Groundwater and Drinking Water Education Program

Green County

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University of Wisconsin-Stevens Point
College of Natural Resources

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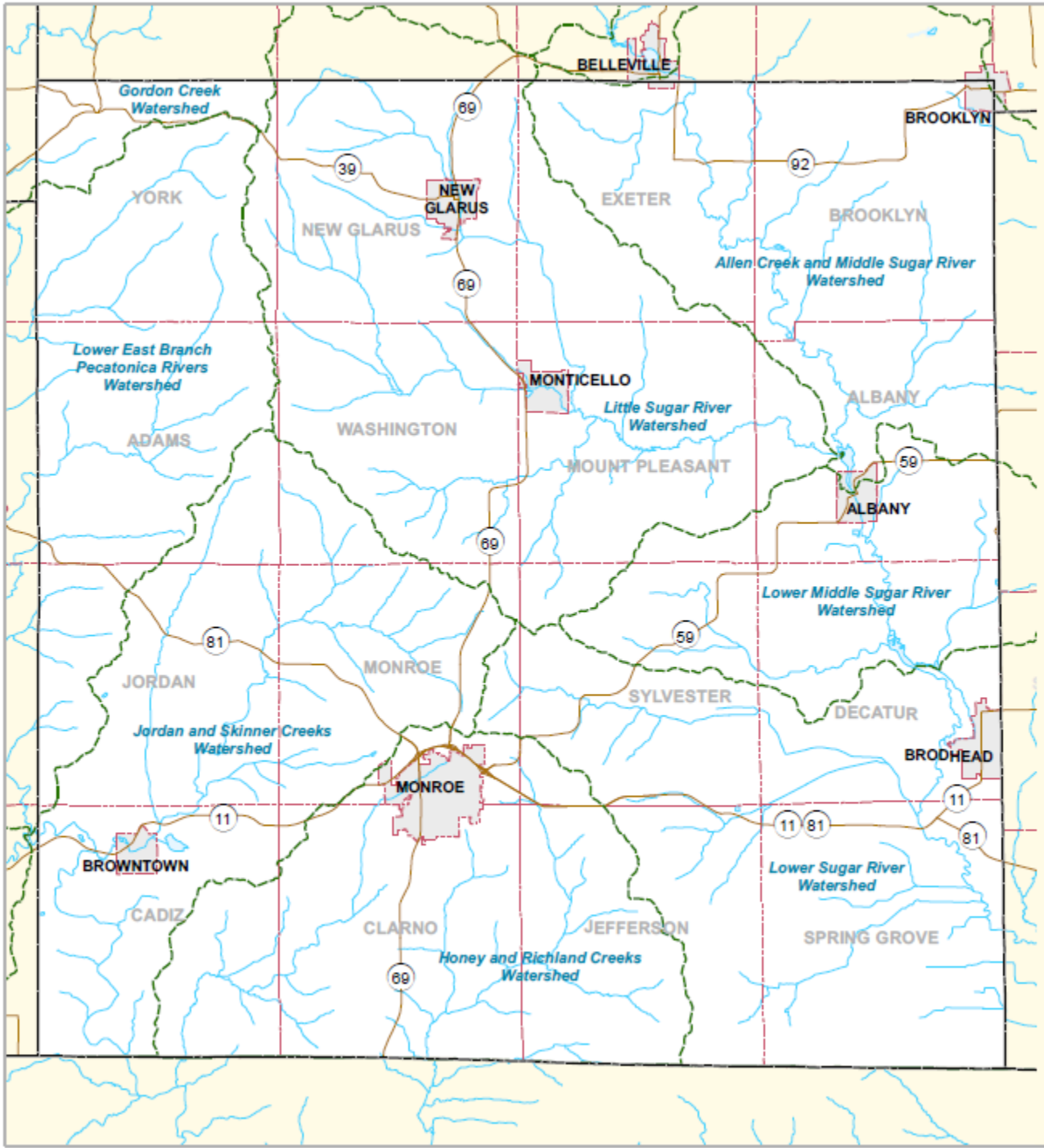
Through the University of Wisconsin-Extension, all Wisconsin people can access University resources and engage in lifelong learning, wherever they live and work.

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 Green County
- Improving your water quality



Green County

1994 - 2015 Summary

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

0 2 4 6 Miles

0 2 4 6 Kilometers

N

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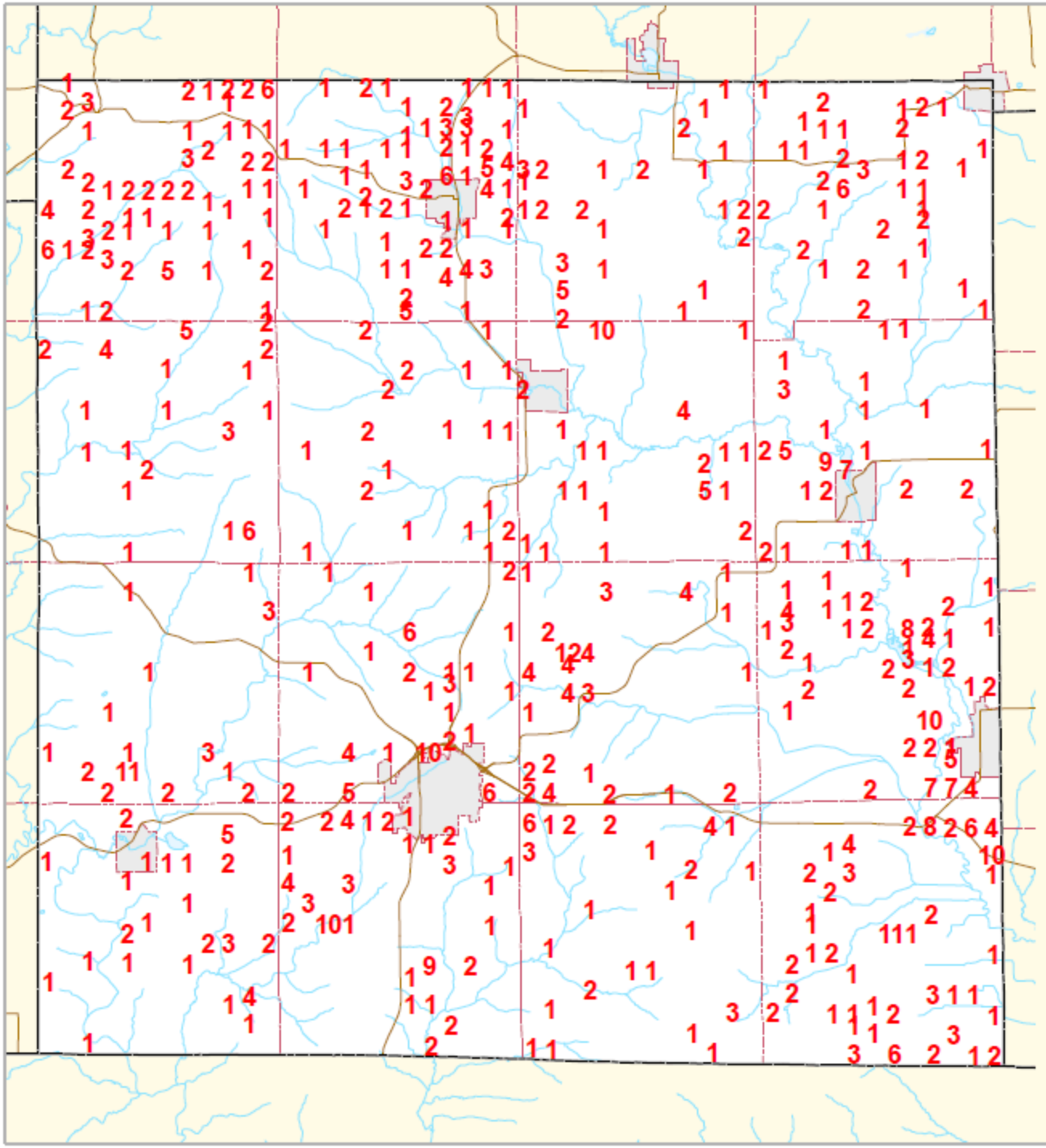

Green County

1994 - 2015 Summary

SAMPLE DISTRIBUTION

NUMBER OF SAMPLES
per 1/4 SECTION

0 2 4 6 Miles

0 2 4 6 Kilometers

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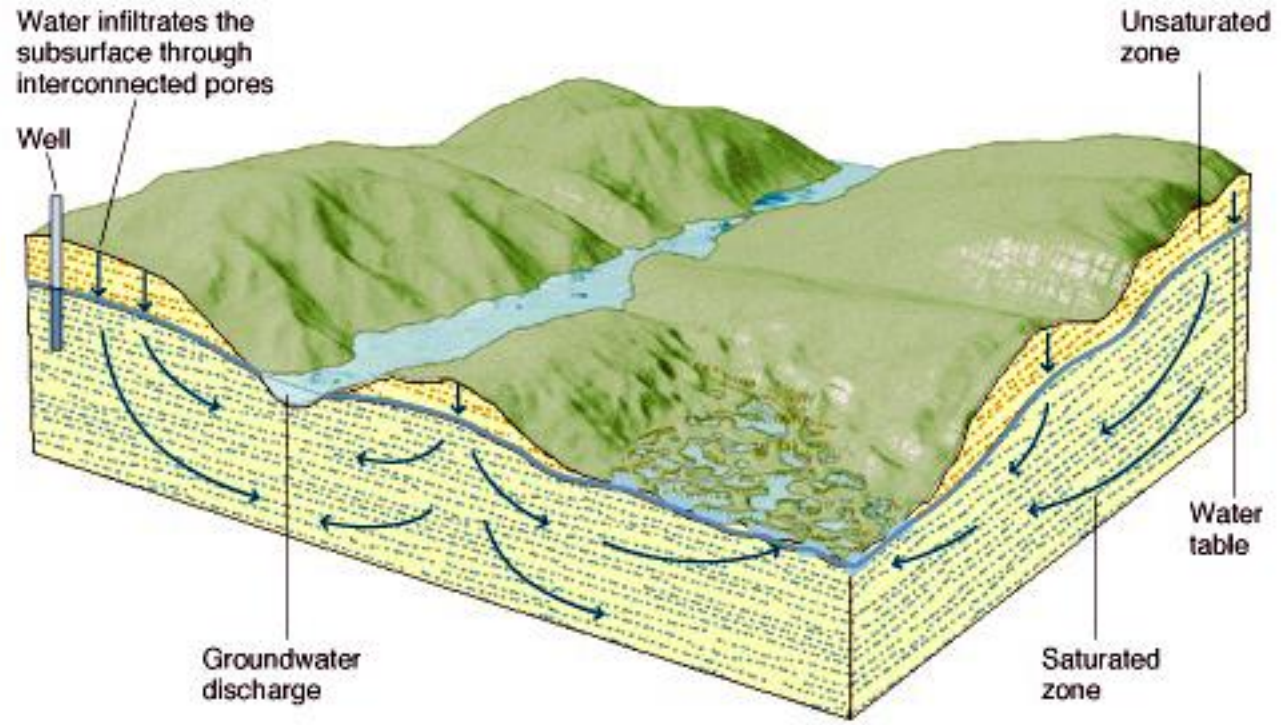
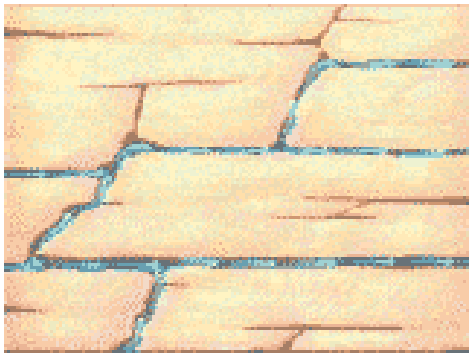
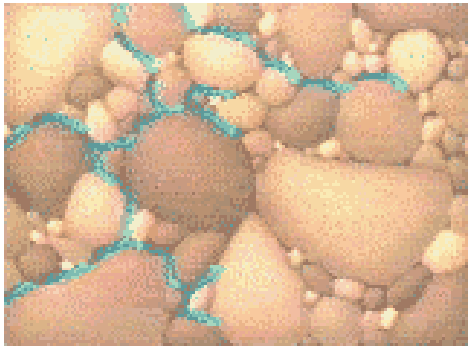
Groundwater Movement



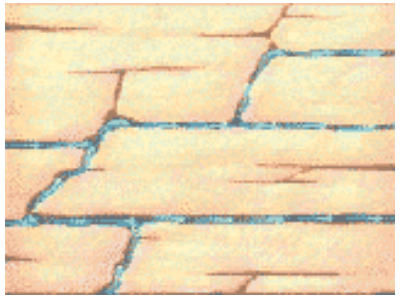




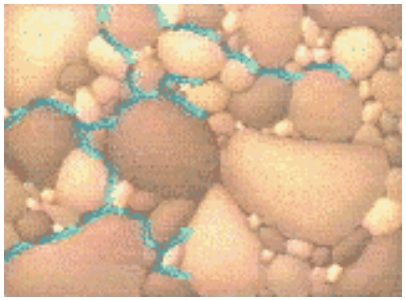
Aquifers: Our groundwater storage units

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.



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.

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.

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

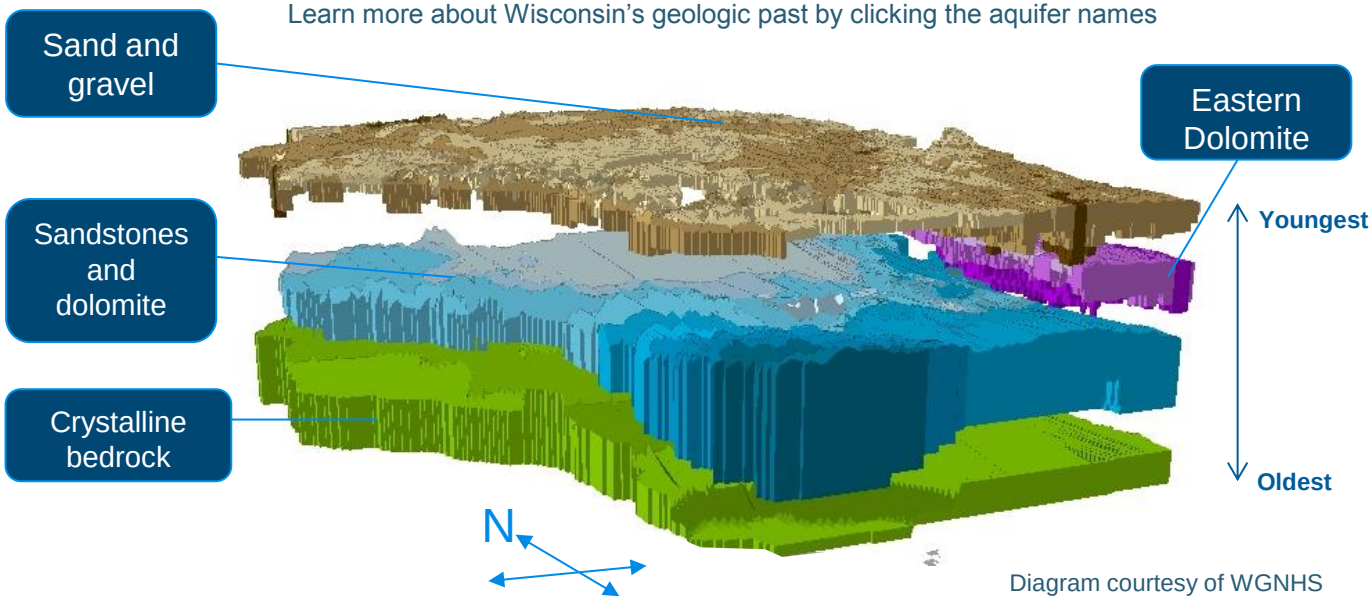
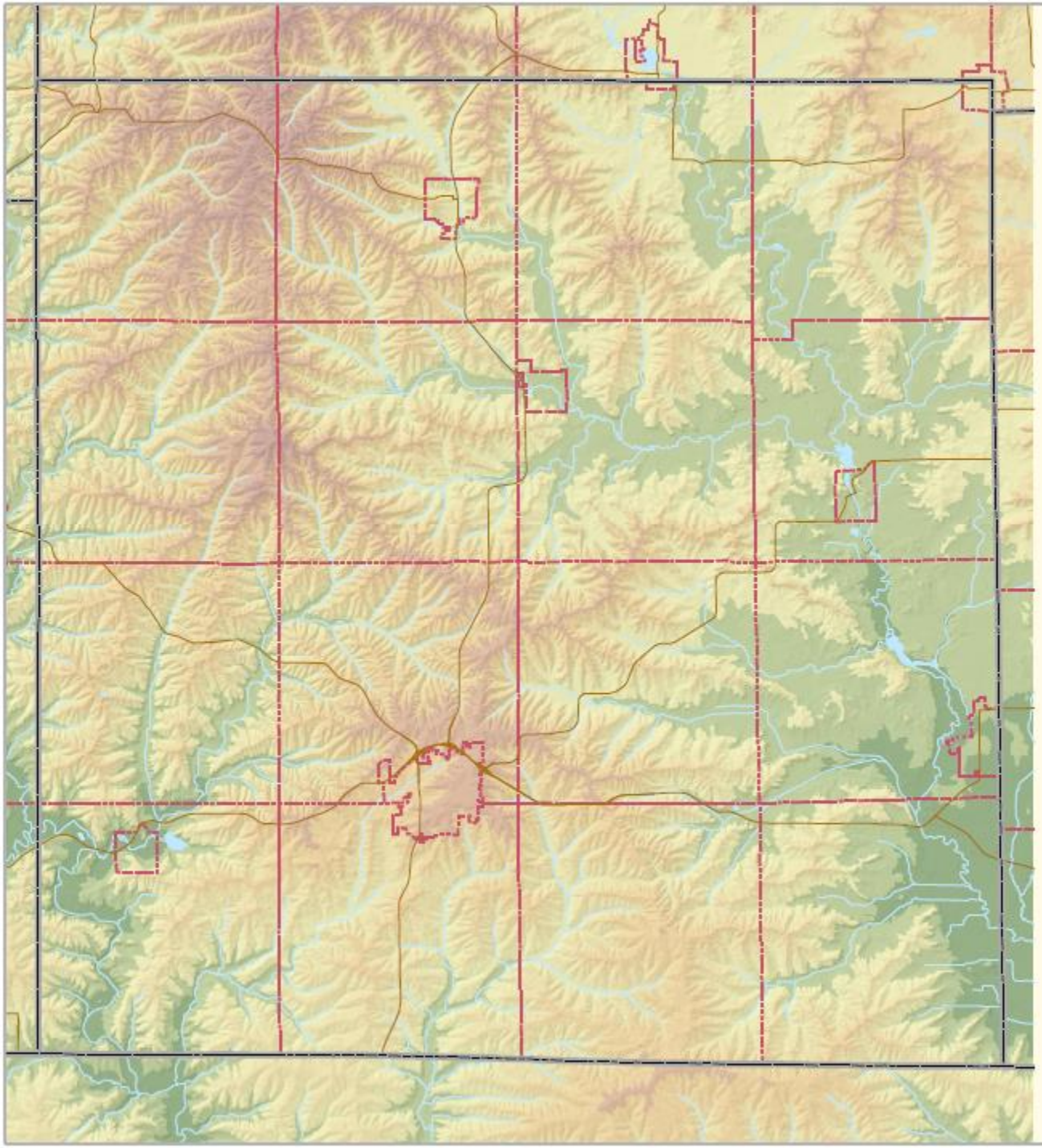


Diagram courtesy of WGNHS



Green County

1994 - 2015 Summary

Elevation:
(meters)

- 230 - 240
- 241 - 260
- 261 - 280
- 281 - 300
- 301 - 320
- 321 - 340
- 341 - 362

0 2 4 6 Miles

0 2 4 6 Kilometers

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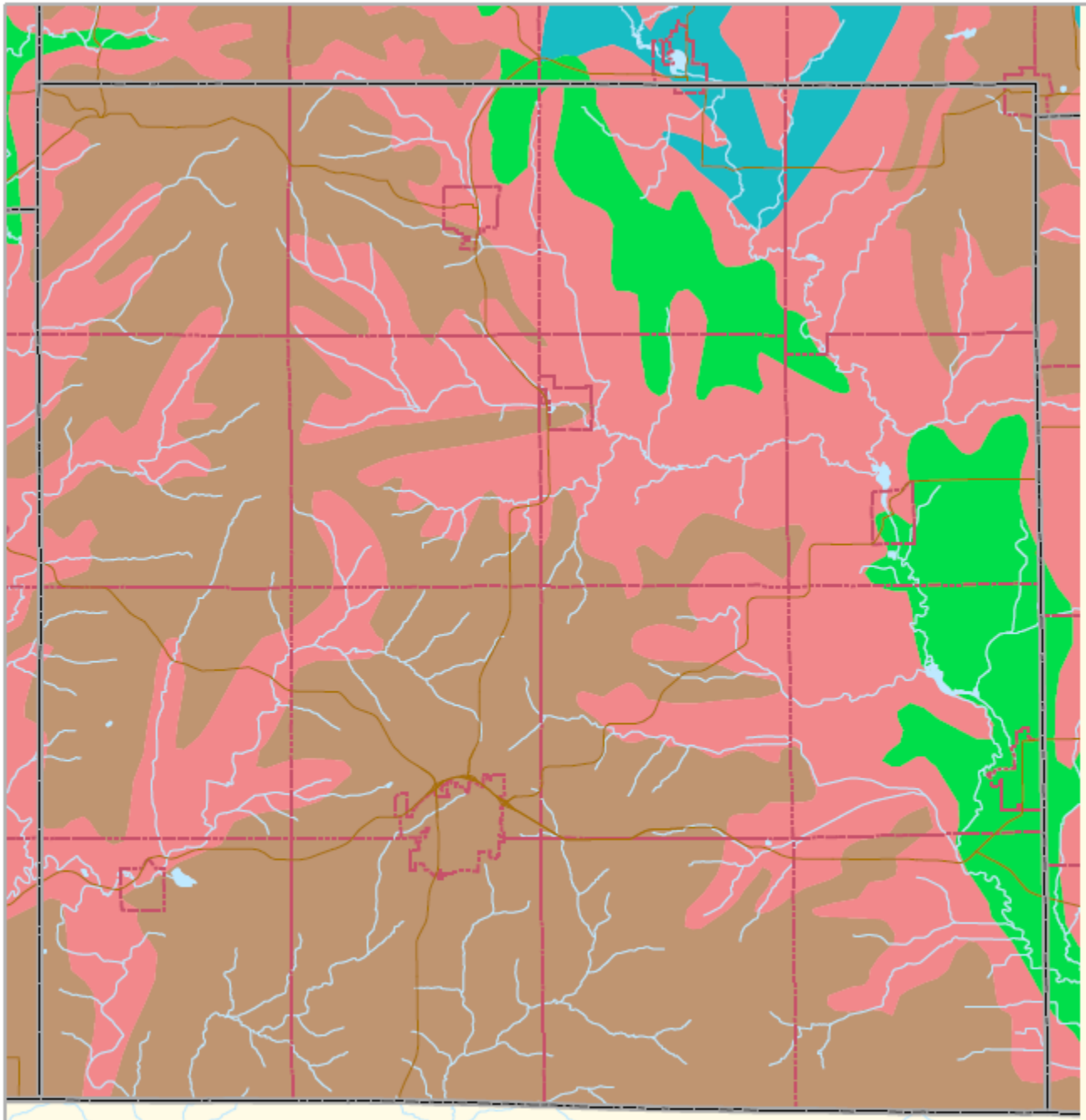

Green County

1994 - 2015 Summary

Bedrock Units:

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

0 2 4 6 Miles

0 2 4 6 Kilometers

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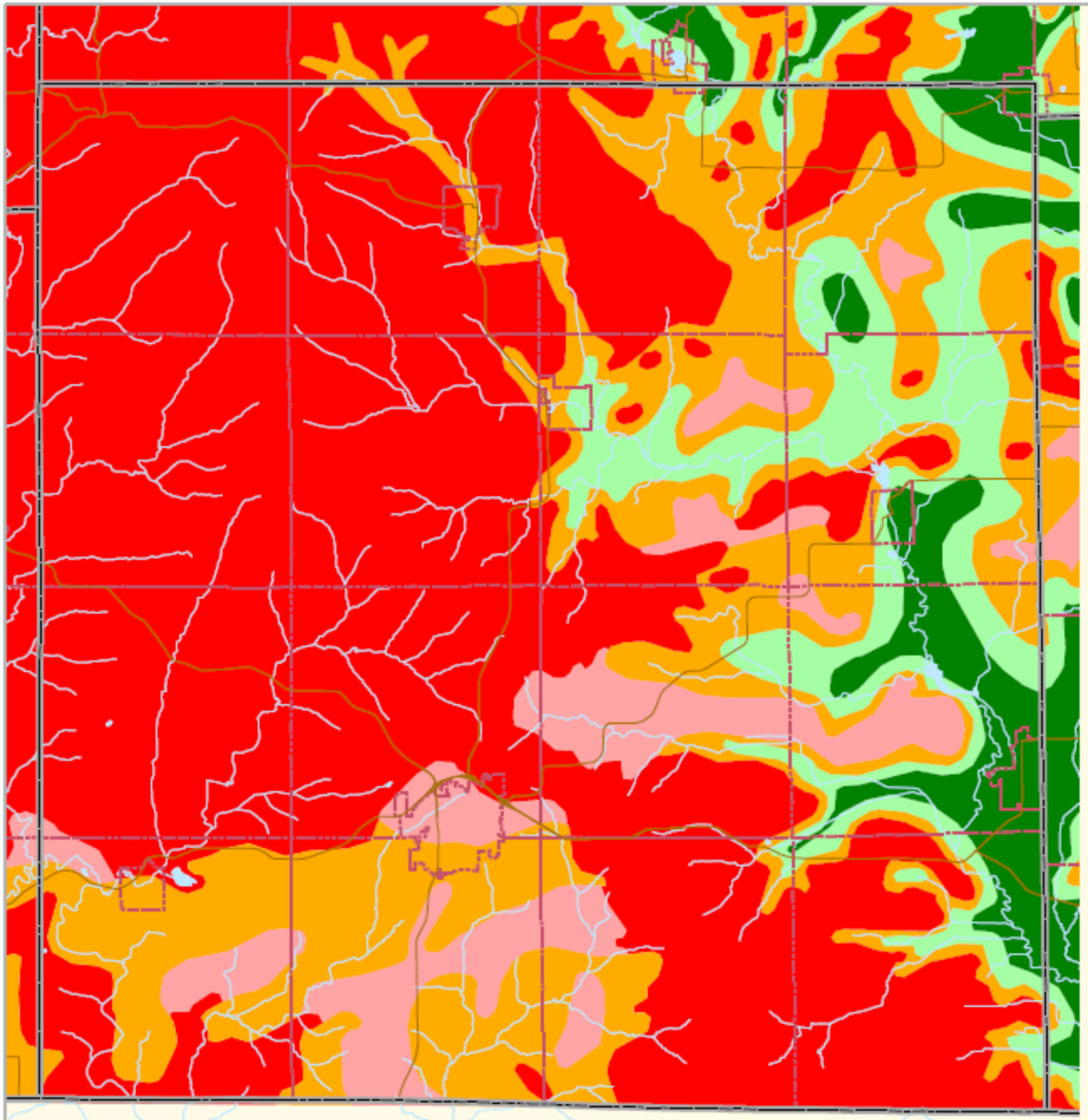

Green County

1994 - 2015 Summary

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

0 2 4 6 Miles

0 2 4 6 Kilometers

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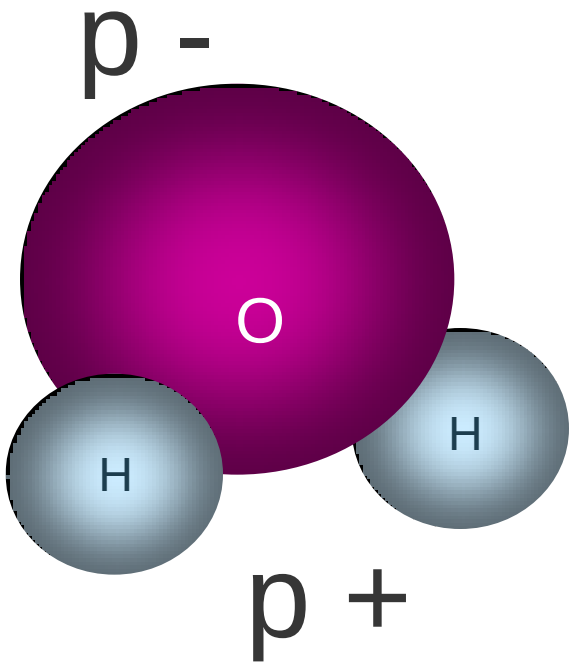
water basics

- "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.

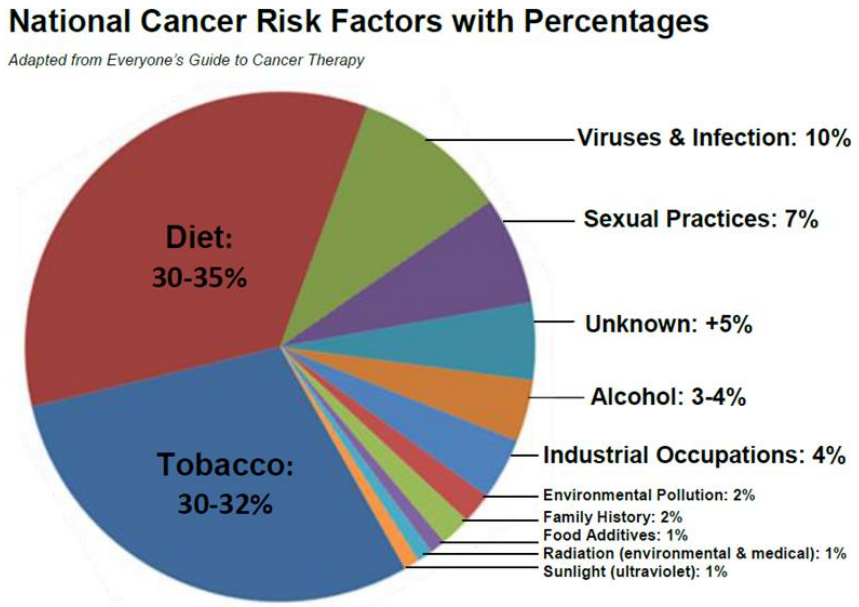
(ex. Bacteria or viral contamination which may cause intestinal disease)

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



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

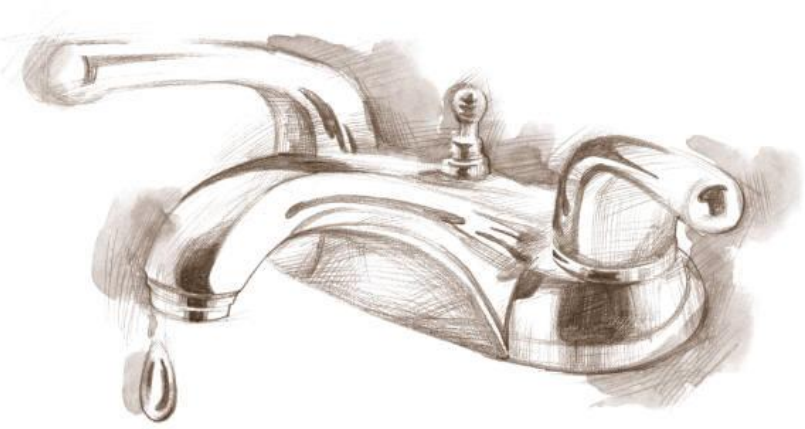
- Regularly tested and regulated by drinking water standards.

Private Wells

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

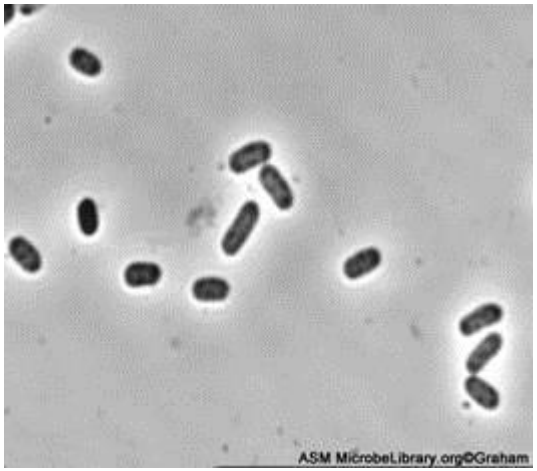
Why do people test their water?

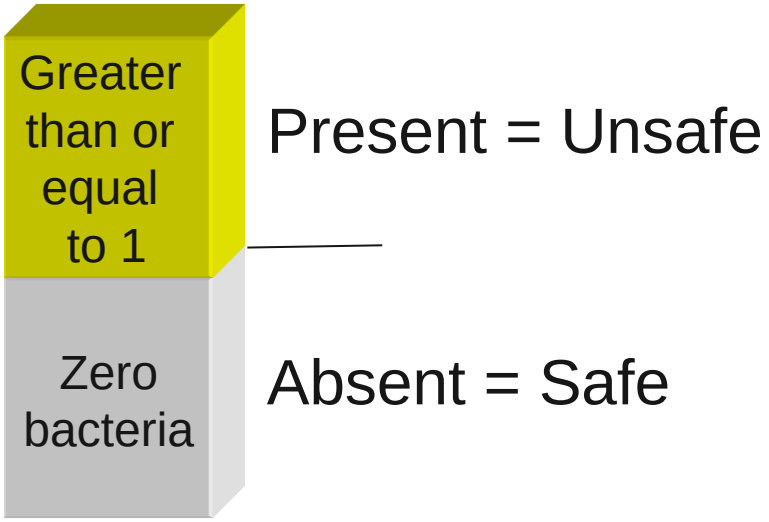
- Installed a new well
- Change in taste or odor
- Buying or selling their home
- Plumbing issues
- Want to know if it’s safe to drink.



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.

Contaminants	Sources	Symptoms
BACTERIA		
Escherichia coliform (E. coli) *Salmonella* *Campylobacter* *E. coli 0157* (Requires a special water test for detection. Causes similar, but more serious illness than other E.coli strains. Requires medical treatment.)	• Infected human and animal feces • Manure • Septic systems • Sewage	• Gastrointestinal illness • Low-grade fever • Begins 12 hrs - 7 days after exposure
Leptosporidia	• Urine of livestock, dogs and wildlife • Manure	• High fever, severe headache and red eyes • Gastrointestinal illness • Begins 2-28 days after exposure
MICROSCOPIC PARASITES		
Cryptosporidia *Giardia*	• Infected human and animal feces • Manure • Septic systems • Sewage	• Gastrointestinal illness • Begins 2-14 days after exposure
VIRUSES		
Norovirus	• Infected human feces and vomit • Septic systems • Sewage	• Gastrointestinal illness • Low-grade fever & headache • Begins 12-48 hrs after exposure
CHEMICALS		
Nitrate	• Fertilizers • Manure • Bio-solids • Septic systems	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.
Atrazine (trade-name herbicide for control of broadleaf and grassy weeds)	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.	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. Long-term exposure above MCL may cause: weight loss, cardio-vascular damage, retinal and some muscle degeneration; cancer.

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)

Well Construction

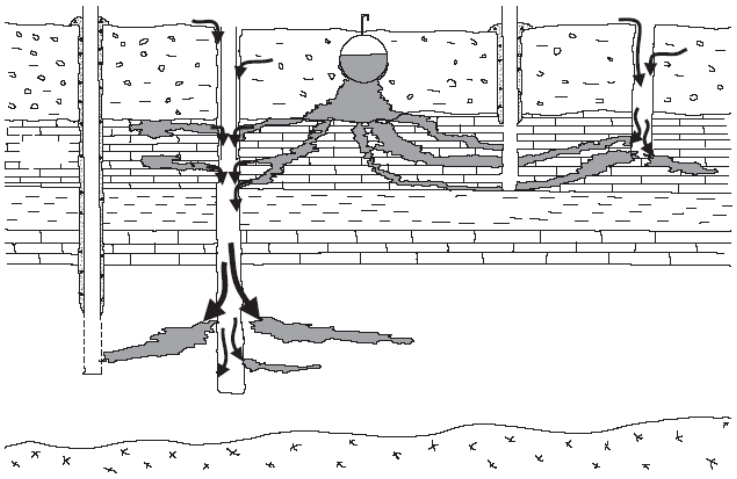
Photos courtesy of: Matt Zoschke

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.

Comm 82.40(8)(e)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 entire 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 Braun	715-340-5387 / 608-283-7455
3	Don Oremus	715-584-2007 / 608-283-7452
4	Don Hough	715-634-4804 / 608-283-7451
5	Ryan Boebel	608-412-3998 / 608-283-7449

SBD-10893-P(R06/09)

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

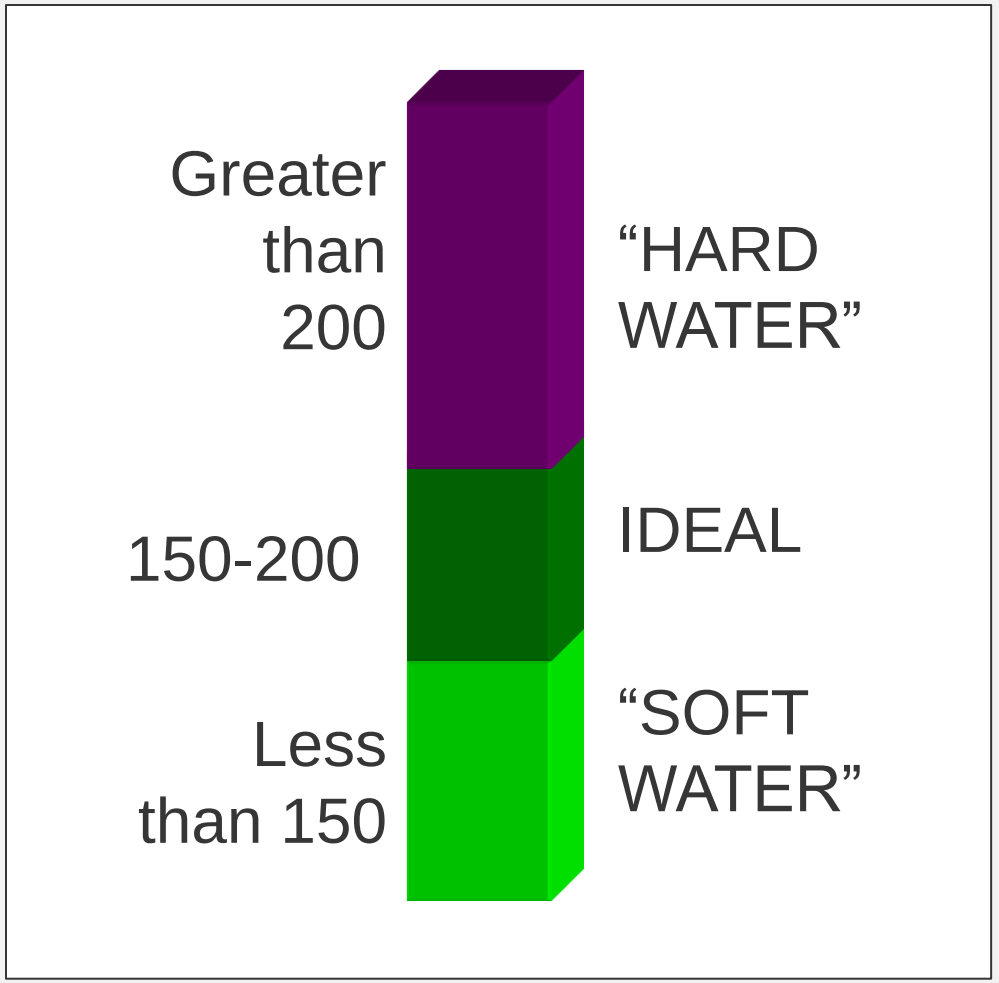
Rock and Soil Impacts on Water Quality

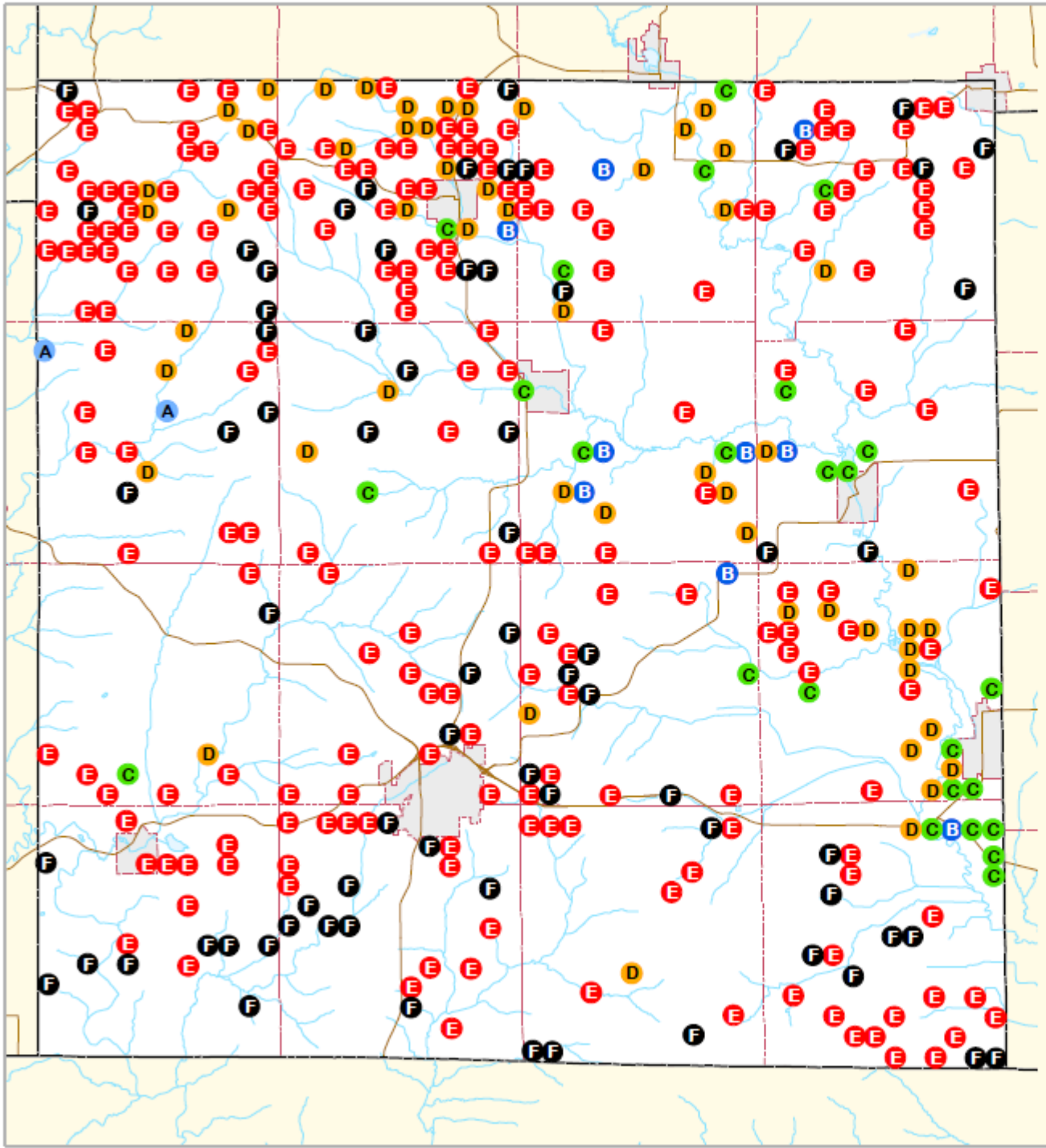
Tests for Aesthetic Problems

Hardness

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

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





Green County

1994 - 2015 Summary

TOTAL HARDNESS (ppm CaCO3)

A	... 50	116	15%
B	51 - 100	20	3%
C	101 - 200	58	7%
D	201 - 300	117	15%
E	301 - 400	337	43%
F	401 ...	128	16%

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

0 2 4 6 Miles

0 2 4 6 Kilometers

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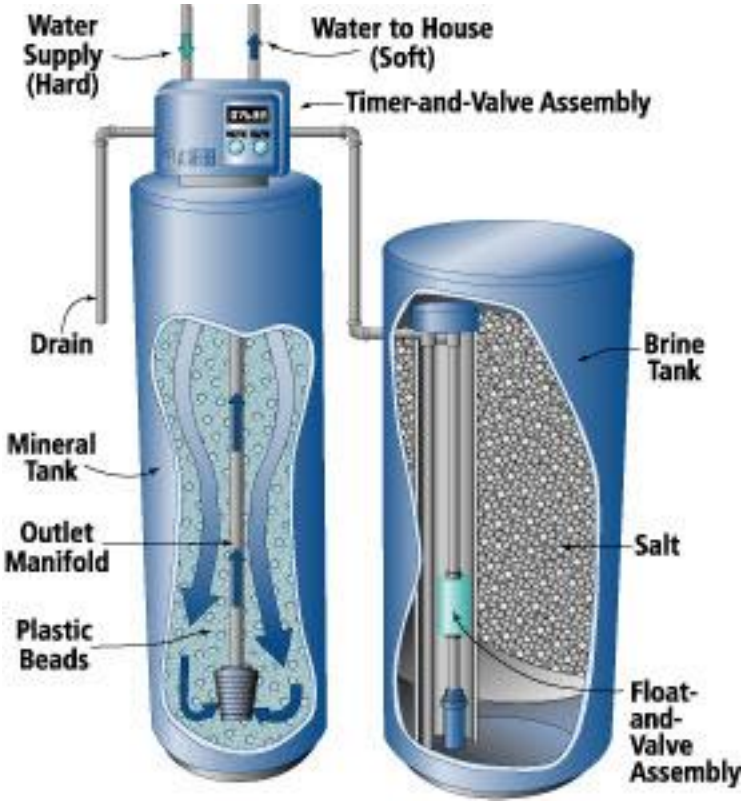
Water Softening

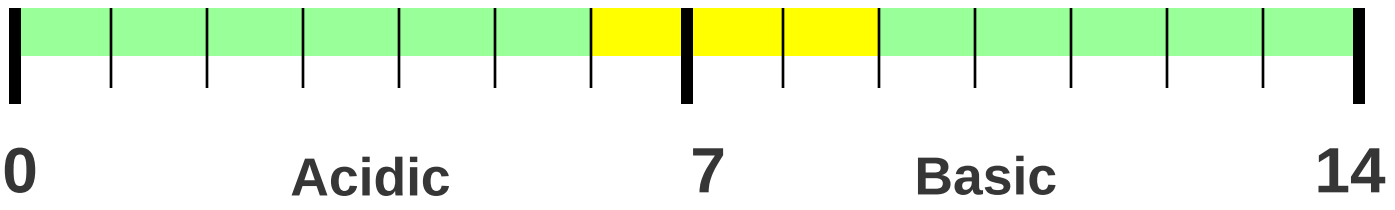
Water softeners remove calcium and magnesium which cause scaling and exchange it for sodium (or potassium).

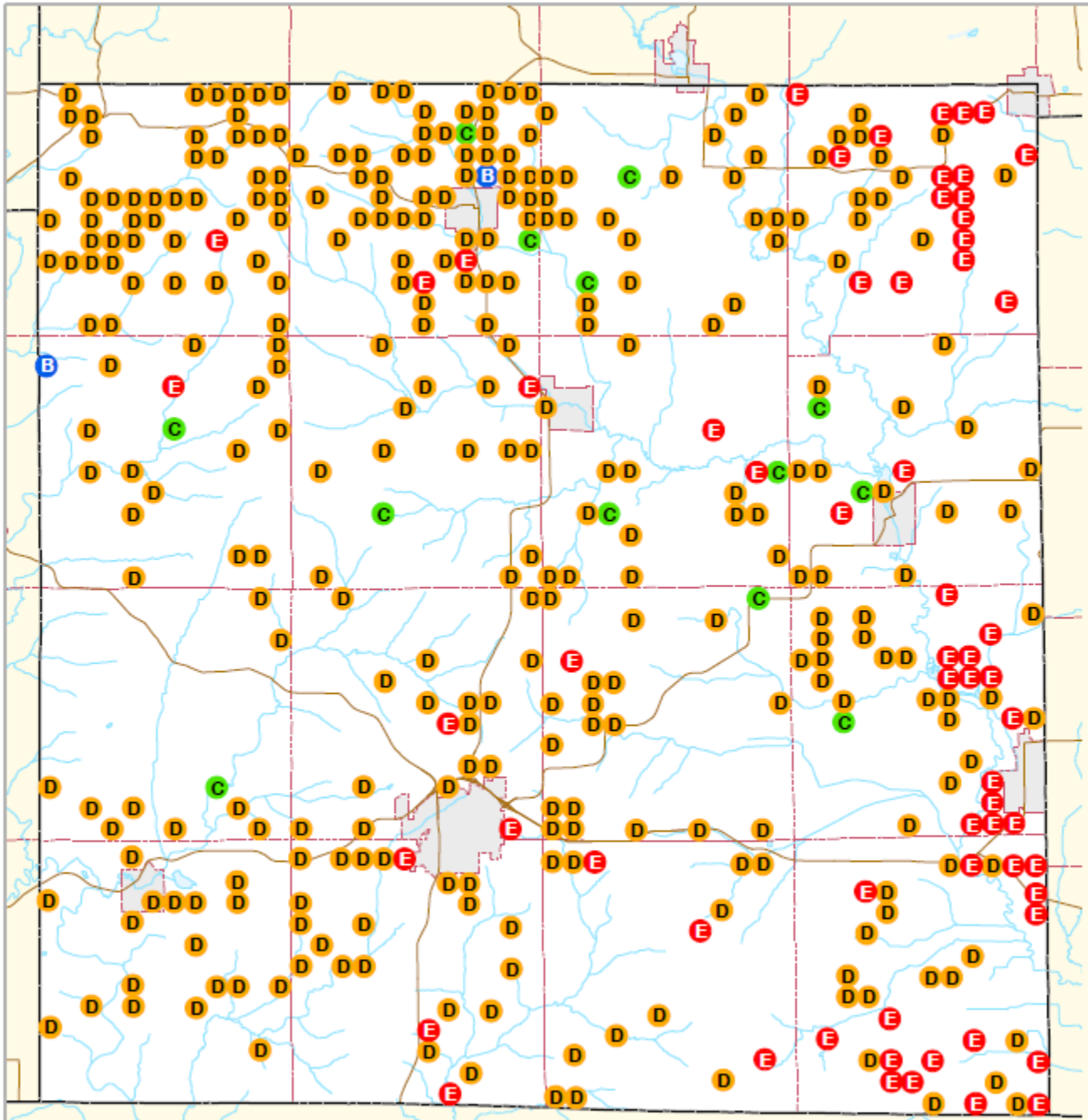
- **Negative: Increases sodium content of water.**
- **Suggestions:**
  - **Bypass your drinking water faucet.**
  - **Do not soften water for outdoor faucets.**
  - **If you are concerned about sodium levels – use potassium chloride softener salt.**



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





Green County

1994 - 2015 Summary

pH

A	... 5.00	0	0 %
B	5.01 - 6.00	4	<1 %
C	6.01 - 7.00	29	4 %
D	7.01 - 8.00	561	72 %
E	8.01 - 9.00	184	24 %
F	9.01 ...	0	0 %

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

0 2 4 6 Miles

0 2 4 6 Kilometers

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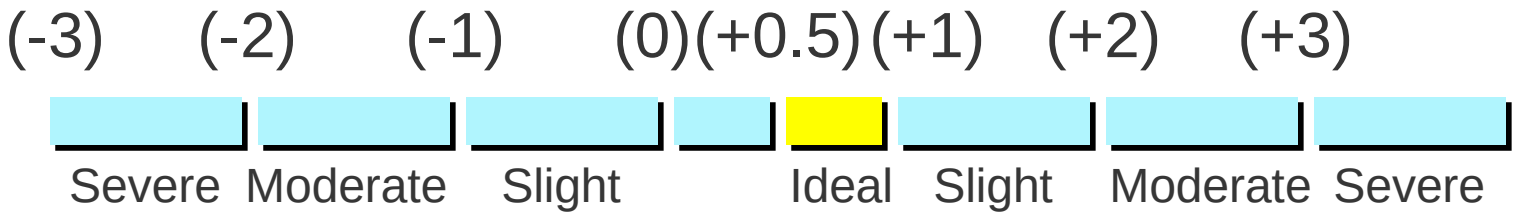
Tests for Overall Water Quality

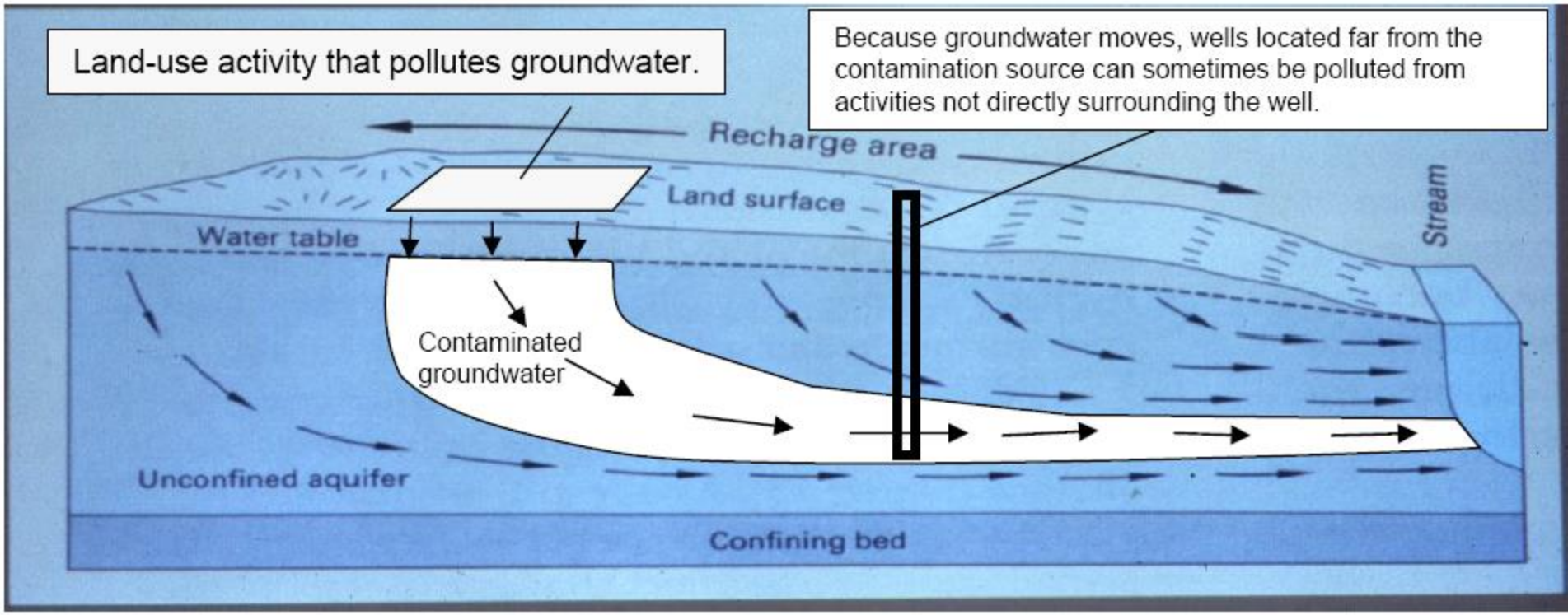
Saturation Index



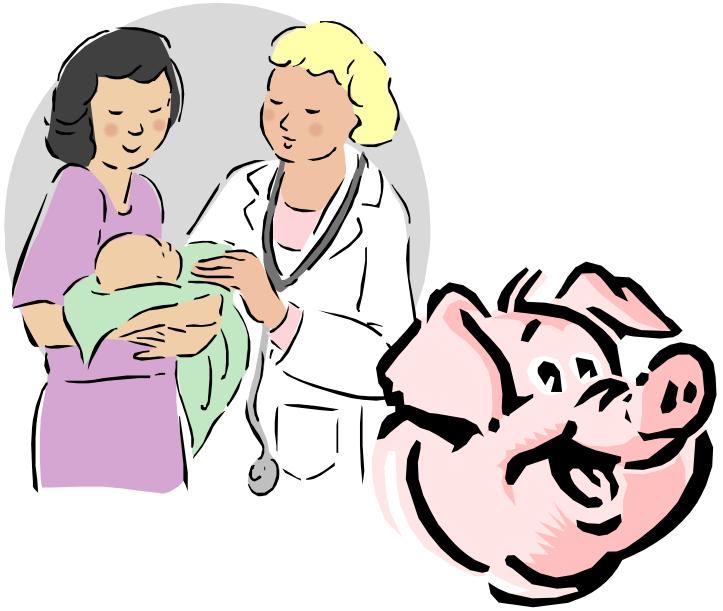
Corrosion occurs

Scaling occurs


OIL
OIL
OIL
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.
Recharge area
Land surface
Water table
Stream
Contaminated groundwater
Unconfined aquifer
Confining bed

Nitrate-Nitrogen



Health Effects:

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

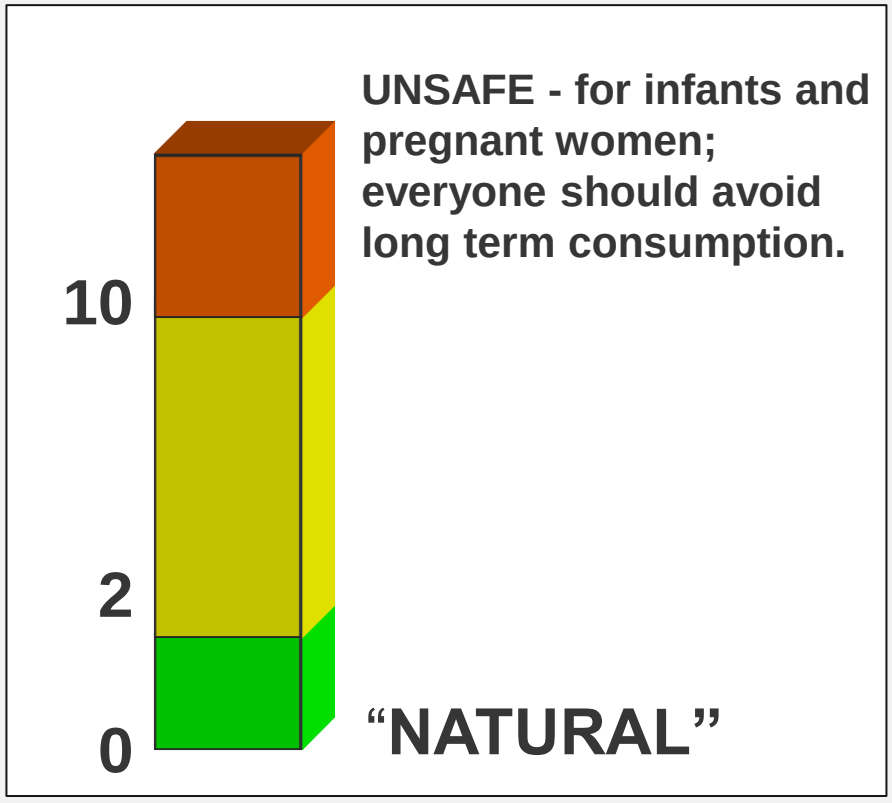
Sources:

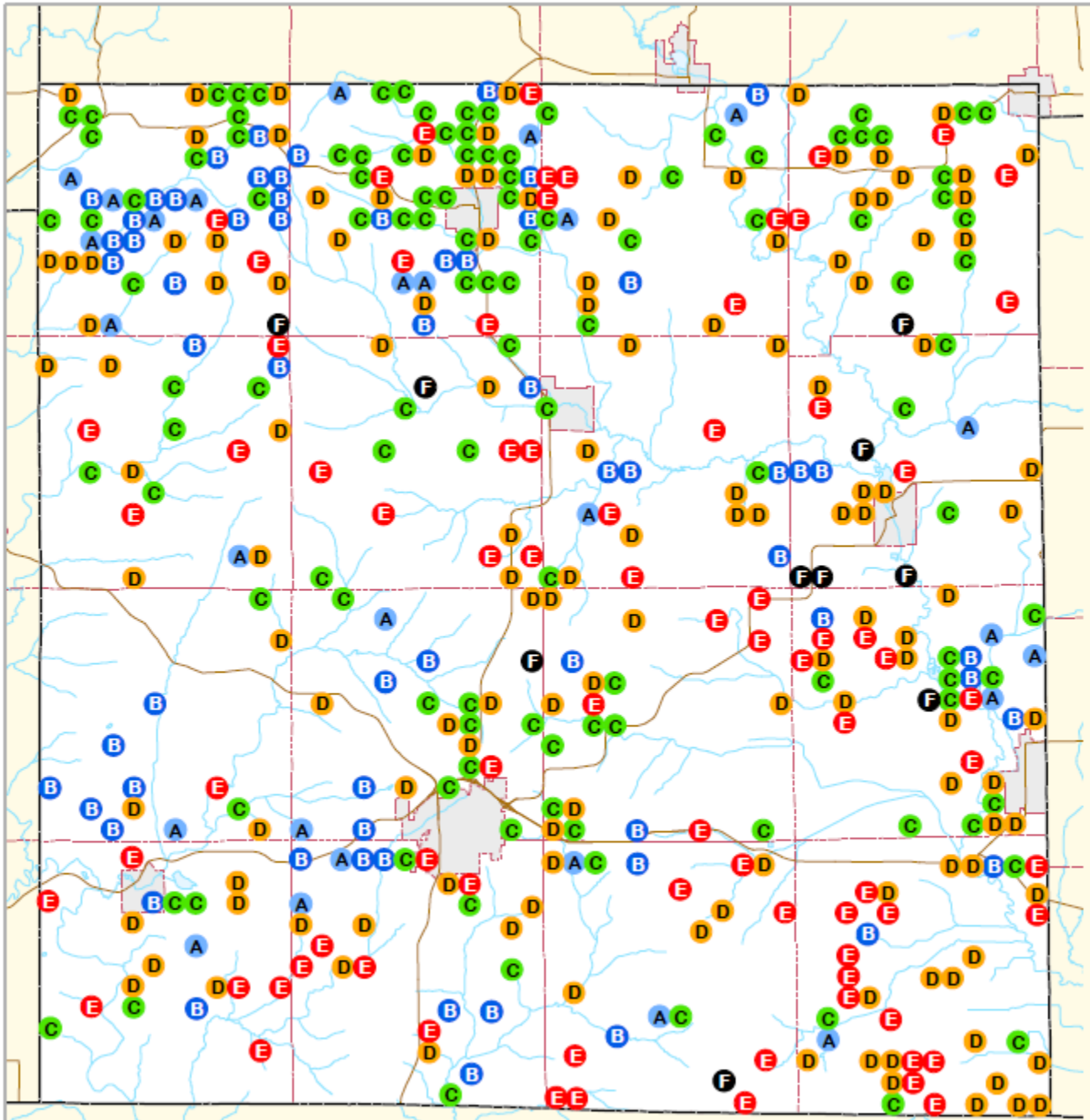
- Agricultural fertilizer
- Lawn fertilizer
- Septic systems
- Animal wastes

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"





Green County

1994 - 2015 Summary

NITRATE-NITRITE (ppm N)

A	None Detected	102	11 %
B	... 2.0	141	15 %
C	2.1 - 5.0	235	26 %
D	5.1 - 10.0	258	28 %
E	10.1 - 20.0	158	17 %
F	20.1 ...	23	3 %

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

0 2 4 6 Miles

0 2 4 6 Kilometers

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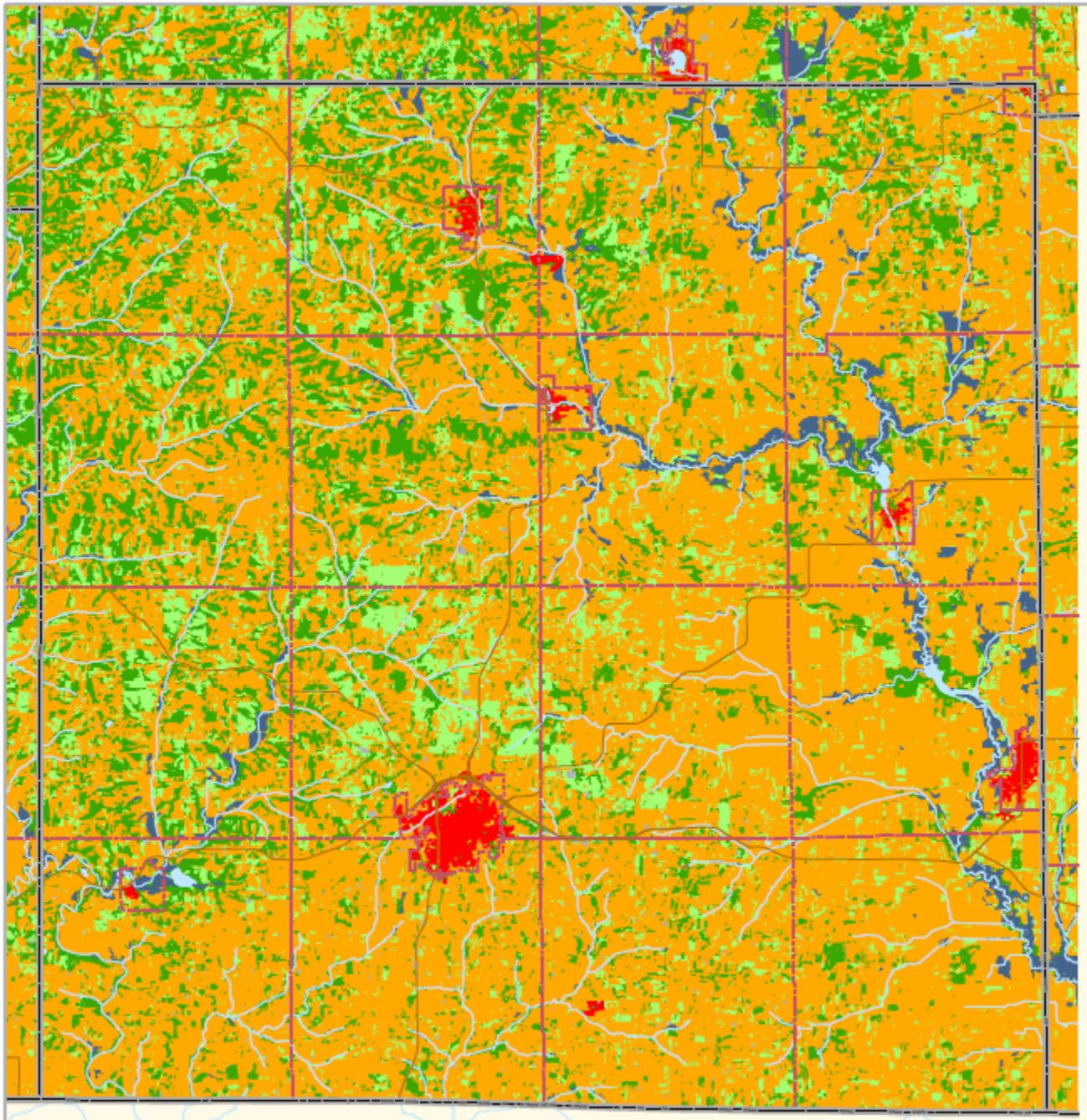

Green County

1994 - 2015 Summary

Land Use:

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

0 2 4 6 Miles

0 2 4 6 Kilometers

N

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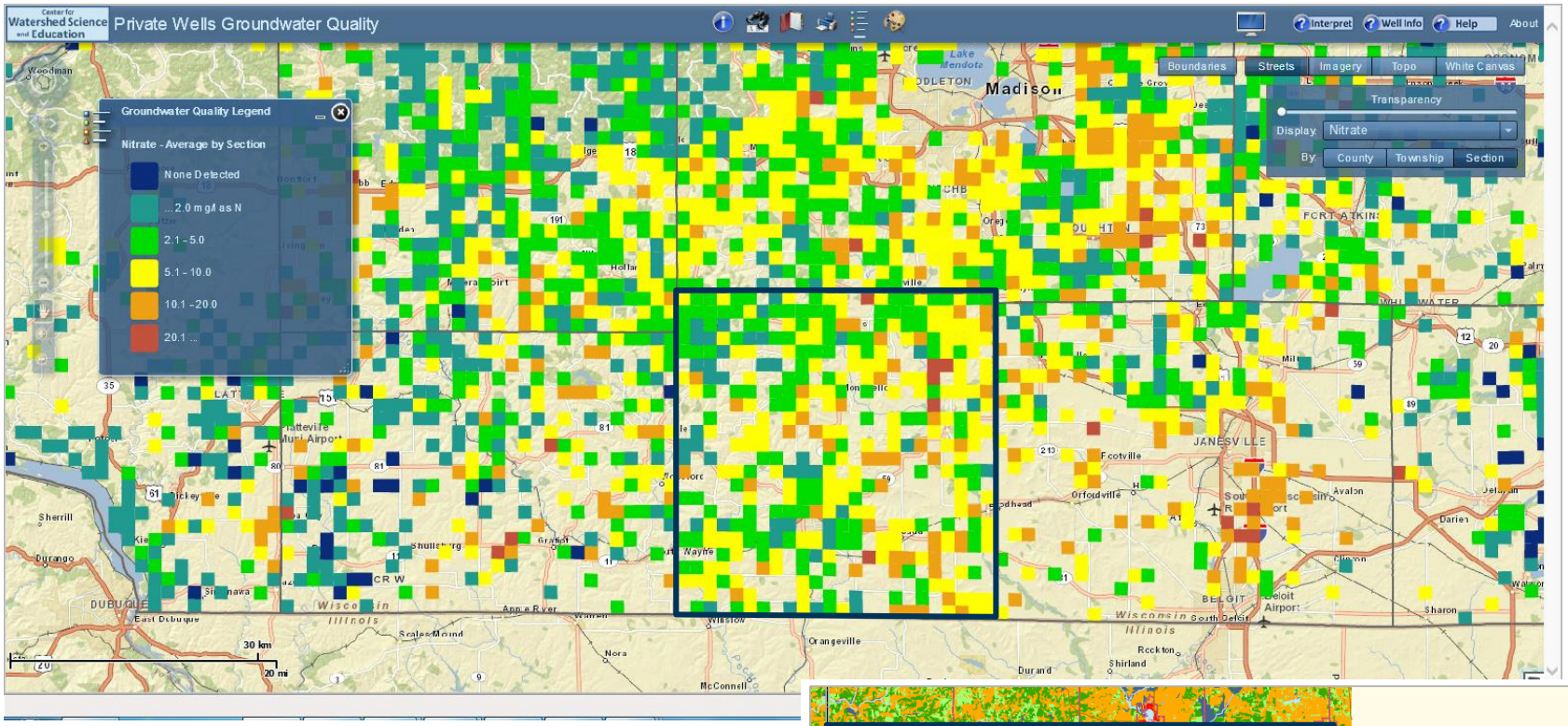
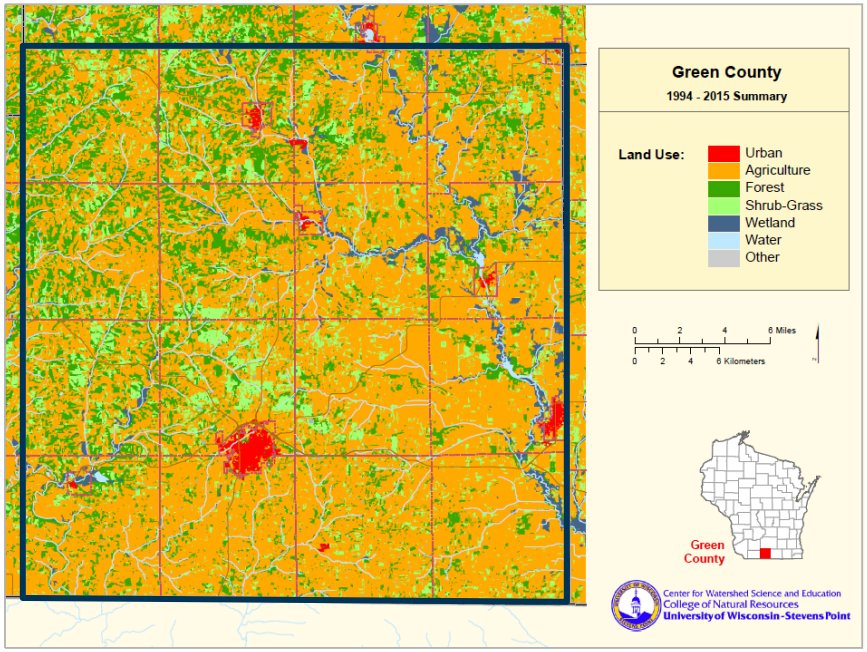

Center for Watershed Science and Education
Private Wells Groundwater Quality
Interpret
Well Info
Help
About
Boundaries
Streets
Imagery
Topo
White Canvas
Transparency
Display: Nitrate
By: County Township Section
Groundwater Quality Legend
Nitrate - Average by Section
None Detected
...2.0 mg/l as N
2.1 - 5.0
5.1 - 10.0
10.1 - 20.0
20.1 ...
Madison
Wisconsin
Illinois
DUBUQUE
JANESVILLE
BELOIT
30 km
20 mi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1994 - 2015 Summary
Land Use:
Urban
Agriculture
Forest
Shrub-Grass
Wetland
Water
Other
0 2 4 6 Miles
0 2 4 6 Kilometers
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What can I do to reduce my nitrate levels?

Solution:

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

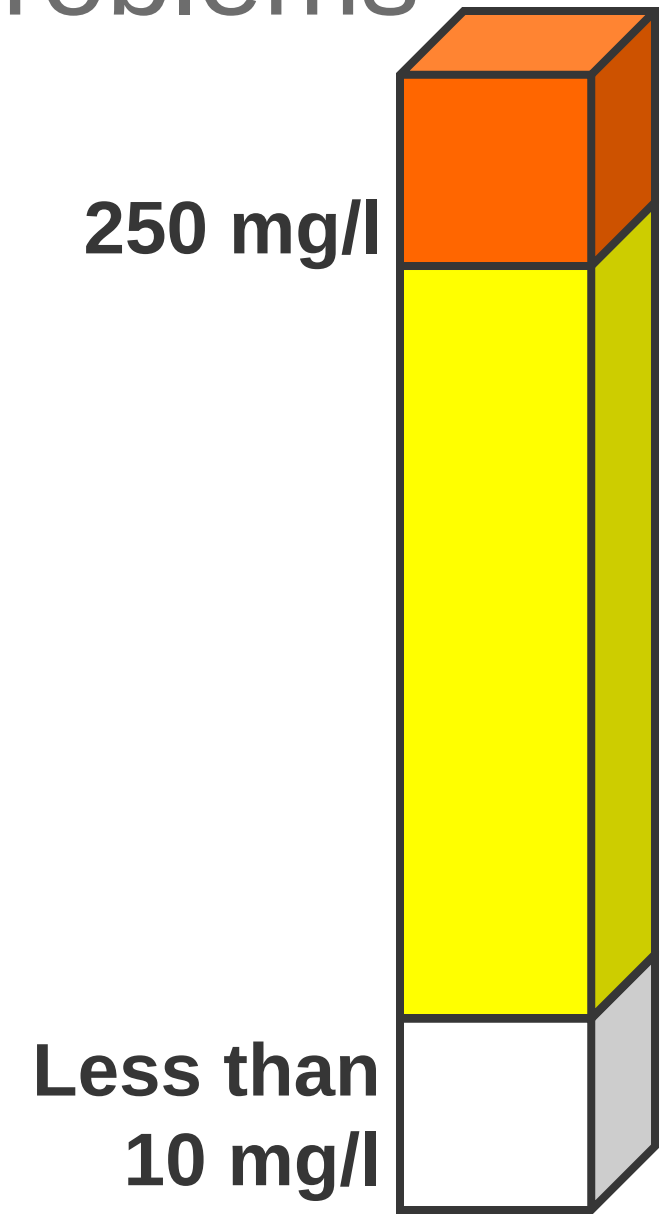
Short term:

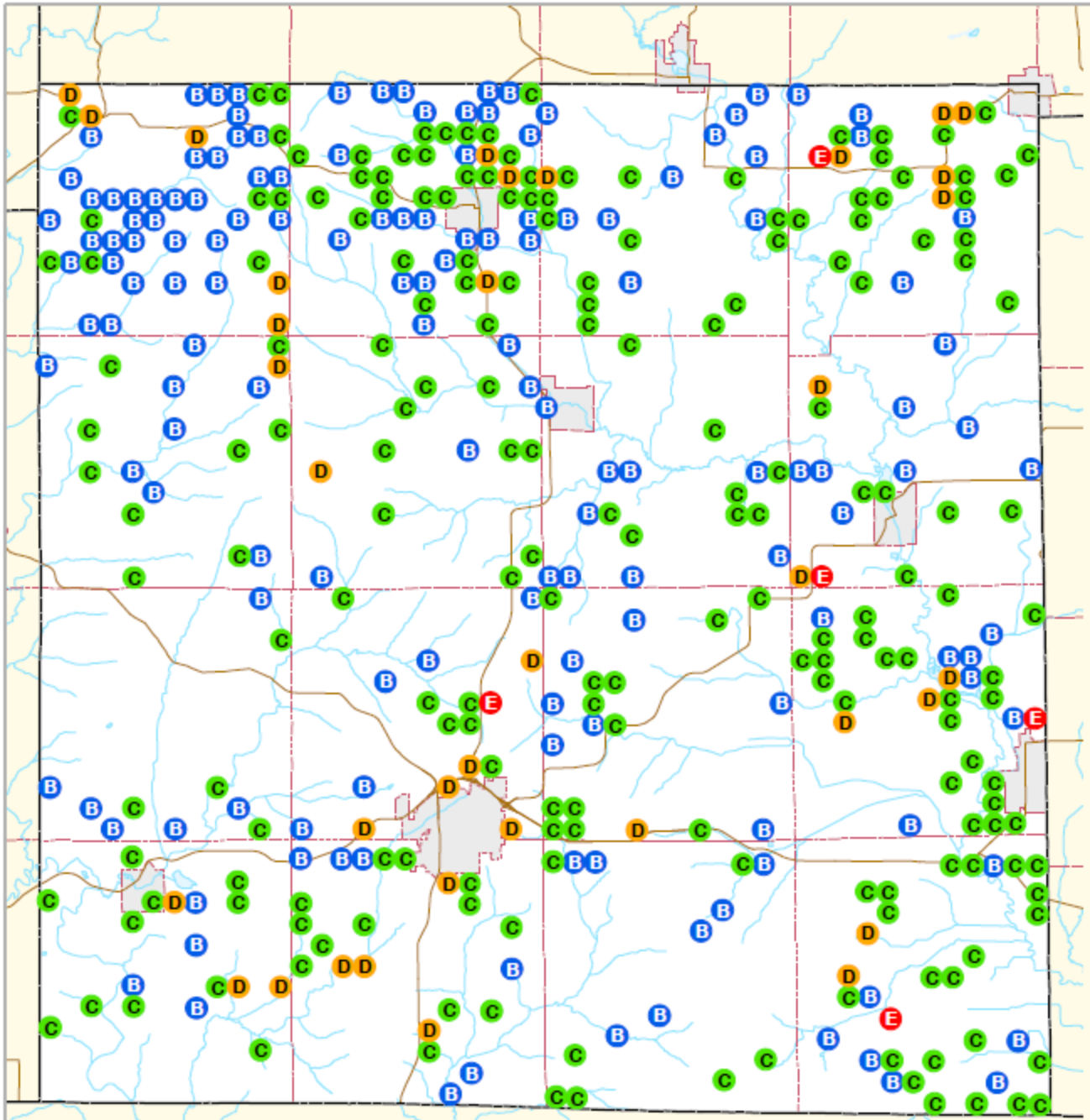
- **Change well depth or relocate well**
- **Carry or buy water**
- **Water treatment devices**
  - **Reverse osmosis**
  - **Distillation**
  - **Anion exchange**

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





Green County

1994 - 2015 Summary

CHLORIDE (ppm)

A	None Detected	4	<1 %
B	... 10	312	40 %
C	11 - 50	375	48 %
D	51 - 100	82	10 %
E	101 - 200	13	2 %
F	201 ...	1	<1 %

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

0 2 4 6 Miles
0 2 4 6 Kilometers

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Test Important to Health

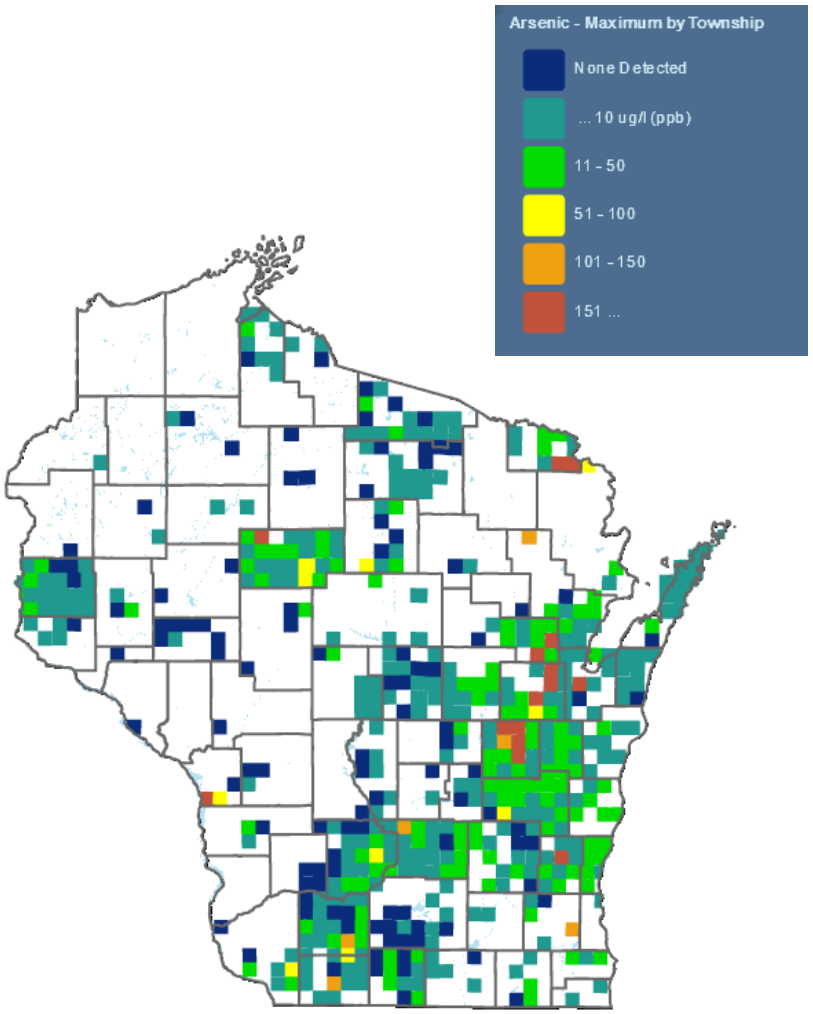
Arsenic

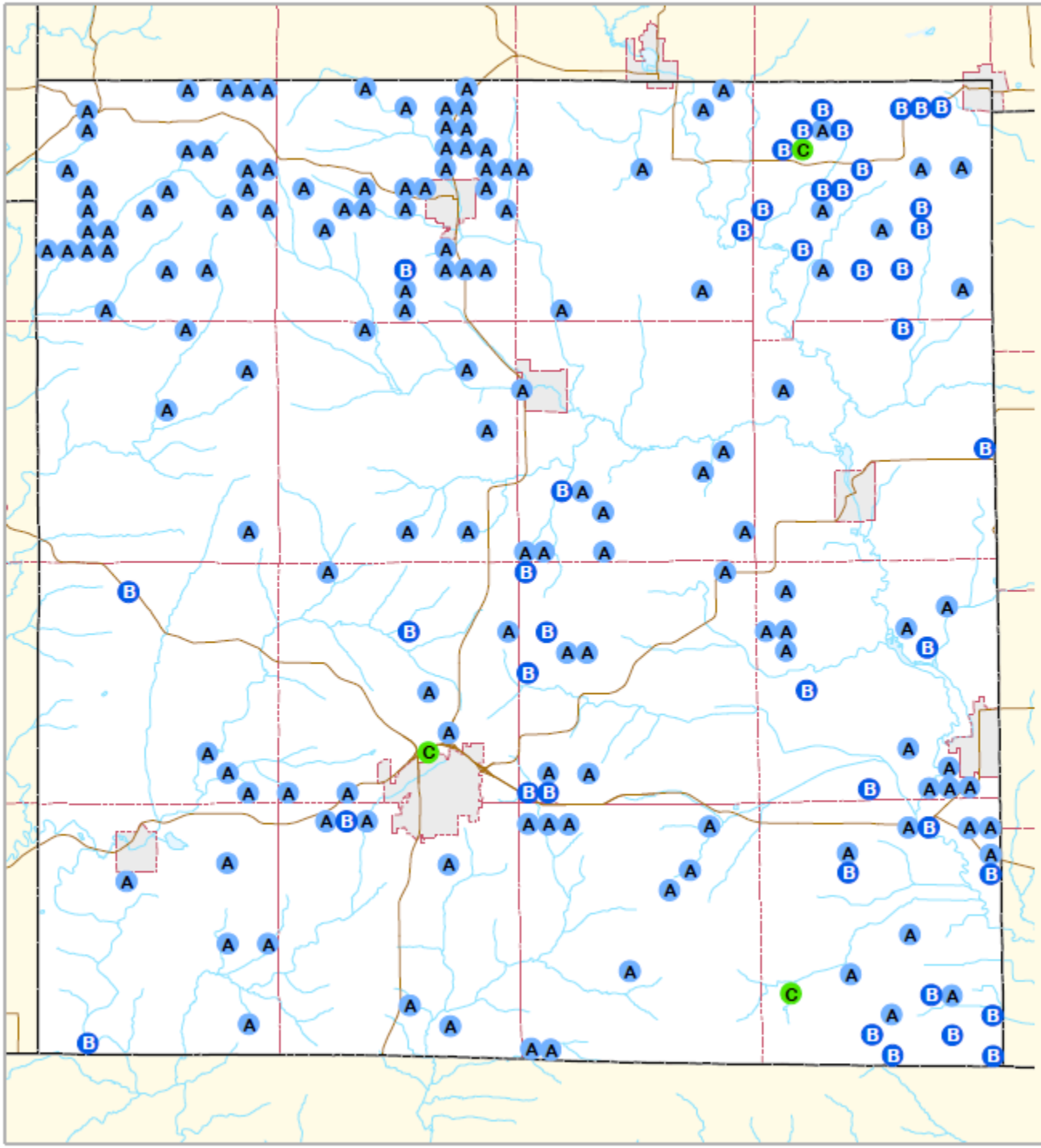
Sources: Naturally occurring in mineral deposits

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





Green County

1994 - 2015 Summary

ARSENIC (mg/l)

A	None Detected	206	79 %
B	... 0.010	48	18 %
C	0.011 - 0.050	7	3 %
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 section
Treated samples not mapped

0 2 4 6 Miles

0 2 4 6 Kilometers

Green County

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Tests for Aesthetic Problems

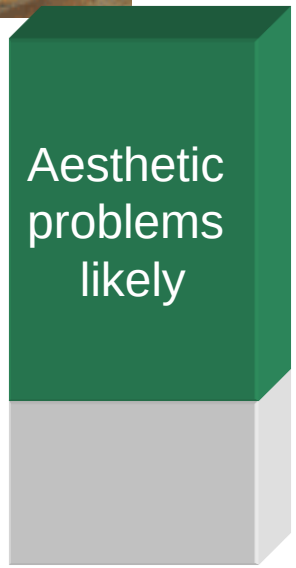
Iron

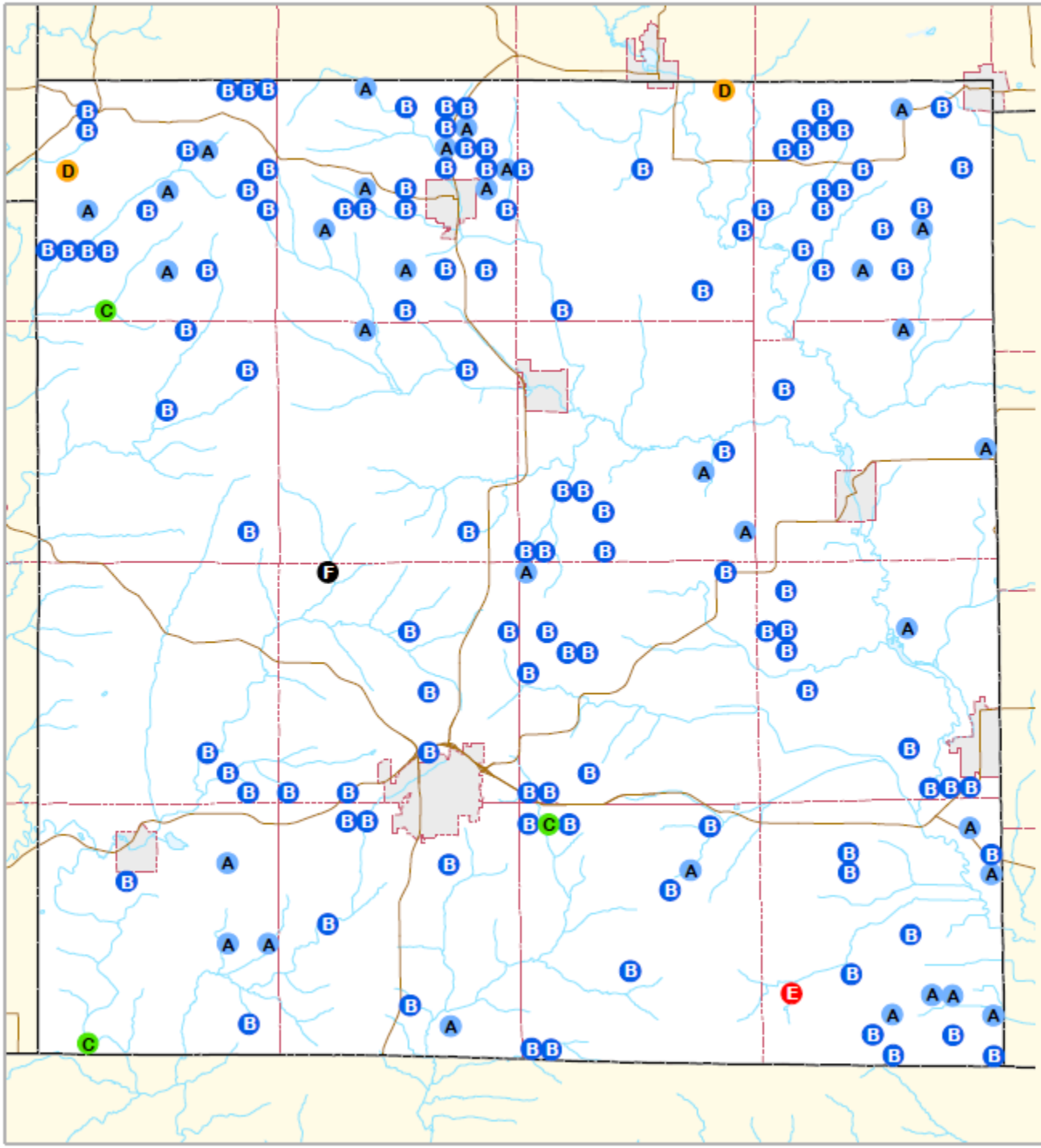
- Natural (rocks and soils)
- May benefit health
- Red and yellow stains on clothing, fixtures

- If iron present, increases potential for iron bacteria
  - Slime, odor, oily film

Greater than 0.3 mg/L

Less than 0.3 mg/L





Green County

1994 - 2015 Summary

IRON (mg/l)

A	None Detected	61	23 %
B	... 0.300	189	72 %
C	0.301 - 1.000	7	3 %
D	1.001 - 2.000	1	<1 %
E	2.001 - 5.000	2	<1 %
F	5.001 ...	1	<1 %

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

0 2 4 6 Miles
0 2 4 6 Kilometers

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Tests for Aesthetic Problems

Manganese

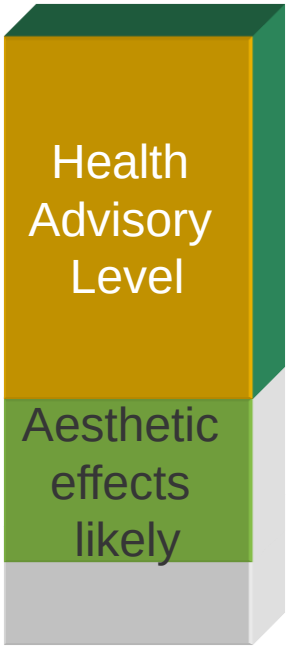
- Natural (rocks and soils)
- Aesthetic issues: taste, odor, color (black staining or precipitates)
- Health Advisory Level: 0.300 mg/L

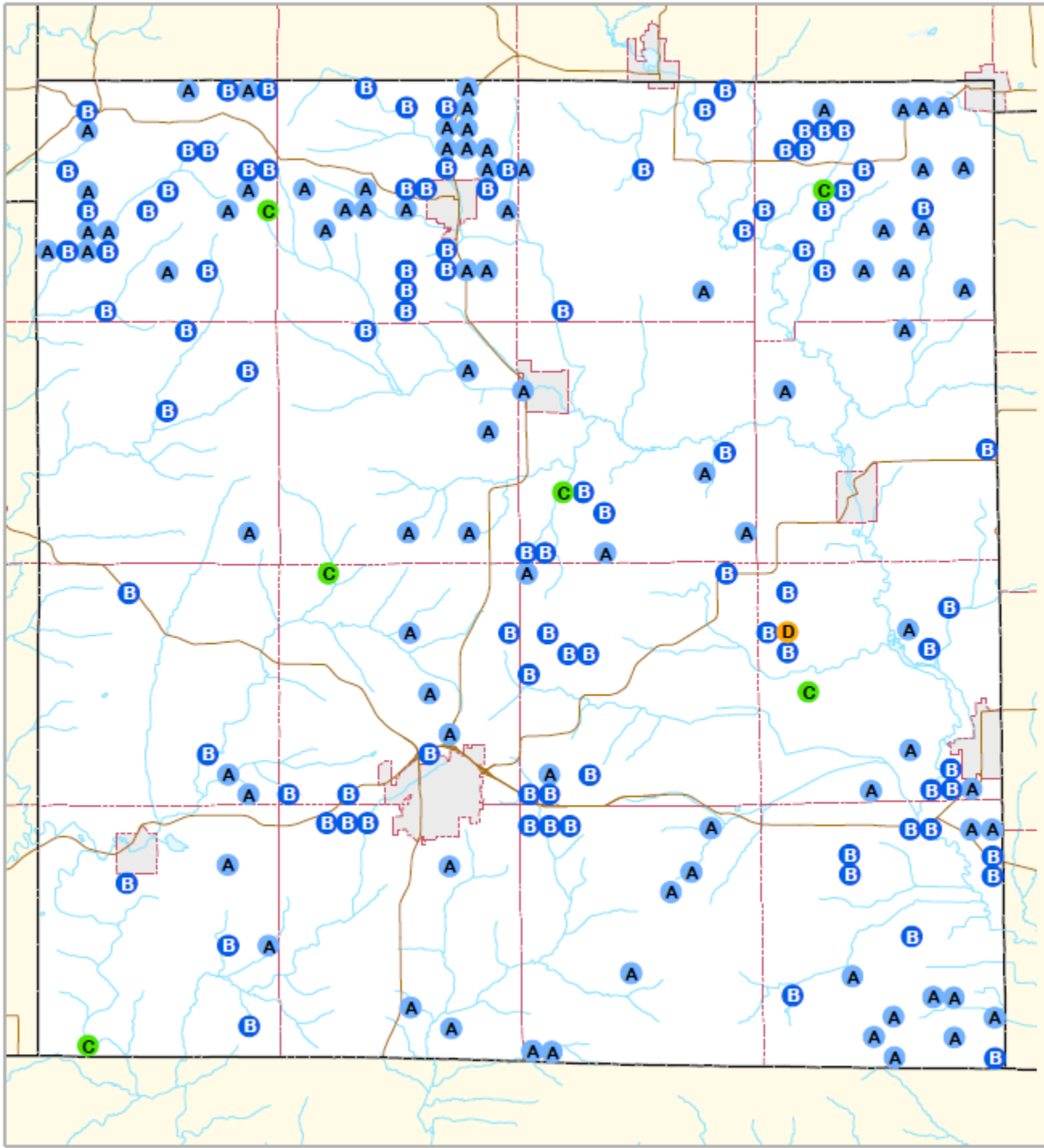
➢ Many years of exposure to high levels of manganese can cause harm to the nervous system. A disorder similar to Parkinson's disease can result. This type of effect is most likely to occur in the elderly. The federal health advisory for manganese is intended to protect against this effect.

Greater than 0.300 mg/L

Greater than 0.050

Less than 0.050





Green County

1994 - 2015 Summary

MANGANESE (mg/l)

A	None Detected	136	52 %
B	... 0.050	114	44 %
C	0.051 - 0.300	9	3 %
D	0.301 - 0.500	0	0 %
E	0.501 - 1.000	1	<1 %
F	1.001 ...	0	0 %

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

0 2 4 6 Miles
0 2 4 6 Kilometers

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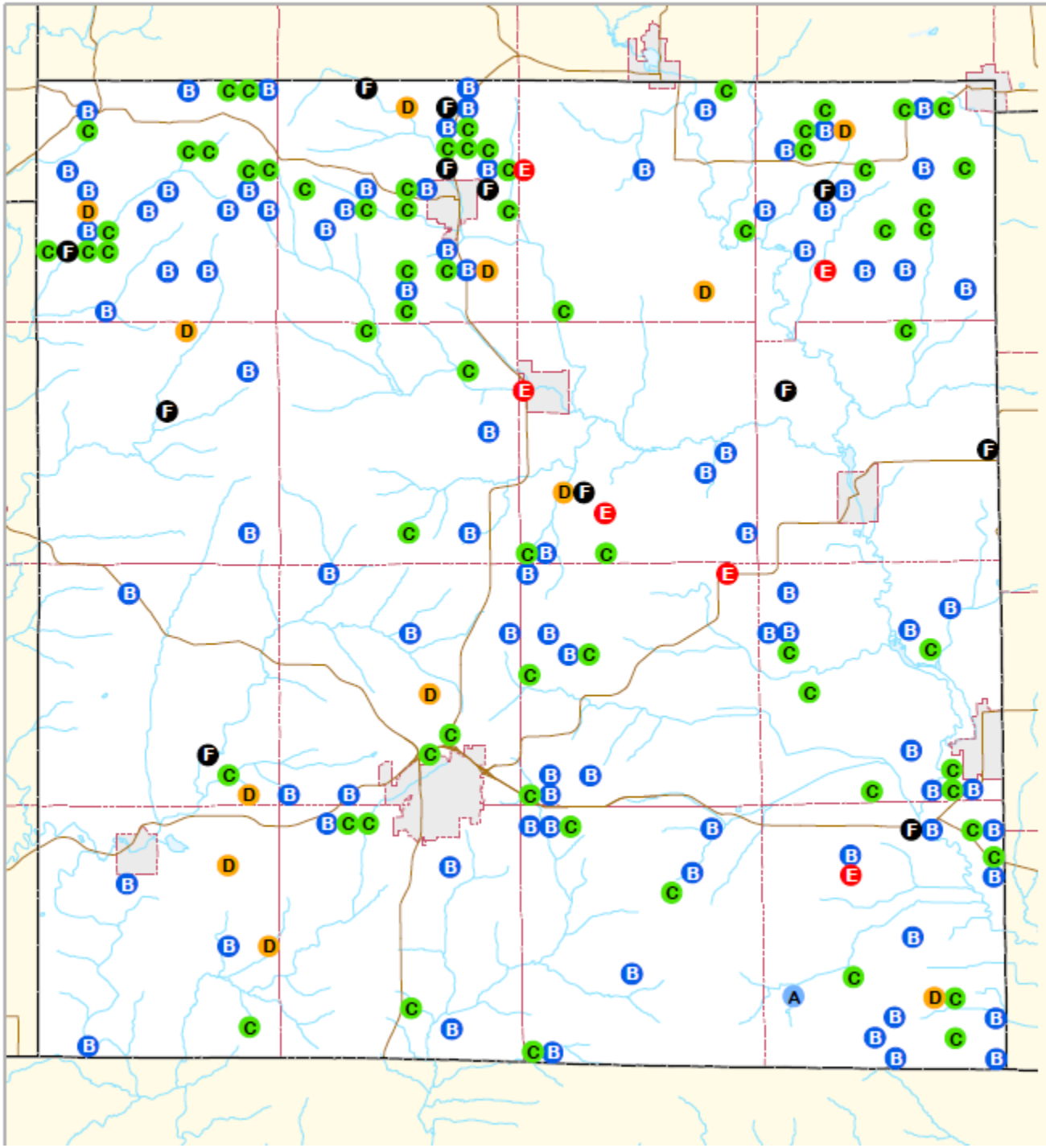
Test Important to Health

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



Green County

1994 - 2015 Summary

COPPER (mg/l)

A	None Detected	3	1 %
B	... 0.130	128	49 %
C	0.131 - 0.500	90	35 %
D	0.501 - 0.900	18	7 %
E	0.901 - 1.300	5	2 %
F	1.301 ...	16	6 %

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

0 2 4 6 Miles

0 2 4 6 Kilometers

N

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Test Important to Health

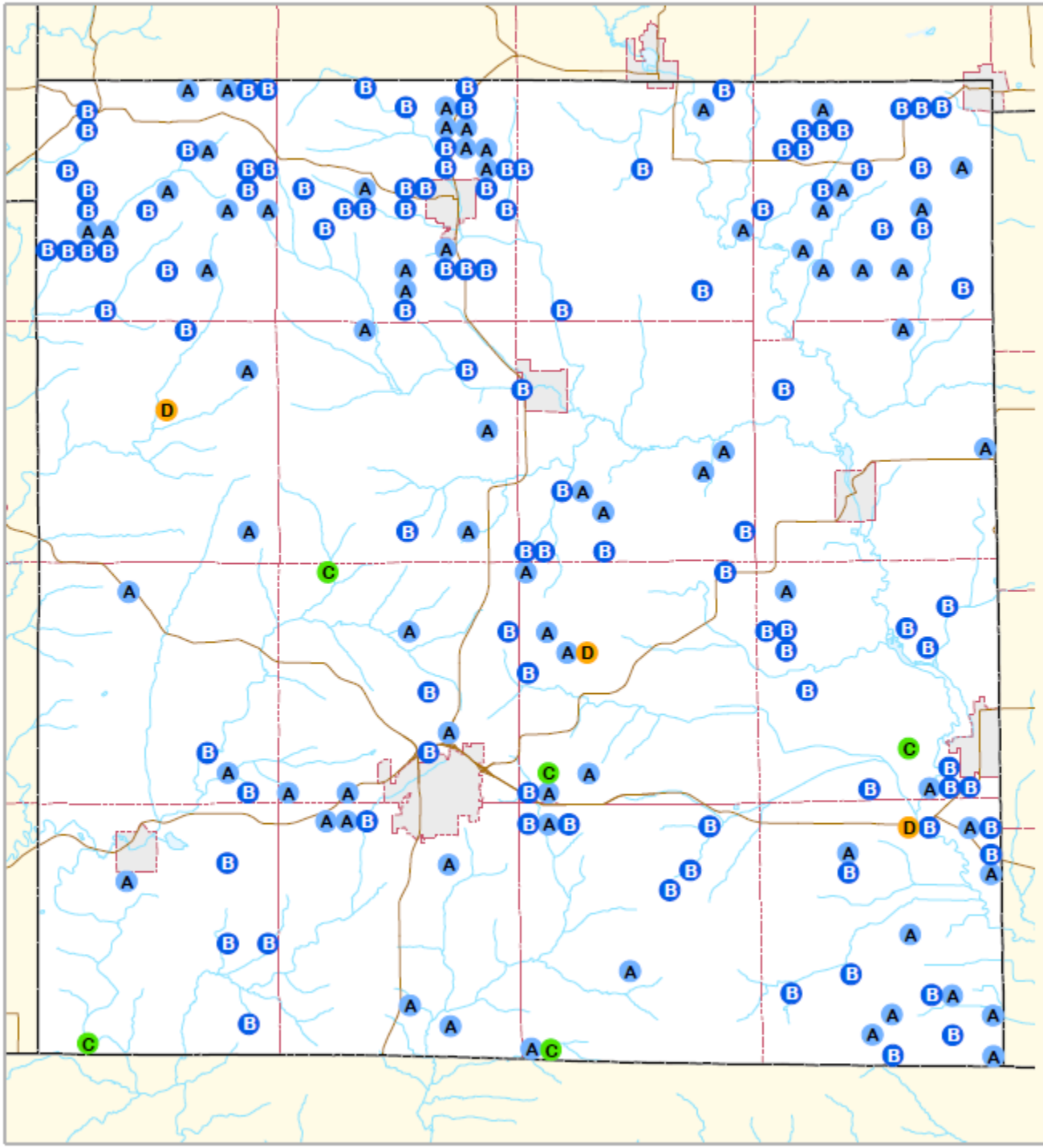
Lead

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.



Green County

1994 - 2015 Summary

LEAD (mg/l)

A	None Detected	124	48 %
B	... 0.015	127	49 %
C	0.016 - 0.025	5	2 %
D	0.026 - 0.050	4	2 %
E	0.051 - 0.100	1	<1 %
F	0.101 ...	0	0 %

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

0 2 4 6 Miles

0 2 4 6 Kilometers

N

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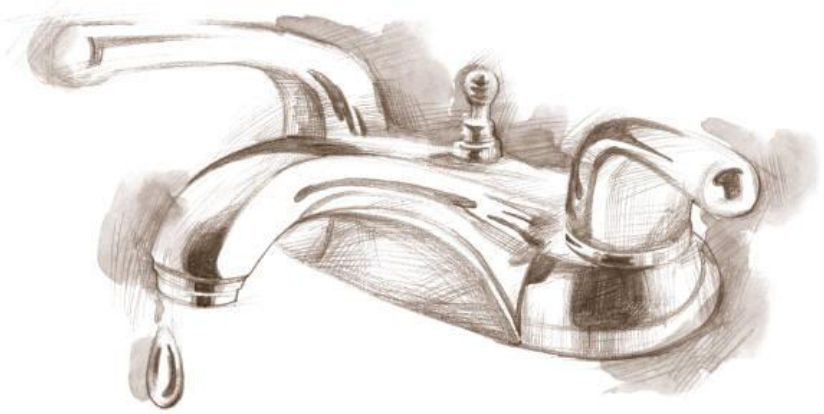
Lead and Copper

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

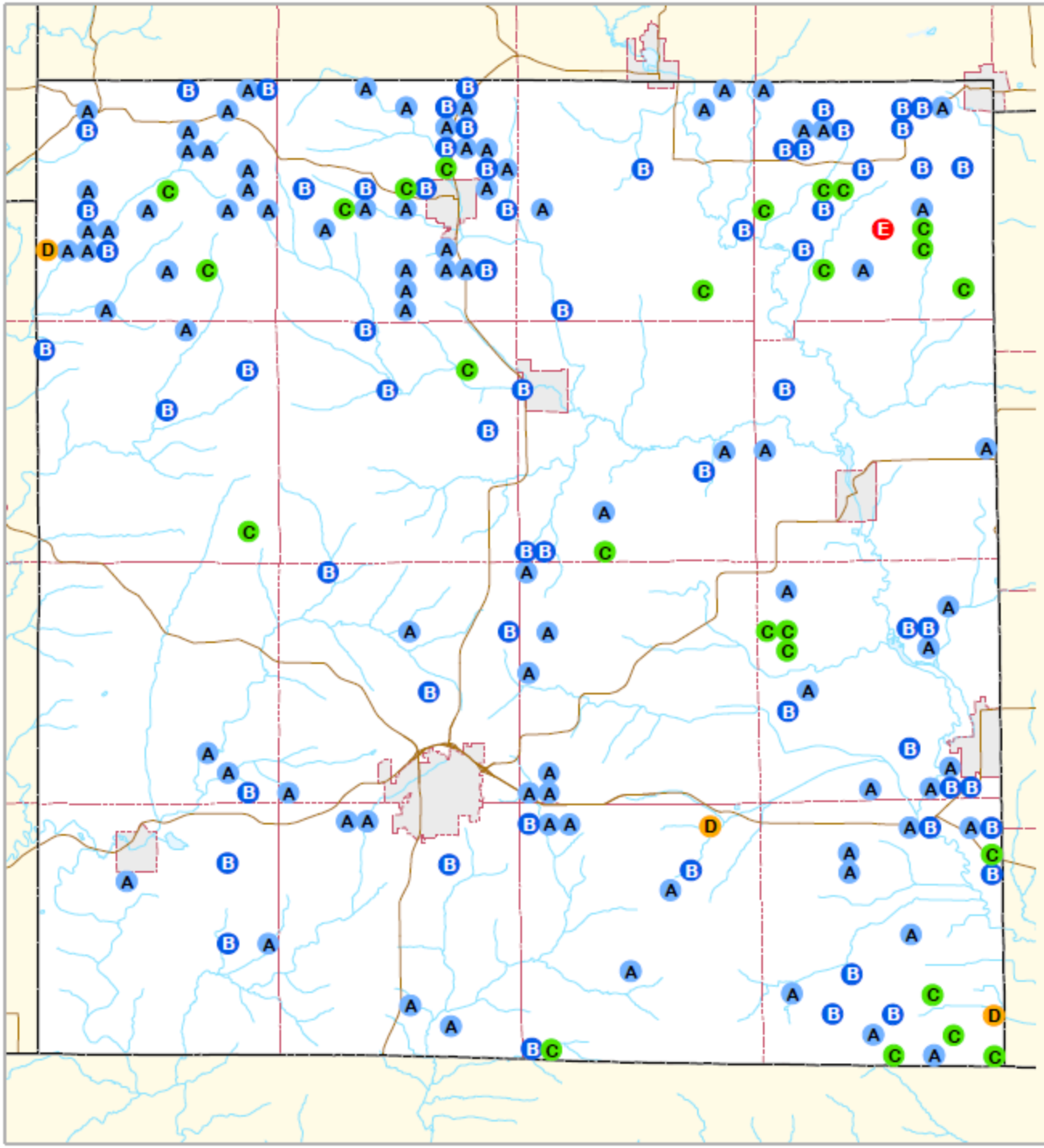
Sources: Triazine pesticides (mainly atrazine used on corn crops)

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)*



Green County

1994 - 2015 Summary

Atrazine Screen (ug/l)

A	None Detected	130	54 %
B	... 0.3	76	32 %
C	0.4 - 1.0	28	12 %
D	1.1 - 2.0	4	2 %
E	2.1 - 3.0	1	<1 %
F	3.1 ...	0	0 %

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

0 2 4 6 Miles

0 2 4 6 Kilometers

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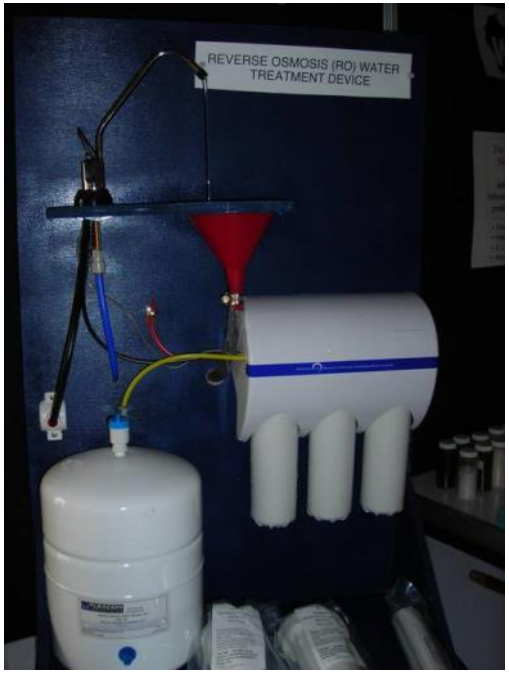
Improving water quality

- **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.

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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.

News From The Center

Postcards from the Central Sands: Kraft interviewed for article on groundwater

USGS report on groundwater pumping impacts on streams

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