

# Groundwater and Drinking Water Education Program

## Osceola and Mitchell

Kevin Masarik  
Center for Watershed Science and Education



**University of Wisconsin-Stevens Point**  
College of Natural Resources



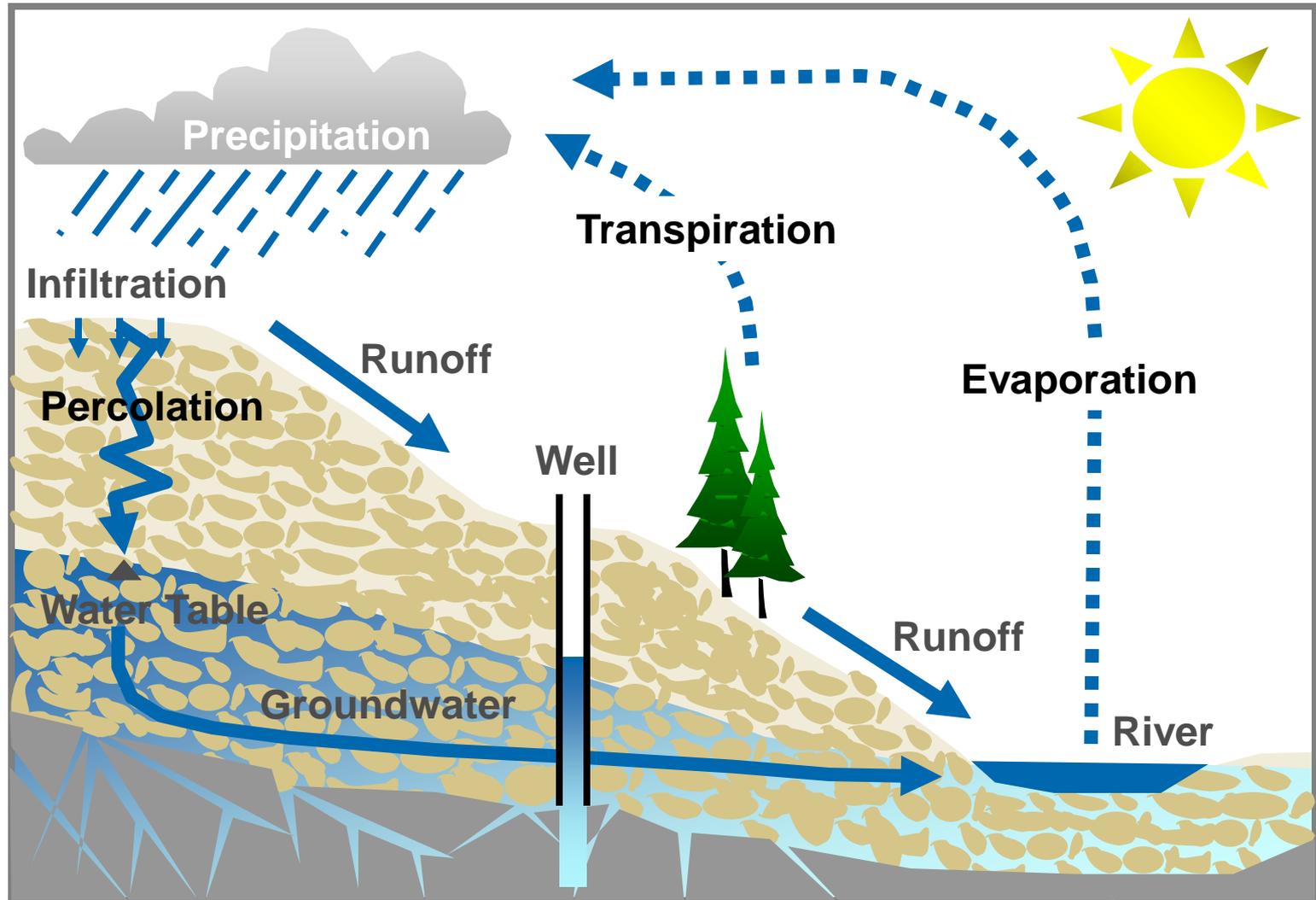
Through the University of Wisconsin-Extension, all Wisconsin people can access University resources and engage in lifelong learning, wherever they live and work.

# Today's presentation

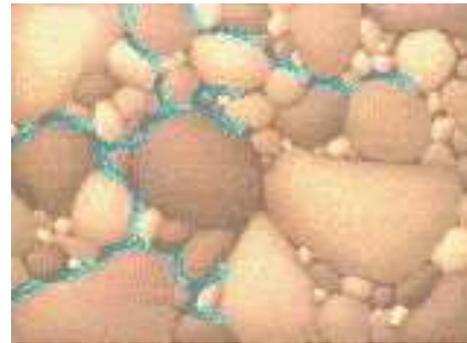
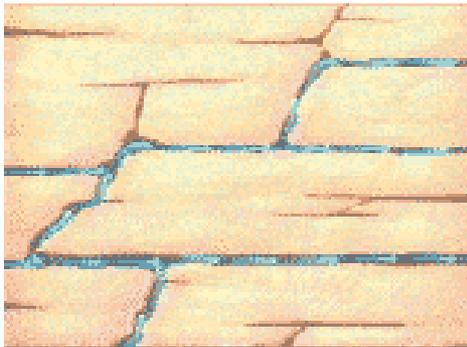
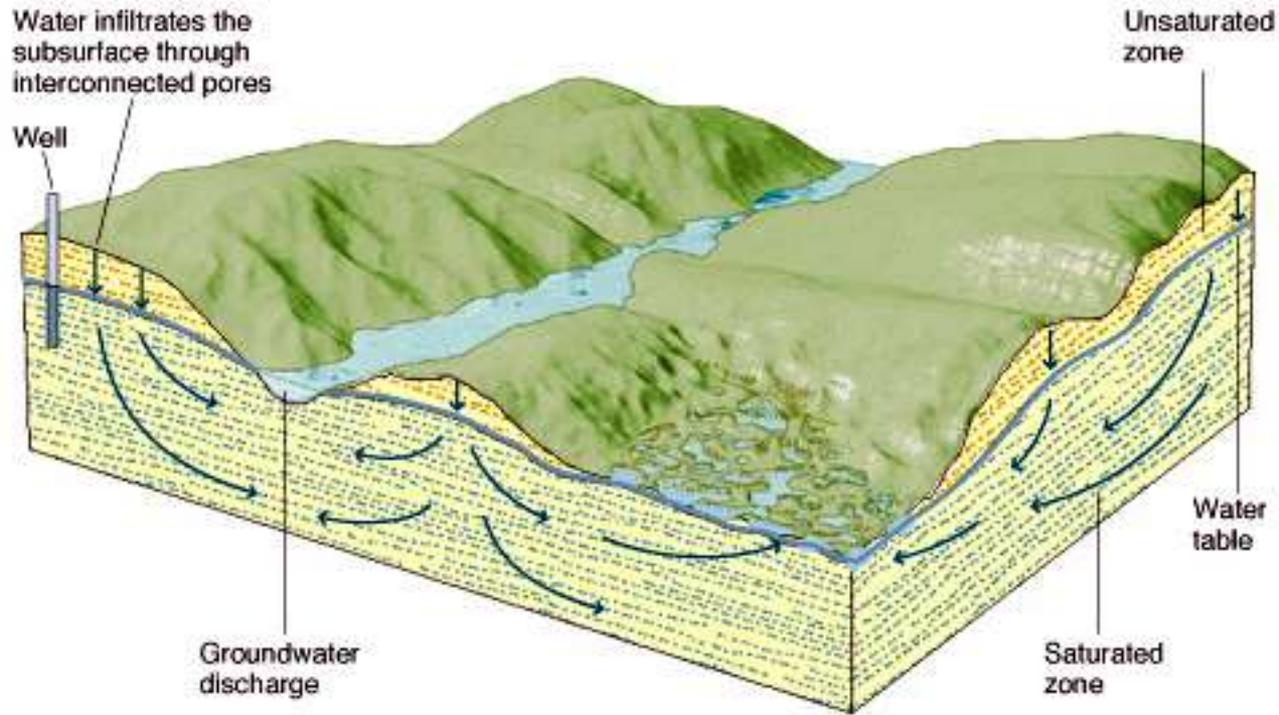
- Groundwater Basics: Where does my water come from
- Well Construction
- What do my individual test results mean?
- General groundwater quality in the Towns of Osceola and Mitchell.
- Improving your water quality



# The Water Cycle



# Groundwater Movement

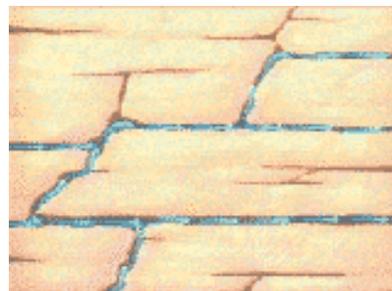


# Aquifers: Our groundwater storage units

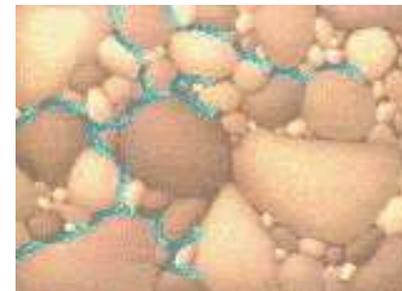
Aquifers are geologic formations that store and transmit groundwater.

The aquifer properties determine how quickly groundwater flows, how much water an aquifer can hold and how easily groundwater can become contaminated. Some aquifers may also contain naturally occurring elements that make water unsafe.

Wisconsin's geology is like a layered cake. Underneath all of Wisconsin lies the Crystalline bedrock which does not hold much water. Think of this layer like the foundation of your house. All groundwater sits on top of this foundation. Groundwater is stored in the various **sandstone, dolomite and sand/gravel** aquifers above the **crystalline bedrock** layer. The layers are arranged in the order which they formed, oldest on the bottom and youngest on top.

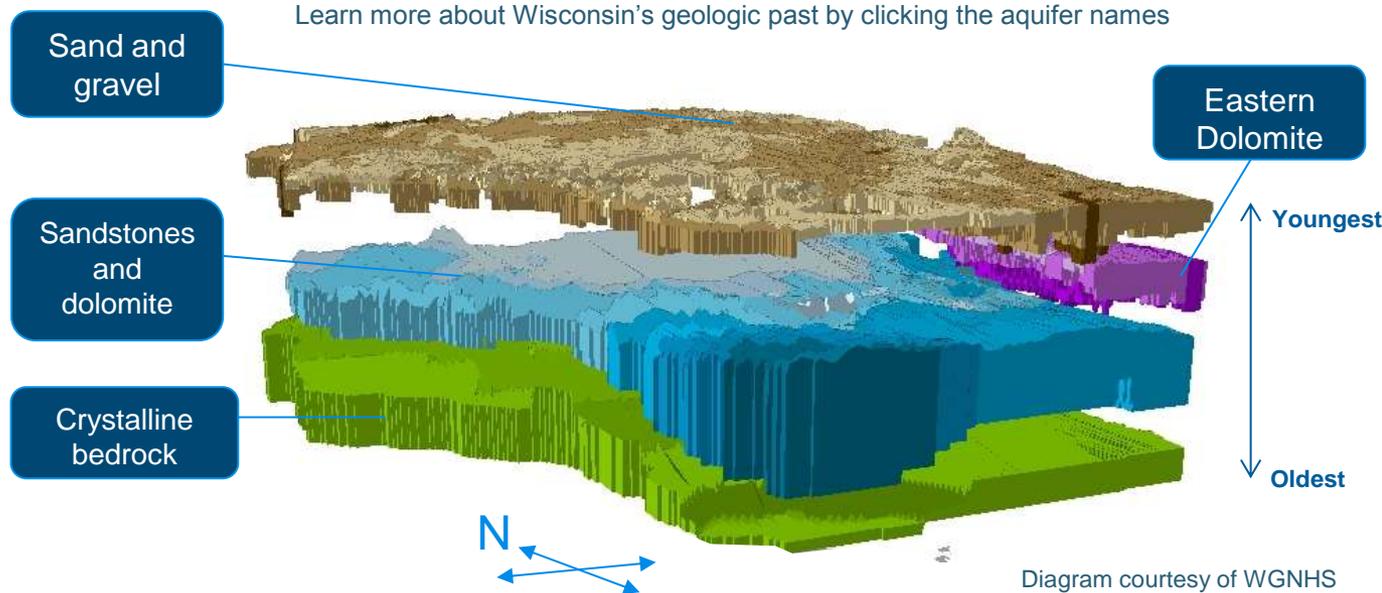


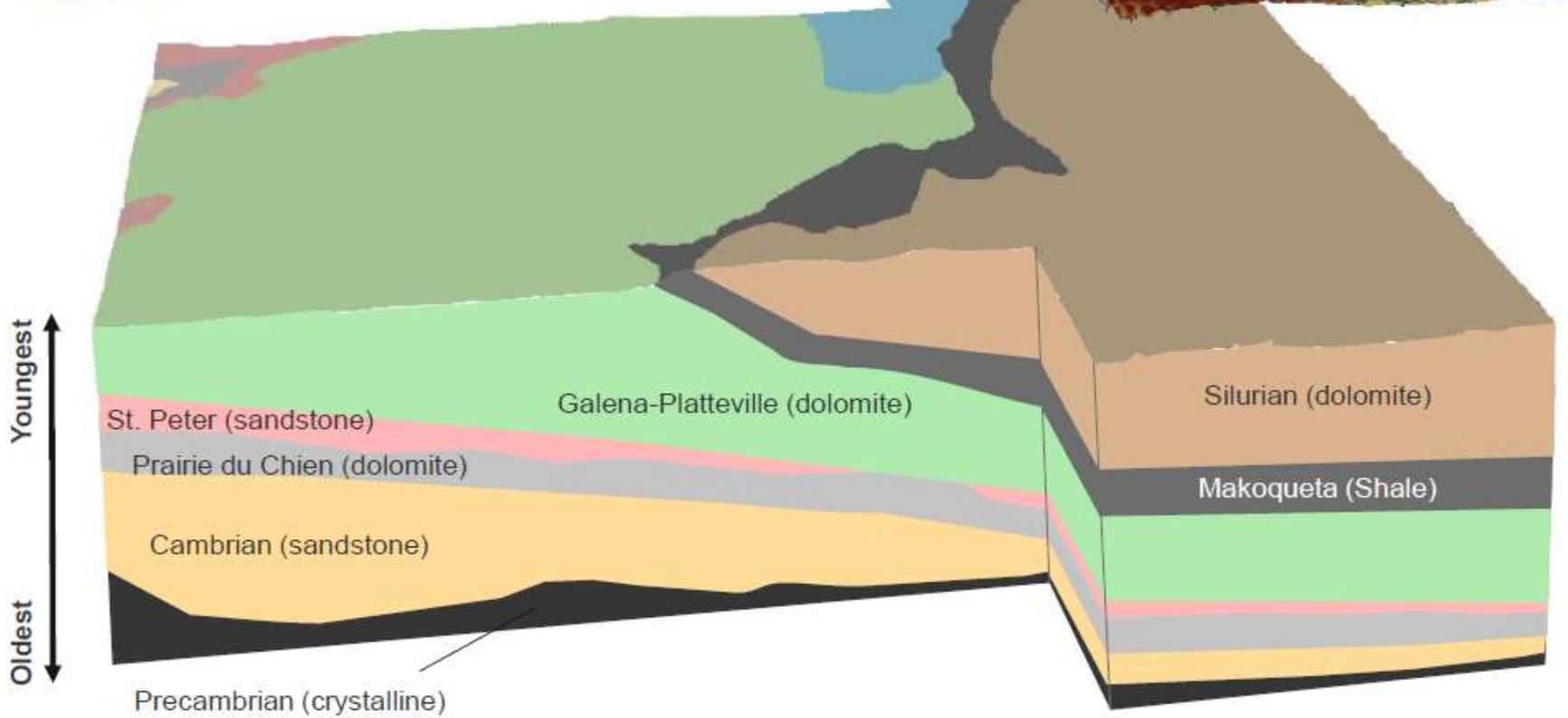
Water and contaminants can move quickly through cracks and fractures.



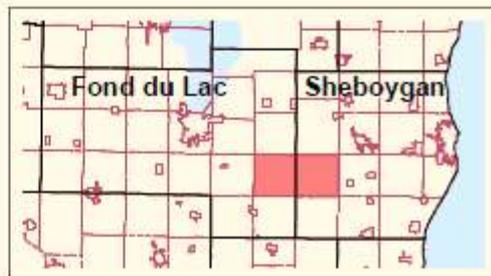
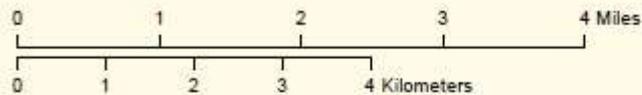
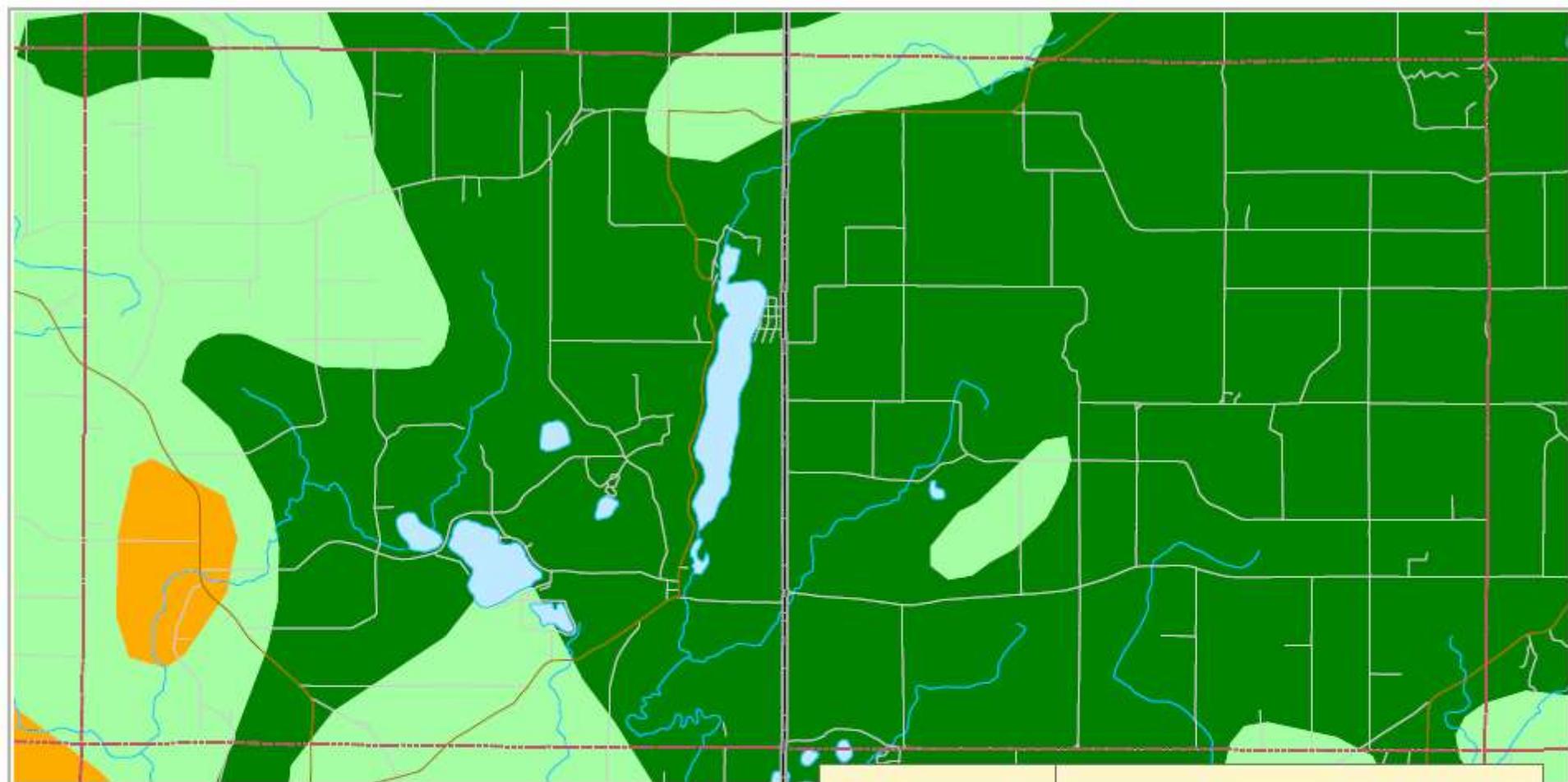
Water moving through tiny spaces in between sand particles or sandstone moves slower and allows for filtration of some contaminants.

Learn more about Wisconsin's geologic past by clicking the aquifer names





Not to Scale



**Osceola**  
Fond du Lac Co

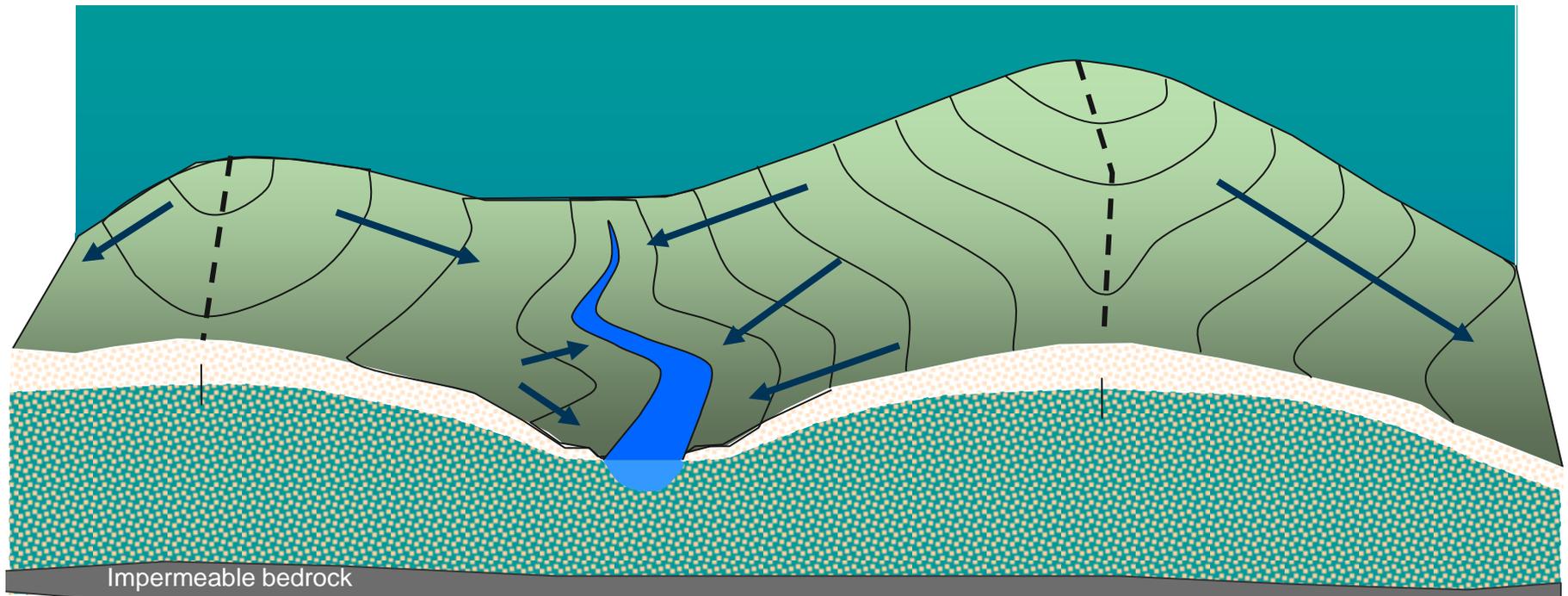
**Mitchell**  
Sheboygan Co

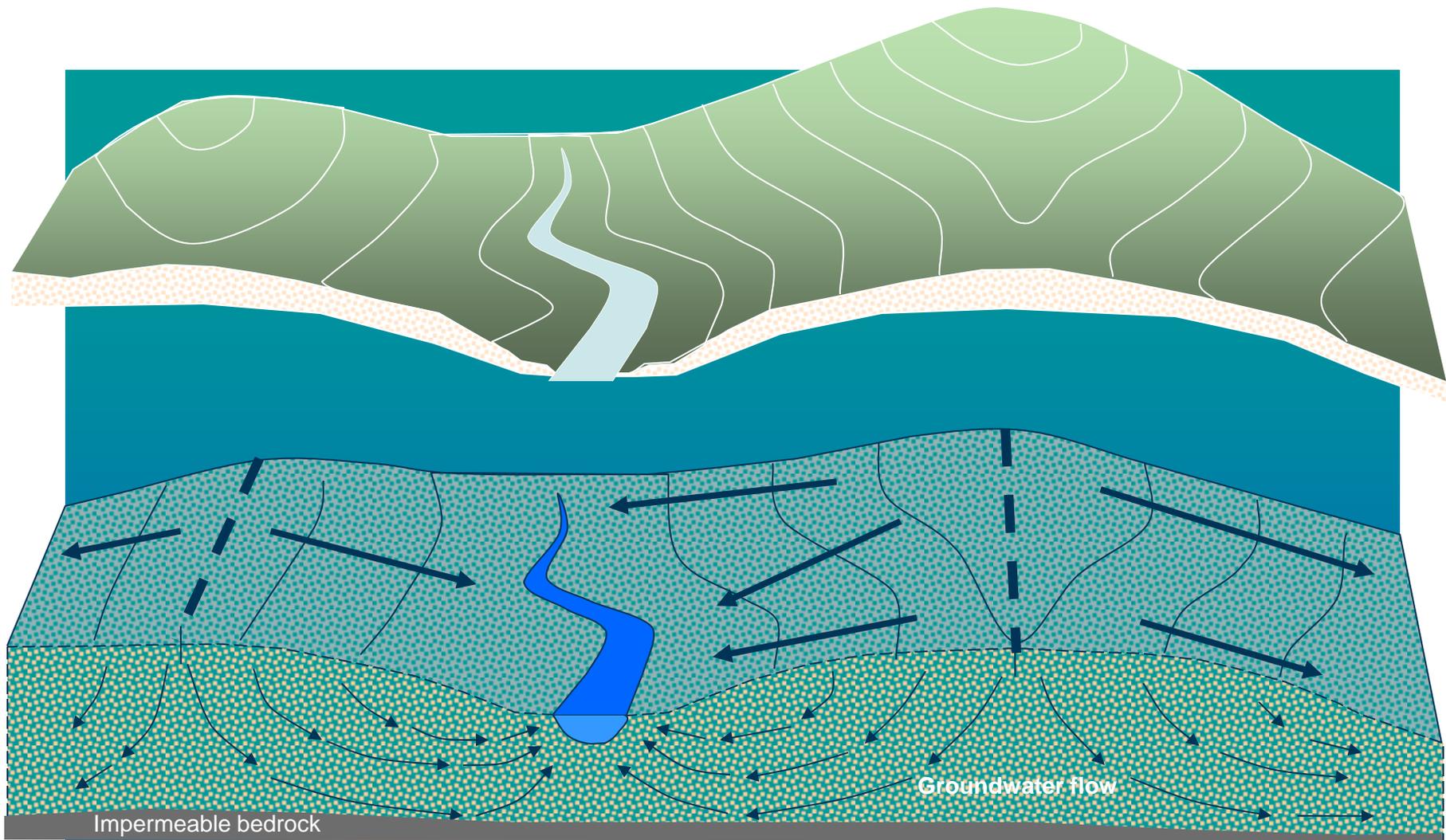
July 2013

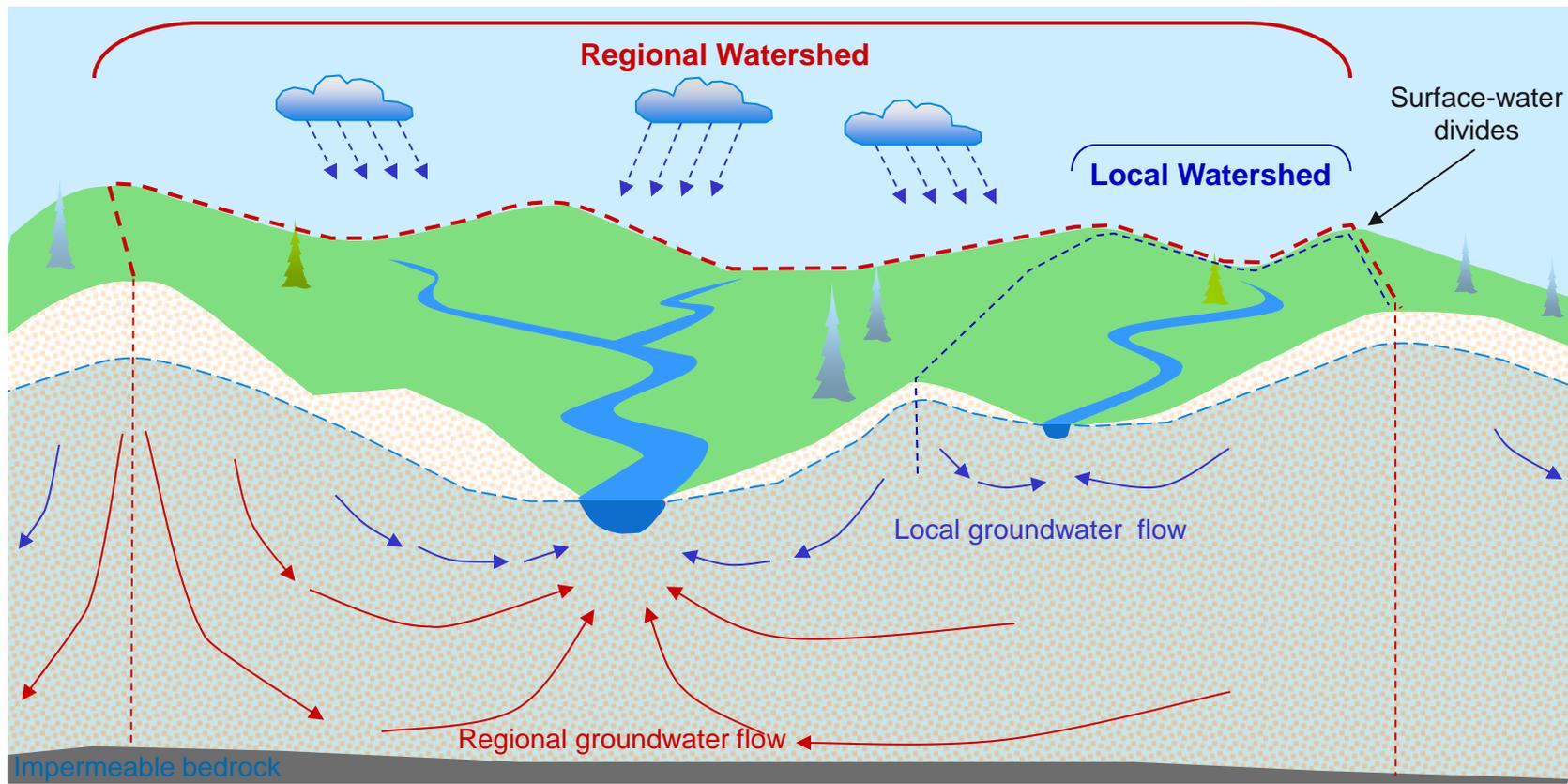
**Depth to Bedrock:**

- within 5 ft - more than 70% of area
- within 5 ft - 35 to 70% of area
- 5 to 50 ft
- 50 to 100 ft
- greater than 100 ft

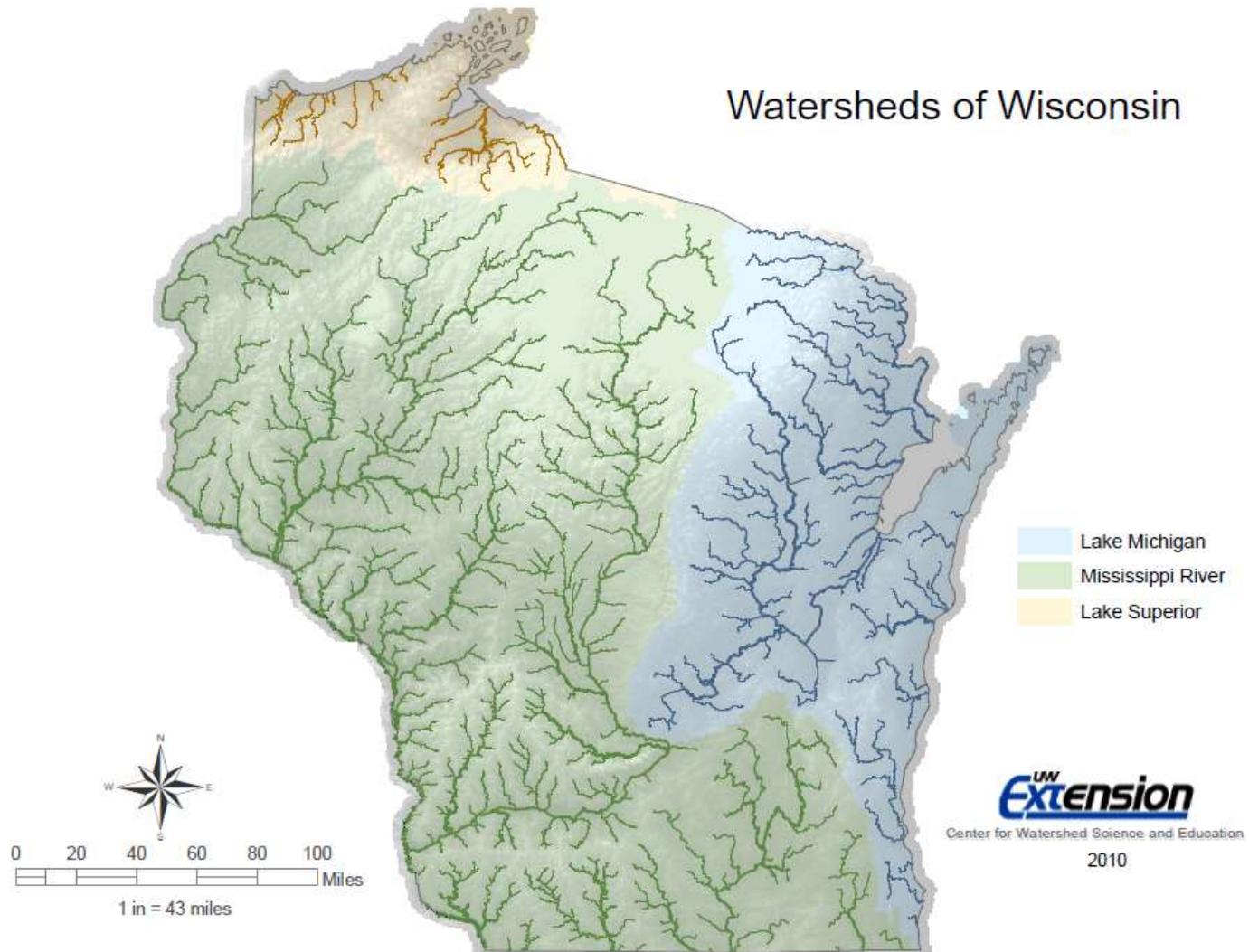
**Watershed** – the land area where water originates for lakes, rivers or streams. Water flows from high elevation to low elevation.



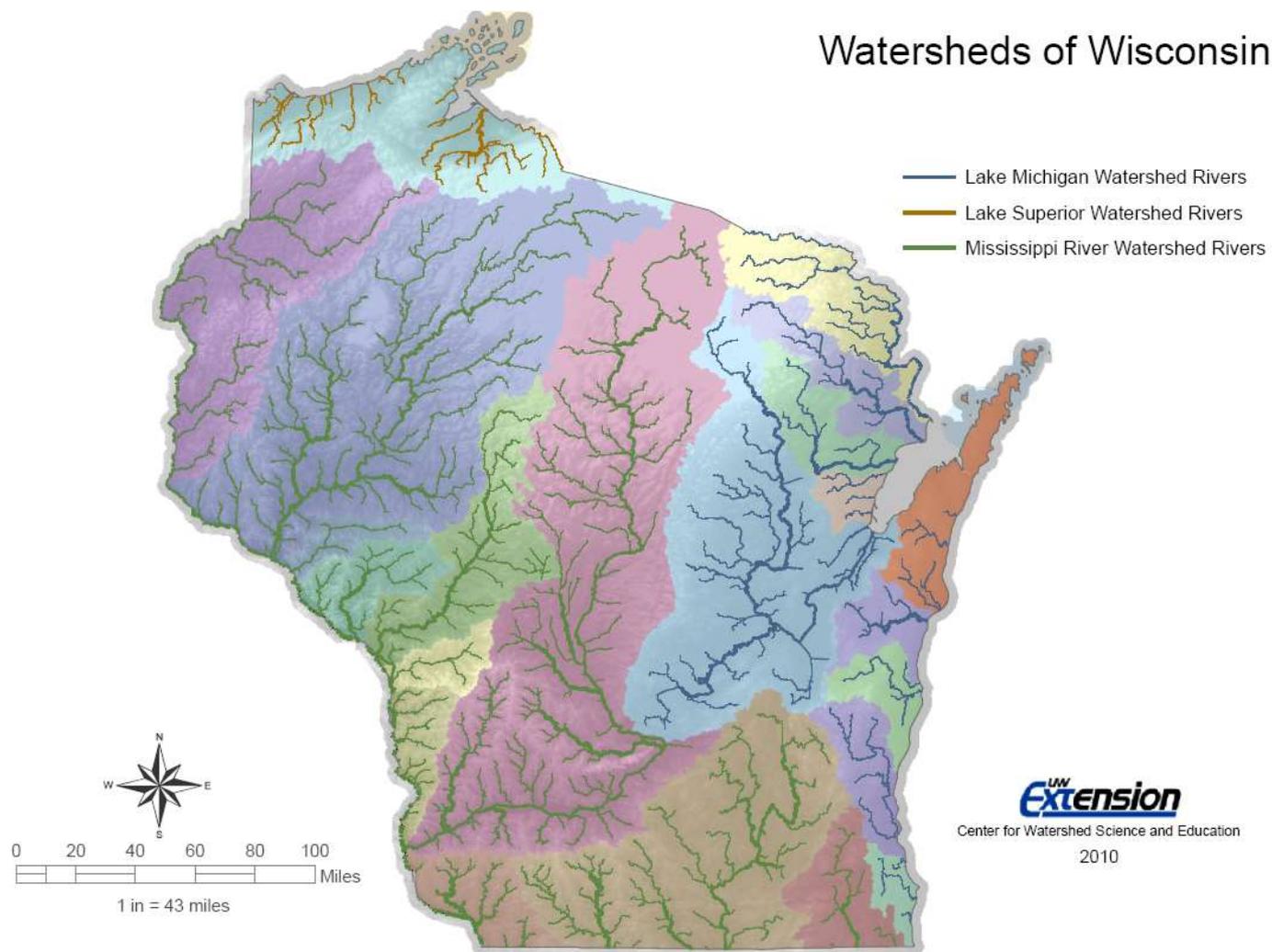




# Wisconsin has 3 main watersheds

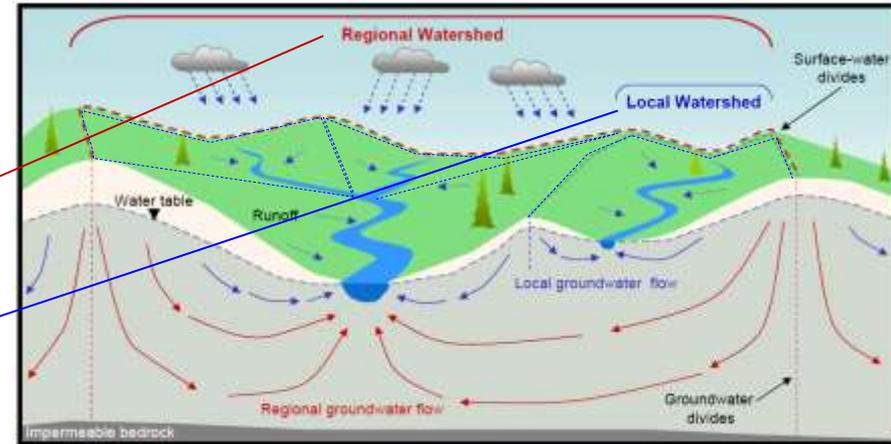
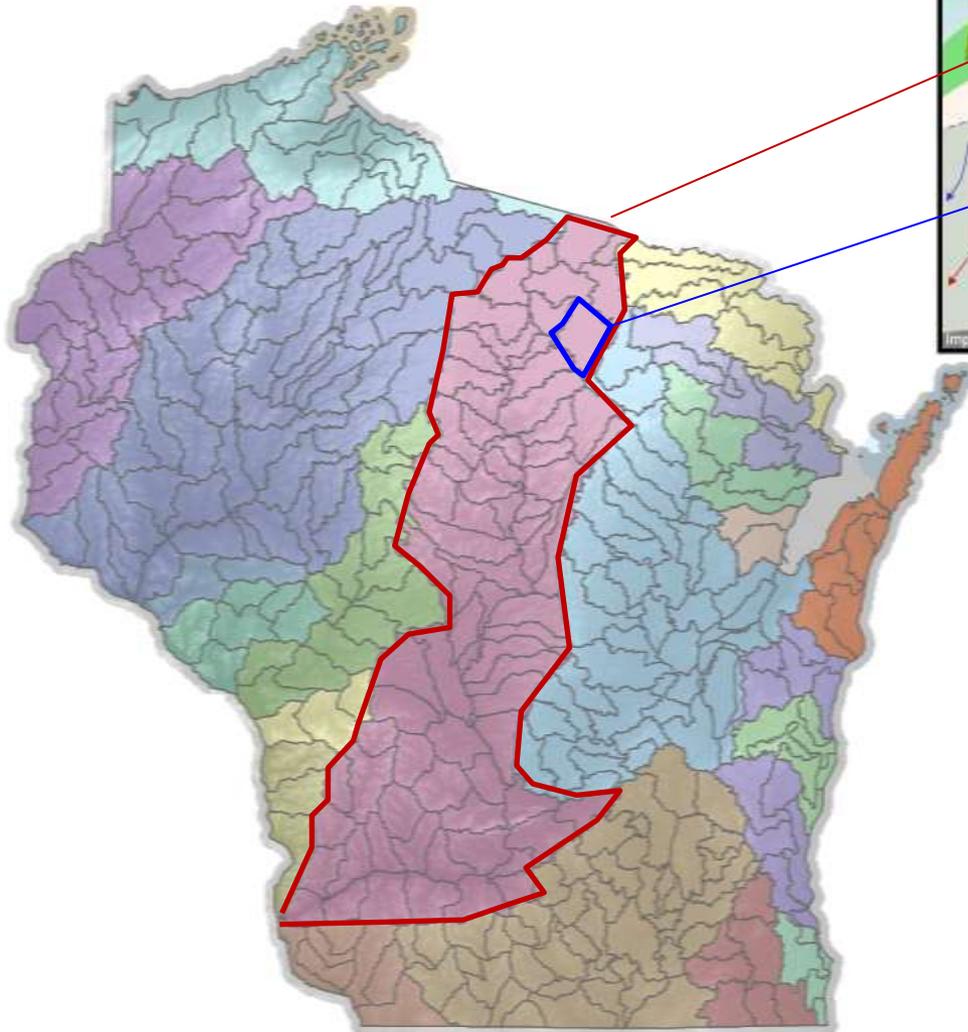


Major watersheds can be divided into regional watersheds that helps us to understand how groundwater and runoff moves through Wisconsin's landscape....



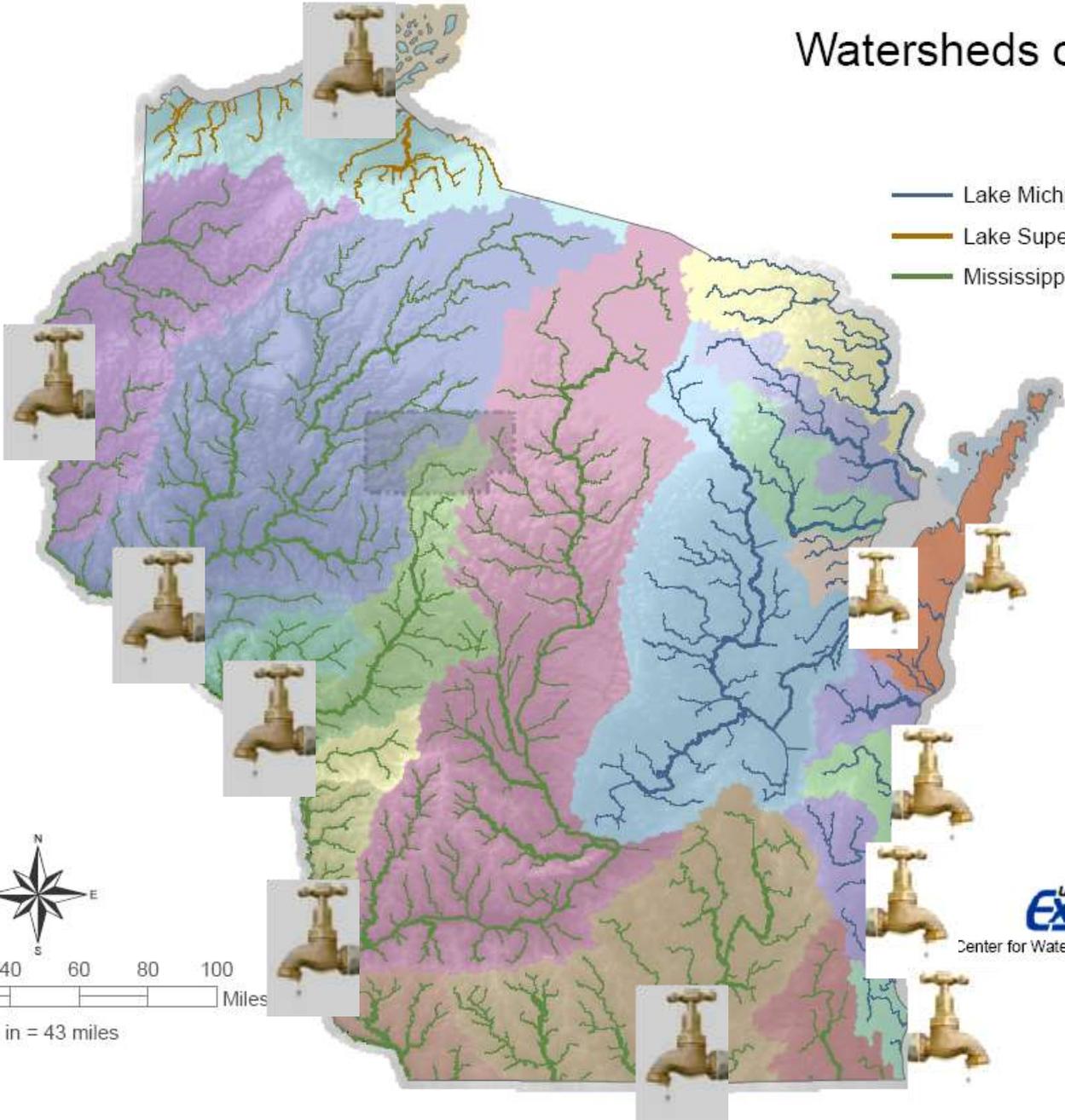


....regional watersheds can be further divided into local watersheds outlined below that help show just how local groundwater quality really is.



# Watersheds of Wisconsin

- Lake Michigan Watershed Rivers
- Lake Superior Watershed Rivers
- Mississippi River Watershed Rivers



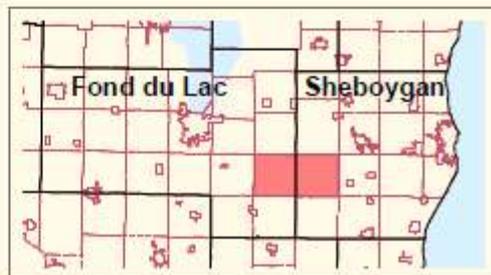
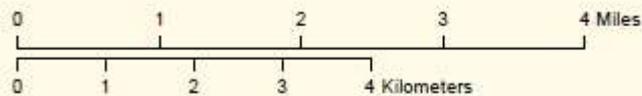
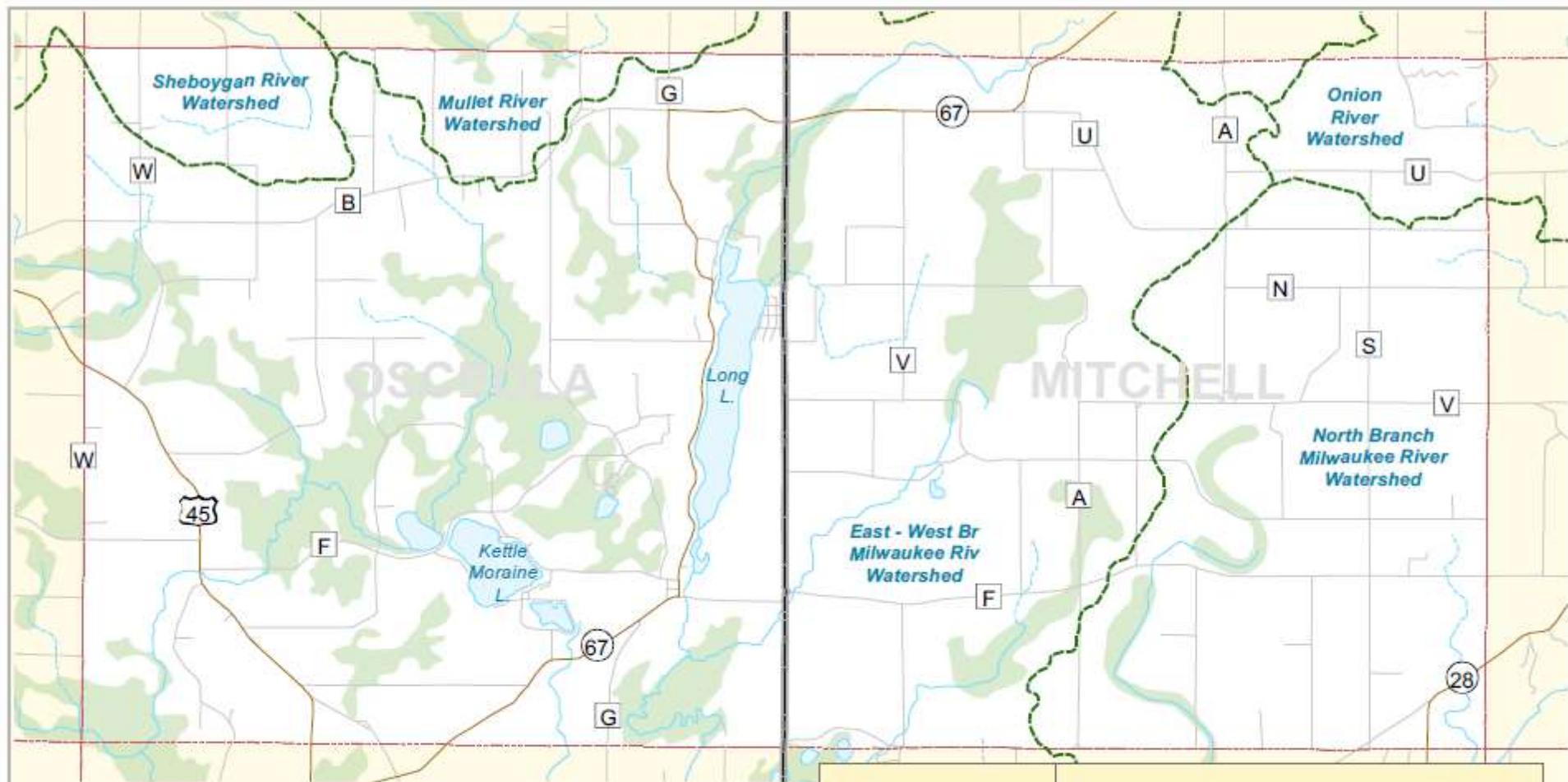
0 20 40 60 80 100 Miles

1 in = 43 miles



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2010



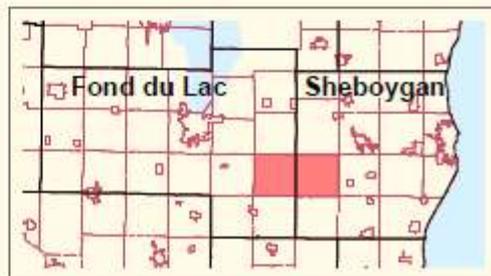
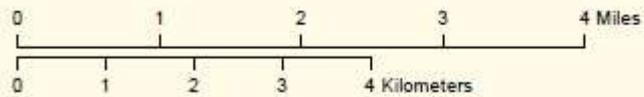
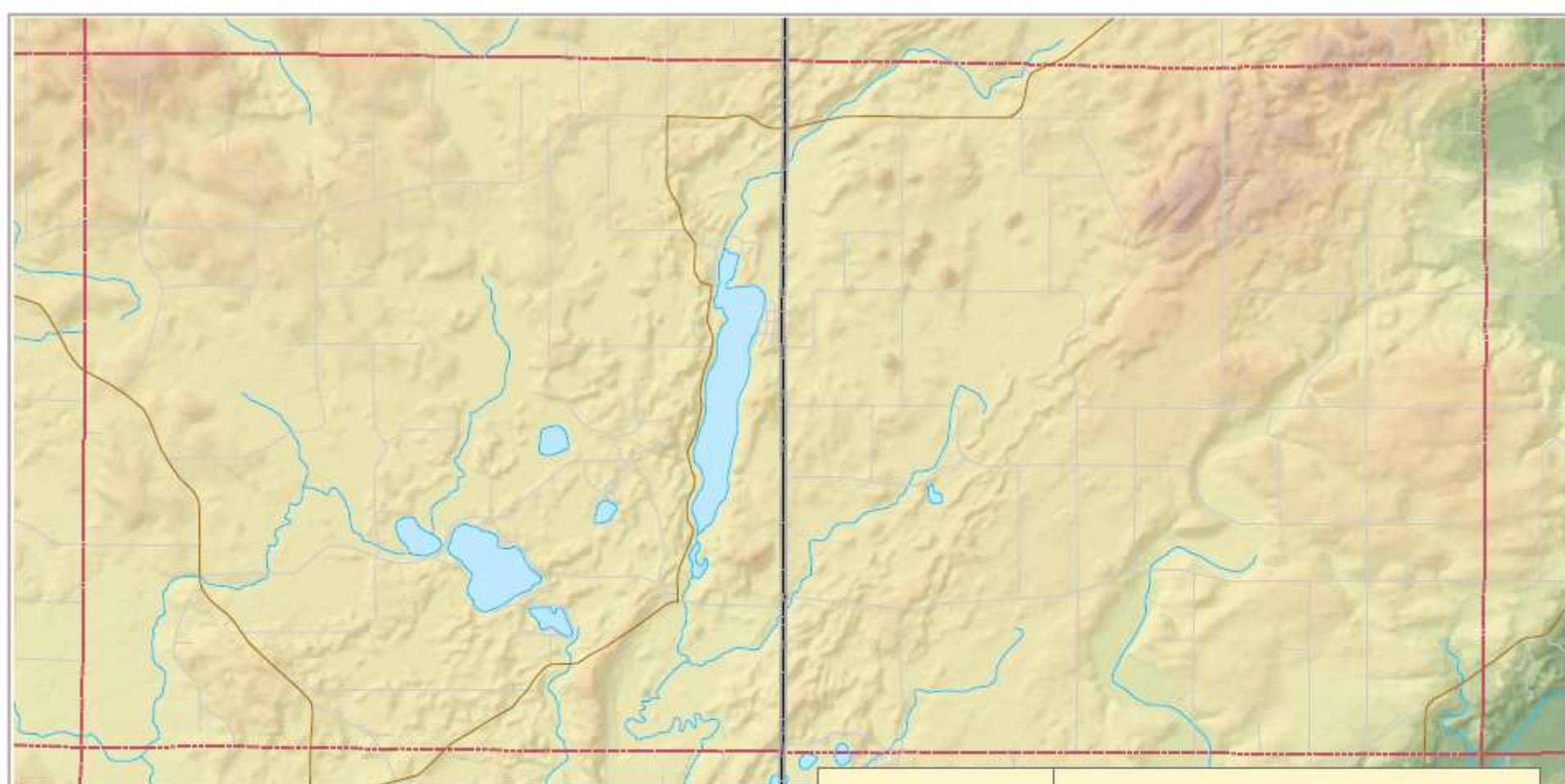
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**Mitchell**  
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- Watershed Boundary
- Streams
- Lakes/Reservoirs
- Wetlands
- State/US Highways
- Other Roads
- Town Boundaries
- Municipalities



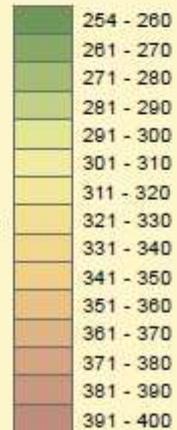
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**Elevation:**  
(meters)



# Types of Wells

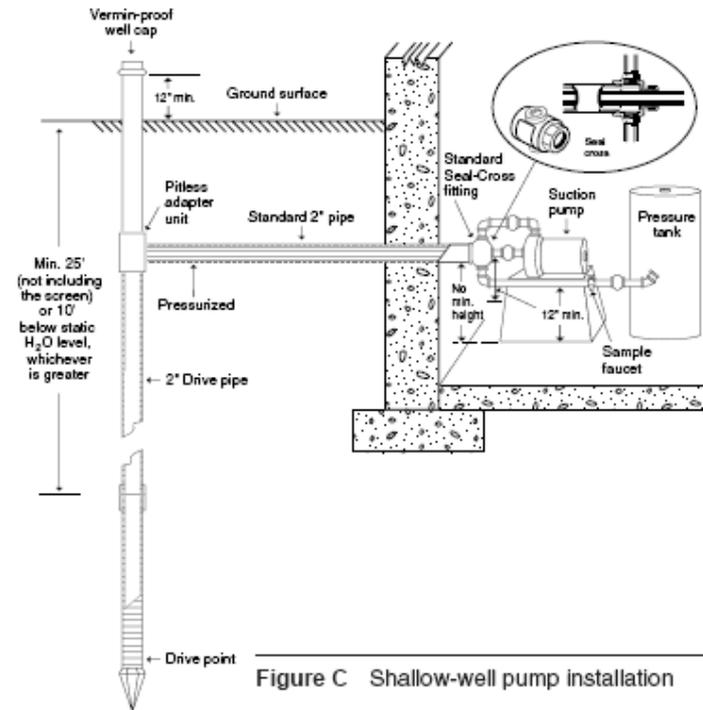
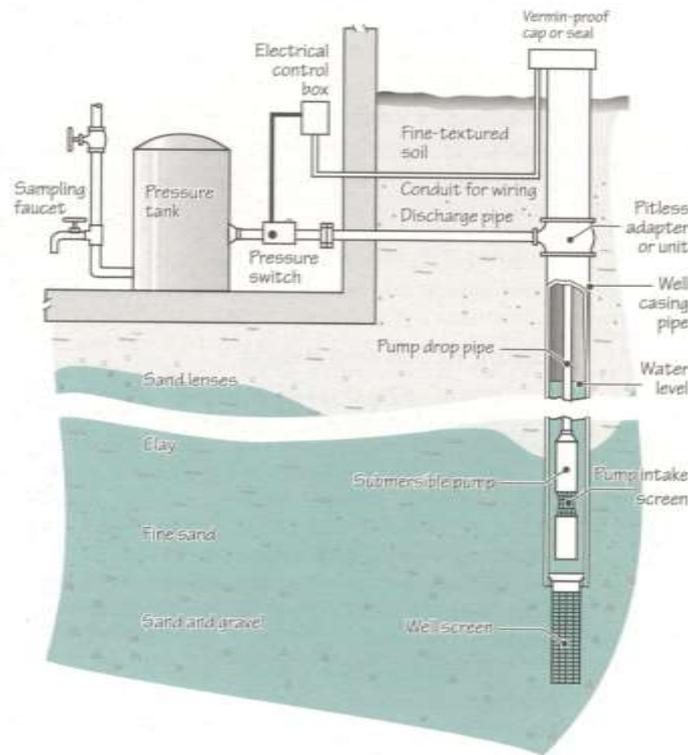
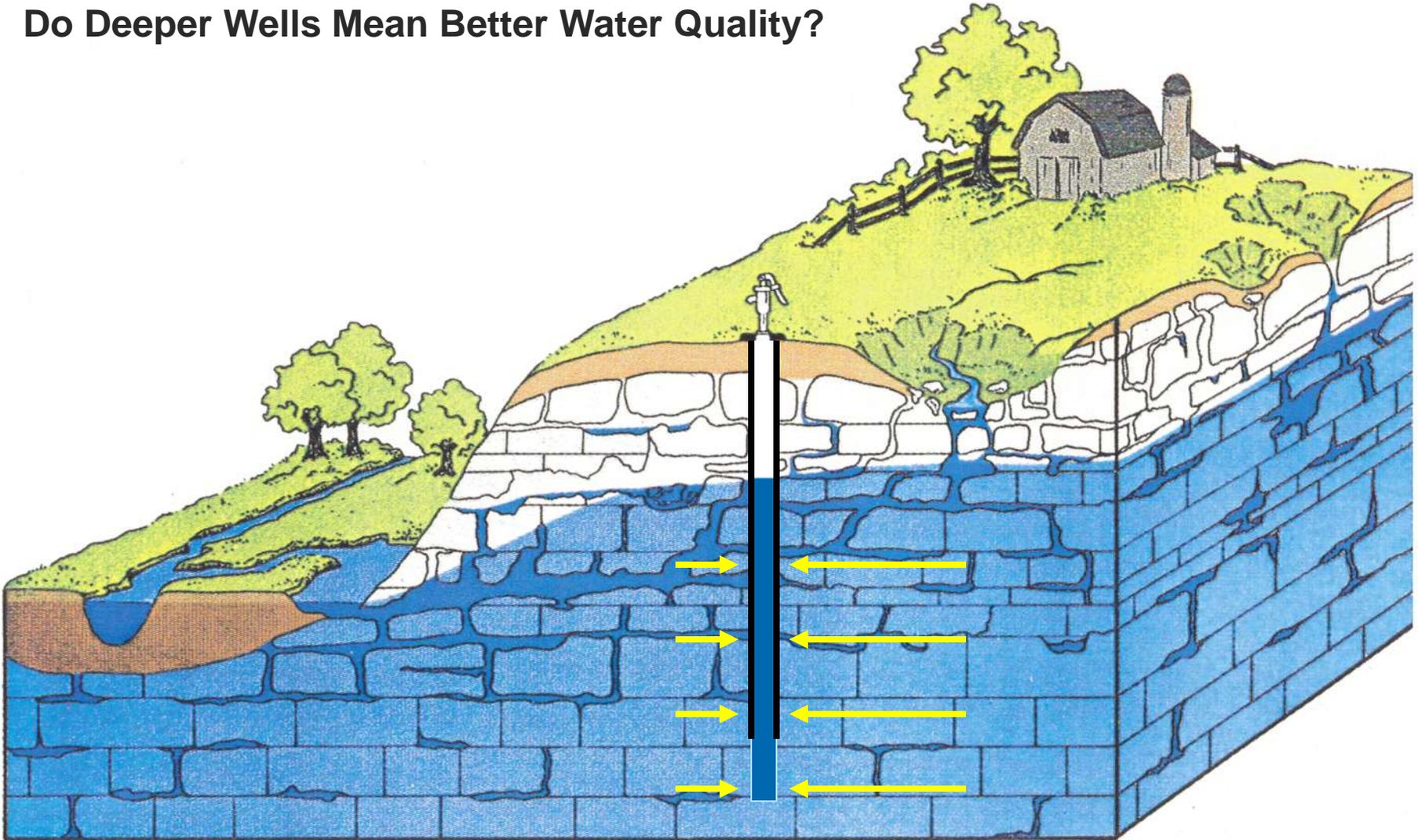


Figure C Shallow-well pump installation

# Do Deeper Wells Mean Better Water Quality?



**Well Construction Report For**  
**WISCONSIN UNIQUE WELL NUMBER CC 566**

Property Owner: Clyde Nuenfeldt Telephone Number: \_\_\_\_\_  
 Mailing Address: Rt 4  
 City: Oshkosh State: WI Zip Code: \_\_\_\_\_  
 County of Well Location: Waupesa Parcel No.: W Well Completion Date: 9/18/89

Department of Natural Resources  
 Private Water Supply - WWS  
 Box 1921  
 Madison, WI 53707

**SAMPLE**

1. Location (Please type or print using a black pen)  
 Town  City  Village  Fire # (if available)  
 of Oshkosh  
 Grid or Street Address or Road Name and Number (if available)  
 Subdivision Name \_\_\_\_\_ Lot # \_\_\_\_\_ Block # \_\_\_\_\_

Well Constructor (Business Name): Wallace Clark Registration # \_\_\_\_\_  
 Address: 5411 Ripon Rd  
 City: Oshkosh State: WI Zip Code: \_\_\_\_\_

2. Mark well location in correct 40-acre parcel of section.  
 N  
 W E  
 S

3. Well Type  
 New  
 Replacement  Reconstruction  
 of unique well # \_\_\_\_\_ constructed in 19\_\_\_\_  
 Reason for new, replaced or reconstructed well?

4. Well serves 1 # of human and/or \_\_\_\_\_  
 (ex: barn, restaurant, church, school, industry, etc.)  
 High Capacity Well?  Yes  No  
 High Capacity Property?  Yes  No

5. Well Located on Highest Point of Property, Consistent with the General Layout and Surroundings?  Yes  No (if no, explain on back side)  
 Well Located in Floodplains?  Yes  No  
 Distance in Feet From Well to Nearest:  
 1. Landfill 100  
 2. Building Overhang 110  
 3. Septic or Holding Tank 150  
 4. Sewage Absorption Unit \_\_\_\_\_  
 5. Nonconforming Pit \_\_\_\_\_  
 6. Buried Home Heating Oil Tank \_\_\_\_\_  
 7. Buried Petroleum Tank \_\_\_\_\_  
 8. Sherdies/Swimming Pool \_\_\_\_\_

9. Downspout/Yard Hydrant \_\_\_\_\_  
 10. Driveway \_\_\_\_\_  
 11. Foundation Drain to Clearwater \_\_\_\_\_  
 12. Foundation Drain to Sewer \_\_\_\_\_  
 13. Building Drain \_\_\_\_\_  
 Cast Iron or Plastic  Other \_\_\_\_\_  
 14. Building Sewer  Gravity  Pressure  
 Cast Iron or Plastic  Other \_\_\_\_\_  
 15. Collector or Street Sewer \_\_\_\_\_  
 16. Clearwater Sump \_\_\_\_\_  
 17. Wastewater Sump \_\_\_\_\_  
 18. Paved Animal Barn Pen \_\_\_\_\_  
 19. Animal Yard or Shelter \_\_\_\_\_  
 20. Silo - Type \_\_\_\_\_  
 21. Barn Gutter \_\_\_\_\_  
 22. Manure Pile  Grassy  Paved  
 Cast Iron or Plastic  Other \_\_\_\_\_  
 23. Other Manure Storage \_\_\_\_\_  
 Other NR 115 Waste Source \_\_\_\_\_

6. Drillsite Dimensions  
 From To  
 Dia. (in.) (ft.) (ft.)  
10 surface 140  
6 140 140

Method of constructing upper enlarged drillsite only:  
 1. Rotary - Mud Circulation  
 2. Rotary - Air  
 3. Rotary - Foam  
 4. Reverse Rotary  
 5. Cable-tool Bit \_\_\_\_\_ in. dia.  
 6. Temp. Outer Casing \_\_\_\_\_ in. dia.  
 Removed?  Yes  No  
 If no, explain \_\_\_\_\_  
 7. Other \_\_\_\_\_

From (ft.)	To (ft.)	Geology Type, Caving/Noncaving, Color, Hardness, Etc.	From (ft.)	To (ft.)
		Clay	surface	12
		Sandy Clay	18	66
		Lime rock	66	100
		Sand Stone	100	140
		Water bearing		

7. Casing, Liner, Screens  
 Material, Weight, Specification  
 Mfg. & Method of Assembly  
 From To  
 Dia. (in.) (ft.) (ft.)  
6 New Black 18.95 surface 140

8. Static Water Level  
 ft. above ground level  
10 ft. below ground surface

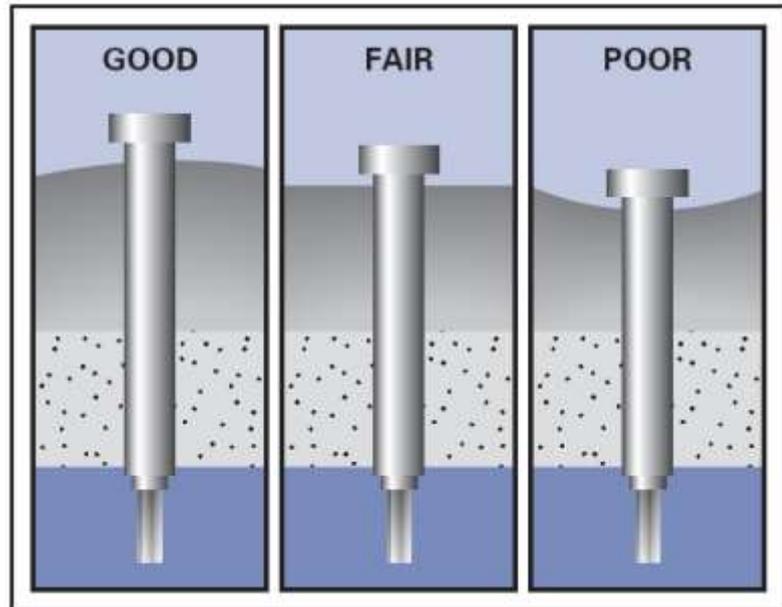
11. Pump Test  
 Pumping Level 13 ft. below surface  
 Pumping at 30 GPM for 2 hours

12. Well Is  
 Above Grade  
 Below Grade  
 Developed?  Yes  No  
 Disintegrated?  Yes  No  
 Capped?  Yes  No

9. Grout or Other Sealing Material  
 Method \_\_\_\_\_  
 Kind of Sealing Material \_\_\_\_\_  
 From To  
 (ft.) (ft.)  
Slurry clay + drillings surface 140

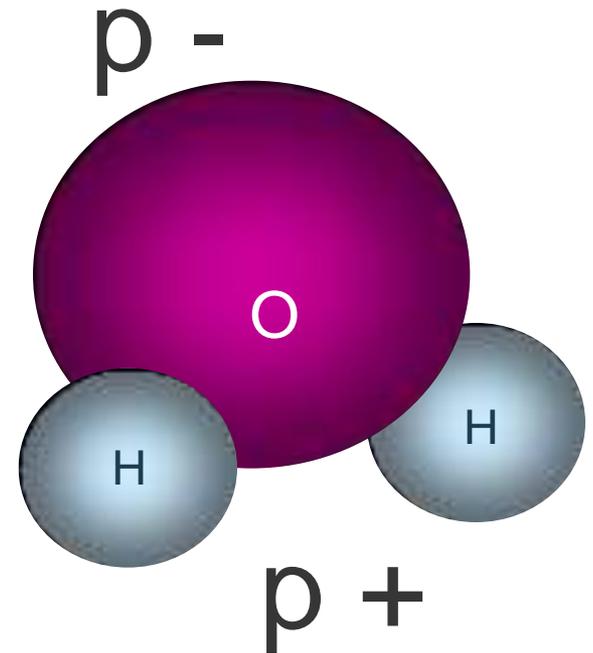
13. Did you permanently seal all unused, noncomplying, or unsafe wells?  
 Yes  No If no, explain \_\_\_\_\_

14. Signature of Point Driver or Registered Driller \_\_\_\_\_ Date Signed \_\_\_\_\_  
 Signature of Drill Rig Operator \_\_\_\_\_ Date Signed \_\_\_\_\_



# water basics

- “Universal Solvent”
- Naturally has “stuff” dissolved in it.
  - Impurities depend on rocks, minerals, land-use, plumbing, packaging, and other materials that water comes in contact with.
- Can also treat water to take “stuff” out



# Interpreting Drinking Water Test Results

## Tests important to health:

- Bacteria
- Sodium
- Nitrate
- Copper
- Lead
- Triazine
- Zinc
- Sulfate
- Arsenic

## Tests for aesthetic (taste,color,odor) problems:

- Hardness
- Iron
- Manganese
- Chloride

## Other important indicator tests:

- Saturation Index
- Alkalinity
- Conductivity
- Potassium

**Red** = human-influenced    **Blue** = naturally found

# Health Concern Categories

## Acute Effects

- Usually seen within a short time after exposure to a particular contaminant or substance.

(ex. Bacteria or viral contamination which may cause intestinal disease)

## Chronic Effects

- Result from exposure to a substance over a long period of time.
- Increase risk of developing health complications later in life.

(ex. Arsenic or pesticides can increase the risk of developing certain cancers)



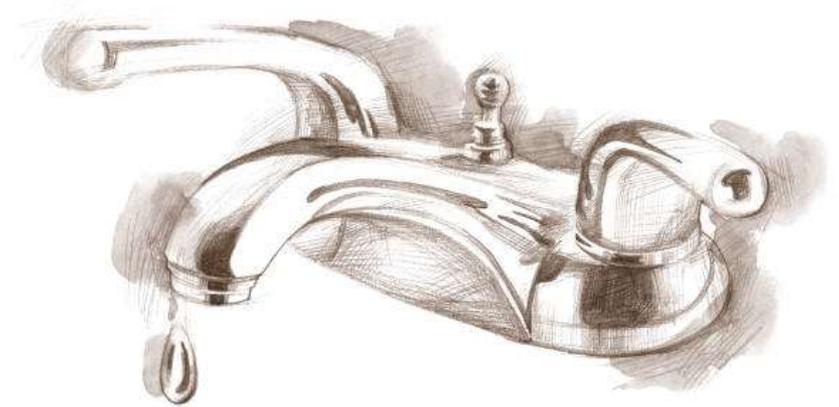
# Understanding Risk?

<b>Being struck by lightning</b>	<b>0.16 in 1,000 chance.</b>
<b>0.010 mg/L of arsenic in drinking water.</b>	<b>3 out of 1,000 people likely to develop cancer.</b>
<b>2 pCi of indoor radon level.</b>	<b>4 out of 1,000 people likely to develop lung cancer.<sup>1</sup></b>
<b>2 pCi of indoor radon combined with smoking.</b>	<b>32 out of 1,000 people could develop lung cancer.<sup>1</sup></b>

Drinking water quality is only one part of an individual's total risk.

# Why do people test their water?

- Installed a new well
- Change in taste or odor
- Buying or selling their home
- Plumbing issues
- Want to know if it's safe to drink.



# Private vs. Public Water Supplies

## Public Water Supplies

- Regularly tested and regulated by drinking water standards.

## Private Wells

- Not required to be regularly tested.
- Not required to take corrective action
- Owners must take special precautions to ensure safe drinking water.



No one test tells us everything we need to know about the safety and condition of a water supply

## Tests for Drinking Water from Private Wells

### Why should I test my well?

As one of Wisconsin's 700,000 private well owners or private well water consumers, you probably use groundwater for doing your family's laundry, drinking, cooking, bathing and watering your garden. Municipalities are required to test their water supplies regularly to ensure the water is safe to drink. Since there is no requirement to test a private well except for bacteria when it is first drilled or the pump is changed, you are responsible for making sure your water is safe.

Most private wells provide a clean, safe supply of water; however, contaminants can pollute private wells, and unfortunately you cannot see, smell or taste most of them. Consequently, you should test your water on a regular basis. The decision on what to test your water for should be based on the types of land uses near your well.

This brochure gives information about several common contaminants found in private wells. It should help you decide when to sample your well and how often, how to find a certified laboratory and who to call for help.

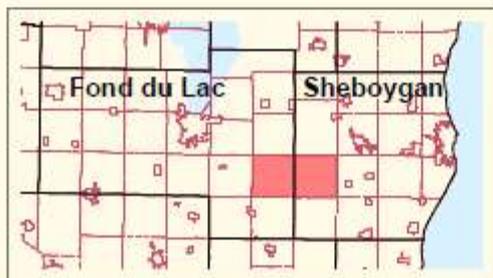
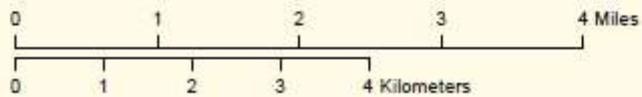
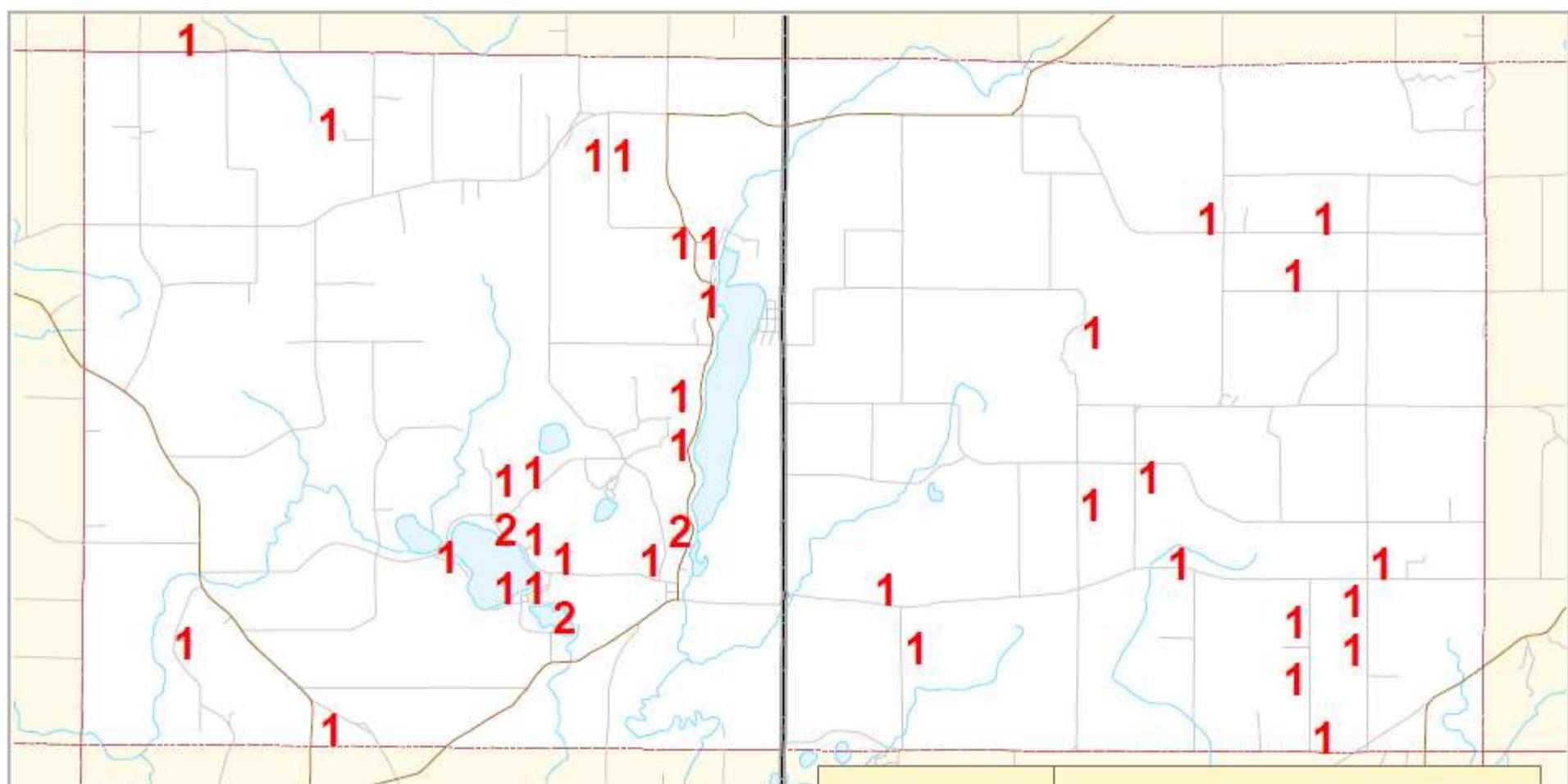
### What tests should be done on my water?

#### Total Coliform Bacteria and E.coli

Coliform bacteria live in soil, on vegetation and in surface water. Coliform bacteria found in the intestines of warm-blooded animals and their feces are called E.coli. Some strains of coliform bacteria can survive for long periods in soil and water and can be carried into well casings by insects. Bacteria washed into the ground by rainwater or snowmelt are usually filtered out as the water seeps through the soil, but they sometimes enter water supplies through cracks in well casings, poorly sealed caps, fractures in the underlying bedrock, and runoff into sinkholes. Coliform bacteria are the most common contaminants found in private water systems. A 1994 Wisconsin survey found them in 23% of the wells tested and E.coli in 2.4% of the wells.

Most coliform bacteria do not cause illness, but indicate a breach in the water system. However, since E.coli bacteria are found in fecal material, they are often present with bacteria, viruses and parasites that can cause flu-like symptoms such as nausea, vomiting, fever and diarrhea. Private wells should be tested at least once a year for





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July 2013

**SAMPLE DISTRIBUTION**

**NUMBER OF SAMPLES  
per 1/4 1/4 SECTION**



### Water and Environmental Analysis Lab

UW-Stevens Point, College of Natural Resources  
Phone (715)346-3209 or Toll Free (877)383-8378  
www.uwsp.edu/cnr/weal



Monday, August 15, 2011

#### WELL INFORMATION:

WI Unique Well Number

Add

City

State

County SAINT CROIX

Town Pleasant Valley

#### Legal Description

SW SW Sec 5 T 28 R 17 W

1/4 1/4 (section) (town) (range)

Map : Gov't Lot#

Year well installed 1950

Casing Diameter:

3" - less  4-9"  10-18"  18+"

Total well depth 160

Depth of casing

Depth to water

#### SOURCE:

Municipal  Spring  
 Other

#### TREATMENT SYSTEM(S) OWNED:

Water softener  Rev Osmosis  
 Carbon filter  Neutralizer  
 Particle filter  Iron Filter  
 Other

#### PROBLEMS OBSERVED:

Color  Taste  Odor  
 Corrosion  Health  None  
 Other

#### LAST DATE TESTED:

Never  Unknown  
 Less than 1 year  1-2 years  
 2-5 years  5-10 years  
 Greater than 10 years

#### REASON FOR TESTING:

Curious about water quality  
 Suspect water quality problems  
 Regularly test my well  
 Required by lending institution  
 Retest of positive bacteria test  
 Retest following well disinfection  
 Infant/pregnant woman/daycare  
 Other

#### MAIL RESULTS TO:

last

First

Add

City

State

phon

#### SAMPLE(S) COLLECTED

Date 4/25/2011

Time 13:30

#### SAMPLE(S) TAKEN FROM:

Pressure Tank  
 Kitchen faucet  
 Bathroom faucet  
 Outside faucet  
 Barn  
 Other

SAMPLE\_ID 78543

Labno 86-11-6

Group ST. CROIX CO 11APR#2

#### LABORATORY RESULTS

Parameter	Qualifier	Results	Units	
Bacteria-Coliform		<b>Absent</b>		(see note 1 below)
Hardness-Total		392	mg/l CaCO3	
Alkalinity		232	mg/l CaCO3	
Conductivity		842	umhos/cm	
pH		7.90	std units	
Saturation Index (Ca)		0.5		Corrosivity Balanced
Nitrogen-Nitrate/Nitrite		27.6	mg/l N	(see note 2 below)
Chloride		51.8	mg/l	
Arsenic	Less Than	0.005	mg/l	
Calcium		93.7	mg/l	
Copper		0.329	mg/l	
Iron		0.002	mg/l	
Lead		0.007	mg/l	
Magnesium		39.0	mg/l	
Manganese	Less Than	0.001	mg/l	
Potassium		16.6	mg/l	
Sodium		15.5	mg/l	
Sulfate		31.5	mg/l	
Zinc		0.697	mg/l	
DACT Screen		0.2	ug/l	

Page 1

(Report continued for Heinbuch, Sample ID 78543)

1. BACTERIA ABSENT – means that no bacteria were found and your water supply is considered bacteriologically safe for uses such as drinking and cooking. You can be reasonably sure that your water supply is free of fecal coliform and other pathogenic bacteria.

To ensure your well remains in good sanitary condition; consider testing your well again for coliform bacteria annually or sooner if you notice a sudden change in taste, color or odor to the water.

2. NITRATE – Water greater than 10 mg/L of nitrate-nitrogen should not be consumed by infants less than 6 months of age or pregnant women. The WI Department of Health Services recommends that all persons should avoid long-term consumption of water with nitrate-nitrogen concentrations greater than 10 mg/L. You may choose to reduce your exposure to nitrate by installing an approved water treatment device (reverse osmosis, distillation or anion exchange), purchasing bottled water or investigate the possibility that a new well would result in lower nitrate levels.

**Disclaimer** - The analyses run on your samples only cover some of the more common water quality characteristics. Safe levels of these chemicals or bacteria do not guarantee that your water is free of all toxic chemicals. Bacteria die-off in samples over 30 hours old may render results inaccurate and are therefore deemed inconclusive. If you suspect gasoline residues, pesticides, or other trace chemicals, you would need additional analyses. Contact the lab or your Extension office for more information.

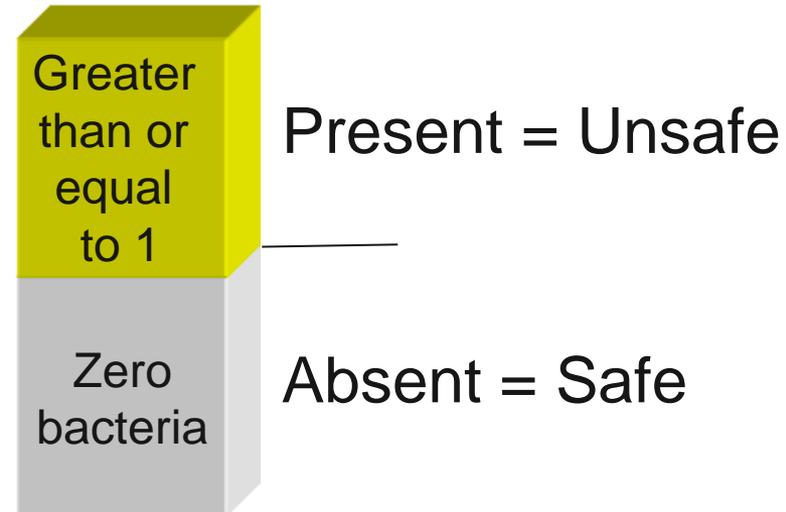
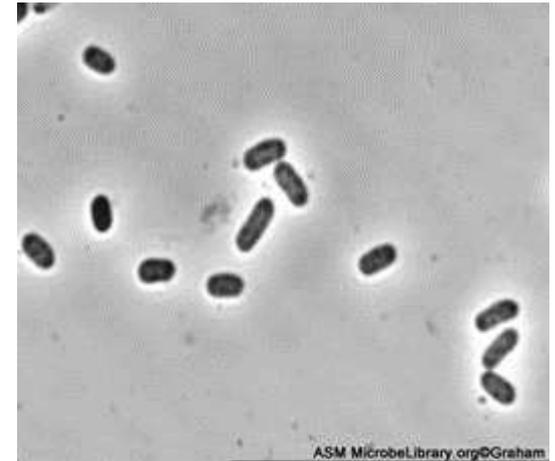
Page 2

milligrams per liter (mg/l) = parts per million (ppm)

1 mg/l = 1000 parts per billion (ppb)

# Coliform bacteria

- Generally do not cause illness, but indicate a pathway for potentially harmful microorganisms to enter your water supply.
  - Harmful bacteria and viruses can cause gastrointestinal disease, cholera, hepatitis
- Well Code: “Properly constructed well should be able to provide bacteria free water continuously without the need for treatment”
- Recommend using an alternative source of water until a test indicates your well is absent of coliform bacteria
- Sources:
  - Live in soils and on vegetation
  - Human and animal waste
  - Sampling error



# If coliform bacteria was detected, we also checked for e.coli bacteria test

- Confirmation that bacteria originated from a human or animal fecal source.
- E. coli are often present with harmful bacteria, viruses and parasites that can cause serious gastrointestinal illnesses.
- Any detectable level of E.coli means your water is unsafe to drink.

Information Sources: United States Department of Health and Human Services – Centers for Disease Control and Prevention ([www.cdc.gov](http://www.cdc.gov)) and United States Environmental Protection Agency ([www.epa.gov](http://www.epa.gov))

Contaminants	Sources	Symptoms
<b>BACTERIA</b>		
<p><i>Escherichia coliform (E. coli)</i>  <i>Salmonella</i>  <i>Campylobacter</i>  <i>E. coli O157</i> (Requires a special water test for detection. Causes similar, but more serious illness than other E.coli strains. Requires medical treatment.)</p> <hr/> <p><i>Leptosporidia</i></p>	<ul style="list-style-type: none"> <li>• Infected human and animal feces</li> <li>• Manure</li> <li>• Septic systems</li> <li>• Sewage</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Urine of livestock, dogs and wildlife</li> <li>• Manure</li> </ul>	<ul style="list-style-type: none"> <li>• Gastrointestinal illness</li> <li>• Low-grade fever</li> <li>• Begins 12 hrs - 7 days after exposure</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• High fever, severe headache and red eyes</li> <li>• Gastrointestinal illness</li> <li>• Begins 2-28 days after exposure</li> </ul>
<b>MICROSCOPIC PARASITES</b>		
<p><i>Cryptosporidia</i>  <i>Giardia</i></p>	<ul style="list-style-type: none"> <li>• Infected human and animal feces</li> <li>• Manure</li> <li>• Septic systems</li> <li>• Sewage</li> </ul>	<ul style="list-style-type: none"> <li>• Gastrointestinal illness</li> <li>• Begins 2-14 days after exposure</li> </ul>
<b>VIRUSES</b>		
<p>Norovirus</p>	<ul style="list-style-type: none"> <li>• Infected human feces and vomit</li> <li>• Septic systems</li> <li>• Sewage</li> </ul>	<ul style="list-style-type: none"> <li>• Gastrointestinal illness</li> <li>• Low-grade fever &amp; headache</li> <li>• Begins 12-48 hrs after exposure</li> </ul>
<b>CHEMICALS</b>		
<p>Nitrate</p> <hr/> <p>Atrazine            (trade-name herbicide for control of broadleaf and grassy weeds)</p>	<ul style="list-style-type: none"> <li>• Fertilizers</li> <li>• Manure</li> <li>• Bio-solids</li> <li>• Septic systems</li> </ul> <hr/> <p>Estimated to be most heavily used herbicide in the U.S. in 1987/89, with its most extensive use for corn and soybeans in the Midwest, including WI. In 1993, it became a restricted-use herbicide nationally. U.S. EPA set a max. contaminant level (MCL) at 3 parts per billion for safe drinking water.</p>	<p>Methemoglobinemia or "Blue Baby Syndrome" – No documented cases in Door County, but elevated nitrate levels in well water may indicate risk of contamination by additional pathogens.</p> <hr/> <p>Short-term exposure above the MCL may cause: congestion of heart, lungs and kidneys; low blood pressure; muscle spasms; weight loss; damage to adrenal glands.</p> <p>Long-term exposure above MCL may cause: weight loss, cardiovascular damage, retinal and some muscle degeneration; cancer.</p>

# Some Common Pathways for Bacteria to Enter Your Water System



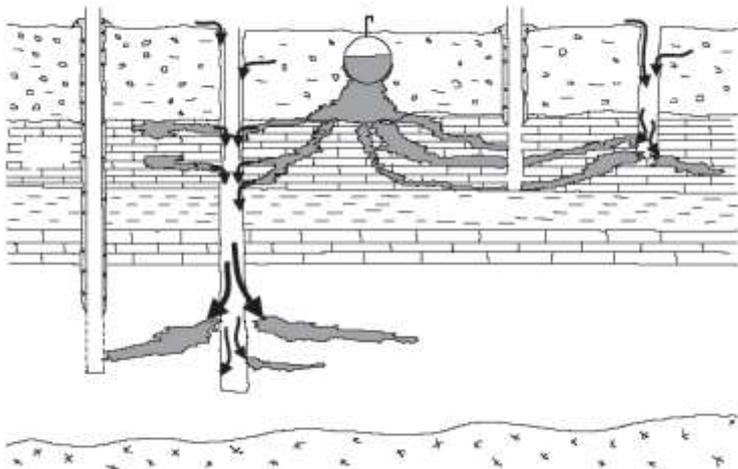
Photo: Sandy Heimke, WI DNR



Photo: Sandy Heimke, WI DNR



## AQUIFER CONTAMINATION THROUGH IMPROPERLY ABANDONED WELLS



Source: Adapted from DiNovo and Jaffe, 1984.

Codes 42.401(4)(c), Wisconsin Administrative Code prohibits the installation of a yard hydrant with a below ground discharge. The code reads:

**"Stop and waste-type control valves may not be installed underground."**

This type of hydrant, with a below ground discharge is popular because of the ease of operation and the relative low cost.



The plugger (control valve) is located below the frost line. When the handle is lifted water enters the riser and flows through the head. A drain at the same level as the plugger allows water to the rear and the head to drain each time the handle is lowered. This draining action prevents freezing temperatures from causing the water in the hydrant riser or head to expand and burst the device. If a hose connected to the hydrant without a hose connection vacuum breaker were submerged in a barrel, the water contents of the barrel could be siphoned through the drain port and could contaminate the groundwater or even your drinking water supply.

If you have further questions, please check the Consumer website at: <http://consumer.wis.gov/50-58-PlumbingProgram.html>

or, contact your local plumbing inspector or, contact one of the consultants listed



District #	Name	Phone/Fax
1	Tim Jovin	480-235-0377 / 480-263-7474
2	Tom Brown	715-545-3367 / 480-263-7473
3	Don Overton	715-546-2007 / 480-263-7472
4	Don Hough	715-546-4004 / 480-263-7471
5	Ryan Buckel	480-412-1999 / 480-383-7448

501-580-7690

## What does an approved yard hydrant look like?



There's a "one" answer for a code-compliant yard hydrant. Many manufacturers produce models that are code compliant. When you buy a hydrant, make sure that it has an approved hose connection vacuum breaker and does not include an underground drain.

And if you install a hose connection vacuum breaker on a yard hydrant make sure you break it during the winter to prevent freezing conditions from bursting the hydrant.

If you find a model that you have questions about, contact the department or your local plumbing inspector.

# What should I do if coliform bacteria was present?

1. Use alternative source of water for drinking
  2. Retest
  3. Try to identify any sanitary defects
    - Loose or non-existent well cap
    - Well construction faults
    - A nearby unused well or pit
    - Inadequate filtration by soil
  4. Disinfect the well
  5. Retest to ensure well is bacteria free.
- *For reoccurring bacteria problems the best solution may be a new well.*

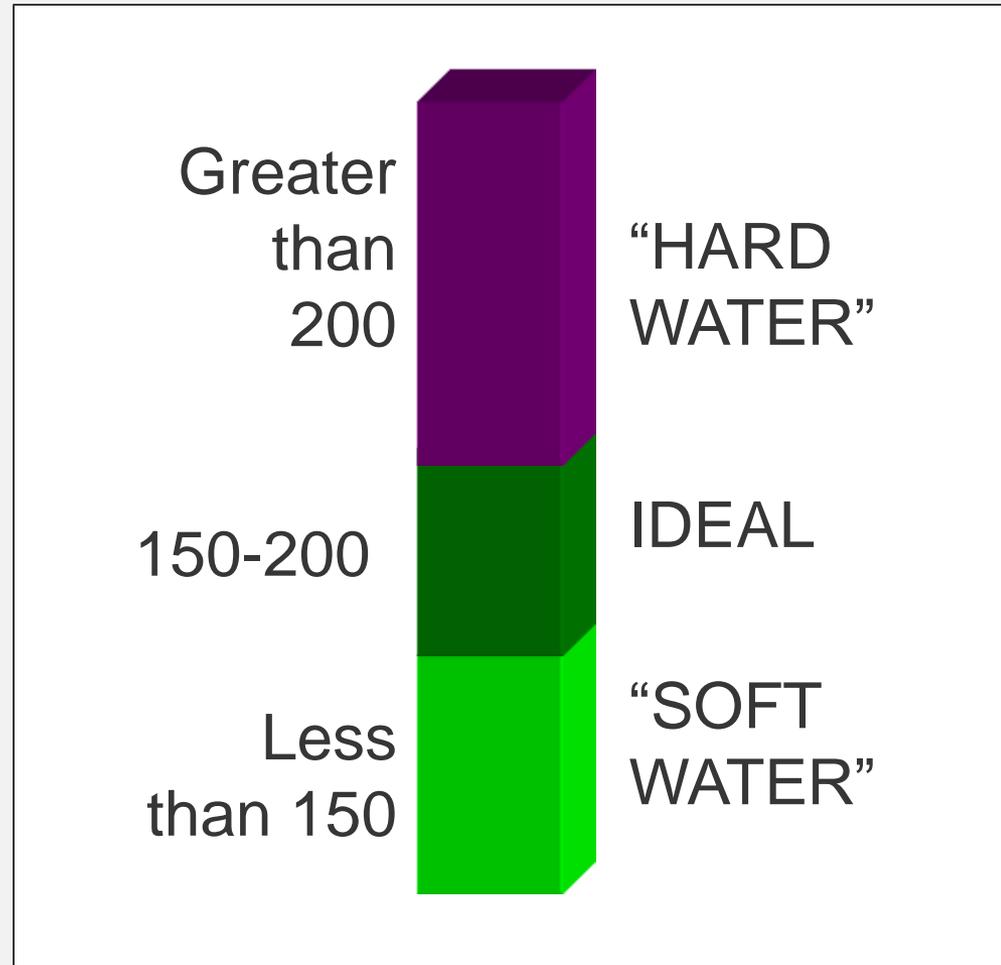


# **Rock and Soil Impacts on Water Quality**

# Tests for Aesthetic Problems

## Hardness

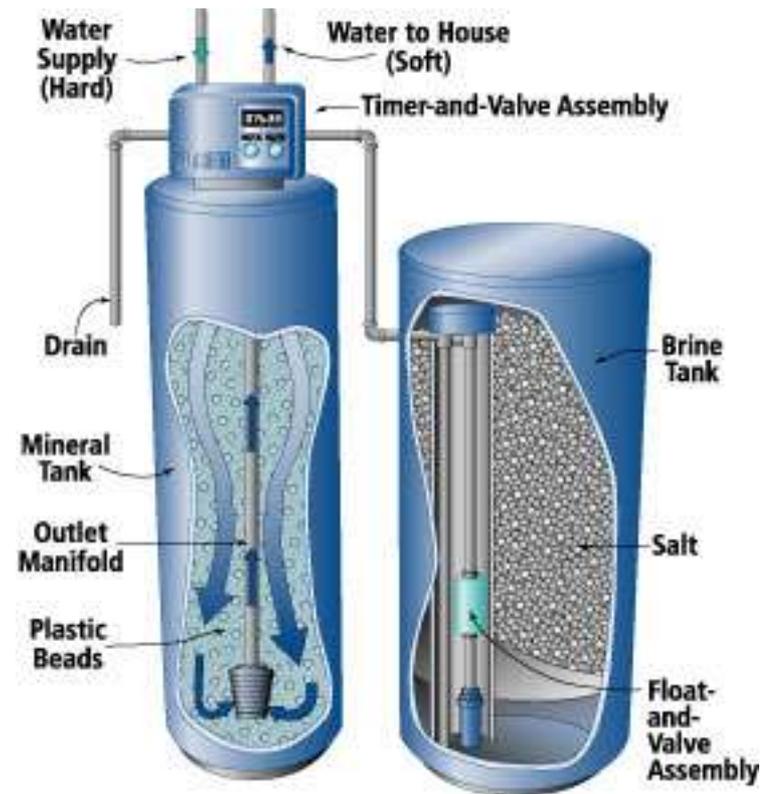
- Natural (rocks and soils)
- Primarily calcium and magnesium
- Problems: scaling, scum, use more detergent, decrease water heater efficiency

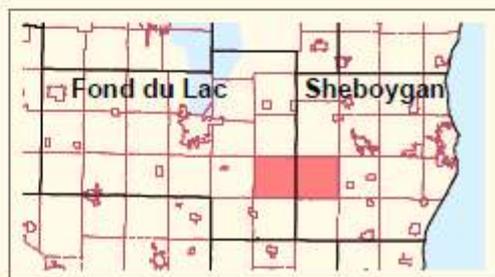
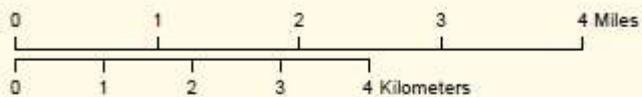
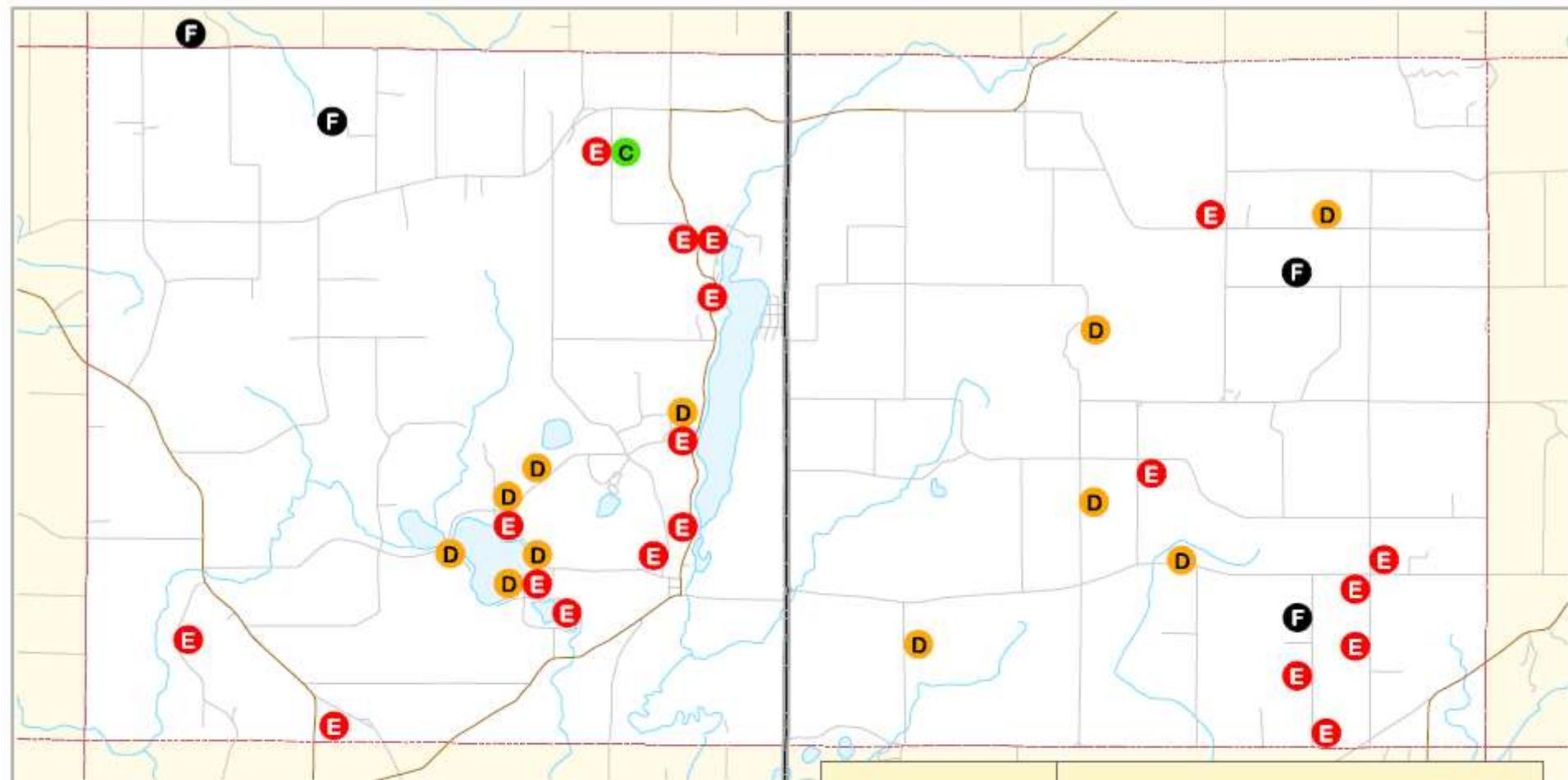


# Water Softening

Water softeners remove calcium and magnesium which cause scaling and exchange it for sodium (or potassium).

- Negative: Increases sodium content of water.
- Suggestions:
  - Bypass your drinking water faucet.
  - Do not soften water for outdoor faucets.
  - If you are concerned about sodium levels – use potassium chloride softener salt.





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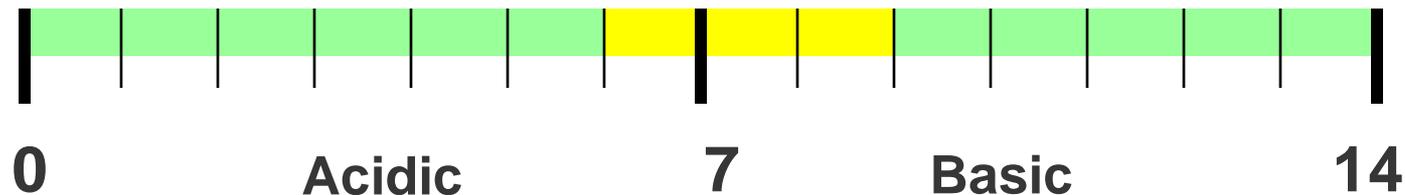
**TOTAL HARDNESS (ppm CaCO<sub>3</sub>)**

<b>A</b> ... 50	2	5%
<b>B</b> 51 - 100	1	2%
<b>C</b> 101 - 200	1	2%
<b>D</b> 201 - 300	11	27%
<b>E</b> 301 - 400	22	54%
<b>F</b> 401 ...	4	10%

Mapped value is the average unless otherwise indicated.  
Treated samples not mapped.

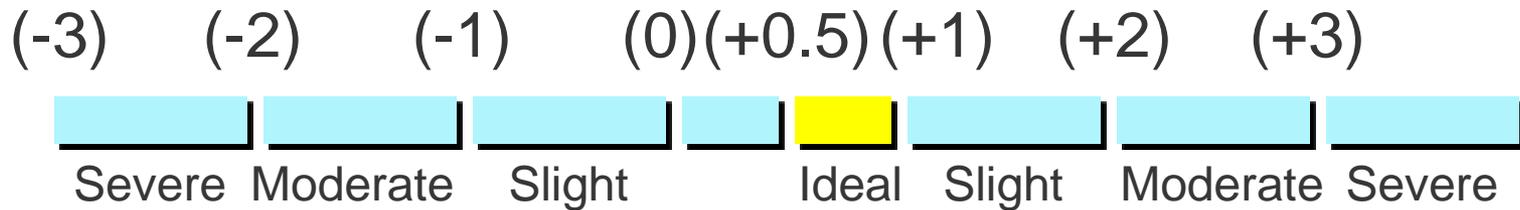
# Tests for Overall Water Quality

- **Alkalinity** – ability to neutralize acid
- **Conductivity** –
  - Measure of total ions
  - can be used to indicate presence of contaminants (~ twice the hardness)
- **pH** – Indicates water's acidity and helps determine if water will corrode plumbing



# Tests for Overall Water Quality

## Saturation Index



Corrosion occurs

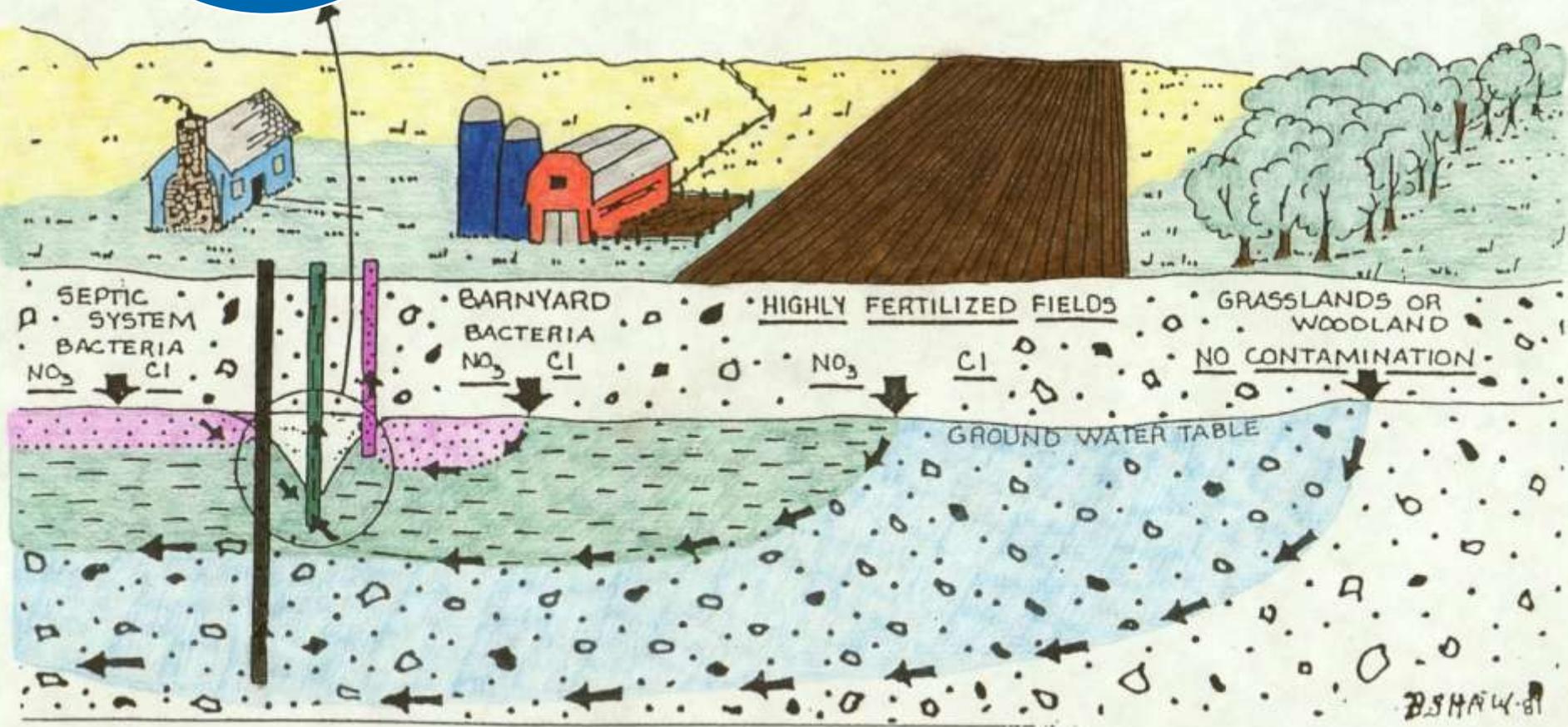


Scaling occurs



Well  
pumping  
water

# Land Use and Water Quality

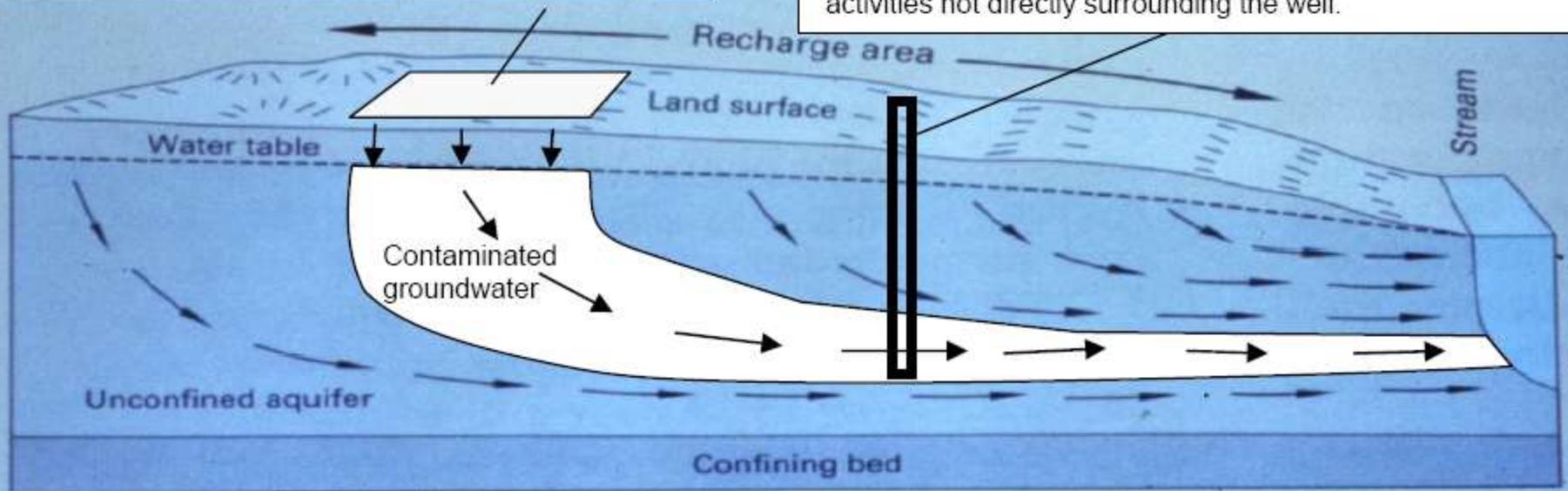




Soil

Land-use activity that pollutes groundwater.

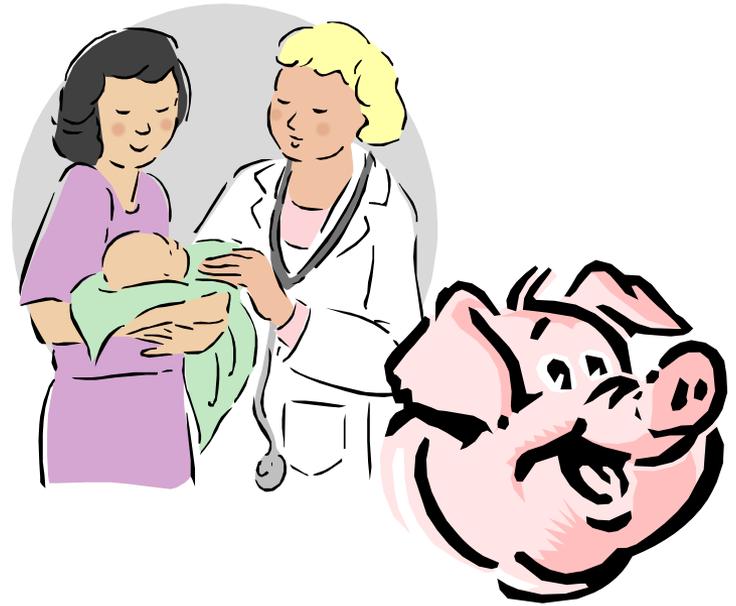
Because groundwater moves, wells located far from the contamination source can sometimes be polluted from activities not directly surrounding the well.



# Nitrate-Nitrogen

## Health Effects:

- Methemoglobinemia (blue baby disease)
- Possible links to birth defects and miscarriages (humans and livestock)
- Indicator of other contaminants



## Sources:

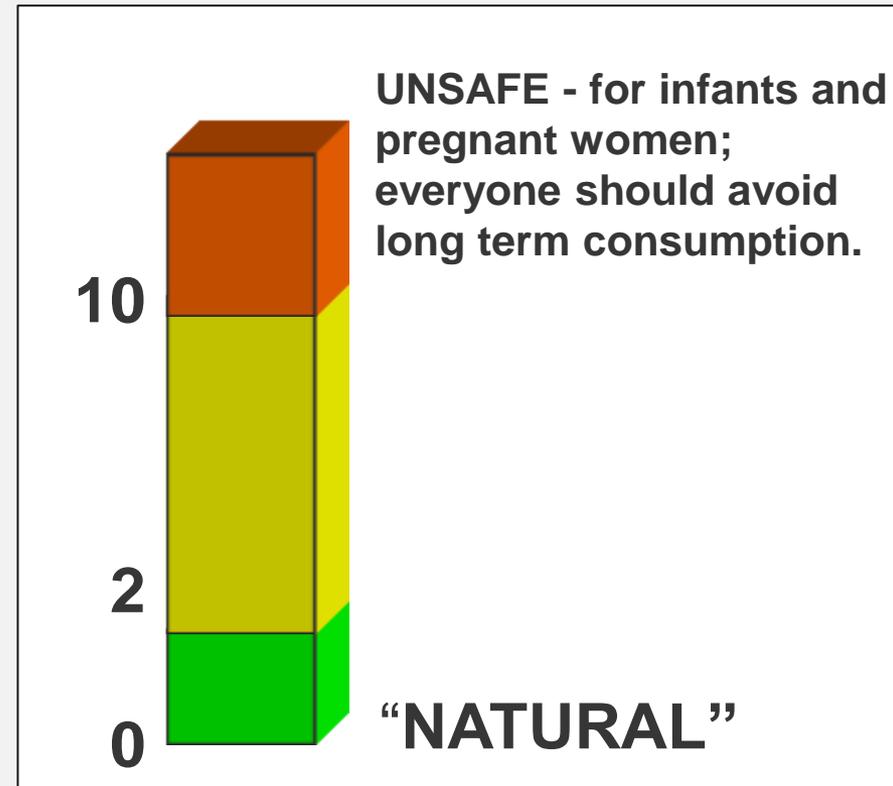
- Agricultural fertilizer
- Lawn fertilizer
- Septic systems
- Animal wastes

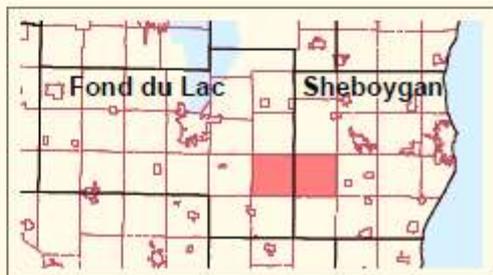
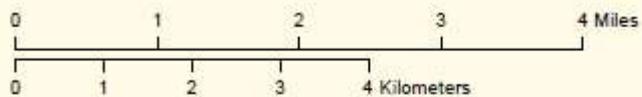
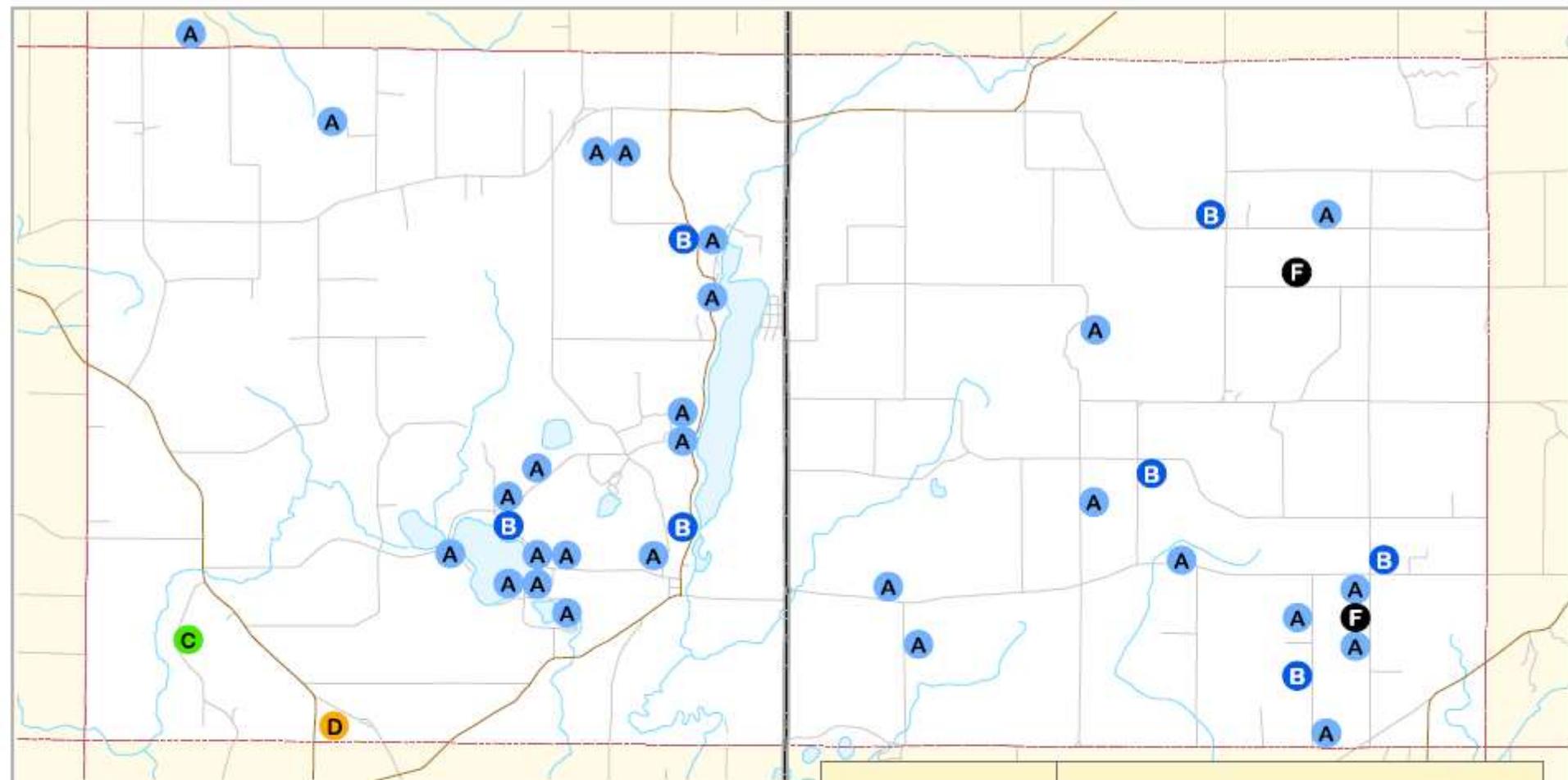


# Test Important to Health

## Nitrate Nitrogen

- **Greater than 10 mg/L**  
*Exceeds State and Federal Limits for Drinking Water*
- **Between 2 and 10 mg/L**  
*Some Human Impact*
- **Less than 2.0 mg/L**  
*“Transitional”*
- **Less than 0.2 mg/L**  
*“Natural”*





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Fond du Lac Co

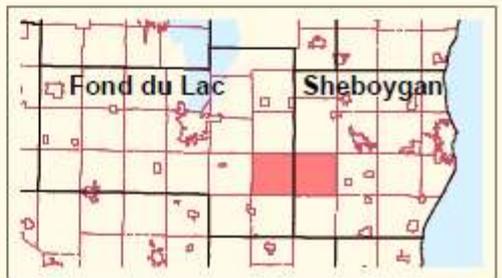
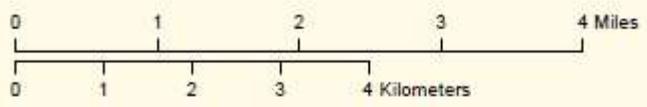
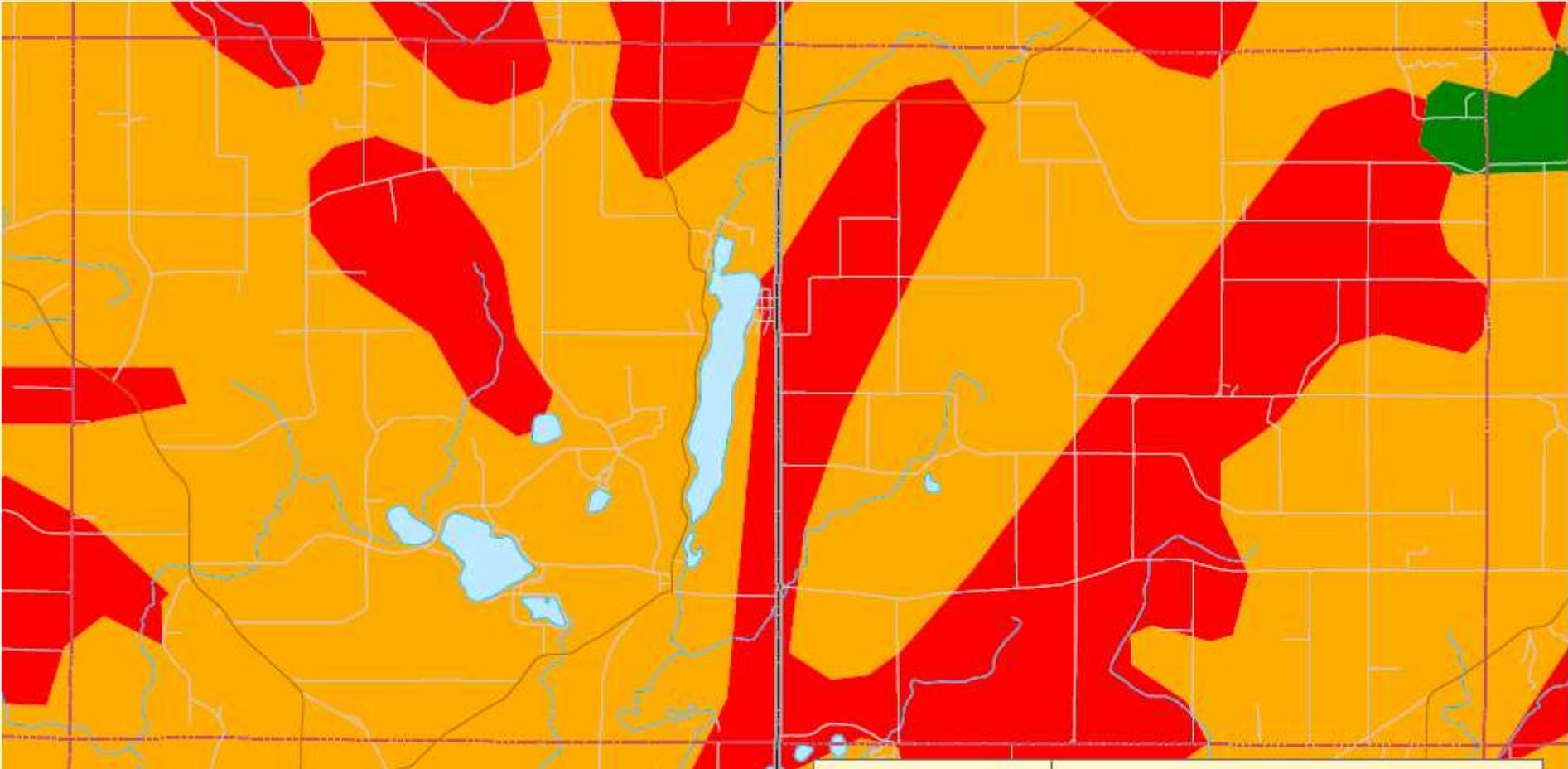
**Mitchell**  
Sheboygan Co

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**NITRATE-NITRITE (ppm N)**

<b>A</b>	<b>None Detected</b>	<b>30</b>	<b>73 %</b>
<b>B</b>	<b>... 2.0</b>	<b>7</b>	<b>17 %</b>
<b>C</b>	<b>2.1 - 5.0</b>	<b>1</b>	<b>2 %</b>
<b>D</b>	<b>5.1 - 10.0</b>	<b>1</b>	<b>2 %</b>
<b>E</b>	<b>10.1 - 20.0</b>	<b>0</b>	<b>0 %</b>
<b>F</b>	<b>20.1 ...</b>	<b>2</b>	<b>5 %</b>

Mapped value is the average unless otherwise indicated.  
Treated samples not mapped.



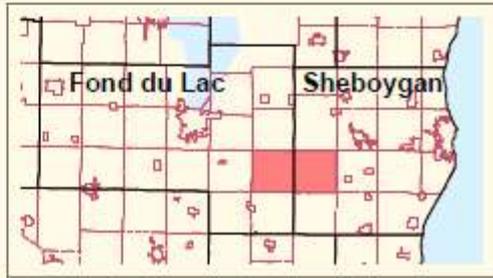
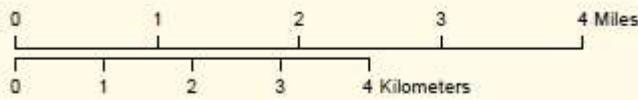
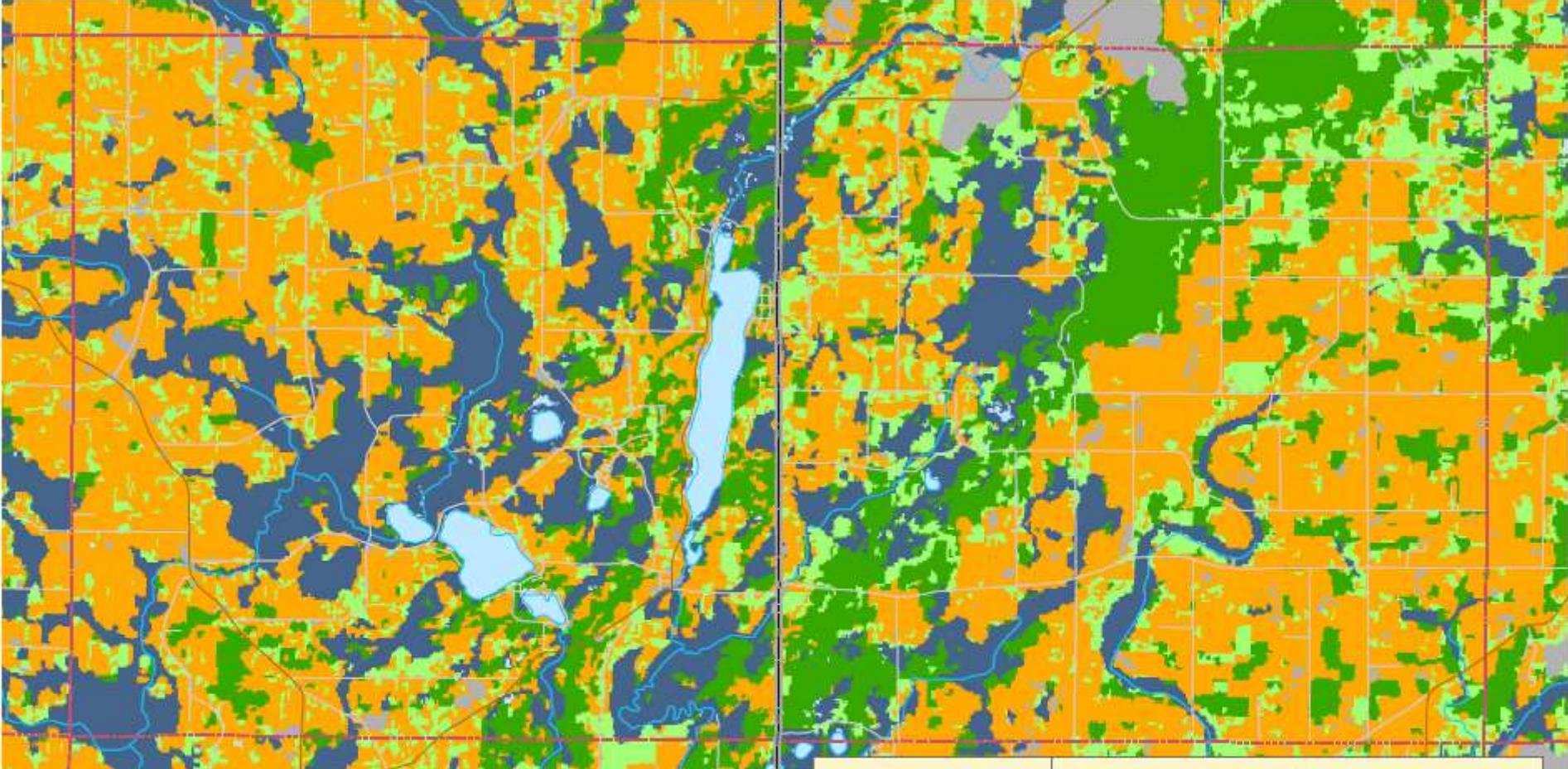
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**Surficial Deposits:**

- Sand & Gravel
- Sand
- Peat
- Loam
- Clay



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**Land Use:**

- Urban
- Agriculture
- Forest
- Shrub-Grass
- Wetland
- Water
- Other

# Private Well Test Results

Nitrate-N Concentration (mg/L)

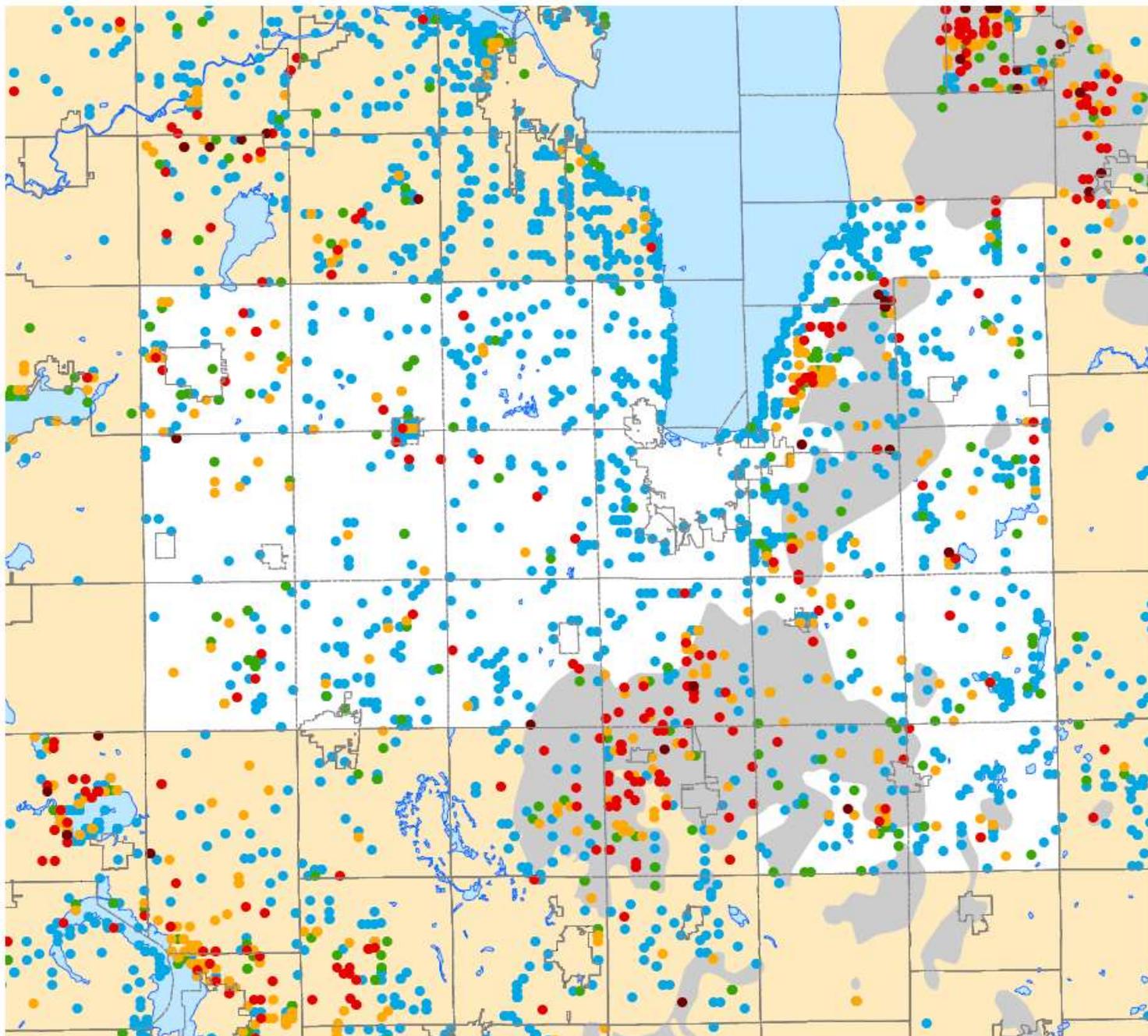
- 0 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- > 20

■ Areas of greatest karst potential



Center for Watershed Science and Education

2007

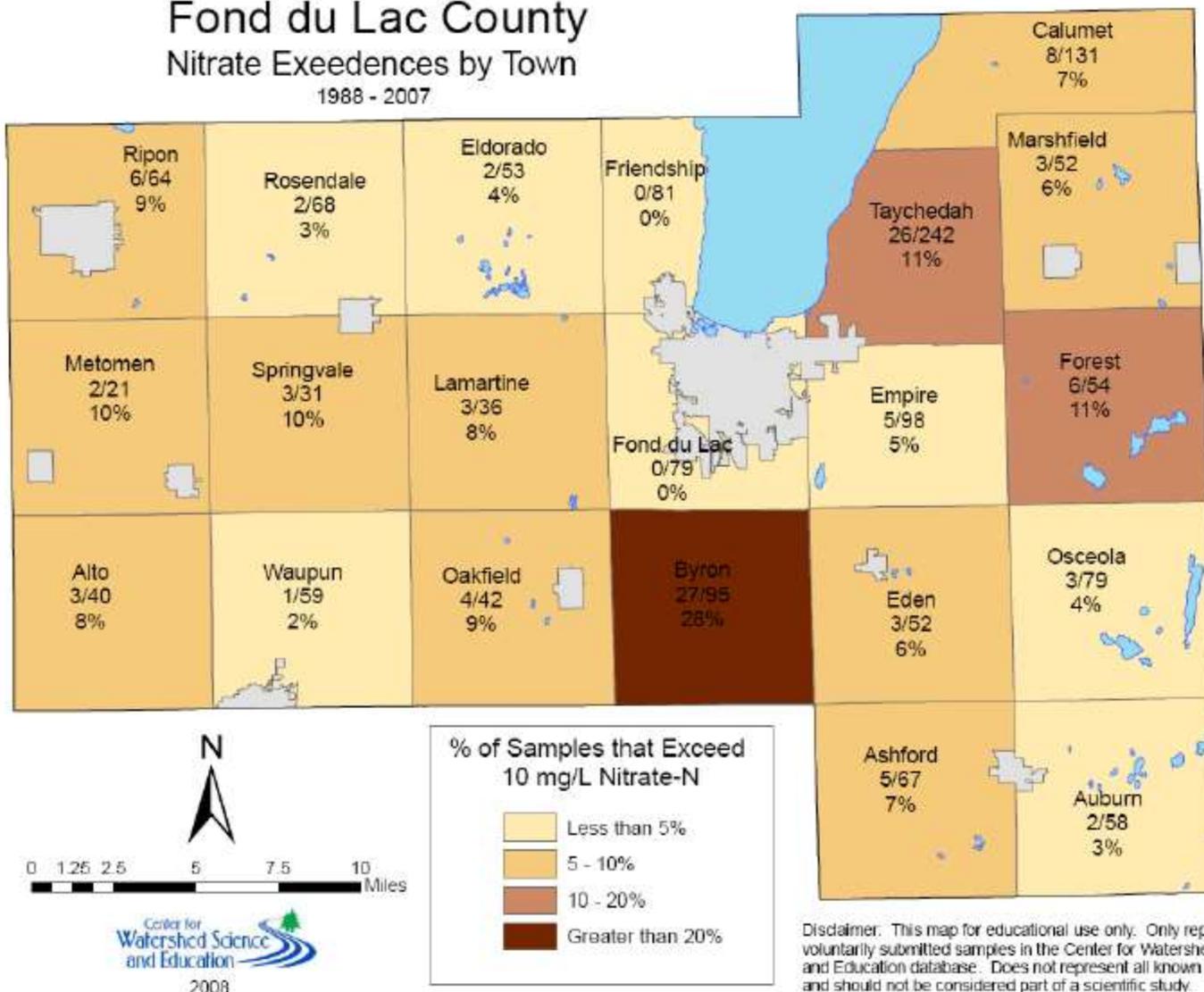


Disclaimer: This map for educational purposes only. It represents private well testing results in the Center for Watershed Science and Education database it does not represent a scientific study.

# Fond du Lac County

## Nitrate Exceedences by Town

1988 - 2007



Percent of samples (by town) that exceed the 10 mg/L safe drinking water standard for nitrate-nitrogen. Numbers indicate the number of exceedences and the total number of samples per town. (1988-2007) (1988-2007 data)

# What can I do to reduce my nitrate levels?

## **Solution:**

- **Eliminate contamination source or reduce nitrogen inputs**

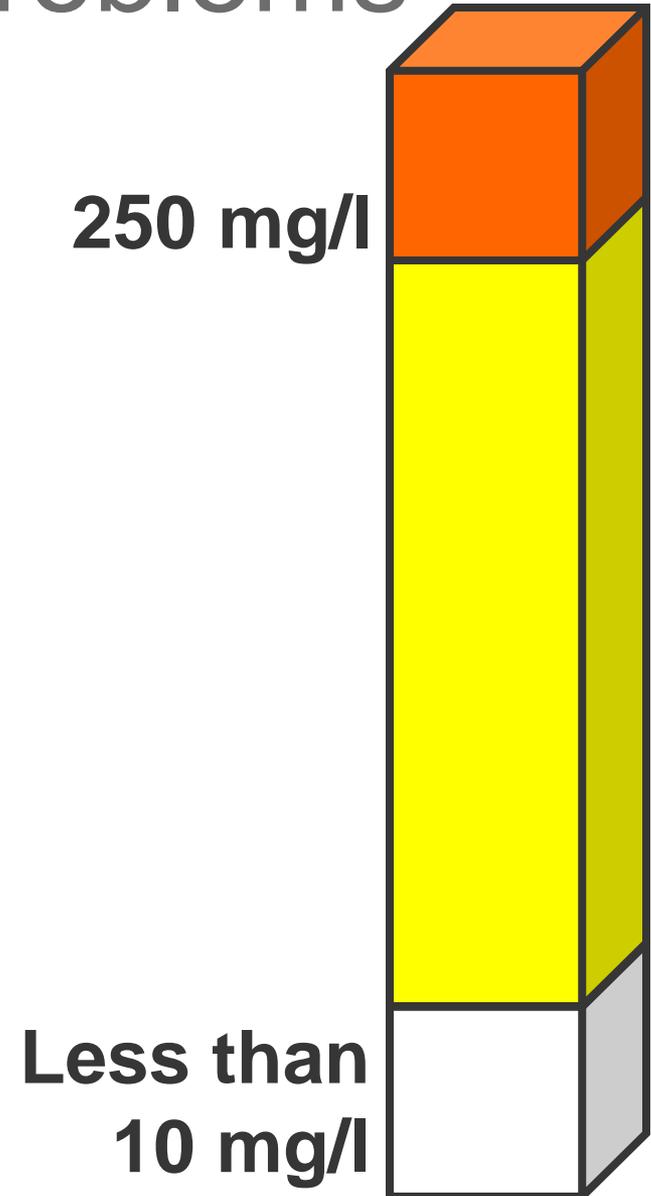
## **Short term:**

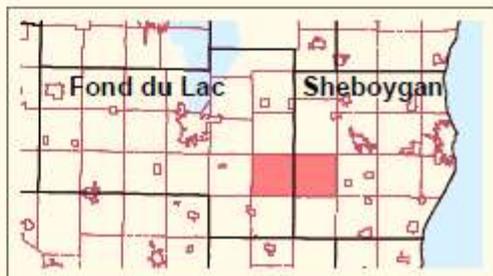
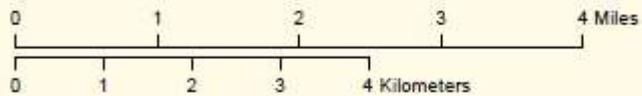
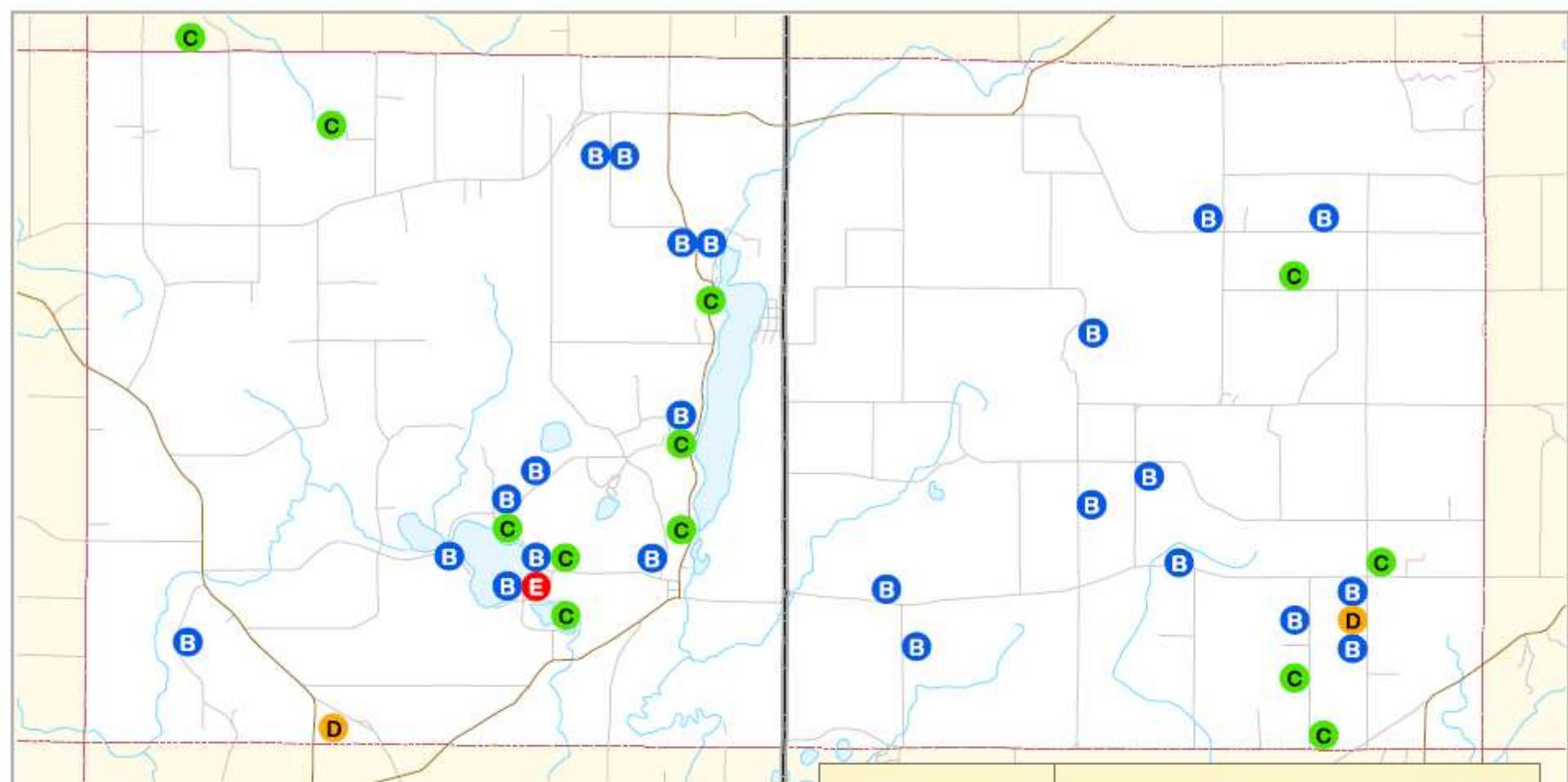
- **Change well depth or relocate well**
- **Carry or buy water**
- **Water treatment devices**
  - **Reverse osmosis**
  - **Distillation**
  - **Anion exchange**

# Tests for Aesthetic Problems

## Chloride

- Greater than 250 mg/l
  - No direct effects on health
  - Salty taste
  - Exceeds recommended level
- Greater than 10 mg/l may indicate human impact
- Less than 10 mg/l considered “natural” in much of WI
- **Sources:** Fertilizers, Septic Systems and Road Salt





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**CHLORIDE (ppm)**

<b>A</b>	<b>None Detected</b>	<b>0</b>	<b>0 %</b>
<b>B</b>	<b>... 10</b>	<b>24</b>	<b>59 %</b>
<b>C</b>	<b>11 - 50</b>	<b>14</b>	<b>34 %</b>
<b>D</b>	<b>51 - 100</b>	<b>2</b>	<b>5 %</b>
<b>E</b>	<b>101 - 200</b>	<b>1</b>	<b>2 %</b>
<b>F</b>	<b>201 ...</b>	<b>0</b>	<b>0 %</b>

Mapped value is the average unless otherwise indicated.  
Treated samples not mapped.

# Tests for Aesthetic Problems

## Iron

- Natural (rocks and soils)
- May benefit health
- Red and yellow stains on clothing, fixtures
  
- If iron present, increases potential for iron bacteria
  - Slime, odor, oily film



**Greater  
than 0.3  
mg/L**

**Aesthetic  
problems  
likely**

**Less  
than 0.3 mg/L**

# Test Important to Health

## Copper

- **Sources:** Copper water pipes
- **Standard:** Less than 1.3 mg/L is suitable for drinking

### Health Effects:

- Some copper is needed for good health
- Too much may cause problems:
  - Stomach cramps, diarrhea,
  - vomiting, nausea
  - Formula intolerance in infants



# Test Important to Health

## Lead

**Sources:** Lead solder joining copper pipes (pre-1985) or brass fixtures

**Standard:** 0.015 mg/L (15 ppb)

### Health Effects:

- Young children, infants and unborn children are particularly vulnerable.
- Lead may damage the brain, kidneys, nervous system, red blood cells, reproductive system.



# Lead and Copper

## Solutions:

- Allow water to run for a minute or two before using for drinking or cooking

or

- Use a treatment device, but generally not necessary



# Test Important to Health

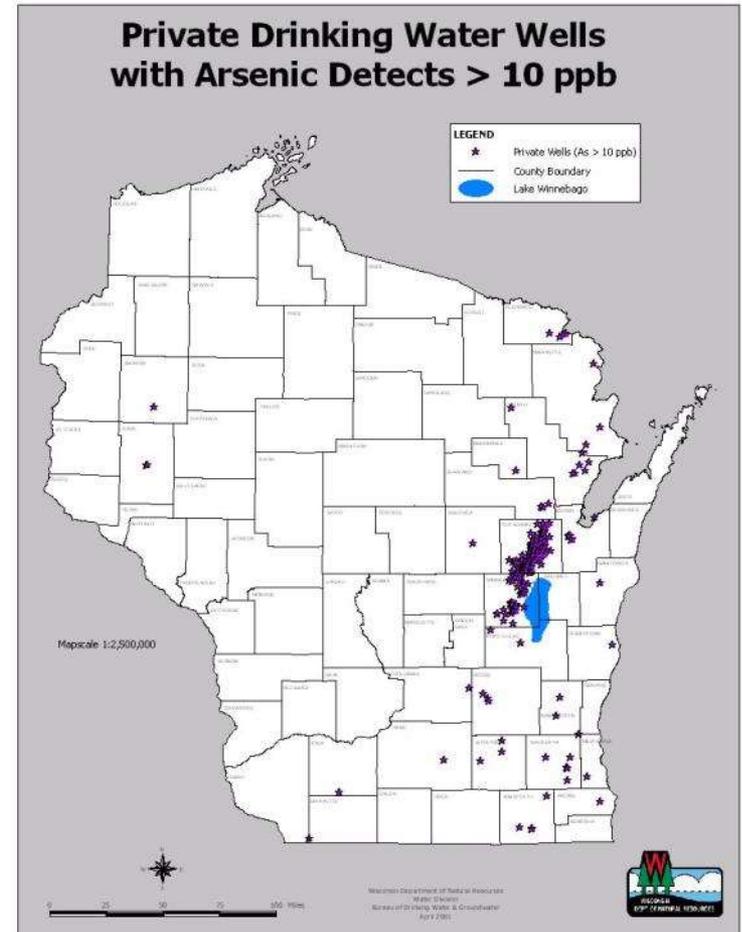
## Arsenic

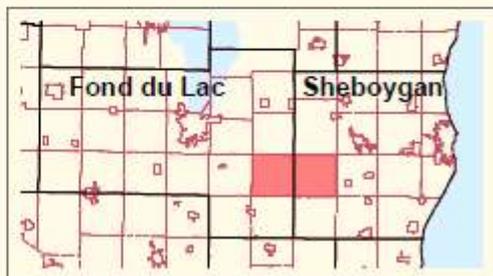
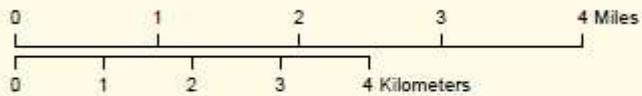
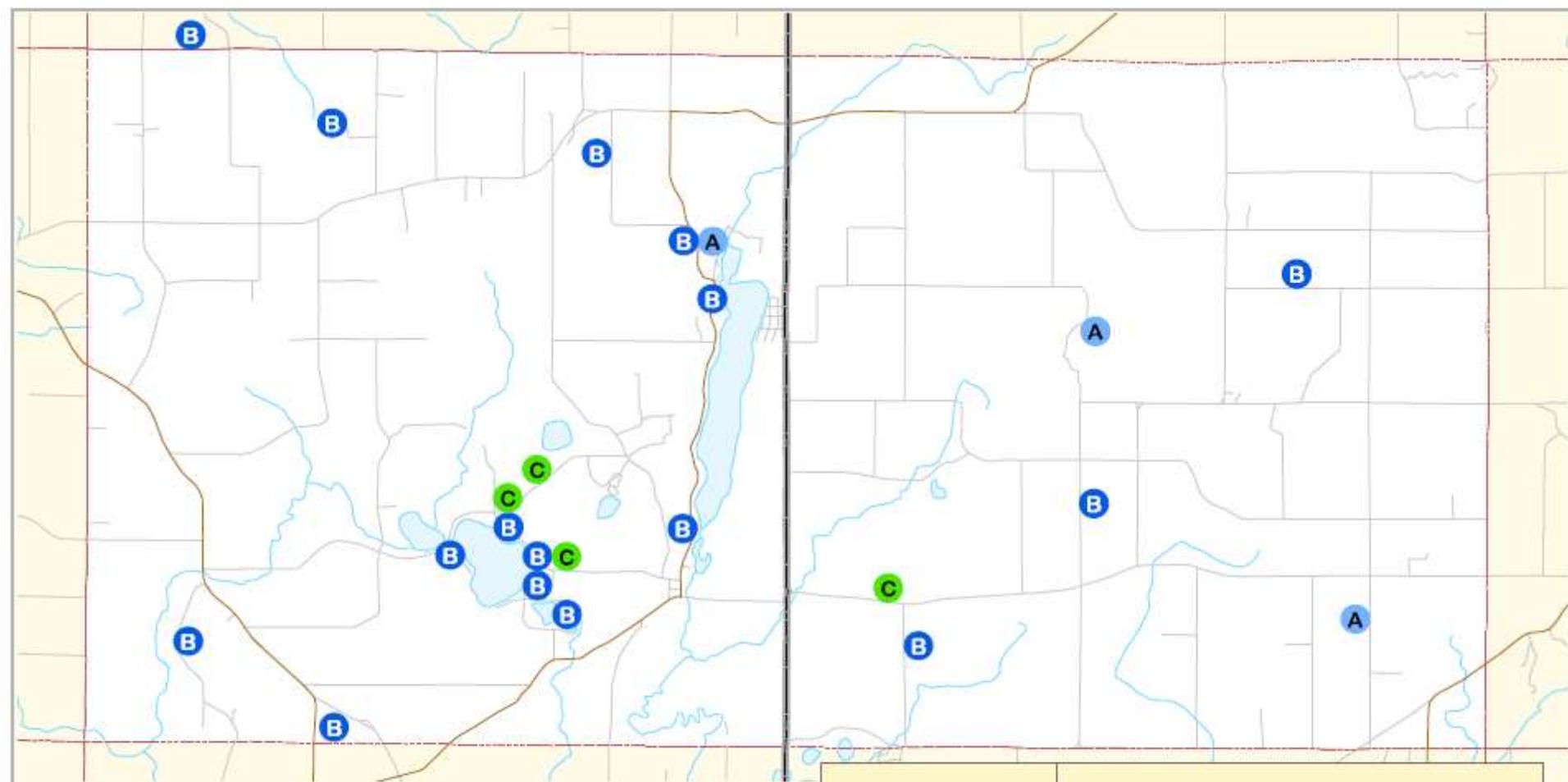
**Sources:** Naturally occurring in mineral deposits

**Standard:** 0.010 mg/L (10 ppb)

### Health Effects:

- Increased risk of skin cancers as well as lung, liver, bladder, kidney, and colon cancers.
- Circulatory disorders
- Stomach pain, nausea, diarrhea
- Unusual skin pigmentation





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**ARSENIC (mg/l)**

Maximum value for the 1/4 1/4 section.

<b>A</b>	<b>None Detected</b>	<b>5</b>	<b>19 %</b>
<b>B</b>	<b>... 0.010</b>	<b>18</b>	<b>67 %</b>
<b>C</b>	<b>0.011 - 0.050</b>	<b>4</b>	<b>15 %</b>
<b>D</b>	<b>0.051 - 0.100</b>	<b>0</b>	<b>0 %</b>
<b>E</b>	<b>0.101 - 0.150</b>	<b>0</b>	<b>0 %</b>
<b>F</b>	<b>0.151 ...</b>	<b>0</b>	<b>0 %</b>

Treated samples not mapped.

# Pesticides in Drinking Water

- Pesticides include: insecticides, herbicides, fungicides and other substances used to control pests.
- Health standards usually only account for parent compound.
- Parent compounds breakdown over time.
- Little research into health effects from the combination of chemicals..
- **Most frequently detected pesticides in Wisconsin:**
  - Alachlor\* and its chemical breakdown products
  - Metolachlor and its chemical breakdown products
  - Atrazine\*\* and its chemical breakdown products
  - Metribuzin
  - Cyanazine and its chemical breakdown products.



# Tests Important to Health

## DACT Screen

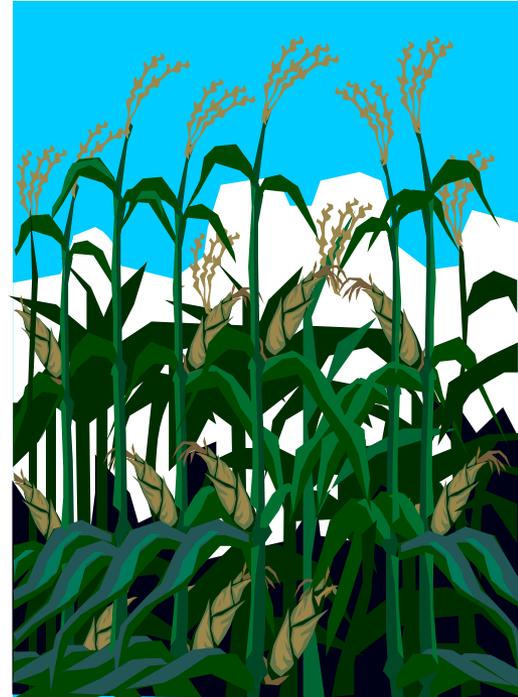
**Sources:** Triazine pesticides (mainly atrazine used on corn crops)

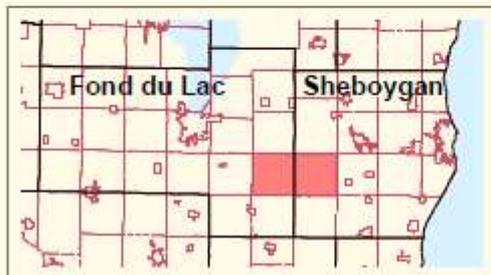
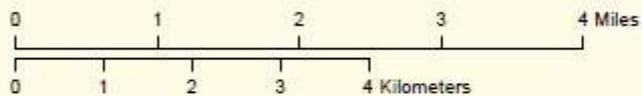
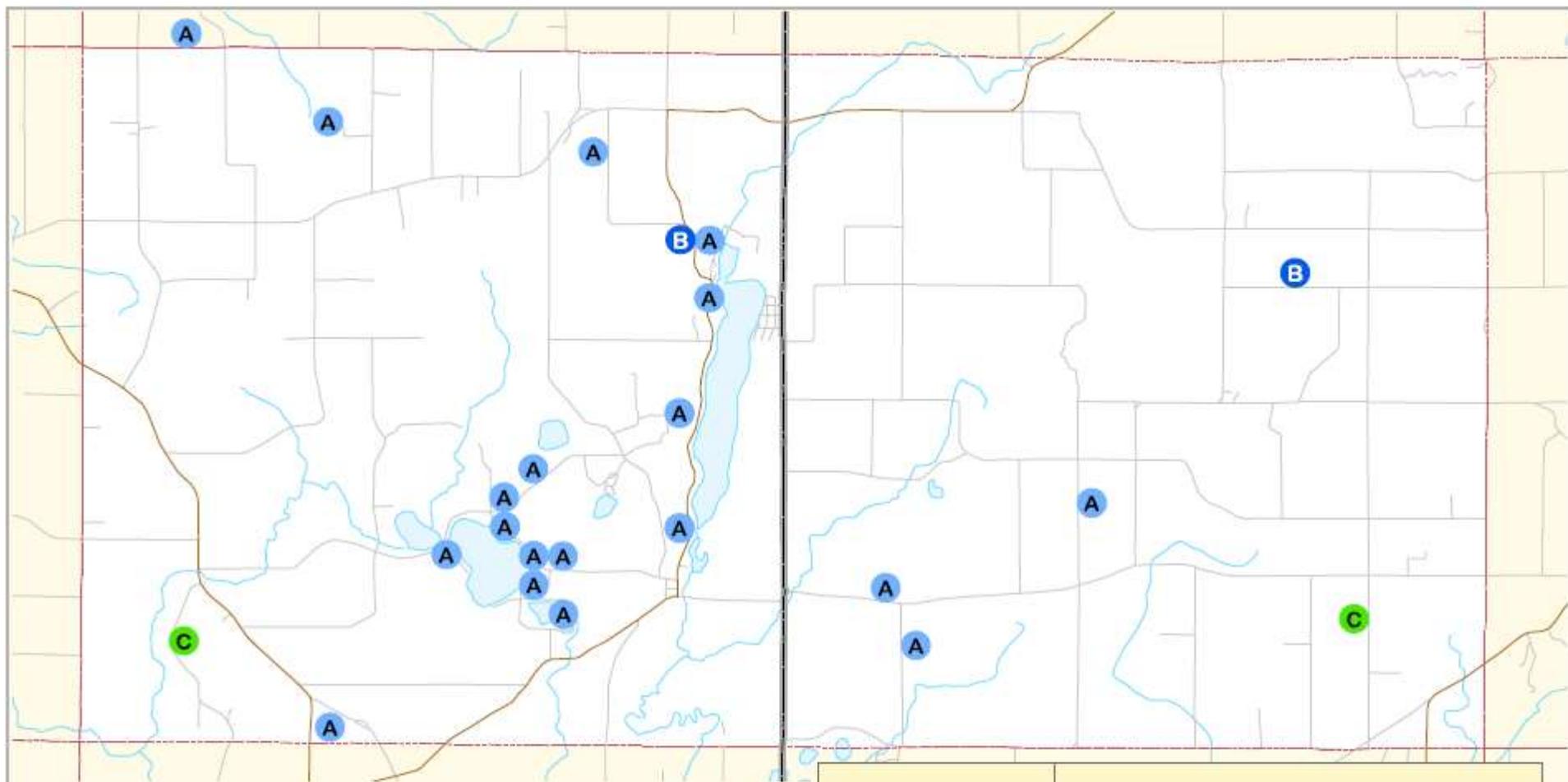
**DACT Screen:** Only measures the diaminochlorotriazine (DACT) residue levels of triazine type pesticides (atrazine, simazine, propazine, cyanazine, etc)

Specific to diaminochlorotriazine (DACT), does not account for parent compound or other breakdown components

Drinking water limit:

- **3 ppb of total atrazine** (*atrazine + the 3 breakdown components*)





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**DACT (ug/l)**

Maximum value for the 1/4 1/4 section.

<b>A</b>	<b>None Detected</b>	20	83 %
<b>B</b>	<b>... 0.3</b>	2	8 %
<b>C</b>	<b>0.4 - 1.0</b>	2	8 %
<b>D</b>	<b>1.1 - 2.0</b>	0	0 %
<b>E</b>	<b>2.1 - 3.0</b>	0	0 %
<b>F</b>	<b>3.1 ...</b>	0	0 %

Treated samples not mapped.

# Improving water quality

## ➤ Long-term improvements

- Eliminate sources of contamination

## ➤ Short-term improvements

- Repair or replace existing well
- Connect to public water supply or develop community water system
- Purchase bottled water for drinking and cooking
- Install a water treatment device
  - Often the most convenient and cost effective solution

# understanding water treatment

- **Advantages:**

- + Reduce level of contaminants and other impurities
- + Improve taste, color and odor

- **Disadvantages:**

- Require routine maintenance.
- Can require large amounts of energy.
- Testing is often the only way to know it is functioning properly for most health related contaminants.

- **Cautions:**

- Treatment methods often selective for certain contaminants
- Multiple treatment units may be necessary
- Treatment may also remove beneficial elements from water in the process.



# Before investing in treatment....

- Always have water tested at a certified lab before investing in water treatment.
  - Know the types and amounts of chemicals you would like removed.
- Choose a device that has been approved by the Wisconsin Department of Commerce.
  - Ask for a copy of the approval letter.  
or
  - Check the agency's Drinking Water Treatment Product Approval website:  
[http://dsps.wi.gov/sb\\_ppalopp/disclaimer1.phtml/c/270](http://dsps.wi.gov/sb_ppalopp/disclaimer1.phtml/c/270)

# Where do you go from here: Recommended next steps

- Test well annually for bacteria, or if water changes color or clarity.
- If levels are elevated, test again in 15 months for nitrate.
- If you detected pesticides, you may want to perform a more extensive and accurate pesticide analysis.



## Center for Watershed Science and Education

College of Natural Resources and University of Wisconsin-Extension

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Quality Viewer

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### About our Center

The Center for Watershed Science and Education is a partnership between the UW-Stevens Point College of Natural Resources and UW - Extension. In the spirit of the Wisconsin Idea, the Center works across the state helping to:

- Support watershed stewardship
- Assist citizens with lake, river and drinking water quality problems
- Promote management strategies for water resource protection
- Provide water quality assessment and support
- Prepare students for careers as water resource professionals.

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