## GROUNDWATER RESOURCES AND SUSCEPTIBILITY GREEN COUNTY, WISCONSIN





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## WHO ARE WE?

### TRC Environmental, Madison

- John Rice, PH, PE
  - Lead Hydrologist
  - Groundwater and Modeling
- James Wedekind, PG
  - Lead Geologist
  - Fractured Rock and Karst
- Jesse Papez, GISP
  - GIS Analyst, Cartographer, Geologist

#### **Green County**

- Todd Jenson, Tonya Gratz, Chris Newberry
  - Green County Land & Water Conservation
- Rob Sommers
  - Green County Land Information Office



# SUMMARY OF GROUNDWATER RESOURCES AND SUSCEPTIBILITY OF GREEN COUNTY

## PROJECT SCOPE/OUTLINE

- I. Provide maps of bedrock geology and depth to bedrock
  - First occurrence of rock in the subsurface
  - Well logs
  - Field reconnaissance
- 2. Provide a water table map
  - Springs, surface water, well logs
- 3. Conduct groundwater recharge modeling
  - USGS Soil-Water-Balance (SWB) recharge model
- 4. Prepare groundwater susceptibility map
  - WDNR groundwater susceptibility model



## GROUNDWATER SUSCEPTIBILITY

#### What does this study provide?

- Map showing the general ability of soil and rock to facilitate the movement of water (and contaminants) from the land surface to the shallow groundwater (water table)
- A resource to guide interested parties to areas of potential concern that may require further study
- Can be combined with more detailed land use maps, groundwater quality data, contamination source information, etc. to assist Green Co. to make groundwater management and land use planning decisions



## PREVIOUS STATEWIDE ANALYSIS

Wisconsin's Groundwater Management Plan

# Groundwater Contamination Susceptibility in Wisconsin

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#### Resource Maps Combined for the Composite Map



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Report No. 5 r Contamination ptibility Map and Evaluation

## GROUNDWATER SUSCEPTIBILITY

#### What is does <u>not</u> do:

- Predict areas that will be (or are) contaminated
- Predict areas that are safe from contamination
- Replace site-specific data evaluation



## GROUNDWATER SUSCEPTIBILITY

Whether or not groundwater at a particular site is contaminated depends on a variety of factors including:

- The type of substance released
- The concentration of the released substance
- Site-specific subsurface conditions







## GREEN COUNTY

#### TOPOGRAPHY



## TOPOGRAPHY AND GEOLOGY



Modified from Hindell and Skinner 1973



### UNCONSOLIDATED SURFACE DEPOSITS

SOILS

**GLACIAL SEDIMENT** 



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#### **GLACIAL SEDIMENT**



Results you can rely on

www.trcsolutions.com

1970

### **ROCK UNITS OF WISCONSIN**



## **INFORMATION SOURCES – WELL LOGS**

- Geologist interpreted
- Very reliable
- Few available (6, from WGNHS)

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a 70	100-120	30 1	Dolomite, light gray	11
1	125-130	10	Sandstone, coarse to fine, it gray, quartzitic	
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	165-170	5	Siltatone, light gray, sandy, dolomitic	1 1
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Formations: Surface (laks or wind deposit); St. Peter; Lower Magnesian (Prairie du Chien or On Trempealcau; Franconia (formerly Masomanie); Dresbach (Galesville); Eau Claire

k				CITY WELL NO. 5. MONBOE, WIS. NETWEE sec. 35. T. 2 N. R. 7 E.	Gn-9
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				Samples examined by F. T. Thwaites, Nos	. 143321-143447,
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F	65-85	20 5	1 1	Dolomite, blue-grey, light grey	- 23" hole
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-					pipe



V Tested at 452 g.p.m. specific capacity = 7.3 g.p.m.

## INFORMATION SOURCES – WELL LOGS

#

Reco 41967 Found

- Driller Interpreted, abundant but not always reliable
- Typically available to Q or QQ section level (not good enough)
- Improve Location with GIS (w/ help from Co.)
- 2,677 observations/logs used
- Not all usable

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Madison	<i>f.</i> z.g 11	58		Yes	< N	o
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06	er	-					
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#### SINNIPEE GROUP (OS) PRIMARILY DOLOMITE



#### QUARRY ON CTY H



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#### **SINNIPEE GROUP** FORMS LEDGES OR RUBBLE IN OUTCROP – SOIL COVER IS OFTENTHIN





STH 39 / York Valley Rd



#### Fossils are common



#### CTH KS / Twin Grove Rd



Note the repeated pattern of vertical fractures and thin soil cover



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#### DOLOMITE IS HIGHLY FRACTURED AND WEATHERS TO FORM VOIDS









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ENLARGED FRACTURES CAN PRODUCE VOIDS THIS TYPE OF SOLUTIONAL ACTIVITY IN ROCK PRODUCES CONDUITS FOR VERTICAL FLOW



#### SINNIPEE / ANCELL CONTACT PLATTEVILLE/GLENWOOD FORMATIONS

CTH EE



The contact is important because it was typically easy to identify in the field and gave us good control on a specific surface.

This photo also shows evidence of conduit formation along the contact itself.





- Predominately sandstone
- Found as low ridges and outcrops in fields
- High grade sand mined for frac sand and glass production

Includes two formations

CTH EE

- Glenwood
- St. Peter

# ANCELL GROUP



Often crops out along the sides of low hills





## ANCELL GROUP

#### ST. PETER SANDSTONE

The St. Peter weathers gray with some fractures, but is often massive in appearance with little weathering.

Tunnel Rd



#### ST. PETER SANDSTONE MASSIVE ROCK – VERY FEW PARTINGS





#### ST. PETER SANDSTONE SPARSE VERTICAL FRACTURES





## ST. PETER SANDSTONE

CLOSER LOOK SHOWS A FEW MORE





## ST. PETER SANDSTONE

## EVEN A FEW FAULTS! – BUT OF NO SIGNIFICANCE TO GROUNDWATER SUSCEPTIBILITY





#### ST. PETER SANDSTONE

#### INTERSECTING FRACTURES

Fractures in sandstone are present but not enlarged like they are in limestone and dolomite.

Lower potential for transport compared to Sinnipee

Thin soil cover, as is common





#### PRAIRIE DU CHIEN GROUP (Opc)

Few outcrops – usually buried beneath glacial deposits or stream sediment

Predominately dolomite – often with white chert

Often missing altogether from past erosion

County Hwy F

Water St, Blanchardville

## CAMBRIAN SANDSTONE (Cu)

- Not exposed at the surface in Green County
- Aquifer for many cities in Wisconsin including Monroe, New Glarus, Brodhead
- Found mostly in the western part of the State - most famously in the Dells







#### Not Green County





## DEPTH TO BEDROCK



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## **INFORMATION SOURCES – WELL LOGS**

- Driller Interpreted, more reliable for depth to bedrock than geology
- Some additional well logs are usable for this task, if not finished in • bedrock or nonspecific rock naming is used
- Field observations of outcrops, documented outcrops (zero depth) •

3,254 observations/data points/logs used (Thanks Rob!!!!)

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www.trcsolutions.com	m 🏻	your spance concerning other possible names, increasion concerning difficulties enrice intent, and data relating to nearby wells, arrents, an failwing the wells, amount of consent used in growing, blasting, etc., should be given on reverse side.	in, meaning of
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#### PLATE 2 Green County Depth to Bedrock

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- Personal Steam/River Fuestion
- Internet to an Acare/Res Cleasta-
- Reputer Fire (Cos/Villago
- Approximate Edge of Glavid Advance (high increase planer-time)

#### DEPTH TO BEDROCK FEATURES

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### HYDROLOGY RECHARGE AND SUSCEPTIBILITY



## HYDROLOGY – WATER TABLE

- First occurrence of groundwater in the subsurface
- The water table is a subdued reflection of the topography
- Springs and surface water (i.e. rivers and lakes are an expression of the water table
- The water table was also estimated using water elevations measured in wells





## HYDROLOGY – GROUNDWATER FLOW

- Precipitation infiltrates to the water table in areas of recharge
- Groundwater discharges to lakes and streams and pumping wells
- Groundwater flows from areas of recharge to areas of discharge





## THE WATER CYCLE

- <u>Conceptual</u> model created by the WDNR/WGNHS
- Matches Green Co. very well

#### Groundwater and land use in the water cycle

• Soil cover on uplands is thinner than depicted







## INFORMATION SOURCES

- Well Logs with static water level observations
- Surface water information (USGS NHD)
- Spring location information (WGNHS)
- 3,260 data points used

WELL CONSTRUCTOR'S REPORT TO Y	VISCONSIN STATE BOARD OF HEALTH
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#### PLATE 3 Green County Water Table Map

#### BASEMAP FEATURES



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WATER TABLE FEATURES

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Private Well Location with Reserved State Depth to Witter

Surface Water Features

Internation System/Ray, Flowing

\* Spring Tabasion

#### ABOUT THIS MAP

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## GROUNDWATER RECHARGE

- Provides estimate that groundwater replenishes from rain and surface water
- Represents effects on water infiltration related to surface and subsurface features above the water table
- High recharge rates can be an indicator of added susceptibility risk



## GROUNDWATER RECHARGE MODEL

#### "SWB" USGS developed Soil-Water Balance model

- Applied in other county studies
- Daily climate information (1981, NR151.12 typical year)
- Land use types
- Soil hydric properties
- Soil water capacity
- Topographic model, surface water flow direction (Green Co. LiDAR)
- Modeled on a 50'x50' grid covering county





## GROUNDWATER SUSCEPTIBILITY

- Provides relative contaminant susceptibility rating across county
- Use as a planning tool to review potential groundwater contamination potential from surface sources
- Does not replace site-specific environmental impact assessments (but TRC can help with that too)



## GROUNDWATER SUSCEPTIBILITY MODEL

- Developed by WDNR
- Provides and objective basis for evaluating the vulnerability of groundwater to pollution from surface impacts
- Uses county geologic and hydrologic data





## SUSCEPTIBILITY MODEL -ASSUMPTIONS

- Contamination source is the surface
- Contamination is driven by infiltration from precipitation
- Contamination is carried by groundwater





## GROUNDWATER SUSCEPTIBILITY MODEL

Model developed by WDNR/WGNHS for statewide study

- Conducted at significantly higher resolution for Green Co. than statewide study
- Bedrock Geology
- Depth to Bedrock
- Water Table
- Soil Properties



Composite Scor

Table(multiplier)] + [Soil Characteristics(value) x Soil Characteristics(multiplier)]

## PREVIOUS STATEWIDE ANALYSIS

Wisconsin's Groundwater Management Plan

# Groundwater Contamination Susceptibility in Wisconsin

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Valued bosonces, in comparison with the U.S. Geological Service and with constants: from the Waterscher Dipological and National History Schwerg and the Directory of Waterscher, and workland the project devices the work of the Directory of Waterscher and Waterscher Dipological Constants and program to the Service and Annual History and Service Constants to geored-work matter comparison of the pro- and here: susceptibility to geored-work matter comparison of the pro-

Five physical resource characteristics were identified as important is determining how easily a contain instruction be carried through over sing manefals in the group/distant. To see there are dependent bedrack, repe-at bestruct, wall characteristics, should be water faille and characteristics of sufficiel deposits. This project defined "generation may supply by " in the case with which a constructed can be hanged by how the back surface to the log of the generation reacted the "water cable".

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#### Resource Maps Combined for the Composite Map



Resource Map 1: Depth to Bedrock

Control to the second s



Resource Map is Groth to Water Jable

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Reissary Map 3: Surficial Espants

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#### Use of This Map

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Report No. 5 r Contamination ptibility Map and Evaluation

## PREVIOUS COUNTY ANALYSIS

- Actually just a clip from statewide evaluation
- Very low resolution

Green County – Groundwater-Contamination Susceptibility Analysis





**5 KILOMETERS** 

**EXPLANATION** 

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### QUESTIONS??







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#### FOCUS AREA, JUST SOUTH OF BROWNTOWN

![](_page_66_Figure_0.jpeg)

![](_page_67_Figure_0.jpeg)

## FOCUS AREA, JUST SOUTH OF BROWNTOWN

![](_page_68_Figure_1.jpeg)

![](_page_68_Picture_2.jpeg)

![](_page_69_Figure_0.jpeg)

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