

Groundwater Quantity & High Capacity Wells in North Central Wisconsin



Rachel Greve
Madeline Gotkowitz
Wisconsin DNR Water Use Section
January 30, 2024

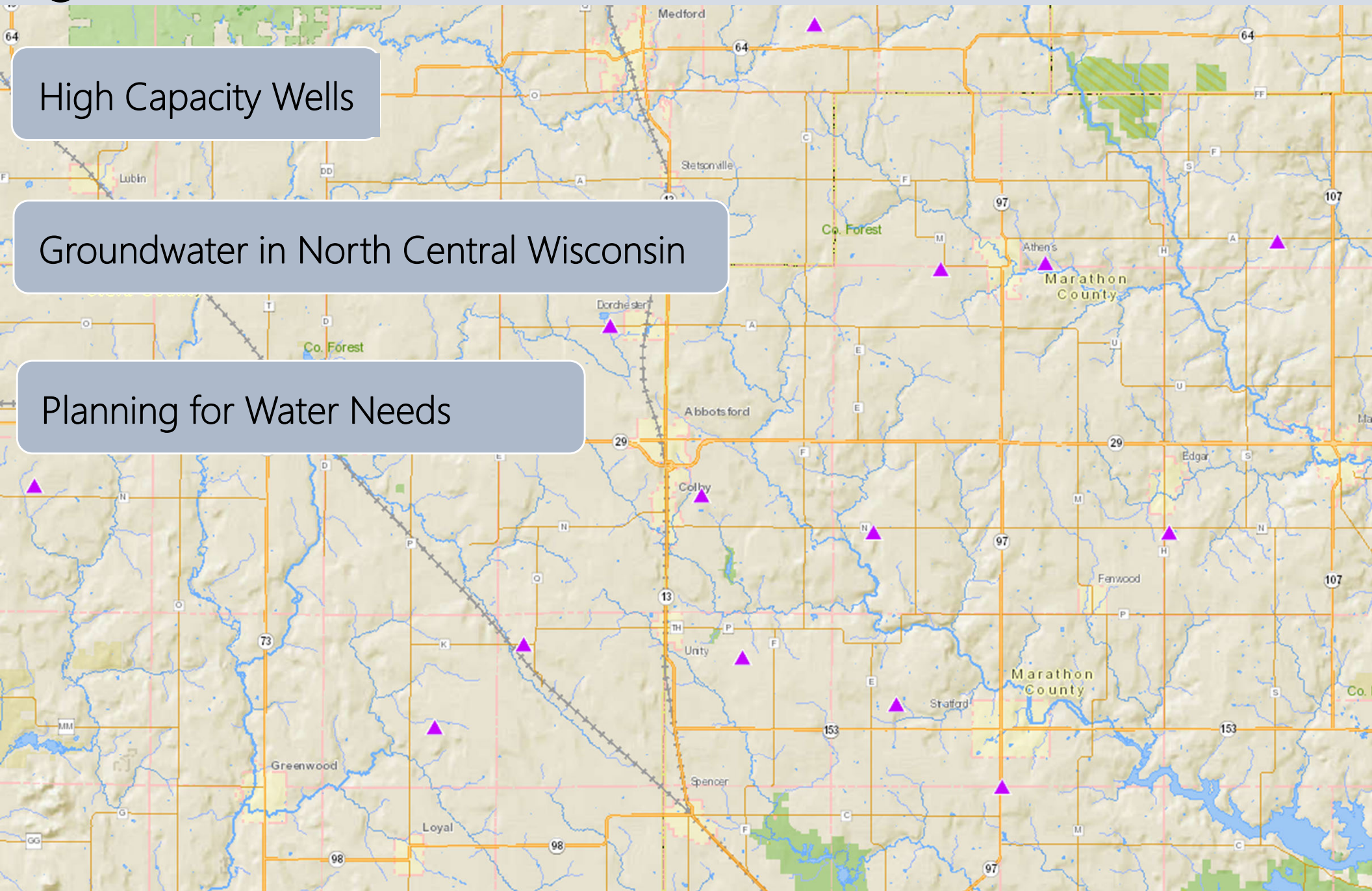


Agenda

High Capacity Wells

Groundwater in North Central Wisconsin

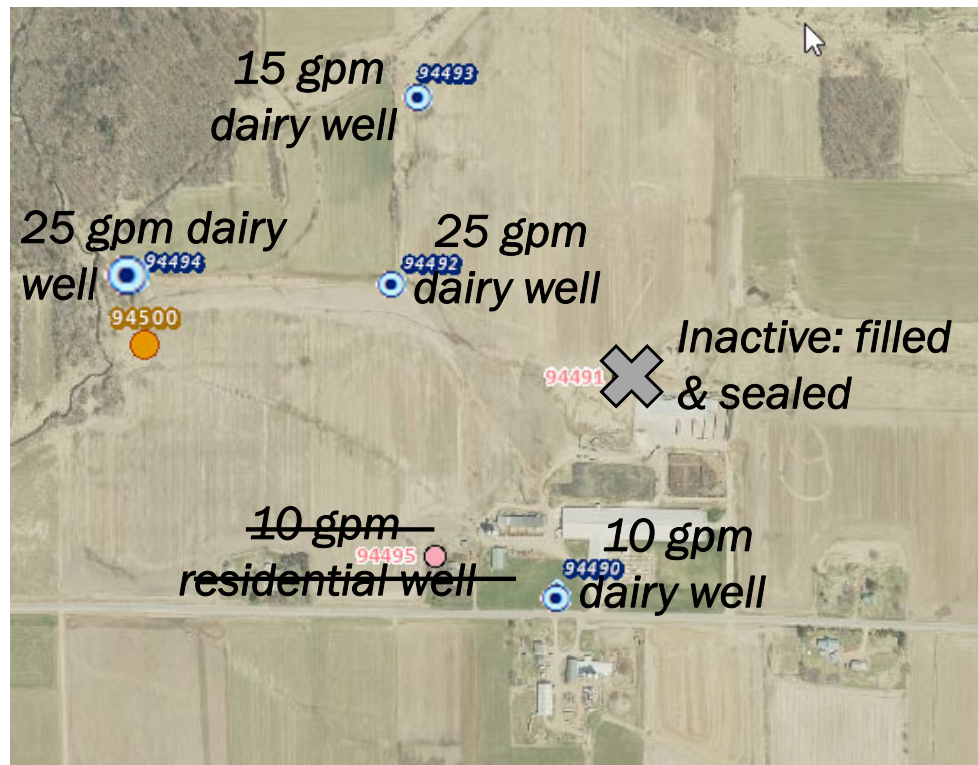
Planning for Water Needs



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

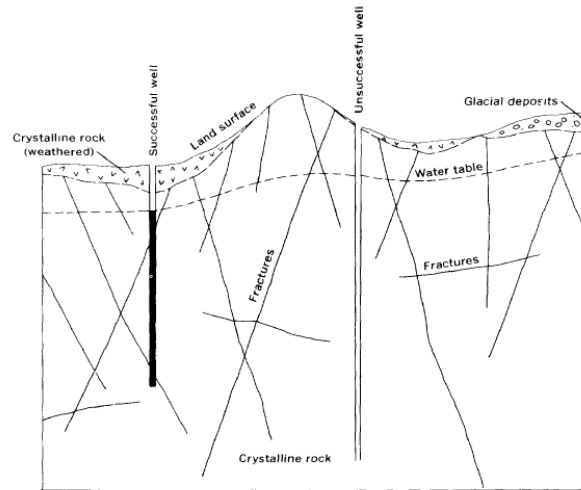
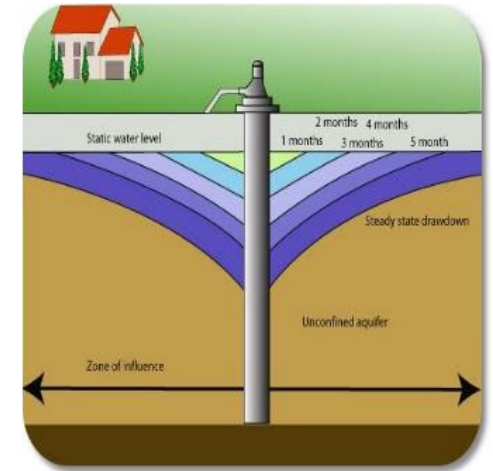


FIGURE 2.—Occurrence of ground water in crystalline rock.



Resource Inventory

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

Conceptualization

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

Quantify Impact

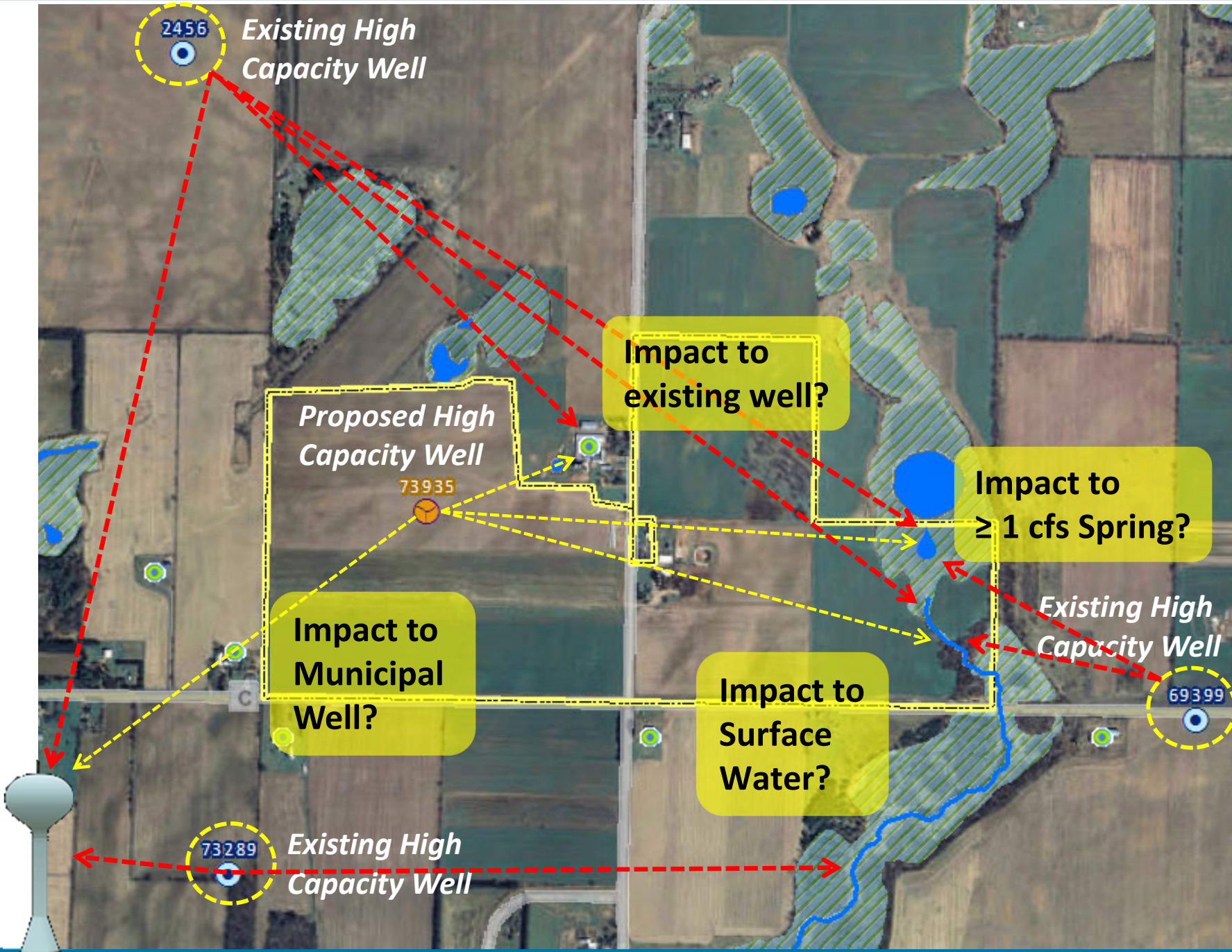
- Estimate potential drawdown at nearby private wells, streams etc.



High capacity well review process

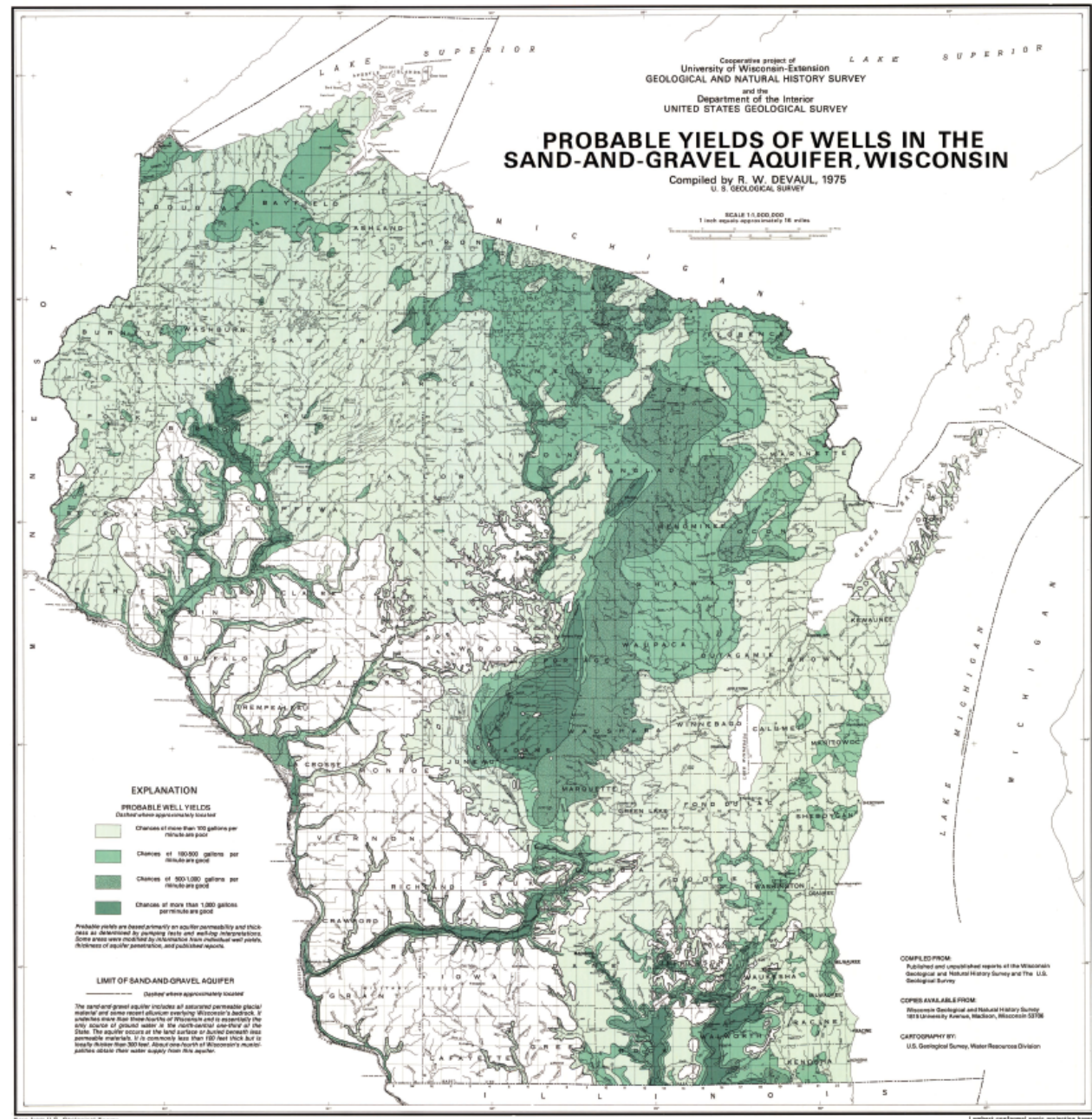
1. Well Construction: Does the proposed well meet current code requirements?
2. Water Quality: Does the construction of the proposed well degrade safe drinking water, degrade the groundwater resource, or impact public safety?
3. Water Quantity:
 - Is the proposed well in a groundwater protection area 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



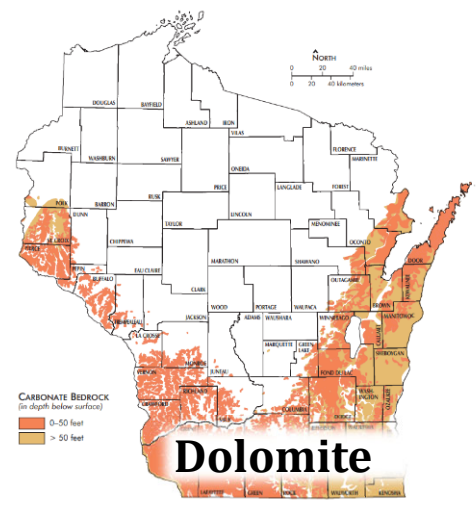
Wisconsin's hydrogeology

Well yields of the sand & gravel aquifer...



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

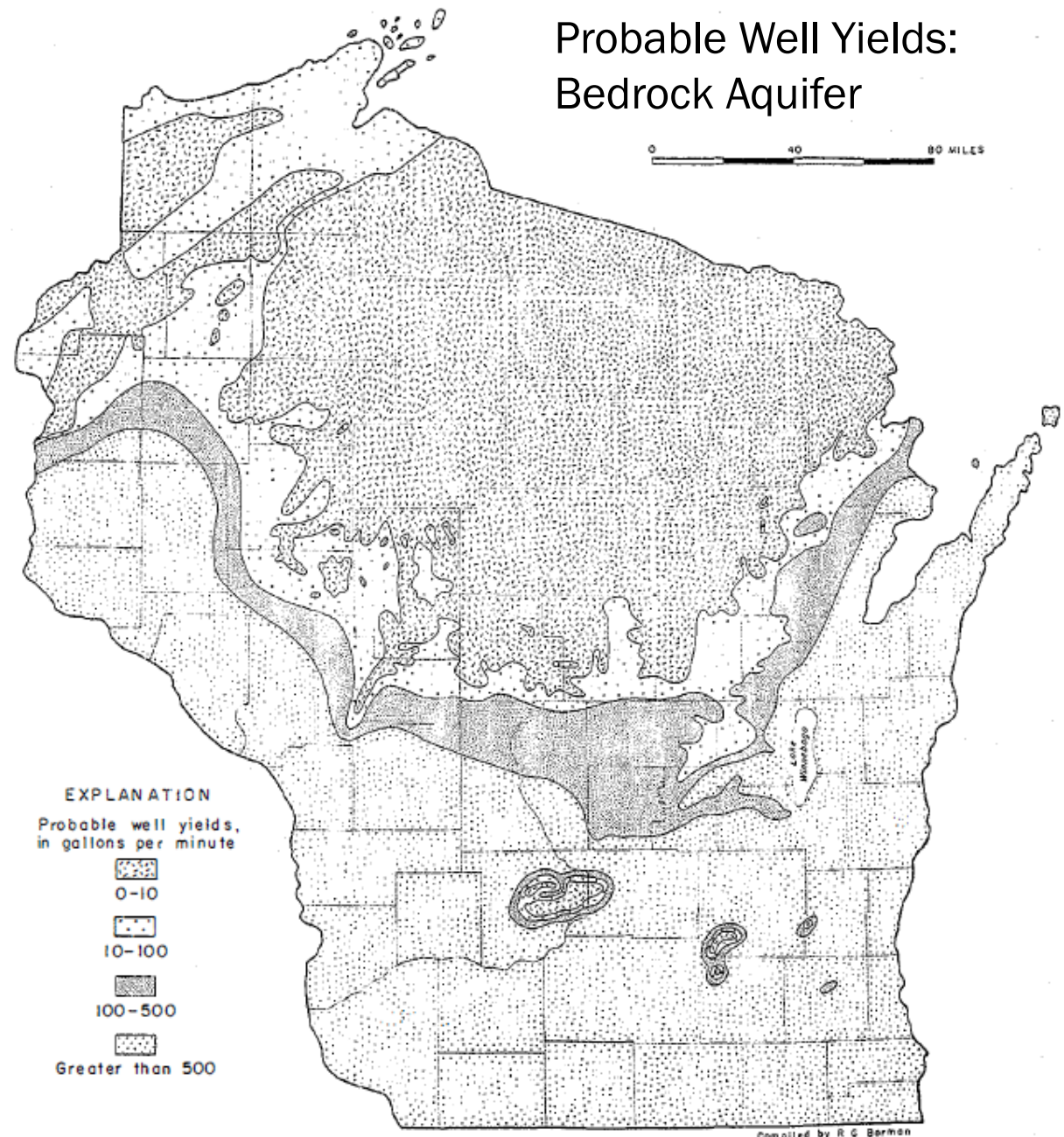
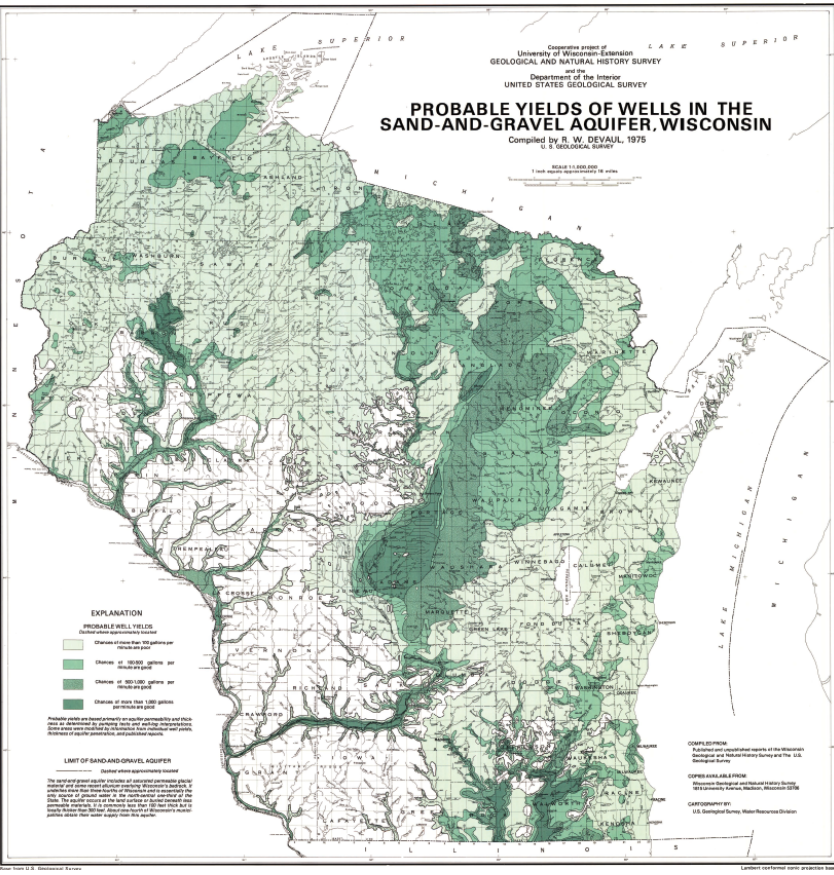
Switched figure to show the whole karst area i.o. just the Silurian

Greve, Rachel M - DNR, 2024-01-22T16:42:23.427

Wisconsin's hydrogeology

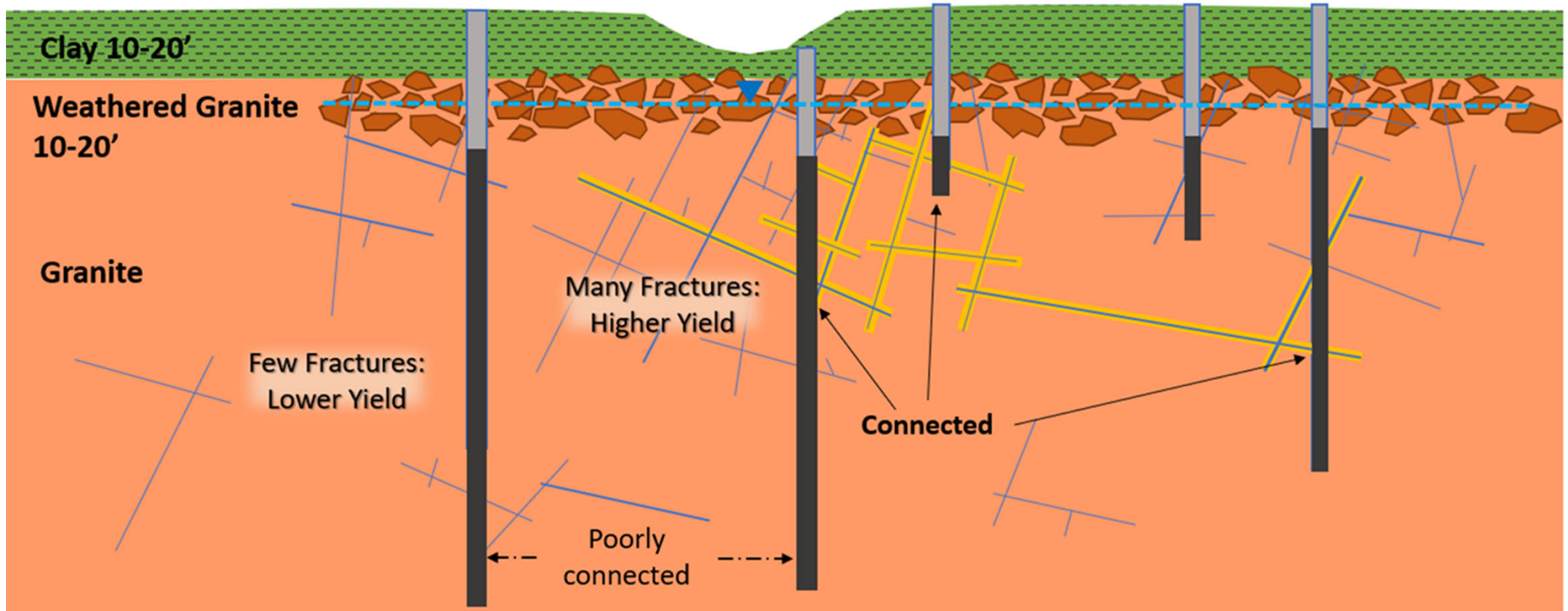
Water availability...

Probable Well Yields:
Bedrock Aquifer



Wisconsin's hydrogeology

Wells in fractured bedrock: challenges



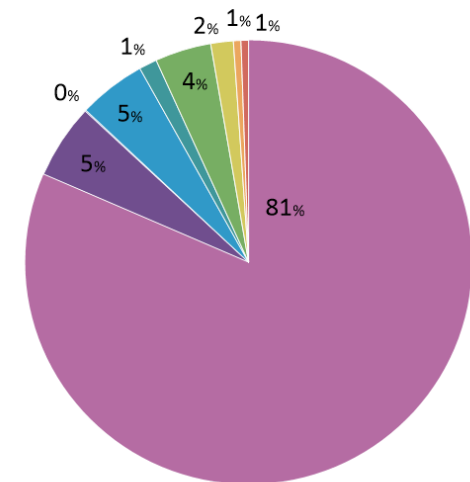
- Low well yields that often require multiple wells to meet dairy needs
- Fractures often connect wells, leading to “interference” and drawdown
- Some farms and villages may have sufficient sand and gravel overlying the fractured granite

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?

Summertime dairy water use estimate



Planning for current & future water needs

1. How much water is currently used?

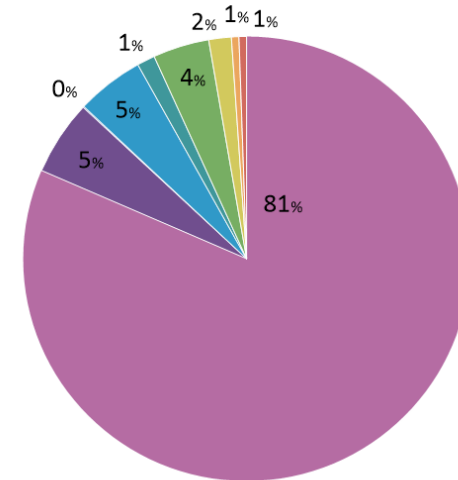
- Measure (meters may be required by the high capacity well approval)
- Estimate based on (herd size, cleaning, sprinkling, etc.)
- Inventory existing wells – location, construction, capacity

2. Develop a water budget

- Estimate future need

3. Apply for a new well or larger pump capacity

Summertime dairy water use estimate



Questions?

CONNECT WITH US

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Water Use Line
(General Questions, Reporting)
608 266-2299



/WIDNR



@WIDNR



@WI_DNR



/WIDNRTV



"WILD WISCONSIN:
OFF THE RECORD"

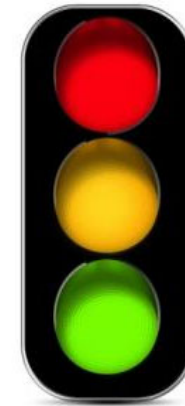
Extra slides

2017 Wisconsin Act 10

Changes to existing high capacity wells

Action to Existing High Capacity Well	Statutory Requirements
Replacement	<ol style="list-style-type: none">1. Fill and seal existing well2. Meet one of the following<ul style="list-style-type: none">• 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 <u>or</u> farther away from the nearest groundwater protection area than the existing well.3. Adhere to all other conditions of existing high capacity well approval4. DNR must be notified within 90 days
Reconstruction	<ol style="list-style-type: none">1. Maintain same depth and specifications of existing well2. Adhere to all conditions of existing high capacity well approval3. DNR must be notified within 90 days
Transfer	<ol style="list-style-type: none">1. Adhere to all conditions of existing high capacity well approval2. 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



- 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

Submitting the Application

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

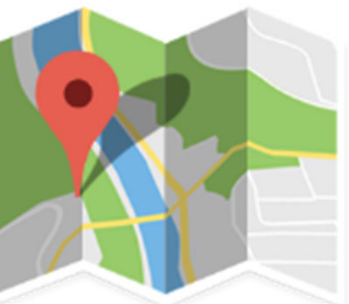
* Prior department approval may not be needed for the repair, reconstruction, replacement or transfer of existing high capacity wells if certain criteria are met

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

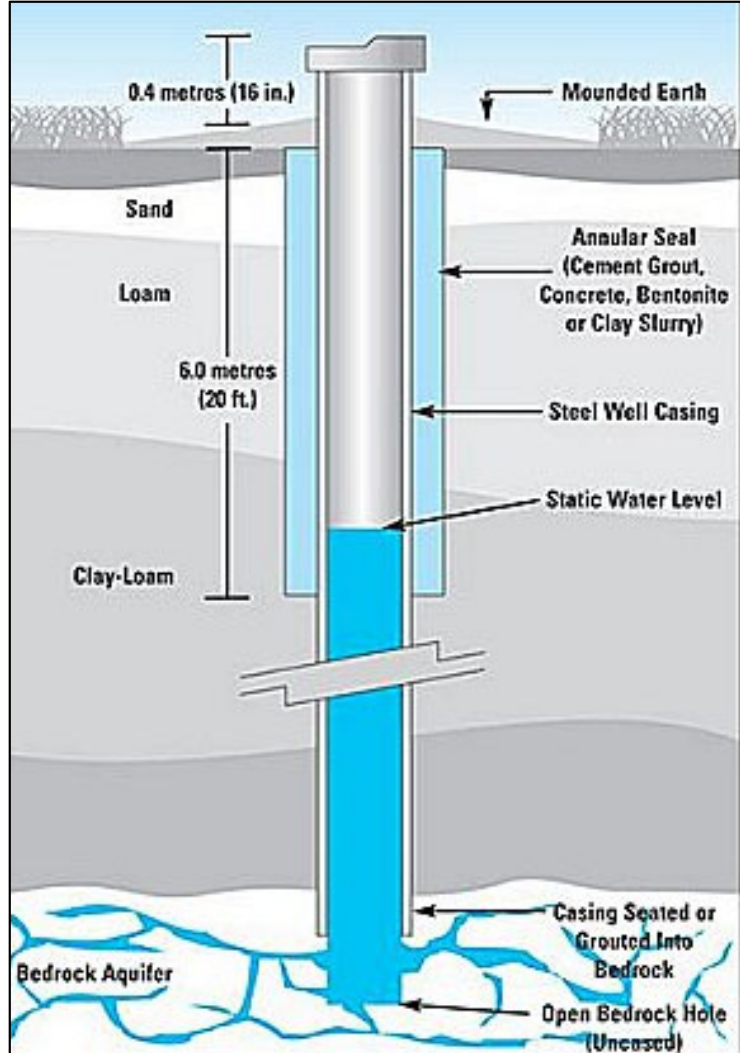


Location



dodge.uwex.edu

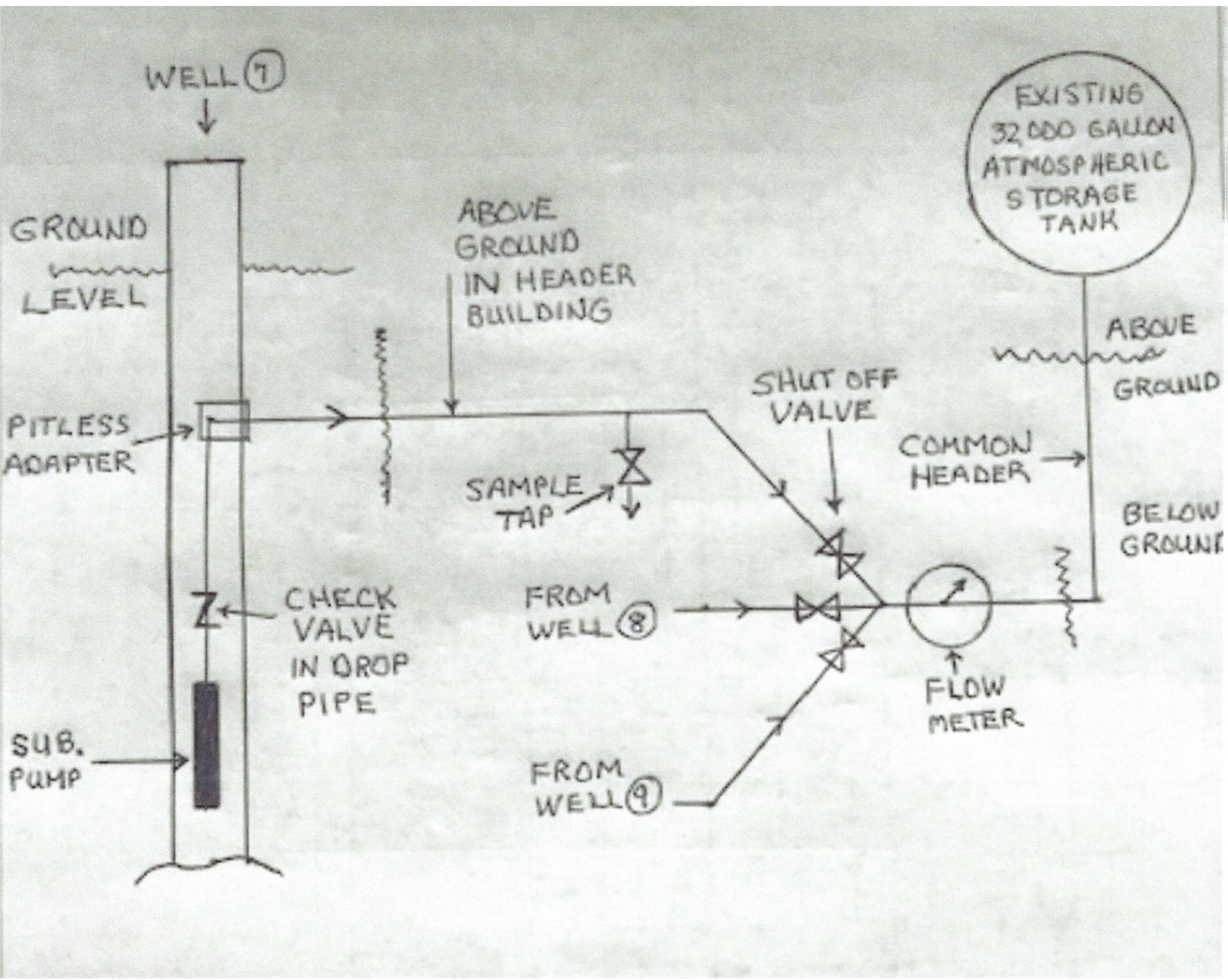
Water Use Type, Frequency, & Volume



www.bcgroundwater.ca

Well Construction

Submitting the Application



The Wisconsin High Capacity Well Application Process



Denied

Approved with
Modifications

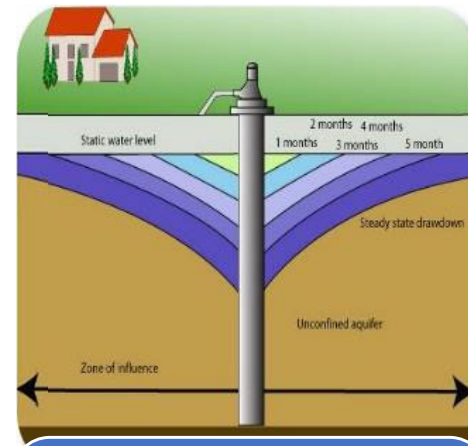
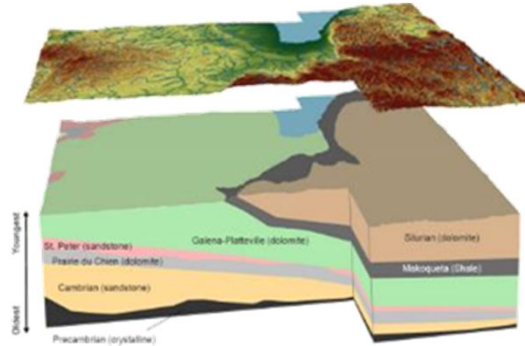
Approved

High Capacity Well
Application Submitted to
DNR

DNR conducts
review of high
capacity well
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DNR determines
outcome of high
capacity well
application

High Capacity Well Review Process



Resource Inventory

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

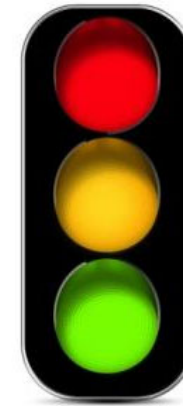
Conceptualization

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

Quantify Impact

- Analytic Methods
- Numeric Methods

The Wisconsin High Capacity Well Application Process



Denied

Approved with
Modifications

Approved

High Capacity Well
Application Submitted to
WI DNR

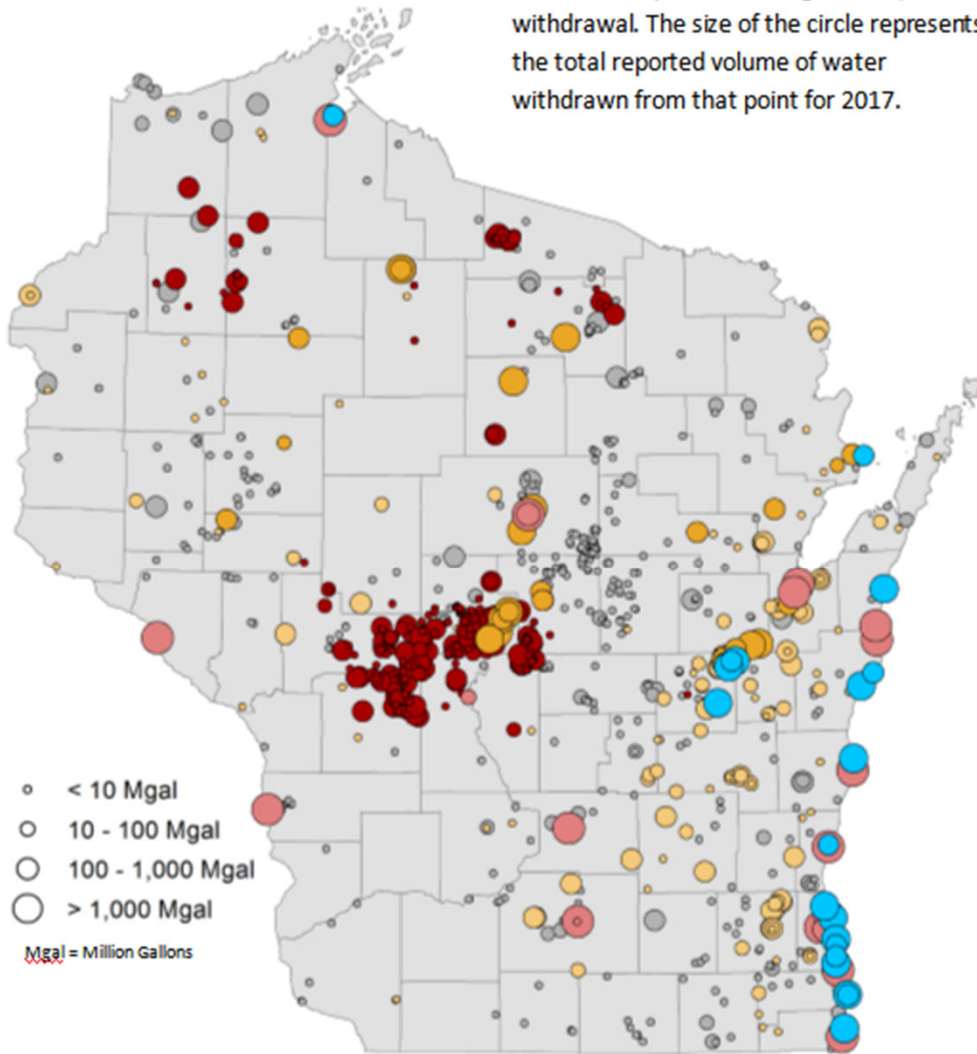
WI DNR conducts
review of high
capacity well
application

WI DNR determines
outcome of high
capacity well
application

Wisconsin's Water Withdrawals

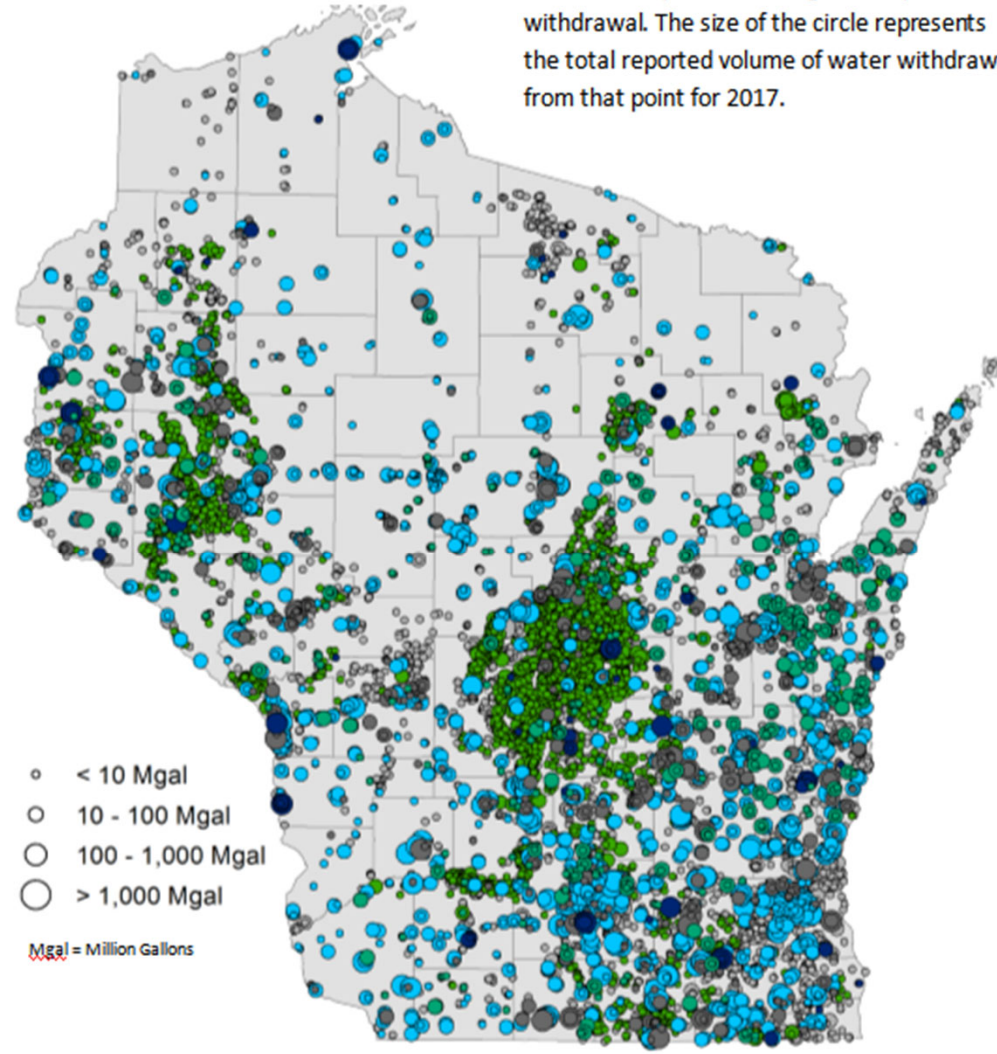
2017 Surface Water Annual Withdrawals

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.



2017 Groundwater Annual Withdrawals

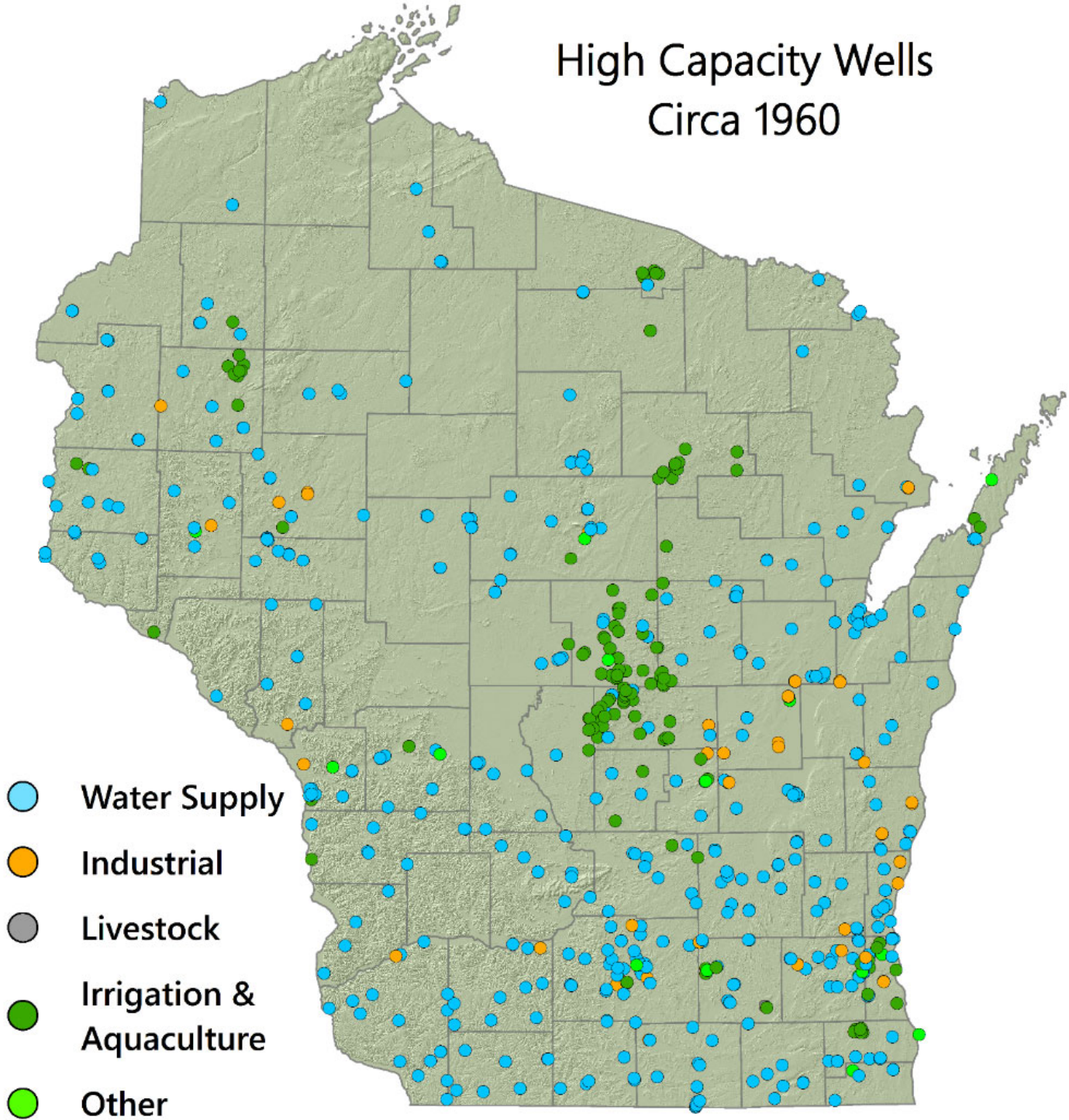
Each circle represents a single 2017 point of withdrawal. The size of the circle represents the total reported volume of water withdrawn from that point for 2017.



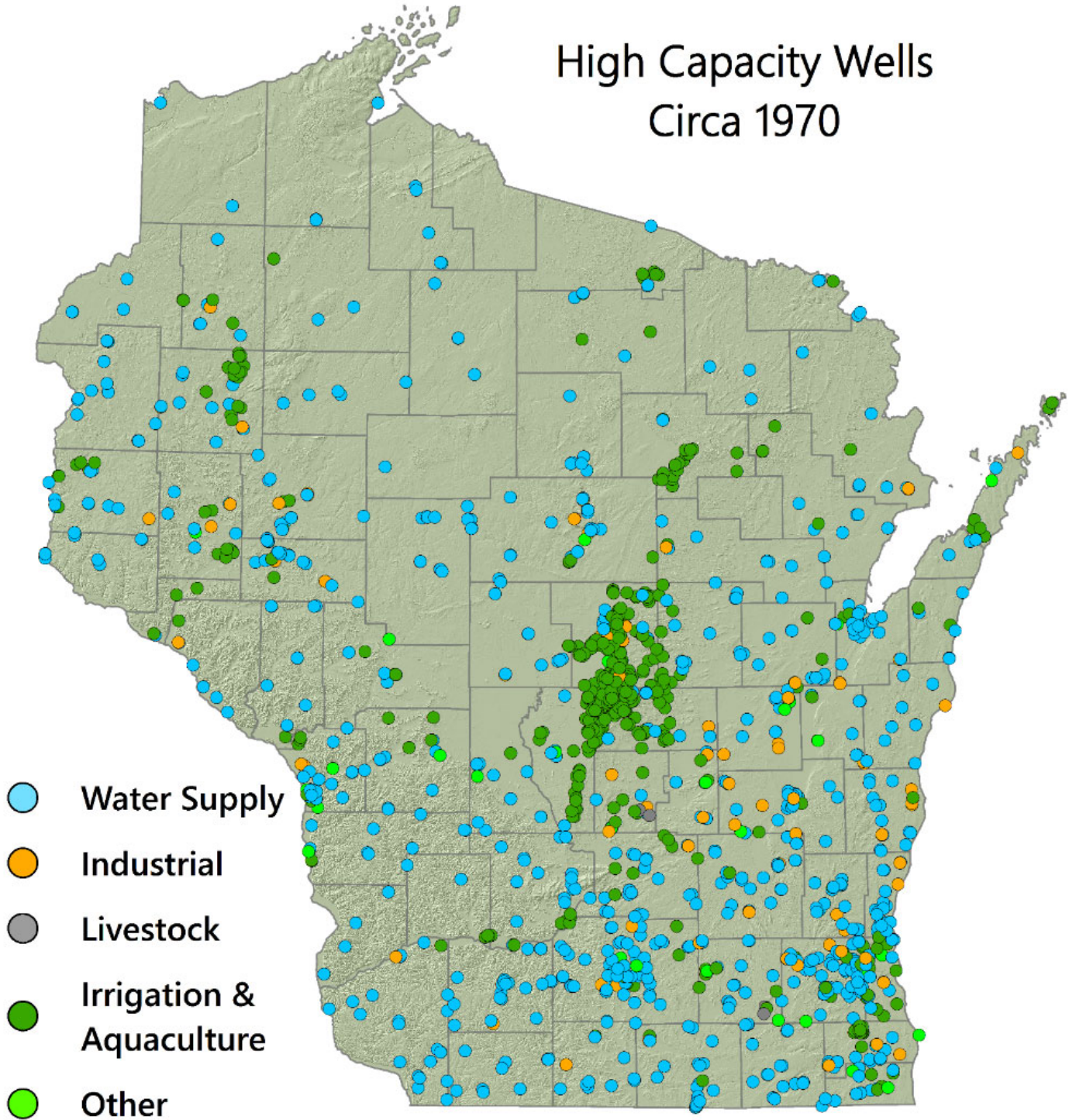
- Power Generation
- Municipal Water Supply
- Mining
- Paper Production
- Cranberry Production
- All Other Uses

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

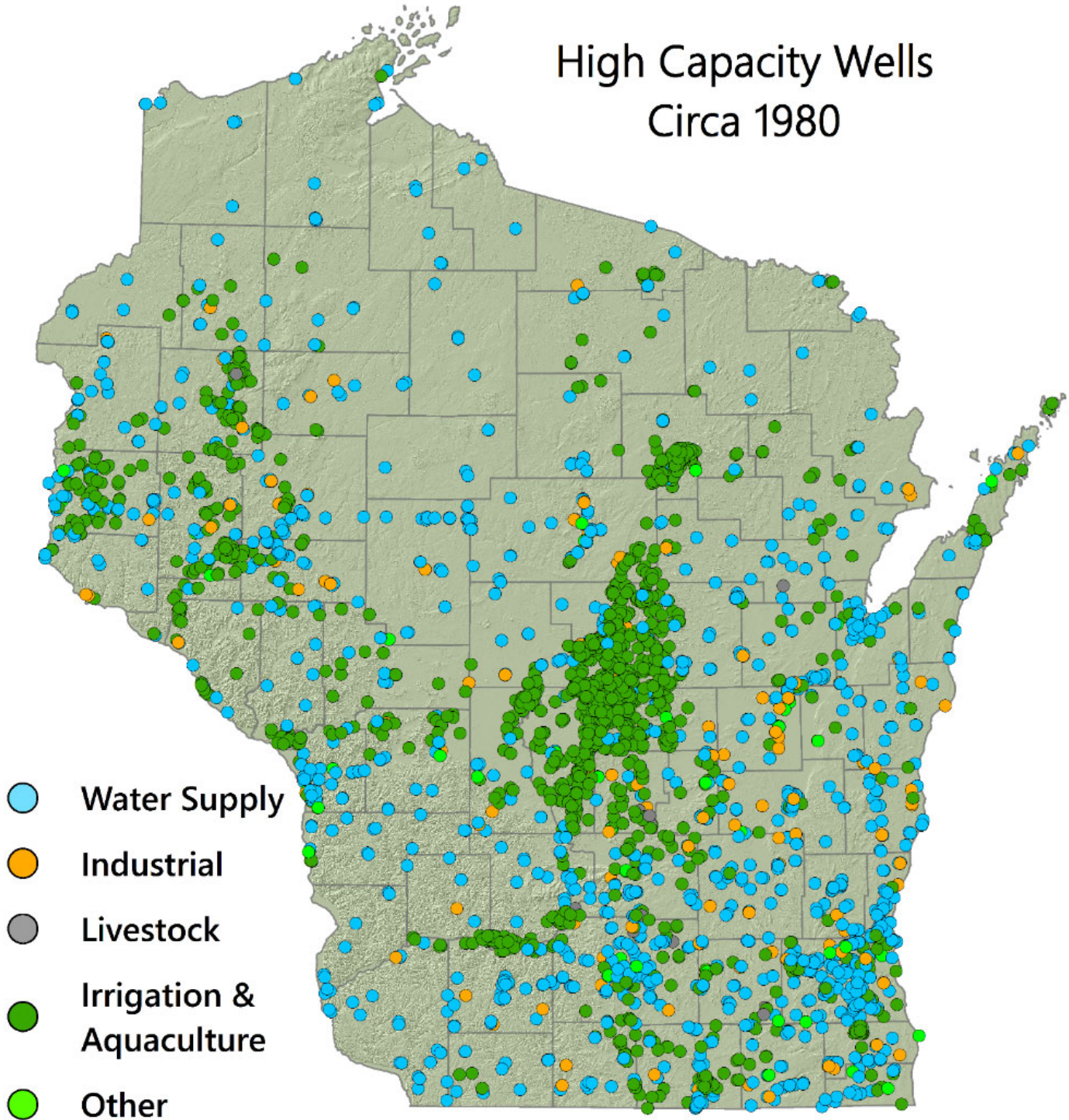
High Capacity Wells Circa 1960



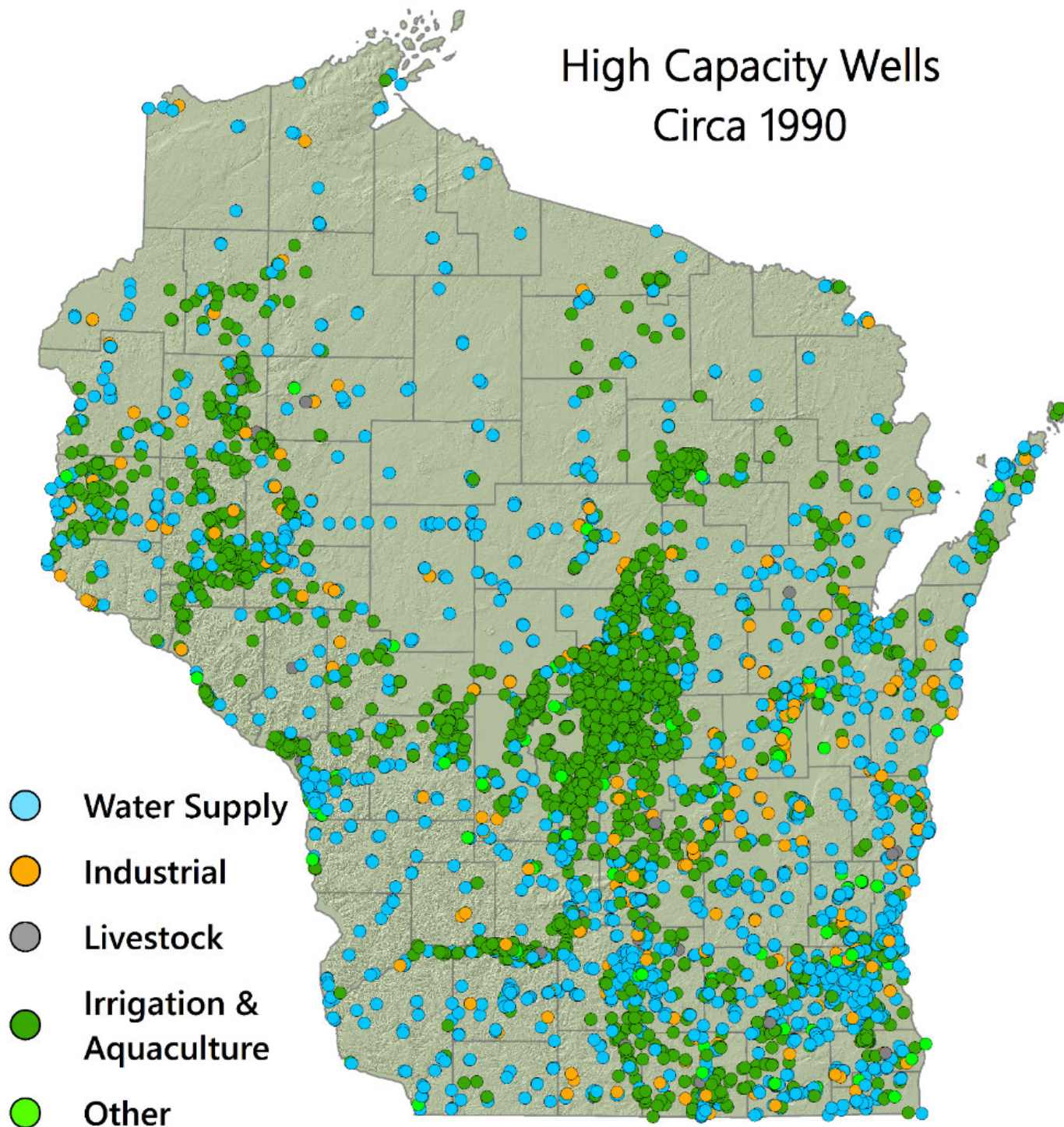
High Capacity Wells Circa 1970



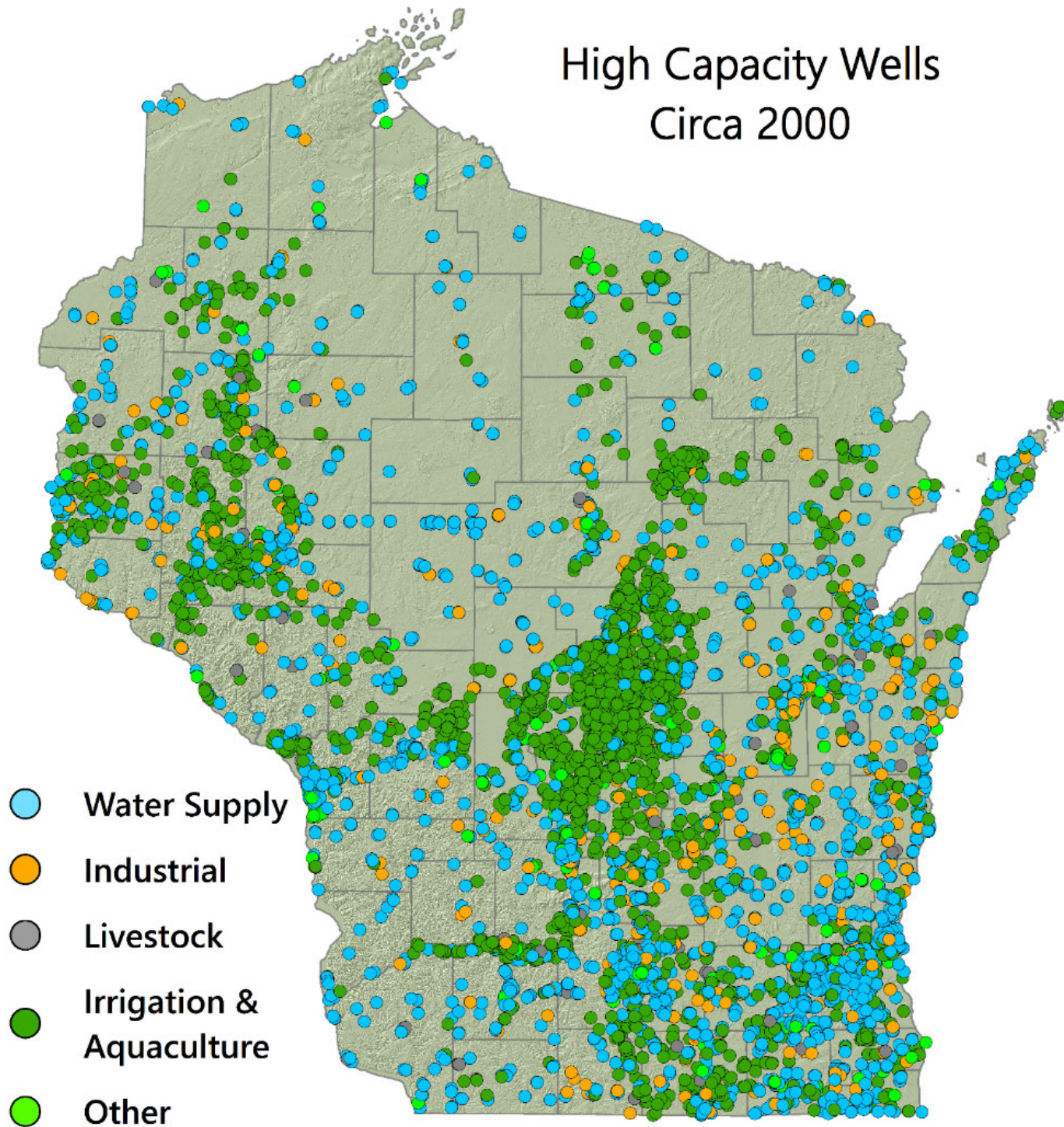
High Capacity Wells Circa 1980



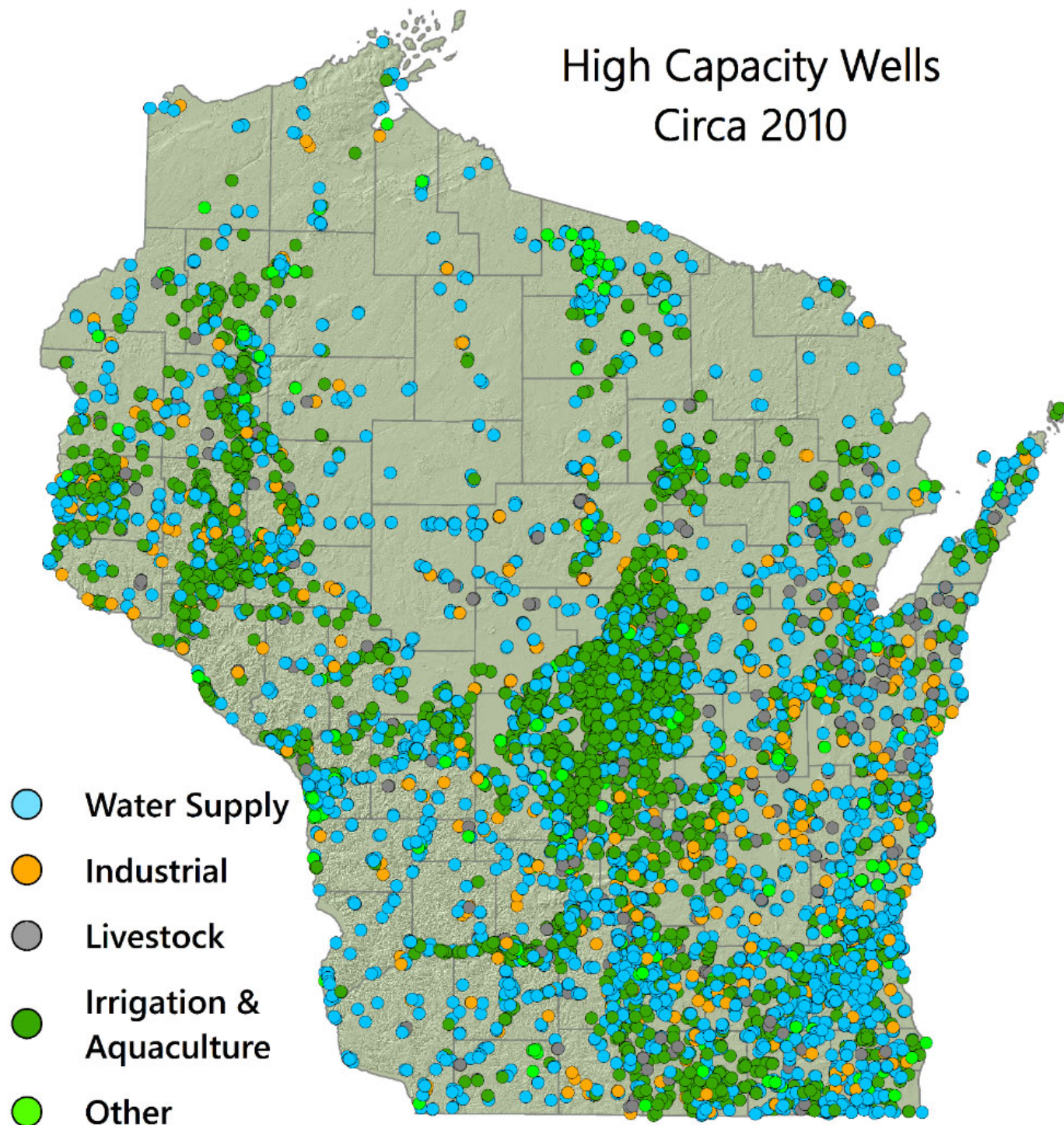
High Capacity Wells Circa 1990



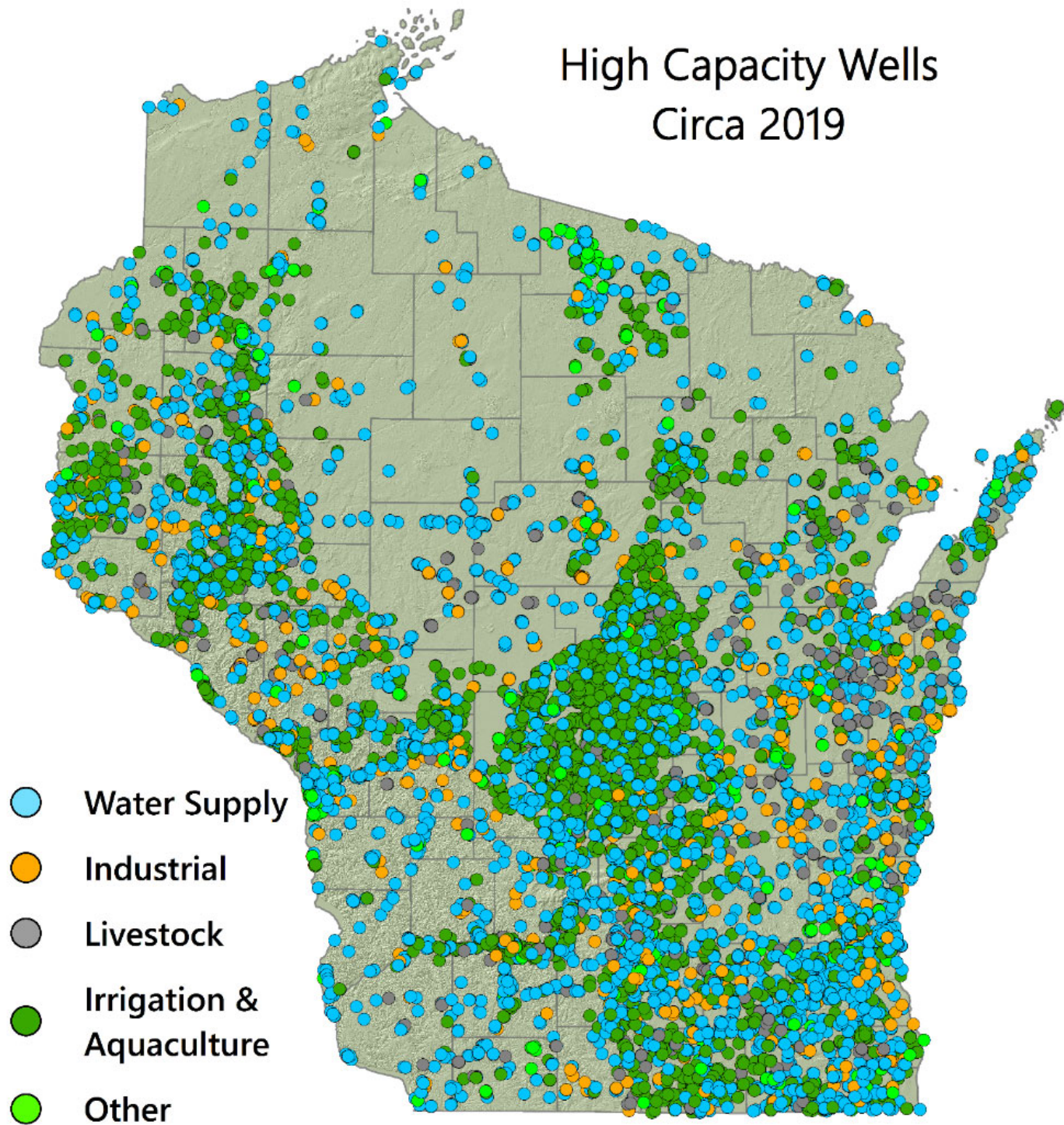
High Capacity Wells Circa 2000



High Capacity Wells Circa 2010

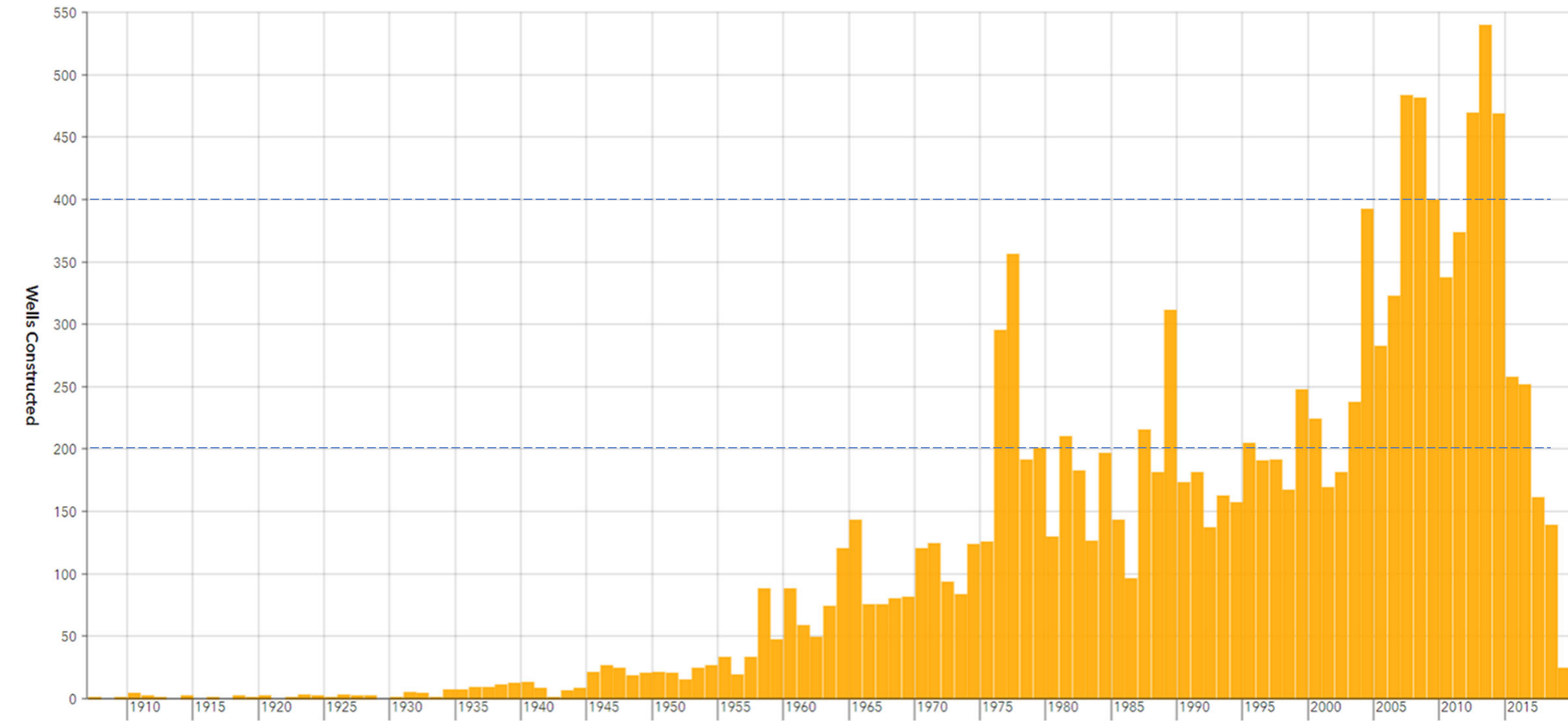


High Capacity Wells Circa 2019



High Capacity Well Construction Per Year

High Capacity Well Construction



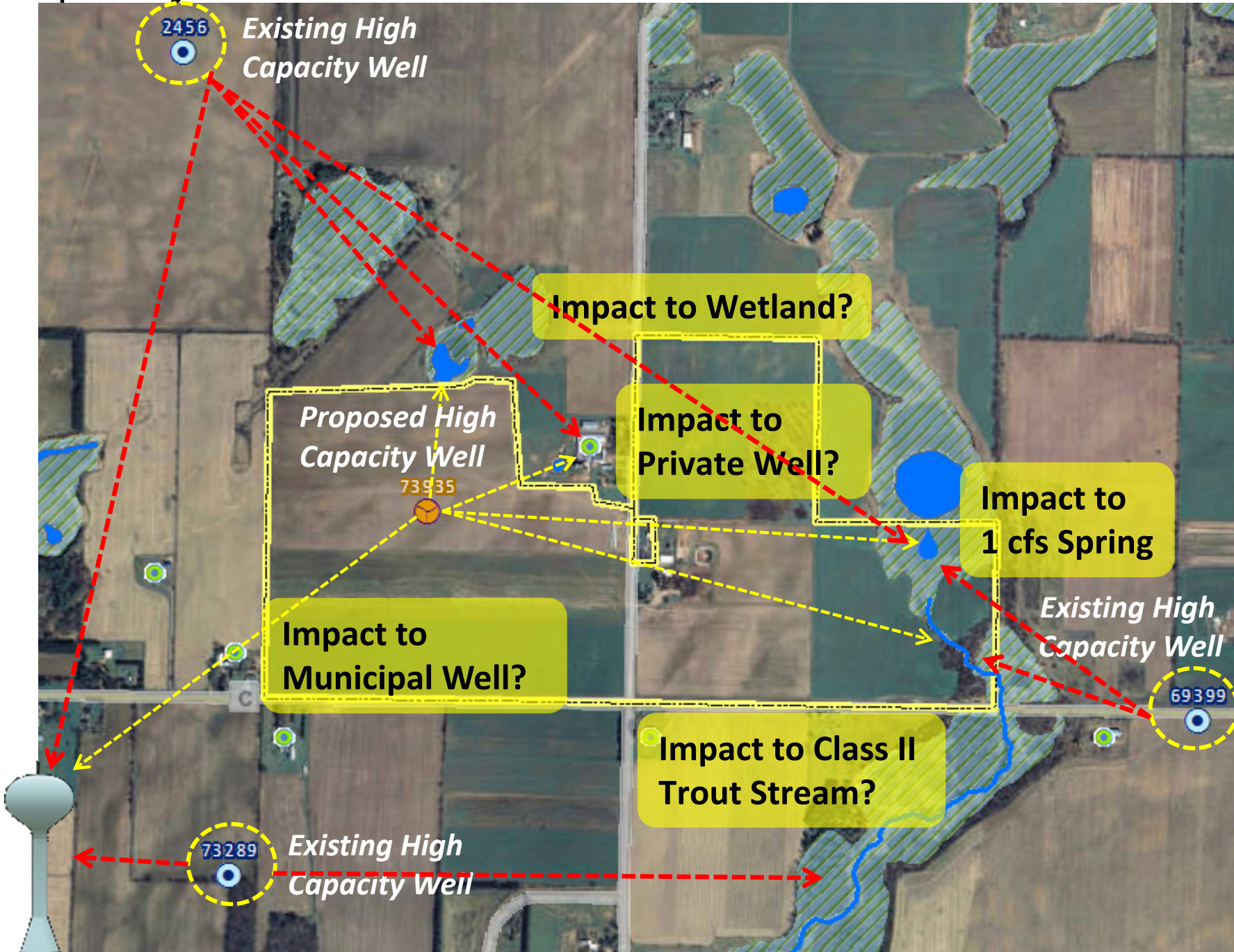
High Capacity Well Review: Resource Inventory

Identify the proximity of each water resources:

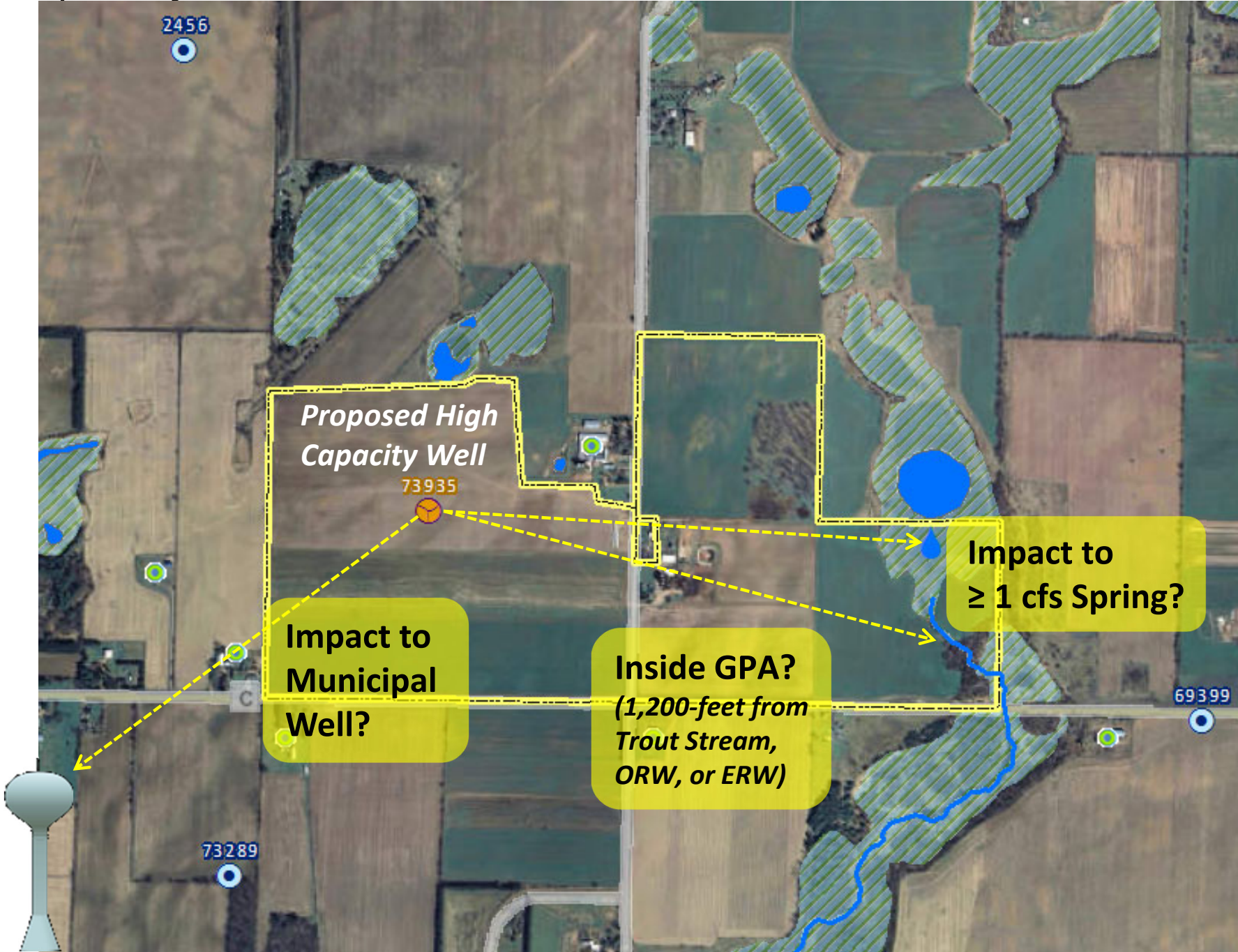
- Navigable Perennial Streams
- Navigable Lakes
- Springs (≥ 1 cfs)
- Municipal Wells



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

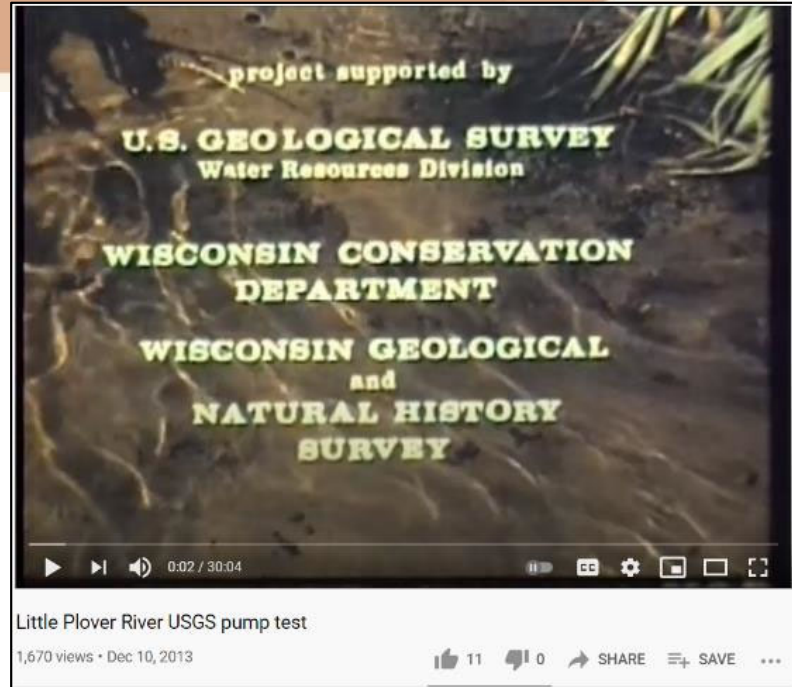
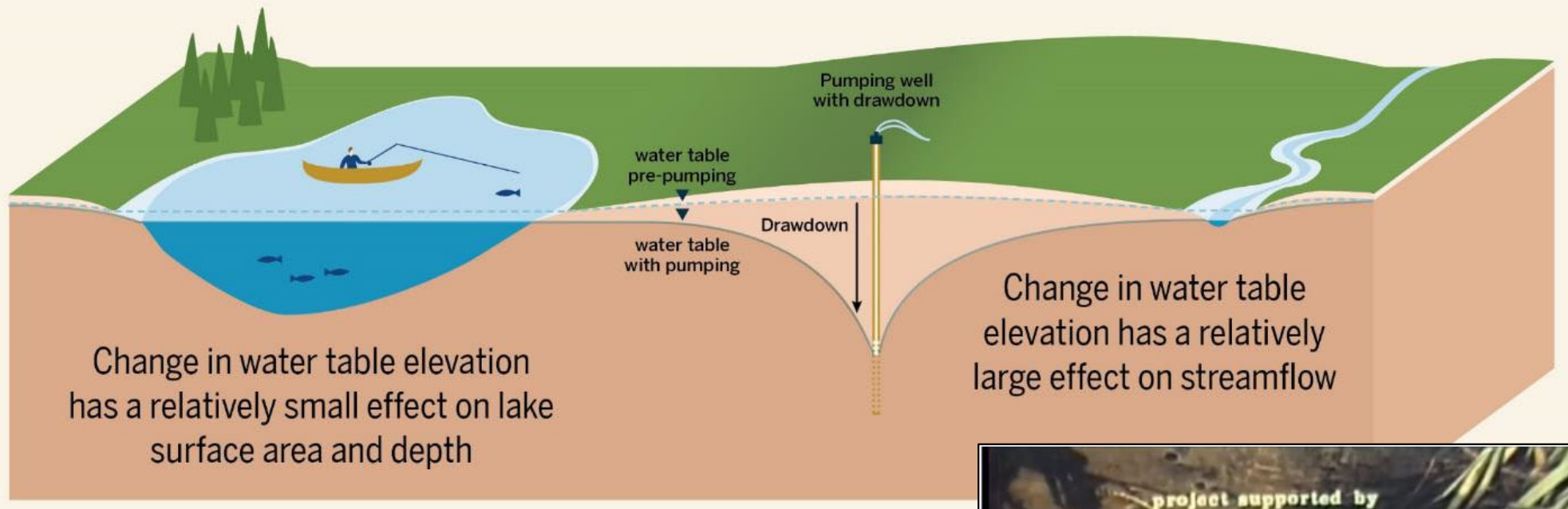


WI High Capacity Well Review Process (May 10, 2016 – June 2, 2020)



High Capacity Well Review: Conceptualization

Relative Impact of a Pumping Well on a Lake and a Stream



<https://www.youtube.com/watch?v=GW9cYdIT8iM>

Understanding the Water Budget

Deposits

- Precipitation
- Groundwater & Surface Water Inflow



Withdrawals

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

Balance

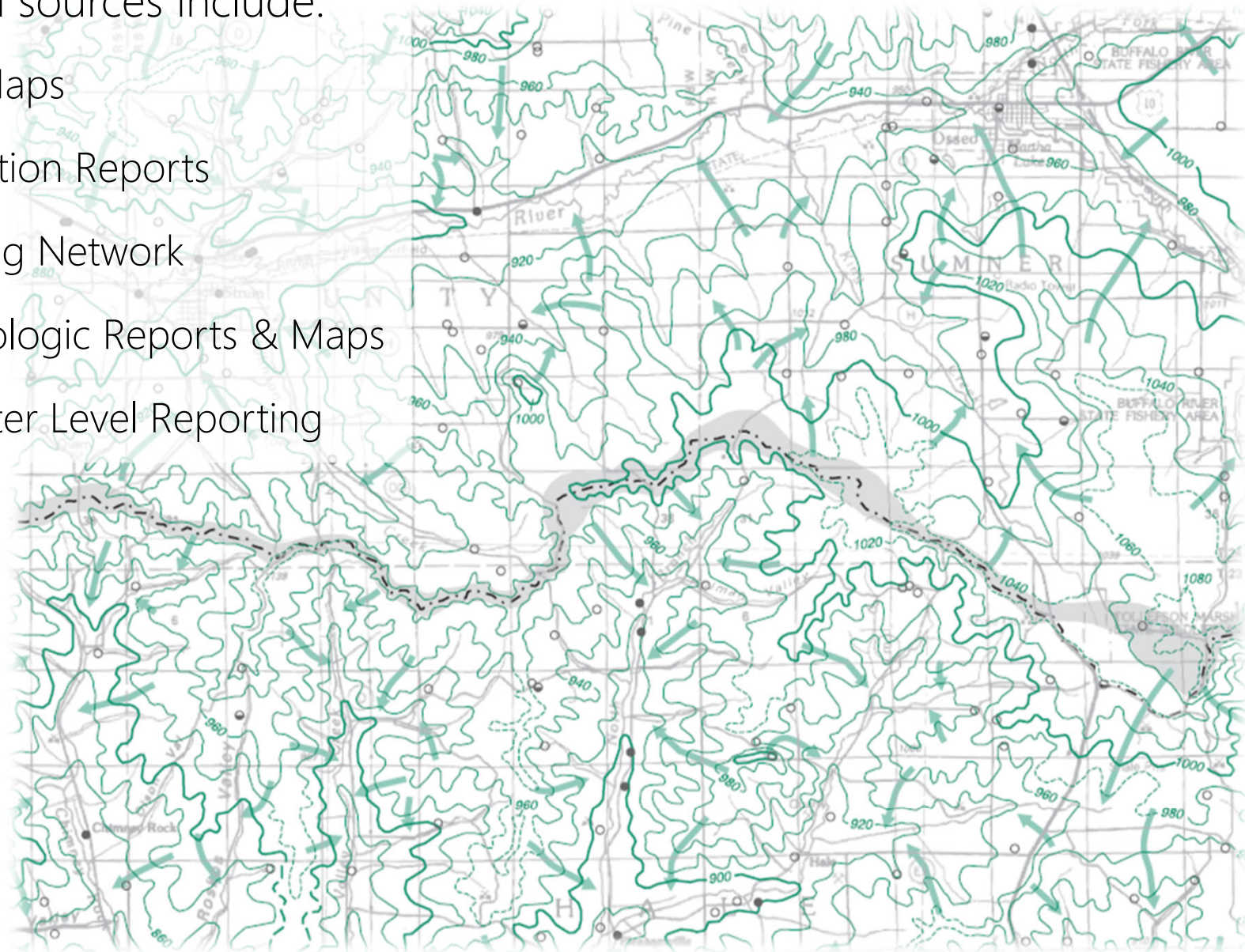
- Baseflow
- Lake Levels
- Groundwater Levels



High Capacity Well Review: Conceptualization

Hydrogeologic data sources include:

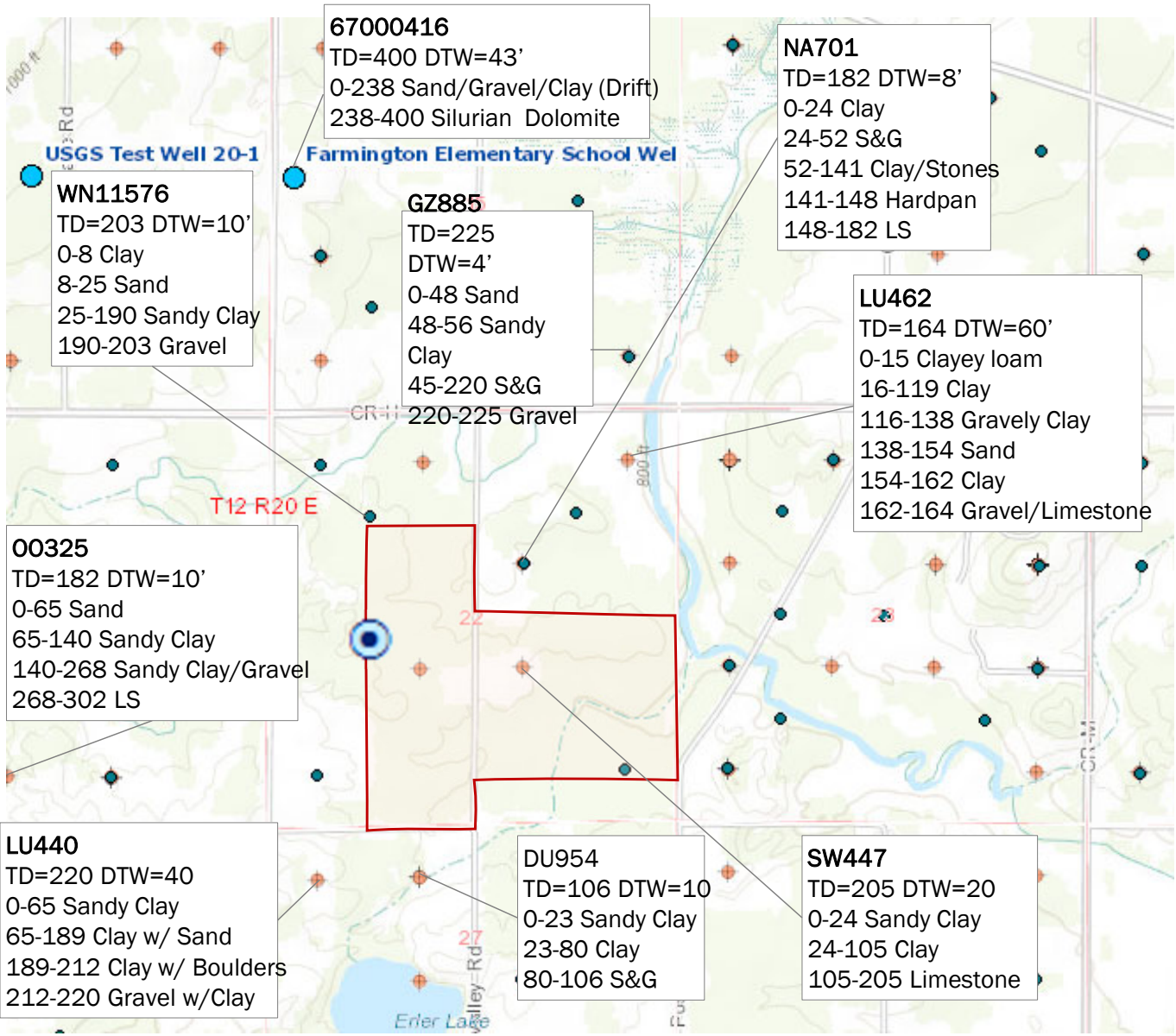
- Water Table Maps
- Well Construction Reports
- GW Monitoring Network
- Published Geologic Reports & Maps
- Municipal Water Level Reporting



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



State of Wisconsin
Department of Natural Resources
Private Well Supply
Box 794
Madison, Wisconsin 53707

NOTE:
White Copy - Division's Copy
Green Copy - Driller's Copy
Yellow Copy - Owner's Copy

WELL CONSTRUCTION REPORT
Form 3900-15
Rev. 2-79
MAY 8 1985

1. COUNTY: Jefferson CHECK (1) ONE: Town Village City Name: Platteville

2. LOCATION: N5 Section 21 Township 3N Range 10W 3. NAME: Platteville OWNER/AGENT AT TIME OF DRILLING CHECK (1) ONE: OWNER/AGENT

4. DISTANCE IN FEET FROM WELL TO ADJACENT: (Record answer in appropriate blocks)

San.	Storm	C.I.	Other	Sanitary Slop. Drain	Sanitary Slop. Sewer	Other	C.I.	Other	Sanitary Slop. Drain	Sanitary Slop. Sewer	Other	C.I.	Other
20													

5. WELL IS INTENDED TO SUPPLY WATER FOR:

Kind	From (ft.)	To (ft.)
Clay	Surface	8
Gravel	8	121
Hard Rock	121	183
Blue Rock	183	192
Oil Rock	192	155
Limestone	155	210
St. Peter	210	244

6. DRILLHOLE

Di. (in.)	From (ft.)	To (ft.)	Di. (in.)	From (ft.)	To (ft.)
10	Surface	42			
6	42	244			

7. CASING, LINER, CURBING AND SCREEN

Di. (in.)	Material	Weight	Specification	From (ft.)	To (ft.)
6	4537 galvanized			Surface	42

8. GROUT OR OTHER SEALING MATERIAL

Kind	From (ft.)	To (ft.)
Cement	Surface	42

11. MISCELLANEOUS DATA

Yield Test: 2 GPM

Depth from surface to normal water level: 130 Ft.

Depth of water level when pumping: 160 Ft. Stabilized Yes No

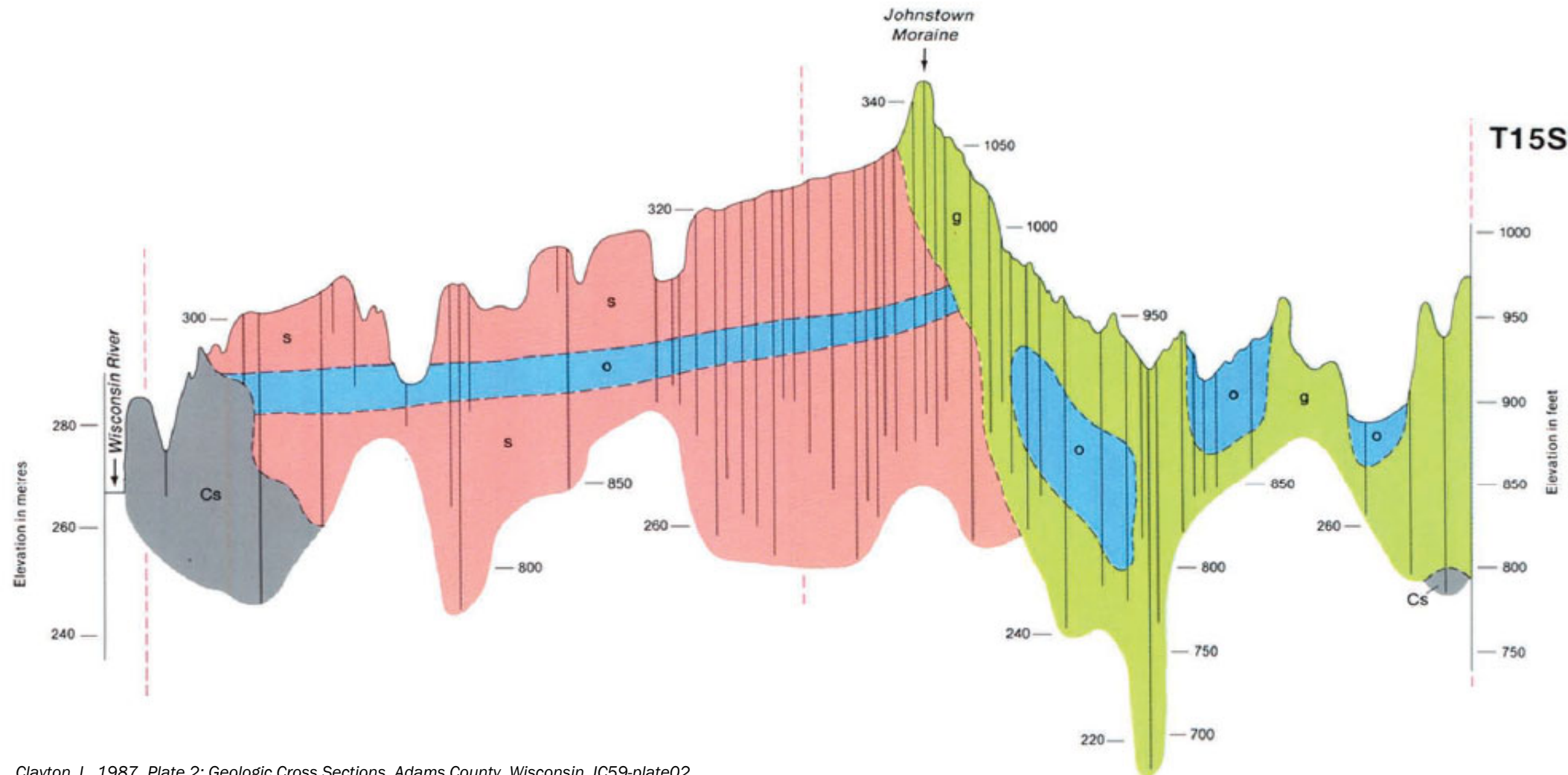
Water sample sent to Madison laboratory on 5-1 1985

Signature: Ralph J. Schmitt Registered Well Driller

Business Name and Complete Mailing Address: Safety Drilling Co.

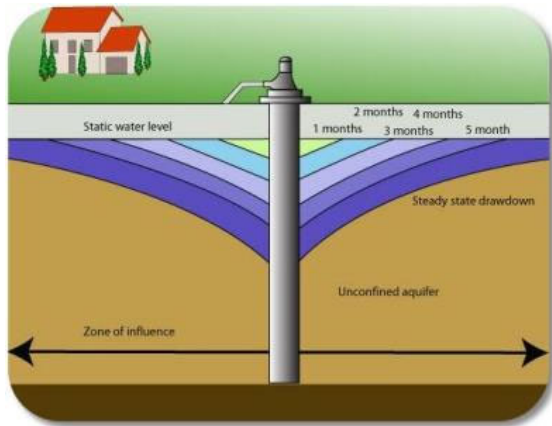
High Capacity Well Review: Conceptualization

- Published cross section and narrative descriptions of geology



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

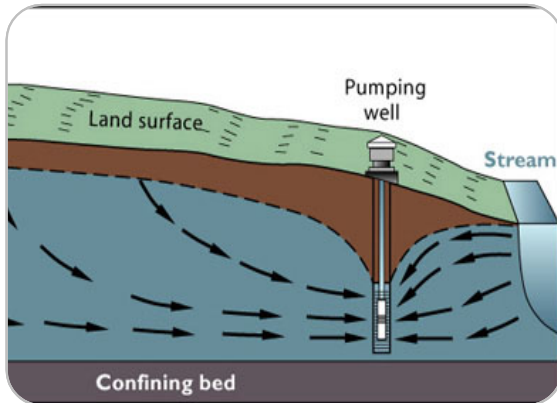
High Capacity Well Review: Mathematical Solutions



Drawdown

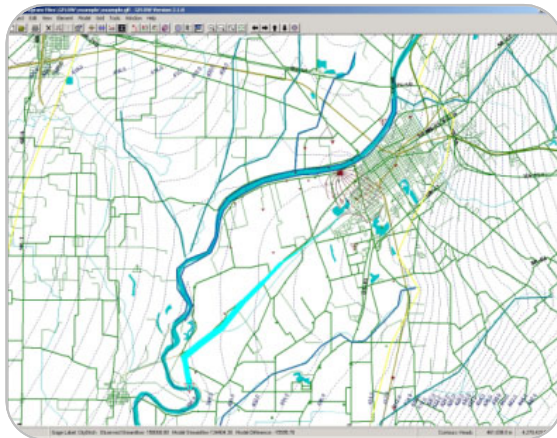
- Theis Solution

$$\left(\begin{array}{l} s = \frac{Q}{4\pi T} \int_u^{\infty} \frac{e^{-y}}{y} dy \\ u = \frac{r^2 S}{4Tt} \end{array} \right)$$



Analytic Stream Depletion

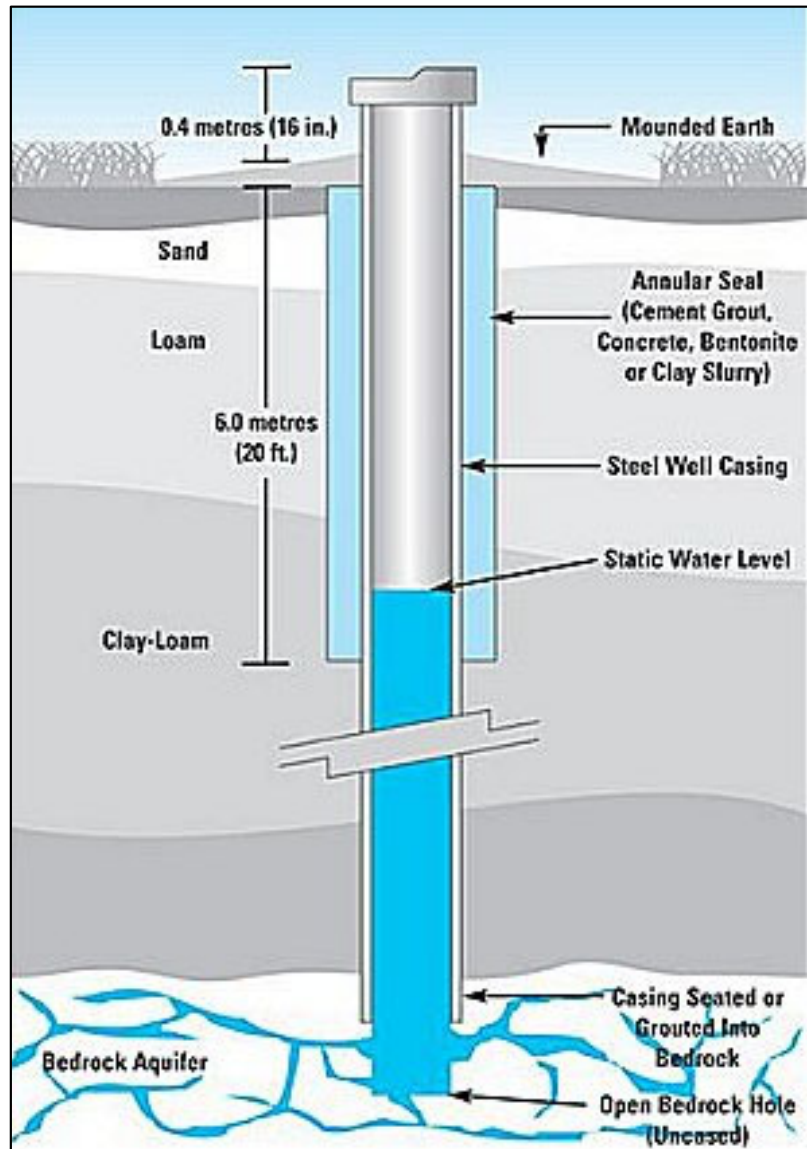
- *Walton Method, quantify depletion after 5 years*



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.

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>

The screenshot displays the Wisconsin Department of Natural Resources website. At the top, there is a navigation menu with links for HUNTING, FISHING, PARKS, CLIMATE, ENVIRONMENT, FORESTRY, LICENSES, NEWS, ABOUT, and CONTACT. Below the menu is a large banner image of a waterfall with the text "WATER USE IN WISCONSIN". Underneath the banner is a grid of resource cards:

- HIGH CAPACITY WELL DATA AND MAPS**: A map of Wisconsin showing the locations of high capacity wells.
- REPORTING WATER USE**: A card with an image of a water meter and text explaining that registered withdrawers must report water use monthly and annually to DNR.
- GREAT LAKES COMPACT AND DIVERSIONS**: A card with an image of a lake and text describing an agreement between Great Lakes states to manage and protect the lakes.
- WISCONSIN WATER WITHDRAWAL DATA & REPORTS**: A card with a bar chart and text stating that users can view yearly reports and summaries of water withdrawals.
- WATER USE REGISTRATION**: A card with an image of a well and text explaining that users must register a water withdrawal if they have a water supply system with a capacity to withdraw 100,000 gallons per day.
- HIGH CAPACITY WELLS**: A card with an image of a well and text defining a high capacity well as one that can withdraw more than 100,000 gallons per day.
- CENTRAL SANDS LAKES STUDY**: A card with an image of a lake and text explaining that DNR is evaluating the hydrology of three lakes in the Central Sands to implement 2017 Wisconsin Act 10.
- WATER USE PERMITTING**: A card with an image of a water treatment plant and text stating that users must apply for and receive a permit before withdrawing water in the Great Lakes Basin.
- WATER CONSERVATION AND EFFICIENCY**: A card with an image of a waterfall and text stating that Wisconsin's abundant water resources are the foundation for safe drinking water, recreation, and economic activity.

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

Available High Capacity Well Resources

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

Wisconsin Department of Natural Resources
Drinking & Ground Water Use Information System

Application

Application Search

Applicant Name <i>i</i>	<input type="text"/>	Applicant No <i>i</i>	<input type="text"/>
Owner Name <i>i</i>	<input type="text"/>	Owner No <i>i</i>	<input type="text"/>
Approved <i>i</i>	From <input type="text"/> To <input type="text"/>	Received <i>i</i>	From <input type="text"/> To <input type="text"/>
County	Select one or more county <input type="text"/>	Water Use Code <i>i</i>	Select one or more water use code <input type="text"/>
Town	<input type="text"/> Range <input type="text"/>	DIR	-- <input type="text"/>
Application Type	--Select-- <input type="text"/>	Section	<input type="text"/>
		Application Status	--Select-- <input type="text"/>

Only recent approval documents are generated within this database. If you need original record, please contact wateruseregistration@wi.gov or 608-266-2299

Source Search

Source Type

Registered Groundwater Sources *i*

Registered Surface Water Sources *i*

Both

Owner Name <i>i</i>	<input type="text"/>	Owner# <i>i</i>	<input type="text"/>	Property# <i>i</i>	<input type="text"/>
County	Select one or more county <input type="text"/>	Water Use Code <i>i</i>	Select one or more water use code <input type="text"/>		
Status	--Select-- <input type="text"/>	WI Unique Well #	<input type="text"/>	HiCap Well No	<input type="text"/>
Major Basin Code <i>i</i>	--Select-- <input type="text"/>	Town	<input type="text"/>	Range	<input type="text"/>
Well Construction <i>i</i>	From <input type="text"/> To <input type="text"/>	DIR	-- <input type="text"/>	Section	<input type="text"/>
Max Approved(GPM) <i>i</i>	From <input type="text"/> To <input type="text"/>	Well Approval <i>i</i>	From <input type="text"/>	To <input type="text"/>	

Advanced Search

Only water withdraw reports from 2010 - present are generated within this database. If you need information on other water withdrawal data, please contact wateruseregistration@wi.gov or 608-266-2299

High Capacity Well Application Search

Existing Registered Sources Searches

