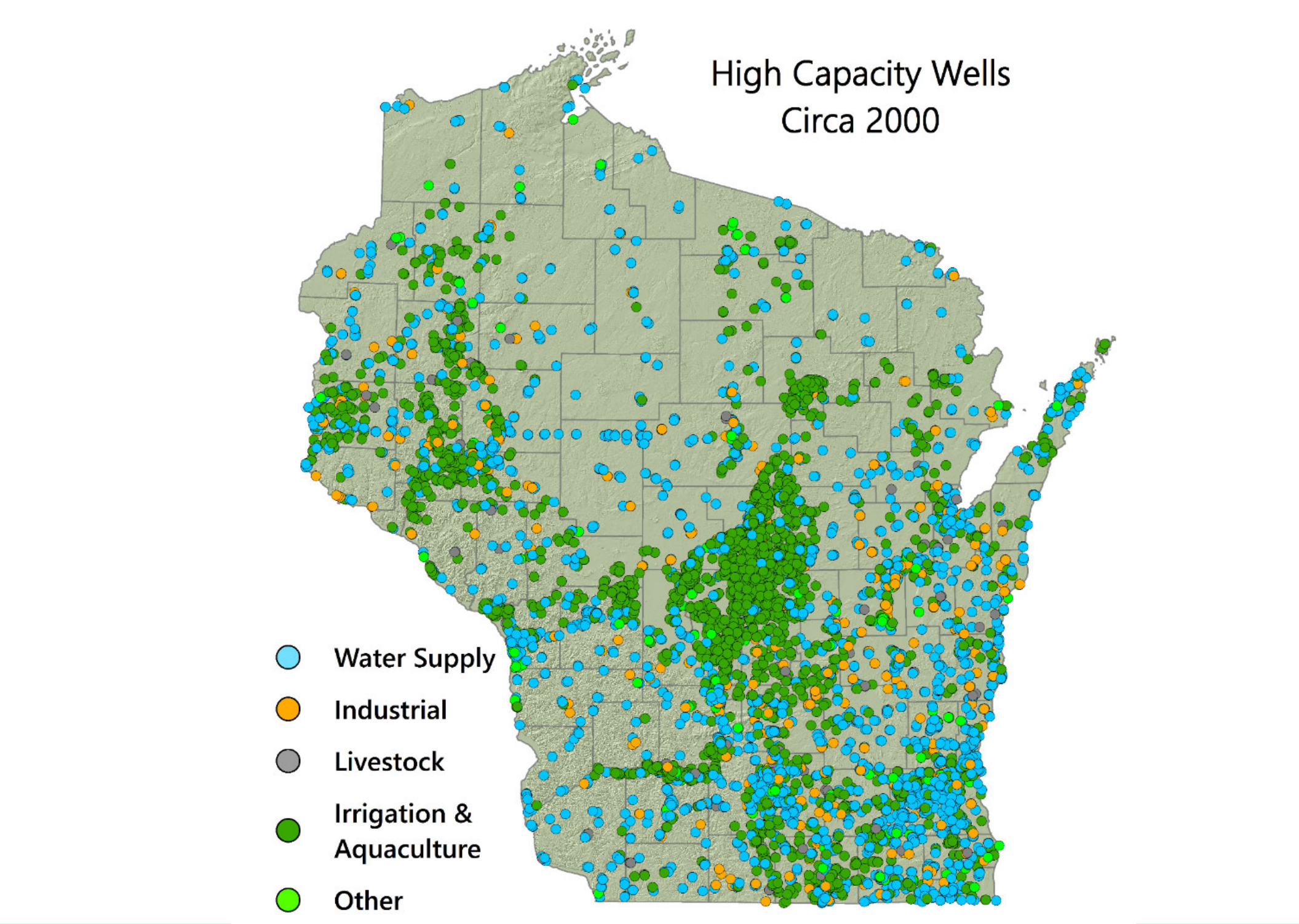
Municipal Water Supply
Industrial (incl. mining)
Dairy Production
Agricultural Irrigation
Aquaculture
All other uses

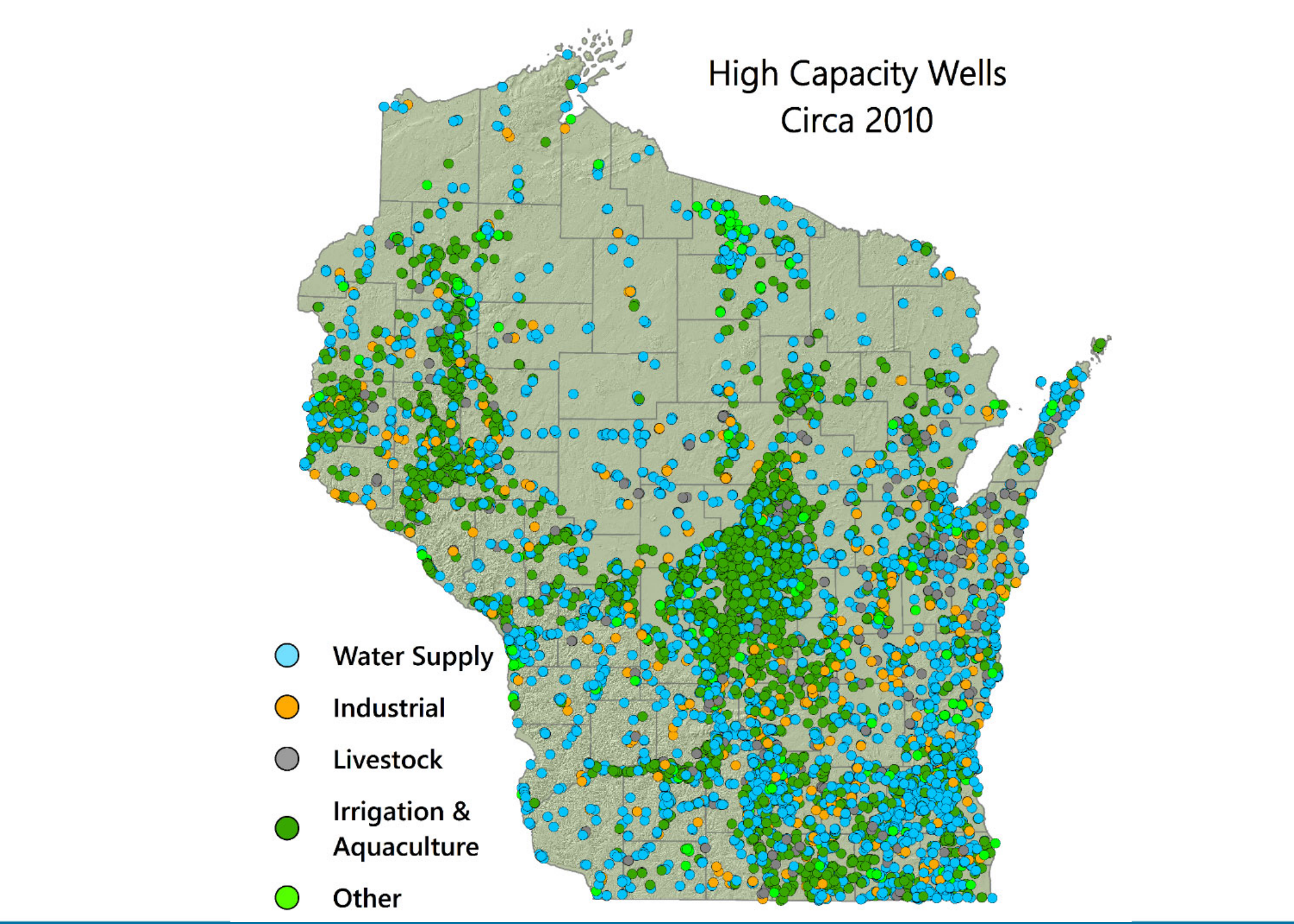

High Capacity Wells
Circa 1960
Water Supply
Industrial
Livestock
Irrigation &
Aquaculture
Other

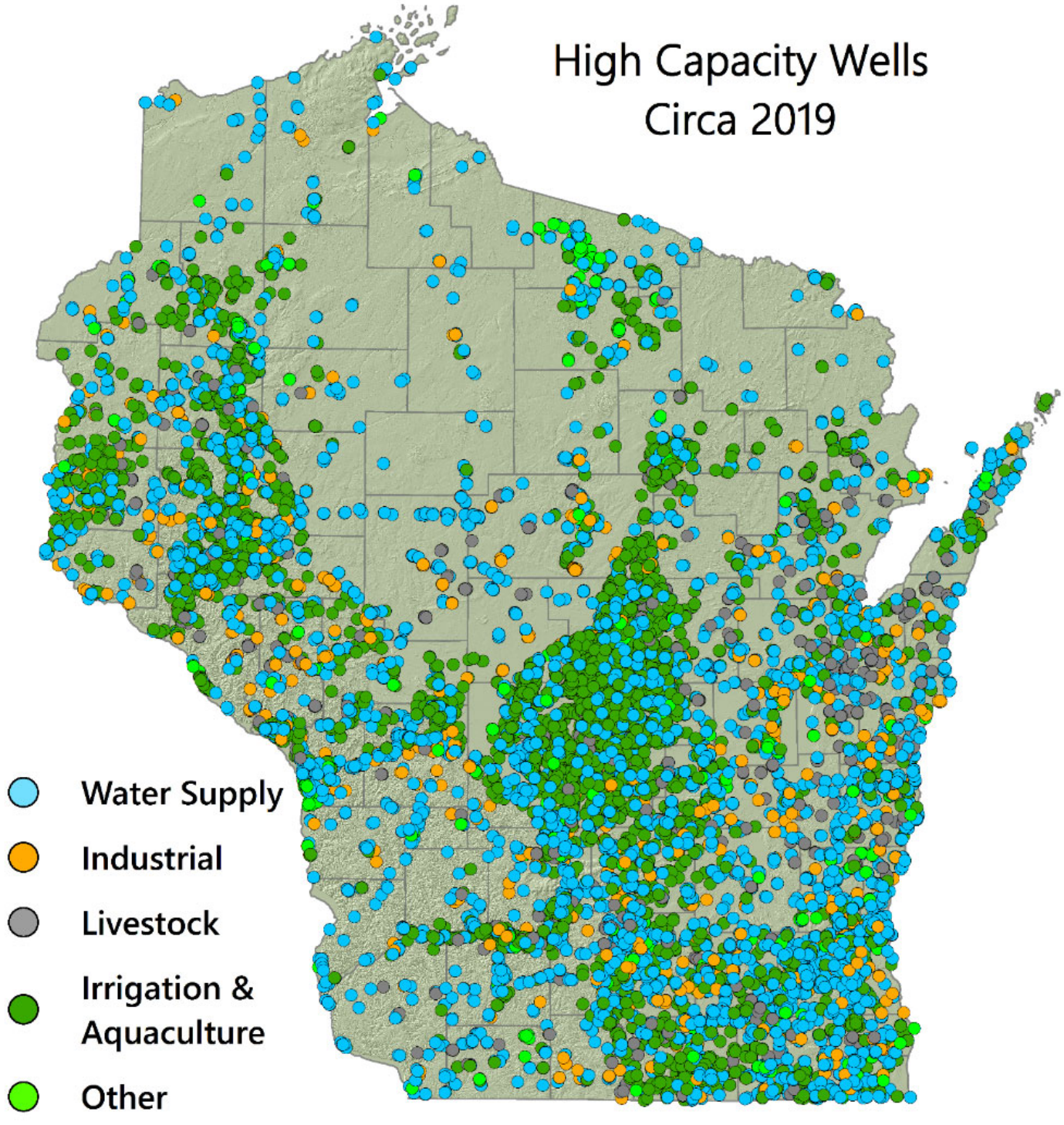

High Capacity Wells
Circa 1970
Water Supply
Industrial
Livestock
Irrigation &
Aquaculture
Other


High Capacity Wells
Circa 1980
Water Supply
Industrial
Livestock
Irrigation &
Aquaculture
Other

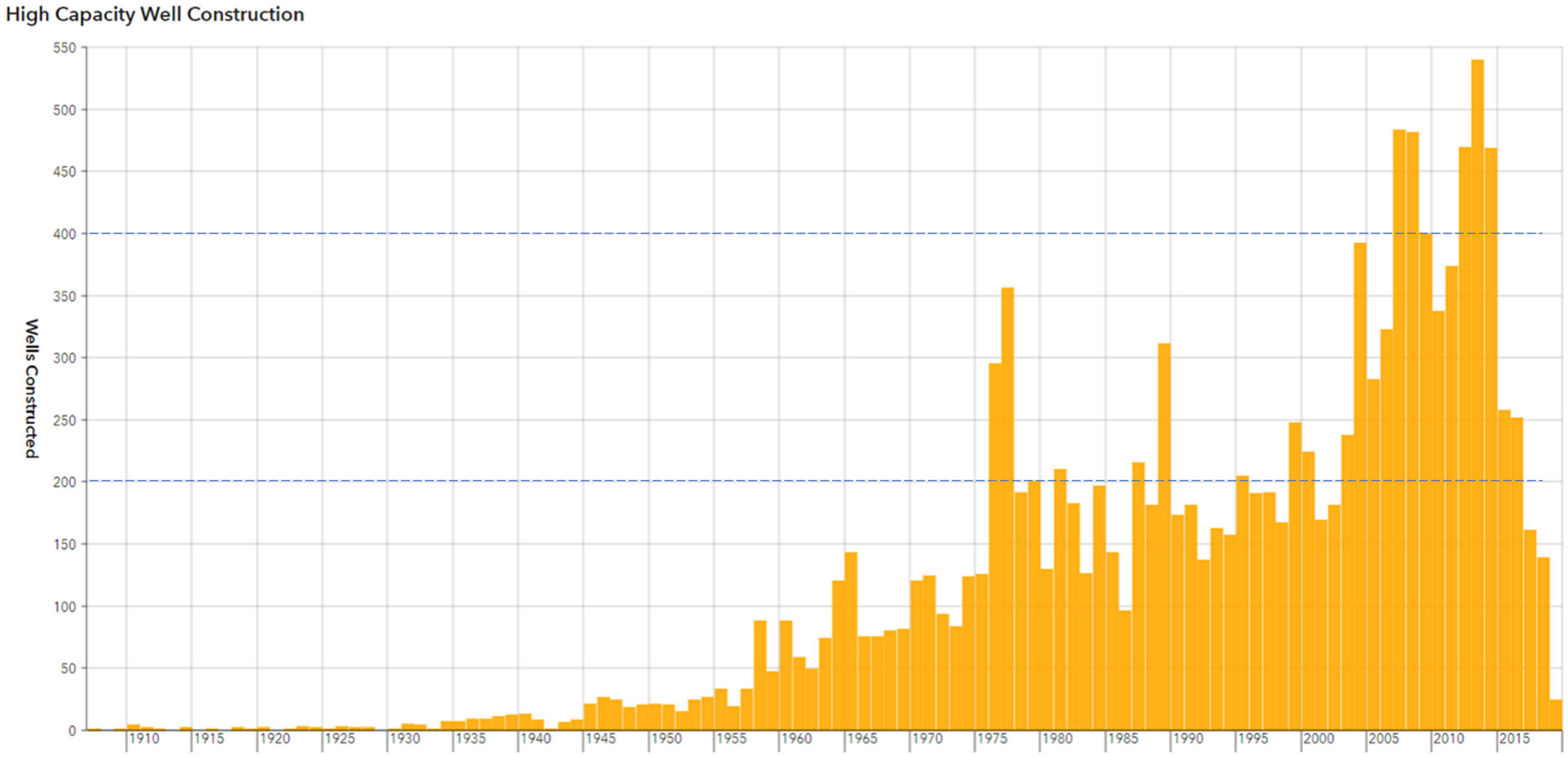

High Capacity Wells
Circa 1990
Water Supply
Industrial
Livestock
Irrigation &
Aquaculture
Other


High Capacity Wells
Circa 2000
Water Supply
Industrial
Livestock
Irrigation &
Aquaculture
Other


High Capacity Wells
Circa 2010
Water Supply
Industrial
Livestock
Irrigation &
Aquaculture
Other


High Capacity Wells
Circa 2019
Water Supply
Industrial
Livestock
Irrigation &
Aquaculture
Other

High Capacity Well Construction Per Year



High Capacity Well Review: Resource Inventory

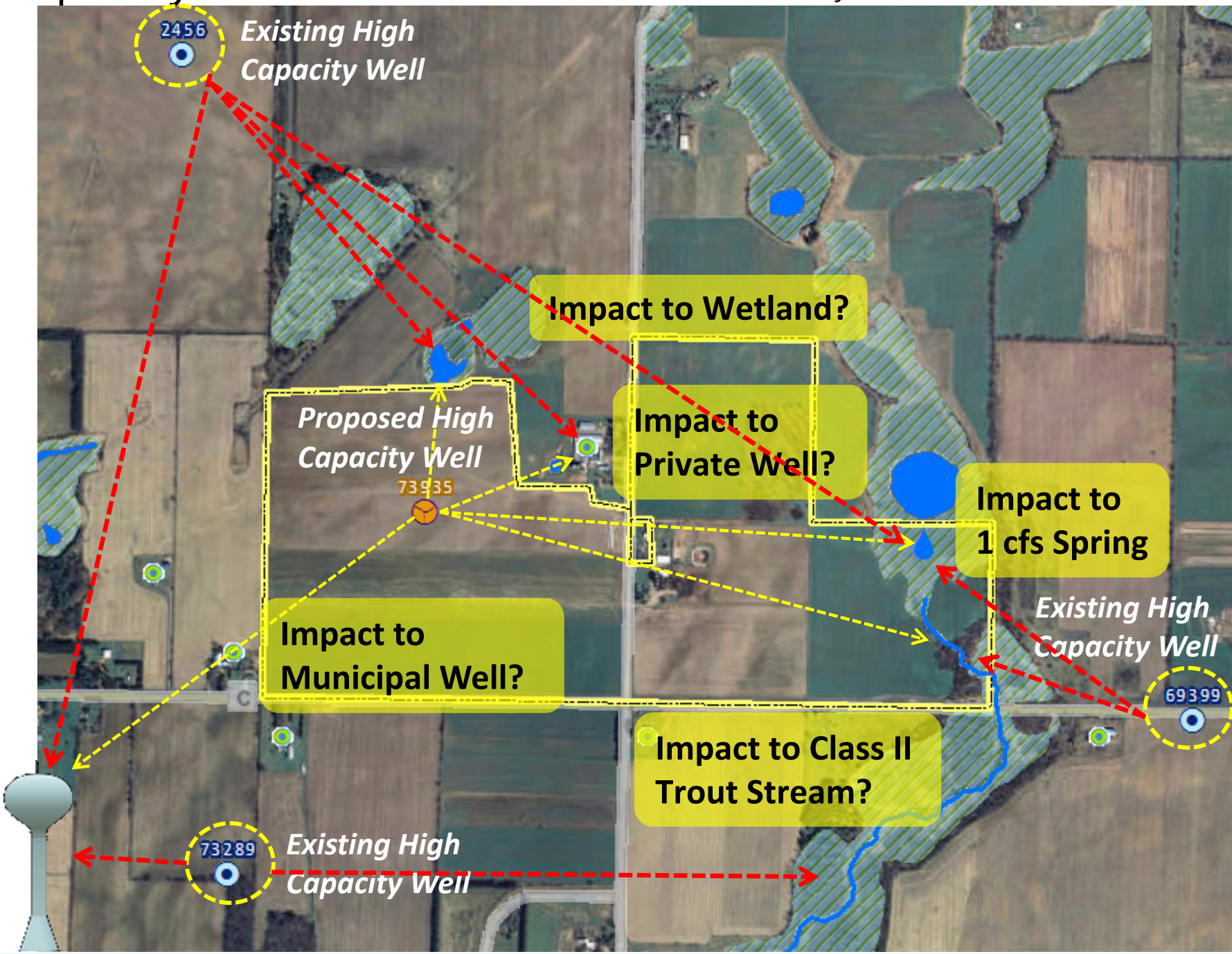
Identify the proximity of each water resources:

- Navigable Perennial Streams
- Navigable Lakes
- Springs (≥ 1 cfs)
- Municipal Wells

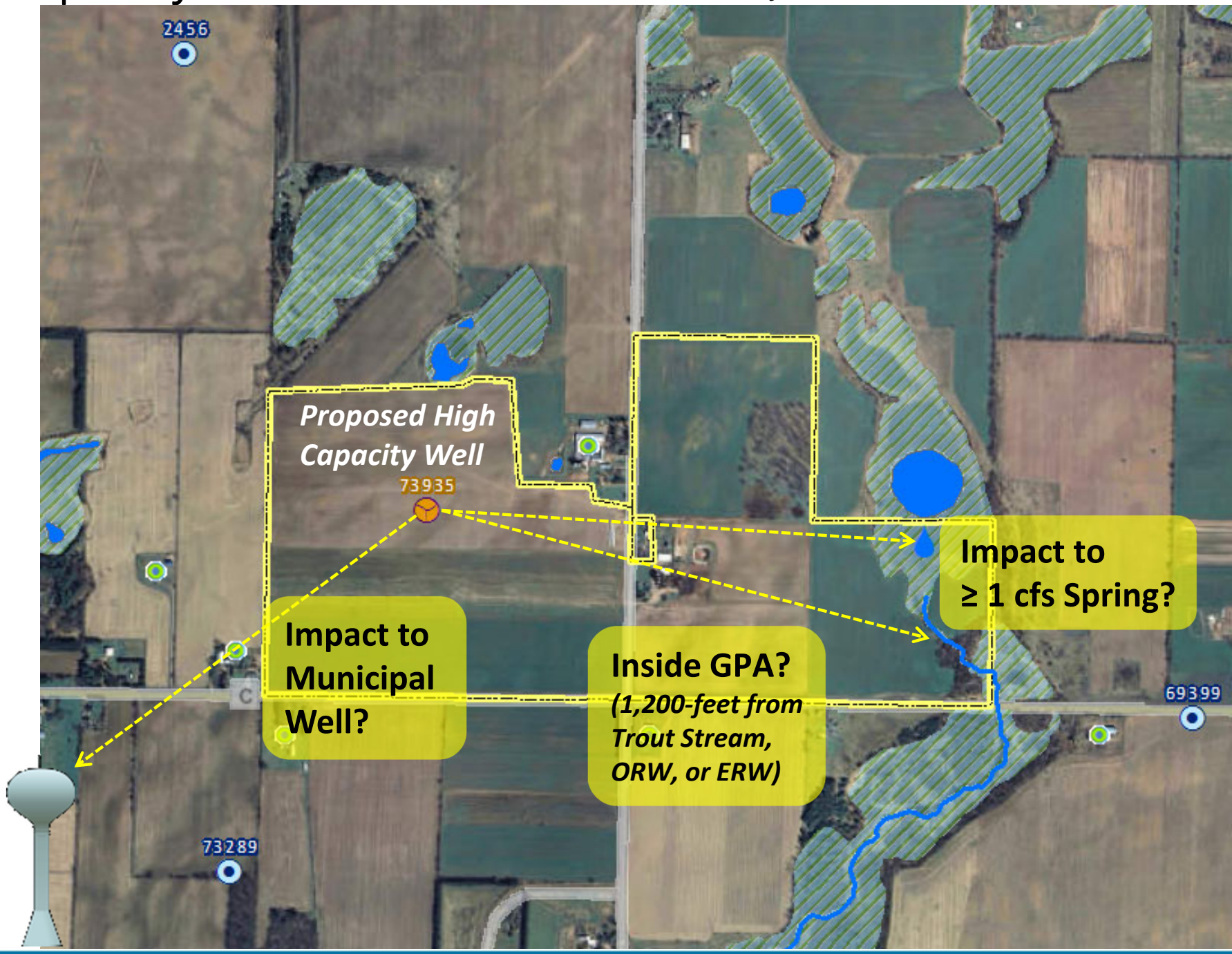

Jim Gifford

SEH

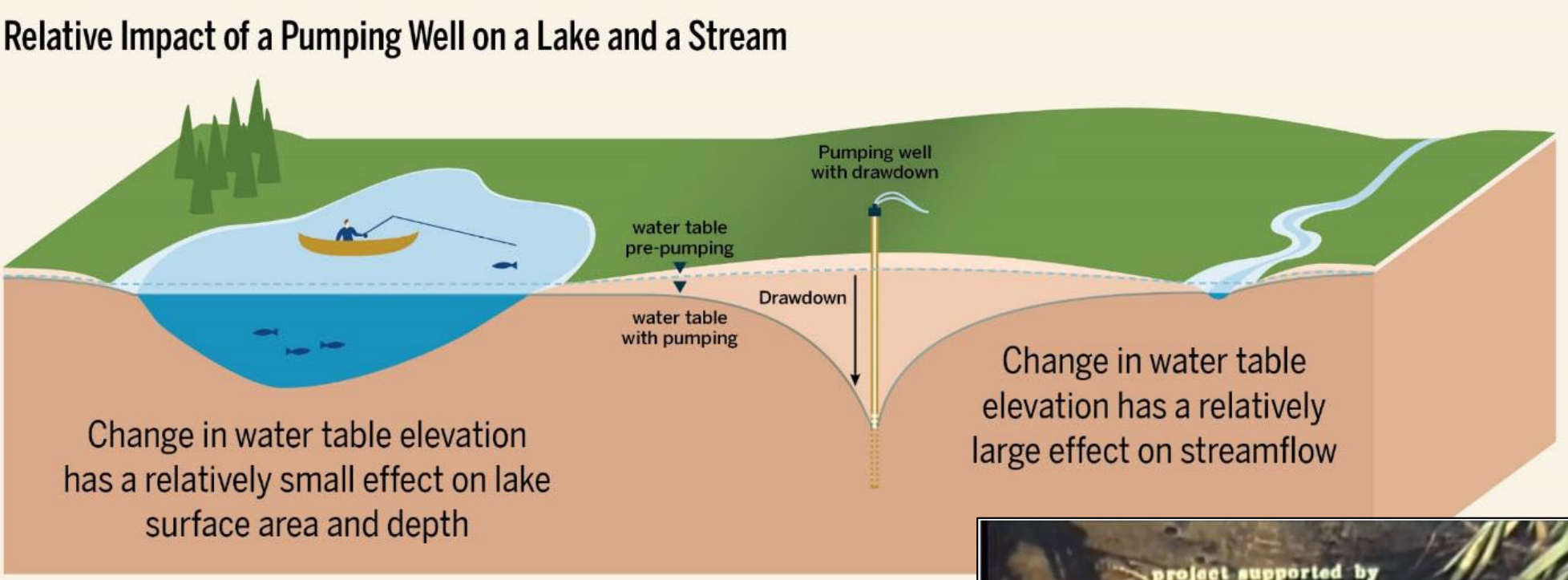
WI High Capacity Well Review Process (Pre May 10, 2016)

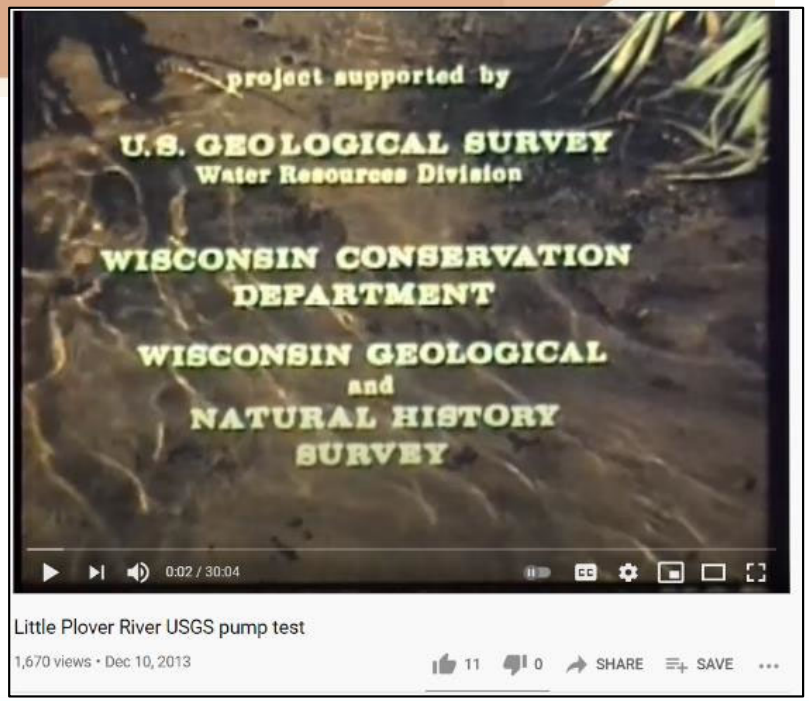


WI High Capacity Well Review Process (May 10, 2016 – June 2, 2020)



High Capacity Well Review: Conceptualization





https://www.youtube.com/watch?v=GW9cYdlT8iM

Understanding the Water Budget

Deposits

- Precipitation
- Groundwater & Surface Water Inflow

Withdrawals

- Evapotranspiration
- Runoff
- Pumping
- Groundwater & Surface Water Outflow

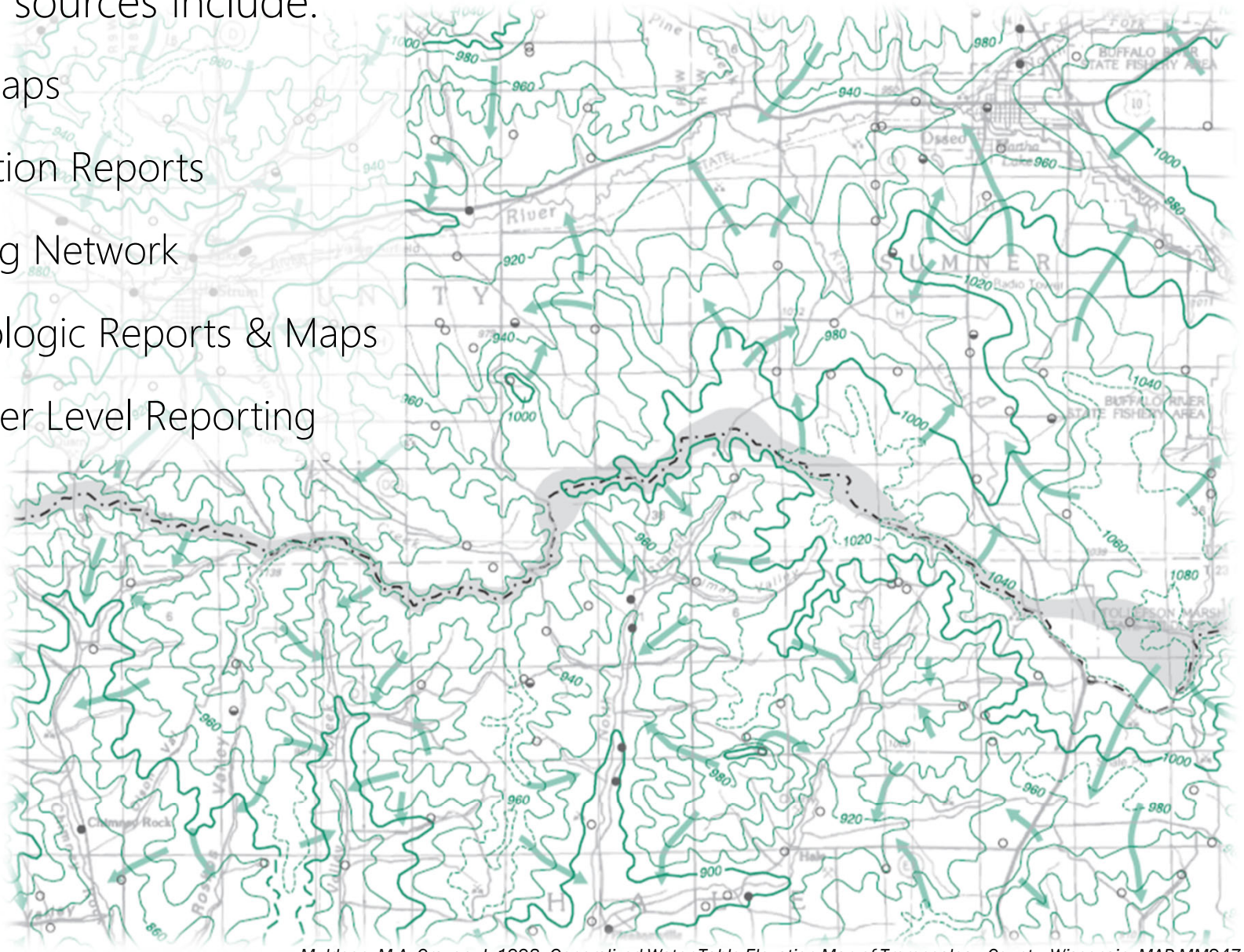
Balance

- Baseflow
- Lake Levels
- Groundwater Levels

High Capacity Well Review: Conceptualization

Hydrogeologic data sources include:

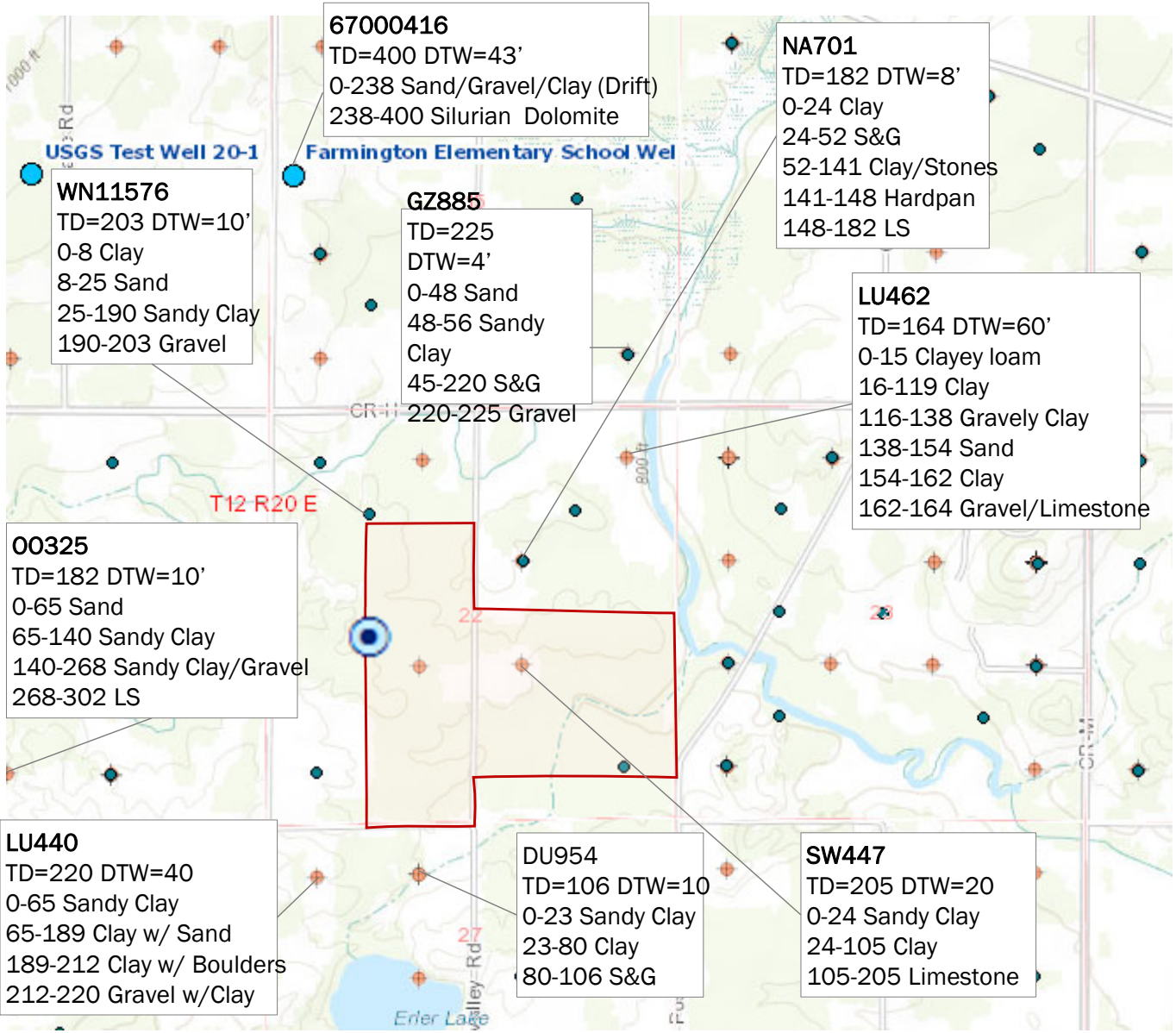
- Water Table Maps
- Well Construction Reports
- GW Monitoring Network
- Published Geologic Reports & Maps
- Municipal Water Level Reporting

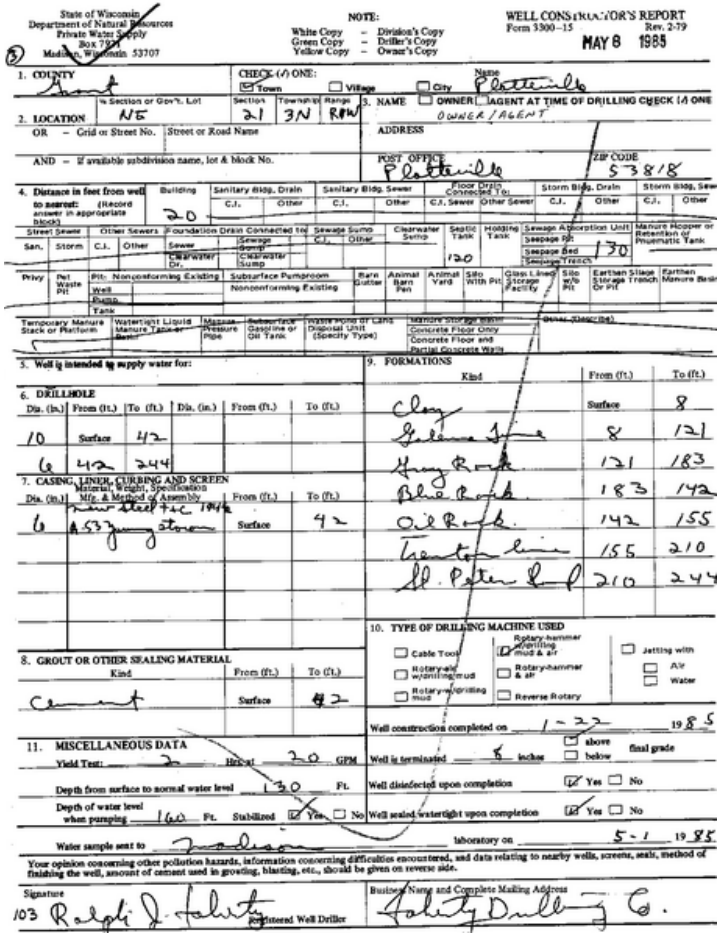


Muldoon, M.A, Craven, J. 1998. Generalized Water-Table Elevation Map of Trempealeau County, Wisconsin. MAP-MMS47.

High Capacity Well Review: Conceptualization

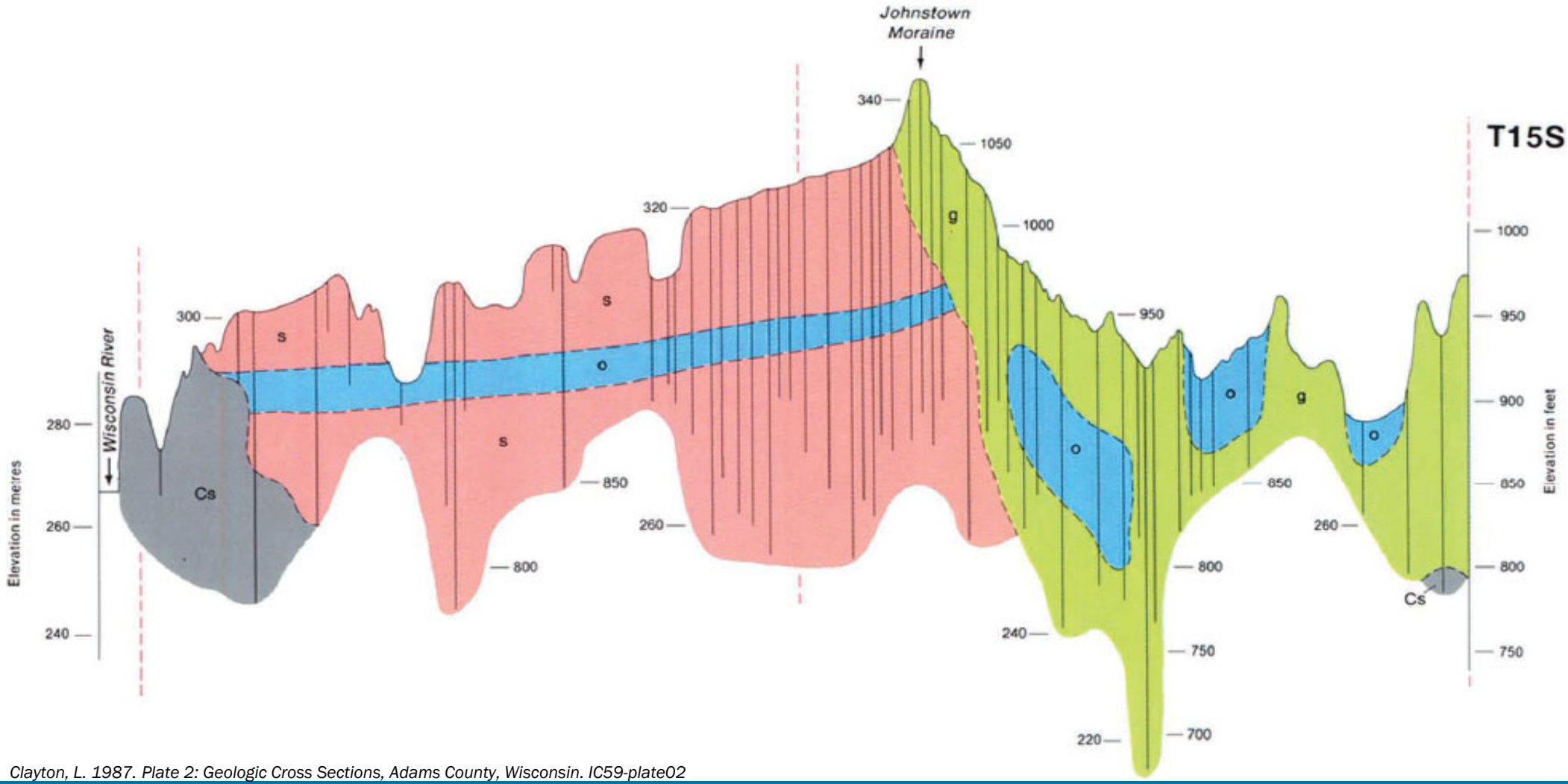
- Existing well construction logs





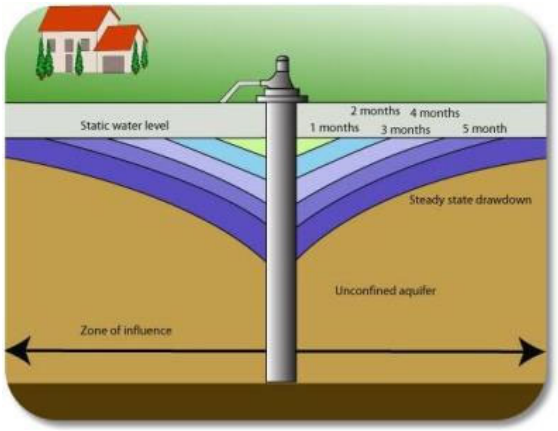
High Capacity Well Review: Conceptualization

- Published cross section and narrative descriptions of geology



Clayton, L. 1987. Plate 2: Geologic Cross Sections, Adams County, Wisconsin. IC59-plate02

High Capacity Well Review: Mathematical Solutions

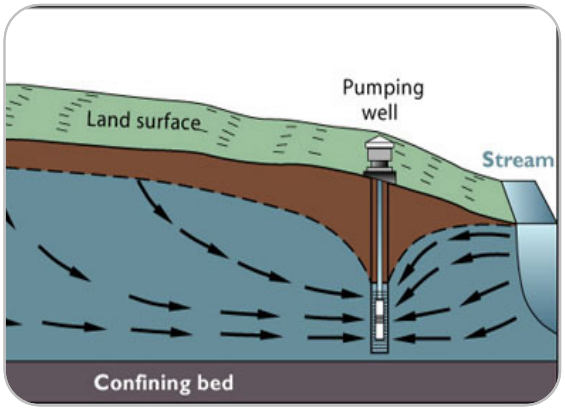


Drawdown

- Theis Solution

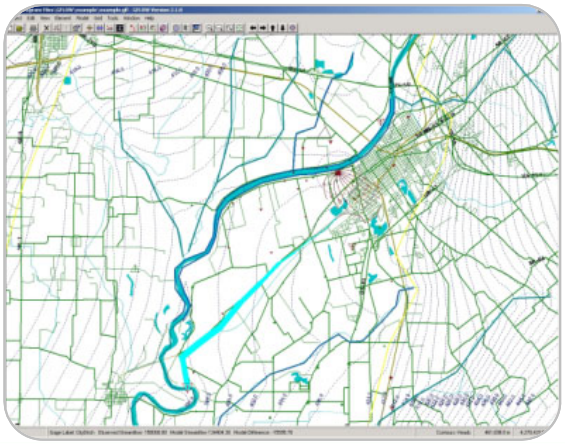
$$s = \frac{Q}{4\pi T}\int_{u}^{\infty}\frac{e^{-y}}{y}dy$$

$$u = \frac{r^2 S}{4Tt}$$



Analytic Stream Depletion

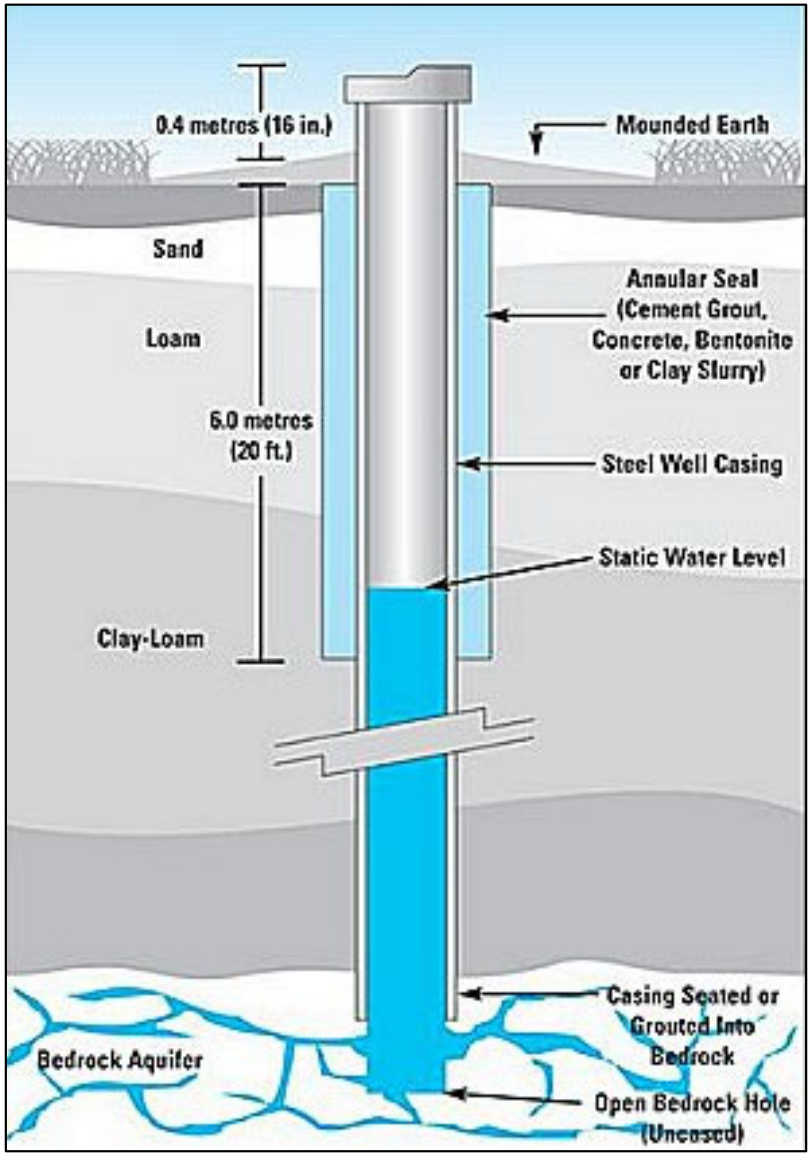
- *Walton Method, quantify depletion after 5 years*



Numeric Groundwater Flow Models

- Development of GFLOW and MODFLOW models
- Update and integrate existing models

High Capacity Well Review: Well Construction



www.bcgroundwater.ca

- Construction requirements driven by Wisconsin Administrative Code NR 812 (Well Construction and Pump Installation)
- The role of well construction with respect to aquifer interaction is very important on the well's impact to any give water resource

Wisconsin High Capacity Well Application Outcomes

The reviewing WI DNR hydrogeologist may determine:

- Approved: Sufficient information exists to determine that there is none of the review criteria thresholds are exceeded.
- Additional Information Required: Existing information is insufficient and applicant may submit supplemental information such as pump test, monitoring, or modeling to facilitate WI DNR review.
- Conditioned: There is sufficient information to require changes to the proposed well. Changes may include a source or property pumping limit (monthly, seasonal, annual), location modification or tolerance, or modification to well construction.
- Denied: Significant impact is not avoidable or already exists and application is denied.

Future Work

Support Data, Tools and Research

Continue **data collection** e.g.:

- Pumping
- Precipitation
- Evapotranspiration
- Water levels

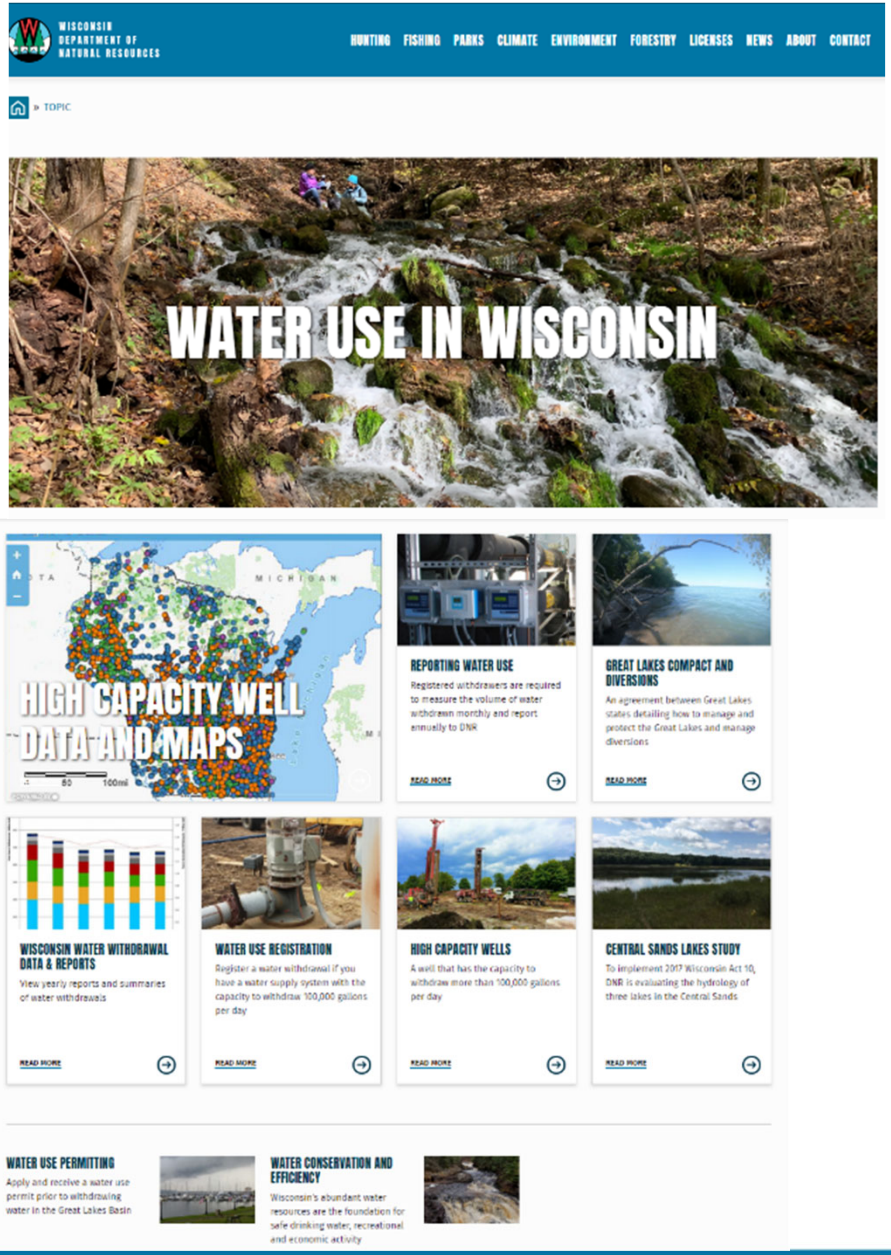
Support **research** on how to collect and interpret recharge and evapotranspiration data

Update, maintain and re-calibrate the **groundwater flow model**

Streamline process for **other lakes and streams**

Available High Capacity Well Resources

https://dnr.wisconsin.gov/topic/WaterUse



- ✓ WI Water Use Story Map
- ✓ WI Groundwater Story Map
- ✓ Water Quantity Data Viewer
- ✓ Water Use Query Tool
- ✓ Central Sands Lakes Study
- ✓ Groundwater Flooding

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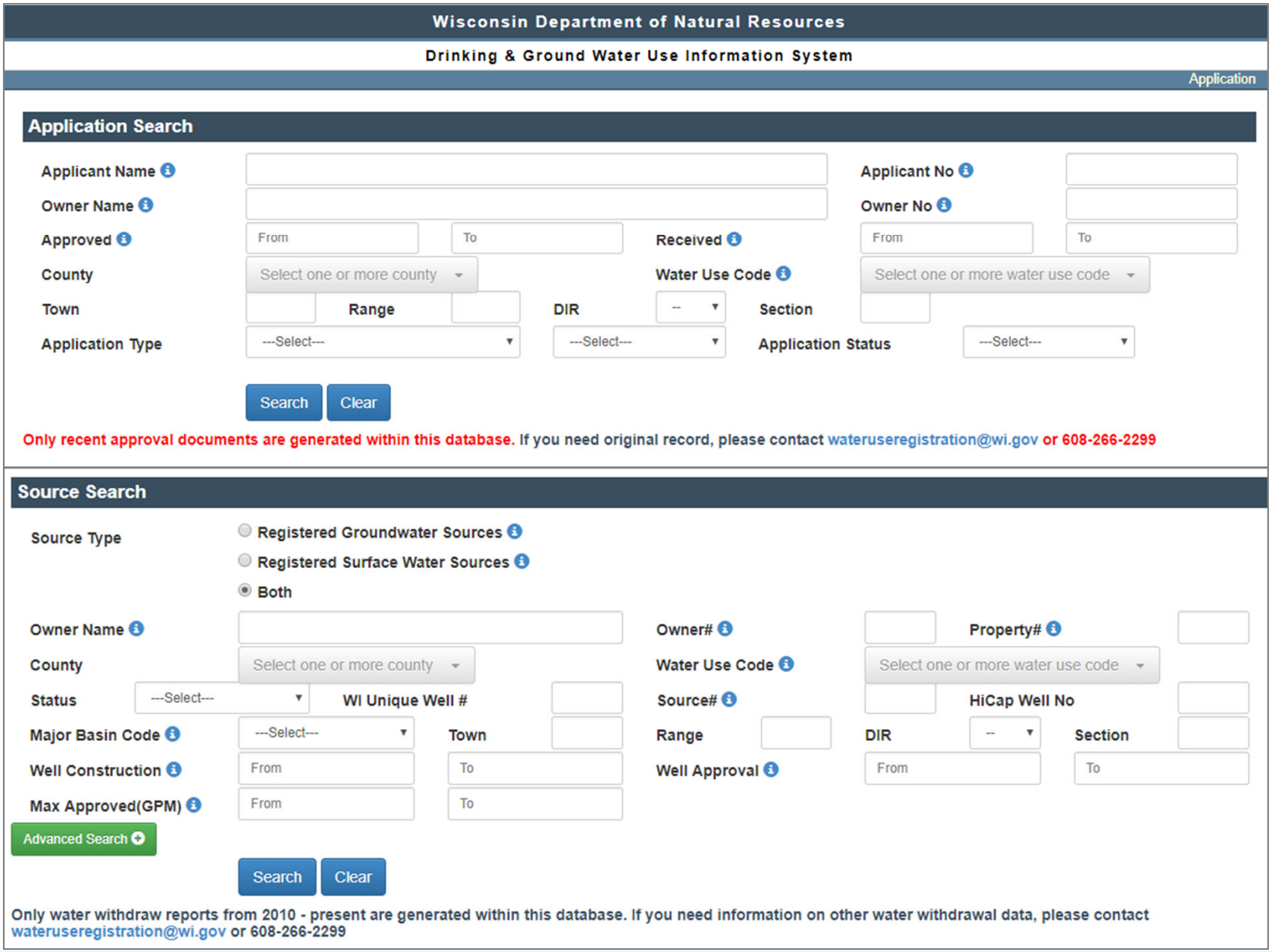

High Capacity Well Application Search

Existing Registered Sources Searches


Dolomite