Emerging contaminants in NC rivers: Strategies for protecting water quality

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On behalf of the NC Coastal Federation
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Unlisted emerging contaminants in drinking water sources

• When chemicals are not included in priority pollutant lists, there are no water quality standards and monitoring is not routinely performed.

• Safe Drinking Water Act provides for priority contaminant monitoring (53 organic chemicals) and emerging contaminant prioritization (Contaminant Candidate List – currently includes 97 chemicals).

• EPA decides which chemicals are priorities for monitoring and future regulation.

• Which chemicals are “emerging”? Which pose risks to human health?
How do we avoid another GenX situation in NC waters?

• The only way to avoid being taken by surprise with unlisted (non-priority designated) emerging contaminants is to monitor for them.

• “Holistic” emerging contaminant monitoring in water is not routine. State labs do not have this capability currently.

• There are two approaches for anticipating emerging contaminant problems in water:
  – **Top Down**: Know which chemicals in commerce are potentially problematic, and monitor for those in water.
  – **Bottom Up**: Extensively monitor drinking water sources for the presence, identity, and levels of pollutants
Top Down: Can we tabulate risky chemicals from regulatory lists?

• Our chemical universe:
  – How many chemicals exist? ~ 80-130 million
  – How many chemicals are used in commerce? ~ 85,000 (TSCA)
  – How many chemicals have been tested for toxicity? < 10,000 (hard to tabulate)
  – How many chemicals are flagged as “priority pollutants” under CWA? 126
  – How many chemicals are flagged as “toxic pollutants” under CWA? 65
  – How many chemicals have been banned by EPA? 9 (PCBs, dioxins, chlorofluorocarbons, asbestos, hexavalent chromium, and four carcinogenic mixed nitrates used in metalworking)
Which chemicals are highly used in commerce?
Example: What can we find out about GenX from EPA TSCA inventory data?
Example: What can we find out about GenX from EPA TSCA inventory data?

“The Chemical Data Reporting (CDR) Rule, issued under the Toxic Substances Control Act (TSCA), requires manufacturers (including importers) to give EPA information on the chemicals they produce domestically or import into the United States. EPA uses the data to help assess the potential human health and environmental effects of these chemicals and makes the non-confidential business information it receives available to the public.”
Top Down chemical prioritization: What do we need to prevent GenX situation?

• More information on which chemicals in commerce are produced and used, with location.

• Full production-volume information on chemicals in commerce (all chemicals on TSCA list).

• Relief from Confidential Business Information (CBI) disclosure limits: must be made available to researchers outside US EPA.
### Bottom Up: Why is it hard to identify emerging contaminants early?

<table>
<thead>
<tr>
<th>Strategies for analytical characterization of emerging contaminants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Screening technique:</strong></td>
</tr>
<tr>
<td>Question:</td>
</tr>
<tr>
<td>Compound Types:</td>
</tr>
</tbody>
</table>

“There are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don’t know we don’t know.”
Challenges for routine Bottom Up analysis of emerging contaminants

• “Non-Targeted” analysis of emerging contaminants relies on very specialized analytical instrumentation.

• The high resolution mass spectrometers needed are not available in most state monitoring labs (~ $1,000,000 capital cost).

• Standard methods are not deployed for performing “Non-Targeted” contaminant monitoring in ambient waters of NC.

• Expertise for such analysis is at research level.
Bottom up analysis of non-priority pollutants in water CAN be done

• Several “Non-Targeted” emerging contaminant surveillance programs are in place within the US and Europe:
  – California EPA State Water Resources Control Board
  – San Francisco Bay Regional Monitoring Program
  – International Rhine River Monitoring Network (Canton of Basel, Switzerland)
California has implemented a state-wide emerging contaminant monitoring program.

- Incorporates risk-based screening as well as ambient monitoring.
- Collaboration of state regulatory agencies, local water boards, non-profit organizations, and academic researchers.
- Multi-Tier, science-based prioritization scheme for anticipating risks associated with emerging contaminants in water.
Statewide CEC Monitoring (1993-2016)

Filter by Program/Station Name
Program: (All)
Station Name: (All)

Filter by Year
Sample Count

Filter by Analyte
Category: Analyte
Antimicrobial: Triclosan, Total
Flame retardants: PBDE 047, Total
PBDE 099, Total
Industrial: Bis(2-ethylhexyl)phthalate, Total
Butyl Benzyl Phthalate, Total
Nonylphenol, p- Total
Pesticides: Bifenthrin, Total
Chlorpyrifos, Total
Fipronil Desulfuryl Amide, Dissolved
Fipronil Desulfuryl, Dissolved
Fipronil Desulfuryl, Total
Fipronil Sulfide, Dissolved
Fipronil Sulfide, Total
Fipronil Sulfone, Dissolved
Fipronil Sulfone, Total
Fipronil, Dissolved
Fipronil, Total
Permethrin, cis-, Total
Permethrin, Total
Permethrin, trans, Total
Pharmaceuticals: Ibuprofen, Total
Surfactants: Perfluorobutanesulfonate, Total
Perfluorobutanoate, Total
Perfluorodecanoate, Total

Sample Count

© OpenStreetMap contributors

Statewide CEC Monitoring Dashboard
152 views | SWAMP OIMA
Contaminants of Emerging Concern (CEC): The San Francisco Bay Story

Slides courtesy of:
Rebecca Sutton, San Francisco Estuary Institute – Aquatic Science Center
Regional Monitoring Program

**Partnership** to understand the **health** of San Francisco Bay
RMP Participants

RMP Fees by Sector: 2017

- Municipal WWTFs: 45%
- Stormwater: 24%
- Dredgers: 18%
- Industry: 11%
- Cooling Water: 2%

Budget: $3.5M
RMP Focus on CECs

- 10+ years of monitoring and studies
  - Primarily ambient water, sediment, biota
  - Some wastewater and stormwater
- 2013 CEC Synthesis and Strategy
  - Added non-targeted analysis, bioanalytical tools
- 2017 Strategy Revision
River Rhine
An Overview...

<table>
<thead>
<tr>
<th>Category</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>1233 km</td>
</tr>
<tr>
<td>Catchment area</td>
<td>220,000 km²</td>
</tr>
<tr>
<td>Total discharge</td>
<td>2,300 m³/sec</td>
</tr>
<tr>
<td>Habitants living in the catchment</td>
<td>58 Mio</td>
</tr>
<tr>
<td>Habitants supplied with drinking water</td>
<td>20 Mio</td>
</tr>
</tbody>
</table>

Courtesy of: Heinz Singer, Rahel Comte, Martin Loos, Matthias Ruff, Juliane Hollender

Swiss Federal Institute for Aquatic Research
International monitoring network

Warning and Alarm Plan

- **7 Headquarters**
- **7 Monitoring stations**

<table>
<thead>
<tr>
<th>Threshold concentration levels [µg/L]</th>
<th>regional</th>
<th>international</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticides, Biocides, Pharmaceuticals</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>other Substances</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Courtesy of: **Heinz Singer, Rahel Comte, Martin Loos, Matthias Ruff, Juliane Hollender**

Swiss Federal Institute for Aquatic Research
Principle of using time series

Sampling → LC-HRMS → Statistical analysis

Courtesy of: Heinz Singer, Rahel Comte, Martin Loos, Matthias Ruff, Juliane Hollender
Swiss Federal Institute for Aquatic Research
Indomethacin spill

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Swiss Federal Institute for Aquatic Research
Indomethacin spill

Polluter could be located!

Concentration (max): > 0.4 µg/L
Load (over 14 days): 170 kg
Take home messages: Anticipating emerging contaminant risks in water

• Routine water quality monitoring programs will NOT protect human health from unlisted, non-priority emerging contaminants.

• Chemical production, use, and release information databases are insufficient for effective emerging contaminant prioritization.

• Sophisticated emerging contaminant monitoring programs are currently in use here in the US and abroad.

• Emerging contaminant surveillance in rivers will require significant investment in expertise and infrastructure.

• State, private, and academic entities can and should all work in concert to avoid another GenX situation in NC.