UCMR3 – What has been found in the Water? 
Update on Chlorate!

Detection patterns in drinking water systems in the Potomac River basin

February 24, 2015
OUTLINE

- Regulatory background
- Quarterly monitoring, EP and MR points
- Analytical method and reporting
- Quarterly downloads, data reduction
- Provisional occurrence (2013-2014)
- Patterns of frequent detection (Chlorate, metals)
- Sources of chlorate
Contaminant Candidate List

- CCL 1 – 1998 (not chlorate)
- CCL 2 – 2005 (perchlorate, but not chlorate)
- CCL 3 – 2009

Third Unregulated Contaminant Monitoring Rule

- Promulgated April 16, 2012
- PWS monitoring: all systems >10,000 (and 800 rep. PWS ≤ 10,000)
- List 1 – Assessment Monitoring (common analytical method)
Sampling Schedule
• Four successive quarterly samples
• During a 12-month period between January 2013 through December 2015

Monitoring Locations
• Entry point (EP) to distribution system, normally at water treatment plant
  • Consecutive systems may use EP connections from supplier
• Maximum residence (MR) time within distribution system, normally at remote limits
• Raw water (not required), additional optional samples by WSSC
UCMR3 – PWS Locations

~33 of 51 PWS reporting (Oct. 2014)

Consecutive PWS

Map Courtesy of ESRI & ICPRB
Analytical Method

- EPA Method 300.1 (Determination of Inorganic Anions in Water by Ion Chromatography), 1993
- Chlorate classified with Inorganic Disinfection Byproducts
  - Other DBPs: Bromate, Bromide, Chlorite
- Holding time 28 days, ethylenediamine preservative
- MRL = 20 µg/L

Reporting

- SDWARS (Safe Drinking Water Accession and Review System)
- PWS review (60 days)
- NCOD (National Contaminant Occurrence Database)
UCMR3 – Data Reduction

NCOD Download

- Updated quarterly postings (latest October 2014)
- Download as zip file, .txt format
- Import as Excel file (22 columns, >500,000 rows)

- Filter by Potomac regions states (DC, MD, PA, VA, WV)
- Filter by PWS name/facility ID (~50 in Potomac River basin)
- Surface water sources (excl. groundwater/wells)
Potomac Occurrence (2013-2014)

- Detected frequently (total number of EP tests = 138)
  - Chlorate
  - Chromium, Hexavalent Chromium, Strontium, Vanadium

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Chromium</th>
<th>Hex. Chromium</th>
<th>Strontium</th>
<th>Vanadium</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n = )</td>
<td>52</td>
<td>126</td>
<td>138</td>
<td>60</td>
</tr>
<tr>
<td>( MRL \ast ) (µg/L)</td>
<td>0.20</td>
<td>0.030</td>
<td>0.30</td>
<td>0.20</td>
</tr>
<tr>
<td>( Range ) (µg/L)</td>
<td>0.20 – 11.3</td>
<td>0.031 – 2.40</td>
<td>15.0 - 518</td>
<td>0.20 – 1.5</td>
</tr>
<tr>
<td>( Mean ) (µg/L)</td>
<td>0.66</td>
<td>0.165</td>
<td>127</td>
<td>0.49</td>
</tr>
<tr>
<td>( Median ) (µg/L)</td>
<td>0.31</td>
<td>0.092</td>
<td>125</td>
<td>0.41</td>
</tr>
<tr>
<td>( HRL \ast ) (µg/L)</td>
<td>100</td>
<td>10 **</td>
<td>4,000</td>
<td>21</td>
</tr>
</tbody>
</table>

- MRL = Minimum reporting level
- HRL = Published health reference or guidance levels (USEPA sources)
- Cr-6 Max. Contaminant Level (CA)

Celestite (SrSO_4), Strontianite (SrCO_3), Chromite (FeCr_2O_4), Patrónite (VS_4)
Potomac Occurrence (2013-2014)
• Detected infrequently
  • 1 synthetic compound, 2 PFs, 1 VOC
  • Molybdenum
• Not detected
  • Hormones
  • Cobalt

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>1,4-dioxane</th>
<th>PFHxS *</th>
<th>PFOS *</th>
<th>Halon 1101</th>
<th>Molybdenum</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n = )</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Range (( \mu g/L ))</td>
<td>0.076 – 0.150</td>
<td>0.066 – 0.069</td>
<td>0.074 – 0.086</td>
<td>0.080 – 2.01</td>
<td>1.1 – 10</td>
</tr>
<tr>
<td>Mean =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.1</td>
</tr>
</tbody>
</table>

- PFHxS = perfluorohexanesulfonic acid
- PFOS = perfluorooctanesulfonic acid
- Halon 1101 = bromochloromethane
Potomac Occurrence (2013-2014)

- **Chlorate**
  - Detected frequently *

<table>
<thead>
<tr>
<th>Source</th>
<th>EP</th>
<th>MR</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n =$</td>
<td>110</td>
<td>106</td>
</tr>
<tr>
<td>$MRL * (\mu g/L)$</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>$Range (\mu g/L)$</td>
<td>20.5 – 897</td>
<td>24.0 – 934</td>
</tr>
<tr>
<td>$Mean (\mu g/L)$</td>
<td>207</td>
<td>220</td>
</tr>
<tr>
<td>$Median (\mu g/L)$</td>
<td>175</td>
<td>172</td>
</tr>
<tr>
<td>$HRL * (\mu g/L)$</td>
<td>210</td>
<td>210</td>
</tr>
</tbody>
</table>

- MRL = Minimum reporting level
- HRL = Published health reference level (USEPA)
- Total number of EP tests = 138, MR tests = 129

Image Courtesy of Wikipedia
### Potomac Occurrence (2013-2014)

- **Chlorate**
  - Raw ≈ EP with chlorine gas

<table>
<thead>
<tr>
<th>Source</th>
<th>Raw (WSSC)</th>
<th>EP (CLGA)</th>
<th>EP (other)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n =)</td>
<td>1</td>
<td>21</td>
<td>85</td>
</tr>
<tr>
<td>(MRL * (\mu g/L))</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>(Range (\mu g/L))</td>
<td>&lt;20 – 40</td>
<td>20.5 – 350</td>
<td>57.7 – 897</td>
</tr>
<tr>
<td>(Mean (\mu g/L))</td>
<td>40</td>
<td>92</td>
<td>233</td>
</tr>
<tr>
<td>(Median (\mu g/L))</td>
<td>40</td>
<td>44</td>
<td>190</td>
</tr>
<tr>
<td>(HRL * (\mu g/L))</td>
<td>n/a</td>
<td>210</td>
<td>210</td>
</tr>
</tbody>
</table>

- **MRL** = Minimum reporting level
- **HRL** = Published health reference level (USEPA)
- **CLGA** = Gaseous chlorine disinfectant

*Image Courtesy of Wikipedia*
from CCL3:
• “Chlorate compounds are used in agriculture as defoliants or desiccants . . .”
• “. . . and may occur in drinking water related to use of disinfectants . . .”

Agricultural Uses:
• Desiccant/Defoliant = Sodium Chlorate (NaClO₃) CAS RN# 7775-09-9
• Trade names “Helena” or “Defol” or “Poly-Foliant”
• Used on cotton, safflower, corn, flax, peppers, soybeans, grain sorghum, southern peas, dry beans, rice and sunflowers crops
• Non-selective contact herbicide, phytotoxic to all green plant parts
• Acute oral LD₅₀ = 1,200 – 7,000 mg/kg
• Environmental persistence: 3 – 4 months in soil, more rapid decomposition in moist soils, >70 degrees F

Sources Courtesy of EXTOXNET,
University of Arizona,
New Mexico State University
from CCL3:

- “Chlorate compounds are used in agriculture as defoliants or desiccants . . .”
- “. . . and may occur in **drinking water** related to use of disinfectants . . .”

**Drinking Water:**

- Disinfectants: esp. chlorine dioxide, hypochlorite
- More from Alex Gorzalski (WAD)

**Questions / Contact:**

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