Groundwater and Well Water Education Program

Towns of Arlington, Dekorra, Leeds, and Lowville

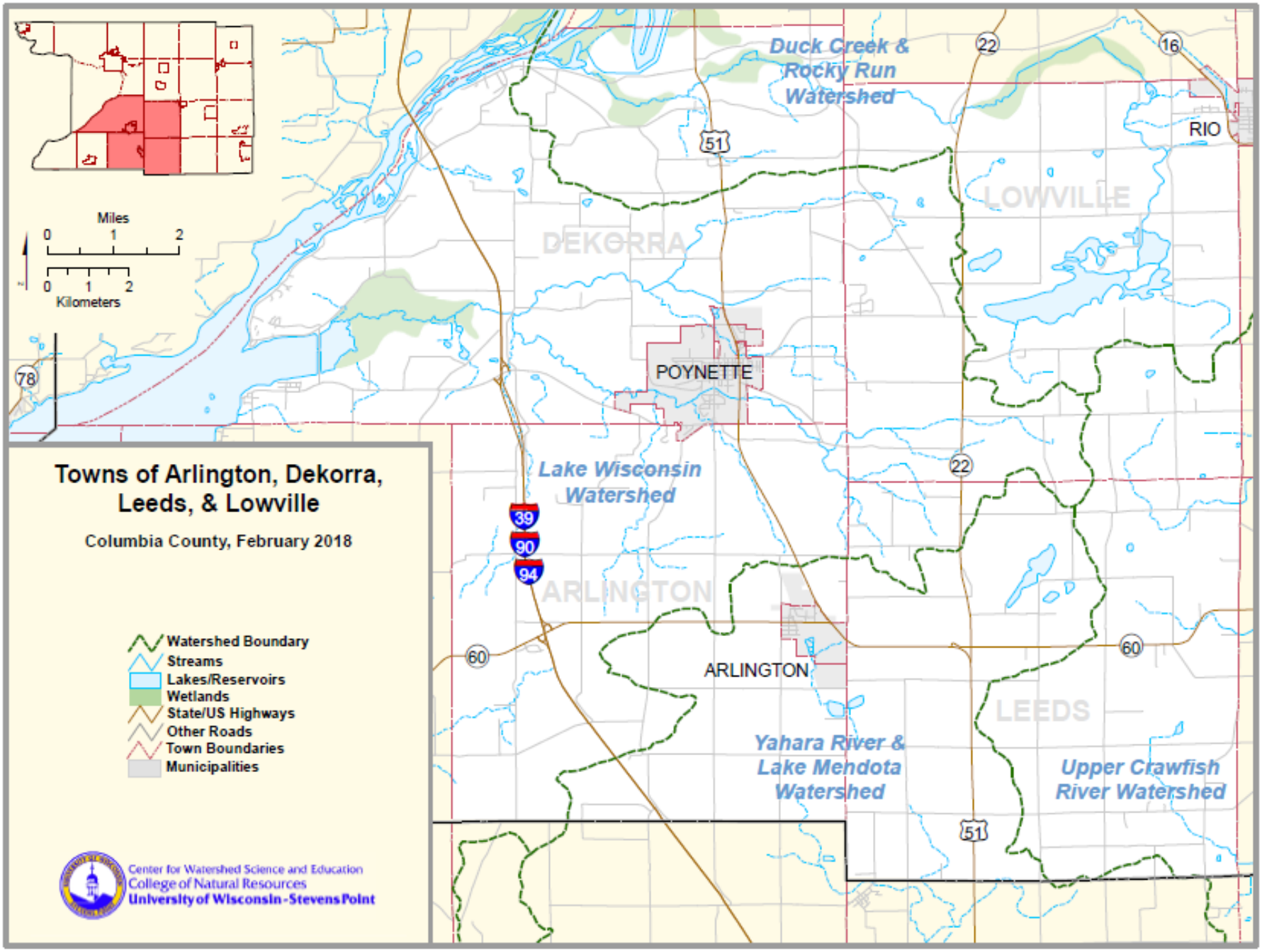
University of Wisconsin-Stevens Point
College of Natural Resources

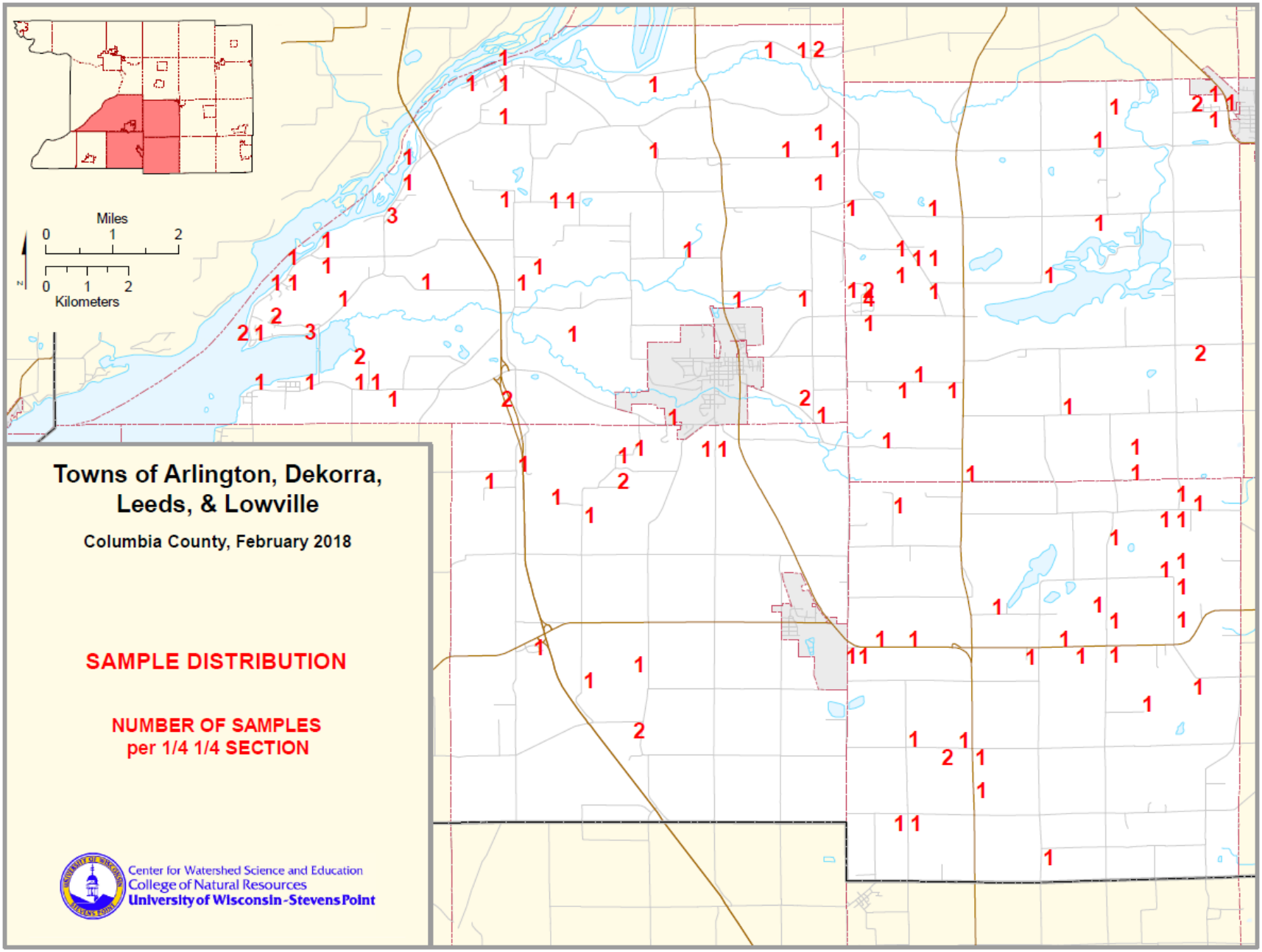
UW Extension
University of Wisconsin-Extension

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

Today's presentation

- Groundwater Basics: Where does my water come from
- Well Construction
- What do my individual test results mean?
- General groundwater quality in the Towns of Arlington, Dekorra, Leeds and Lowville
- Improving your water quality


Towns of Arlington, Dekorra, Leeds, & Lowville
Columbia County, February 2018
Miles
0 1 2
0 1 2
Kilometers
Watershed Boundary
Streams
Lakes/Reservoirs
Wetlands
State/US Highways
Other Roads
Town Boundaries
Municipalities
Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin-Stevens Point
Duck Creek & Rocky Run Watershed
Lake Wisconsin Watershed
Yahara River & Lake Mendota Watershed
Upper Crawfish River Watershed
DEKORRA
LOWVILLE
LEEDS
ARLINGTON
POYNETTE
RIO
ARLINGTON
22
16
51
78
39
90
94
60
22
60
51


Miles
0 1 2
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Kilometers
Towns of Arlington, Dekorra, Leeds, & Lowville
Columbia County, February 2018
SAMPLE DISTRIBUTION
NUMBER OF SAMPLES
per 1/4 1/4 SECTION
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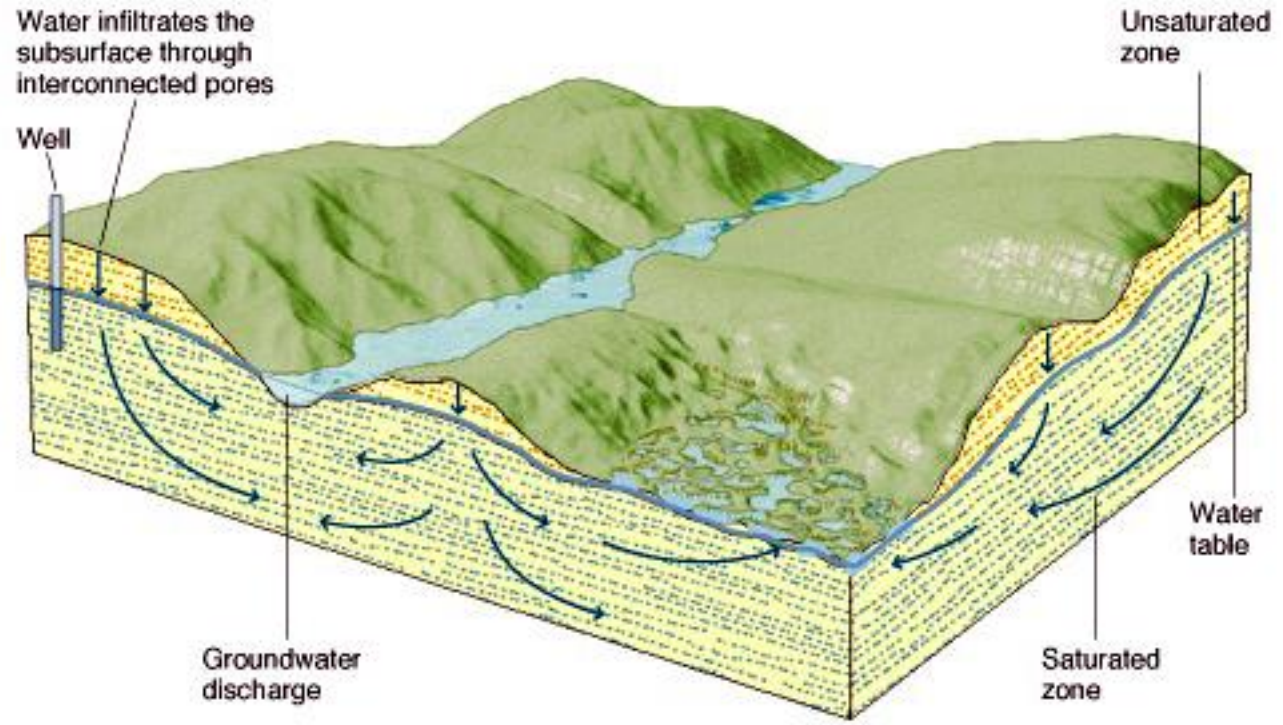
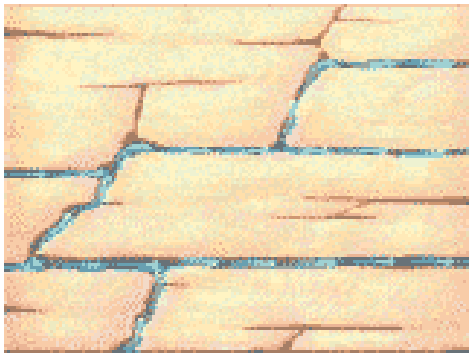
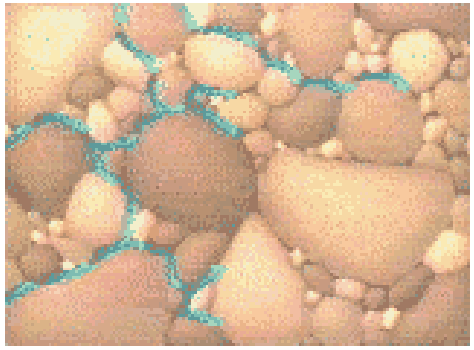
Groundwater Movement







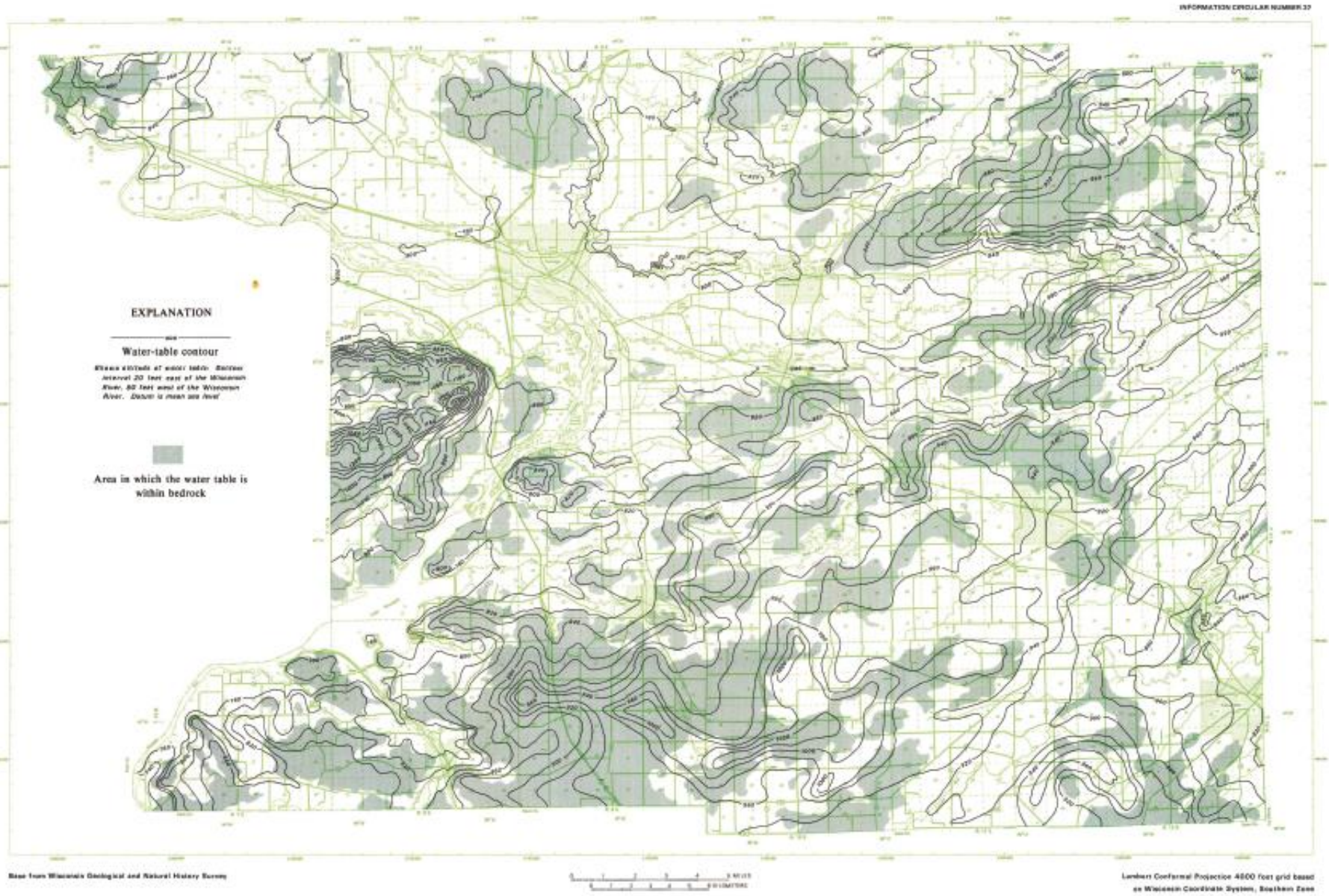
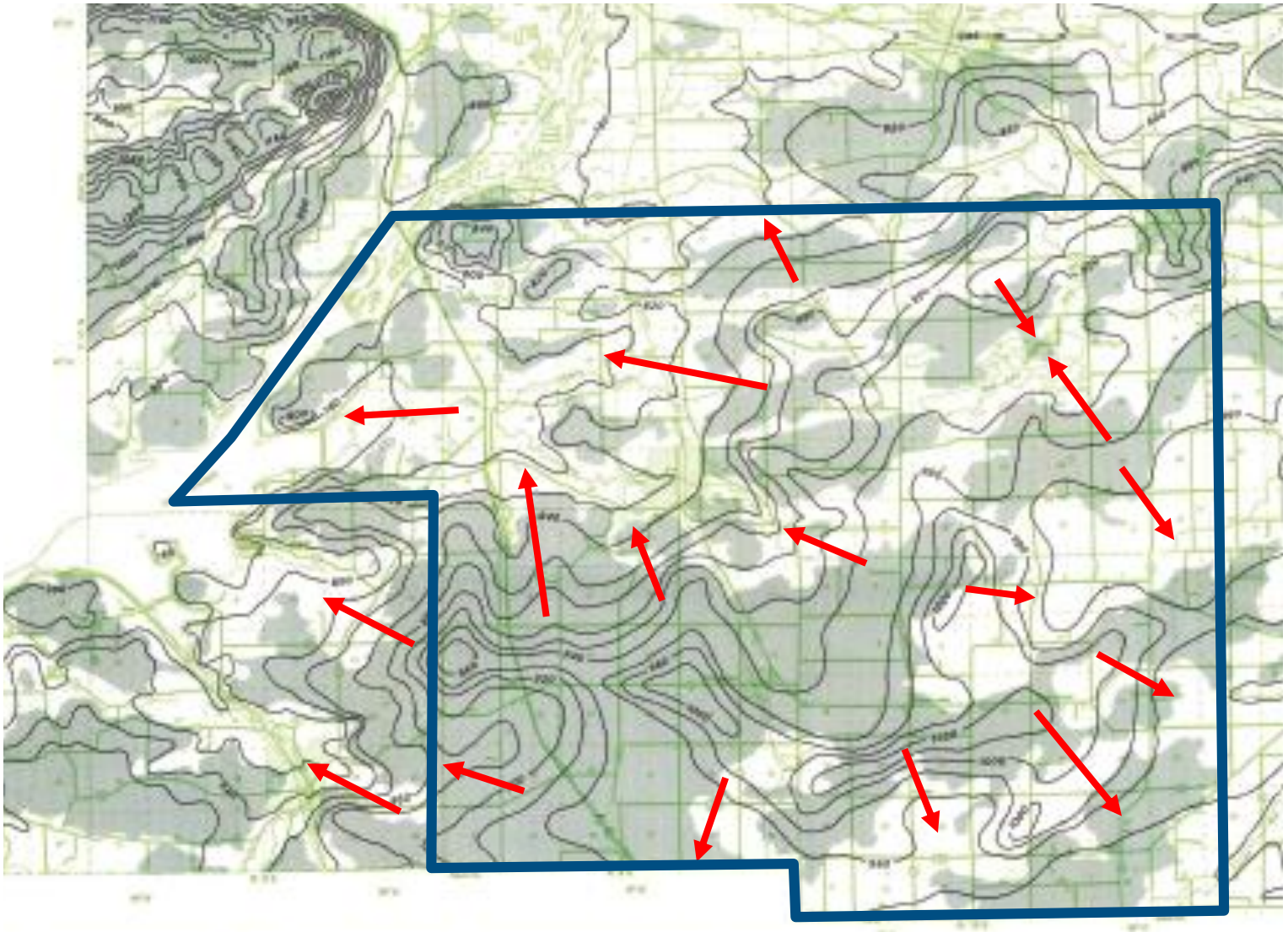


Plate 1. Water-table map of Columbia County, Wisconsin, 1974.

Groundwater flow direction:
Moves from high water table elevation to lower where it eventually discharges to lakes, rivers and streams.

https://wgnhs.uwex.edu/pubs/ic37plate01/

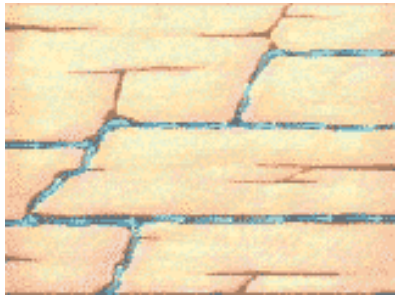


Groundwater flow direction:
Moves from high water table elevation to lower where it eventually discharges to lakes, rivers and streams.

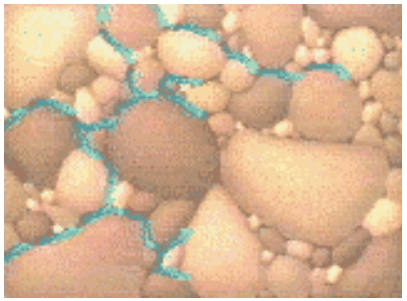
Aquifers: Our groundwater storage units

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

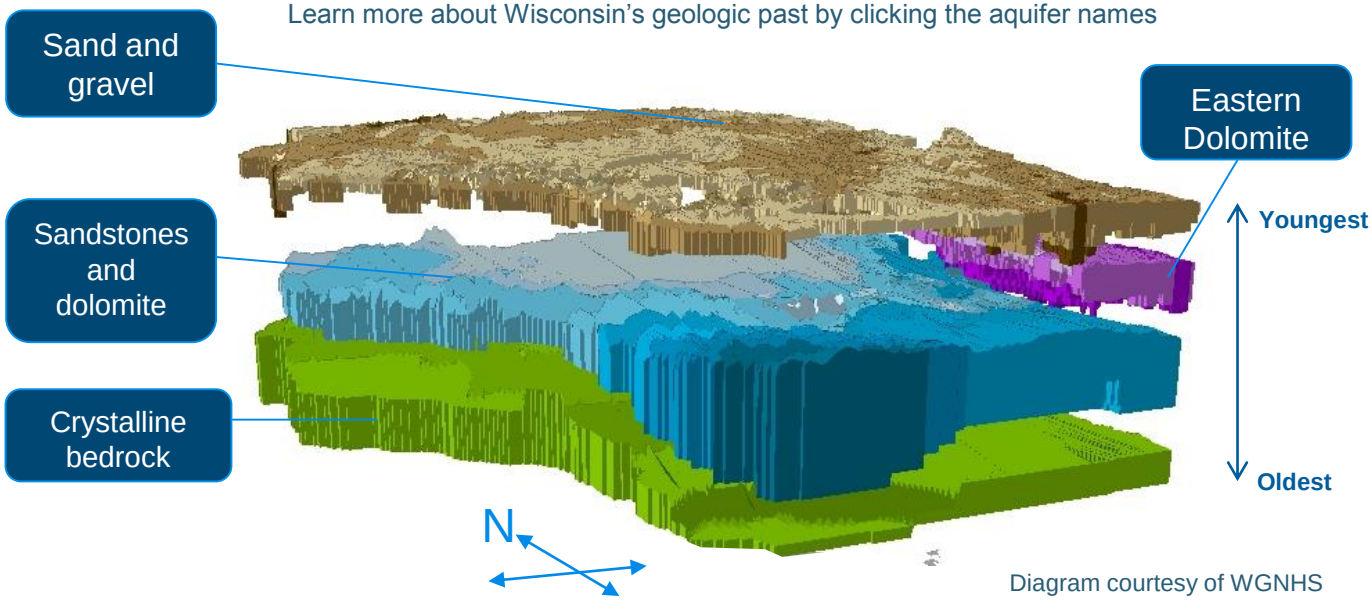
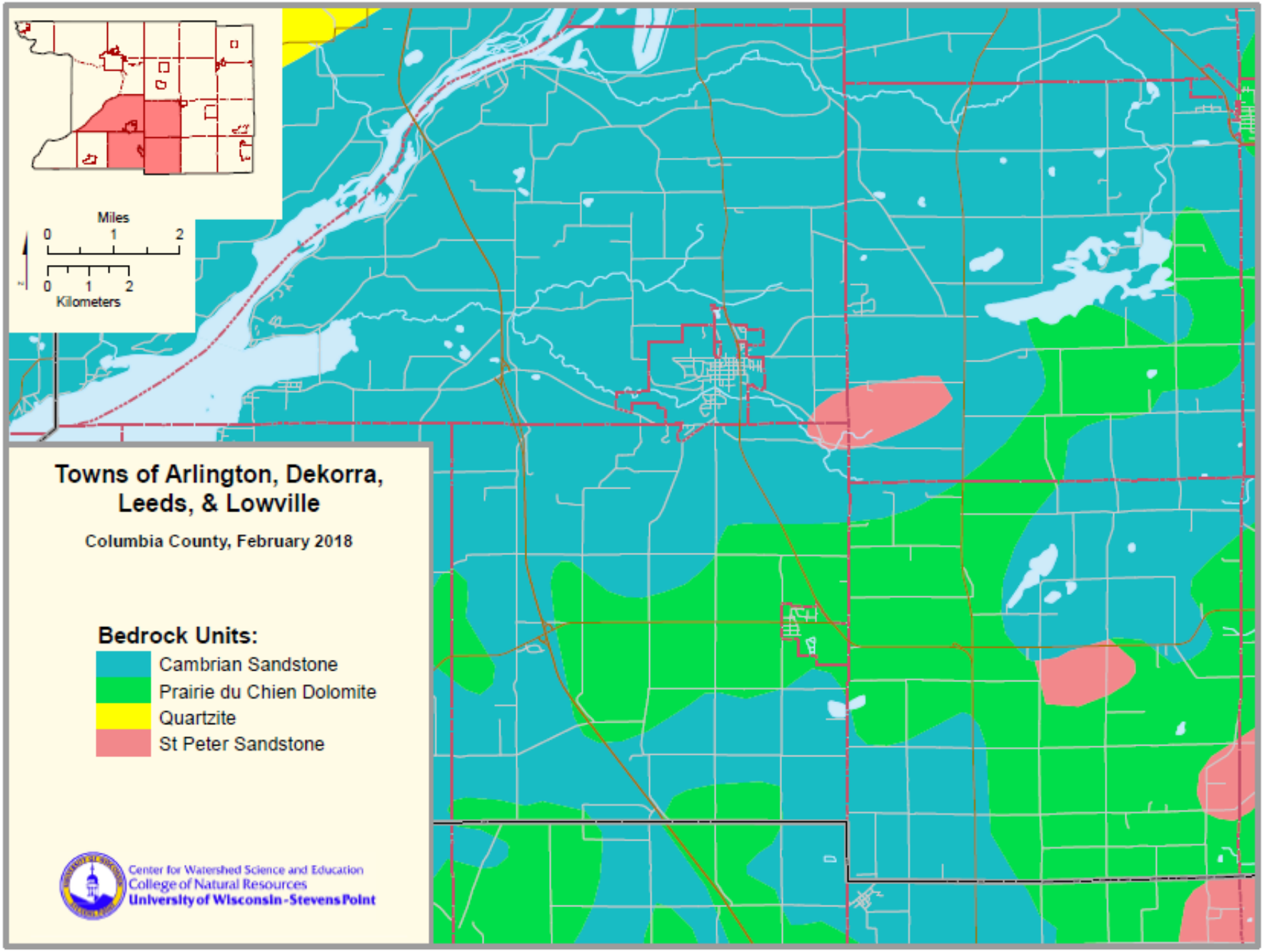


Diagram courtesy of WGNHS


Miles
0 1 2
0 1 2
Kilometers
Towns of Arlington, Dekorra, Leeds, & Lowville
Columbia County, February 2018
Bedrock Units:
Cambrian Sandstone
Prairie du Chien Dolomite
Quartzite
St Peter Sandstone
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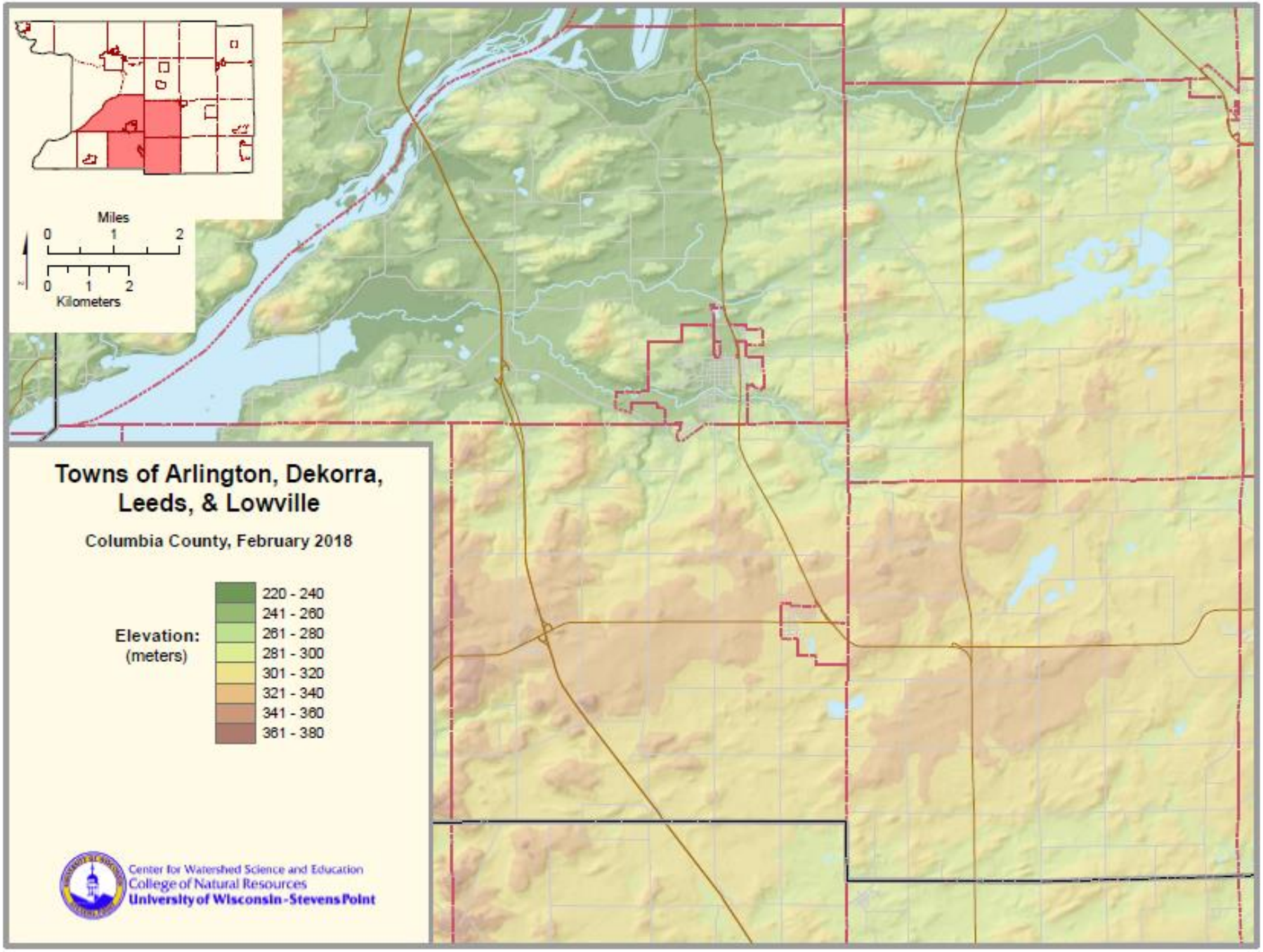
Miles
0 1 2
0 1 2
Kilometers
Towns of Arlington, Dekorra, Leeds, & Lowville
Columbia County, February 2018
Elevation: (meters)
220 - 240
241 - 260
261 - 280
281 - 300
301 - 320
321 - 340
341 - 360
361 - 380
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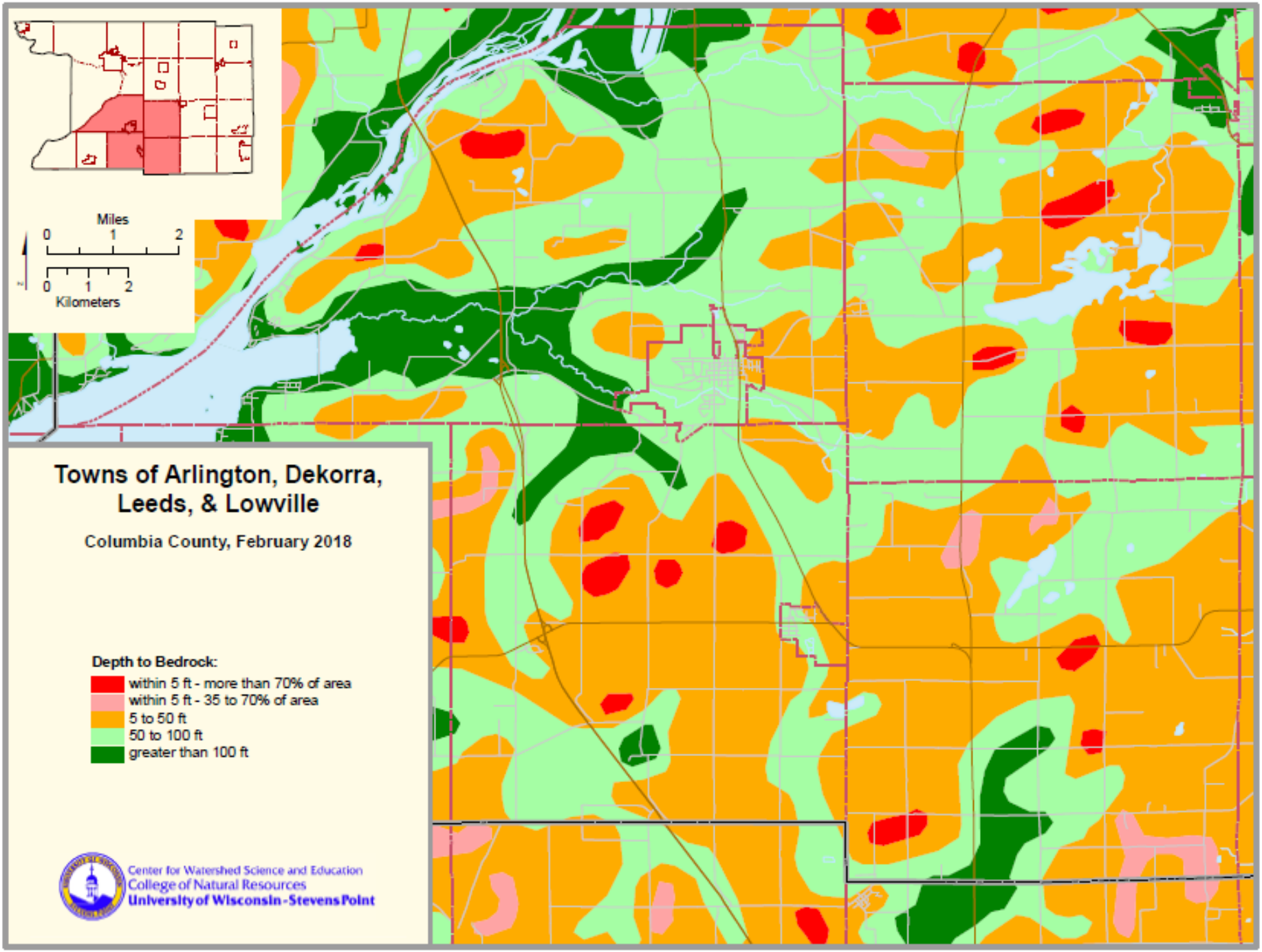
Miles
0 1 2
0 1 2
Kilometers
Towns of Arlington, Dekorra, Leeds, & Lowville
Columbia County, February 2018
Depth to Bedrock:
within 5 ft - more than 70% of area
within 5 ft - 35 to 70% of area
5 to 50 ft
50 to 100 ft
greater than 100 ft
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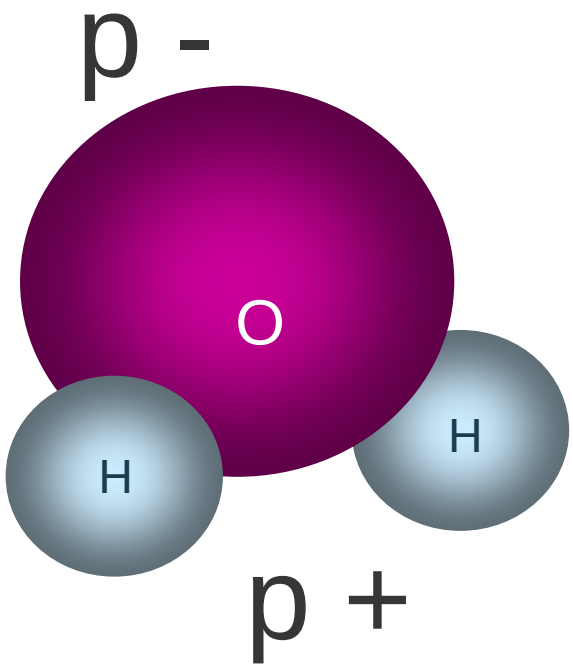
water basics

- "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.

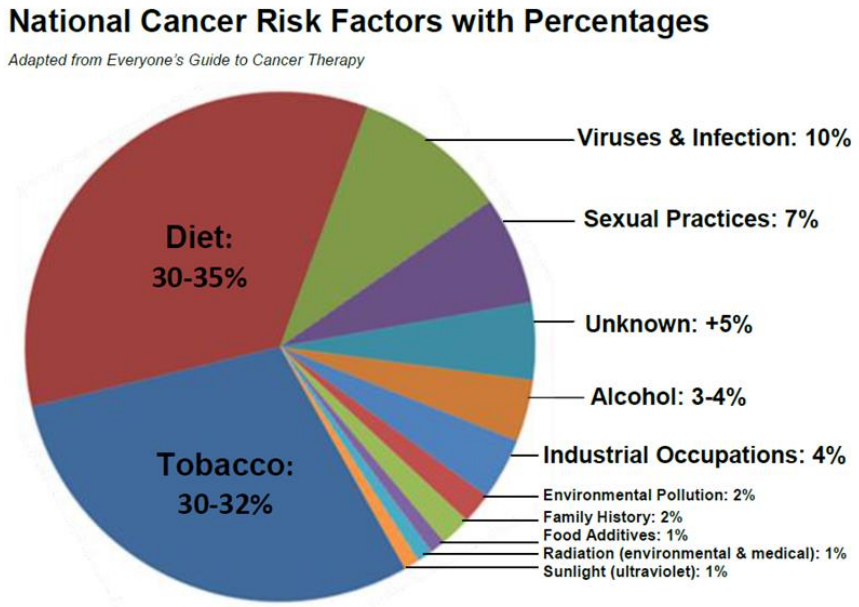
(ex. Bacteria or viral contamination which may cause intestinal disease)

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



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

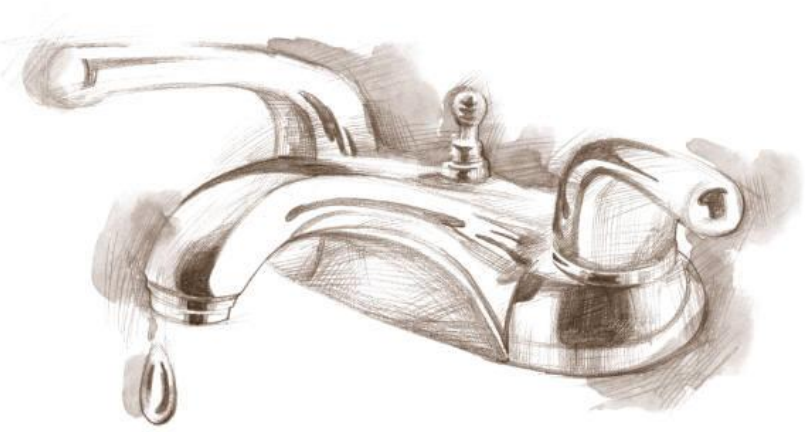
- Regularly tested and regulated by drinking water standards.

Private Wells

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

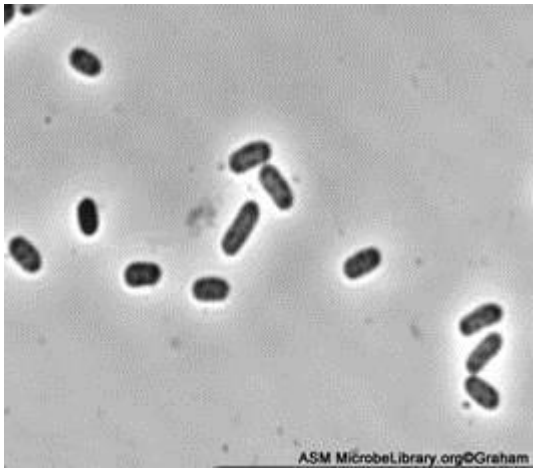
Why do people test their water?

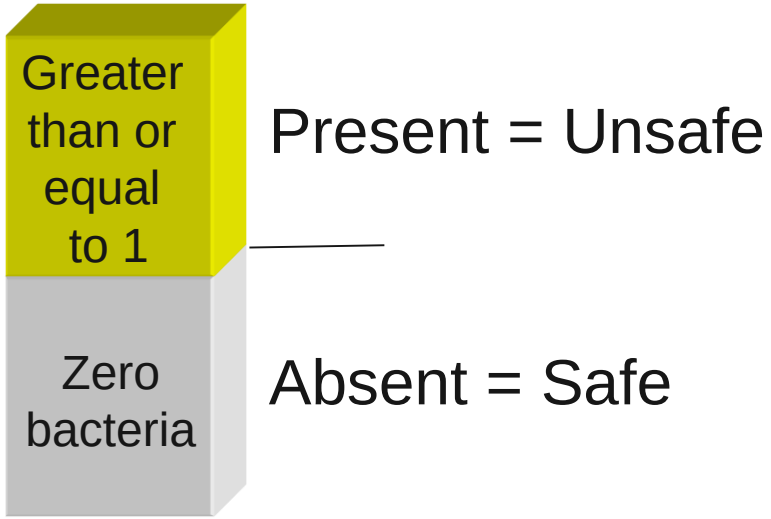
- Installed a new well
- Change in taste or odor
- Buying or selling their home
- Plumbing issues
- Want to know if it’s safe to drink.



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

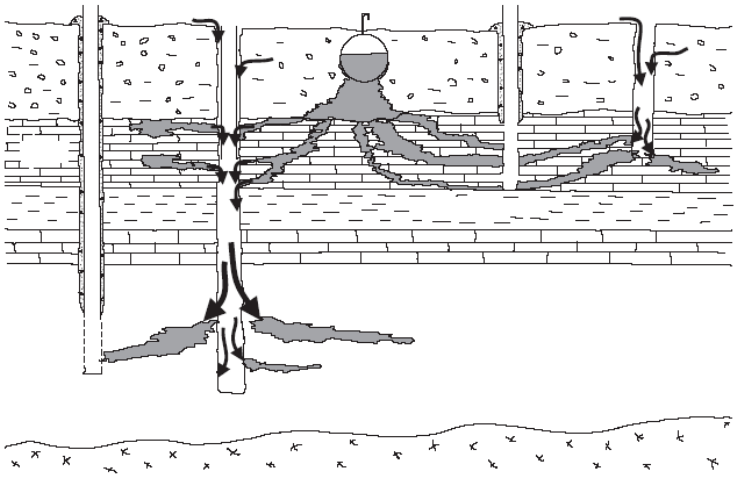
Photos courtesy of: Matt Zoschke

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)

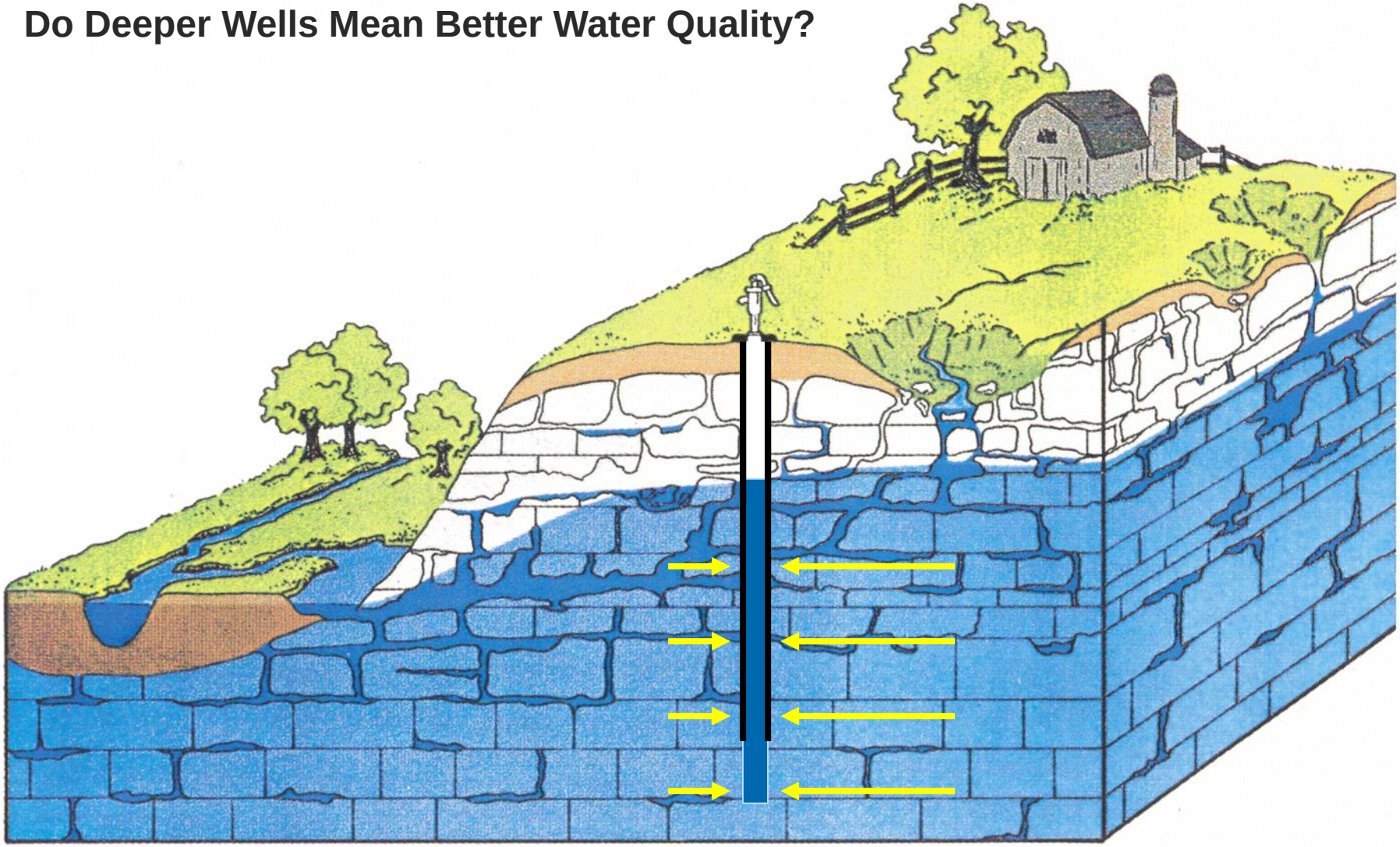
What does an approved yard hydrant look like?

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.

Do Deeper Wells Mean Better Water Quality?



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.***

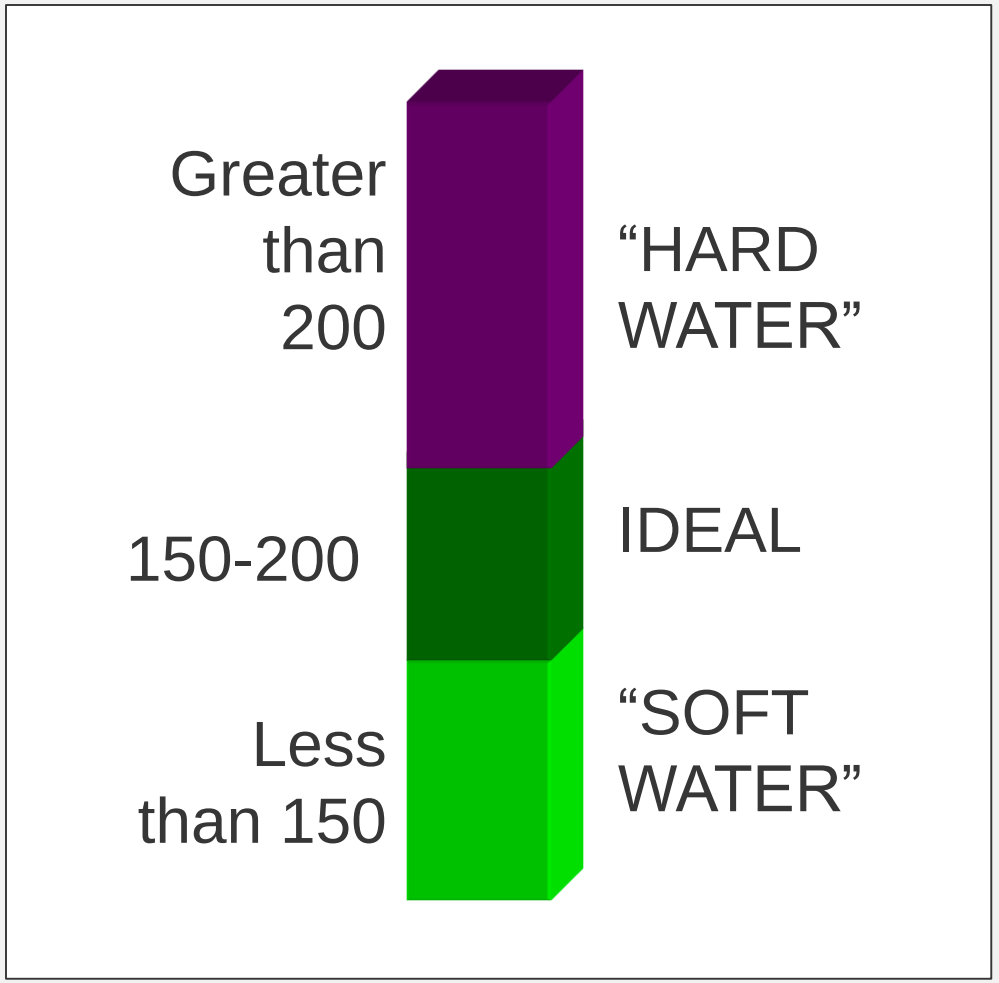
Rock and Soil Impacts on Water Quality

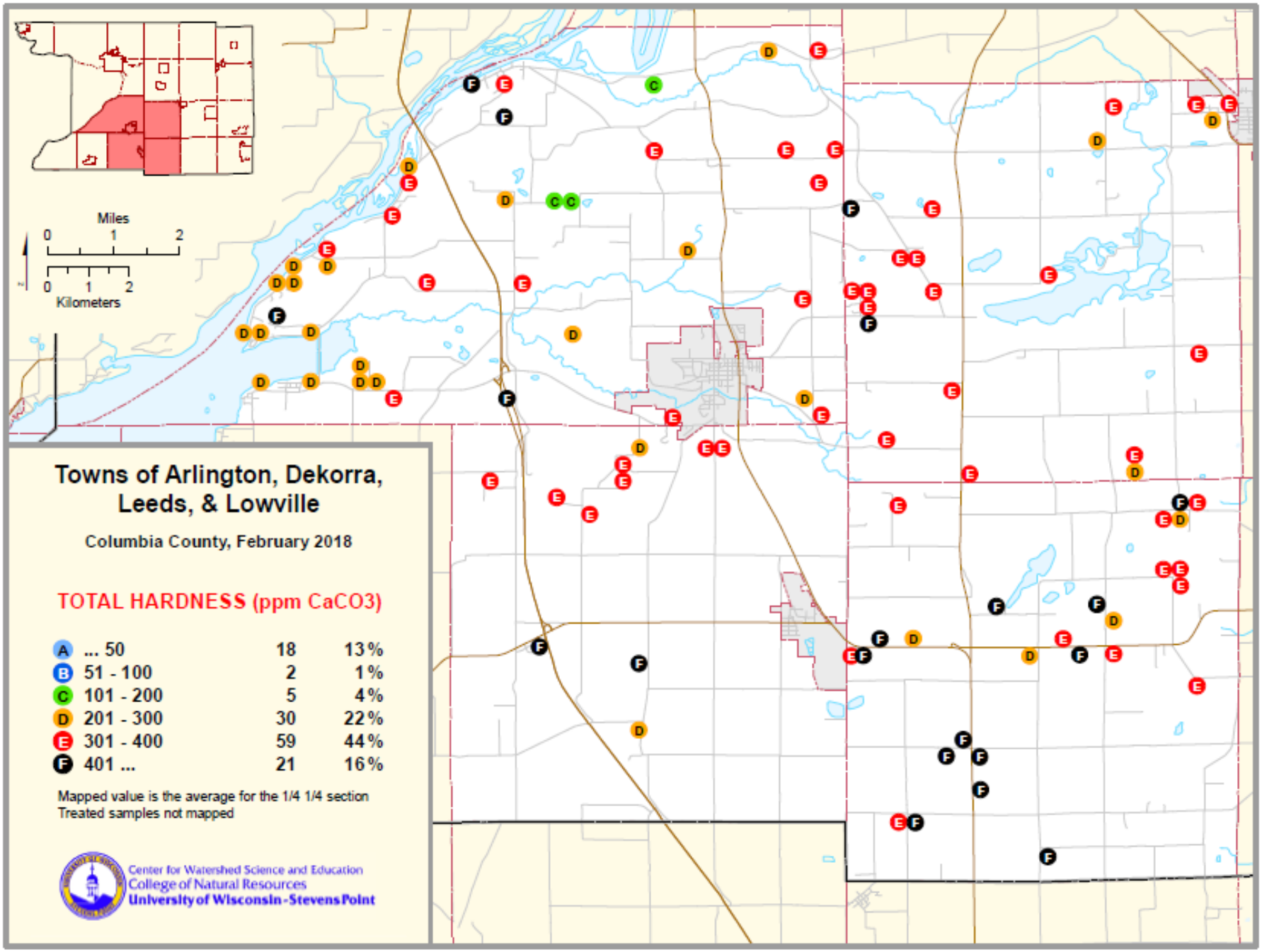
Tests for Aesthetic Problems

Hardness

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

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





Towns of Arlington, Dekorra, Leeds, & Lowville

Columbia County, February 2018

TOTAL HARDNESS (ppm CaCO3)

A	... 50	18	13%
B	51 - 100	2	1%
C	101 - 200	5	4%
D	201 - 300	30	22%
E	301 - 400	59	44%
F	401 ...	21	16%

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

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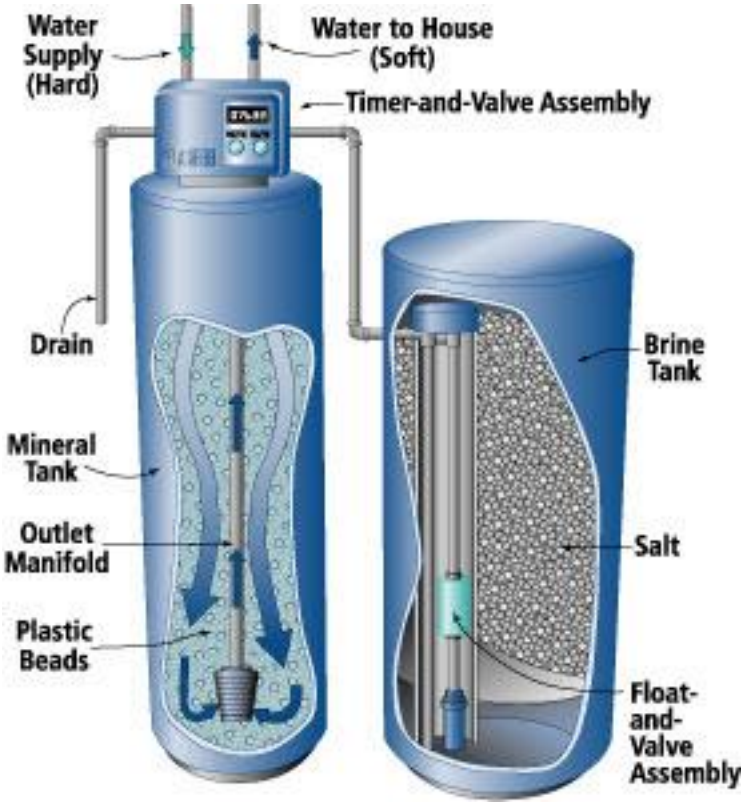
Water Softening

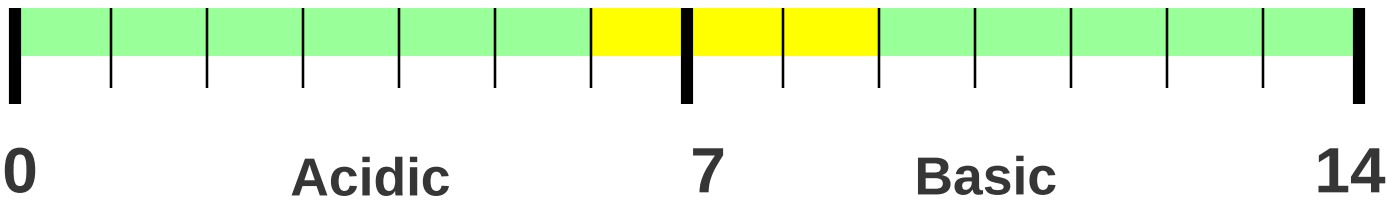
Water softeners remove calcium and magnesium which cause scaling and exchange it for sodium (or potassium).

- **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.**



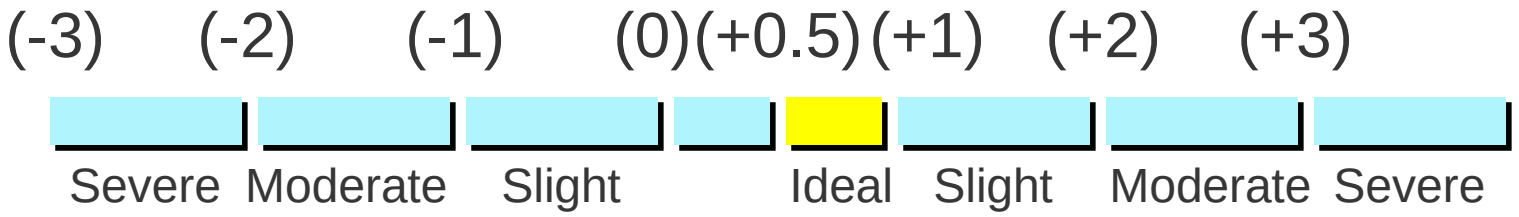
Tests for Overall Water Quality

- **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

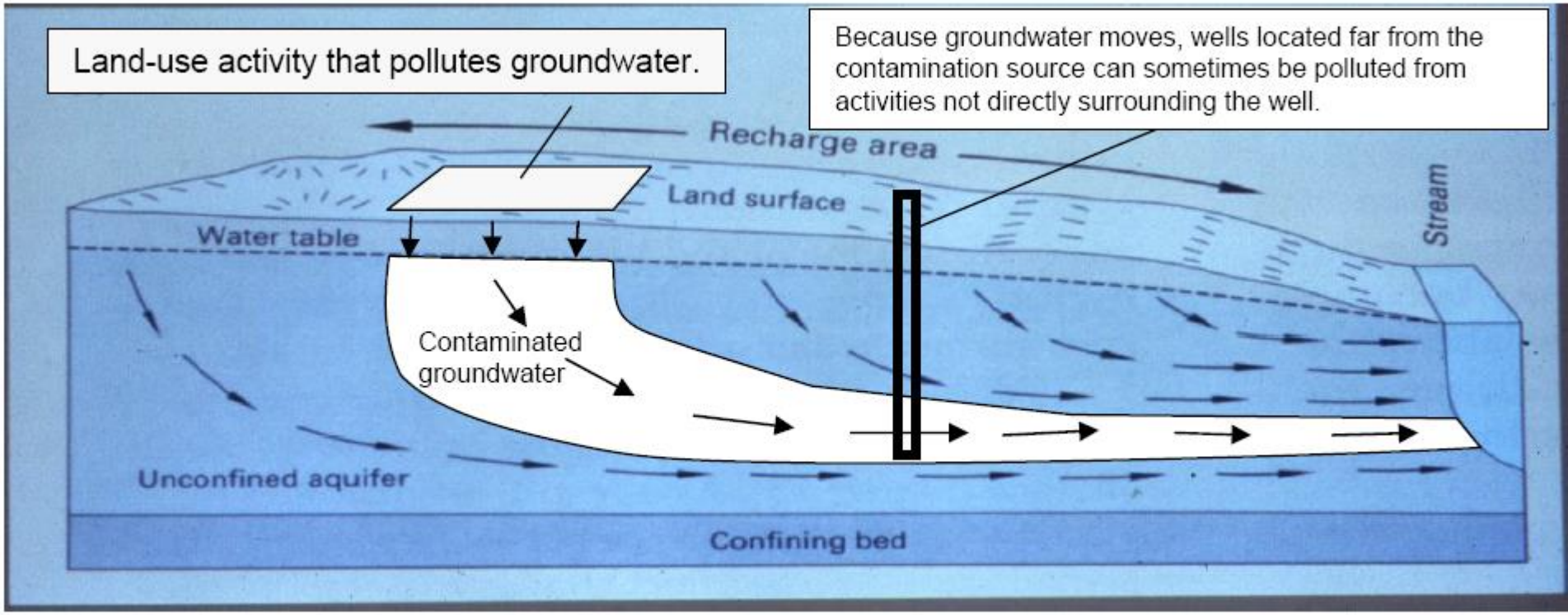
Saturation Index



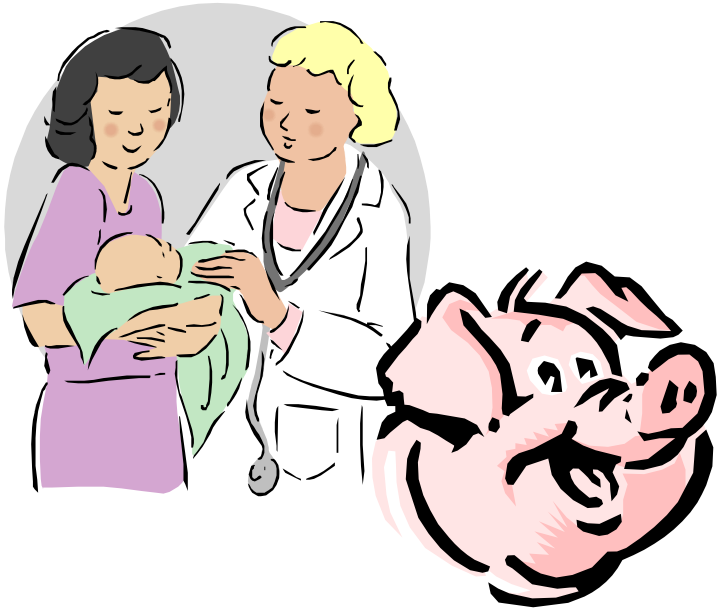
Corrosion occurs

Scaling occurs


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

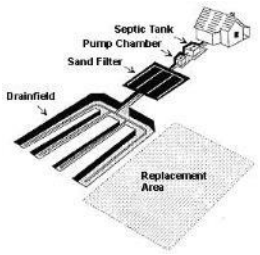


Health Effects:

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

Sources:

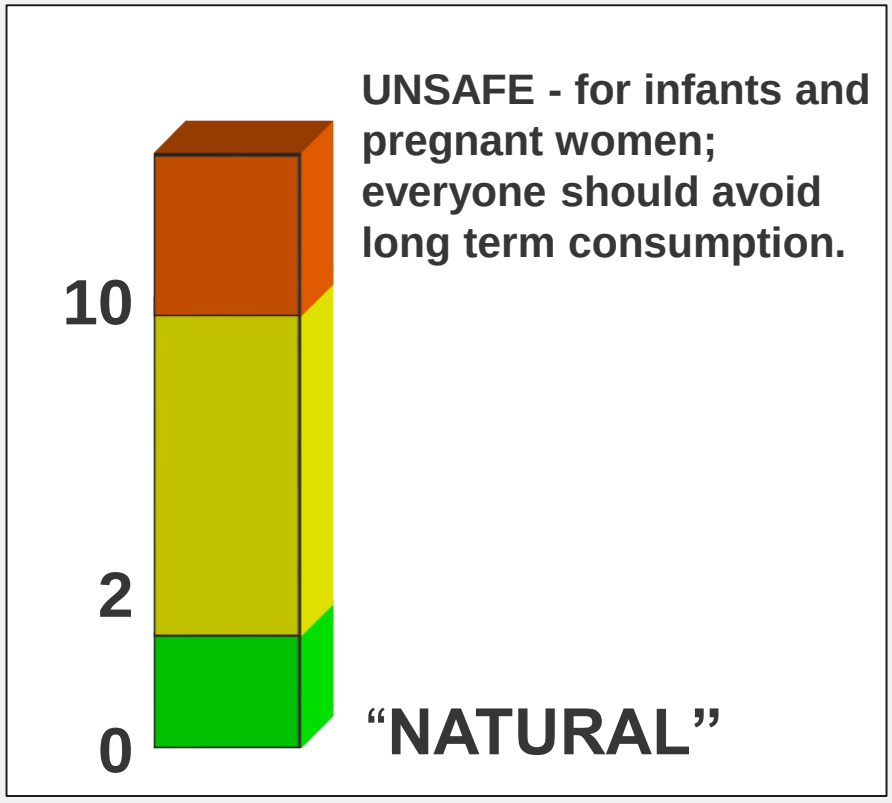
- Agricultural fertilizer
- Lawn fertilizer
- Septic systems
- Animal wastes

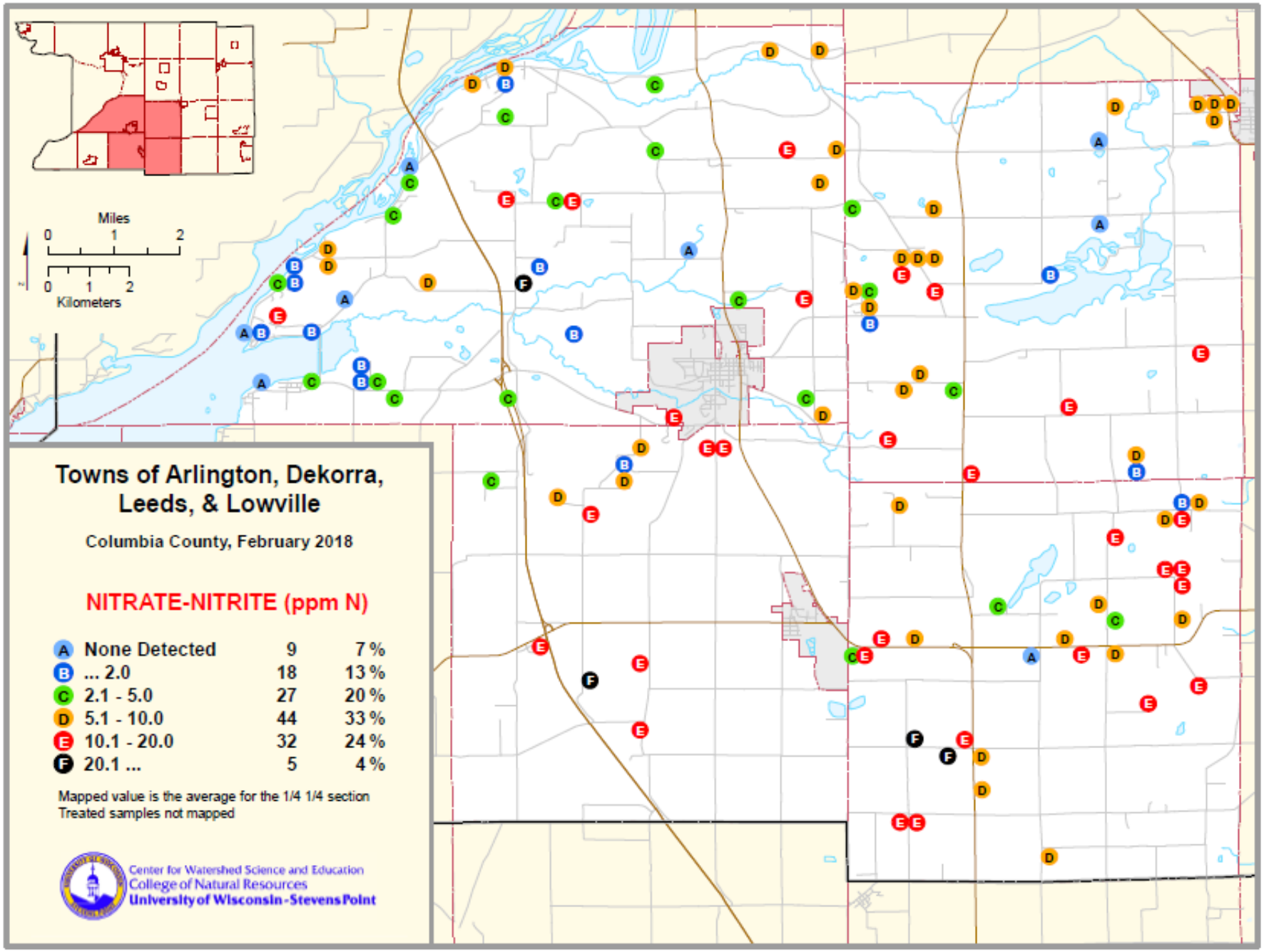


Test Important to Health

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"





Towns of Arlington, Dekorra, Leeds, & Lowville

Columbia County, February 2018

NITRATE-NITRITE (ppm N)

A	None Detected	9	7 %
B	... 2.0	18	13 %
C	2.1 - 5.0	27	20 %
D	5.1 - 10.0	44	33 %
E	10.1 - 20.0	32	24 %
F	20.1 ...	5	4 %

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

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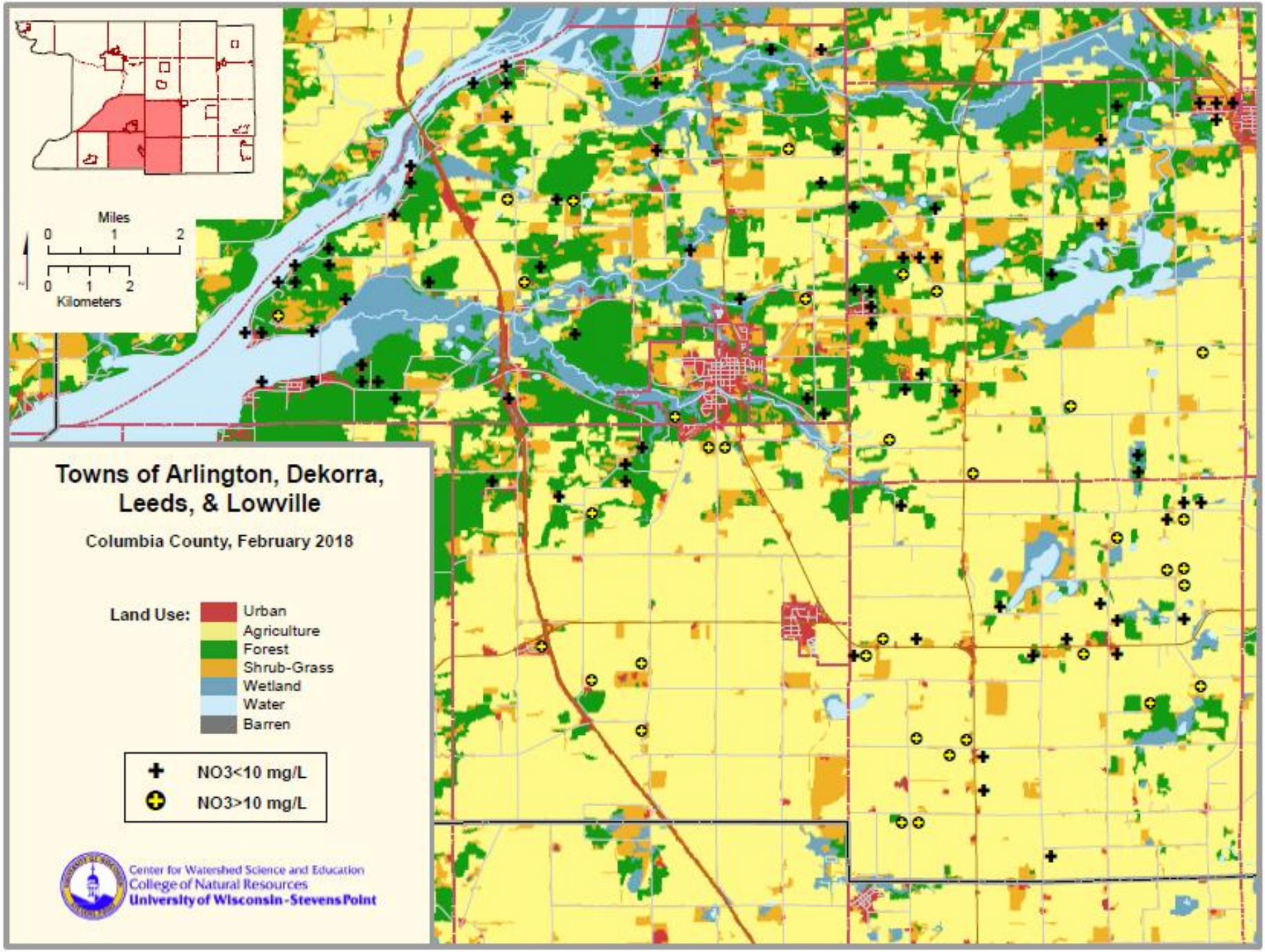

Miles
0 1 2
0 1 2
Kilometers
Towns of Arlington, Dekorra, Leeds, & Lowville
Columbia County, February 2018
Land Use:
Urban
Agriculture
Forest
Shrub-Grass
Wetland
Water
Barren
NO3<10 mg/L
NO3>10 mg/L
Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin-Stevens Point

What can I do to reduce my nitrate levels?

Solution:

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

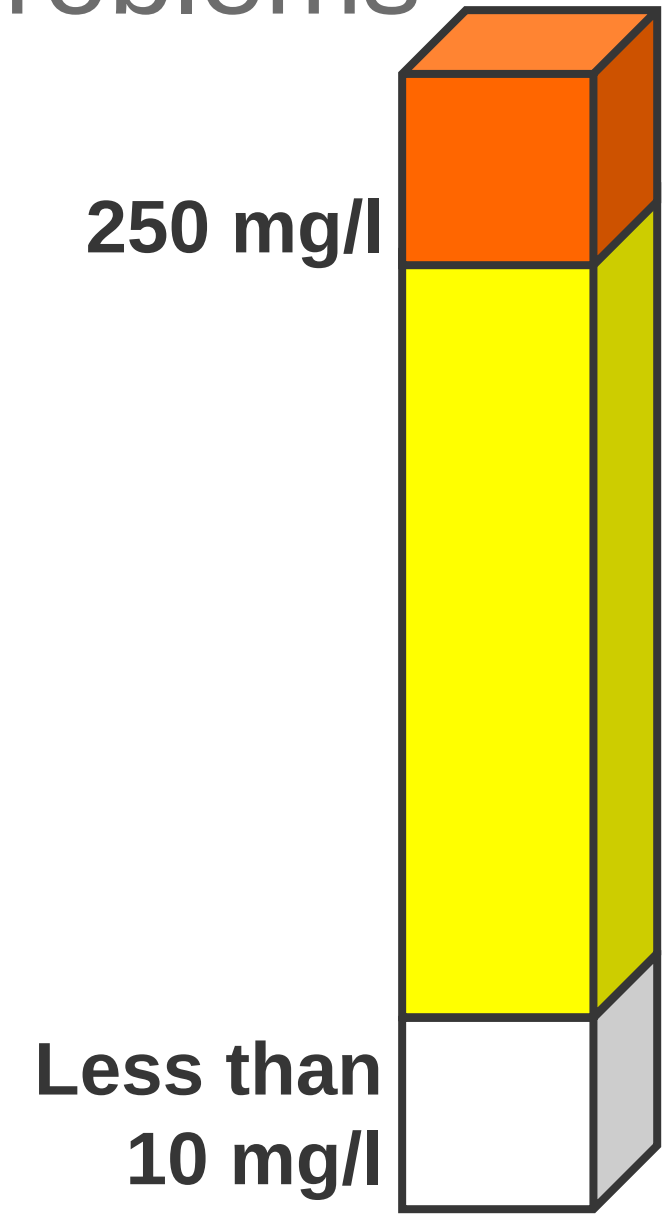
Short term:

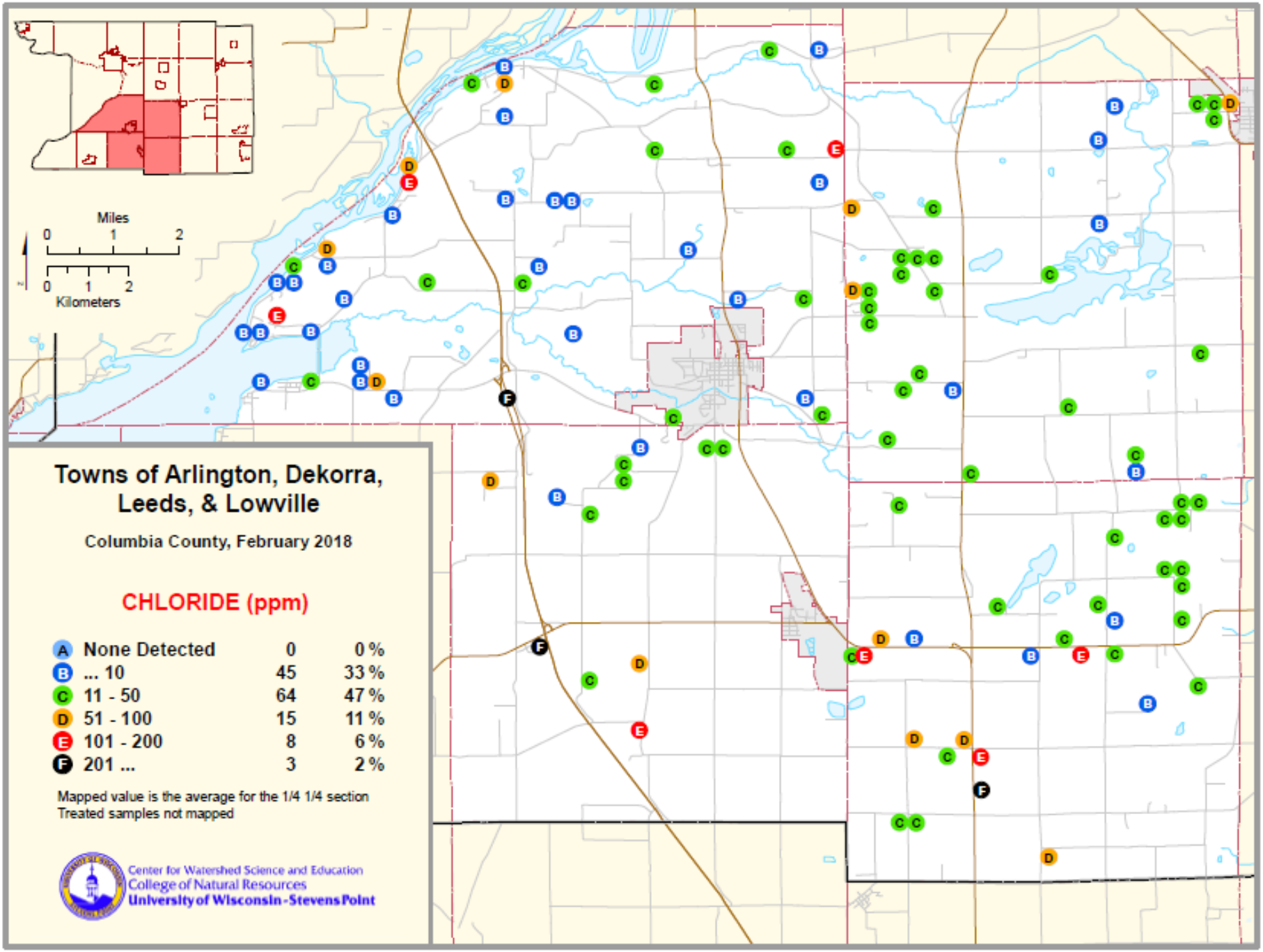
- **Change well depth or relocate well**
- **Carry or buy water**
- **Water treatment devices**
  - **Reverse osmosis**
  - **Distillation**
  - **Anion exchange**

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




Miles
0 1 2
0 1 2
Kilometers
Towns of Arlington, Dekorra, Leeds, & Lowville
Columbia County, February 2018
CHLORIDE (ppm)
A None Detected 0 0 %
B ... 10 45 33 %
C 11 - 50 64 47 %
D 51 - 100 15 11 %
E 101 - 200 8 6 %
F 201 ... 3 2 %
Mapped value is the average for the 1/4 1/4 section
Treated samples not mapped
Center for Watershed Science and Education
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Test Important to Health

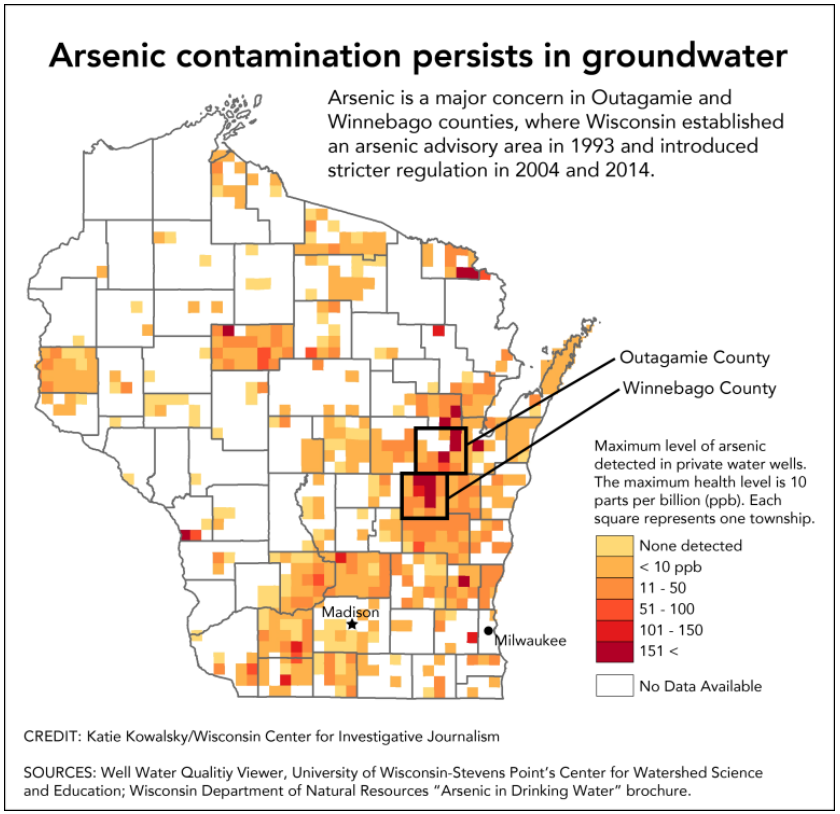
Arsenic

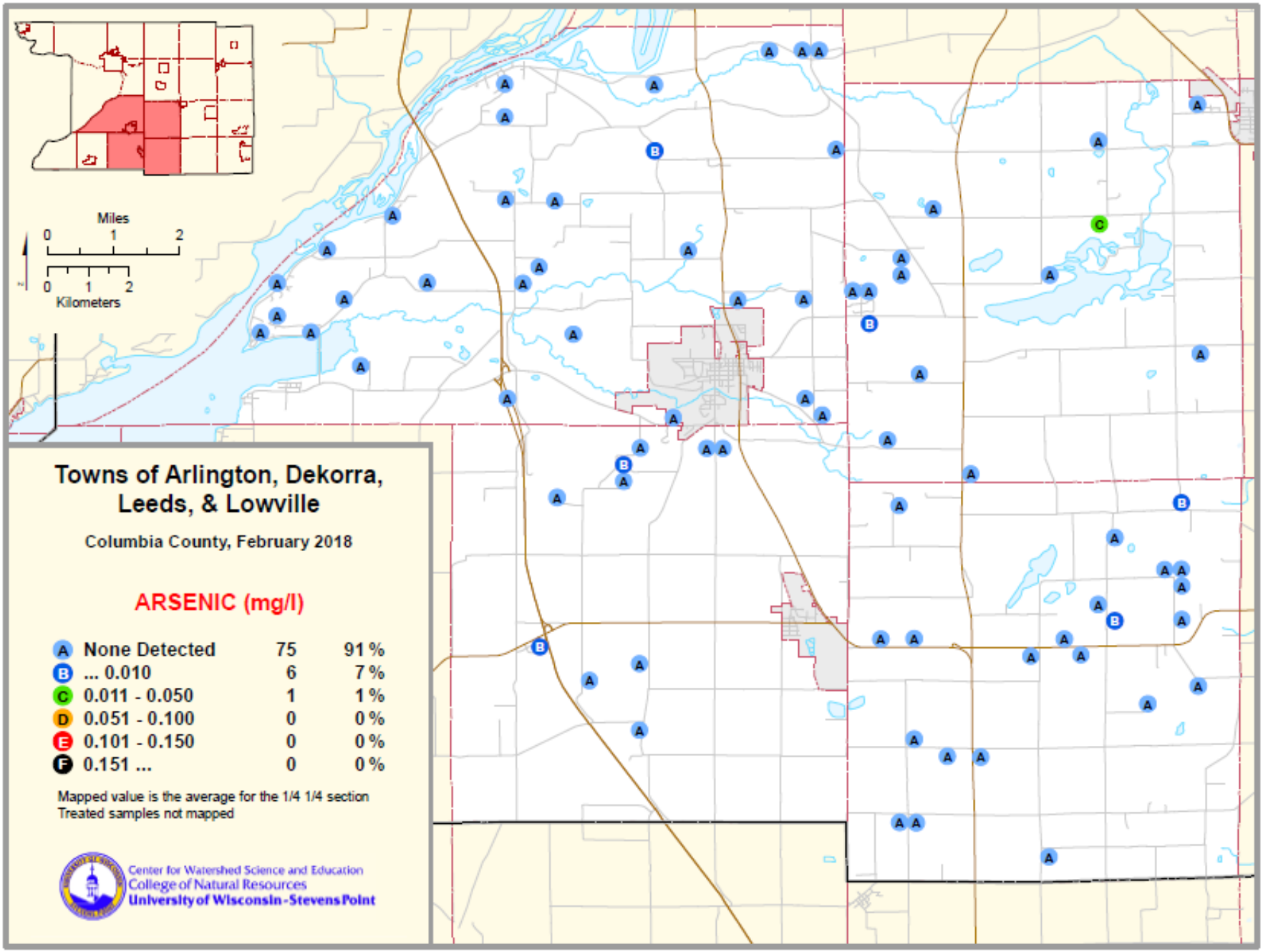
Sources: Naturally occurring in mineral deposits

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





Towns of Arlington, Dekorra, Leeds, & Lowville

Columbia County, February 2018

ARSENIC (mg/l)

A	None Detected	75	91 %
B	... 0.010	6	7 %
C	0.011 - 0.050	1	1 %
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

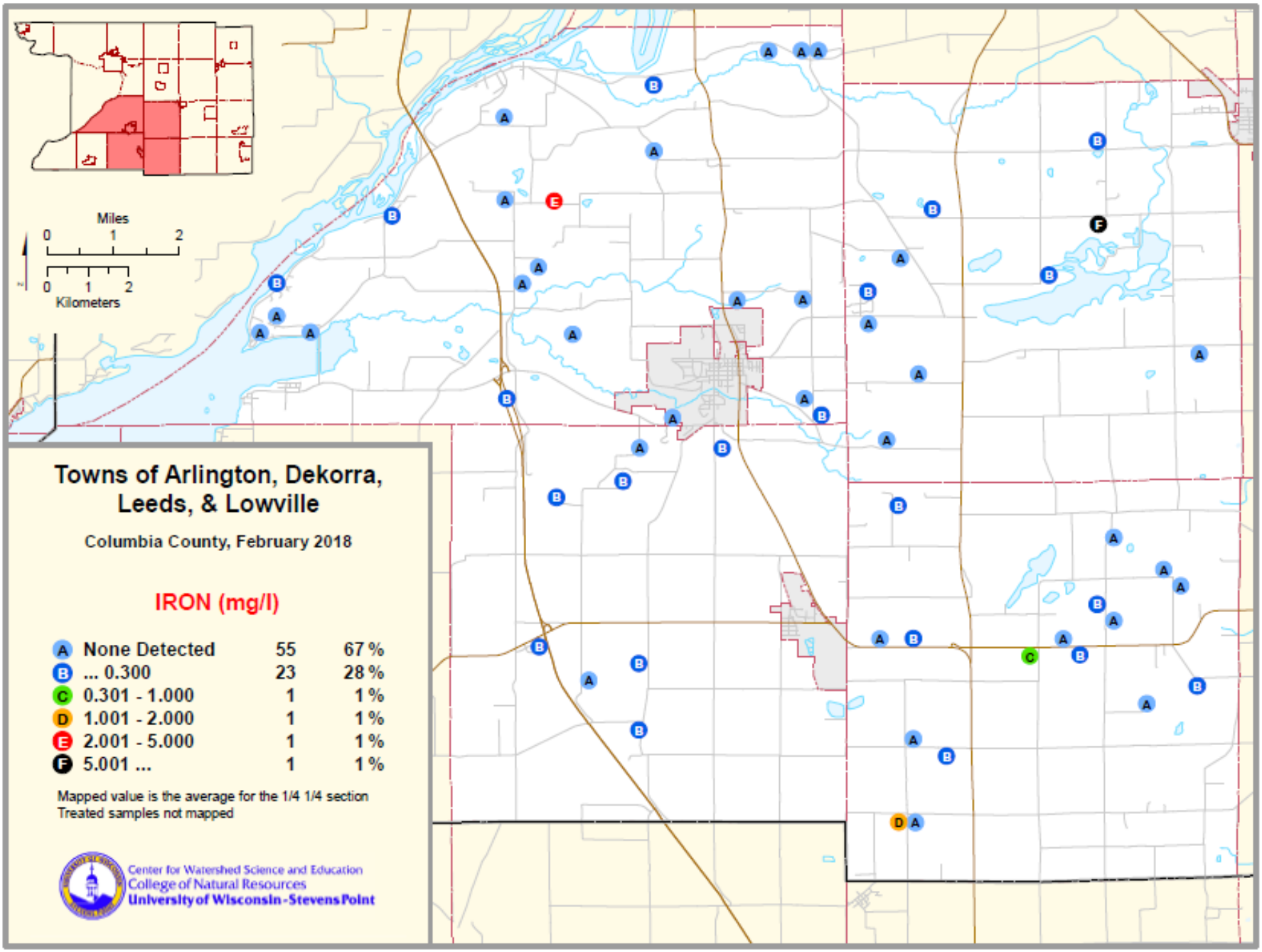
- Natural (rocks and soils)
- May benefit health
- Red and yellow stains on clothing, fixtures

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

Greater than 0.3 mg/L

Aesthetic problems likely

Less than 0.3 mg/L



Towns of Arlington, Dekorra, Leeds, & Lowville

Columbia County, February 2018

IRON (mg/l)

A	None Detected	55	67 %
B	... 0.300	23	28 %
C	0.301 - 1.000	1	1 %
D	1.001 - 2.000	1	1 %
E	2.001 - 5.000	1	1 %
F	5.001 ...	1	1 %

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

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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

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.

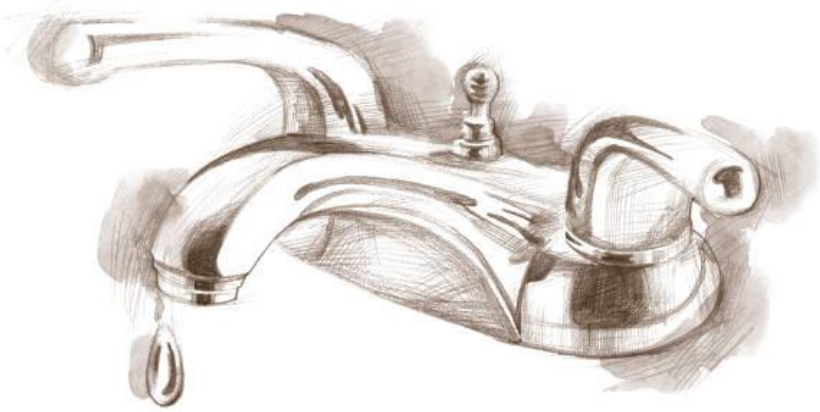
Lead and Copper

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

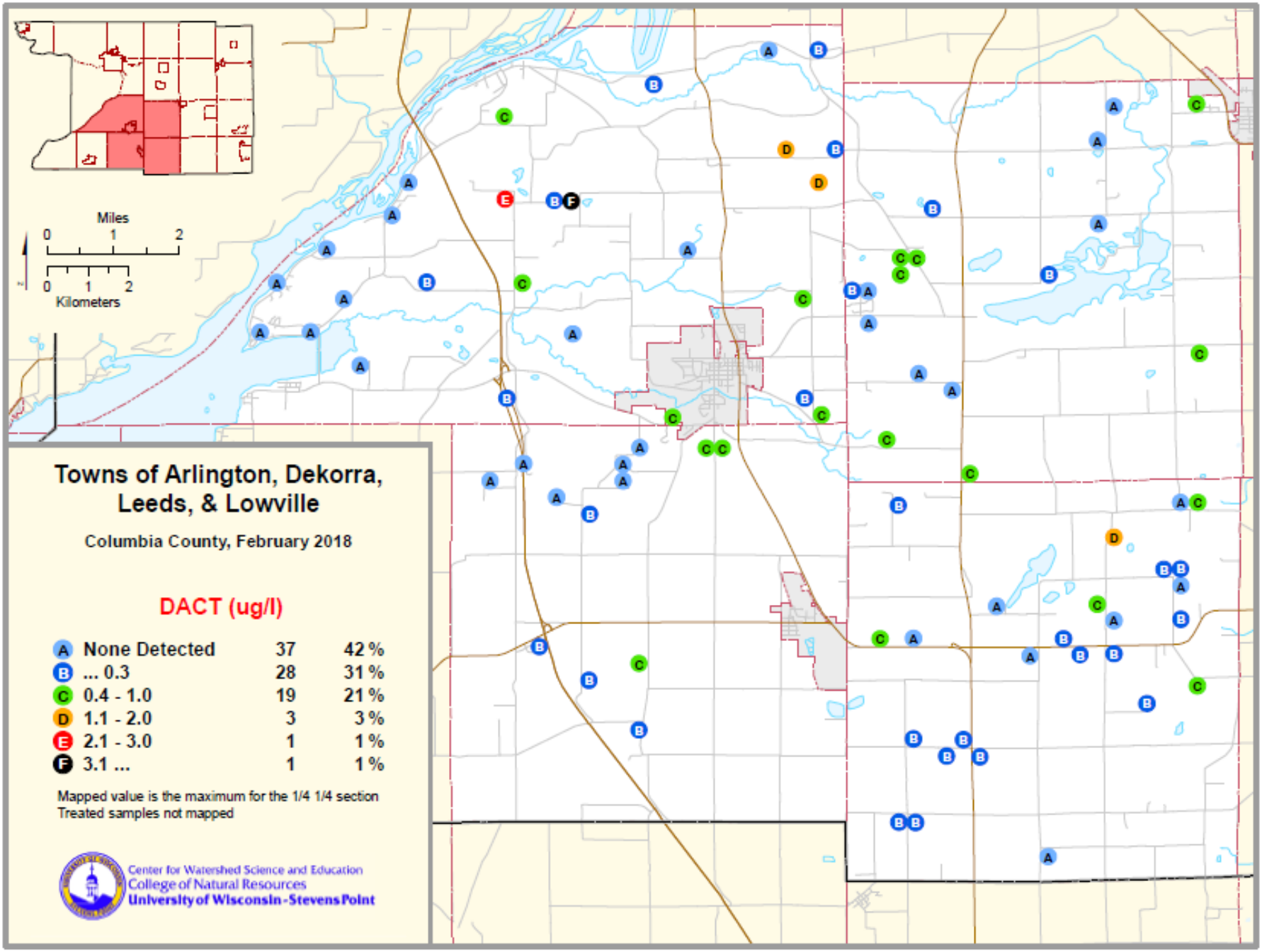
Sources: Triazine pesticides (mainly atrazine used on corn crops)

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)*


Miles
0 1 2
0 1 2
Kilometers
Towns of Arlington, Dekorra, Leeds, & Lowville
Columbia County, February 2018
DACT (ug/l)
A None Detected 37 42 %
B ... 0.3 28 31 %
C 0.4 - 1.0 19 21 %
D 1.1 - 2.0 3 3 %
E 2.1 - 3.0 1 1 %
F 3.1 ... 1 1 %
Mapped value is the maximum for the 1/4 1/4 section
Treated samples not mapped
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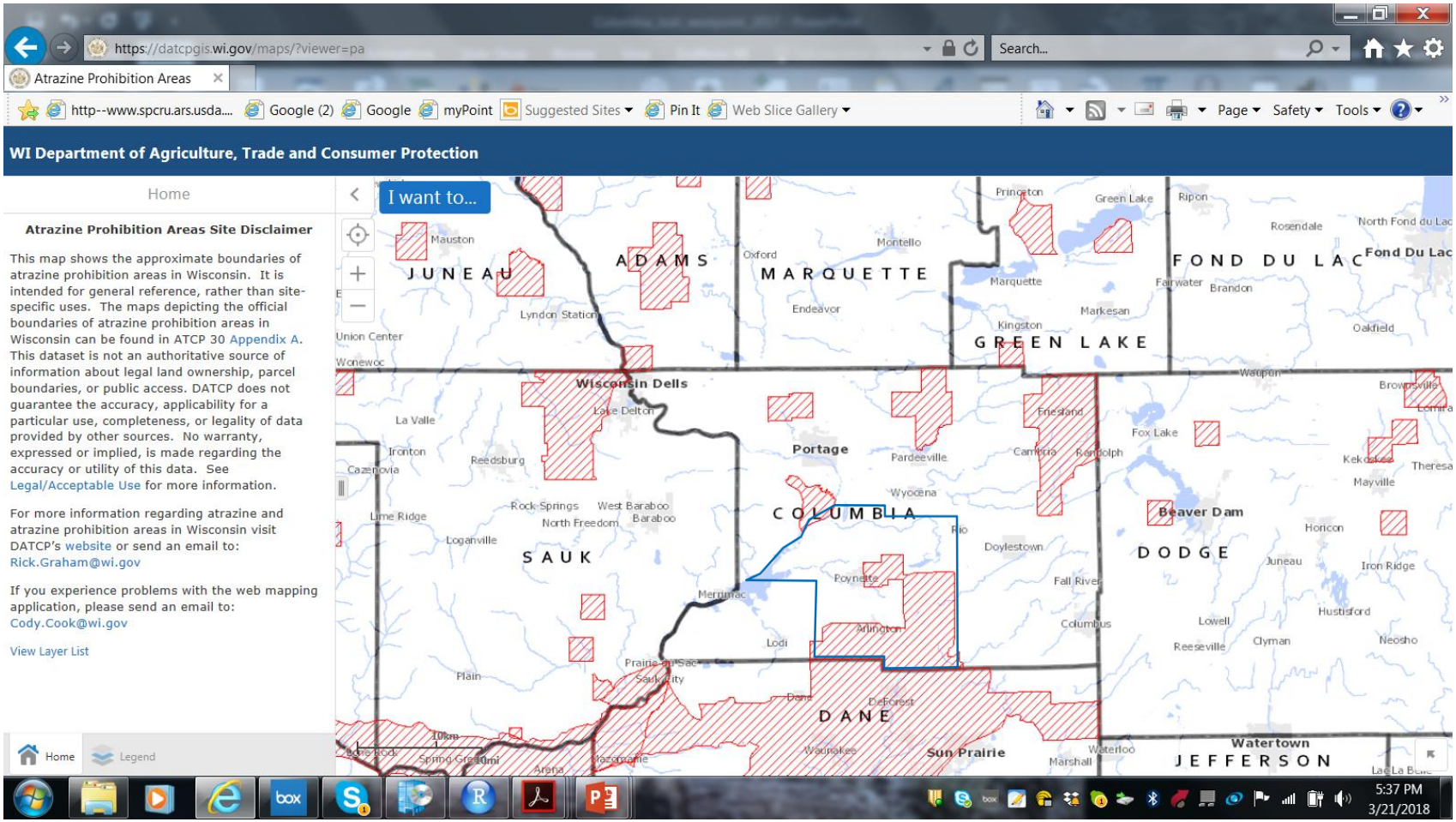
Atrazine Prohibition Areas



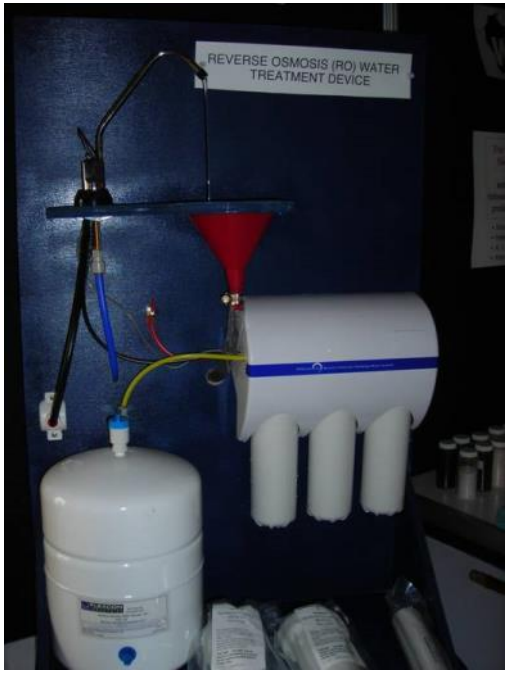
Improving water quality

- **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.

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

- **Towns of Arlington, Dekorra, Leeds, and Lowville**
- **Columbia County UW-Extension**
- **Columbia County Land & Water Conservation Department**

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