May 2nd, 10:30 AM - 12:00 PM

What Goes Down the Drain Eventually Reaches the River: Characterizing Contaminants of Emerging Concern (CECs) in the Columbia River Basin

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WHAT GOES DOWN THE DRAIN EVENTUALLY REACHES THE RIVER: CHARACTERIZING CONTAMINANTS OF EMERGING CONCERN IN THE COLUMBIA RIVER BASIN

Jennifer Morace, USGS Oregon Water Science Center
First Steps...

- Targeted at known knowledge gaps
- Characterize important pathways of contaminant transport to Columbia River
- Begin to offer information on a broad suite of toxics that will help water managers and policy makers make informed decisions
Columbia River Inputs Study

- Characterize pathways contributing directly to the Columbia River

- WWTP effluent
- Stormwater runoff
Wenatchee
Richland
Umatilla
Vancouver
Portland
Hood River
The Dalles
Longview
St Helens
Vancouver
Portland
Contaminants analyzed in WWTP effluent

- Pharmaceuticals
- Anthropogenic-indicator compounds
- Organochlorine compounds
- PCBs
- PBDEs
- Mercury
- Currently used pesticides
- Estrogenicity
# Contaminants measured in WWTP effluents

## Percent of compounds detected

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent Detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasticizers</td>
<td>100%</td>
</tr>
<tr>
<td>Steroids</td>
<td>100%</td>
</tr>
<tr>
<td>Detergent metabolites</td>
<td>87.5%</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>78.6%</td>
</tr>
<tr>
<td>Personal care products</td>
<td>78.6%</td>
</tr>
<tr>
<td>PAHs</td>
<td>80%</td>
</tr>
<tr>
<td>Flame retardants</td>
<td>86.7%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>78.6%</td>
</tr>
<tr>
<td>PCBs</td>
<td>50%</td>
</tr>
<tr>
<td>Pesticides</td>
<td>26.4%</td>
</tr>
<tr>
<td>Overall</td>
<td>58.1%</td>
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</tbody>
</table>

*Data from USGS*
### Percent of detection at each WWTP sampled

<table>
<thead>
<tr>
<th></th>
<th>Total # analyzed</th>
<th>Wenatchee</th>
<th>Richland</th>
<th>Umatilla</th>
<th>The Dalles</th>
<th>Hood River</th>
<th>Vancouver</th>
<th>Portland (am)</th>
<th>Portland (noon)</th>
<th>Portland (pm)</th>
<th>St. Helens</th>
<th>Longview</th>
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</thead>
<tbody>
<tr>
<td>Plasticizers</td>
<td>4</td>
<td>100</td>
<td>50</td>
<td>25</td>
<td>50</td>
<td>25</td>
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<td>100</td>
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<tr>
<td>Steroids</td>
<td>4</td>
<td>100</td>
<td>100</td>
<td>75</td>
<td>75</td>
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<td>75</td>
<td>75</td>
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<td>75</td>
<td>100</td>
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<td>Detergent Metabolites</td>
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<td>50</td>
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<td>63</td>
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<tr>
<td>Pharmaceuticals</td>
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<td>53</td>
<td>34</td>
<td>41</td>
<td>54</td>
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<td>46</td>
<td>47</td>
<td>47</td>
<td>42</td>
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<td>Personal Care Products</td>
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<td>33</td>
<td>47</td>
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<td>53</td>
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<td>47</td>
<td>53</td>
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<td>11</td>
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<td>0</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>22</td>
<td>44</td>
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<td>Flame Retardants</td>
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<td>76</td>
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<td>82</td>
<td>65</td>
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<tr>
<td>Miscellaneous</td>
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<td>47</td>
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<td>29</td>
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<td>35</td>
<td>35</td>
<td>47</td>
<td>35</td>
<td>53</td>
</tr>
<tr>
<td>PCBs</td>
<td>18</td>
<td>44</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>11</td>
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<tr>
<td>Pesticides</td>
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<td>12</td>
<td>18</td>
<td>15</td>
<td>13</td>
<td>16</td>
<td>9</td>
<td>13</td>
<td>9</td>
<td>13</td>
<td>15</td>
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<tr>
<td>Overall</td>
<td>255</td>
<td>37</td>
<td>25</td>
<td>28</td>
<td>33</td>
<td>29</td>
<td>30</td>
<td>29</td>
<td>32</td>
<td>30</td>
<td>33</td>
<td>40</td>
</tr>
</tbody>
</table>
Compounds found at all WWTPs
maximum concentrations shown in micrograms per liter (ppb)

- Tri(2-chloroethyl)phosphate – 0.65
- Tri(dichloroisopropyl)phosphate – 0.69
- Benzophenone – 0.28
- 1,4-Dichlorobenzene – 0.88
- Galaxolide (HHCB) – 2.5
- Cholesterol – E 6.3
- 3-beta-Coprostanol – E 5.8
- beta-Sitosterol – E 3.2
- PBDE congeners (47, 66, 85, 99, 100, 153, 154)
- trans-Chlordane – 0.00019

E = estimated
Pharmaceuticals found at all WWTPs

maximum concentrations shown in micrograms per liter (ppb)

- Iminostilbene – 0.4
- Citalopram (Celexa, Cipramil) – 0.5
- Diltiazem – 0.4
- Lidocaine – 0.4
- Methocarbamol (Robaxin) – 13
- Phenobarbital – 0.2
- Tramadol (Ultram) – 0.4
- Carbamazepine – 0.12
- Phenytoin (Dilantin) – 0.6
- Diphenhydramine (Benadryl, Motrin PM, …) – 0.11

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.
Diphenhydramine

- Antihistamine

- Uses
  - Relieves allergy and cold symptoms
  - Prevents and treats motion sickness
  - Treats insomnia
  - Controls abnormal movements (Parkinson’s syndrome)

- Products
  - 89 different brand names
  - 112 brand names for combination medications

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.
Loadings to the Columbia

- Diphenhydramine in Portland
  - 49 mgd from WWTP
  - Average concentration of 0.064 µg/L
  - 10 g/day of diphenhydramine
  - 1 tablet = 25 mg
  - 400 tablets/day (16 boxes)

- Could lead to Columbia concentration of 0.001 µg/L

Idea of "pseudo-persistence"
Lessons learned

- The actions of society have an effect on the ecosystem.
- What goes down the drain reaches the river and the biota that rely on it. Not everything is cleaned up by the WWTP.
- Most stormwater is not treated.
Columbia River Contaminants and Habitat Characterization

http://www.youtube.com/watch?v=S2RRlbpIGHg

EDCs and PBDEs
Foodweb Sampling Design

Passive samplers

- contaminant analyses
- sediment transport modeling
- estrogen screen

Large-scale Suckers

- contaminant analyses
- organ and whole body biomarkers

Sediments

Invertebrates

- contaminant analyses
- community assessment

Osprey

- contaminant analyses
- productivity assessment
- well bird blood analyses
Biomagnification in the food web

BDE100

BMF=8

Largescale sucker

BMF=122

Macroinvertebrates

BSAF=30

Osprey

Sediment

Science of the Total Environment, v. 484, pp. 319-389

Special Section: Foodweb Transfer, Sediment Transport, and Biological Effects of Emerging and Legacy Organic Contaminants in the Lower Columbia River, Oregon and Washington, USA

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Questions?

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503.251.3229

Jack Ohman, The Oregonian, May 2007

THE VIAGRA IN THE WATER MAKES ME WANT TO SWIM UPSTREAM, BUT THE PROZAC IS MAKING ME TOO TIRED.