

Southwest Wisconsin Groundwater and Geology (SWIGG) Study

A multi-county effort to better understand private drinking water

Task Force on Water Quality Public Hearing
May 8, 2019

"This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information."

Background

- Jan. 2018 Moratorium & Manure Spreading Restriction requests
- Dr. Mark Borchardt & Dr. Madeline Gotkowitz Presented
- Invited Iowa & Lafayette Counties
- Grant County approved Groundwater study
- Grant, Iowa & Lafayette Counties discussed groundwater study



SWIGG Study Purpose:

To give counties and the state better information about how to ensure residents have safe water to drink

Goals:

- assess how widespread any well contamination is
- identify sources of any contamination
- analyze risk factors associated with well contamination
- develop geological maps

Researchers:

- **Dr. Ken Bradbury**, Director and State Geologist, WI Geological & Natural History Survey
- **Dr. Mark Borchardt**, Research Microbiologist, USDA Agricultural Research Service
- **Joel Stokdyk**, Biologist, U.S. Geological Survey

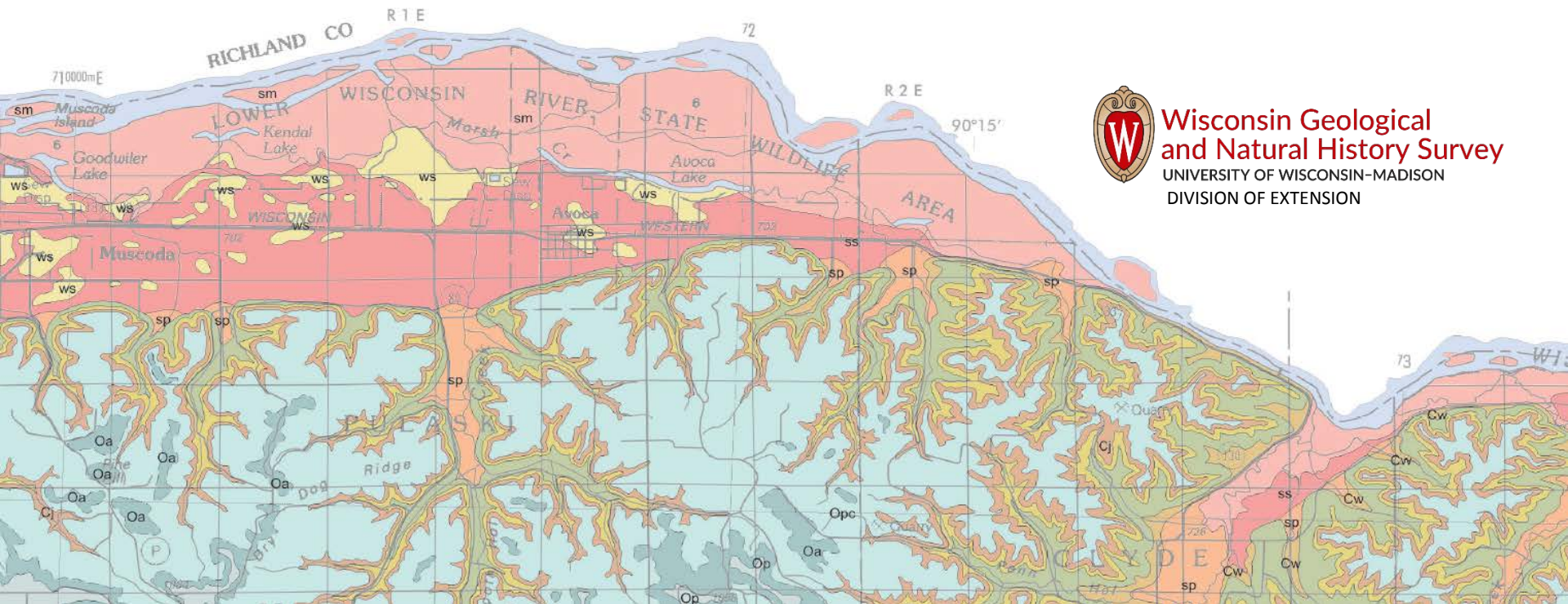


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- Land Conservation Committees & Departments were created in 1982 to provide local leadership in protecting Wisconsin's land & water resources
 - Authorized to implement DATCP, DNR, & County Conservation Programs
 - Farmland Preservation
 - Conservation Reserve Enhancement Program
 - Soil & Water Resource Management Program
 - Nonpoint Source Pollution Control Program
 - Land & Water Resource Management Plan

Wisconsin Geological and Natural History Survey

We provide objective scientific information about the geology, mineral resources, and water resources of Wisconsin

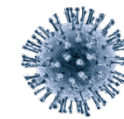
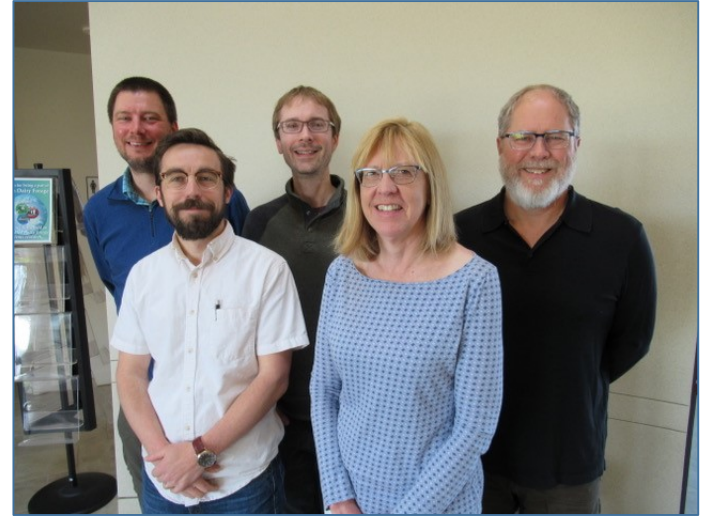
- Hydrogeology
- Geologic mapping
- GIS
- Well construction analysis
- Project guidance



**Wisconsin Geological
and Natural History Survey**
UNIVERSITY OF WISCONSIN-MADISON
DIVISION OF EXTENSION

Laboratory for Infectious Disease and the Environment

- Interagency research lab, USDA-ARS and USGS
- Study occurrence, transport, and health effects of human pathogens in the environment
- Special focus on water quality and waterborne infectious disease
- More than 200 research publications



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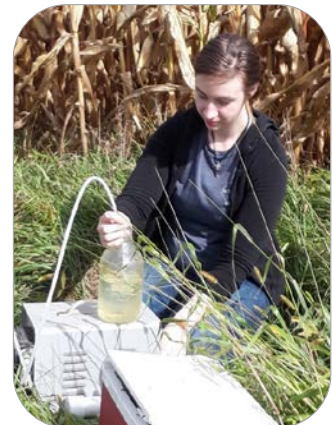


LABORATORY FOR INFECTIOUS DISEASE AND THE ENVIRONMENT

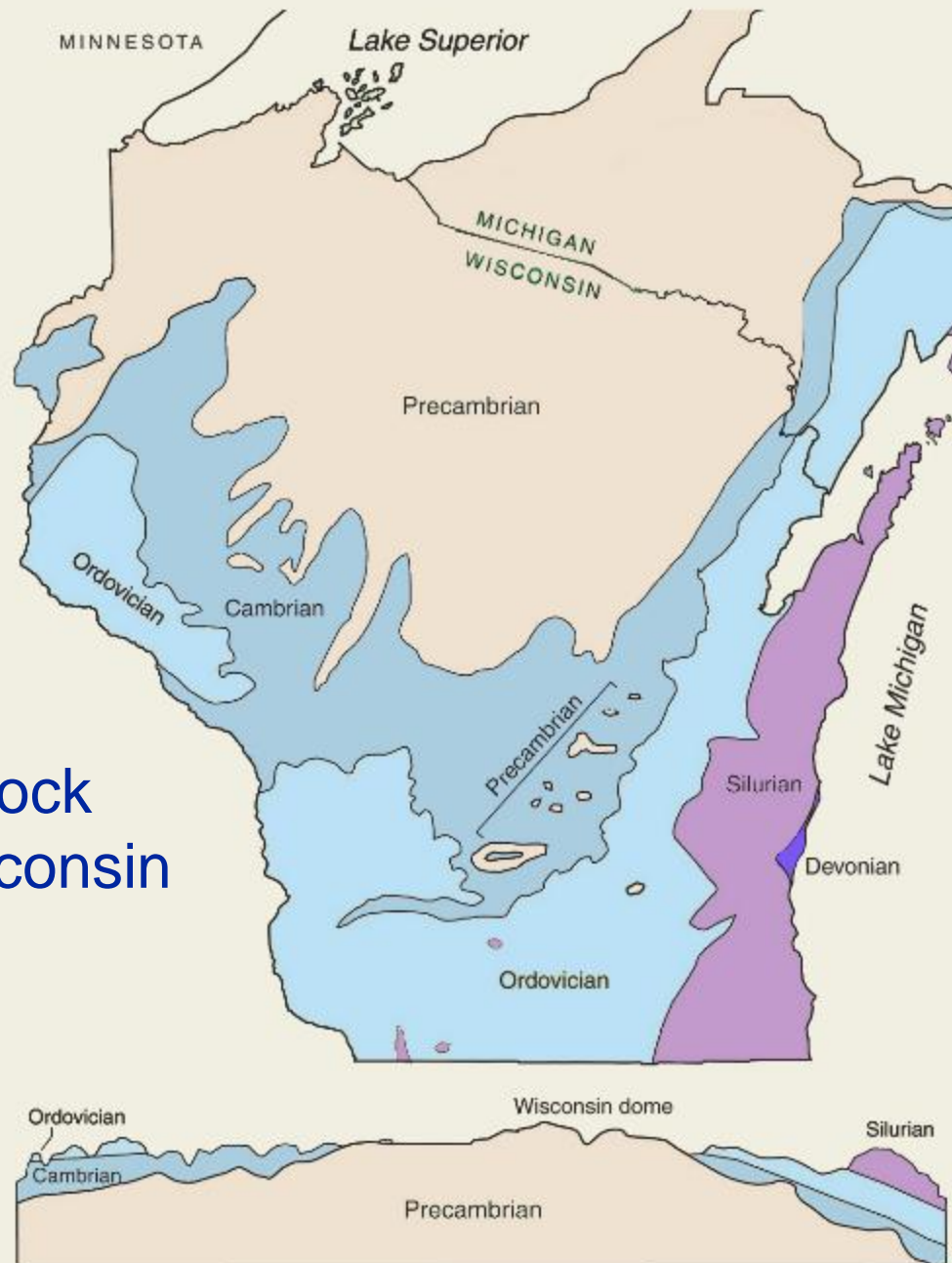


Water and Environmental Analysis Lab (WEAL)

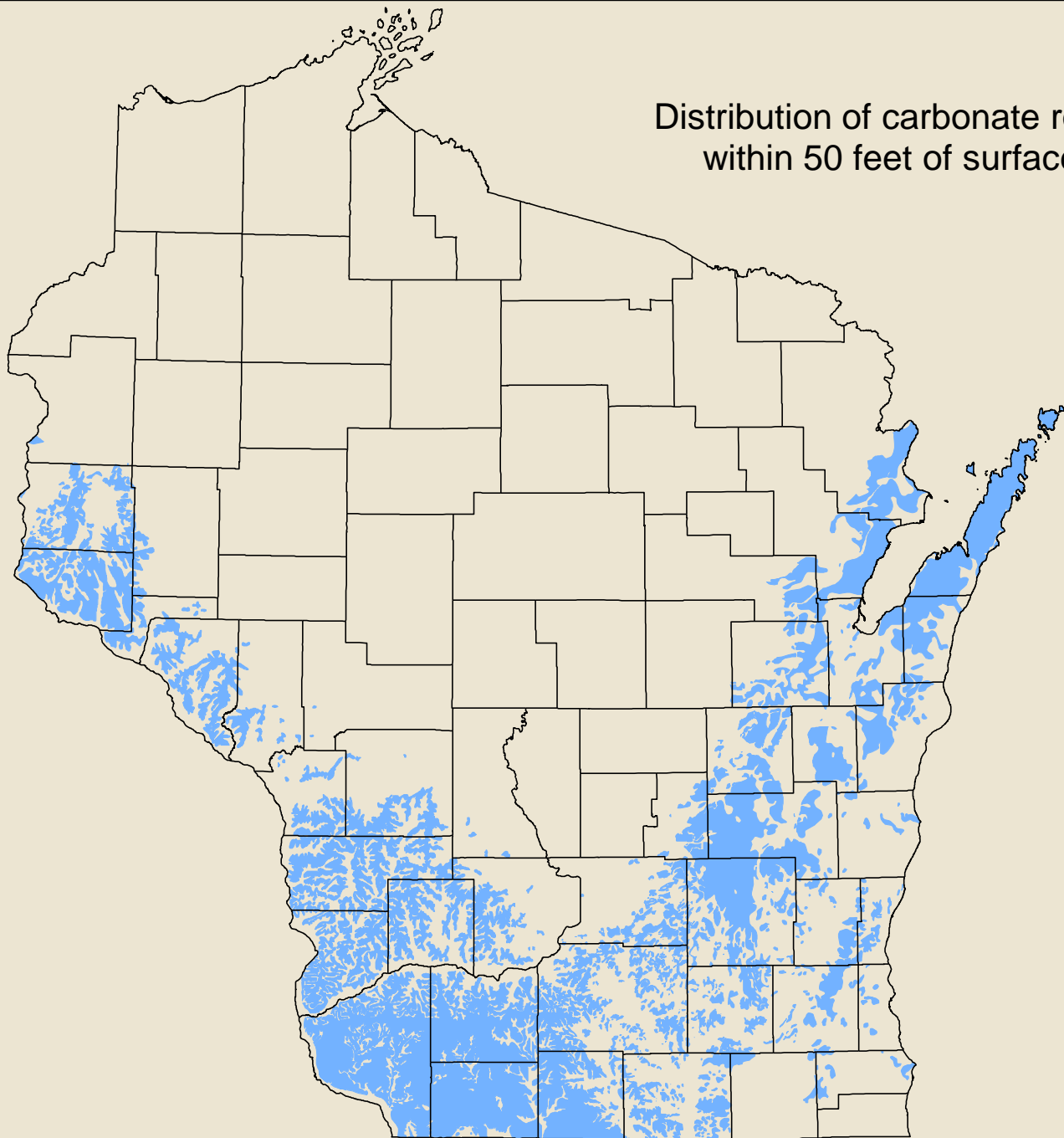
- UW-Stevens Point Center for Watershed Science and Education
- Wisconsin DNR and DATCP certified
- Outreach services
 - Well water education
 - Lake/river monitoring
 - GIS (mapping/modeling)
- Analyses Offered
 - Bacteria
 - Nutrients
 - Nitrate
 - Metals
 - Water chemistry
 - Pesticides and metabolites; pharmaceuticals



Simplified bedrock geology of Wisconsin



Distribution of carbonate rock
within 50 feet of surface



Hydrogeology of Southwest Wisconsin

- Bedrock aquifers
- Carbonate rock near surface
- Groundwater moves through fractures and karst conduits
- Flow can be very rapid
- Sinkholes and karst features occur
- A very vulnerable landscape



Bedding plane fractures are common in dolomite



Iowa County

Karst Features...

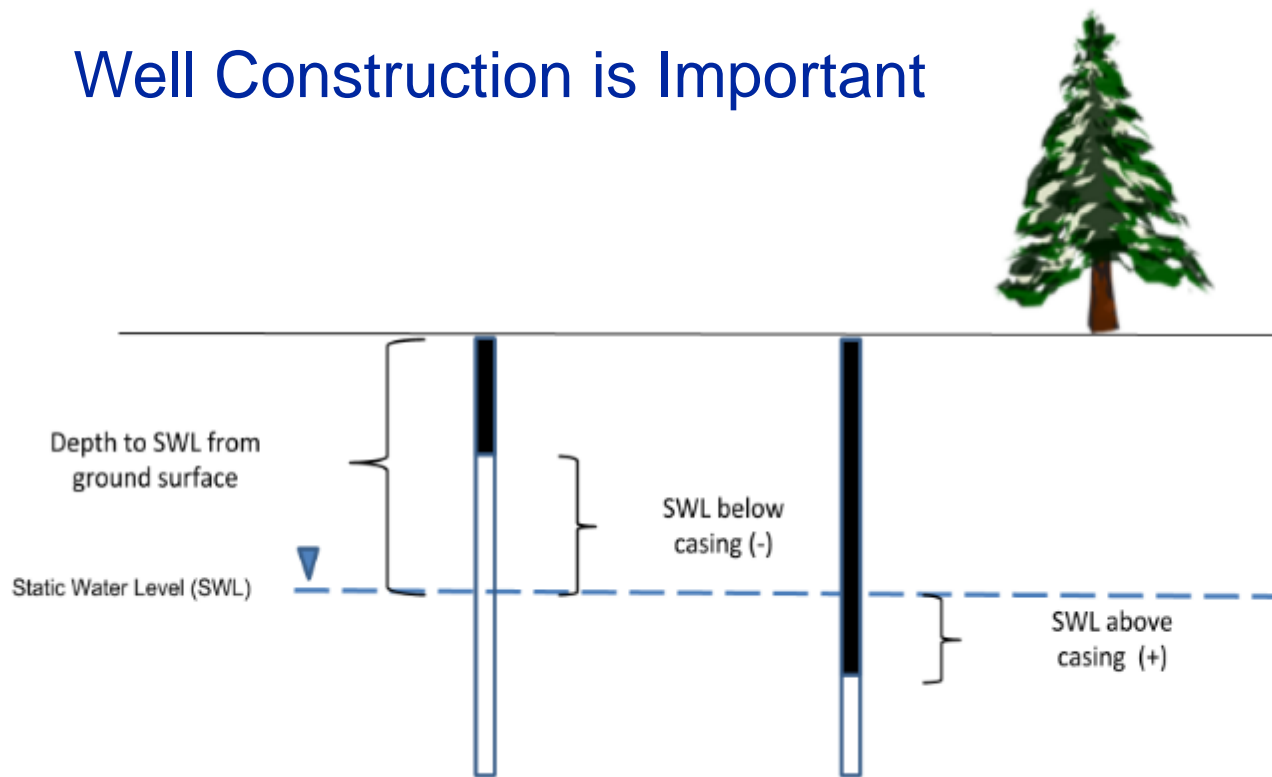


Evidence of subsurface
dissolution and collapse

Geology is Important

- Geology & soil depth affect groundwater vulnerability
- One objective is to develop **geological maps**
 - Depth to bedrock
 - Rountree formation
- Data will be included in the analysis of well contamination factors
- Maps are resources for uses beyond this study

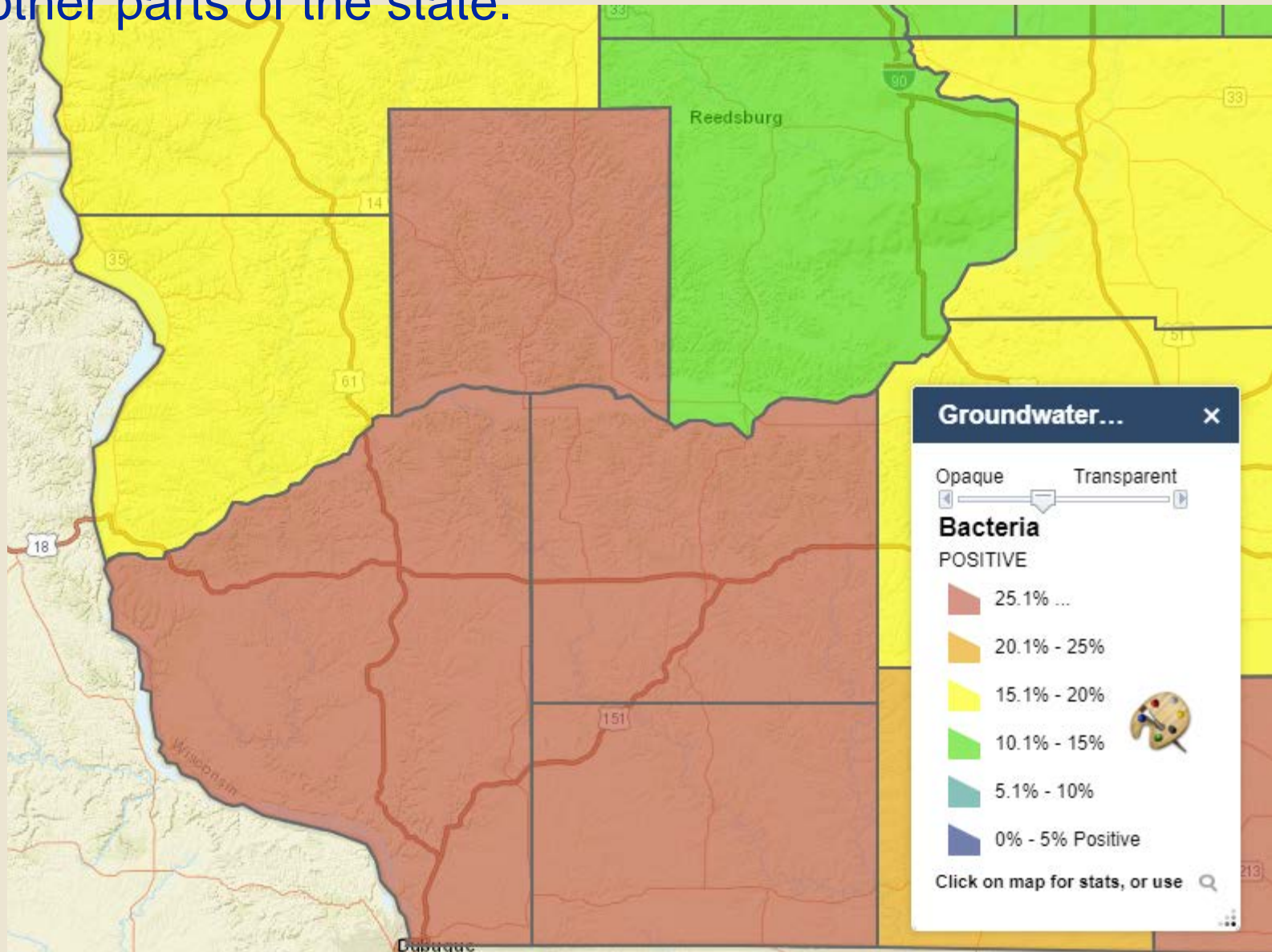
Well Construction is Important



Wells with shallow casings (cased above water table) are more vulnerable to contaminants originating at the land surface than more deeply-cased wells.

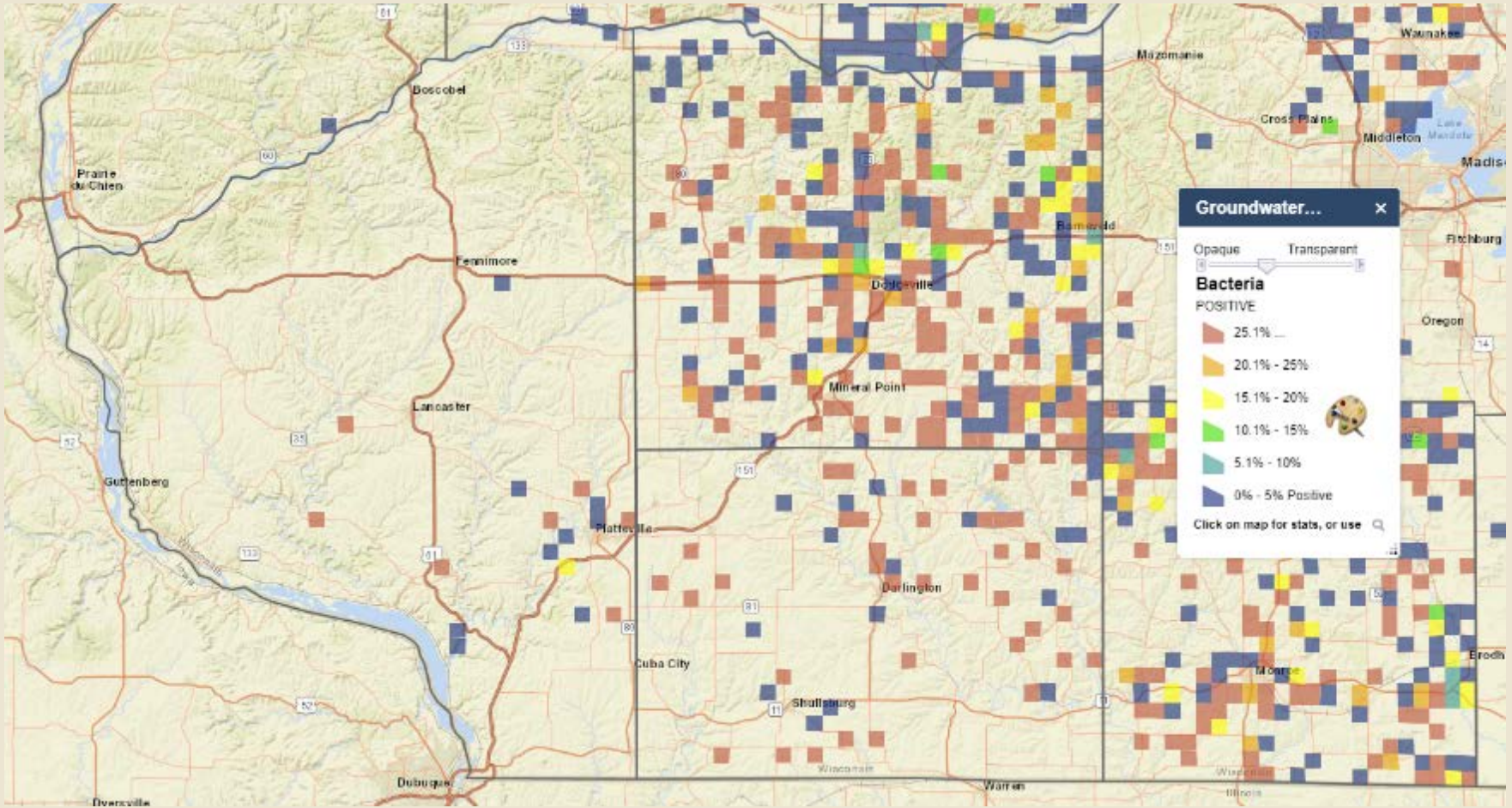
A preliminary review of well construction identified over 900 such wells in Grant County alone.

Based on historical water sampling, southwest Wisconsin has a higher incidence of bacterial presence in wells than many other parts of the state.



from UWSP water quality viewer: www.uwsp.edu/cnr-ap/watershed/Pages/WellWaterViewer.aspx

Prior to this study, well sampling was relatively sparse.



from UWSP water quality viewer: www.uwsp.edu/cnr-ap/watershed/Pages/WellWaterViewer.aspx

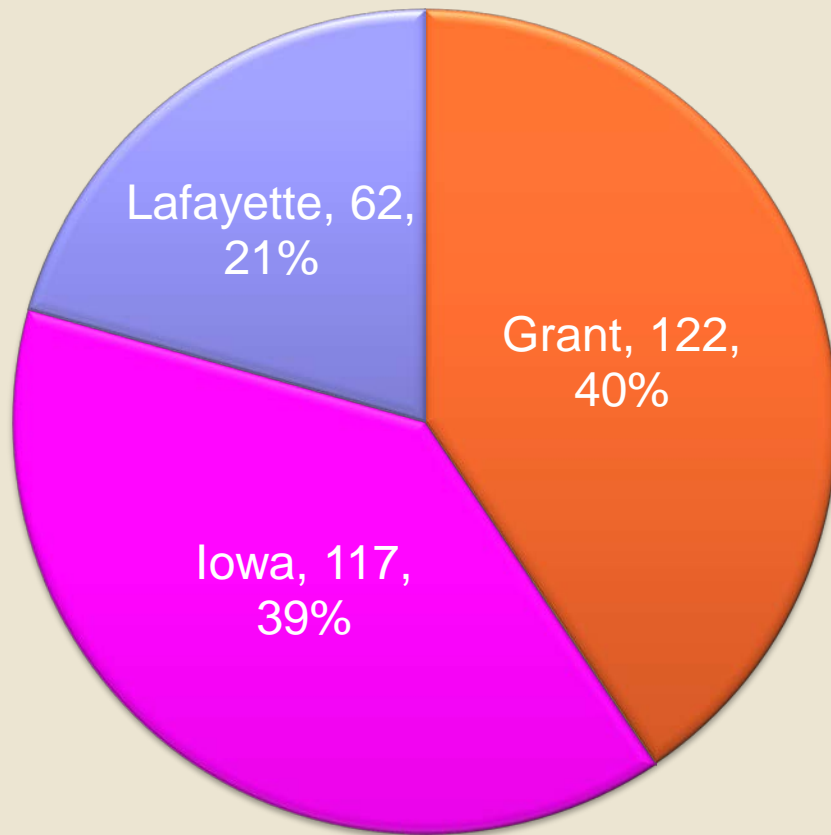
What We've Done So Far:

- Completed first round of randomized sampling (November, 2018).
 - Homeowners collected samples
 - Samples analyzed for total coliform, *E. coli*, & nitrate by WEAL (UW-Stevens Point)
 - Results reported to individual home owners in December.
- Completed second round of randomized sampling (April, 2019).
 - Analyze for total coliform, *E. coli*, nitrate
 - Laboratory analysis & data review in progress
- Completed first round of sampling to determine fecal source of contamination (April, 2019).

How Widespread Is Contamination?

Results from the first sampling event

Number of Wells Sampled = 301



- Proportioned approximately by population
- Samples from individual counties represent the 3-county region
 - Similar geology
 - Representative sample

Results of First Sampling Round, Nov. 9-10, 2018

Percentage of wells positive for indicator bacteria or with high nitrate

	Wells sampled	Total coliform	<i>E. coli</i>	High nitrate*	Total coliform or high nitrate
SWIGG	301	34%	4%	16%	42%
Statewide 1997	534	23%	3%	7%	-
Statewide 2013	3838	18%	-	10%	-

*High nitrate is $\text{NO}_3^- \text{-N} > 10 \text{ mg/L}$

Percentages of wells with contaminants detected in the three counties generally exceed statewide averages.

USGS disclaimer for study data: "Preliminary Information-Subject to Revision. Not for Citation or Distribution."

Statewide averages: Information on the quality of water found at community water systems and private wells. United States GAO/RCED-97-123, June 1997.

Knobloch L., Gorski P., Christenson M., and Anderson H. 2013. Private drinking water quality in rural Wisconsin. Journal of Environmental Health 75:16-20.

Nitrate & Indicator Bacteria: Standard Water Quality Tests

Nitrate

- Source: manure, human wastewater, & fertilizer
- Maximum contaminant level: 10 ppm NO_3^- -N

Total coliform

- Source: fecal & non-fecal
- Maximum contaminant level goal: 0

E. coli

- Source: fecal
- Maximum contaminant level goal: 0

**All three: Indicate contamination but not the
fecal source**

42% of wells in the first sampling round had bacteria or high nitrate

Where's it coming from?
What factors are involved?

Potential fecal sources

- Septic systems: 16,092
- Septage-applied s: ?
- Hogs & pigs: 71,983
- Cattle & calves: 373,411

Other factors

- Well characteristics
- Rainfall
- Geology



What are potential sources of contamination?

Approach: Test a portion of contaminated wells for *host-specific* microorganisms

- Random selection from contaminated wells
- Laboratory staff collect samples
- Test microbes unique to humans, cows, pigs

Outcome: Identify contamination source for a subset of wells

Fecal source is important, but other factors help us understand & address contamination

Which factors affect contamination?

Approach: Evaluate relationship between contamination & well characteristics

- Well & casing depth
- Age
- Depth to bedrock
- Others

Outcome: Statistical assessment of factors that are related to contamination

SWIGG Study Outcomes

1. Percentage of wells contaminated using standard nitrate & bacteria tests
2. Determination of the contamination source (human, bovine, swine) for a subset of wells
3. Evaluation of well characteristics associated with contamination
4. Geologic maps for bedrock depth & Rountree formation

SWIGG Study: Local Funding

County	Portion of SWIGG region
Grant	56%
Iowa	26%
Lafayette	18%

- Estimated total project cost: \$203,000
- Grant: Some 2018 dollars available
- Iowa: Work it into plan for 2019 & 2020 budgets
- Lafayette: Work it into the normal budget process
 - Lafayette Co. for 2019: \$15,470
 - Lafayette Ag Stewardship Alliance: \$7,000
 - Private donations: \$7,910

Funding Needs

- ☐ Complete funding of SWIGG study
- ☐ With cost-sharing requirements County funds aren't anywhere near the amount needed to address water quality issues
 - 2019 average allocation per County is about \$200,000 for staff and cost-sharing
 - Estimated need: Roughly \$2-4 million per County per year
(based on an Iowa County impaired watershed estimate)
- ☐ See WI Land & Water Association recommendations and estimates

Problem-solving Approach

- ☐ Area-specific data and solutions
 - More capacity for microbial source tracking
- ☐ Complex problems require complex solutions
 - Stakeholder collaboration, problem-solving, buy-in, and accountability
 - Avoid thinking there is a quick fix or silver bullet
 - May need to look at agriculture policy and economics
 - May need to explore research and demonstrations of new technology or practices
- ☐ Solutions that are both feasible to implement and effective

Possible Solutions

- ☐ IF contamination is correlated to well design:
 - Well code updates and region-specific standards
 - Well testing and inspection programs
- ☐ IF contamination is correlated to septic systems:
 - Upgrade old septic systems
 - Analyze if current septic system standards can handle modern needs
- ☐ Incorporate groundwater considerations into land use planning and zoning

Possible Solutions

- ☐ IF contamination is correlated to livestock:
 - Alternate manure handling methods and technology
 - Balance surface, groundwater, and odor concerns of manure management
- ☐ Nitrogen:
 - Develop nitrogen recommendations for groundwater protection
 - Demonstrations of soil health and profitability with different nitrogen strategies
- ☐ Incentivize and facilitate adoption of conservation-based farming systems

Next Steps

- Continue outreach & education
- Communicate with stakeholders
- Complete the study
 - Base any further action on the data
 - Collaborate with stakeholders
 - Seek region-specific, feasible, & effective solutions



Southwest Wisconsin Groundwater and Geology Study Team

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Katie Abbott, Iowa County Land Conservation Department

Terry Loeffelholz, Lafayette County Land Conservation, Planning & Zoning Dept

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Joel Stokdyk, Biologist, U.S. Geological Survey

Mark Borchardt, Research Microbiologist, USDA Agricultural Research Service

Scott Laeser, Clean Wisconsin

Barry Hottmann, Community Educator, UW Extension-Iowa County

Lafayette Ag Stewardship Alliance

Iowa County Uplands Watershed Group

Water & Environmental Analysis Laboratory, UW-Stevens Point



**Wisconsin Geological &
Natural History Survey**

