Calculating MCLs

1. Target Human Serum Level
   - Animal serum level
   - + Uncertainty factors

2. Dosimetric Adjustment Factor
   - Volume of distribution
   - \( \times \)
   - \( \frac{\ln(2)}{\text{human half-life}} \)

3. Reference Dose

4. Exposure Estimates
   - Relative source contribution
   - +
   - Ingestion rate

5. Maximum Contaminant Level (MCL)
**Exposure Estimates**

**Relative source contribution (RSC)**

- **Ingestion rate**

**RSC**

- Proportion of the total daily exposure to a chemical that is attributed to or allocated to tap water
- US EPA guidance on RSC*:  
  - Use values between 20%-80% (0.2-0.8)  
  - Default to 20% if inadequate data

**Example RSCs Used**

<table>
<thead>
<tr>
<th></th>
<th>NJ</th>
<th>NH</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOA</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>PFOS</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>PFHxS</td>
<td>na</td>
<td>0.5</td>
</tr>
<tr>
<td>PFNA</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000)*

### Ingestion Rate

- How much water is consumed on a per body weight basis
- We consume different volumes of water at different life stages*
- Infants and children drink more water on a per body weight basis than adults

### Ingestion Rates Used

<table>
<thead>
<tr>
<th></th>
<th>L/kg/day</th>
<th>Based on:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJ</td>
<td>0.029</td>
<td>non-pregnant, non-lactating adult</td>
</tr>
<tr>
<td>NH</td>
<td>0.055</td>
<td>lactating woman</td>
</tr>
<tr>
<td>VT</td>
<td>0.175</td>
<td>first year of life based on combined direct and indirect water intake</td>
</tr>
</tbody>
</table>

https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252
1. Many PFAS are bioaccumulative
2. PFAS cross the placenta
3. PFAS are transferred to infants in breastmilk
4. Infants are particularly vulnerable
   • Highest exposure estimates on a per body weight basis
   • Susceptible to developmental programming
A New Exposure Model For PFAS

A transgenerational toxicokinetic model and its use in derivation of Minnesota PFOA water guidance

Helen M. Goeden¹ · Christopher W. Greene¹ · James A. Jacobus¹
• Infant consumes formula reconstituted with PFAS contaminated water
• Infant exclusively breastfed for 6 months with breastfeeding tapered to zero by 12 months

• BOTH MODELS:
  • PFAS crosses placenta –born with existing body burden
  • Continues drinking PFAS contaminated water throughout life
INPUT

- Half life
- Placental transfer ratio
- Breast milk transfer ratio
- Volume of distribution
- Target human serum level

OUTPUT

- 50% of the reference serum concentration
- 20% of the reference serum concentration

Dependent on target human serum level
What Are The Predicted Serum Concentrations Over Time Given A Particular Drinking Water Concentration?

50% of reference serum concentration:
- 0.050 µg/L (50 ppt)

20% of reference serum concentration:
- 0.040 µg/L (40 ppt)
- 0.035 µg/L (35 ppt)
Model Outputs Based on MDH Target Human Serum Level

The drinking water level suggested for formula-fed infants (150 ppt), would not have been protective for breastfed infants, so MDH set a health based guidance value of 35 ppt based on breastfed infants. MDH PFOA HBGV
Impacts of Exposure Assumptions in NHDES MCL Calculations

Modeled Serum PFOA Concentrations

- 38 ppt (NHDES proposed MCL)
- 10 ppt (using model for breastfed infants)
- >50% for 9 years

Modeled Serum PFOS Concentrations

- 70 ppt (NHDES proposed MCL)
- 38 ppt (using model for breastfed infants)
- >50% for 8.5 years
Impacts of Exposure Assumptions in NHDES MCL Calculations

**Modeled Serum PFHxS Concentrations**

- 85 ppt (NHDES proposed MCL)
- 49 ppt (using model for breastfed infants)
- >50% for 11.5 years

**Modeled Serum PFNA Concentrations**

- 23 ppt (NHDES proposed MCL)
- 7 ppt (using model for breastfed infants)
- >50% for 9.5 years
The new exposure model created by MN Dept. of Health more fully considers the
- long half life of PFAS
- ability to cross the placenta and pass through breastmilk.

The new model is protective of a vulnerable population – infants and children.

The model predicts that current MCLs proposed by NHDES will not protect children for the first 10 years of their life.
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• Tides Foundation

View our full comments to NHDES at:
https://endocrinedisruption.org/assets/media/documents/TEDX_NHDES_comments.pdf