THANK YOU!

If you have questions during this meeting, you can text or email us

Website: pollEV.com/iredell
Text: IREDELL to 22333

This research was supported by the US Environmental Protection Agency and the National Science Foundation.
Agenda

Welcome: Brady Freeman, Iredell Health and Senator Sawyer

Overview of team: Marc Edwards, Virginia Tech

Overview of sampling: Kelsey Pieper, Virginia Tech

Water results: Rebecca Kriss and Kory Wait, Virginia Tech

Treatment solutions: Wilson Mize, DHHS

Questions
Our research goals

1. Measure lead in drinking water from private wells
2. Examine well water quality and recovery behaviors after Hurricanes Florence and Michael.

Funded by the US Environmental Protection Agency and the National Science Foundation.
Sample collection

6+ hours no water use

First draw sample
Sample collection

6+ hours no water use

Flushed for 5 minutes

First draw sample

Flushed sample
Sample collection

6+ hours no water use

Flushed for 5 minutes

**WATER SOURCE:**

1. What household water supply source was drawn for sample? Check one:
   - □ well
   - □ spring
   - □ cistern
   - □ other → specify: __________________________

   If well is checked above: (a) is it a: □ dug or bored well □ drilled well □ don’t know;
   (b) what is the well’s depth, if known? ______ ft □ don’t know
   (c) what year was well constructed, if known? ______ □ don’t know

2. What water treatment devices are currently installed? Check **all** that apply:
   - □ none
   - □ ultraviolet (UV) light
   - □ acid neutralizer
   - □ water softener (conditioner)
2,358 water samples were collected from 786 residents

Kory Wait, Rebecca Kriss, and Griffin Savedge
2,358 water samples were collected from 786 residents. Over $350,000 in well water testing

Kory Wait, Rebecca Kriss, and Griffin Savedge
### Health-based water quality parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>US EPA standard</th>
<th>NC groundwater standard</th>
<th>NC IMAC and health screening level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>&lt;0.1 µg/L</td>
<td>µg/L</td>
<td>6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Arsenic</td>
<td>&lt;0.1 µg/L</td>
<td>µg/L</td>
<td>10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Barium</td>
<td>9.1 µg/L</td>
<td>µg/L</td>
<td>2,000</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>Boron</td>
<td>8.5 µg/L</td>
<td>µg/L</td>
<td>-</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>Chromium (Total)</td>
<td>0.40 µg/L</td>
<td>µg/L</td>
<td>100</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Hexavalent Chromium (Cr6)</td>
<td>0.10 µg/L</td>
<td>µg/L</td>
<td>-</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.2 µg/L</td>
<td>µg/L</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.1 mg/L</td>
<td>mg/L</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td>1.9 µg/L</td>
<td>µg/L</td>
<td>50</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Thallium</td>
<td>&lt;0.1 µg/L</td>
<td>µg/L</td>
<td>2</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Uranium</td>
<td>19.9 µg/L</td>
<td>µg/L</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vanadium</td>
<td>1.1 µg/L</td>
<td>µg/L</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

**First draw sample**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>Nuisance-based standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium</td>
<td>&lt;0.1 µg/L</td>
<td>µg/L</td>
<td>5</td>
</tr>
<tr>
<td>Copper</td>
<td>0.1250 µg/L</td>
<td>µg/L</td>
<td>1,300</td>
</tr>
<tr>
<td>Lead</td>
<td>1.14 µg/L</td>
<td>µg/L</td>
<td>15</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.230 µg/L</td>
<td>µg/L</td>
<td>100</td>
</tr>
</tbody>
</table>

**5-minute flush sample**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>Nuisance-based standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium</td>
<td>&lt;0.1 µg/L</td>
<td>µg/L</td>
<td>1</td>
</tr>
<tr>
<td>Copper</td>
<td>&lt;1.0 µg/L</td>
<td>µg/L</td>
<td>1,300</td>
</tr>
<tr>
<td>Lead</td>
<td>&lt;0.1 µg/L</td>
<td>µg/L</td>
<td>15</td>
</tr>
<tr>
<td>Nickel</td>
<td>&lt;0.1 µg/L</td>
<td>µg/L</td>
<td>100</td>
</tr>
</tbody>
</table>

### Nuisance-based water quality standards

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>Nuisance-based standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>&lt;10.0 µg/L</td>
<td>µg/L</td>
<td>200</td>
</tr>
<tr>
<td>Chloride</td>
<td>3.7 mg/L</td>
<td>mg/L</td>
<td>250</td>
</tr>
<tr>
<td>Iron</td>
<td>2,566.7 µg/L</td>
<td>µg/L</td>
<td>500</td>
</tr>
<tr>
<td>Manganese</td>
<td>21.7 µg/L</td>
<td>µg/L</td>
<td>50</td>
</tr>
<tr>
<td>Sulfate</td>
<td>4 mg/L</td>
<td>mg/L</td>
<td>250</td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>106.9 mg/L</td>
<td>mg/L</td>
<td>500</td>
</tr>
</tbody>
</table>

### Unregulated water quality parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>Recommended Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>1 mg/L</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Hardness</td>
<td>6.6 mg/L</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Magnesium</td>
<td>1.0 mg/L</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>22.4 µg/L</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Potassium</td>
<td>3567.82 µg/L</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Sodium</td>
<td>3.5 mg/L</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Strontium</td>
<td>172.9 µg/L</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

For more information, contact Kelsey Pieper at Virginia Tech or Andrew George at UNC:

Kelsey Pieper  
Virginia Tech  
kpieper@vt.edu  
(513) 928-0177

Andrew George  
UNC Institute for the Environment  
andrewg@email.unc.edu  
(919) 966-7839
## Health-based water quality parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>US EPA standard(^1)</th>
<th>NC groundwater standard(^2)</th>
<th>NC IMAC(^3) and health screening level(^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>6</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Arsenic</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>10</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Barium</td>
<td>9.1</td>
<td>μg/L</td>
<td>2,000</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Boron</td>
<td>8.5</td>
<td>μg/L</td>
<td>-</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Chromium (Total)</td>
<td>0.40</td>
<td>μg/L</td>
<td>100</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Hexavalent Chromium (Cr6)</td>
<td>0.10</td>
<td>μg/L</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.2</td>
<td>μg/L</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.1</td>
<td>mg/L</td>
<td>4</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Selenium</td>
<td>1.9</td>
<td>μg/L</td>
<td>50</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Thallium</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>2</td>
<td>-</td>
<td>0.2</td>
</tr>
</tbody>
</table>
Enforceable standards for **regulated municipal systems**.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>US EPA standard&lt;sup&gt;1&lt;/sup&gt;</th>
<th>NC groundwater standard&lt;sup&gt;2&lt;/sup&gt;</th>
<th>NC IMAC&lt;sup&gt;3&lt;/sup&gt; and health screening level&lt;sup&gt;4&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>6</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Arsenic</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>10</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Barium</td>
<td>9.1</td>
<td>μg/L</td>
<td>2,000</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Boron</td>
<td>8.5</td>
<td>μg/L</td>
<td>-</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Total Chromium</td>
<td>0.40</td>
<td>μg/L</td>
<td>100</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Hexavalent Chromium (Cr&lt;sub&gt;6&lt;/sub&gt;)</td>
<td>0.10</td>
<td>μg/L</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.2</td>
<td>μg/L</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.1</td>
<td>mg/L</td>
<td>4</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Selenium</td>
<td>1.9</td>
<td>μg/L</td>
<td>50</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Thallium</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>2</td>
<td>-</td>
<td>0.2</td>
</tr>
</tbody>
</table>
## Health-based water quality parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>US EPA standard(^1)</th>
<th>NC groundwater standard(^2)</th>
<th>NC IMAC(^3) and health screening level(^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Arsenic</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>10</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Barium</td>
<td>9.1</td>
<td>μg/L</td>
<td>2,000</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Boron</td>
<td>8.5</td>
<td>μg/L</td>
<td></td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>(^5)Chromium (Total)</td>
<td>0.40</td>
<td>μg/L</td>
<td>10</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>(^5)Hexavalent Chromium (Cr6)</td>
<td>0.10</td>
<td>μg/L</td>
<td></td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.2</td>
<td>μg/L</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.1</td>
<td>mg/L</td>
<td>2</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Selenium</td>
<td>1.9</td>
<td>μg/L</td>
<td>5</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Thallium</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td></td>
<td></td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Health-based groundwater standards**
### Health-based water quality parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Your Result</th>
<th>Units</th>
<th>US EPA standard</th>
<th>NC groundwater standard</th>
<th>NC IMAC and health screening level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Arsenic</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>10</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Barium</td>
<td>9.1</td>
<td>μg/L</td>
<td>2,000</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Boron</td>
<td>8.5</td>
<td>μg/L</td>
<td>-</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Chromium (Total)</td>
<td>0.40</td>
<td>μg/L</td>
<td>100</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Hexavalent Chromium (Cr6)</td>
<td>0.10</td>
<td>μg/L</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.2</td>
<td>μg/L</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.1</td>
<td>mg/L</td>
<td>4</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Selenium</td>
<td>1.9</td>
<td>μg/L</td>
<td>50</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Thallium</td>
<td>&lt;0.1</td>
<td>μg/L</td>
<td>2</td>
<td>-</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Interim standards and goals that have not been fully adopted
Water Testing Results

Rebecca Kriss and Kory Wait

Virginia Tech
Sources of Potential Contaminants

Photo credit: Virginia Household Water Quality Program
Sources of Potential Contaminants

Groundwater

Photo credit: Virginia Household Water Quality Program
Sources of Potential Contaminants

Surface Water

Groundwater

Photo credit: Virginia Household Water Quality Program
Sources of Potential Contaminants

Surface Water

Groundwater

Plumbing materials

Photo credit: Virginia Household Water Quality Program
Sources of Potential Contaminants

Surface Water

Plumbing materials
- Copper
- Lead
- Nickel
- Cadmium
- Zinc
- Iron
- Manganese

Groundwater

Photo credit: Virginia Household Water Quality Program
Sources of Potential Contaminants

Groundwater

Surface Water

Plumbing materials
- Copper
- Lead
- Nickel
- Cadmium
- Zinc
- Iron
- Manganese

Photo credit: Virginia Household Water Quality Program
Metals in Water
Metals in Water
Metals in Water

Water Quality Concerns

Plumbing & Appliance Concerns
Corrosion Problems are Not Uncommon in Wells
Corrosion Problems are Not Uncommon in Wells

Of 2,144 Virginia wells tested 1 in 5 exceeded standards
Corrosion Problems are Not Uncommon in Wells

- Copper: 12%
- Lead: 19%
- Cadmium: 1%
- Nickel: 3%

* Nickel is NC State Standard

n= 786 homes
Corrosion Problems are Not Uncommon in Wells

- Copper: 10.8% exceeding standard
- Lead: 7.5% exceeding standard
- Cadmium: 0.4% exceeding standard
- Nickel: 15% exceeding standard

n = 786 homes

*Nickel is NC State Standard*
Few Wells Exceeded Nuisance-Based Standards

**Nuisance:** Bad Smell, Taste, Staining, Color
Few Wells Exceeded Nuisance-Based Standards

**Nuisance:** Bad Smell, Taste, Staining, Color

- **Iron***: 8%
- **Zinc**: 3%
- **Manganese***: 10%

*After 5 minutes of flushing

n = 786 homes
Few Wells Exceeded Nuisance-Based Standards

**Nuisance:** Bad Smell, Taste, Staining, Color

- **Iron***: 5.7% (Iredell Sampling), 8% (Virginia)
- **Zinc**: 4.6% (Iredell Sampling), 3% (Virginia)
- **Manganese***: 3.8% (Iredell Sampling), 10% (Virginia)

*After 5 minutes of flushing

n= 786 homes
Lead Concentration (\(\mu g/L\))

n = 786 homes
Lead Concentration (µg/L)

EPA Standard: 15 µg/L

n = 786 homes
7.5% of wells exceeded EPA Lead Action Level

EPA Standard: 15 μg/L

n = 786 homes
Copper Concentration (µg/L)

n= 786 homes

Copper
Copper

n= 786 homes

EPA Standard: 1,300 µg/L
Copper Concentration (μg/L)

11% of wells exceeded EPA Standard

EPA Standard: 1,300 μg/L

n = 786 homes
How to Treat Metals in Water
How to Treat Metals in Water
How to Treat Metals in Water

*NSF 53 Certified
How to Treat Metals in Water

*NSF 53 Certified
Flushing
Flushing

First Draw Sample

<table>
<thead>
<tr>
<th></th>
<th>n= 786 homes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>8%</td>
</tr>
<tr>
<td>Copper</td>
<td>11%</td>
</tr>
<tr>
<td>Nickel*</td>
<td>15%</td>
</tr>
</tbody>
</table>

* Nickel is NC State Standard
Flushing

- First Draw Sample
- 5-minute Flushed Sample

**n= 786 homes**

<table>
<thead>
<tr>
<th></th>
<th>Lead</th>
<th>Copper</th>
<th>Nickel*</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Exceeding Standard</td>
<td>8%</td>
<td>11%</td>
<td>15%</td>
</tr>
<tr>
<td>5-minute Flushed Sample</td>
<td>0.4%</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

* Nickel is NC State Standard
Lead removed by filter
Lead removed by filter

Lead Concentration ($\mu$g/L)

Before filter

*NSF 53 Certified
Lead removed by filter

Lead Concentration ($\mu$g/L)

- Before filter:
  - 25.2
  - 26.5
  - 29.3

- After filter:
  - 0.2
  - 0.1
  - 0.1
  - 0.2
  - 0.2

*NSF 53 Certified*
Sources of Potential Contaminants

Surface water

Plumbing materials

Groundwater

Photo credit: Virginia Household Water Quality Program
Sources of Potential Contaminants

Surface water

Plumbing materials

Groundwater

- chloride
- fluoride
- sulfate
- uranium
- chromium

Photo credit: Virginia Household Water Quality Program
Few wells exceed EPA or NC regulations
Few wells exceed EPA or NC regulations

- Uranium: 1.8%
- Fluoride: 0.0%
- Total Chromium: 0.0%
- Boron: 0.0%

n= 786 homes
Few wells exceed EPA or NC regulations

<table>
<thead>
<tr>
<th>Substance</th>
<th>EPA Health Standards</th>
<th>NC GW Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium</td>
<td>1.8%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total Chromium</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Boron</td>
<td>0.1%</td>
<td>* Boron is NC State Standard</td>
</tr>
</tbody>
</table>

n= 786 homes
Uranium

Uranium Concentration (μg/L)

US EPA Standard = 30 μg/L

n = 786
Uranium Concentration ($\mu$g/L)

US EPA Standard = 30 $\mu$g/L

Average = 2.5 $\mu$g/L

$n = 786$
Uranium

US EPA Standard = 30 μg/L

Max = 133.3 μg/L

Average = 2.5 μg/L

n = 786
Few wells exceed nuisance based standards
Few wells exceed nuisance based standards

Nuisance = Bad Smell, Taste, Staining, Color
Few wells exceed nuisance based standards

- Total Dissolved Solids: 2.3% exceeding standards
- Sulfate: 1.5% exceeding standards
- Chloride: 0.1% exceeding standards

Nuisance = Bad Smell, Taste, Staining, Color

n = 786 homes
Hexavalent Chromium (Chrome VI)

**EPA**

Total Chromium = 100 μg/L

Chrome VI = No health based standards
Hexavalent Chromium (Chrome VI)

**EPA**
Total Chromium = 100 μg/L
Chrome VI = No health based standards

**NC**
Total Chromium = 10 μg/L
Chrome VI = No regulatory standards
Hexavalent Chromium (Chrome VI)

EPA
- Total Chromium = 100 μg/L
- Chrome VI = No health based standards

NC
- Total Chromium = 10 μg/L
- Chrome VI = No regulatory standards

NC
- Chrome VI Screening Level = 0.07 μg/L
# Hexavalent Chromium (Chrome VI)

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Average (\mu g/L)</th>
<th>Maximum (\mu g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Survey (US state, not NC) ((n=141))</td>
<td>1.30</td>
<td>16.7</td>
</tr>
<tr>
<td>National Chrome VI Survey ((n=341))</td>
<td>1.08</td>
<td>52.6</td>
</tr>
<tr>
<td>Iredell Sampling Campaign ((n=786))</td>
<td>0.84</td>
<td>13.9</td>
</tr>
<tr>
<td>NCDHHS Well Database ((n=192))</td>
<td>0.64</td>
<td>12.3</td>
</tr>
</tbody>
</table>
Hexavalent Chromium (Chrome VI)

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Average (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Survey (US state, not NC) (n = 141)</td>
<td>1.30</td>
</tr>
<tr>
<td>National Chrome VI Survey (n = 341)</td>
<td>1.08</td>
</tr>
<tr>
<td>Iredell Sampling Campaign (n = 786)</td>
<td>0.84</td>
</tr>
<tr>
<td>NCDHHS Well Database (n = 192)</td>
<td>0.64</td>
</tr>
</tbody>
</table>
## Hexavalent Chromium (Chrome VI)

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Average (μg/L)</th>
<th>Maximum (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Survey (US state, not NC) (n = 141)</td>
<td>1.30</td>
<td>16.7</td>
</tr>
<tr>
<td>National Chrome VI Survey (n = 341)</td>
<td>1.08</td>
<td>52.6</td>
</tr>
<tr>
<td>Iredell Sampling Campaign (n = 786)</td>
<td>0.84</td>
<td>13.9</td>
</tr>
<tr>
<td>NCDHHS Well Database (n = 192)</td>
<td>0.64</td>
<td>12.3</td>
</tr>
</tbody>
</table>
Hexavalent Chromium (Chrome VI)

DHHS health goal = 0.07 μg/L

n= 786 homes
Hexavalent Chromium (Chrome VI)

Average = 0.84 μg/L

DHHS health goal = 0.07 μg/L

n= 786 homes
Hexavalent Chromium (Chrome VI)

Max = 13.92 μg/L

Average = 0.84 μg/L

n = 786 homes

DHHS health goal = 0.07 μg/L
Hexavalent Chromium (Chrome VI) Screening Level

Chrome VI Screening Level = 0.07 μg/L

NCDHHS Database (n = 192)
58%
Hexavalent Chromium (Chrome VI) Screening Level

- Chrome VI Screening Level = 0.07 μg/L

**% Exceeding Level**

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Survey (US State)</td>
<td>63%</td>
</tr>
<tr>
<td>NCDHHS Database</td>
<td>58%</td>
</tr>
</tbody>
</table>

- School Survey (US State) (n = 141)
- NCDHHS Database (n = 192)
Hexavalent Chromium (Chrome VI) Screening Level

% Exceeding Level

Iredell Sampling Campaign (n = 786) - 79%
School Survey (US State) (n = 141) - 63%
NCDHHS Database (n = 192) - 58%

Chrome VI Screening Level = 0.07 μg/L
Vanadium

EPA
No regulatory standard

n= 786 homes
Vanadium

EPA
No regulatory standard

NC
No regulatory standard

n= 786 homes
Vanadium

**EPA**
No regulatory standard

**NC**
No regulatory standard

**NC**
Interim Maximum Allowable Concentration = 0.3 μg/L

n = 786 homes
## Vanadium

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Average (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iredell Sampling Campaign (n = 786)</td>
<td>4.2</td>
</tr>
<tr>
<td>School Survey (US State, not NC) (n = 138)</td>
<td>4.9</td>
</tr>
</tbody>
</table>
## Vanadium

### Data Source

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Average (μg/L)</th>
<th>Maximum (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iredell Sampling Campaign (n = 786)</td>
<td>4.2</td>
<td>39.4</td>
</tr>
<tr>
<td>School Survey (US State, not NC) (n = 138)</td>
<td>4.9</td>
<td>47.7</td>
</tr>
</tbody>
</table>
## Vanadium

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Average (μg/L)</th>
<th>Maximum (μg/L)</th>
<th>Above 0.3 μg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iredell Sampling Campaign (n = 786)</td>
<td>4.2</td>
<td>39.4</td>
<td>86.0%</td>
</tr>
<tr>
<td>School Survey (US State, not NC)</td>
<td>4.9</td>
<td>47.7</td>
<td>76.1%</td>
</tr>
</tbody>
</table>
Vanadium Concentration (μg/L)
Vanadium Concentration (μg/L)

Average = 4.2 μg/L

DEQ IMAC = 0.3 μg/L

n = 786 homes
Vanadium Concentration (μg/L)

- Average = 4.2 μg/L
- Max = 39.4 μg/L
- DEQ IMAC = 0.3 μg/L

n= 786 homes
Hexavalent chromium (Chrome VI) removed by filter
Hexavalent chromium (Chrome VI) removed by filter

Before filter

Chrome IV in water (ppb)
Hexavalent chromium (Chrome VI) removed by filter

Chrome IV in water (ppb)

- Before filter
- After filter

<table>
<thead>
<tr>
<th>Before filter</th>
<th>After filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.82</td>
<td>0.03</td>
</tr>
<tr>
<td>0.93</td>
<td>0.02</td>
</tr>
<tr>
<td>1.31</td>
<td>0.02</td>
</tr>
<tr>
<td>1.36</td>
<td>0.03</td>
</tr>
<tr>
<td>1.32</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Drinking Water Treatment

Wilson Mize, R.E.H.S.
Environmental Health Regional Specialist
On-Site Water Protection Branch
Sources of Potential Contaminants

Surface Water

Groundwater

Photo credit: Virginia Household Water Quality Program
Treat water at the kitchen tap

Treat water in the whole house
Physical treatment

Chemical treatment

Alternative source
Treatment options for corrosion problems

Flushing for 1 min.

NSF 53 carbon filter

Reverse Osmosis
Treatment options for uranium

Reverse Osmosis

Anion Exchange
Treatment options for chromium VI

- ZeroWater™ pitcher filter (anion exchange)
- Reverse Osmosis
- Anion exchange
Treatment options for vanadium

- Ion exchange has been shown to remove vanadium from groundwater
  - Not NFS approved at this time

Ion exchange
Recommendations:

• Contact a minimum of 3 water treatment specialists/companies

• Explain or provide water sample results

• Compare pricing and recommended systems!
Do your homework!

• You can find out if a particular product is certified to perform as advertised by visiting: www.nsf.org

• Test and certify drinking water treatment equipment.
Please send us your questions

Website: pollEV.com/iredell
Text: IREDELL to 22333
Virginia Tech: Marc Edwards and Kelsey Pieper

UNC: Kathleen Gray and Andrew George

Iredell Health Department: Jane Hinson, Susan Robertson, Brady Freeman

Department of Health and Human Services: Nancy Deal, Wilson Mize, John Brooks, Virginia Guidry, Kennedy Holt

Department of Environmental Quality: Linda Culpepper, Brandy Costner, Ellen Lorscheider, Mercedes Hernandez