

Water WELLness

Town of Sheboygan

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&
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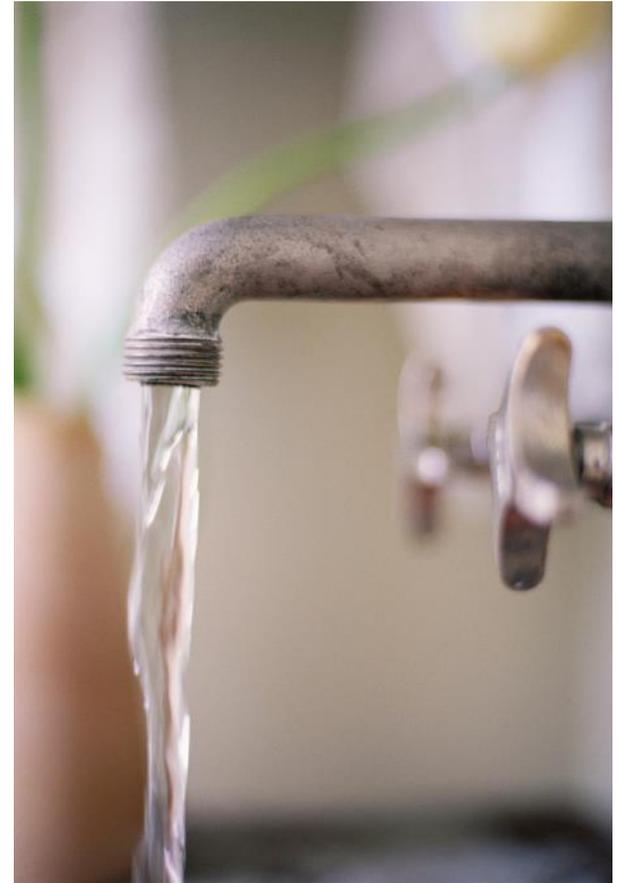
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Extension
UNIVERSITY OF WISCONSIN-MADISON

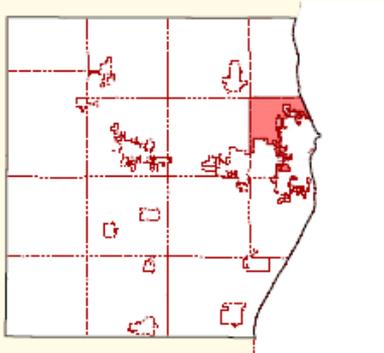
Goals for the presentation:

- Groundwater Basics: Where does my water come from
- Well Construction
- What do my individual test results mean?
- General groundwater quality the Town of Sheboygan
- Improving your water quality

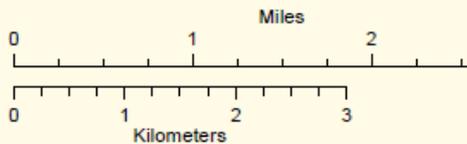


Town of Sheboygan

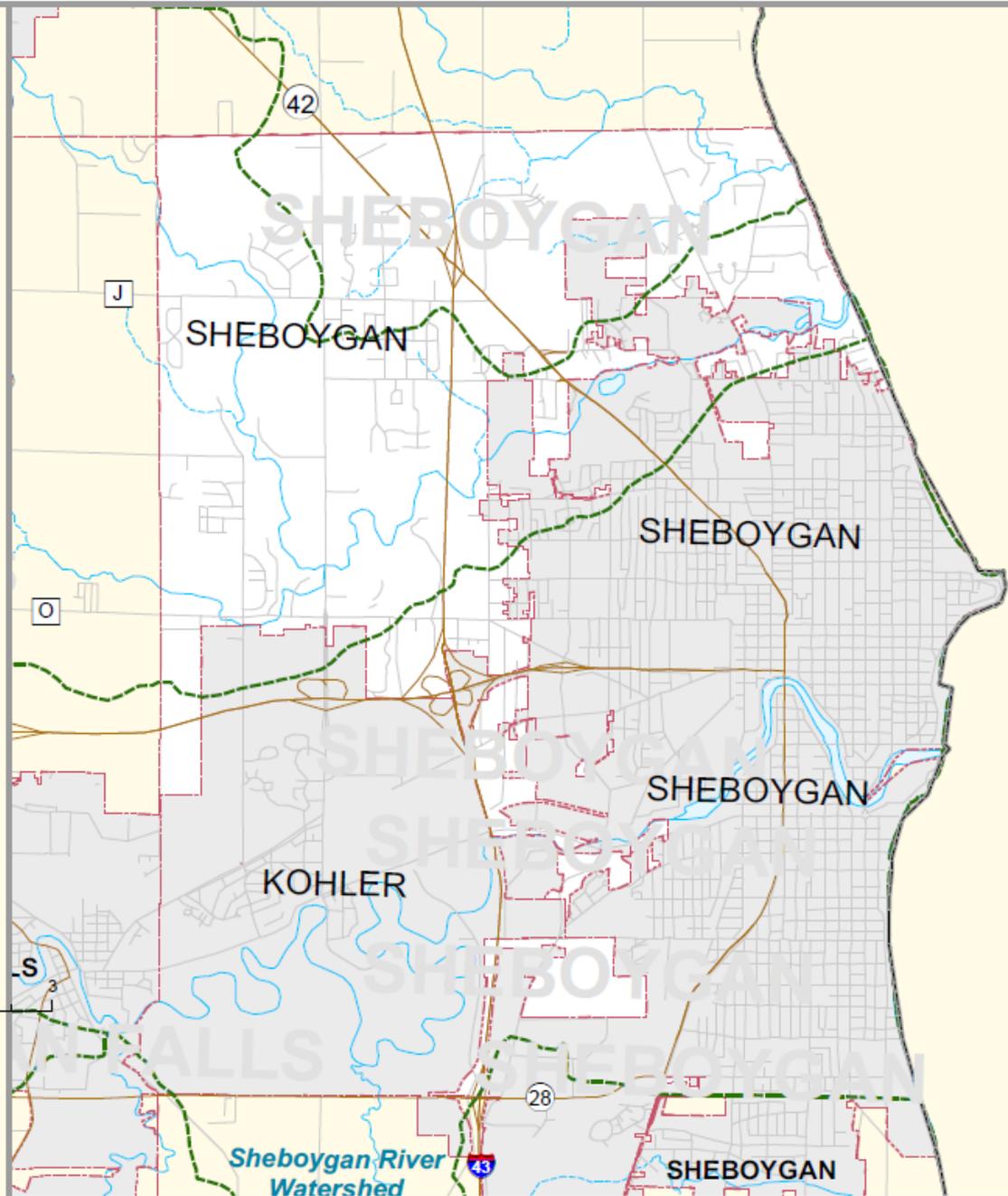
Sheboygan County, October 2022



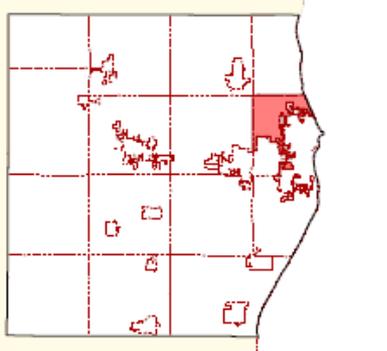
- Watershed Boundary
- Streams
- Lakes/Reservoirs
- Wetlands
- State/US Highways
- Other Roads
- Town Boundaries
- Municipalities



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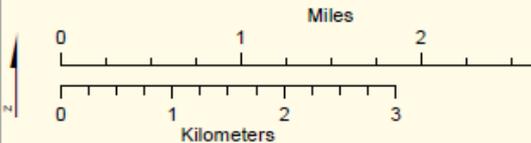
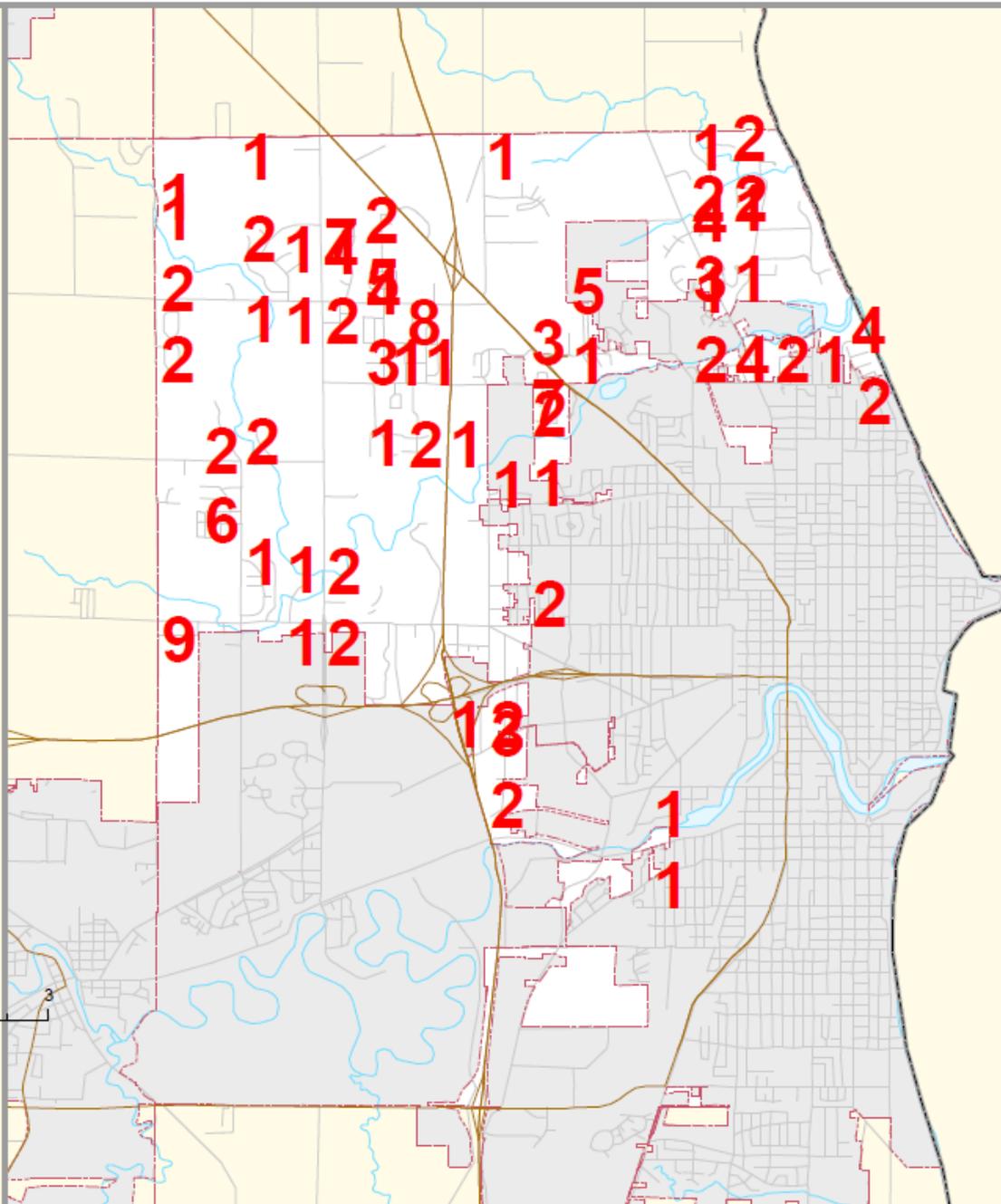


Town of Sheboygan
Sheboygan County, October 2022

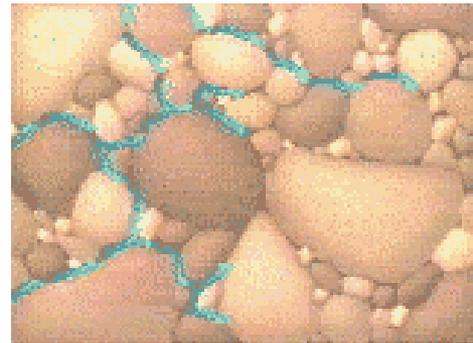
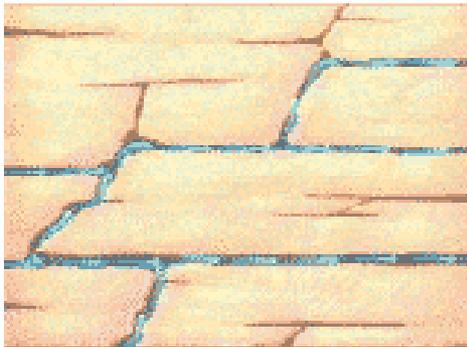
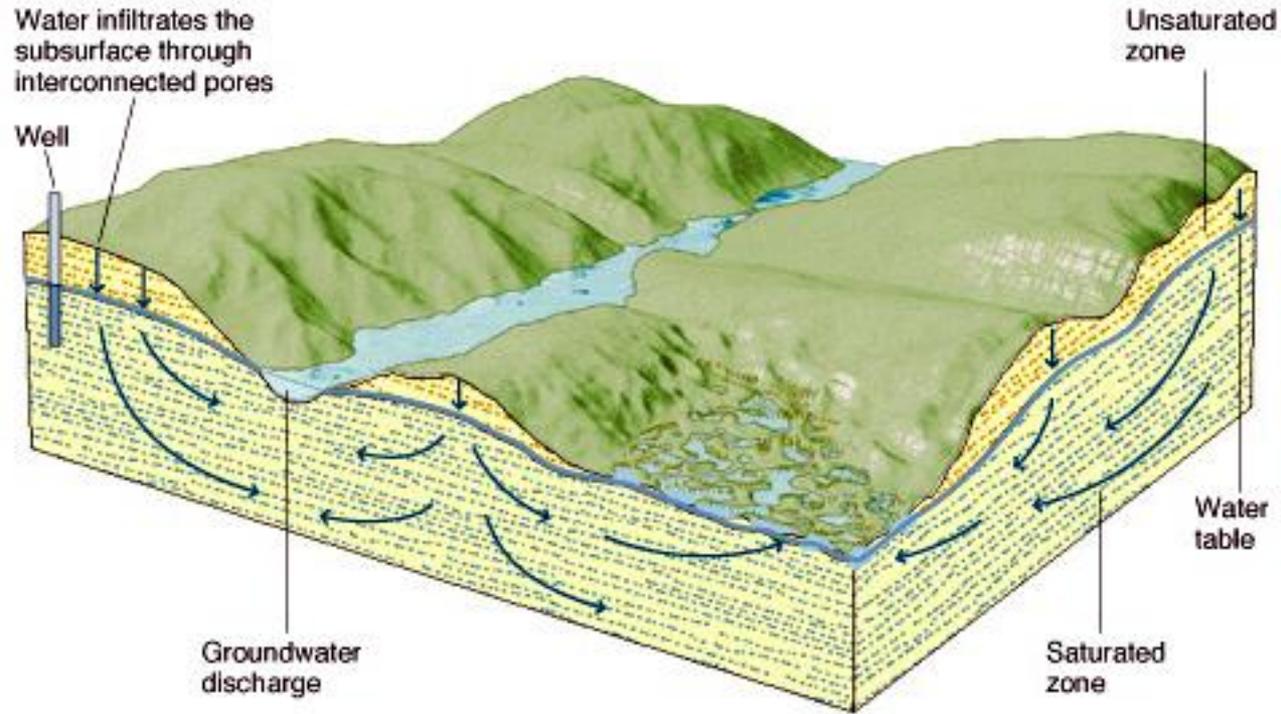


SAMPLE DISTRIBUTION

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



Groundwater Movement

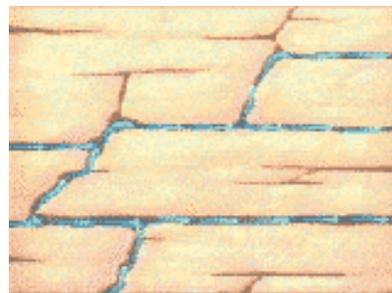


Aquifers: Our groundwater storage units

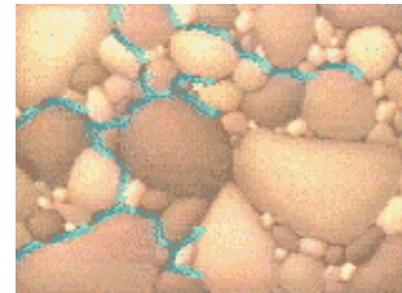
Aquifers are geologic formations that store and transmit groundwater.

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.

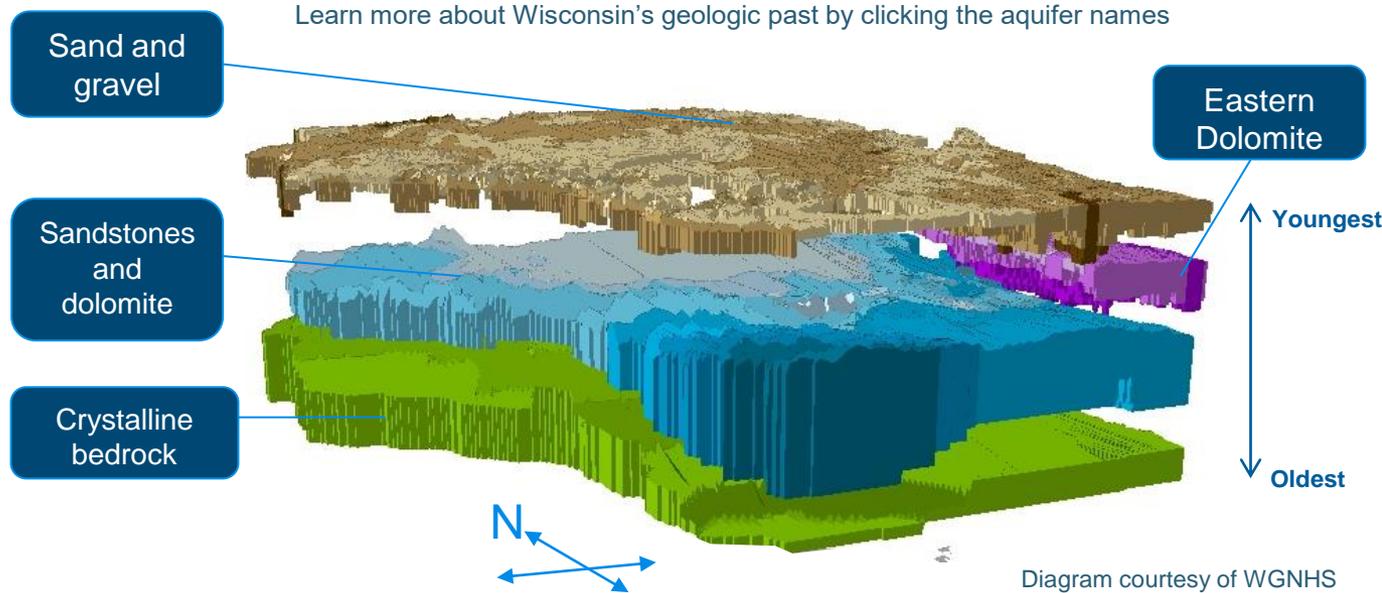


Water and contaminants can move quickly through cracks and fractures.



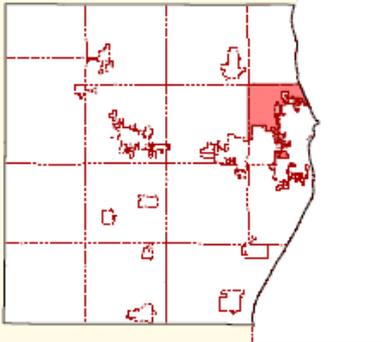
Water moving through tiny spaces between sand particles or sandstone moves slower and allows for filtration of some contaminants.

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



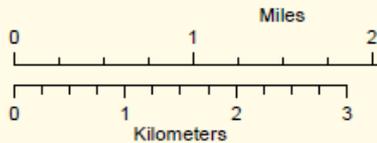
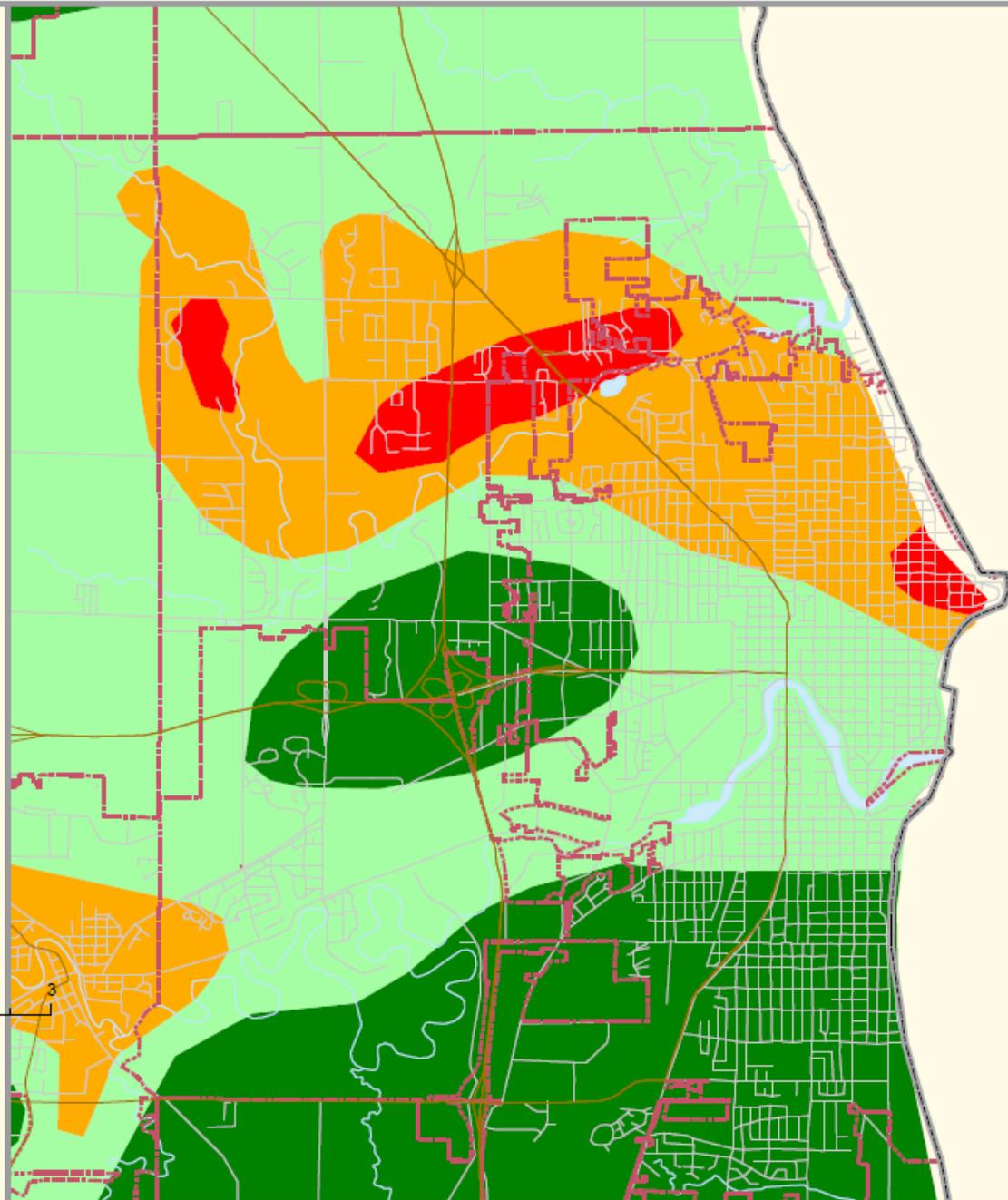
Town of Sheboygan

Sheboygan County, October 2022



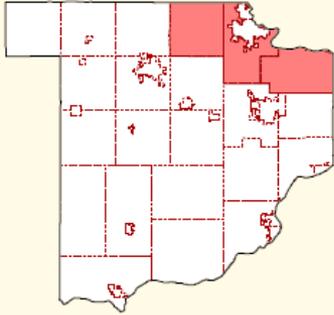
Depth to Bedrock:

-  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



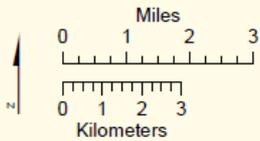
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Towns of Delton, Fairfield and Dellona Sauk County, August 2022

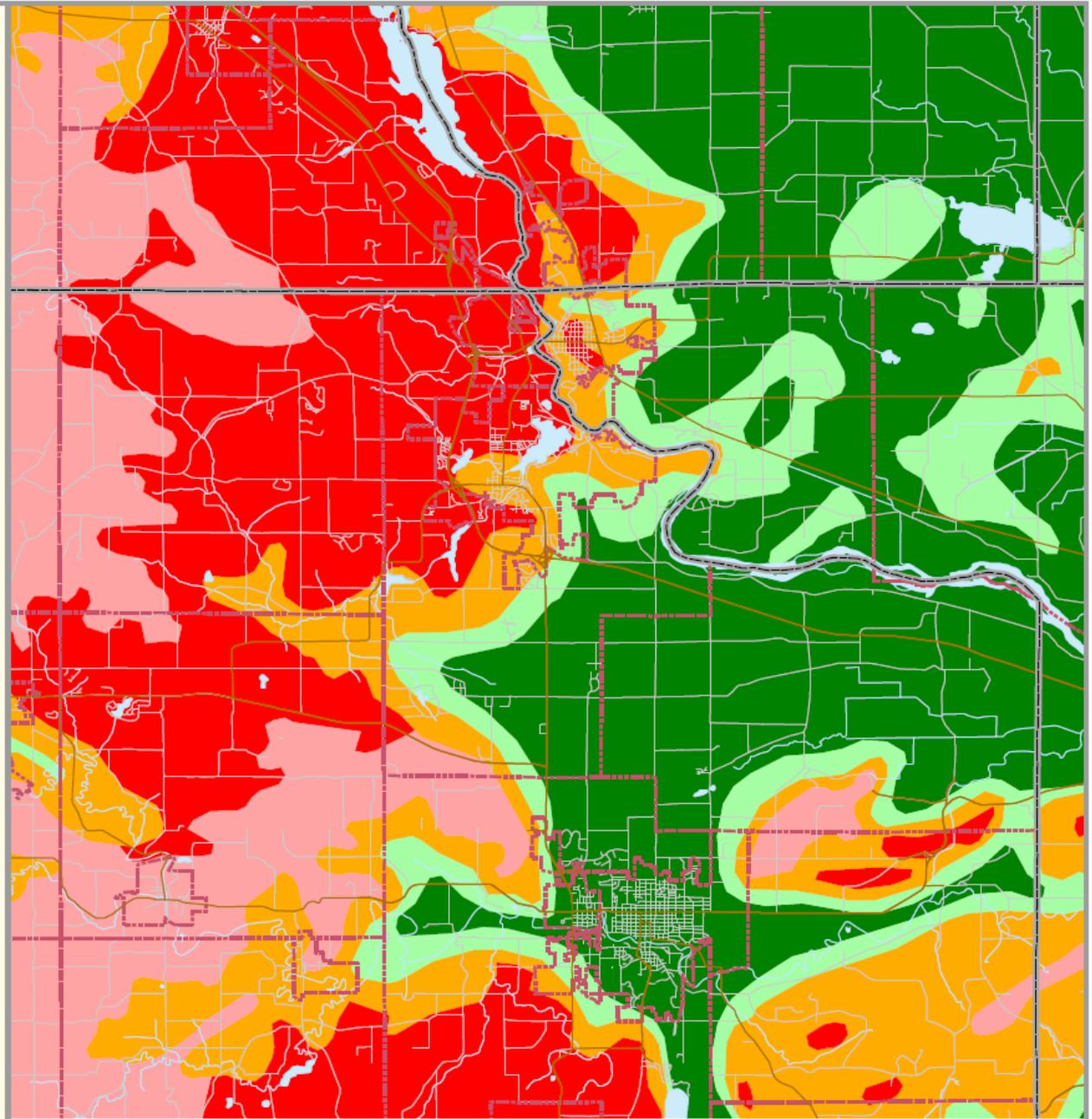


Depth to Bedrock:

-  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

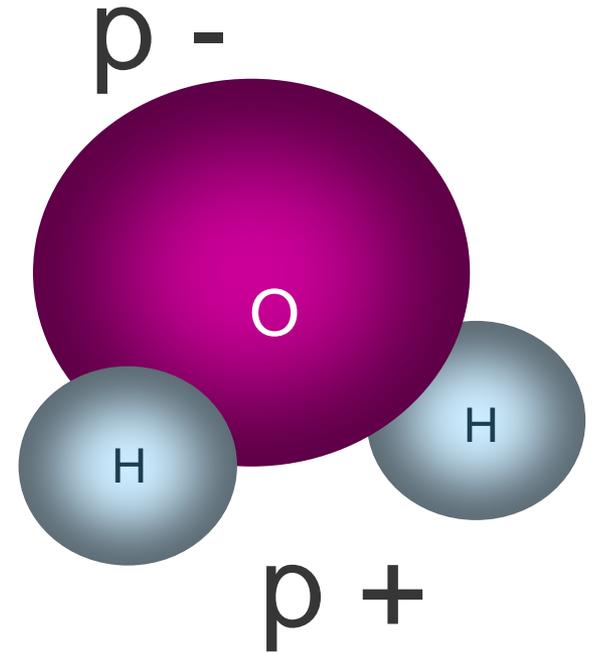


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water basics

- “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.

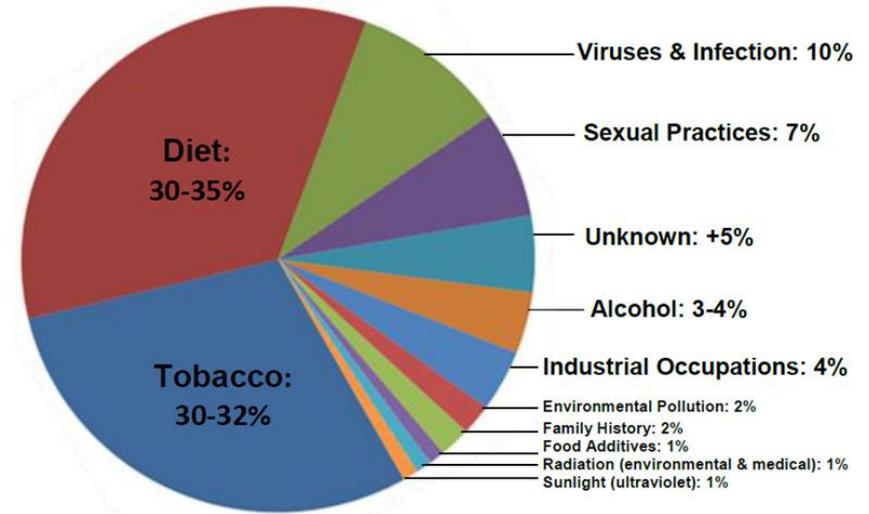
(ex. Arsenic or pesticides can increase the risk of developing certain cancers)



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.

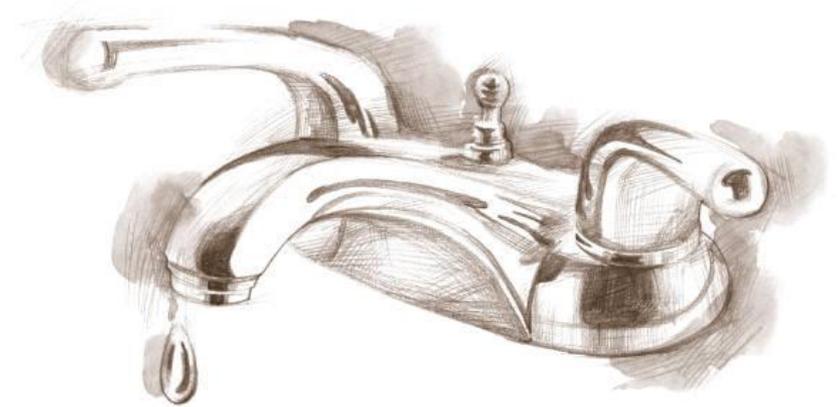
Private Wells

- 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*
- Well or pump work**
- Change in taste or odor
- Buying or selling their home
- Plumbing issues
- Want to know if it's safe to drink.

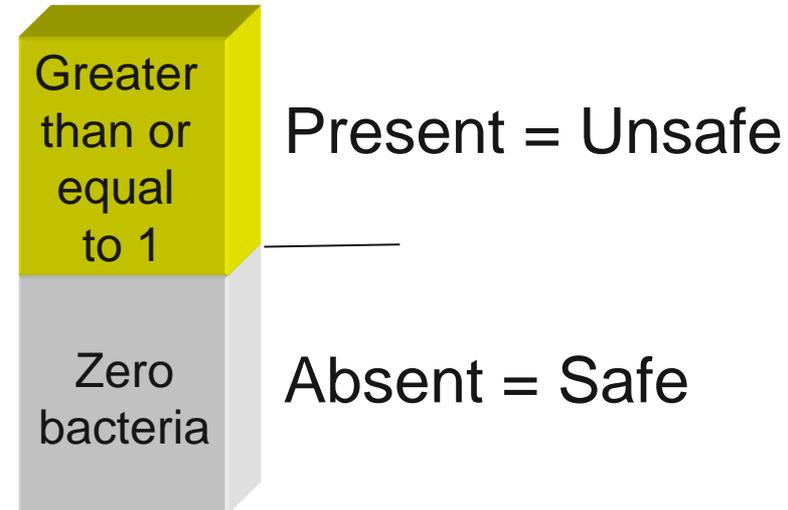
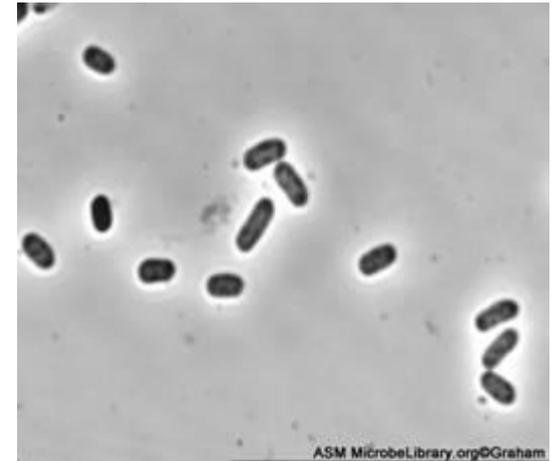


*Required to be tested by well driller for bacteria and *nitrate* (since 2014)

** Required to be tested by well driller/pump installer for bacteria, *nitrate*, and *arsenic*

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>

Well Construction Defects



- Is the well cap or casing cracked?

Well Construction Defects



- Does your well have a vermin-proof cap?



Other Well Construction Defects

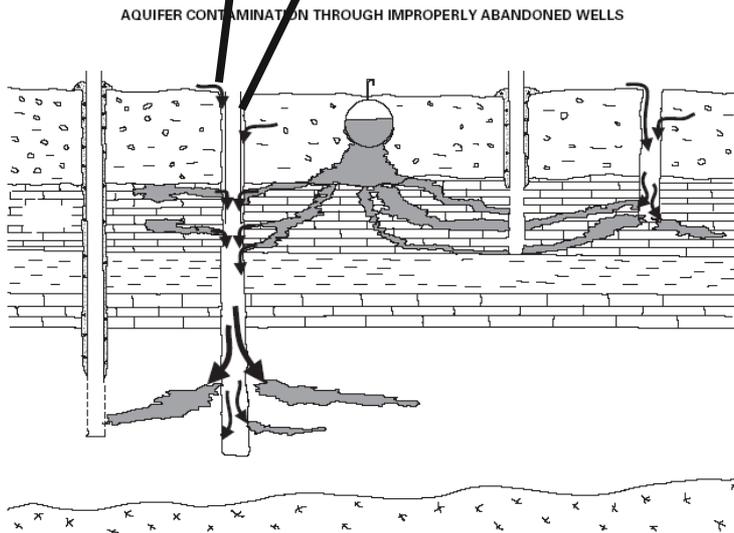


- Electrical conduit not installed correctly
- Don't leash pets within 10 feet of the well
- Avoid bird feeders and other decorations directly above the well

Well Construction Defects



- Are there old wells on the property?
 - Wells are a direct conduit to groundwater
 - Consider having them properly filled and sealed



Well Construction Defects



- Do yard hydrants, livestock waterers, and service to outbuildings have proper backflow prevention?

HOW BACKFLOW CAN HAPPEN

- 1** **Stage 1:** Your home or business has a connection to the public water system not protected by a backflow device.
- 2** **Stage 2:** Water pressure is reduced because of a break in the water main or a fire event using a lot of water suddenly.
- 3** **Stage 3:** The sudden drop in water pressure creates a reverse pressure situation.



- 4** **Stage 4:** Dangerous contaminants from the unprotected connection can now potentially enter the drinking water supply.



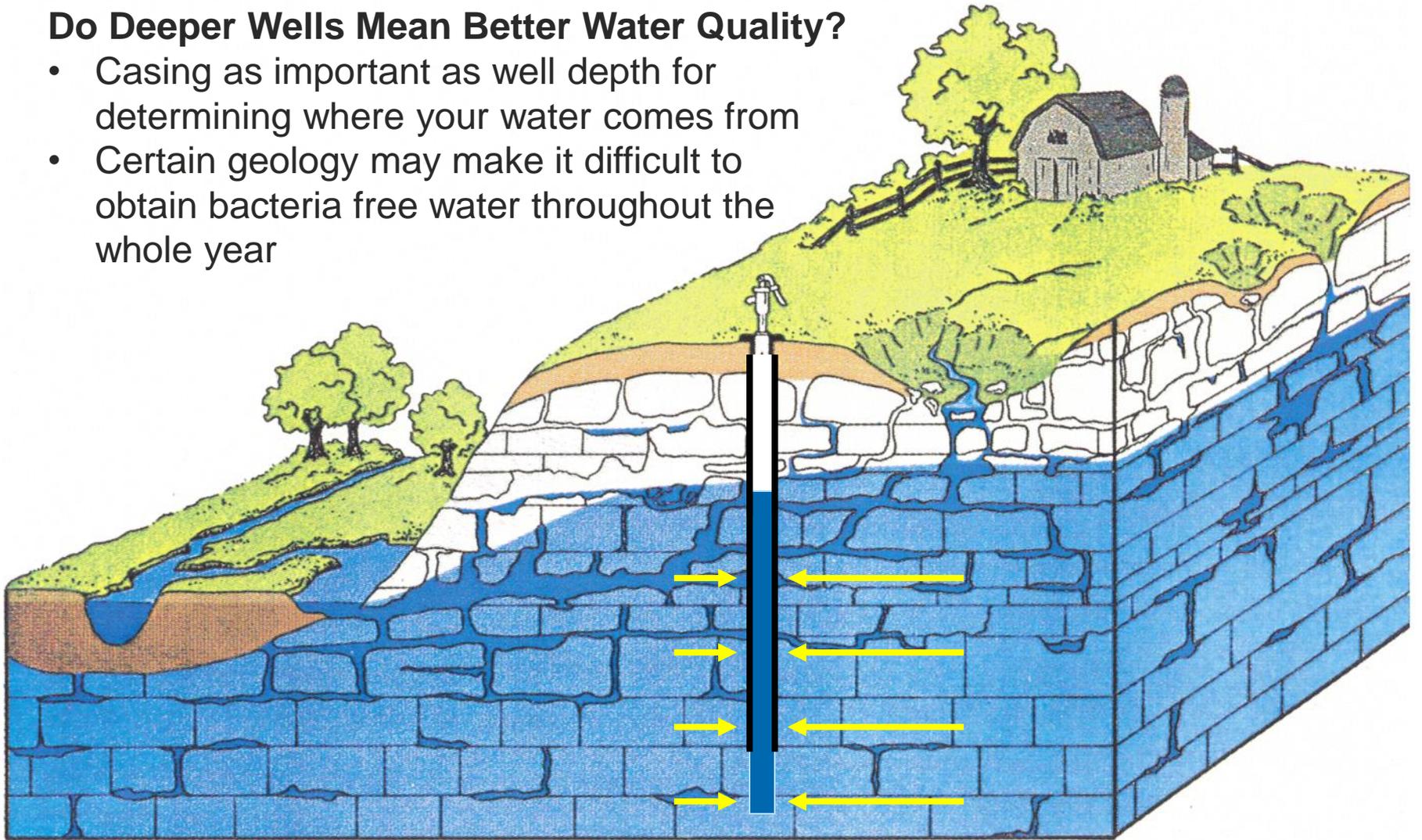
What makes a good well.....



- Vermin proof cap
- Casing extends at least 12" above grade
- Area around well free and clear of debris or other obstructions
- Down spouts or runoff from driveways/other surfaces not directed towards the well

Do Deeper Wells Mean Better Water Quality?

- Casing as important as well depth for determining where your water comes from
- Certain geology may make it difficult to obtain bacteria free water throughout the whole year



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
 - Cross connection
 - 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.*



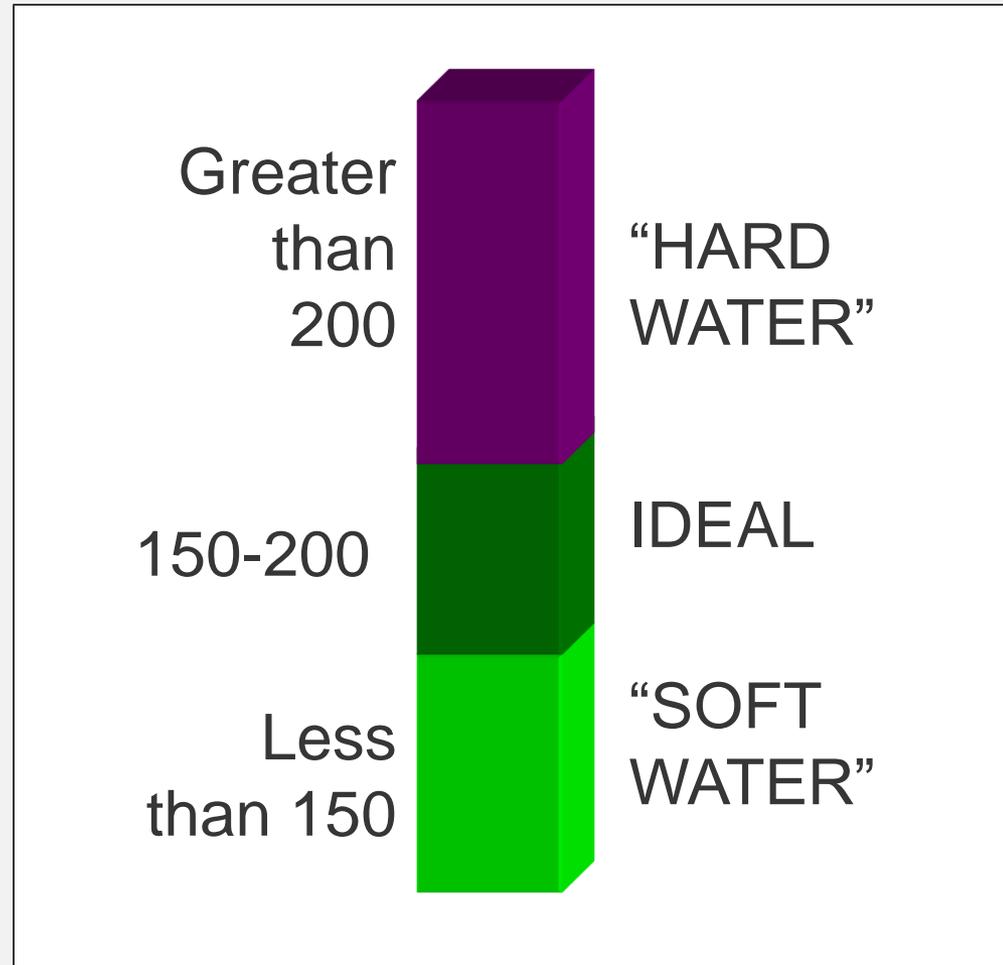
Rock and Soil Impacts on Water Quality

Tests for Aesthetic Problems

Hardness

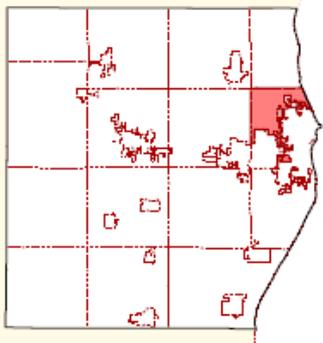
- Natural (rocks and soils)
- Primarily calcium and magnesium

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



Town of Sheboygan

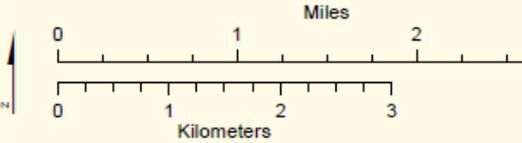
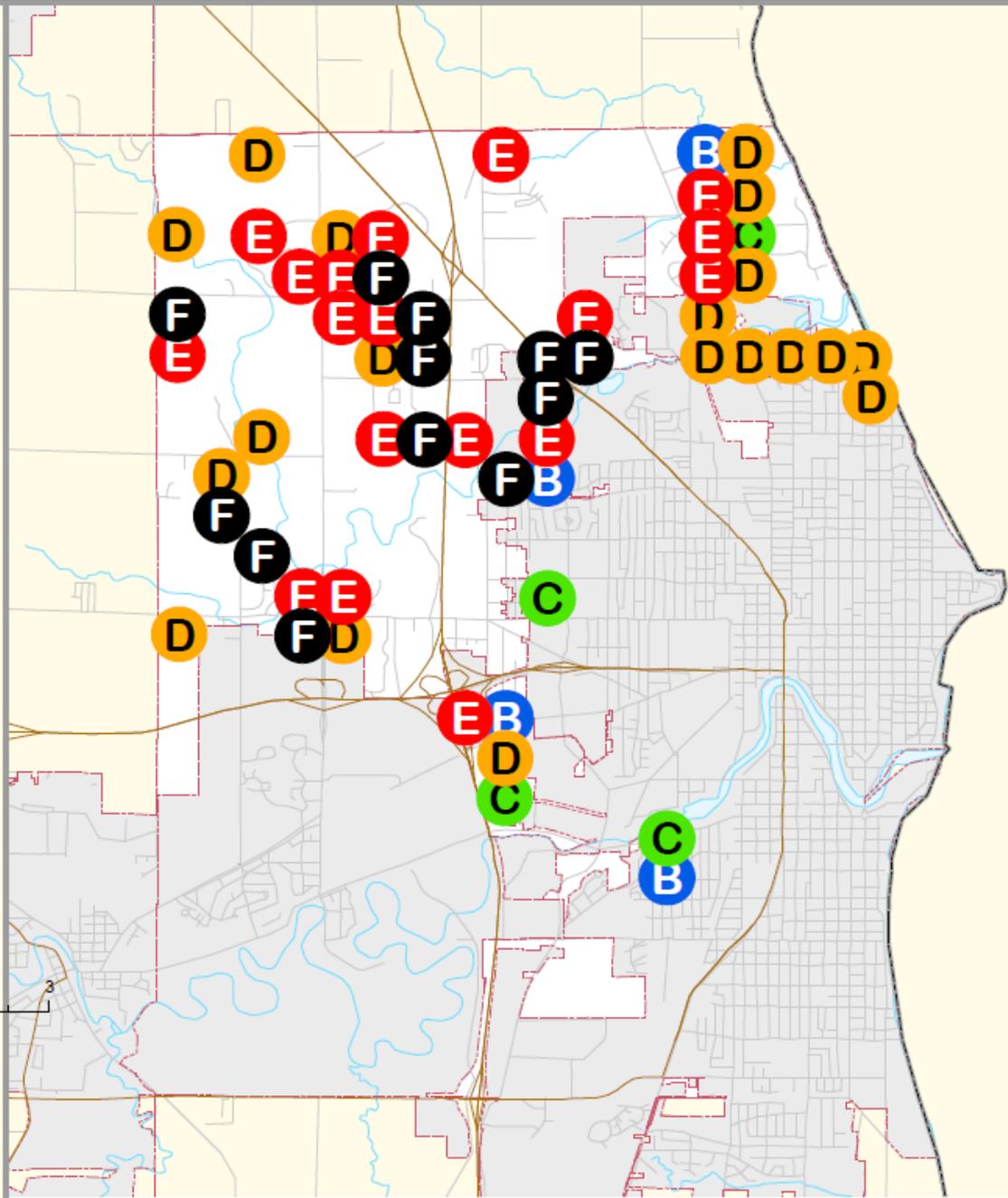
Sheboygan County, October 2022



TOTAL HARDNESS (ppm CaCO3)

A ... 50	22	14%
B 51 - 100	9	6%
C 101 - 200	9	6%
D 201 - 300	40	26%
E 301 - 400	32	21%
F 401 ...	40	26%

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

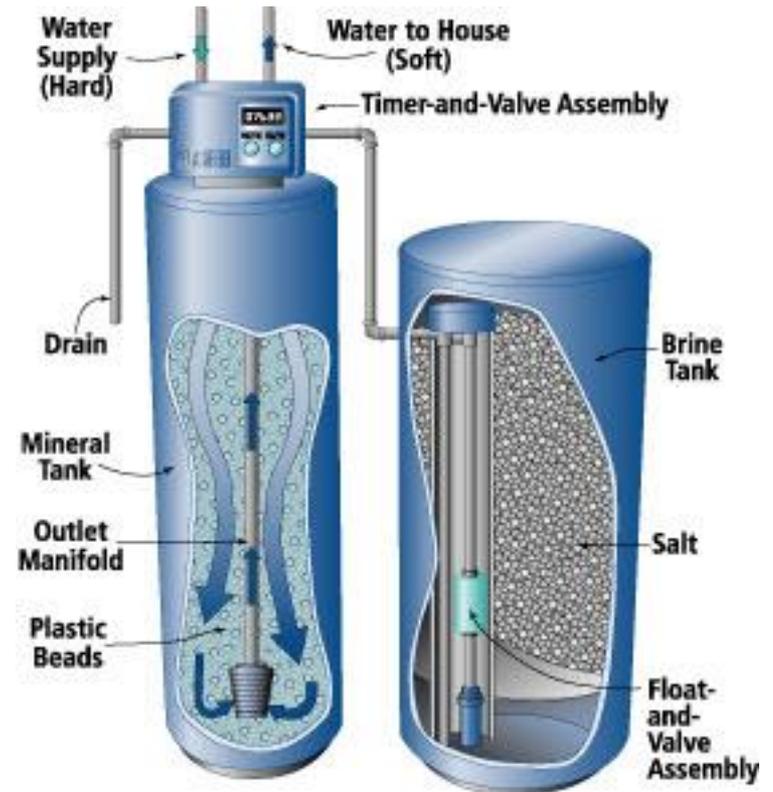


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Water Softening

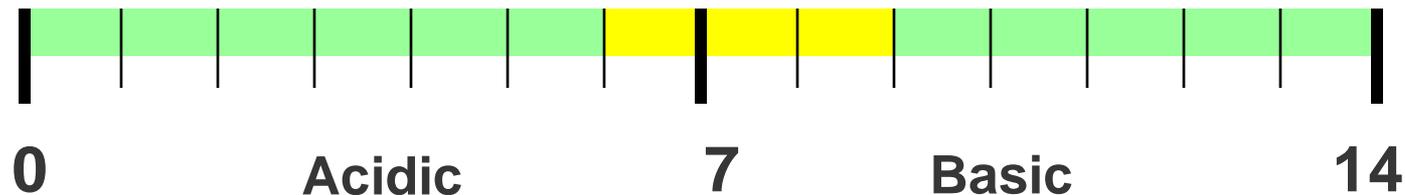
Water softeners remove calcium and magnesium which cause scaling and exchange it for sodium (or potassium).

- 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.



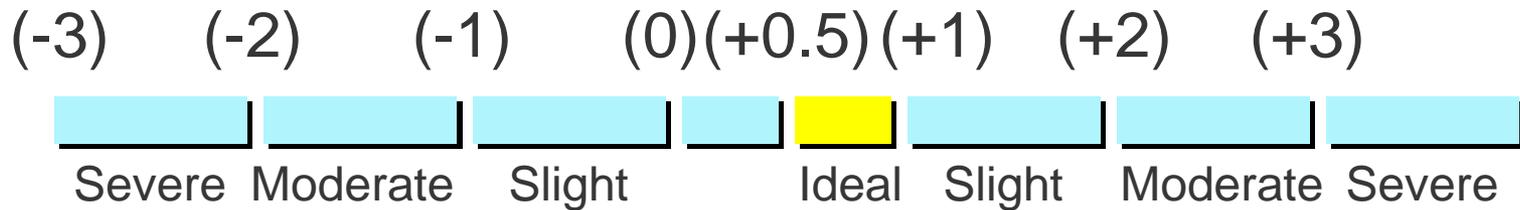
Tests for Overall Water Quality

- **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



Tests for Overall Water Quality

Saturation Index



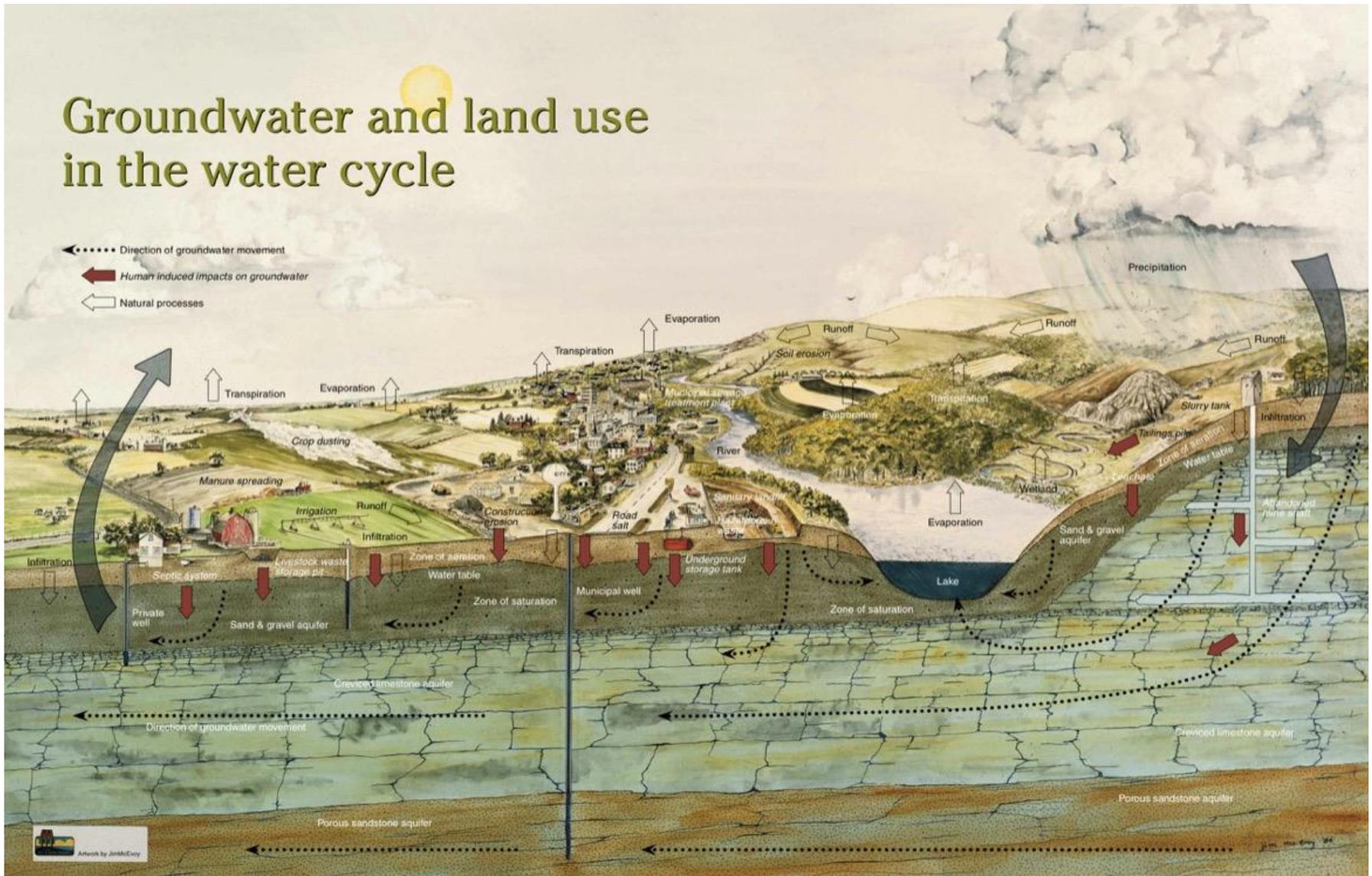
Corrosion occurs



Scaling occurs



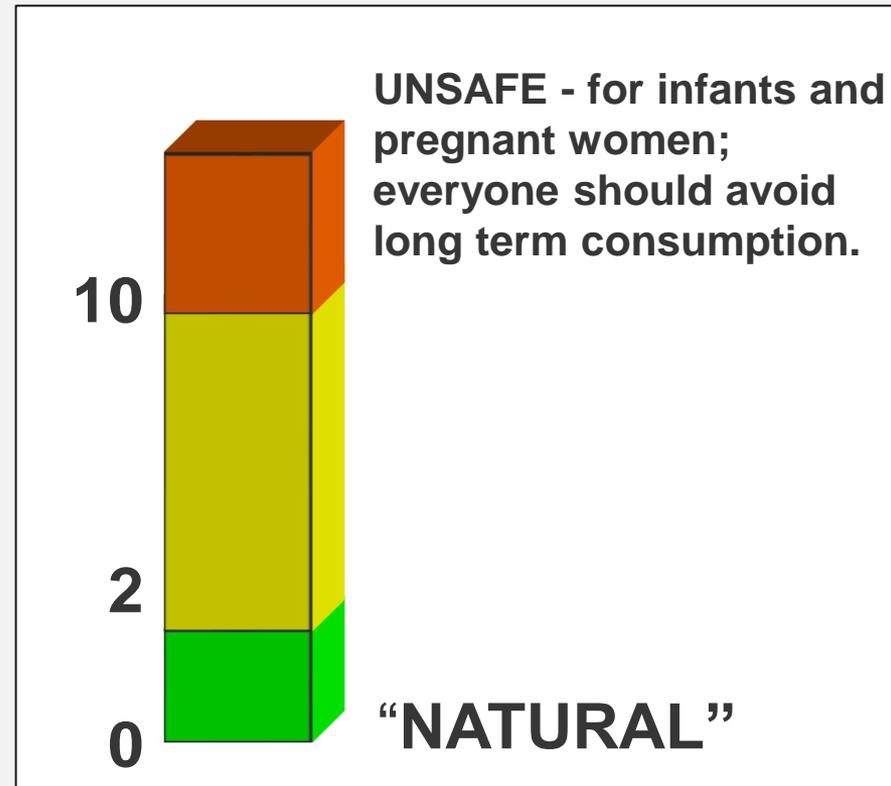
Groundwater and land use in the water cycle



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”



Nitrate-Nitrogen

Health Effects:

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



Source: Wisconsin Department of Health Services

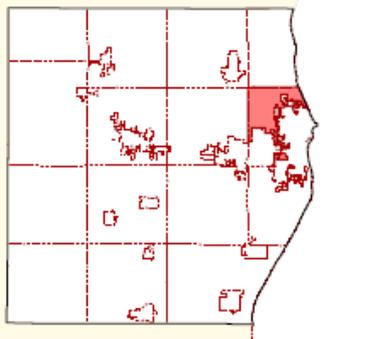
Sources:

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



Town of Sheboygan

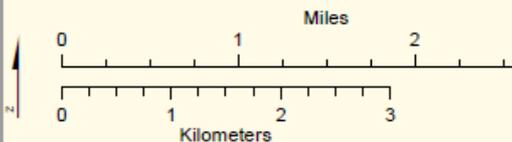
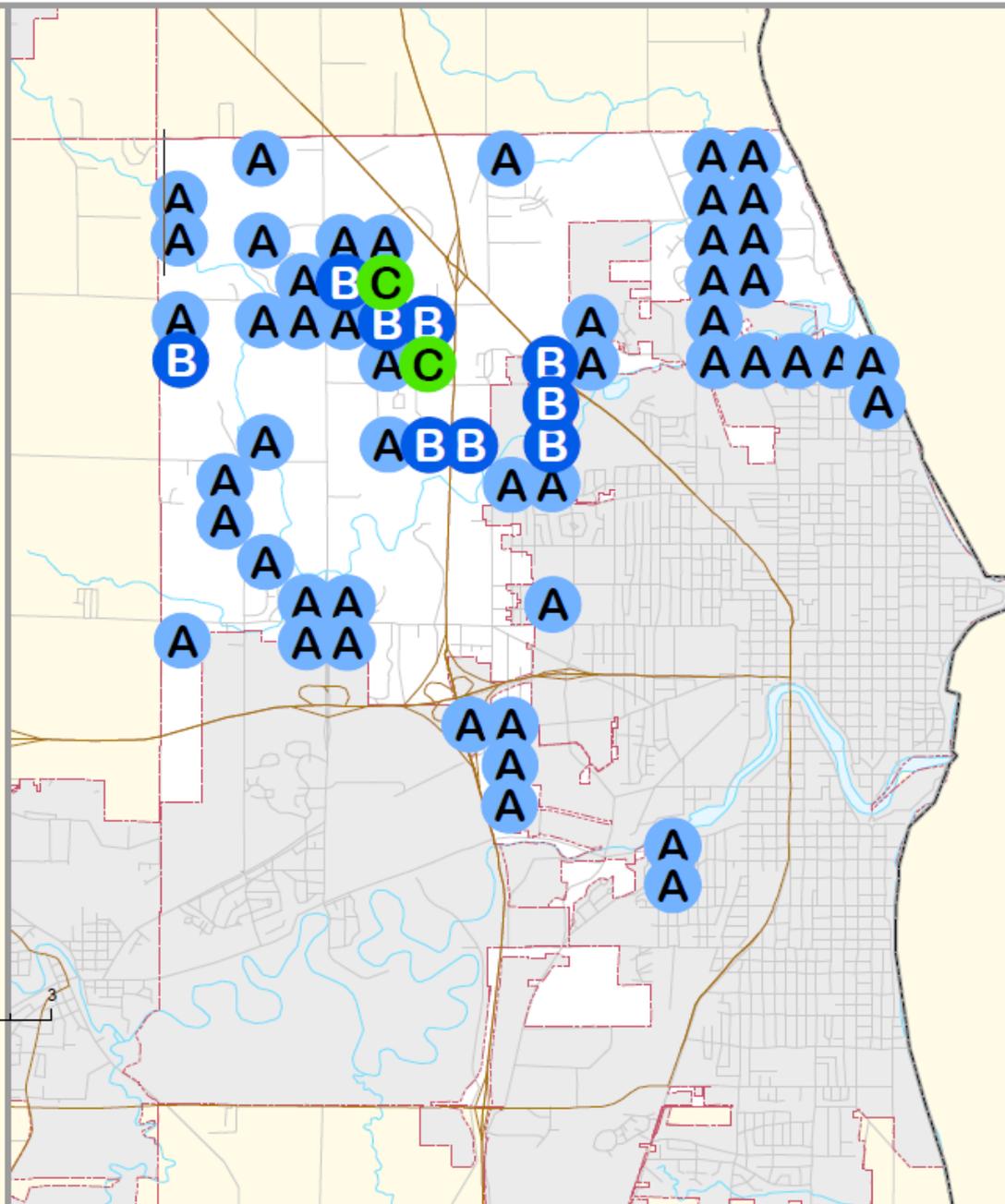
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NITRATE-NITRITE (ppm N)

A None Detected	115	76 %
B ... 2.0	26	17 %
C 2.1 - 5.0	11	7 %
D 5.1 - 10.0	0	0 %
E 10.1 - 20.0	0	0 %
F 20.1 ...	0	0 %

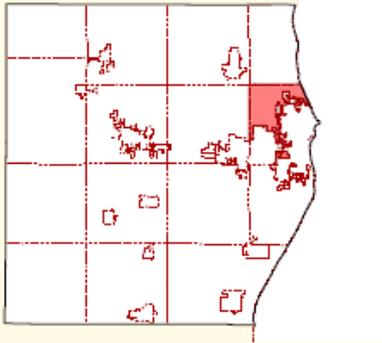
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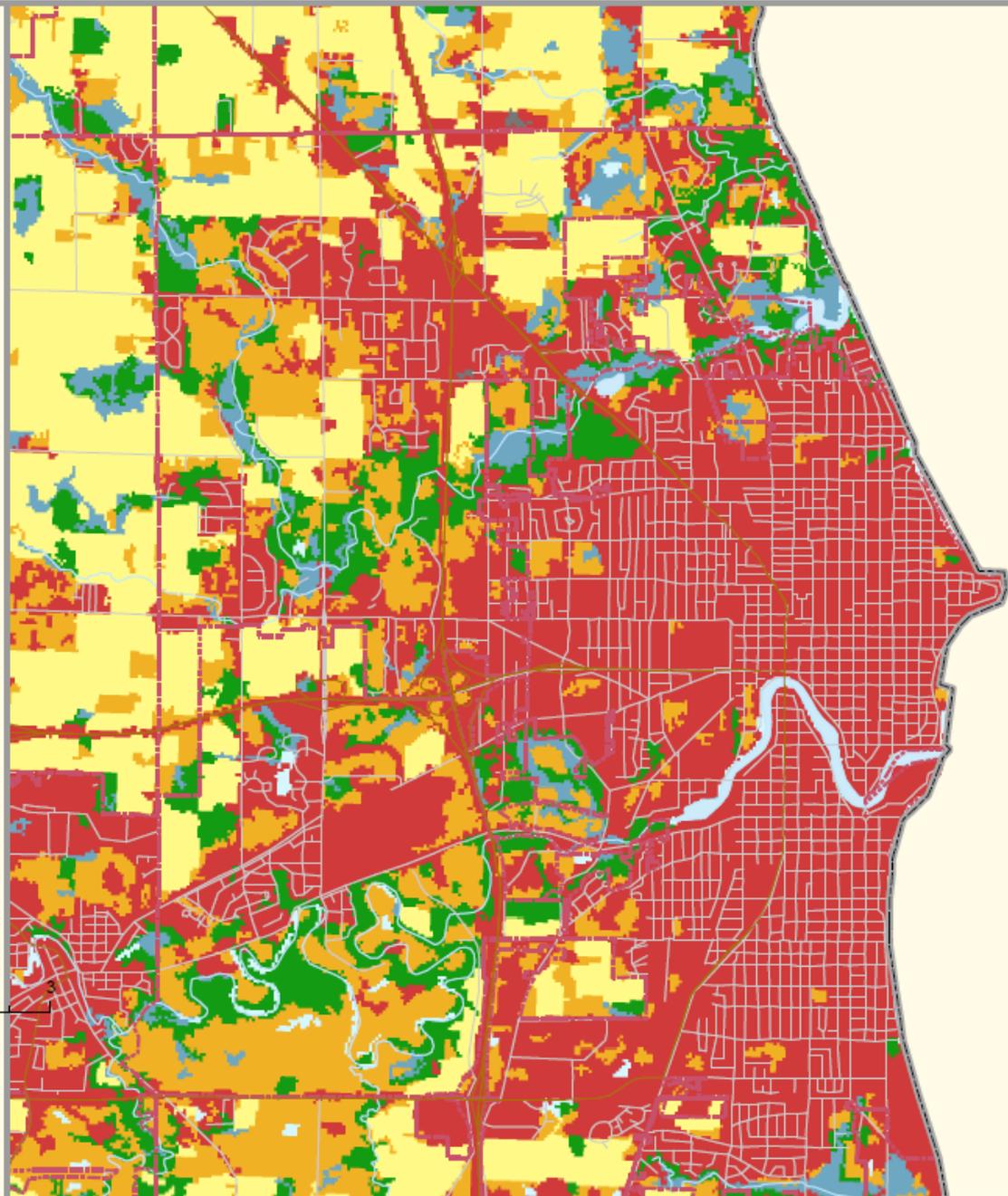
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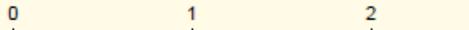


Land Use:

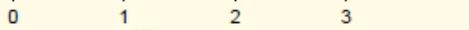
- Urban
- Agriculture
- Forest
- Shrub-Grass
- Wetland
- Water
- Barren



Miles



Kilometers



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What can I do to reduce my nitrate levels?

Solution:

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

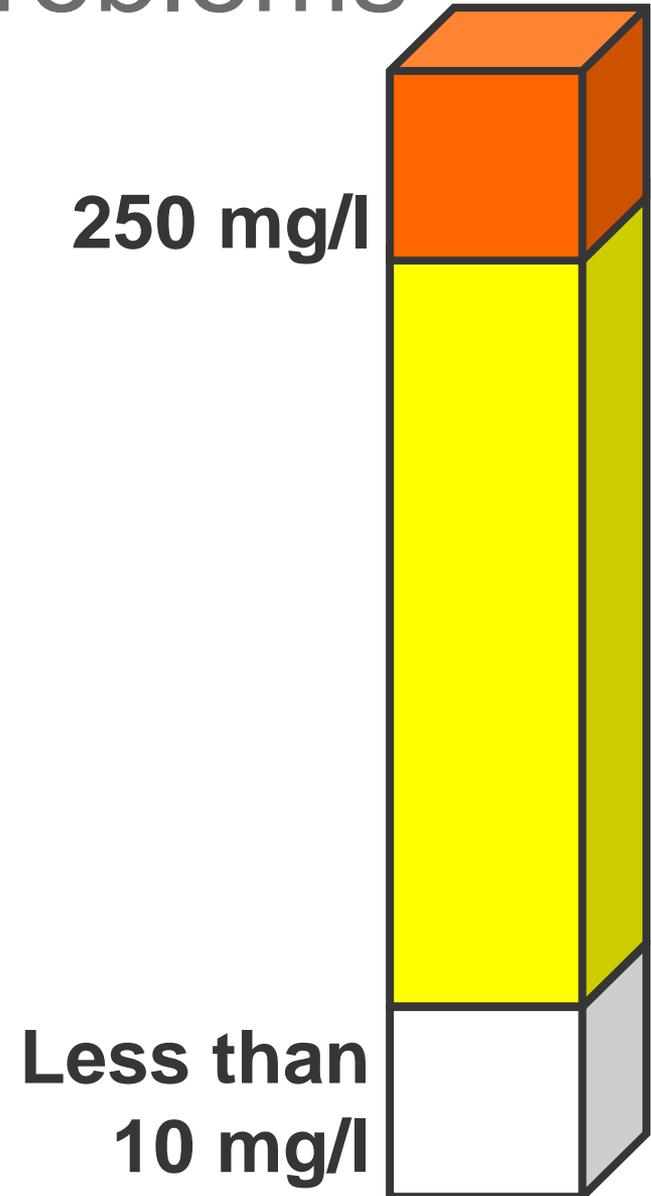
Short term:

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

Tests for Aesthetic Problems

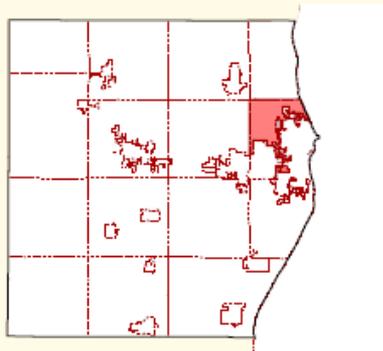
Chloride

- 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



Town of Sheboygan

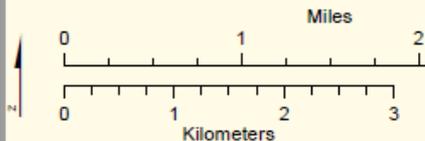
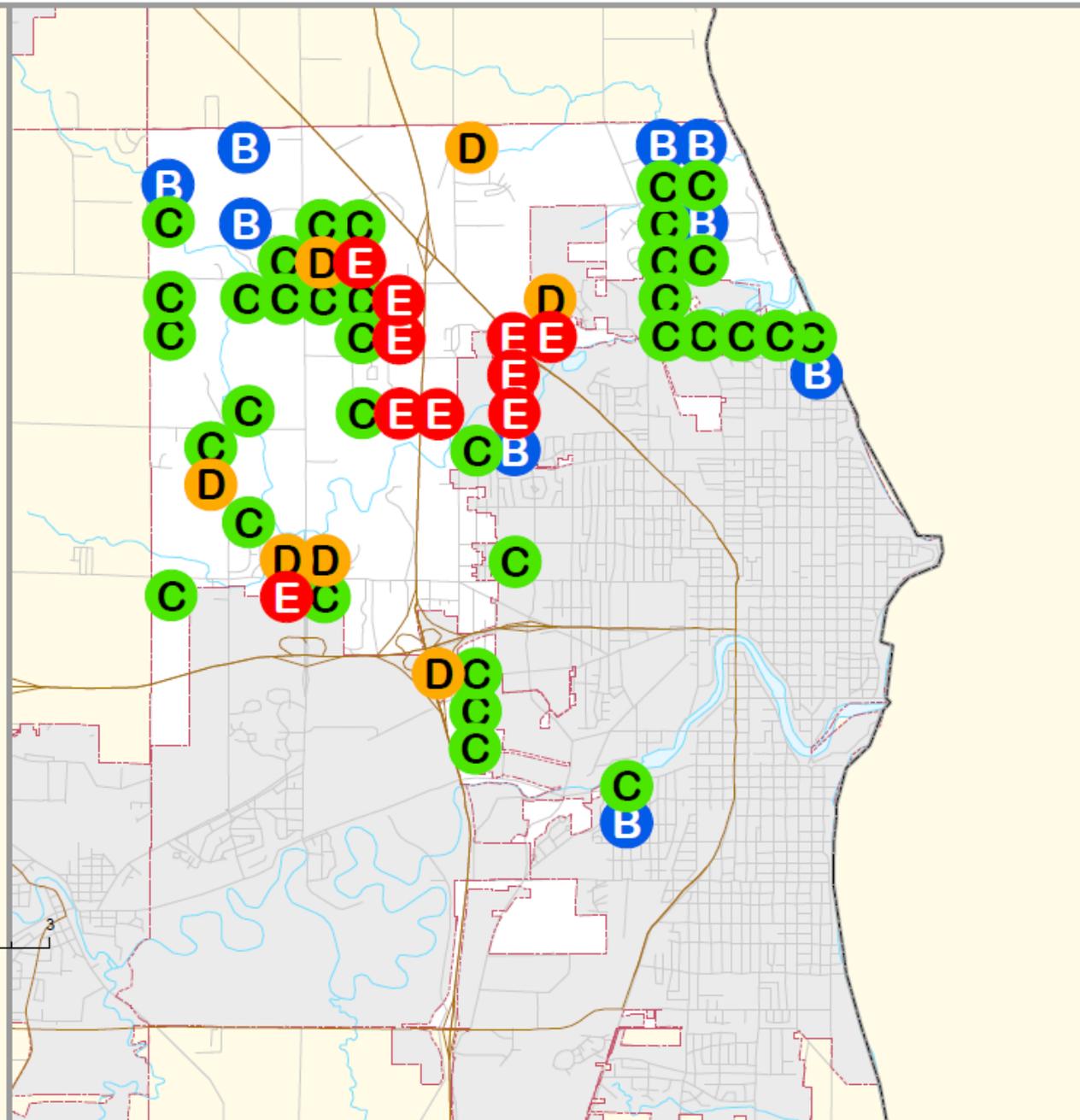
Sheboygan County, October 2022



CHLORIDE (ppm)

A None Detected	1	<1 %
B ... 10	29	19 %
C 11 - 50	66	43 %
D 51 - 100	15	10 %
E 101 - 200	33	22 %
F 201 ...	8	5 %

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



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Test Important to Health

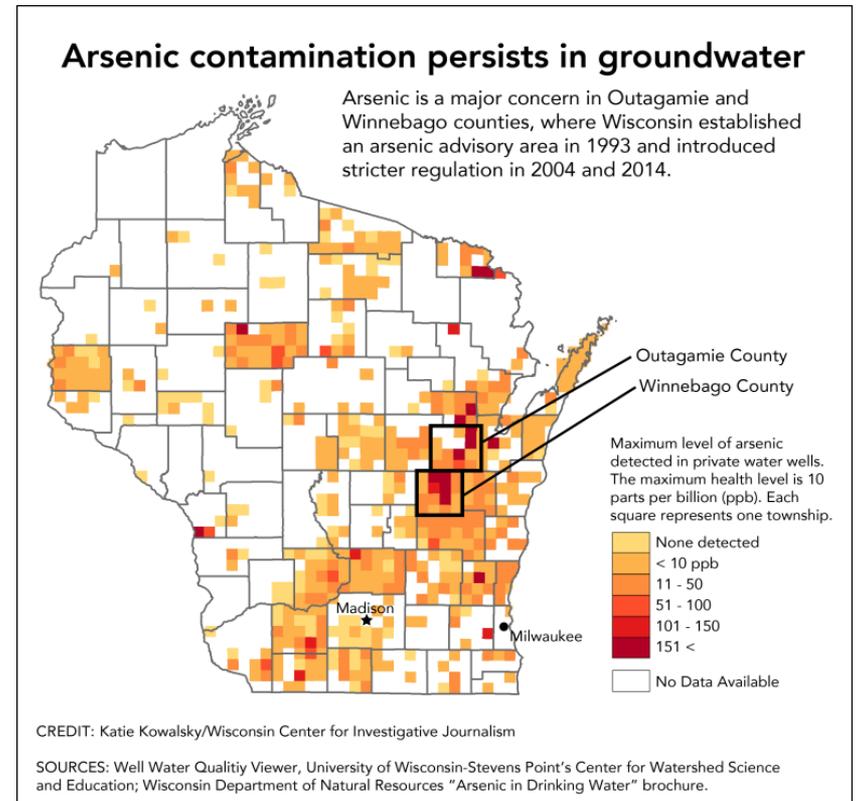
Arsenic

Sources: Naturally occurring in mineral deposits

Standard: 0.010 mg/L (10 ppb)

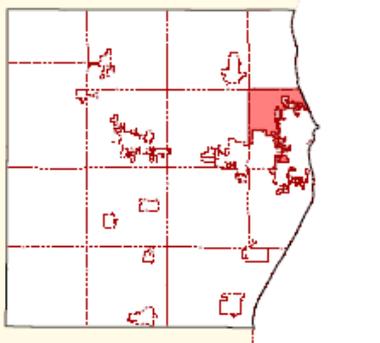
Health Effects:

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



Town of Sheboygan

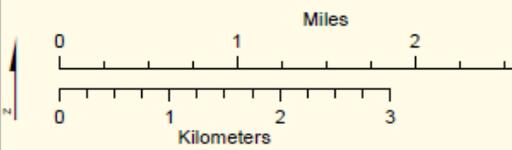
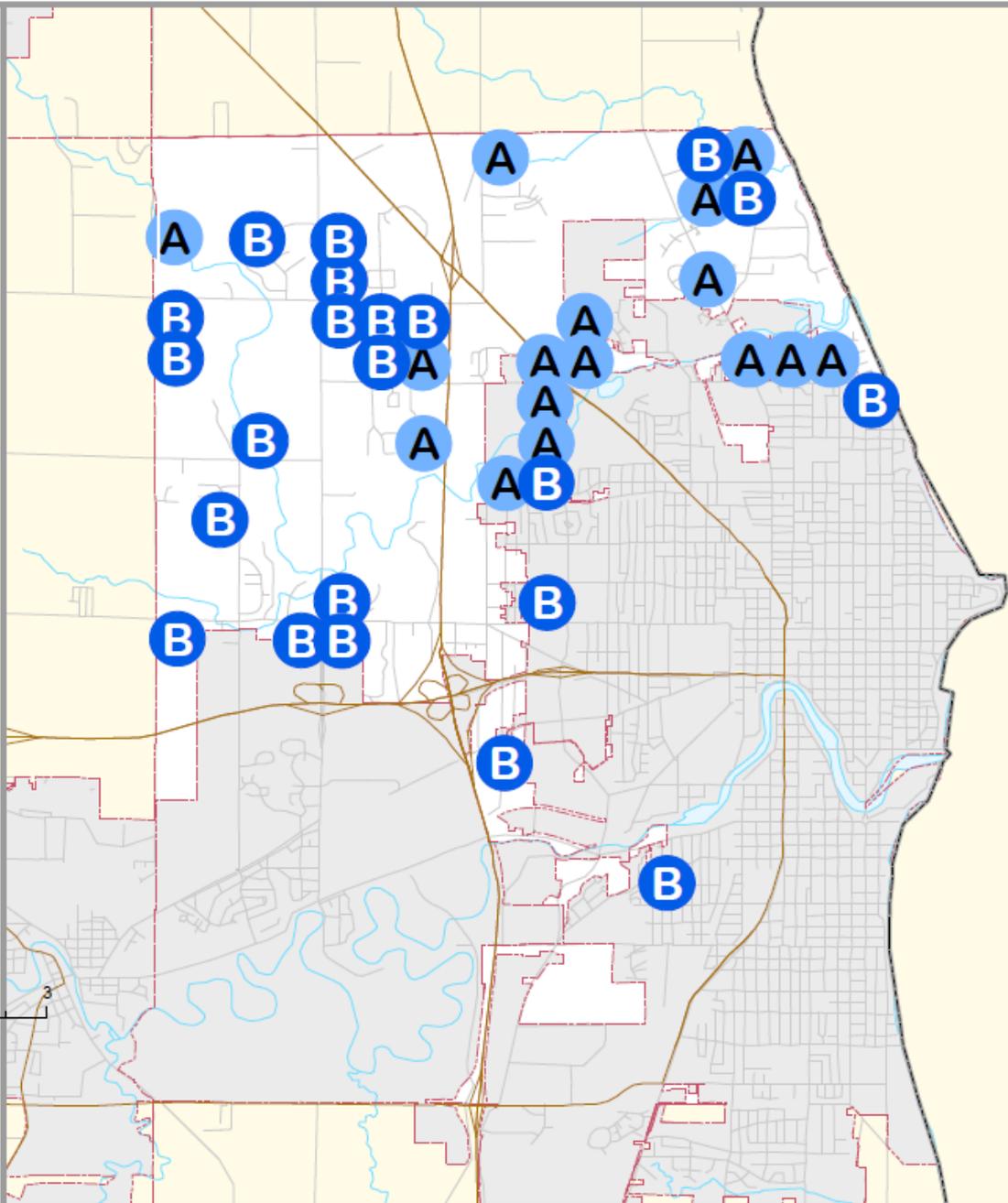
Sheboygan County, October 2022



ARSENIC (mg/l)

A None Detected	32	49 %
B ... 0.010	29	45 %
C 0.011 - 0.050	4	6 %
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



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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:

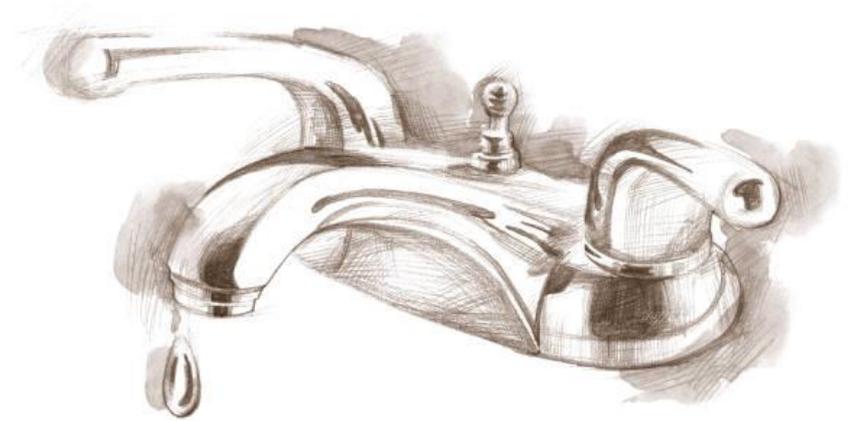
- Young children, infants and unborn children are particularly vulnerable.
- Lead may damage the brain, kidneys, nervous system, red blood cells, reproductive system.



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

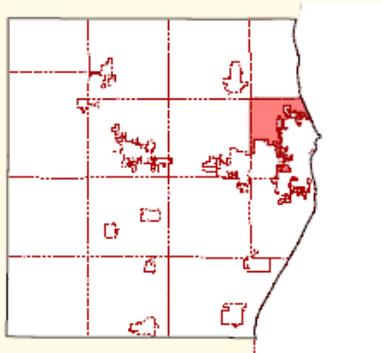
Drinking water limit:

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



Town of Sheboygan

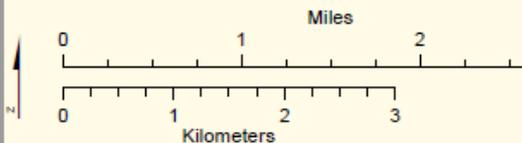
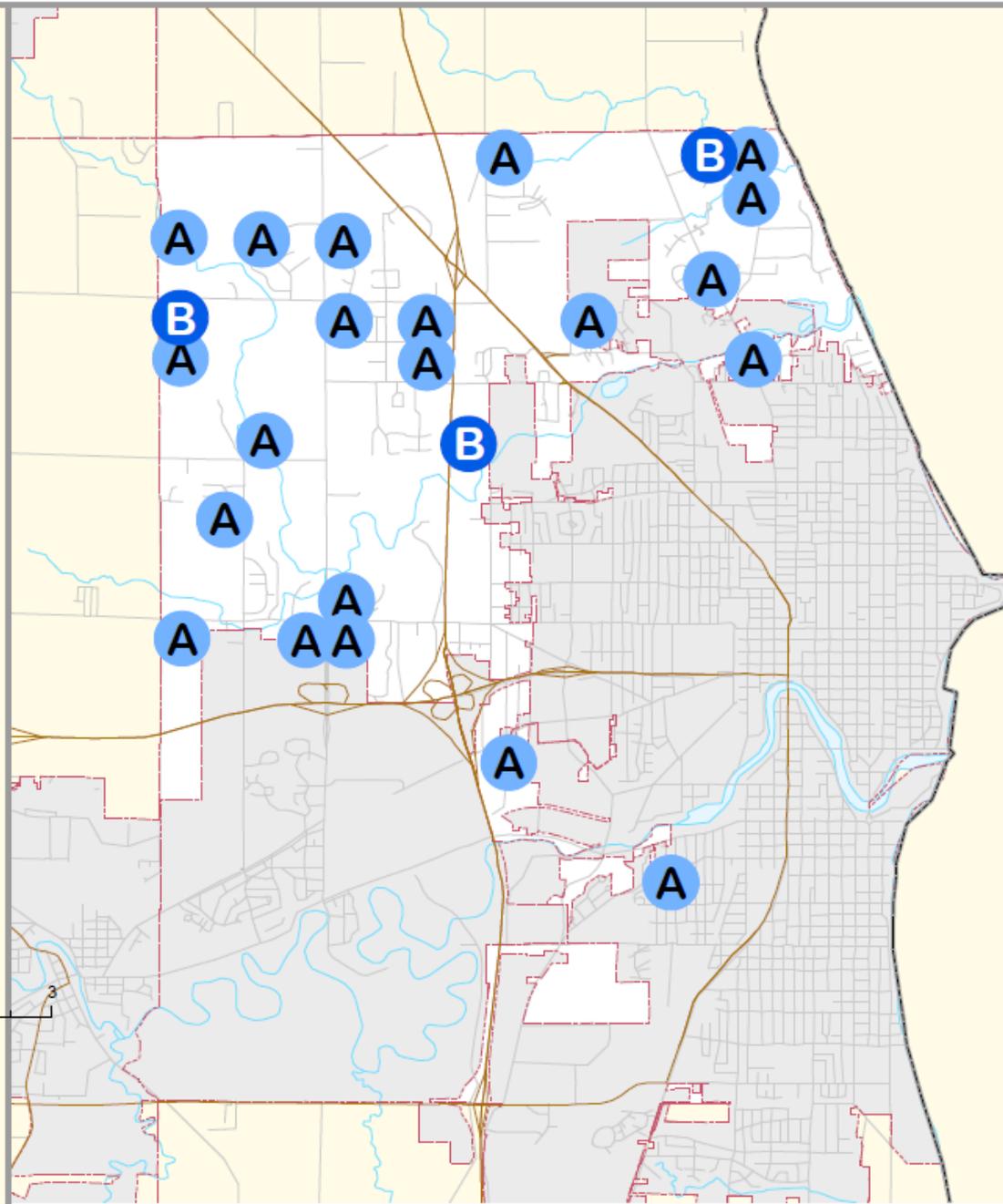
Sheboygan County, October 2022



DACT (ug/l)

A None Detected	33	92 %
B ... 0.3	3	8 %
C 0.4 - 1.0	0	0 %
D 1.1 - 2.0	0	0 %
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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Operating your private water utility:

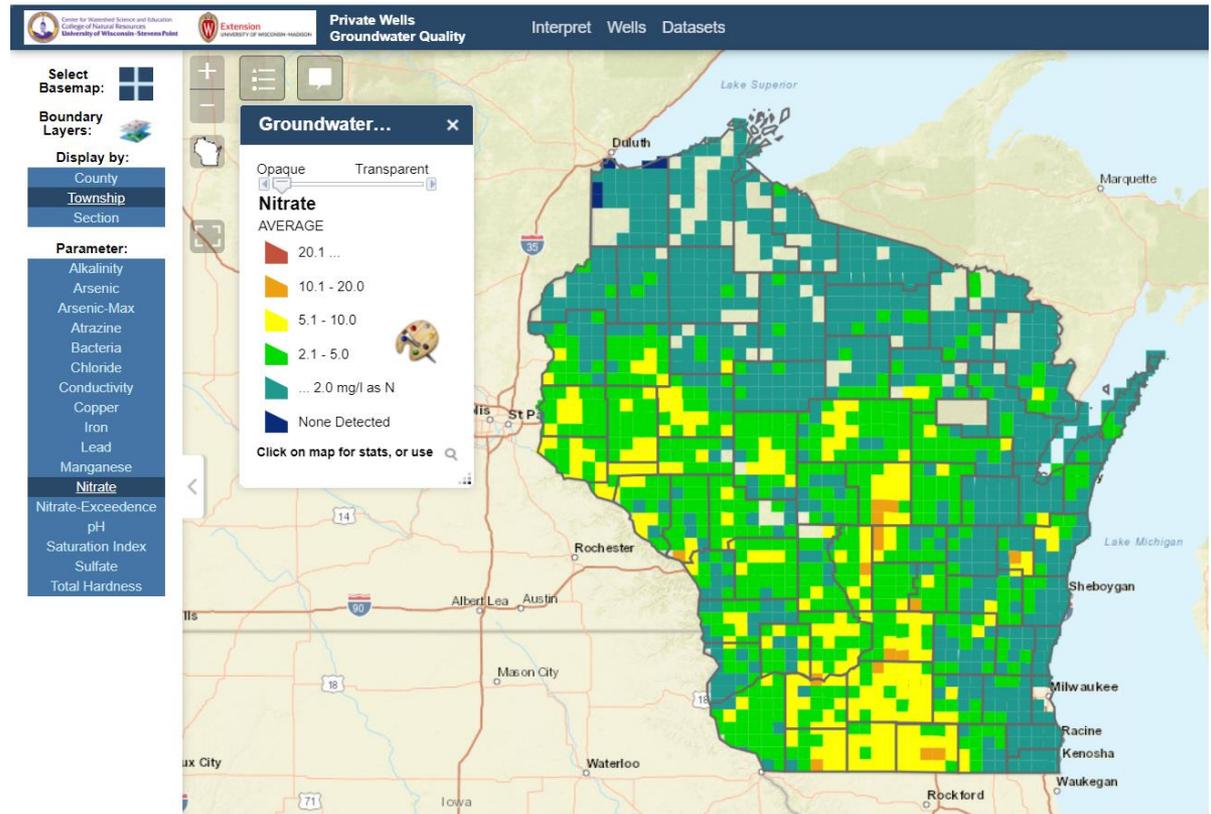
- ***Periodically inspect and maintain*** the area around your well
- ***Test your water regularly*** to evaluate common water quality concerns
- ***If necessary, take corrective actions****



*Know when to call a licensed well driller or pump installer

WI Well Water Viewer

- Find out more about well water quality in your area
- Interactive online dashboard



Thanks to you and the following for helping sponsor this program:

- Town of Sheboygan
- Extension Sheboygan County
- Sheboygan County

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