Groundwater and Drinking Water Education Program
Towns of Jacksonport, Sevastopol and Sturgeon Bay

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Center for Watershed Science and Education

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

- Precipitation
- Infiltration
- Runoff
- River
- Well
- Runoff
- Evaporation
- Transpiration
- Water Table
- Groundwater
- Percolation
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.

Learn more about Wisconsin’s geologic past by clicking the aquifer names.
Door County Geology

Aquifer – (n.) A water bearing geological formation.

Most private wells in the area installed into Silurian Dolomite.
Groundwater Movement
Door County, Wisconsin

Water Table Elevation (feet)

- 590 - 690
- 600 - 700
- 610 - 710
- 620 - 720
- 630 - 730
- 640 - 740
- 650 - 750
- 660 - 760
- 670 - 770
- 680 - 780

This dataset was created by using ArcScan to convert the contours displayed on the door_water_table_elev.jpg raster image from raster to vector data. The ArcScan process was completed by Darrin Hoverson, February, 2006. The original hardcopy map was scanned and georeferenced prior to the ArcScan process.
Types of Wells
Well Construction Report For
WI1SON UNIQUE WELL NUMBER CC 566

Property Owner: Clyde Noonhisher
Location: Rte 4

Well Location:
- Well Name: (
- Address: 441 Ripon Rd
- City: Ripon
- State: WI
- Zip Code: 53961

Well Construction Information:
- Construction Name: (N
- Registration #: (W
- Completion Date: (W

Water Quality:
- High Capacity Well: (W
- High Capacity Property: (W

Wall Location:
- Highest Point of Property: Consistent with the General Layout and Surroundings: (W
- Wall Located in Floodplain?: 
  - Yes
  - No
- Distance In Feet From Wall To Source:
  - Landfill
  - Sewer
  - Septic or Holding Tank

Drillhole Dimensions:
- Diameter: 10
- Depth: 60
- Material: New Block

Casing, Liner, Screen:
- Material: 18.5
- Length: 14.5

Geology:
- Clay
- Sandy Clay
- Lime Rock
- Sand Stone

Groundwater Level:
- Static Water Level: 10
- Depth: 60

Pump Test:
- Pumping Level: 10
- Depth: 60

Sealing Material:
- Concrete

Conclusion:
- Well Size: (N
- Source: (N
- Grade: (N
- Developed?: 
  - Yes
  - No

WATER INSPECTION SUMMARY:

GOOD

FAIR

POOR
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.

<table>
<thead>
<tr>
<th>Being struck by lightning</th>
<th>0.16 in 1,000 chance.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.010 mg/L of arsenic in drinking water.</td>
<td>3 out of 1,000 people likely to develop cancer.</td>
</tr>
<tr>
<td>2 pCi of indoor radon level.</td>
<td>4 out of 1,000 people likely to develop lung cancer.(^1)</td>
</tr>
<tr>
<td>2 pCi of indoor radon combined with smoking.</td>
<td>32 out of 1,000 people could develop lung cancer.(^1)</td>
</tr>
</tbody>
</table>

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.

https://www.wisconsinwatch.org/2013/05/22/20-years-after-fatal-outbreak-milwaukee-leads-on-water-testing/
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

Present = Unsafe
Absent = Safe

Greater than or equal to 1 Zero bacteria
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.
Some Common Pathways for Bacteria to Enter Your Water System

Photo: Sandy Helmke, WI DNR

Photo: Sandy Helmke, WI DNR
Karst Topography

Karst topography – (n.) a landscape created by groundwater dissolving sedimentary rock such as limestone.

Photos courtesy of Brown Co. LCD
COLIFORM BACTERIA

• Detected at least once in 6 wells
• Levels were generally low
• No Wells tested Positive for E-Coli

Figure 4. Monthly sample result for each of the 10 wells sampled. Shaded region represents period when maximum soil temperature at 2 cm was less than or equal to 0 degrees Celsius.
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

![Hardness Chart]

- Greater than 200: "HARD WATER"
- 150-200: IDEAL
- Less than 150: "SOFT WATER"
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

<table>
<thead>
<tr>
<th>(-3)</th>
<th>(-2)</th>
<th>(-1)</th>
<th>(0)</th>
<th>(+0.5)</th>
<th>(+1)</th>
<th>(+2)</th>
<th>(+3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe</td>
<td>Moderate</td>
<td>Slight</td>
<td>Ideal</td>
<td>Slight</td>
<td>Moderate</td>
<td>Severe</td>
<td></td>
</tr>
</tbody>
</table>

Corrosion occurs

Scaling occurs
Land Use and Water Quality

Well pumping water
Land-use activity that pollutes groundwater.

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

Health Effects:
• Methemoglobinemia (blue baby disease)
• Possible links to birth defects and miscarriages (humans and livestock)
• Indicator of other contaminants

Sources:
• Agricultural fertilizer
• Lawn fertilizer
• Septic systems
• Animal wastes
Test Important to Health

Nitrate Nitrogen

- Greater than 10 mg/L
  *Exceeds State and Federal Limits for Drinking Water*

- Between 2 and 10 mg/L
  *Some Human Impact*

- Less than 2.0 mg/L
  *“Transitional”*

- Less than 0.2 mg/L
  *“Natural”*

UNSAFE - for infants and pregnant women; everyone should avoid long term consumption.
Sturgeon Bay - Sevastopol
Jacksonport
Door County  July 2014

NITRATE-NITRITE (ppm N)

- A: None Detected  65  43%
- B: ... 2.0  39  26%
- C: 2.1 - 5.0  33  22%
- D: 5.1 - 10.0  14  9%
- E: 10.1 - 20.0  1  <1%
- F: 20.1 ...  0  0%

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

http://ourbetterhealth.org/category/pets/
Lead and Copper

Solutions:

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

or

• Use a treatment device, but generally not necessary
Test Important to Health

Arsenic

Sources: Naturally occurring in mineral deposits

Standard: 0.010 mg/L (10 ppb)

Possible health effects when above 0.010 mg/L:

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

- **Long-term improvements**
  - Eliminate sources of contamination

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

- **Advantages:**
  - Reduce level of contaminants and other impurities
  - Improve taste, color and odor

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

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

- Always have water tested at a certified lab before investing in water treatment.
  - Know the types and amounts of chemicals you would like removed.

- Choose a device that has been approved by the Wisconsin Department of Commerce.
  - Ask for a copy of the approval letter.
    or
  - Check the agency’s Drinking Water Treatment Product Approval website:
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.

www.uwsp.edu/cnr-ap/watershed
Thanks to you and the following for helping sponsor this program:
- Towns of Jacksonport, Sevastopol and Sturgeon Bay
- Door County Environmental Council

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