KEEPING WATER SAFE, CLEAN, AND SUSTAINABLE
PFAS RESPONSE: UNINTENDED IMPACTS ON UTILITY AND MUNICIPAL OPERATIONS AND BUDGETS

PRESENTED AT THE MEWEA LEGISLATIVE BREAKFAST, FEBRUARY 27, 2020:

BY
ANDREW CARPENTER & LEIGH DORSEY
OF NORTHERN TILTH
OVERNIGHT MORATORIUM ON BIOSOLIDS RECYCLING PROGRAMS IN MAINE, INCLUDING BIOSOLIDS AND SEPTAGE-BASED COMPOSTS IN MARCH 2019

...A STRONG REGULATORY REACTION DRIVEN BY A STRATEGIC NEWS CONFERENCE ON A FARM...
PFAS – WHAT ARE THEY?

- Stable, C-F bond strength
- Low volatility
- High molecular weight

- Thermally stable
- Hydrophobic
- Lipophobic
- Surfactant properties

- Focus on small percentage of the total number of PFAS compounds (3,000+)

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

www.main.gov/dep
What is PFOS?
(perfluorooctane sulfonic acid)

Carbon backbone

Octane

Perfluorooctane sulfonic acid (PFOS)
WHERE ARE PFAS COMPOUNDS USED
(NOT AN EXHAUSTIVE LIST)
We are all exposed to PFOS.

Why are we concerned about PFOS?

Source:
PFOS IS TOXIC

Australian Expert Health Panel (May 2018)
“… there is mostly limited, or in some cases no evidence, that human exposure to PFAS is linked with human disease” and “there is no current evidence that suggests an increase in overall cancer risk”
“… even though the evidence for PFAS exposure and links to health effects is very weak and inconsistent, important health effects for individuals exposed to PFAS cannot be ruled out based on the current evidence”

excerpted from Dr. Linda Lee (Perdue U.) 2019 presentation
### ME AND NH BIOSOLIDS AND SEPTAGE-BASED COMPOST RESULTS

<table>
<thead>
<tr>
<th></th>
<th>PFOA</th>
<th>PFOS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ug/kg (ppb) dry wt. basis</td>
<td></td>
</tr>
<tr>
<td><strong>Median values</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biosolids Compost ME</td>
<td>3.1</td>
<td>5.2</td>
</tr>
<tr>
<td>Septage Compost ME</td>
<td>18.2</td>
<td>35.7</td>
</tr>
<tr>
<td>WRRF Solids ME</td>
<td>3.8</td>
<td>22.9</td>
</tr>
<tr>
<td>Biosolids NH</td>
<td>1.6</td>
<td>13.0</td>
</tr>
<tr>
<td><strong>Maximum values</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biosolids Compost ME</td>
<td>23.8</td>
<td>17.0</td>
</tr>
<tr>
<td>Septage Compost ME</td>
<td>60</td>
<td>82</td>
</tr>
<tr>
<td>WRRF Solids ME</td>
<td>46</td>
<td>120</td>
</tr>
<tr>
<td>Biosolids NH</td>
<td>10</td>
<td>28</td>
</tr>
<tr>
<td>Maine Screening Std.</td>
<td>2.5</td>
<td>5.2</td>
</tr>
<tr>
<td>NEBRA data summary</td>
<td>Avg.</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>2001 US biosolids *</td>
<td>Avg.</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>34</td>
<td>403</td>
</tr>
</tbody>
</table>

No clear trends in types of processing/size of WRRF v. PFAS concentrations, but it does appear that septage compost concentrations are typically higher than biosolids compost concentrations.

Voluntary phase out of PFOA and PFOS use in US → lower levels in the environment

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PFAS SAMPLING

SOME PFAS SAMPLING NO-NO’S
(NOT AN EXHAUSTIVE LIST)

• GORE-TEX & OTHER WATERPROOF FABRICS
• MOST SUNSCREENS & INSECT REPELLENTS
• CLOTHES THAT HAVE BEEN WASHED FEWER THAN 6 TIMES SINCE PURCHASE
• CLOTHING LAUNDERED WITH FABRIC SOFTENER
• POST-IT NOTES
• PLASTIC CLIPBOARDS
• CHEMICAL (BLUE) ICE PACKS
• ALUMINUM FOIL

Image Source: SIXCLASSES.ORG.
Reproduced here for educational purposes only.
SAMPLING PROCEDURES FOR SOIL

• DIG A HOLE 10” DEEP

• USE THE “DIRTY” SPOON TO SCRAPE AWAY THE SOIL THAT CAME INTO CONTACT WITH SHOVEL

• USE THE “CLEAN” SPOON TO SCOOP A COLUMN OF SOIL FROM THE SIDE OF THE HOLE FROM 8” DEEP TO THE SURFACE

• REPEAT THIS 10-20 TIMES PER FIELD, DEPENDING ON FIELD SIZE! YAY!!
CO$T CONSIDERATIONS

• AN EXPERIENCED 2-PERSON TEAM CAN AVERAGE 30 – 45 MINUTES PER FIELD IF FIELDS ARE 10 ACRES OR LESS & CLOSE TOGETHER

• COST OF ANALYSIS FOR SOIL IS $235-$300 PER SAMPLE

• QUALITY CONTROL MEASURES SUCH AS FIELD & EQUIPMENT BLANKS ARE ~ $175 PER SAMPLE. “EXTRACT & HOLD” IS AN OPTION FOR REDUCING COSTS IF ACCEPTABLE TO STATE REGULATORS

• NO EPA-APPROVED METHOD FOR ANALYZING COMPOUNDS IN ANY MEDIA OTHER THAN GROUNDWATER → CRITICAL TO WORK WITH LABS THAT HAVE MODIFIED METHODS THAT HAVE BEEN DEEMED ACCEPTABLE BY REGULATORY AGENCIES
UNINTENDED CONSEQUENCES - LANDFILLING

- BIOSOLIDS THAT HAVE BEEN HISTORICALLY RECYCLED TO IMPROVE SOIL HEALTH AND REDUCE THE USE OF COMMERCIAL FERTILIZERS HAVE BEEN DIVERTED TO LANDFILLS.
- LANDFILLS ONLY HAVE SO MUCH CAPACITY TO TAKEN IN MATERIALS WITH THE PHYSICAL CONSISTENCY OF BIOSOLIDS:
  - GREATER EXPENSE FOR LANDFILLING
  - CAPACITY APPEARS TO NOT EXIST FOR THIS SHIFT IN MANAGEMENT OF BIOSOLIDS
- BIOSOLIDS BEING DIVERTED TO CANADA → VERY HIGH HAULING COSTS
GREENHOUSE GAS EMISSIONS IMPACTS
(EACH SCENARIO INCLUDES THICKENING, DE-WATERING AND TRANSPORT)

- CO₂ Equivalence (Mg/year)

-5000 0 5000 10000 15000 20000 25000

- Energy recovery
- Cold wet climate

- 800°C
- 25% solids
- Digested solids
- No recovery

- 900°C
- 30% solids
- Undigested
- Energy recovery
- Cement replacement

- Class A using recycled lime source such as CKD

- Heat and electricity recovered
- 1% fugitive

- Landfill
- Incineration 1
- Incineration 2
- Land Ap
- Class A Alkaline
- Anaerobic dig.
UNINTENDED CONSEQUENCES: FARMERS NEED TO PROTECT THEIR PRODUCTS FROM BAD PRESS
### PFOS Concentration In Soil Using Site-Specific Background

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Current Soil Concentration (ug/kg)</td>
<td>2.13</td>
</tr>
<tr>
<td>PFOS concentration in compost (ug/kg)</td>
<td>17.8</td>
</tr>
<tr>
<td>PFOS soil increase per year (ug/kg)</td>
<td>0.04</td>
</tr>
<tr>
<td>% background increase from 1 application</td>
<td><strong>1.84</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Years Residual Applied</th>
<th>PFOS Conc in Soil After Application (ug/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.17</td>
</tr>
<tr>
<td>2</td>
<td>2.21</td>
</tr>
<tr>
<td>3</td>
<td>2.25</td>
</tr>
<tr>
<td>4</td>
<td>2.29</td>
</tr>
<tr>
<td>5</td>
<td>2.33</td>
</tr>
</tbody>
</table>
### RESULTS FROM OTHER MEDIA

There has been a significant decrease in the concentration of PFOA and PFOS in the US population over the last 2 decades.

<table>
<thead>
<tr>
<th>Source</th>
<th>PFOA</th>
<th>PFOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Blood - US population 1999 (CDC NHANES)</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Human Blood - US population 2012 (CDC NHANES)</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Dust in US Daycare Centers (Strynar and Lindstrom, 2008)</td>
<td>142</td>
<td>201</td>
</tr>
<tr>
<td>Household compost (Europe, Brandli et al 2007. J. Env. Monitoring)</td>
<td>median</td>
<td>6 (sum of PFAS)</td>
</tr>
<tr>
<td>Vermont Background Soil conc. (Zhu et al 2019, by UVM for VT DEC)</td>
<td>Avg.</td>
<td>0.52</td>
</tr>
<tr>
<td>Concealer/Foundation cosmetic (Danish EPA 2018)</td>
<td>Up to</td>
<td>2370</td>
</tr>
</tbody>
</table>
In the spring and summer of 2019 the Maine Dept. of Ag and NEBRA analyzed milk and forage from a combined four farms that have used biosolids on a regular basis as a soil amendment. All PFAS compounds analyzed (PFBS, PFOA and PFOS) were below analytical reporting limits in all samples. This in contrast to detections in milk and forage results for one farm in southern Maine with significant levels of PFAS in milk and forage that which the Maine DEP has determined is not from biosolids land applied on that farm.

- Tested three commercial dairy farms across the state.
  - All three farms <50 ng/L Reporting Limit
- Two with long-term histories of biosolid application from different waste water treatment plants and/or paper mill residual. Third close to the farm with a PFAS problem.
- Based on the survey and these three farm results, DACF has high confidence in the safety of Maine-produced milk.

excerpted from McBrady ME DACF presentation Jan. 2020
Results from other media.

From Choi et al. 2019. Perfluoroalkyl acid characterization in U.S. municipal organic solid waste composts. – supporting data provided by Dr. Linda Lee, Purdue University

<table>
<thead>
<tr>
<th>Source Description</th>
<th>PFOA conc. (ug/kg dry wt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Municipal solid waste</td>
<td>6.88</td>
</tr>
<tr>
<td>2 Municipal solid waste and wood products</td>
<td>2.54</td>
</tr>
<tr>
<td>3 Residential and commercial food and yard waste, compostable food serviceware products</td>
<td>3.58</td>
</tr>
<tr>
<td>4 Residential food and yard waste</td>
<td>7.85</td>
</tr>
<tr>
<td>5 Mixed group, hands</td>
<td>10.31</td>
</tr>
<tr>
<td>6 Residential food and yard waste, &amp; compostable food serviceware</td>
<td>2.73</td>
</tr>
<tr>
<td>7 Food waste, horse manure, wood shavings, coffee grounds and lobster shells, &amp; compostable food serviceware</td>
<td>3.64</td>
</tr>
<tr>
<td>8 Leaves and grass waste from municipalities</td>
<td>0.48</td>
</tr>
<tr>
<td>9 Residential back yard compost bin</td>
<td>1.05</td>
</tr>
<tr>
<td>10 Leaves</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Note that the PFOA level in several of these non-biosolids composts would be higher than the Maine screening standard of 2.5 ppb.

As we work towards recovering a greater percentage of our organic wastes, the likelihood of unintentionally capturing more PFAS-type compounds is likely.
Exhibit ES-1 - Average and Maximum Total PFAS Concentrations by Waste Type
PFAS IN THE LARGER CONTEXT OF USING ORGANIC WASTES TO BUILD SOIL HEALTH AND FERTILITY

• DIOXIN/FLAME RETARDANTS
• ANTIBIOTICS
• RESIDUAL PESTICIDES
• TRACE METALS
  • CADMIUM IN PHOSPHORUS SOURCES
  • ARSENIC IN CHICKEN MANURE
  • ZINC IN WOOD ASH

WHY PFAS IS DIFFERENT THAN SOME OF THE OTHER PAST CHALLENGES

DIFFERENCES BETWEEN FARM WITH IMPACTS AND GENERAL PRACTICES AND SOIL LEVELS
RECOMMENDATIONS/REQUESTS

- RECOGNITION THAT PFAS COMPOUNDS ARE A PASS-THROUGH MATERIAL AT WRRFS AND IN BIOSOLIDS
  - THEY ARE NOT CREATED DURING THE WASTEWATER TREATMENT PROCESS; WE ARE KEEPING WATER CLEAN AND IMPROVING SOIL HEALTH AND HAVE TO DEAL WITH THE TRACE LEVELS OF THESE COMPOUNDS THAT COME FROM OUR THEIR WIDESPREAD USE IN CONSUMER PRODUCTS

- IMPROVED RISK-BASED SOIL AND SOIL AMENDMENT STANDARDS, BASED ON STUDIES AND PATHWAYS SPECIFIC TO LAND APPLICATION AND COMPOSTING/COMPOST USE
  - BIOSOLIDS AND COMPOST PFAS LEVELS APPEAR TO BE DECREASING OVER TIME, HOWEVER WITH CURRENT MAINE STANDARDS, LEVELS FOUND IN CONTEMPORARY BIOSOLIDS AND BIOSOLIDS PRODUCTS CONSTRAIN PROGRAMS IN WHICH THE MATERIALS ARE RECYCLED AS SOIL AMENDMENTS

- CLEAR COMMUNICATION THAT THE PFAS PROBLEM IDENTIFIED ON ONE FARM IS NOT RELATED TO THE PAST USE OF BIOSOLIDS FROM MUNICIPAL WRRFS

- LESS FOCUS ON BIOSOLIDS AS THE PROBLEM, AND MORE FOCUS ON OTHER PATHWAYS OF EXPOSURE AND WHAT CAN BE DONE TO DECREASE ACTUAL RISKS TO HUMANS AND THE ENVIRONMENT
  - ENCOURAGE DELIBERATE REGULATORY APPROACHES THAT CONSIDER BENEFITS AS WELL AS RISKS RELATED TO RECYCLING RESIDUALS AS SOIL AMENDMENTS