Artesian Water Company, Inc.
Emerging Contaminants and Secondary Water Standards in the Mid-Atlantic Region
Artesian Water Company, Inc on the Delmarva Peninsula
WATER SERVICE FACTS

Population Served – approximately 301,000
Metered Customers – 88,300
Annual Production – 7.9 billion gallons
Miles of main – 1,311
Active Wells - 191
Treatment Facilities – 66
Storage Capacity – 174 million gallons
Water Service Territory – 285 square miles
Wastewater Service Territory – 26 square miles
Average Cost Per Day - $1.68
The Fourth Unregulated Contaminant Monitoring Rule (UCMR4)

What is the Unregulated Contaminant Monitoring Rule?

The 1996 amendments to the Safe Drinking Water Act (SDWA) require that once every five years, the U.S. Environmental Protection Agency (EPA) issue a new list of no more than 30 unregulated contaminants to be monitored by public water systems (PWS). The Unregulated Contaminant Monitoring Rule (UCMR) provides EPA and other interested parties with scientifically valid data on the occurrence of contaminants in drinking water. This national survey is one of the primary sources of information on occurrence and levels of exposure that the Agency uses to develop regulatory decisions for contaminants in the public drinking water supply.

The "Revisions to the Unregulated Contaminant Monitoring Rule (UCMR 4) for Public Water Systems and Announcement of Public Meeting" was published in the Federal Register on December 20, 2015 (81 FR 52666). UCMR 4 monitoring will occur from 2018-2020 and includes monitoring for a total of 30 chemical contaminants: 10 cyanotoxins (nine cyanotoxins and one cyanotoxin group) and 20 additional contaminants (two metals, eight pesticides plus one pesticide manufacturing byproduct, three brominated haloacetic acid [HAA] disinfection byproducts groups, three alcohols, and three semivolatile organic chemicals [SVOCs]).

What contaminants are systems monitoring for under UCMR 4?

Under UCMR 4, PWSs will conduct sampling for Assessment Monitoring ("List 1") contaminants as shown in the table below. For additional information on these contaminants, please review the contaminant-specific UCMR Fact Sheet.

10 Cyanotoxins (Nine Cyanotoxins and One Cyanotoxin Group)

- Total microcystins
- Microcystin-LR
- Microcystin-LY
- Microcystin-YR
- Anatoxin-a
- Cyanoheptadine
- Cyanoheptadine N-oxide
- Cyanoheptadine monomethylamine
- Cyanoheptadine dimethylamine
- Cyanoheptadine trimethylamine

20 Additional Contaminants

- Germanium
- Manganese
- Alpha-hexachlorocyclohexane
- Profenofos
- Chlorpyrifos
- Tebuconazole
- Diketonoin
- Total permethrin (ica- & trans-)
- Etohexaprop
- Trihexafos
- Oxfluorfen
- HAAs
- HAABs
- 1-butanol
- 2-Propan-1-ol
- 2-Methoxyethanol
- Butylated hydroxyanisole
- 3-Tolualine
- Quinoline

Which water systems will participate in UCMR 4?

Approximately 6,000 PWS will participate in UCMR 4. All community water systems (CWSs) and non-transient non-community water systems (NTNCWSs) serving more than 10,000 people (i.e., large systems) are required to monitor:

- All large surface water (SW) and ground water under the direct influence of surface water (GWUDI) systems will monitor for cyanotoxins and the 20 additional contaminants.
- All large ground water systems will monitor for the 20 additional contaminants.

Office of Water (Ms-140) EPA 815-F-16-007 December 2016

- Fourth Unregulated Contaminant Monitoring Rule (UCMR4)
- Testing 2018 – 2020
- Includes Herbicides, Pesticides, Fungicides and Plant Growth Regulators
Llangollen

$4.7 million invested to enhance capability in New Castle County
Proposed UCMR5

PFOS, PFOA and PFCs first on list

Already setting Health Advisory Limits

Still found in products
June 12, 2014 Public Notice

Artesian’s Wilmington Manor 3 Treatment Plant detected levels of Perfluorooctane Sulfonate (PFOS) Above Provisional Health Advisory

Our water system recently exceeded a provisional health advisory. As our customers, you have a right to know what happened, what you should do, and what we are doing to correct the situation.

As part of the federal Unregulated Contaminant Monitoring Rule 3 (UCMR3), we monitored for the presence of an EPA selected group of 28 unregulated drinking water contaminants. On June 2, 2014, we received notice that the samples collected on July 17, 2013 and January 28, 2014 showed at our Wilmington Manor 3 Treatment Plant that we exceeded the Federal provisional health advisory for PFOS
NARUC 2019 SUMMER POLICY SUMMIT

Artesian Water Company, Inc.
Emerging Contaminants and Secondary Water Standards in the Mid-Atlantic Region
Emerging Contaminants
Poly and Perfluoroalkyl Substances

July 23, 2019
Robert R. Scott, Commissioner
New Hampshire Department of Environmental Services
Emerging Contaminants

- USEPA tests for select unregulated contaminants every 5 years
- Often originate from everyday consumer products (pharmaceuticals, personal care products, coatings, fabrics, paint, pesticides etc.)
- Perceived, potential, or real threat to human health or the environment
- Lack of published health standards
- New source or new pathway to humans has been discovered
- New detection method or treatment technology has been developed
What was “0” just years ago is now detectable. Better lab equipment is fueling public concern.

Emerging Contaminants are not regulated and generally health effects are not well understood.

Wide range of data on emerging contaminants, some backed by science and some by fake news.

Utilities are expected to provide water that meets regulatory standard which is often different than the public’s demands for water with “0” levels of contamination.

Contrary to public opinion the cost of treating all water to a Maximum Contaminant Level Goal Of Zero is more than the public can afford.

The “vocal” public believes no risk is acceptable.

The public believes the cost of treatment should be borne by the Utility.
Poly and Perfluoroalkyl Substances

• A class of chemicals that are ubiquitous due to
  – Wide variety of uses
  – Persistence
  – High Mobility

• They are a concern due to:
  – Known or suspected toxicity, especially for PFOS, PFOA, PFNA and PFHxS
  – Bioaccumulation (ppt in water = ppb in blood)

• Information on PFAS is rapidly evolving
  – EPA Health Advisory Levels for PFOA/PFOS were substantially lowered in 2016
  – NH has recently adopted new standards that are 6-7 times lower
Uses & Sources of PFAS

PFAS are used in a wide variety of industries and commercial products for their valuable properties, including fire resistance, dust suppression, and oil, stain, grease, and water repellence. (Some examples of uses are on the following slides)

- Fire fighting foams (AFFF) used in military and civilian airports as well as some other industrial facilities.
Uses & Sources of PFAS

- Polishes, waxes, paints
- Stain repellants (carpets, clothing and upholstered furniture)
- Cleaning products

From: Hillary Thornton, USEPA Region 4
Uses & Sources of PFAS

- Food surfaces (Teflon\textsuperscript{1} pans, pizza boxes, popcorn bags, food wrappers)

\textsuperscript{1} https://en.wikipedia.org/wiki/Polytetrafluoroethylene PFOA, which used to be a key ingredient in making Teflon, has been phased out, however there is little evidence that the chemicals that have replaced PFOA are much safer.

\textsuperscript{2} Shaider, \textit{Environ. Sci. Technol. Lett.}, Publication Date (Web): February 1, 2017
http://pubs.acs.org/doi/epdf/10.1021/acs.estlett.6b00435

From: Hillary Thornton, USEPA Region 4
Uses & Sources of PFAS

- Dust suppression for chrome plating
- Electronics manufacturing
- Oil and mining for enhanced recovery
- Performance chemicals (hydraulic fluid, fuel)

From: Hillary Thornton, USEPA Region 4
Uses & Sources of PFAS

1) Paints.
2) Sealants, including products used on grout, countertops and floor treatments.
3) House cleaners and stain removers.
4) Floor wax removers.
5) Stain-resistant textiles (or chemicals used to treat textiles in homes and businesses) including, but not limited to, carpets, shoes and clothing.
6) Furniture with stain-resistant fabric.
7) Water proof textiles.
8) Food cooking ware and utensils.
9) Ski and boat waxes.
10) Dental floss, cosmetics, sunscreen and other personal care products.
11) Construction materials, including caulk sealants and plumbing sealants.
12) Pesticides.
13) Treated paper.
14) Chemical coatings for metal roofing.
15) Solar panels.
16) Purchased garden soils.
17) Automotive supplies, including waxes, cleaners, windshield wipers and additives to fluids used in automobiles.
18) Camping and other outdoor gear.
19) Spray- and grease-based lubricants.
20) Inks.
PFAS Sampling Timeline in NH

2013-2015 UCMR 3
(21 water systems / 80 sources)

2014 – DoD / Superfund Sampling
(3 major water supply wells)

2016 – Sampling of wells around two air emissions sites
(1000+ wells)

Present – Statewide sampling
(3000+ multi-media samples)
PFAS INVESTIGATION
Updated: July 9, 2019

SAMPLES WITH PFAS DETECTS
TOTAL PFAS (ppt)

- 70+
- 45 - <70
- Detect - <45

Existing Remedial Site
with PFAS Detections

Political Boundary
Major Waterbody
Conservation Land

Miles
0  12.5  25  50

NEW HAMPSHIRE DEPARTMENT OF Environmental Services
## Public Water System Sampling in NH

<table>
<thead>
<tr>
<th>Combined PFOA &amp; PFOS Result</th>
<th>Number of Public Water System Sources</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 70 ppt</td>
<td>18</td>
<td>4%</td>
</tr>
<tr>
<td>Greater than 60 ppt</td>
<td>20</td>
<td>4%</td>
</tr>
<tr>
<td>Greater than 50 ppt</td>
<td>21</td>
<td>4%</td>
</tr>
<tr>
<td>Greater than 40 ppt</td>
<td>22</td>
<td>5%</td>
</tr>
<tr>
<td>Greater than 30 ppt</td>
<td>30</td>
<td>6%</td>
</tr>
<tr>
<td>Greater than 20 ppt</td>
<td>47</td>
<td>10%</td>
</tr>
<tr>
<td>Greater than 10 ppt</td>
<td>74</td>
<td>16%</td>
</tr>
<tr>
<td>Greater than 5 ppt</td>
<td>102</td>
<td>22%</td>
</tr>
<tr>
<td>Greater than ND</td>
<td>179</td>
<td>40%</td>
</tr>
<tr>
<td>Non-detect</td>
<td>277</td>
<td>62%</td>
</tr>
</tbody>
</table>

Number of Sources Tested = 471
<table>
<thead>
<tr>
<th>Substance</th>
<th>Number of Detections</th>
<th>Maximum Concentration Detected (ppt)</th>
</tr>
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<tbody>
<tr>
<td>PFOA/PFOS</td>
<td>179</td>
<td>279</td>
</tr>
<tr>
<td>PFOA</td>
<td>170</td>
<td>106</td>
</tr>
<tr>
<td>PFOS</td>
<td>83</td>
<td>173</td>
</tr>
<tr>
<td>PFHPA*</td>
<td>69</td>
<td>22.8</td>
</tr>
<tr>
<td>PFHXS</td>
<td>62</td>
<td>159</td>
</tr>
<tr>
<td>PFHXA</td>
<td>52</td>
<td>79.1</td>
</tr>
<tr>
<td>PFBS</td>
<td>50</td>
<td>49</td>
</tr>
<tr>
<td>PFPEA</td>
<td>41</td>
<td>76</td>
</tr>
<tr>
<td>PFBA</td>
<td>34</td>
<td>19.7</td>
</tr>
<tr>
<td>PFNA</td>
<td>17</td>
<td>73</td>
</tr>
<tr>
<td>PFHPS</td>
<td>4</td>
<td>2.66</td>
</tr>
<tr>
<td>N_ETFOSA</td>
<td>2</td>
<td>5.81</td>
</tr>
<tr>
<td>PFDS</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PFTRDA</td>
<td>1</td>
<td>4.28</td>
</tr>
<tr>
<td>FOSA</td>
<td>1</td>
<td>4.6</td>
</tr>
</tbody>
</table>

*PFHPA has been identified as a common lab contaminant.
NH Adopted MCLs

Health-Based Risk Assessment Process based on non-cancer endpoints

<table>
<thead>
<tr>
<th>Specific PFAS</th>
<th>NHDES Revised MCLs</th>
<th>Health Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOA</td>
<td>12 ng/L</td>
<td>Liver toxicity &amp; altered lipid metabolism</td>
</tr>
<tr>
<td>PFOS</td>
<td>15 ng/L</td>
<td>Suppressed immune response to vaccines</td>
</tr>
<tr>
<td>PFHxS</td>
<td>18 ng/L</td>
<td>Reduced female fertility</td>
</tr>
<tr>
<td>PFNA</td>
<td>11 ng/L</td>
<td>Liver toxicity &amp; altered lipid metabolism</td>
</tr>
</tbody>
</table>
## Drinking Water / Groundwater

*(Select Locations – Established or Proposed Standards and Guidance Values)*

<table>
<thead>
<tr>
<th>Location</th>
<th>Concentration (ng/L) (* also includes sum of indicated analytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PFOA</td>
</tr>
<tr>
<td>USEPA</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Alaska*</td>
<td>70</td>
</tr>
<tr>
<td>Rhode Island*</td>
<td>*70</td>
</tr>
<tr>
<td>Maine</td>
<td>*70</td>
</tr>
<tr>
<td>Connecticut*</td>
<td>*70</td>
</tr>
<tr>
<td>Vermont</td>
<td>*20</td>
</tr>
<tr>
<td>Massachusetts*</td>
<td>*20</td>
</tr>
<tr>
<td>Minnesota</td>
<td>35</td>
</tr>
<tr>
<td>California</td>
<td>10</td>
</tr>
<tr>
<td>New Jersey</td>
<td>14</td>
</tr>
<tr>
<td>New York</td>
<td>10</td>
</tr>
<tr>
<td>New Hampshire</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

* - Indicates standard is based on the sum of multiple PFAS compounds

Sources: State webpages and ITRC PFAS Fact Sheets (https://pfas-1.itrcweb.org/fact-sheets/)
Survey of States Adopting PFAS MCLs

- 7 states have or are in the process of establishing MCLs
- 3 states may establish MCLs
- 15 states can establish MCLs but currently do not intend to
- 12 states have laws or policies prohibiting them from making any standard that is more stringent than Federal requirements

13 states did not respond to the survey

Source: Association of State Drinking Water Administrators – June 2019
New Hampshire is suing the original makers of toxic PFAS chemicals for allegedly contaminating the state's drinking water.

At a press conference Wednesday, Gov. Chris Sununu joined officials from the Departments of Justice and Environmental Services to announce two statewide lawsuits against eight companies – including 3M, DuPont and its spinoff, Chemours.

"New Hampshire is taking, again, a preeminent position not just for ourselves and our citizens, but in the country ... in making a stand against the introduction of the PFAS compounds into our drinking water," Sununu says.

You can read the complaints at:

https://www.courts.state.nh.us/caseinfo/index.htm
PFAS Presents Unique Challenges

- Two sites in NH Contaminated by Air Emissions
- Its presence in drinking water is measurable in our residents’ blood – health implication is not known
- Currently have standards for four out of thousands PFAS
- Public exposed to PFAS in drinking water are demanding regulations be set at “0” or “non-detect”
  - Feel no level is safe
  - Remediate their bodies
Concept of Regulating a Contaminant to “0”

- No state drinking water standard is set at 0 or non-detect.
- Detection limits keep getting lower. At some level there is no such thing as non-detect.

- Standards need necessary justification
  - Public health improvement
  - Consistent with public health protection approach for other contaminants

- NH provides information on how homeowners can treat to non-detect for $200-$3000.

- Standards must be based on real-world limitations
  - Treatment technologies/Analytical limitations
  - Simultaneous compliance with other safe drinking water regulations
Challenge to Water Utilities

- Public confidence
  - Waiting on the science
- Cost to treat
  - Carbon/resin
  - Blending
  - Well closures
  - Higher O&M costs
- Regulatory Uncertainty
  - What’s next?
Approaches to PFAS removal

Mark Vannoy, P.E.
ECT2
### USEPA PFAS treatment assessment – Fayetteville Regional Summit

#### Drinking Water Treatment for PFOS

#### Ineffective Treatments
- Conventional Treatment
- Low Pressure Membranes
- Biological Treatment (including slow sand filtration)
- Disinfection
- Oxidation
- Advanced oxidation

#### Effective Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Percent Removal</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anion Exchange Resin (IEX)</td>
<td>90 to 99</td>
<td>Effective</td>
</tr>
<tr>
<td>High Pressure Membranes</td>
<td>93 to 99</td>
<td>Effective</td>
</tr>
<tr>
<td>Powdered Activated Carbon (PAC)</td>
<td>10 to 97</td>
<td>Effective for only select applications</td>
</tr>
<tr>
<td>Granular Activated Carbon (GAC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Extended Run Time</td>
<td>0 to 26</td>
<td>Ineffective</td>
</tr>
<tr>
<td>- Designed for PFAS Removal</td>
<td>&gt; 89 to &gt; 98</td>
<td>Effective</td>
</tr>
</tbody>
</table>

#### PAC Dose to Achieve
- 50% Removal: 16 mg/L
- 90% Removal: >50 mg/L

*Dudley et al., 2015*
PFAS treatment options

- Biological Treatment
- Air Stripping
- Ion Exchange (IEX) Resin
- Reverse Osmosis
- GAC
- Foam Fractionation
- Reverse Osmosis
- Advanced Oxidation
How does IEX resin remove PFAS?

Dual mechanism of removal: IEX and adsorption

PFOS Molecule

By Manuel Almagro Rivas - Own work using: Avogadro, Discovery Studio, GIMP, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=47567609

Simplified Resin Bead

GAC only has Adsorption
Removal comparison – PFOS + PFOA

**GAC**
- First sample at 574 gals Treated 2860 BVs
- HAL – 70 ppt PFOS+PFOA
- City Stopped GAC at 10,400 gal Treated

**IX Resin**
- IX Resin is ND after 171,000 BV’s or 34,300 gals Treated (2.5 min EBCT)
## Weston & Sampson’s (independent consultant) lifecycle cost analysis

<table>
<thead>
<tr>
<th>Treatment Option</th>
<th>Capital Cost</th>
<th>Annual Operating Cost</th>
<th>Present Worth Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAC</td>
<td>$2,140,000</td>
<td>$304,000</td>
<td>$6,271,000</td>
</tr>
<tr>
<td>Resin</td>
<td>$1,090,500</td>
<td>$99,300</td>
<td>$3,173,000</td>
</tr>
</tbody>
</table>

**Twenty-Year Present Worth Analysis (USD)**
PFAS contamination at RAAF Base Tindal
Public outcry is driving action
Town of Katherine water supply IX resin system: expedited overseas transport in Antonov AN-225 Mriya
Treatment system being loaded onto Antonov in the US
Plug and play installation
Questions?

Mark Vannoy
(207) 482-4668
mvannoy@ect2.com