

Groundwater and Drinking Water Education Program Green County

Kevin Masarik
Center for Watershed Science and Education



University of Wisconsin-Stevens Point
College of Natural Resources

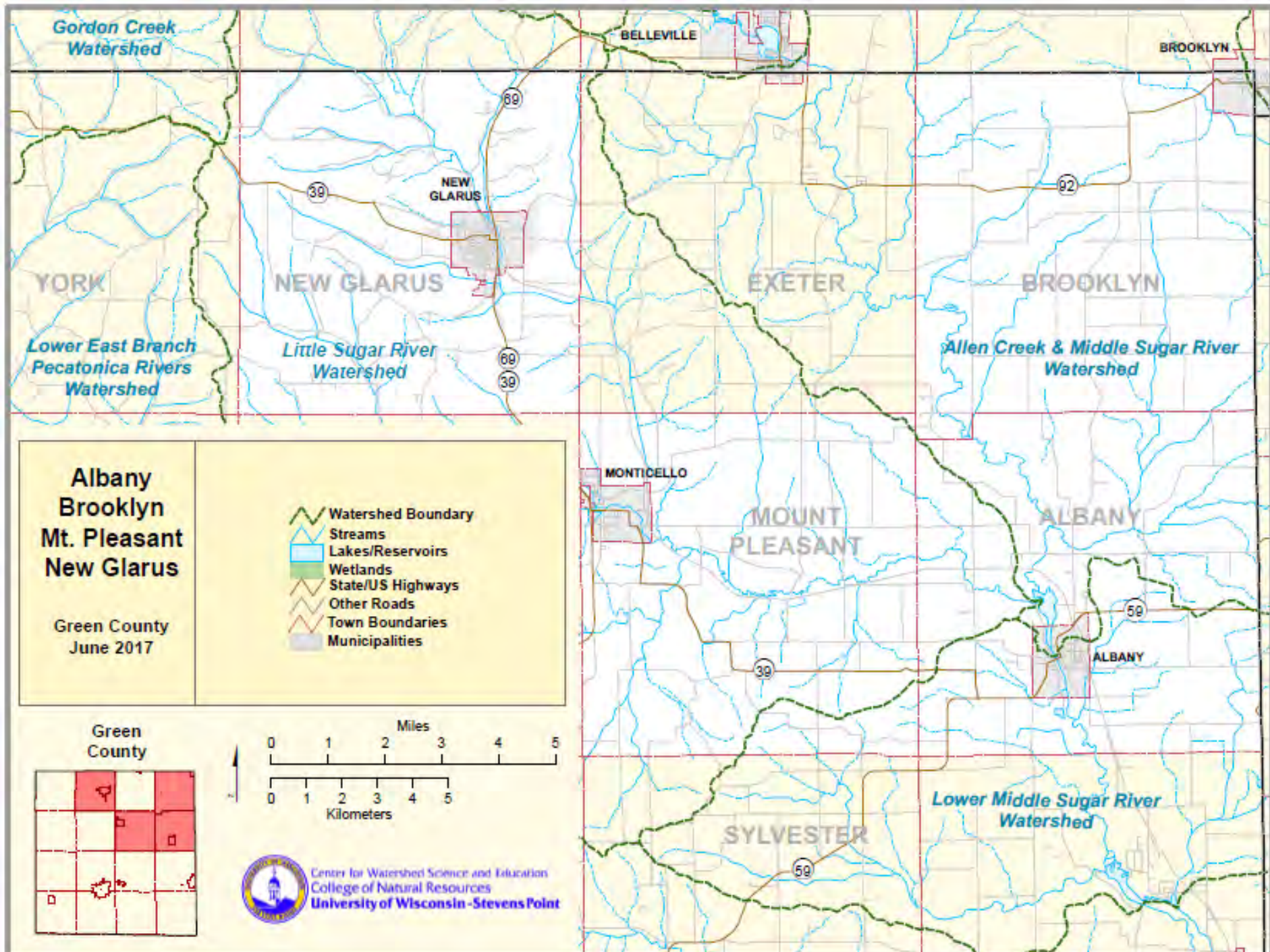


Through the University of Wisconsin-Extension, all Wisconsin people can access University resources and engage in lifelong learning, wherever they live and work.

Today's presentation

- Groundwater Basics: Where does my water come from
- Well Construction
- What do my individual test results mean?
- General groundwater quality in Albany, Brooklyn, Mt. Pleasant, and New Glarus
- Improving your water quality

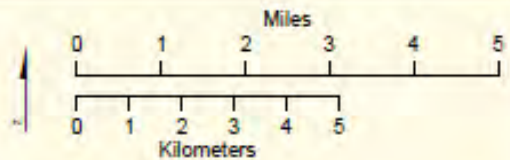
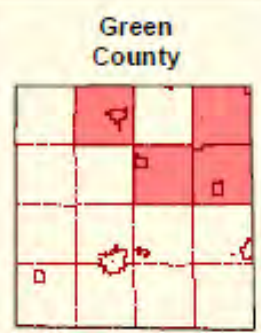




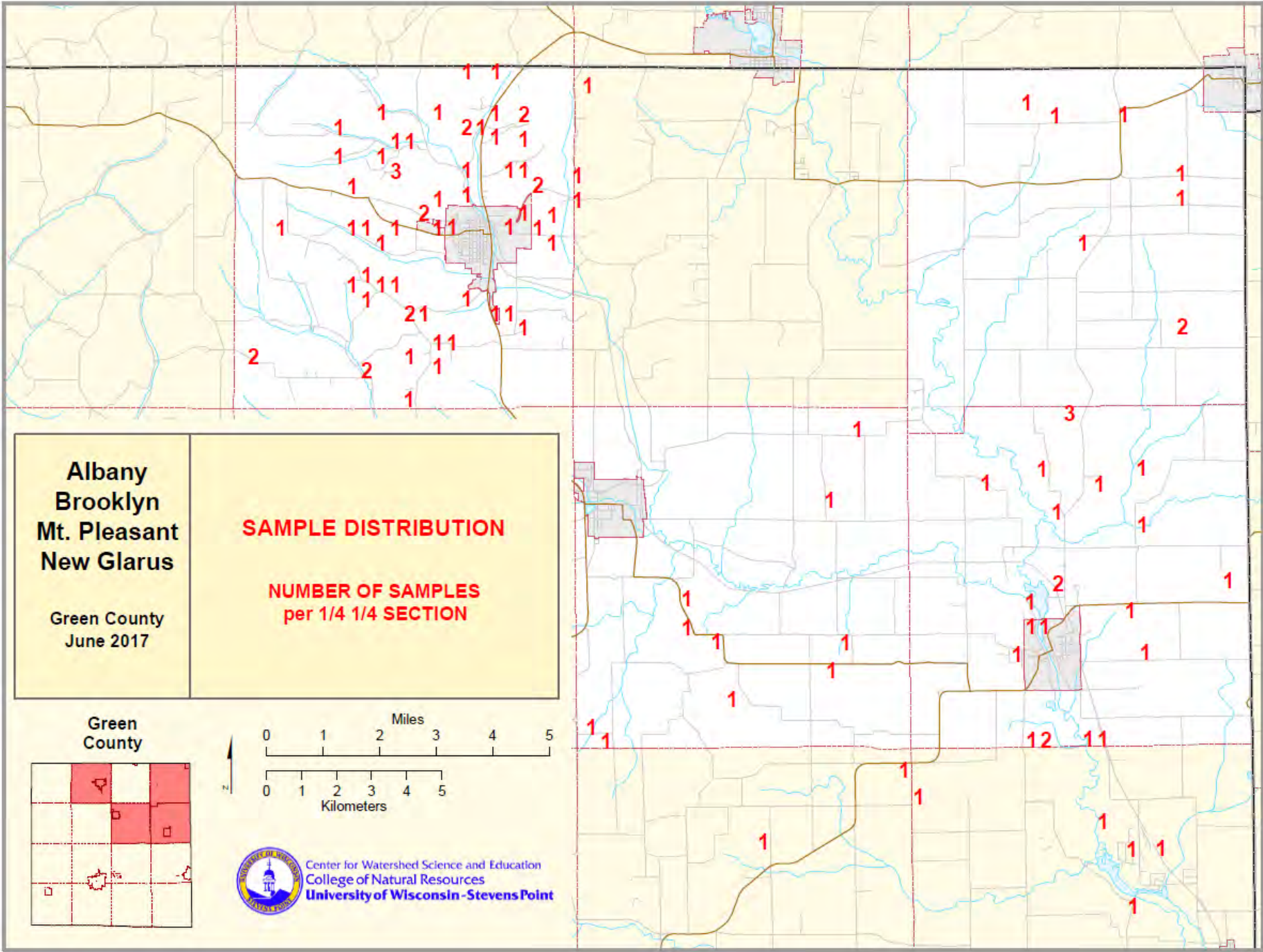
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-  Watershed Boundary
-  Streams
-  Lakes/Reservoirs
-  Wetlands
-  State/US Highways
-  Other Roads
-  Town Boundaries
-  Municipalities



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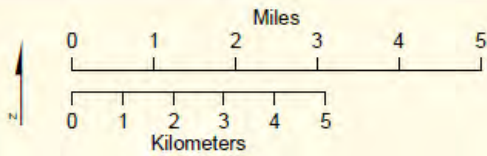
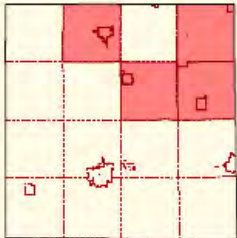
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SAMPLE DISTRIBUTION

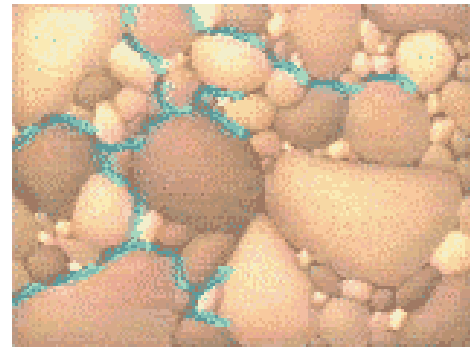
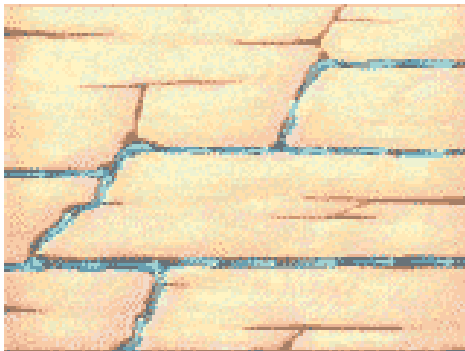
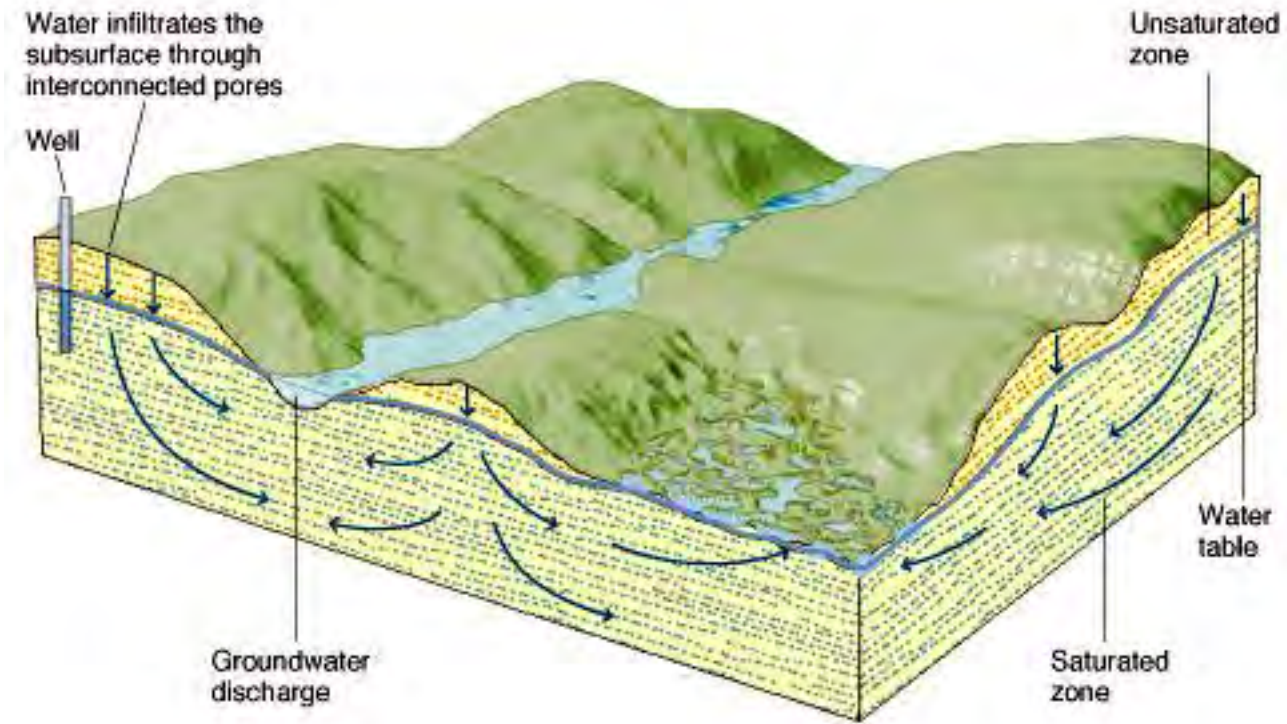
**NUMBER OF SAMPLES
per 1/4 1/4 SECTION**

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Groundwater Movement

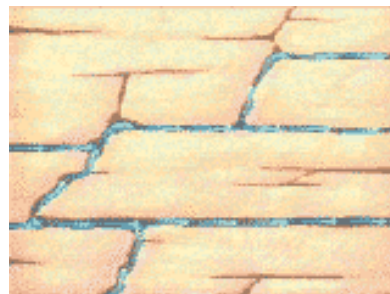


Aquifers: Our groundwater storage units

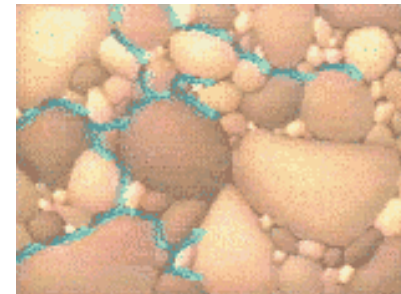
Aquifers are geologic formations that store and transmit groundwater.

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.

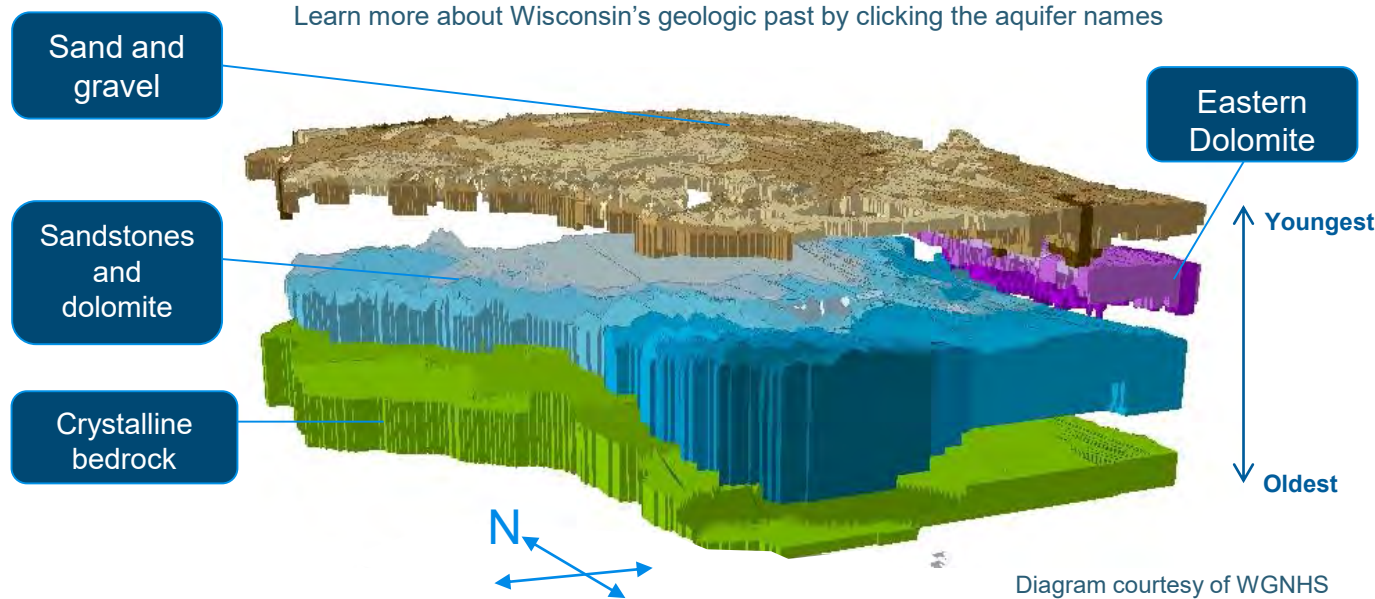


Water and contaminants can move quickly through cracks and fractures.



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



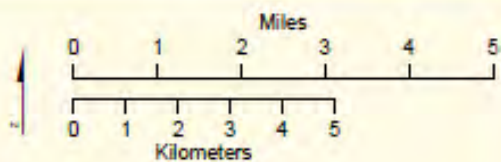
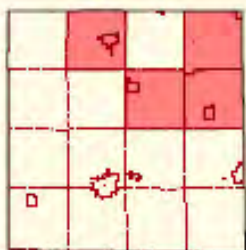
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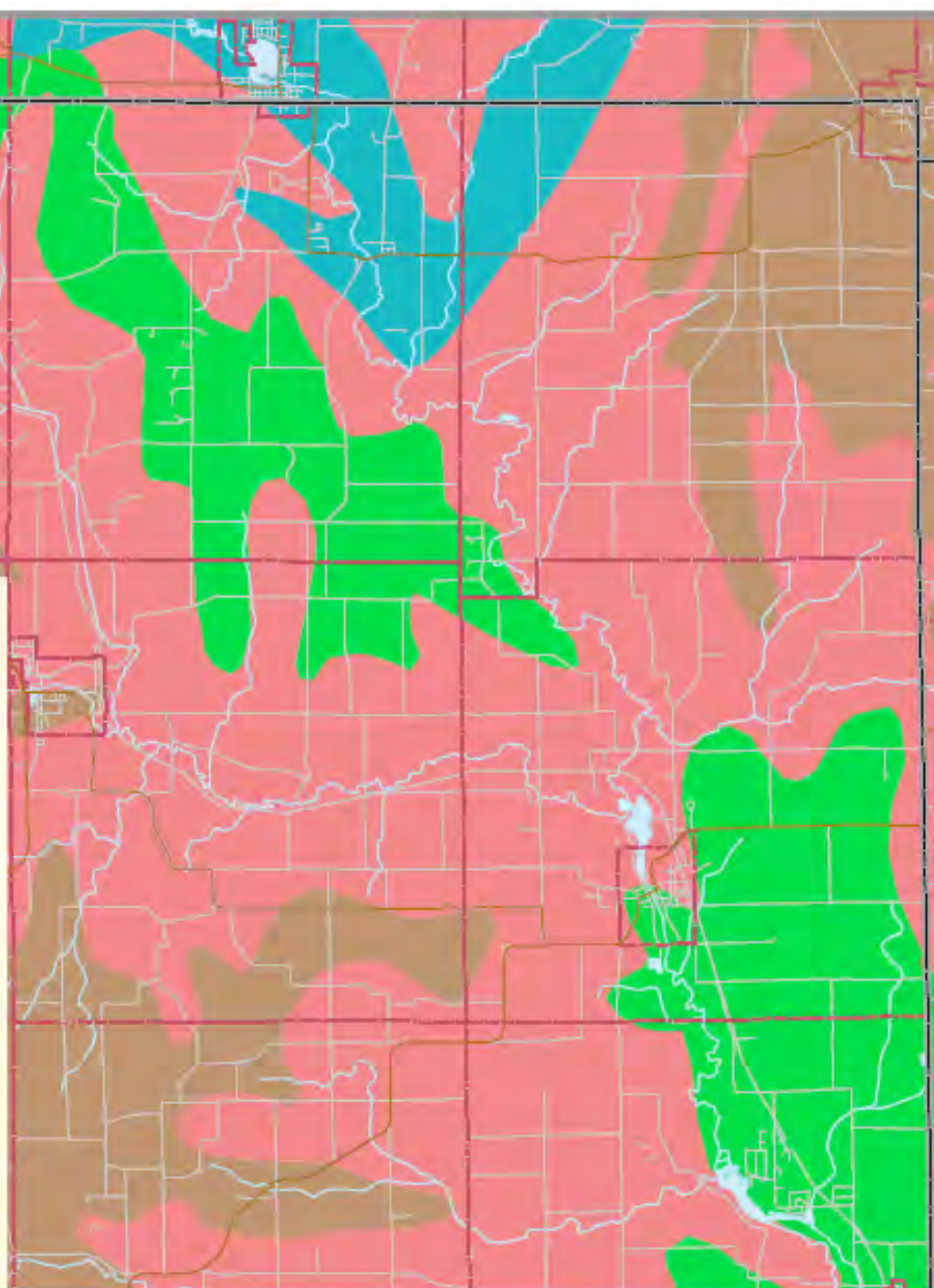
Bedrock Units:

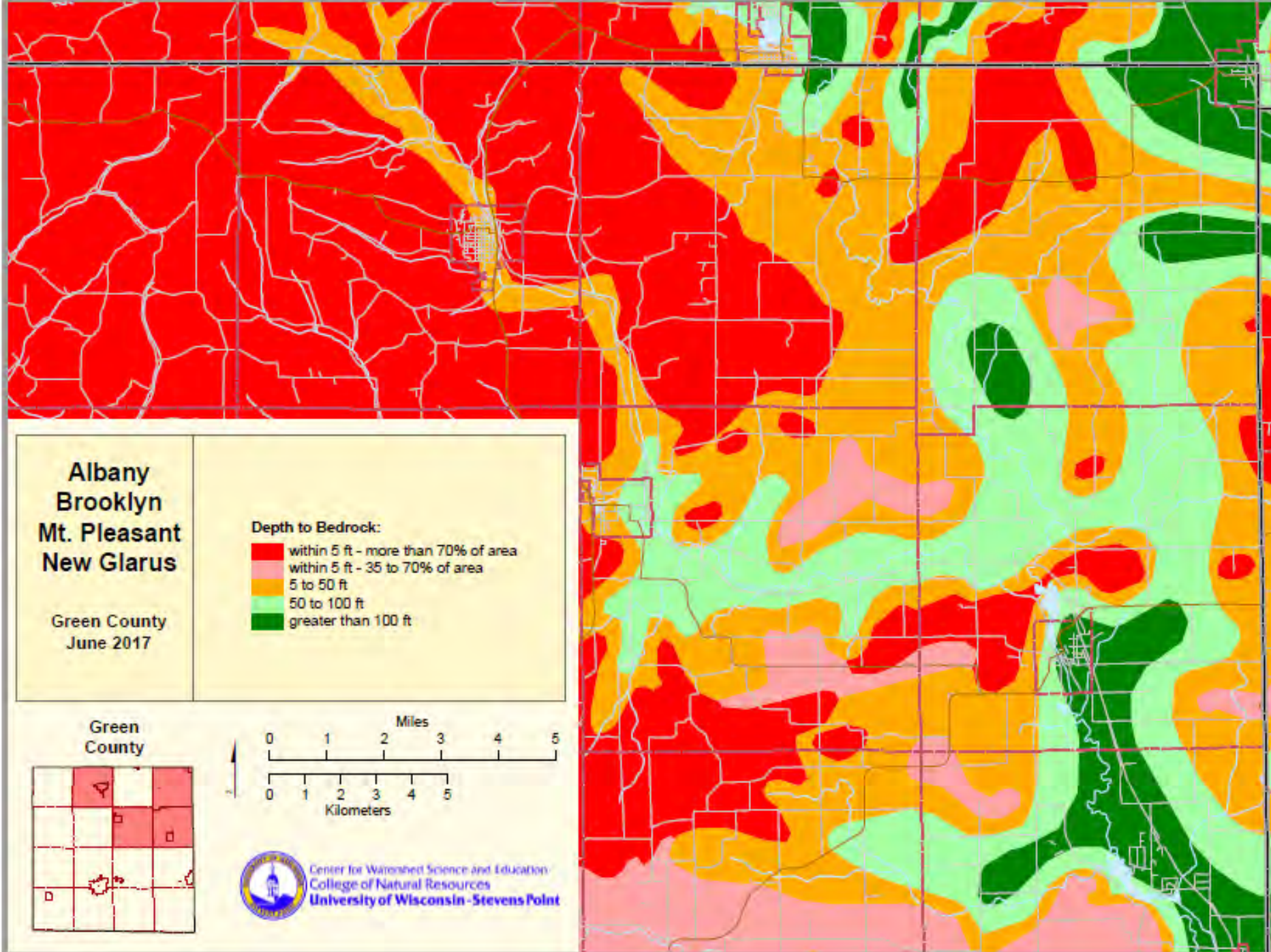
-  Cambrian Sandstone
-  Galena-Platteville Dolomite
-  Prairie du Chien Dolomite
-  St Peter Sandstone

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





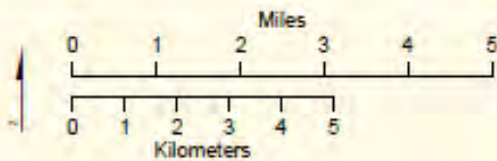
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Depth to Bedrock:

-  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

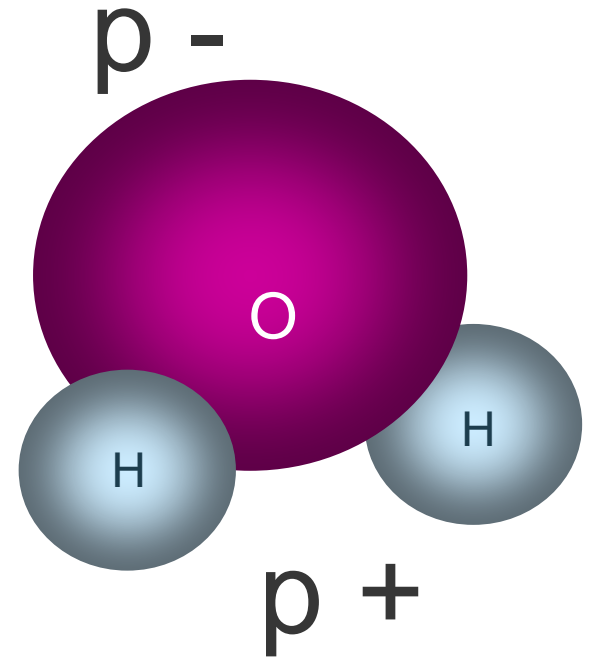
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water basics

- “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.

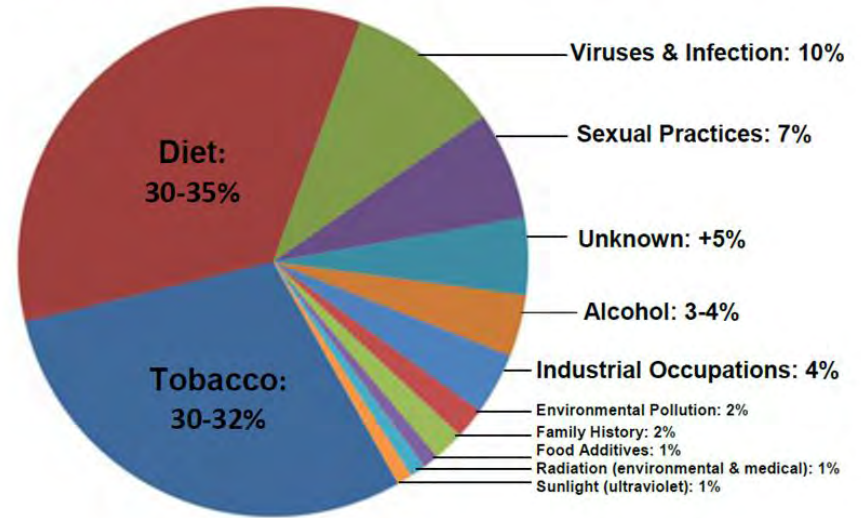
(ex. Arsenic or pesticides can increase the risk of developing certain cancers)



Chronic related health concerns are generally about risk management

National Cancer Risk Factors with Percentages

Adapted from *Everyone's Guide to Cancer Therapy*



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

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

¹<http://www.epa.gov/radon/healthrisks.html>

Private vs. Public Water Supplies

Public Water Supplies

- Regularly tested and regulated by drinking water standards.

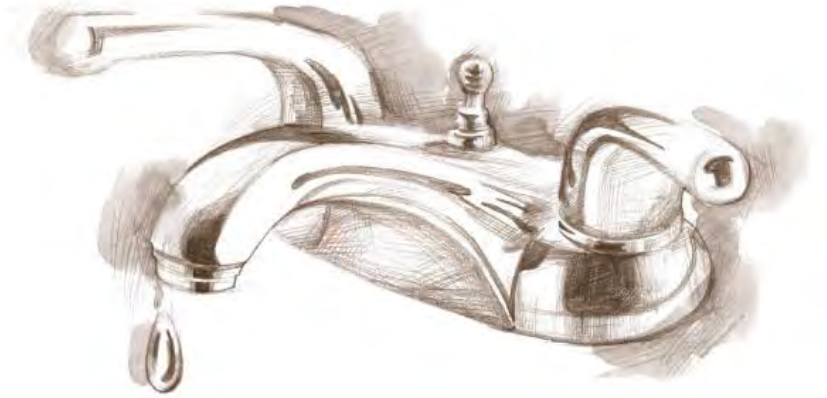
Private Wells

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



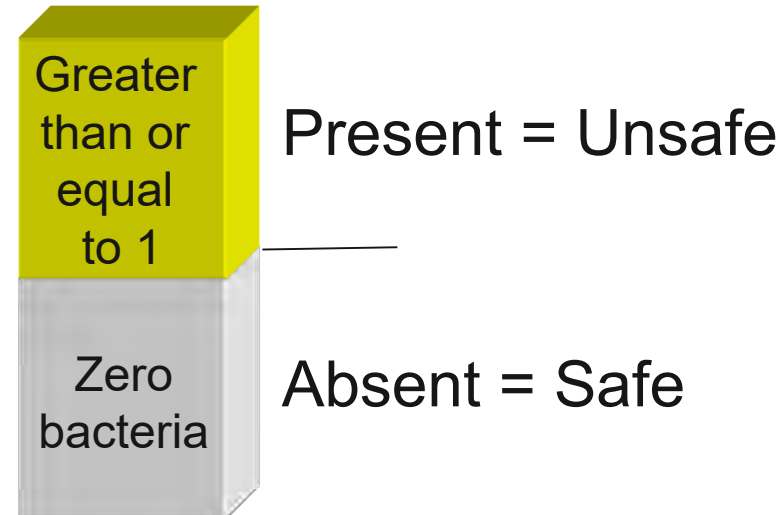
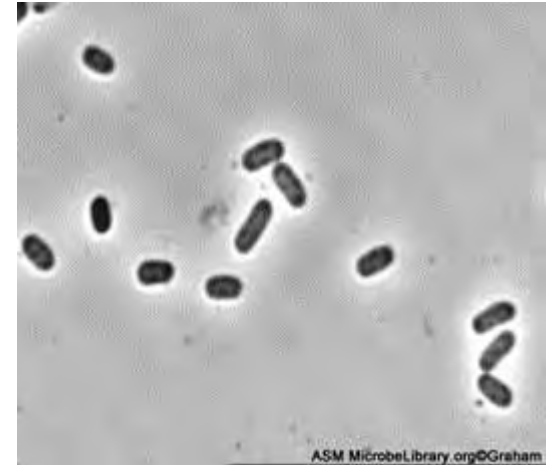
Why do people test their water?

- 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.



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) and United States Environmental Protection Agency (www.epa.gov)

Contaminants	Sources	Symptoms
BACTERIA		
<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"> • Infected human and animal feces • Manure • Septic systems • Sewage <hr/> <ul style="list-style-type: none"> • Urine of livestock, dogs and wildlife • Manure 	<ul style="list-style-type: none"> • Gastrointestinal illness • Low-grade fever • Begins 12 hrs - 7 days after exposure <hr/> <ul style="list-style-type: none"> • High fever, severe headache and red eyes • Gastrointestinal illness • Begins 2-28 days after exposure
MICROSCOPIC PARASITES		
<p><i>Cryptosporidia</i> <i>Giardia</i></p>	<ul style="list-style-type: none"> • Infected human and animal feces • Manure • Septic systems • Sewage 	<ul style="list-style-type: none"> • Gastrointestinal illness • Begins 2-14 days after exposure
VIRUSES		
<p>Norovirus</p>	<ul style="list-style-type: none"> • Infected human feces and vomit • Septic systems • Sewage 	<ul style="list-style-type: none"> • Gastrointestinal illness • Low-grade fever & headache • Begins 12-48 hrs after exposure
CHEMICALS		
<p>Nitrate</p> <hr/> <p>Atrazine (trade-name herbicide for control of broadleaf and grassy weeds)</p>	<ul style="list-style-type: none"> • Fertilizers • Manure • Bio-solids • Septic systems <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



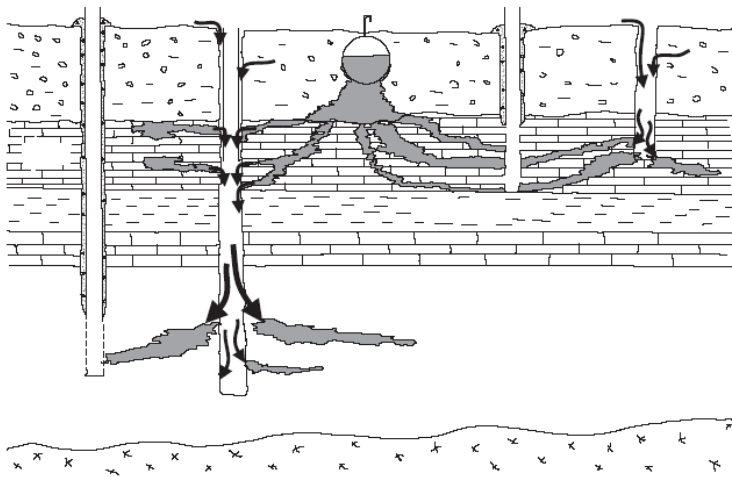
Photo: Sandy Heimke, WI DNR



Photo: Sandy Heimke, WI DNR



AQUIFER CONTAMINATION THROUGH IMPROPERLY ABANDONED WELLS



Source: Adapted from DiNovo and Jaffe, 1984.

Code 82.40(1)(c)2, 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 plunger 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 plunger allows water in the riser 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 outer 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 Commerce website at: <http://commerce.wi.gov/SB/SB-PlumbingProgram.html>

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



District #	Name	Phone/fax
1	Tim Joyce	608-235-0557 / 608-283-7454
2	Tom Braas	715-340-3367 / 608-283-7455
3	Don Orenus	715-584-2007 / 608-283-7452
4	Don Hough	715-633-3004 / 608-283-7451
5	Ryan Berkel	608-412-3998 / 608-283-7449

503.0003 PLUMBING

What does an approved yard hydrant look like?



There's no "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 freeze 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.

Well Construction



Photos courtesy of: Matt Zoschke

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 or if new well is unlikely to remedy the problem because of geology, may seek approval for treatment.*



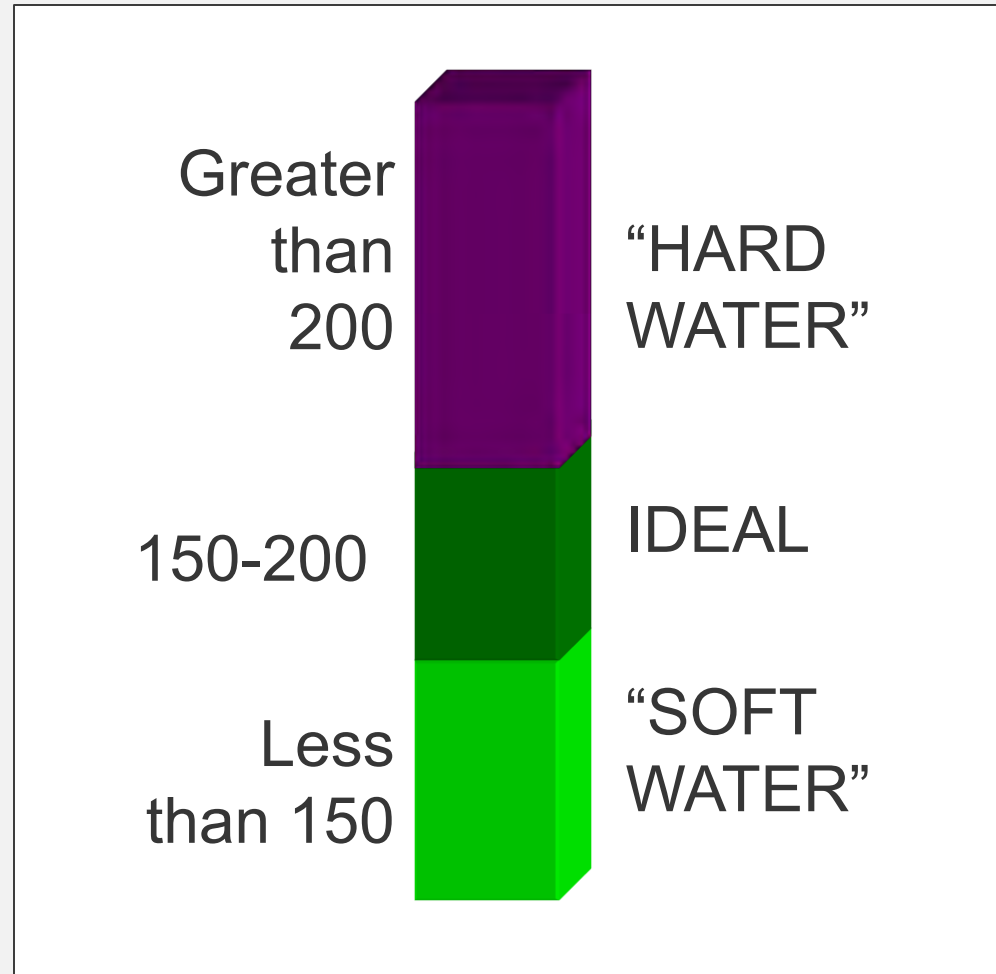
Rock and Soil Impacts on Water Quality

Tests for Aesthetic Problems

Hardness

- Natural (rocks and soils)
- Primarily calcium and magnesium

- Problems: scaling, scum, use more detergent, decrease water heater efficiency



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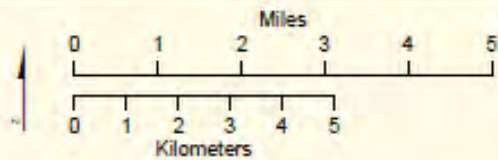
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TOTAL HARDNESS (ppm CaCO₃)

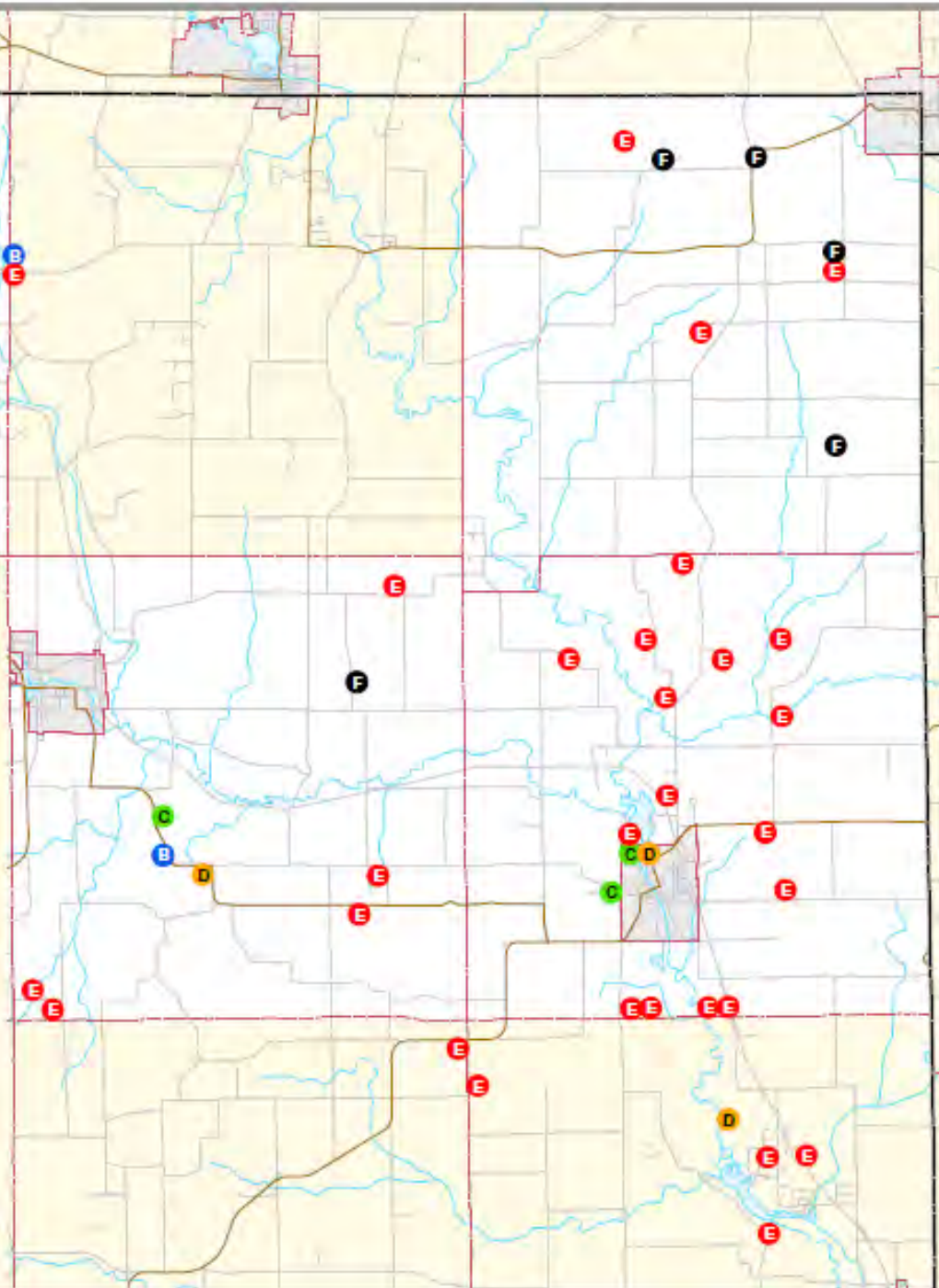
A ... 50	14	11 %
B 51 - 100	2	2 %
C 101 - 200	3	2 %
D 201 - 300	10	8 %
E 301 - 400	82	65 %
F 401 ...	16	13 %

Mapped value is the average for the 1/4 1/4 section
Treated samples not mapped

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Water Softening

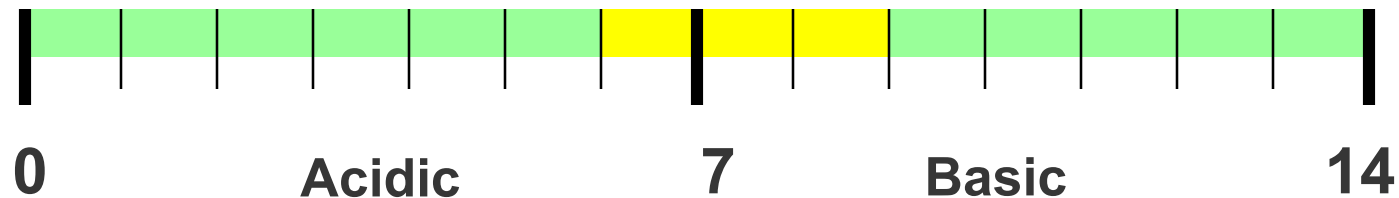
Water softeners remove calcium and magnesium which cause scaling and exchange it for sodium (or potassium).

- 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.



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



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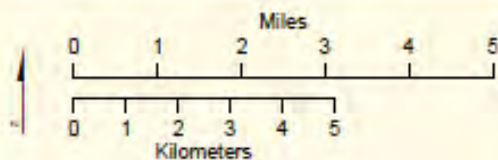
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pH

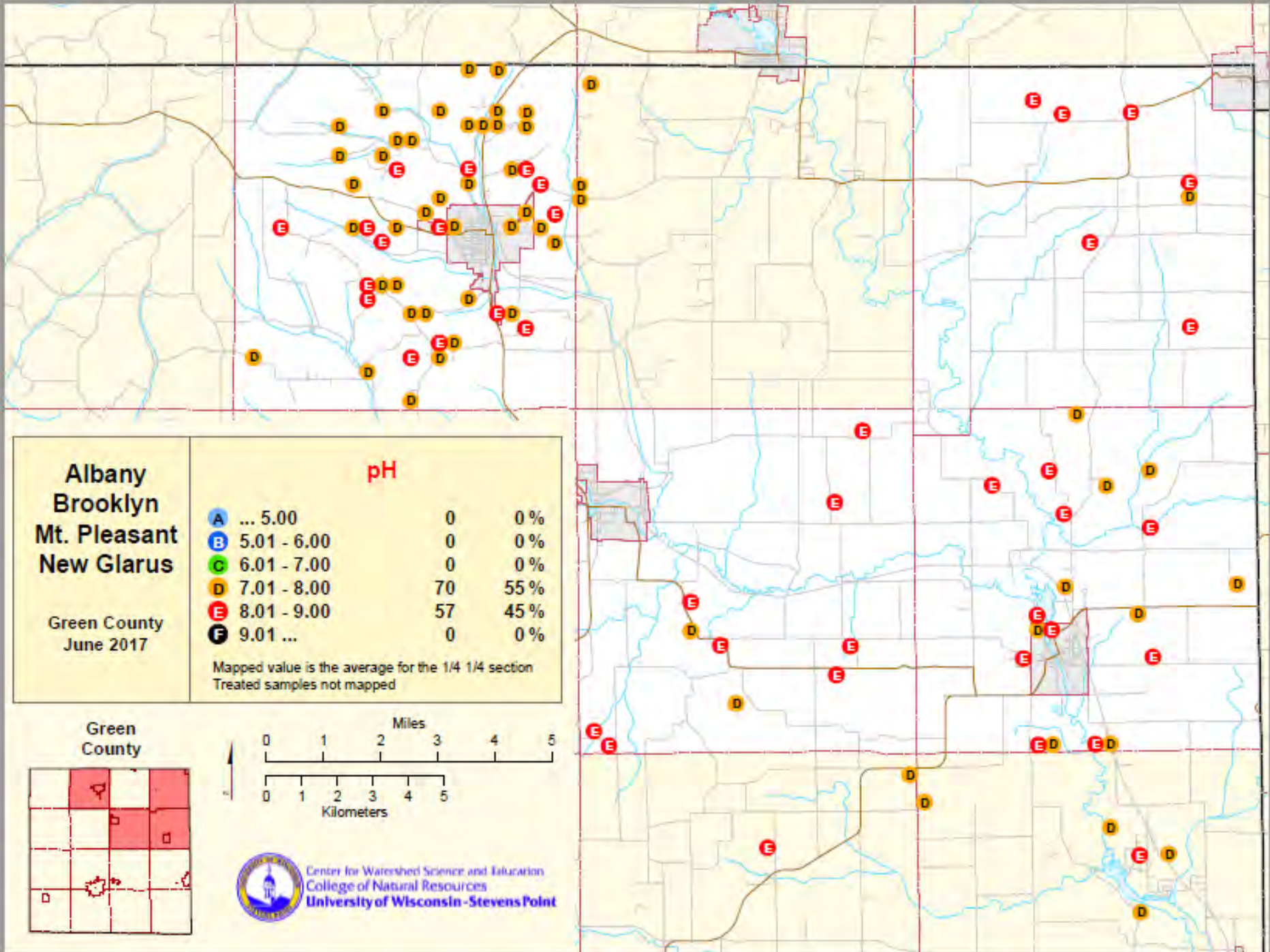
A ... 5.00	0	0 %
B 5.01 - 6.00	0	0 %
C 6.01 - 7.00	0	0 %
D 7.01 - 8.00	70	55 %
E 8.01 - 9.00	57	45 %
F 9.01 ...	0	0 %

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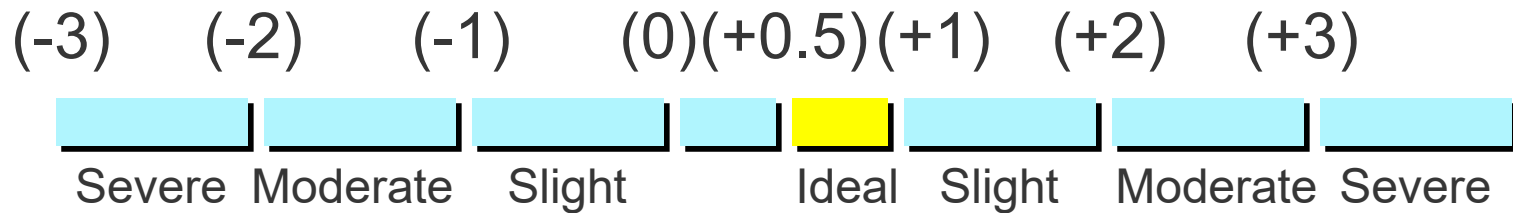


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Tests for Overall Water Quality

Saturation Index



Corrosion occurs



Scaling occurs

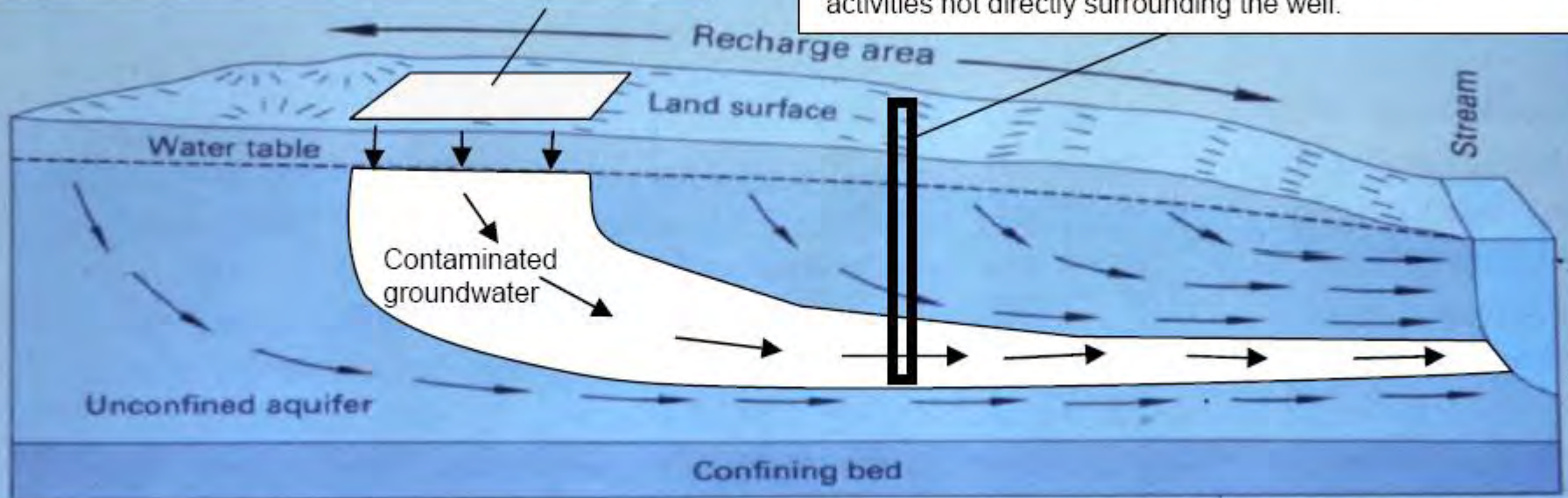




Soil

Land-use activity that pollutes groundwater.

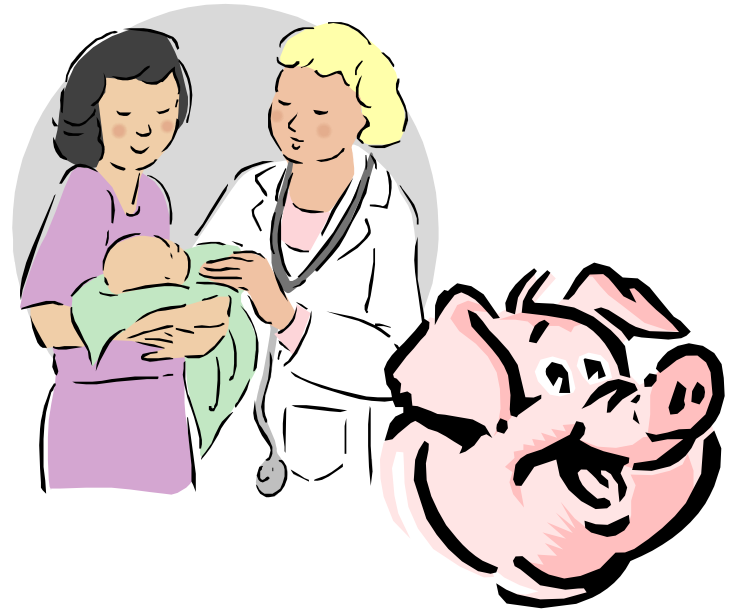
Because groundwater moves, wells located far from the contamination source can sometimes be polluted from activities not directly surrounding the well.



Nitrate-Nitrogen

Health Effects:

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



Sources:

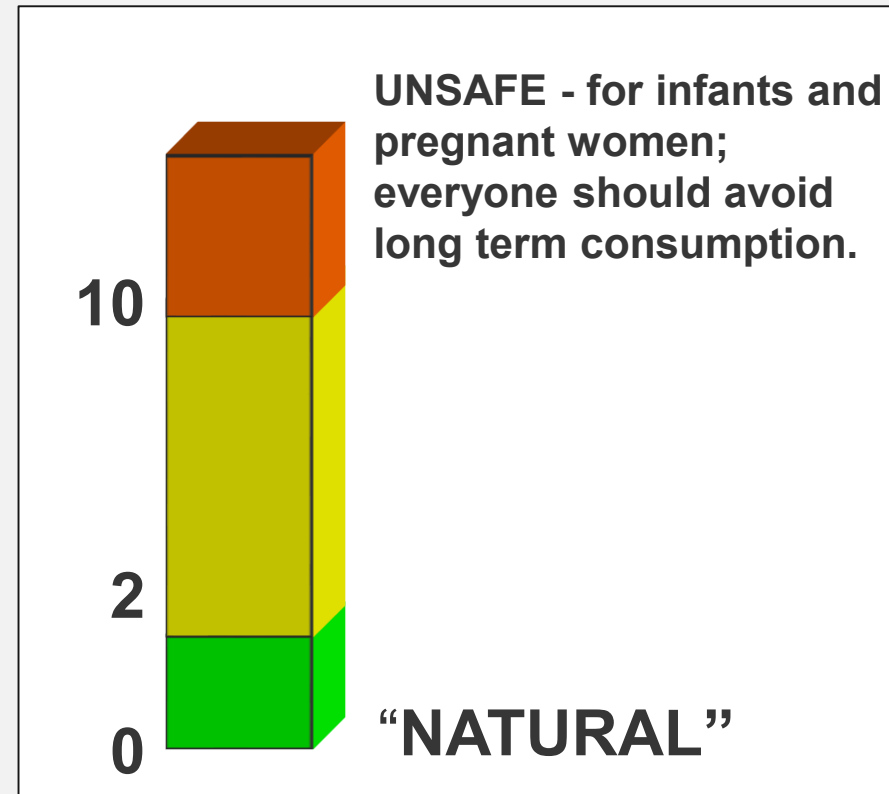
- Agricultural fertilizer
- Lawn fertilizer
- Septic systems
- Animal wastes



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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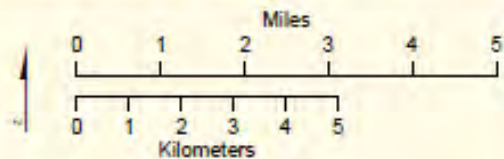
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NITRATE-NITRITE (ppm N)

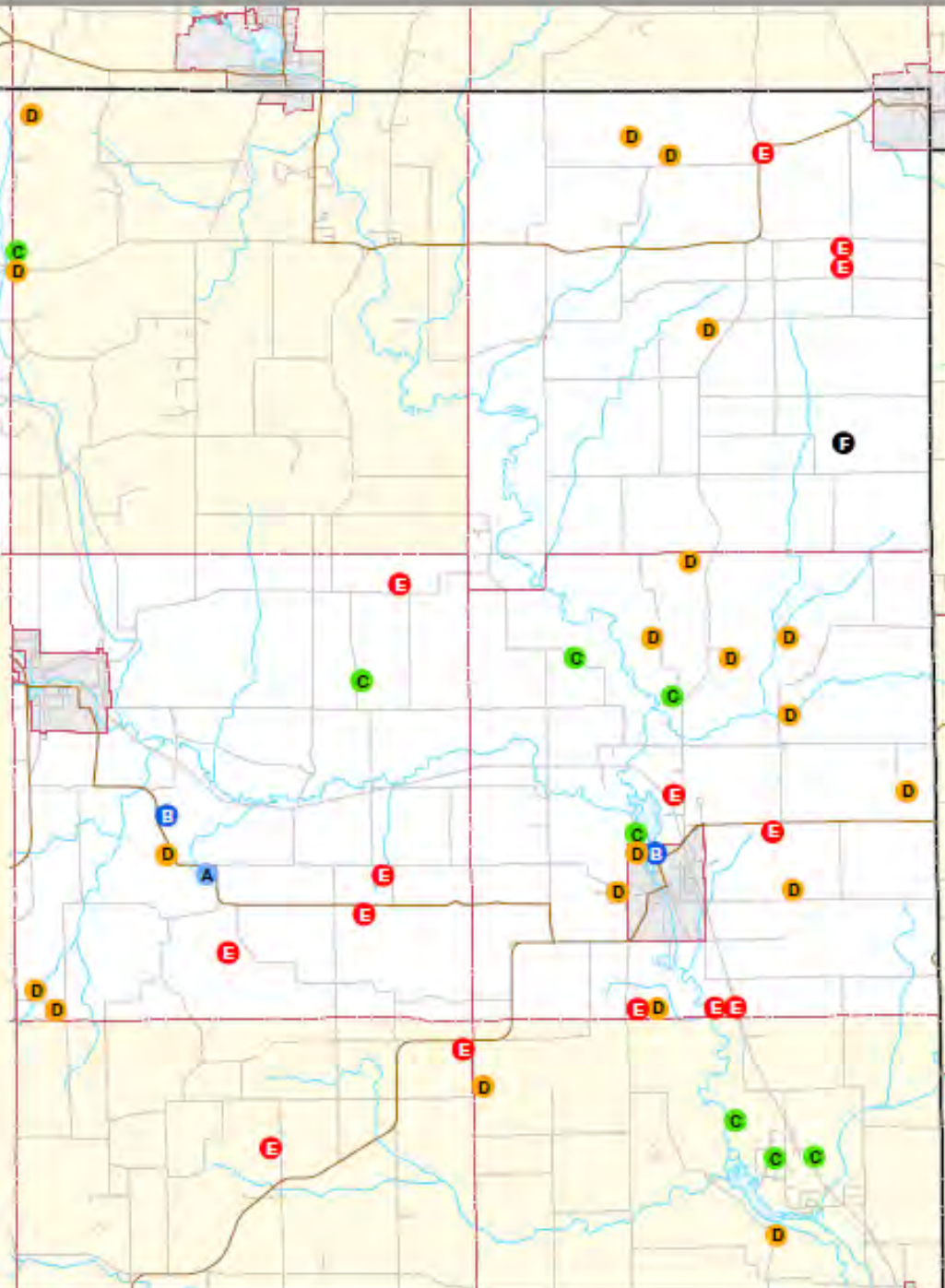
A	None Detected	14	11 %
B	... 2.0	13	10 %
C	2.1 - 5.0	38	30 %
D	5.1 - 10.0	43	34 %
E	10.1 - 20.0	16	13 %
F	20.1 ...	3	2 %

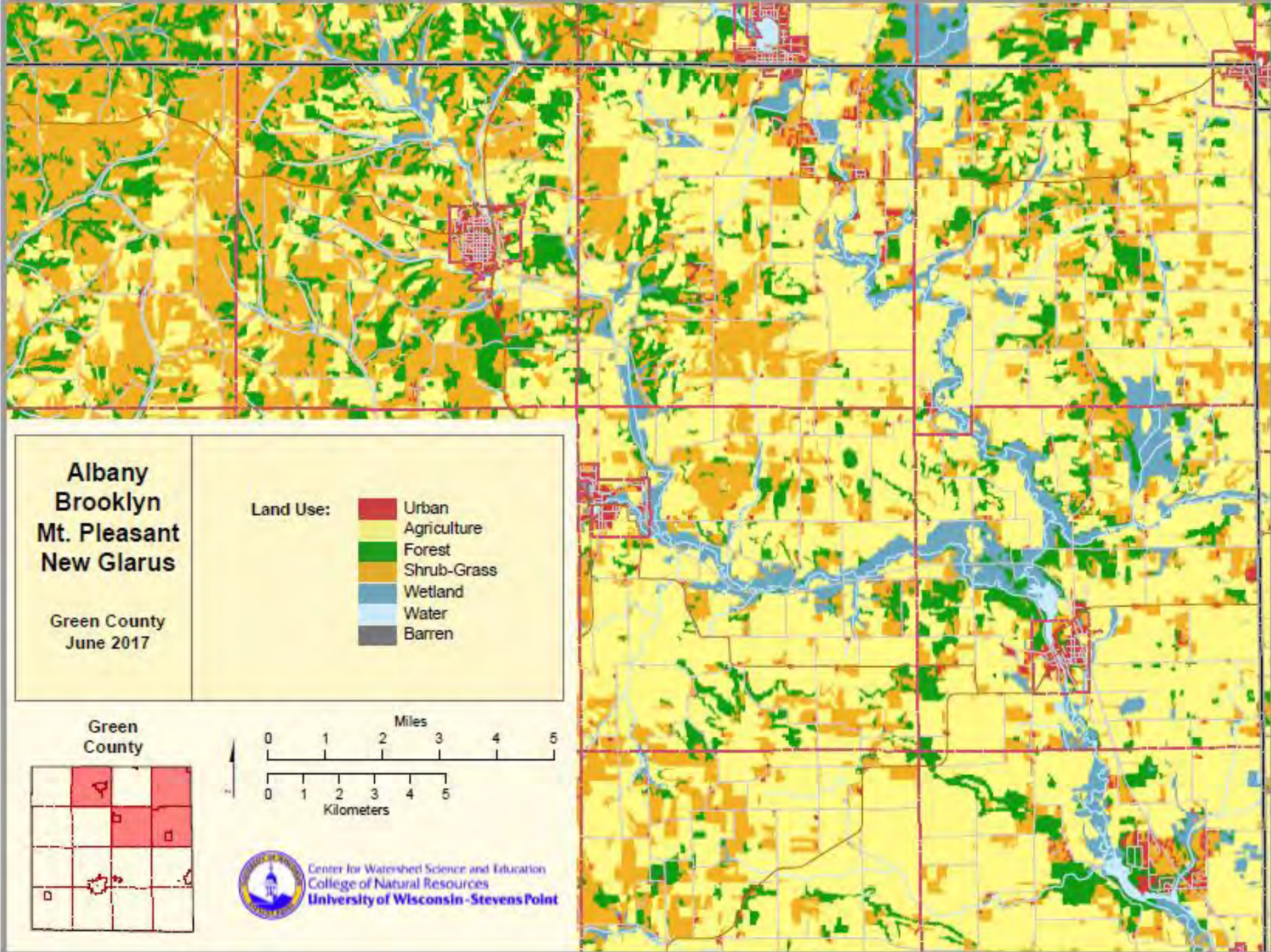
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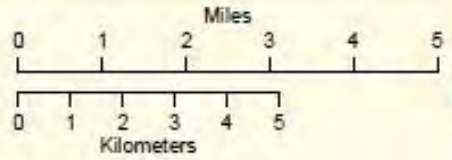


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- Land Use:
- Urban
 - Agriculture
 - Forest
 - Shrub-Grass
 - Wetland
 - Water
 - Barren

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What can I do to reduce my nitrate levels?

Solution:

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

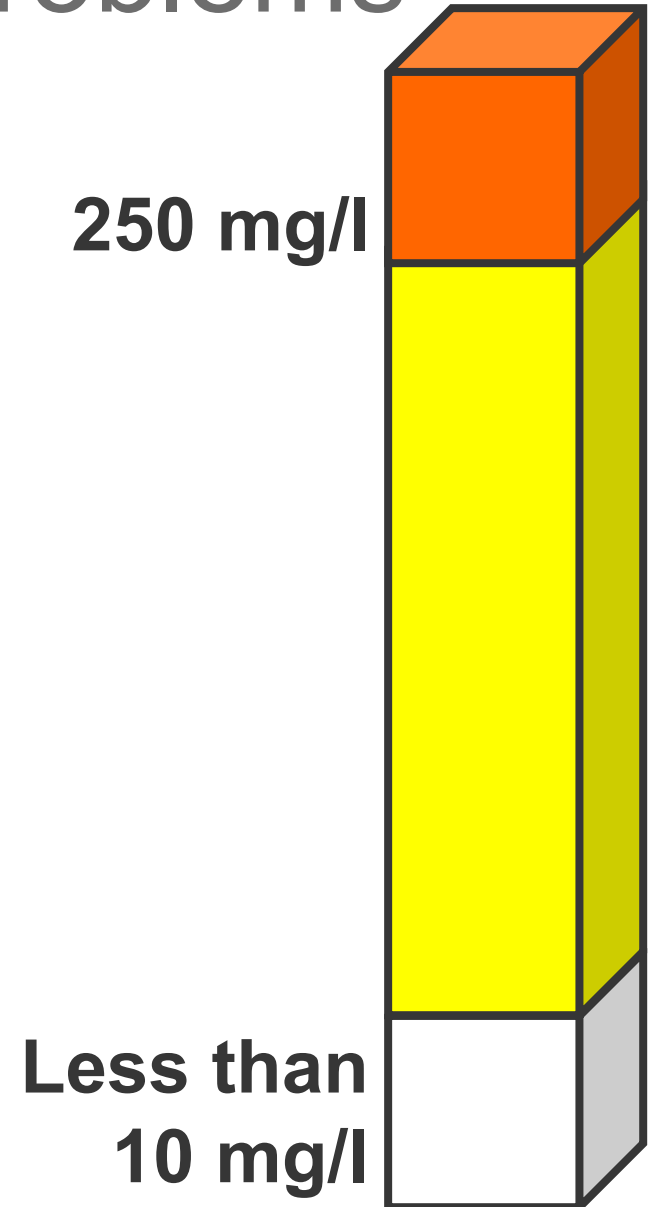
Short term:

- **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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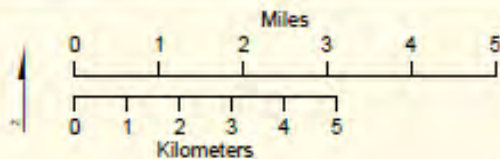
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CHLORIDE (ppm)

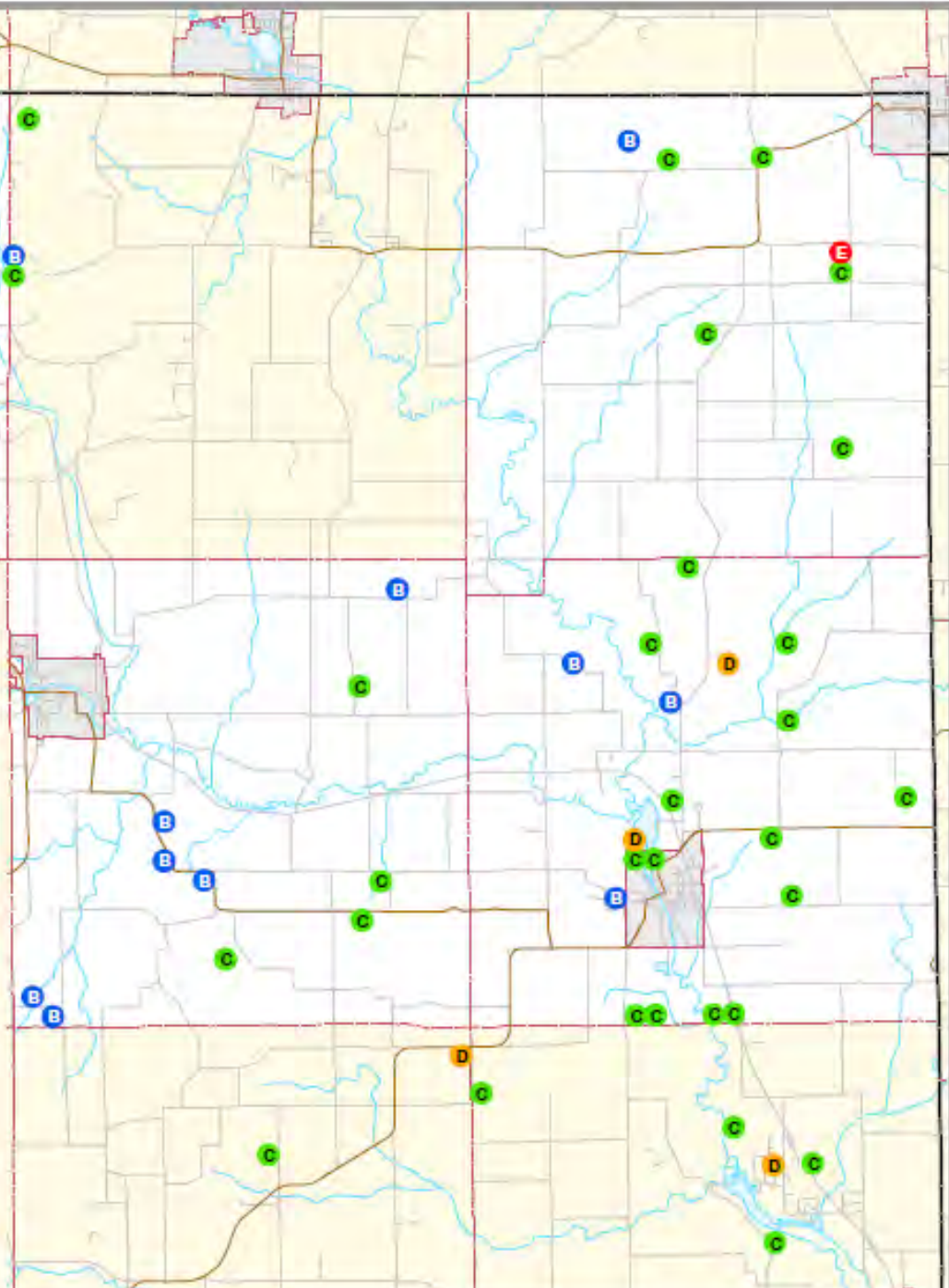
A None Detected	0	0 %
B ... 10	48	38 %
C 11 - 50	67	53 %
D 51 - 100	10	8 %
E 101 - 200	2	2 %
F 201 ...	0	0 %

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Test Important to Health

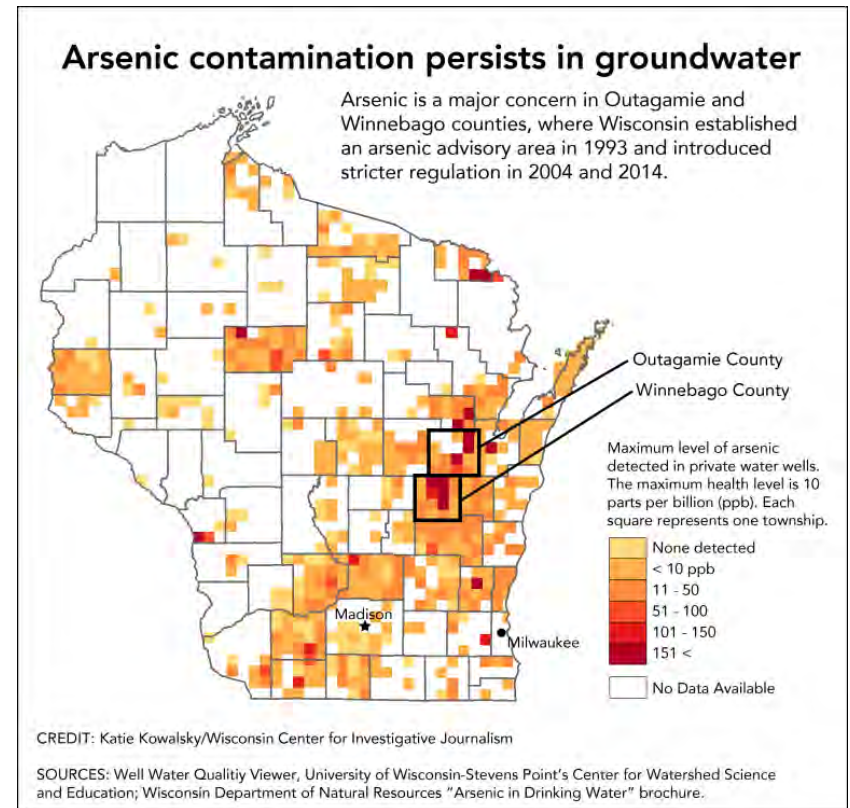
Arsenic

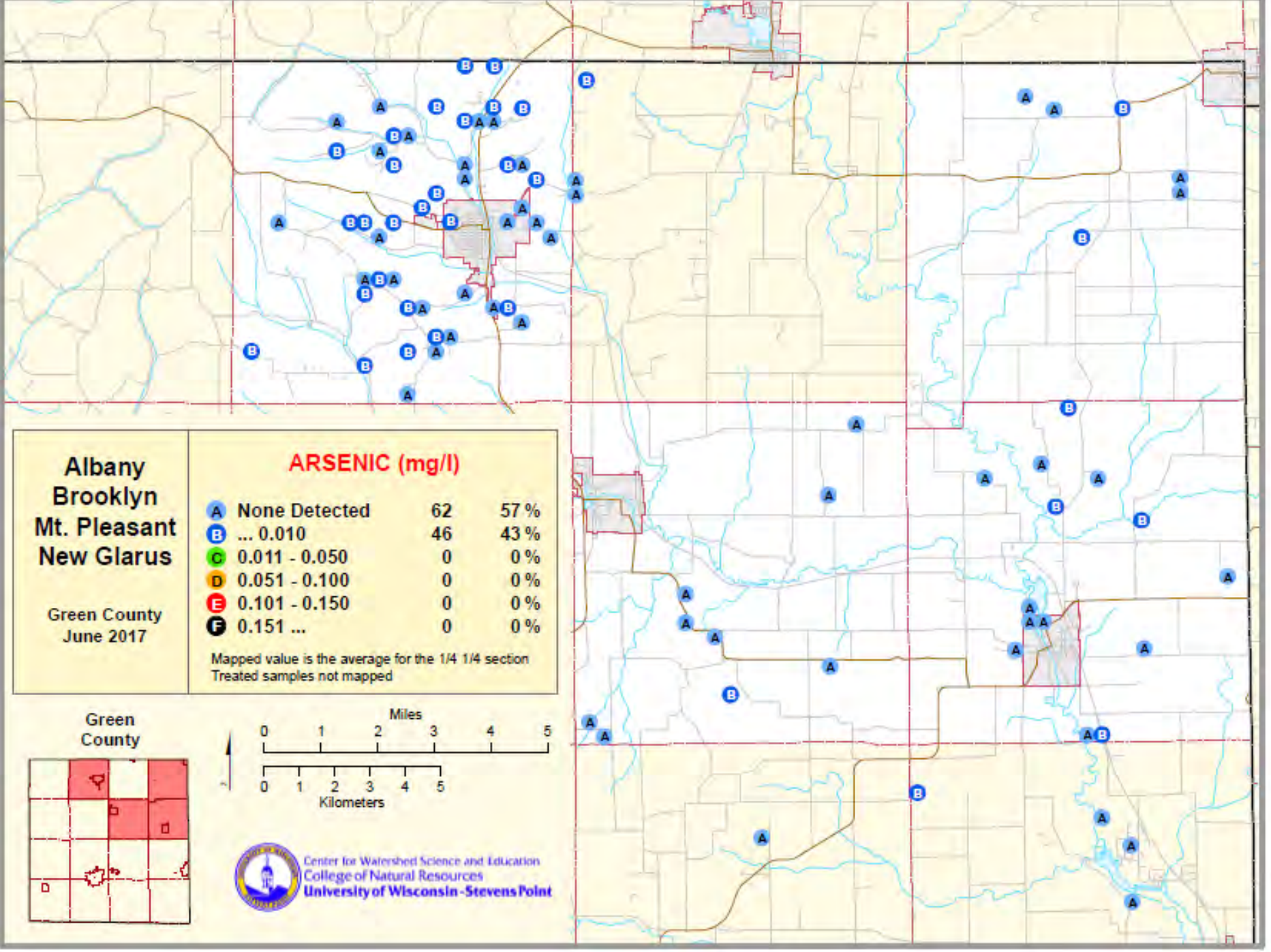
Sources: Naturally occurring in mineral deposits

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





**Albany
Brooklyn
Mt. Pleasant
New Glarus**

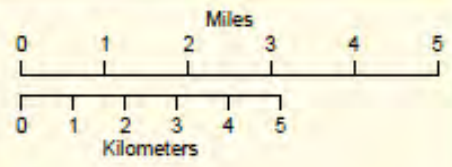
Green County
June 2017

ARSENIC (mg/l)

A	None Detected	62	57 %
B	... 0.010	46	43 %
C	0.011 - 0.050	0	0 %
D	0.051 - 0.100	0	0 %
E	0.101 - 0.150	0	0 %
F	0.151 ...	0	0 %

Mapped value is the average for the 1/4 1/4 section
Treated samples not mapped

Green
County



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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**

**Less
than 0.3 mg/L**

**Aesthetic
problems
likely**

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

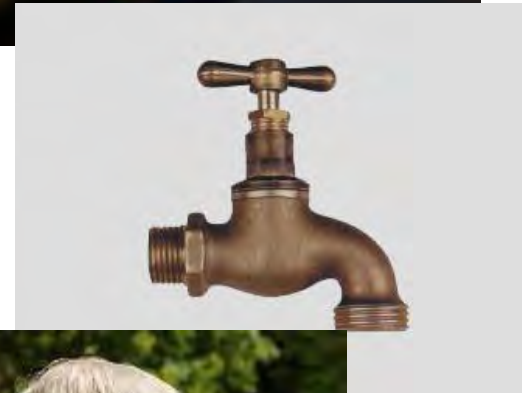
Lead

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.



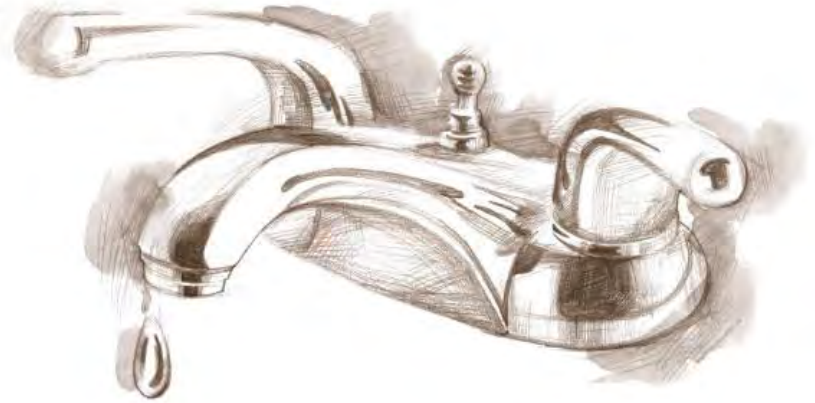
Lead and Copper

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



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)

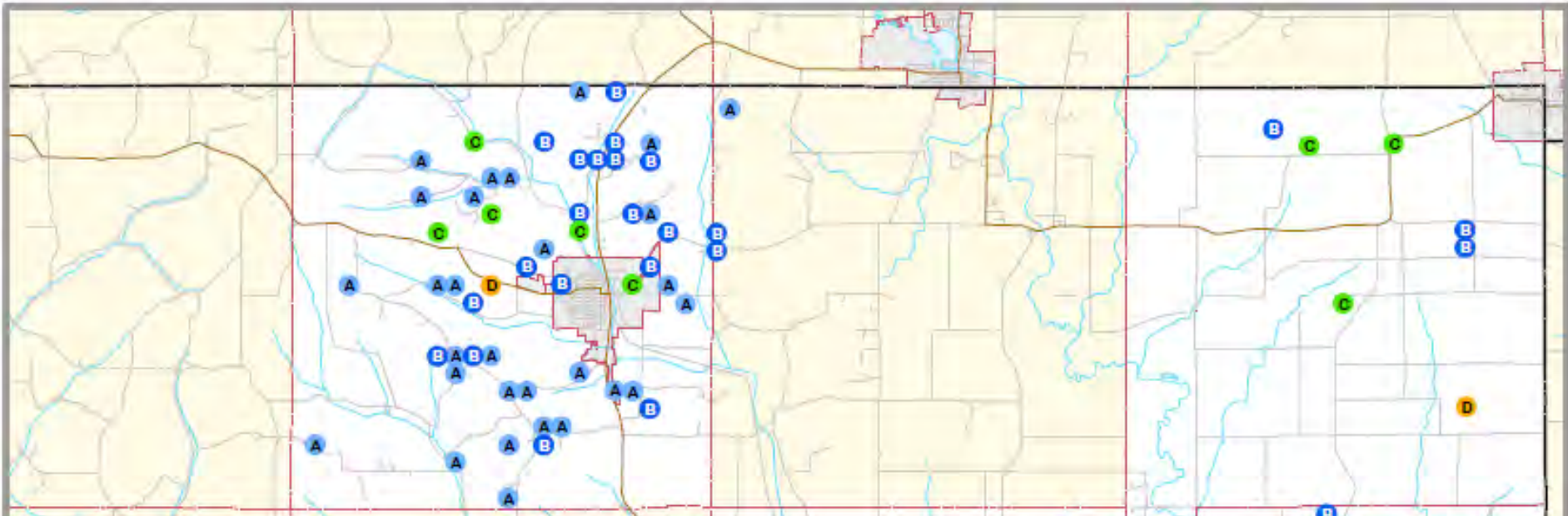
DACT Screen: Only measures the diaminochlorotriazine (DACT) residue levels of triazine type pesticides (atrazine, simazine, propazine, cyanazine, etc)

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*)





**Albany
Brooklyn
Mt. Pleasant
New Glarus**

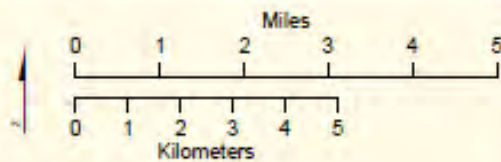
Green County
June 2017

DACT (ug/l)

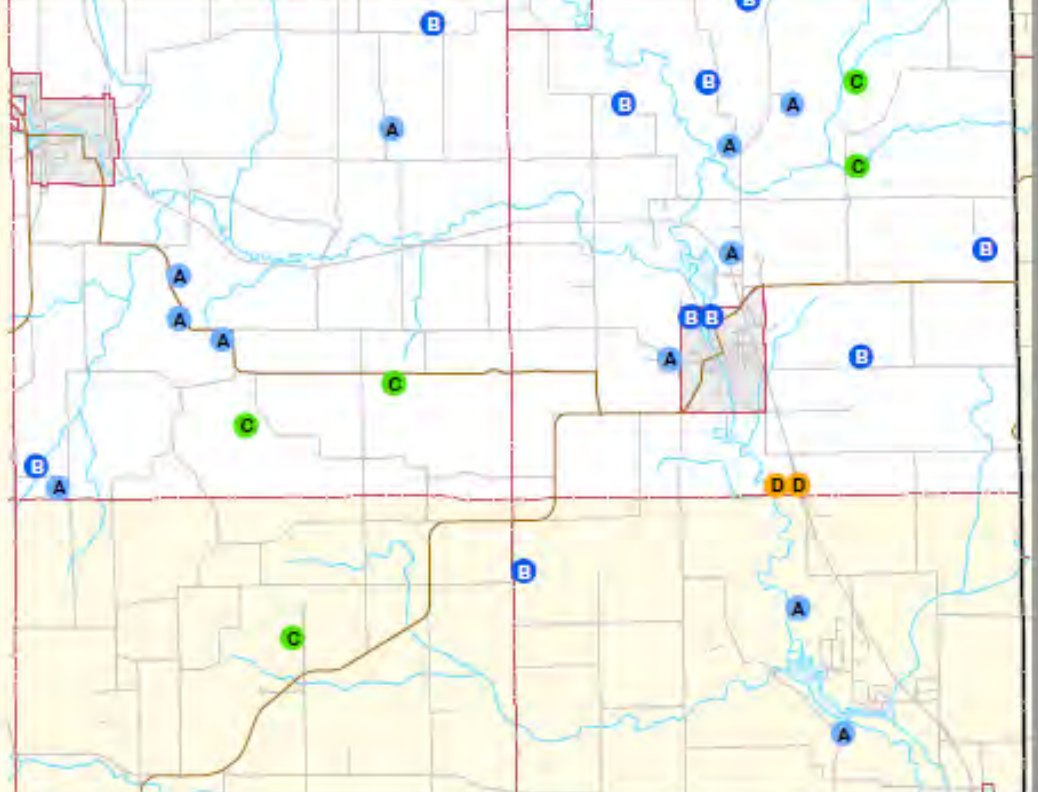
A	None Detected	55	50 %
B	... 0.3	37	33 %
C	0.4 - 1.0	15	14 %
D	1.1 - 2.0	4	4 %
E	2.1 - 3.0	0	0 %
F	3.1 ...	0	0 %

Mapped value is the maximum for the 1/4 1/4 section
Treated samples not mapped

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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.



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 haven't checked for arsenic consider testing.
- If arsenic was present, test again in 15 months to see if levels have changed significantly.



Center for Watershed Science and Education

College of Natural Resources and University of Wisconsin-Extension

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- Groundwater Center
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- WI Well Water Quality Viewer
- Student Involvement
- Staff/Contact Us



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.

Wisconsin Well Water 101:
Helping you make decisions about your private water system

Wisconsin Well Water 101: Helping you make decisions about your private water system. Includes sections for: 1. Understanding Your Well, 2. Testing Your Water, 3. Protecting Your Well, 4. Maintaining Your Well, 5. Finding a Professional, 6. Well Water 101 Summary.

Wisconsin Well Water 101: Helping you make decisions about your private water system. [www.wisconsinwellwater101.com](#)



News From The Center

[Postcards from the Central Sands: Kraft interviewed for article on groundwater](#)

[USGS report on groundwater pumping impacts on streams](#)

[Use our Well Water Quality Viewer to access groundwater information for your community](#)

[Central Sands study on pumping effects on lakes and streams published in international scientific journal](#)

[Walking on Water: Essays for the Central Sands. Get your free copy today!](#)

www.uwsp.edu/cnr-ap/watershed

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- **Towns of Albany, Brooklyn, Mt. Pleasant and New Glarus**
- **Green County UW-Extension Office**

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