Incorporating New Exposure Model In Drinking Water Calculations

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THE ENDOCRINE DISRUPTION EXCHANGE

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CHE-Alaska

Calculating MCLs

1. **Target Human Serum Level**

   Animal serum level
   ÷
   Uncertainty factors

×

2. **Dosimetric Adjustment Factor**

   Volume of distribution
   X
   Ln(2) / 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

	NJ	NH
PFOA	0.2	0.4
PFOS	0.2	0.5
PFHxS	na	0.5
PFNA	0.5	0.5

*Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000)
https://www.epa.gov/sites/production/files/2018-10/documents/methodology-wqc-protection-hh-2000.pdf

Exposure Estimates

Relative source contribution (RSC) ÷ **Ingestion rate**

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

	L/kg/day	Based on:
NJ	0.029	non-pregnant, non-lactating adult
NH	0.055	lactating woman
VT	0.175	first year of life based on combined direct and indirect water intake

*U.S. EPA. Exposure Factors Handbook 2011 Edition (Final Report) https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252

These Exposure Estimates Are Inadequate For PFAS

1. Many PFAS are bioaccumlative
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

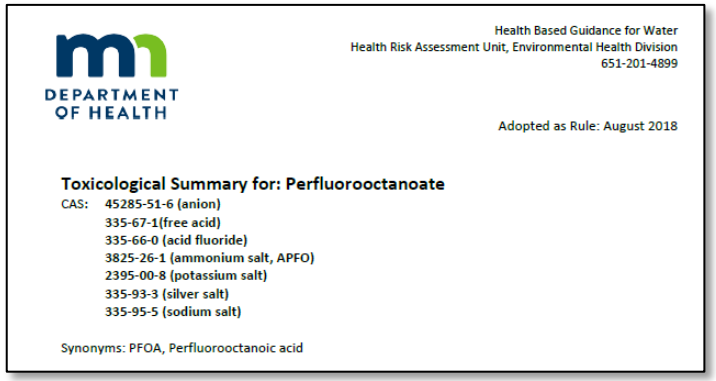
A New Exposure Model For PFAS

Journal of Exposure Science & Environmental Epidemiology
https://doi.org/10.1038/s41370-018-0110-5

ARTICLE

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

Helen M. Goeden[1] · Christopher W. Greene[1] · James A. Jacobus[1]



DEPARTMENT OF HEALTH

Health Based Guidance for Water
Health Risk Assessment Unit, Environmental Health Division
651-201-4899

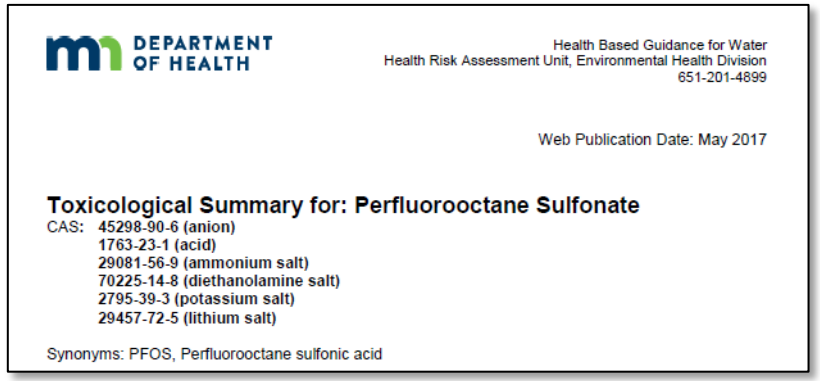
Adopted as Rule: August 2018

Toxicological Summary for: Perfluorooctanoate

CAS: 45285-51-6 (anion)
335-67-1(free acid)
335-66-0 (acid fluoride)
3825-26-1 (ammonium salt, APFO)
2395-00-8 (potassium salt)
335-93-3 (silver salt)
335-95-5 (sodium salt)

Synonyms: PFOA, Perfluorooctanoic acid

MDH PFOA HBGV



DEPARTMENT OF HEALTH

Health Based Guidance for Water
Health Risk Assessment Unit, Environmental Health Division
651-201-4899

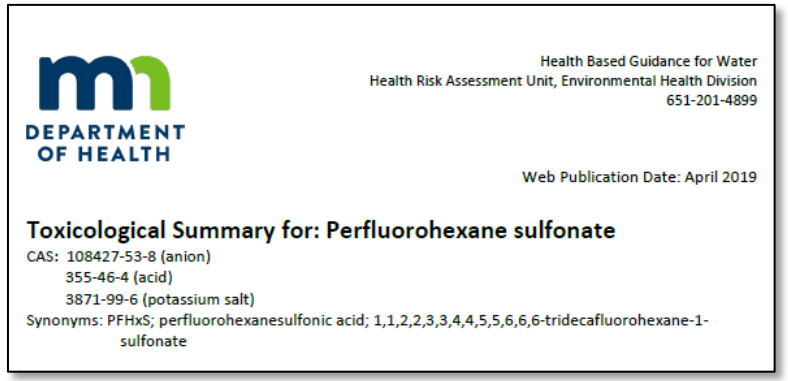
Web Publication Date: May 2017

Toxicological Summary for: Perfluorooctane Sulfonate

CAS: 45298-90-6 (anion)
1763-23-1 (acid)
29081-56-9 (ammonium salt)
70225-14-8 (diethanolamine salt)
2795-39-3 (potassium salt)
29457-72-5 (lithium salt)

Synonyms: PFOS, Perfluorooctane sulfonic acid

MDH PFOS HBGV



DEPARTMENT OF HEALTH

Health Based Guidance for Water
Health Risk Assessment Unit, Environmental Health Division
651-201-4899

Web Publication Date: April 2019

Toxicological Summary for: Perfluorohexane sulfonate

CAS: 108427-53-8 (anion)
355-46-4 (acid)
3871-99-6 (potassium salt)

Synonyms: PFHxS; perfluorohexanesulfonic acid; 1,1,2,2,3,3,4,4,5,5,6,6,6-tridecafluorohexane-1-sulfonate

MDH PFHxS HBGV

Two Exposure Scenarios

- Infant consumes formula reconstituted with PFAS contaminated water
- Infant exclusively breastfed for 6 months with breastfeeding tapered to zero by 12 months

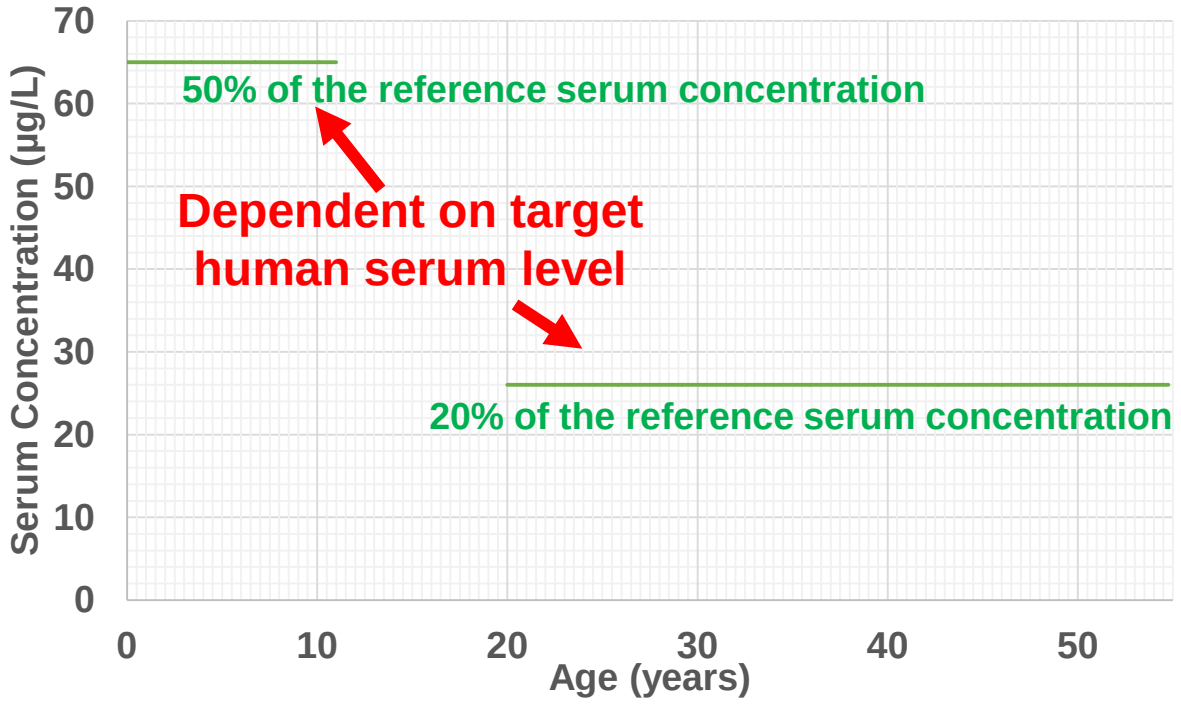
- BOTH MODELS:
  - PFAS crosses placenta –born with existing body burden
  - Continues drinking PFAS contaminated water throughout life

Using the Model

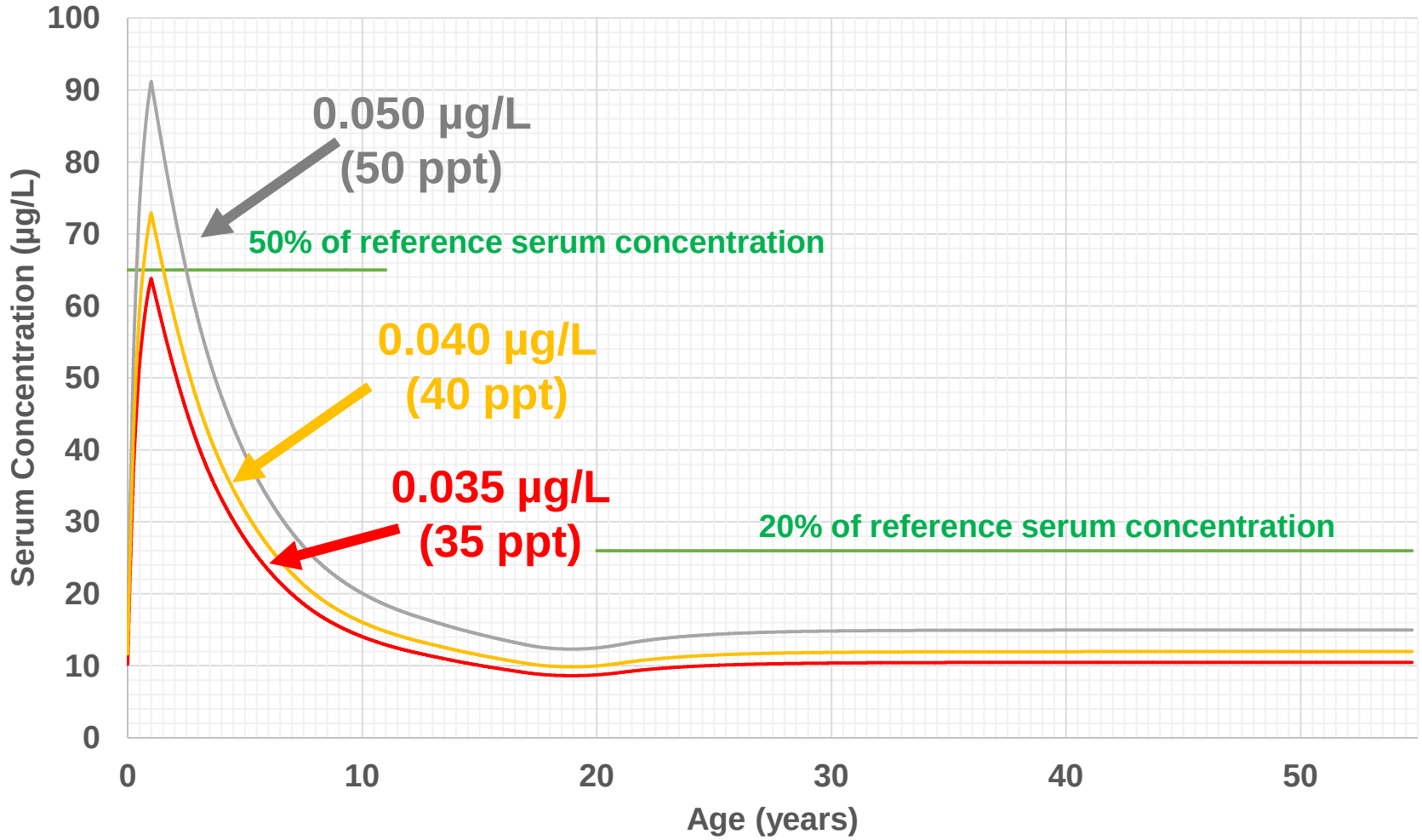
INPUT

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

OUTPUT

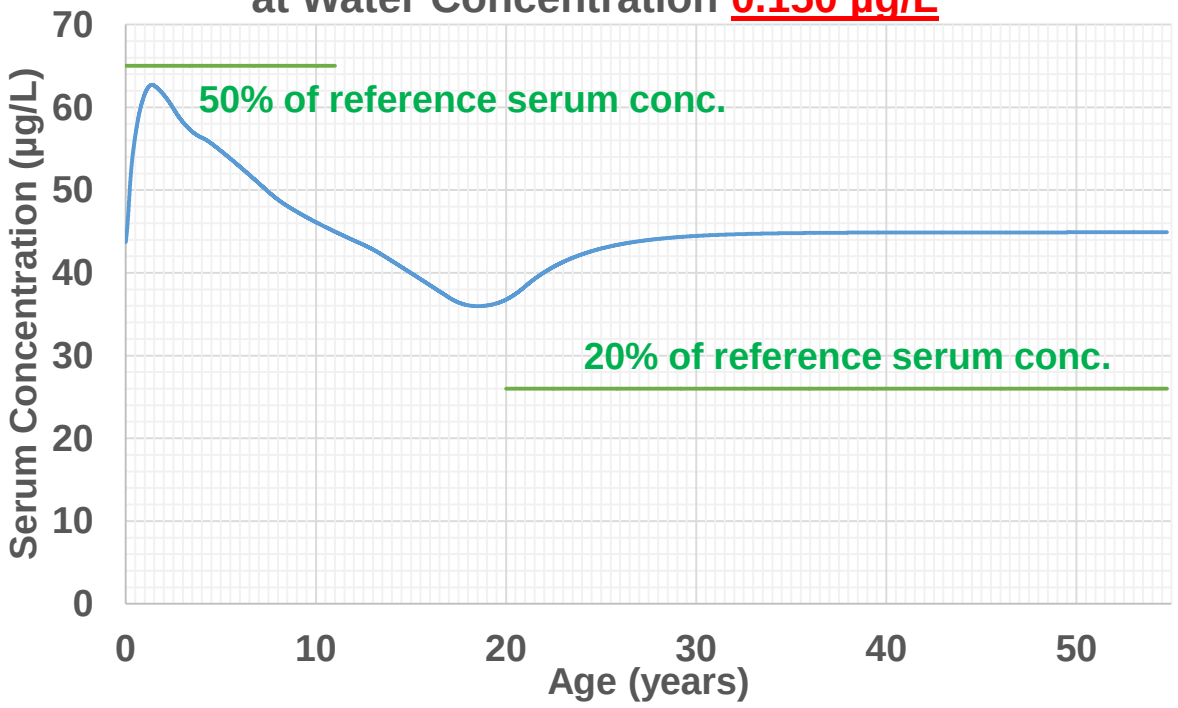


What Are The Predicted Serum Concentrations Over Time Given A Particular Drinking Water Concentration?

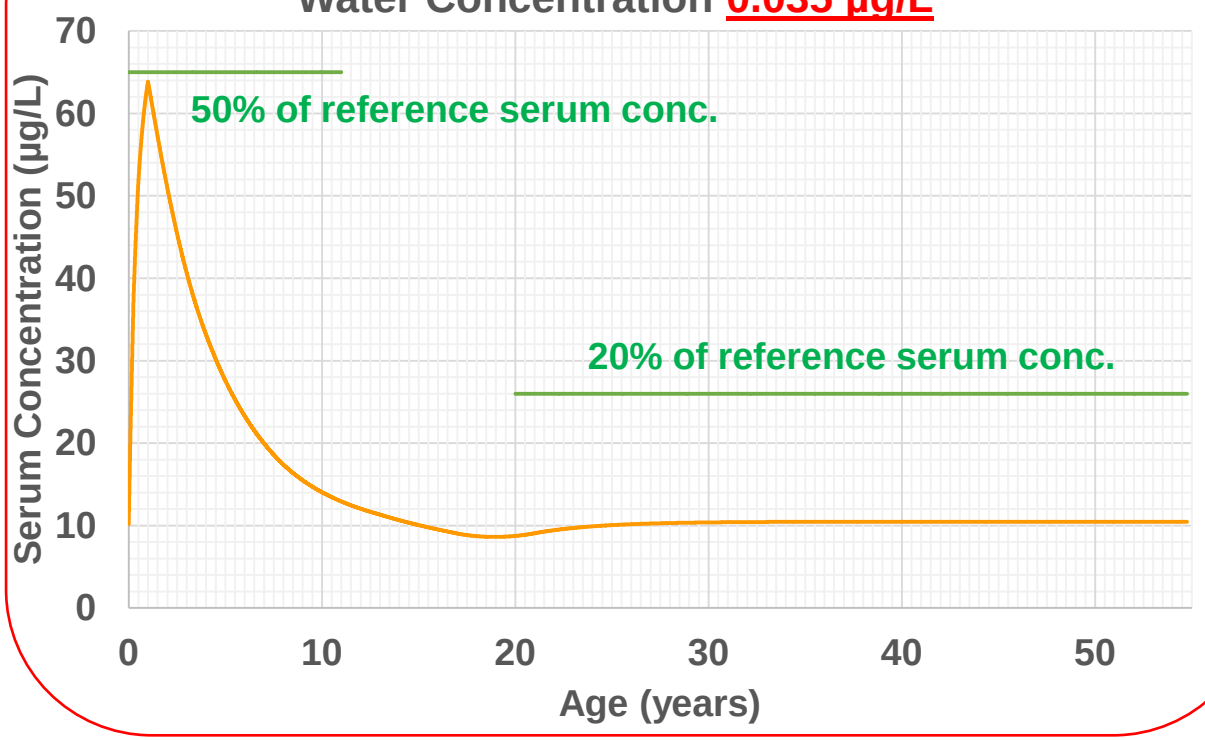


Model Outputs Based on MDH Target Human Serum Level

Formula-fed Infant Scenario PFOA Serum Concentration at Water Concentration **0.150 µg/L**



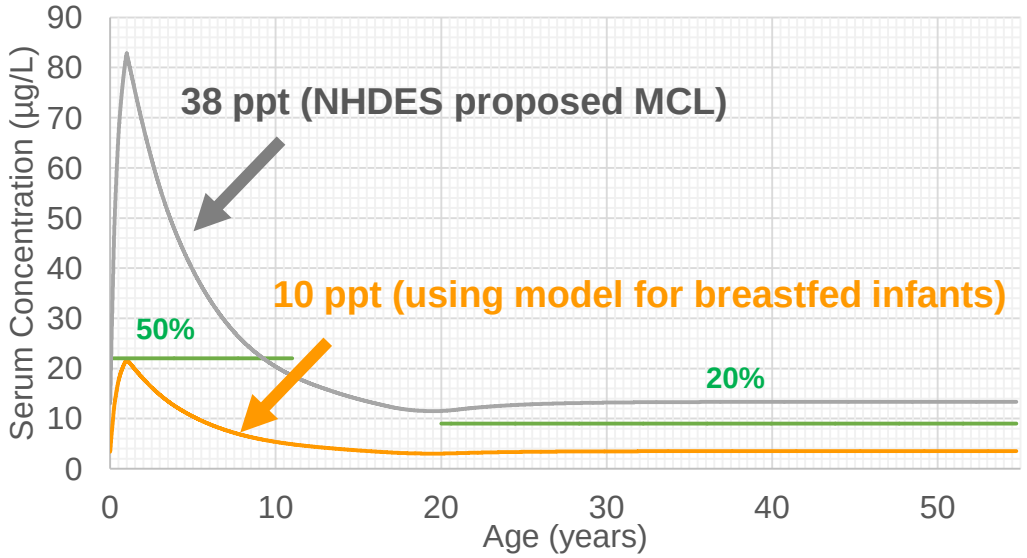
Breastfed Infant Scenario PFOA Serum Concentration at Water Concentration **0.035 µg/L**



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

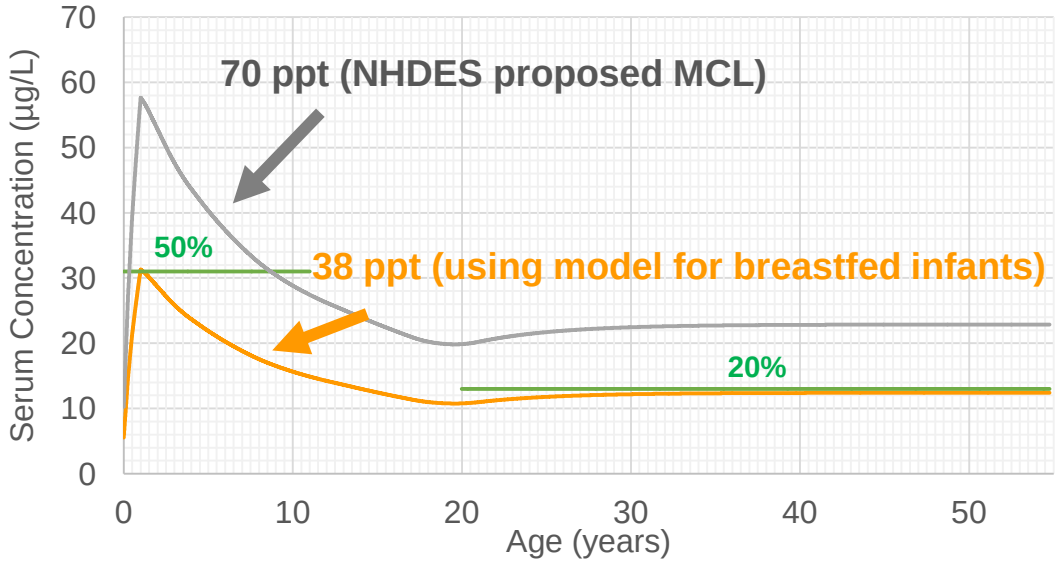
Impacts of Exposure Assumptions in NHDES MCL Calculations

Modeled Serum PFOA Concentrations



>50% for 9 years

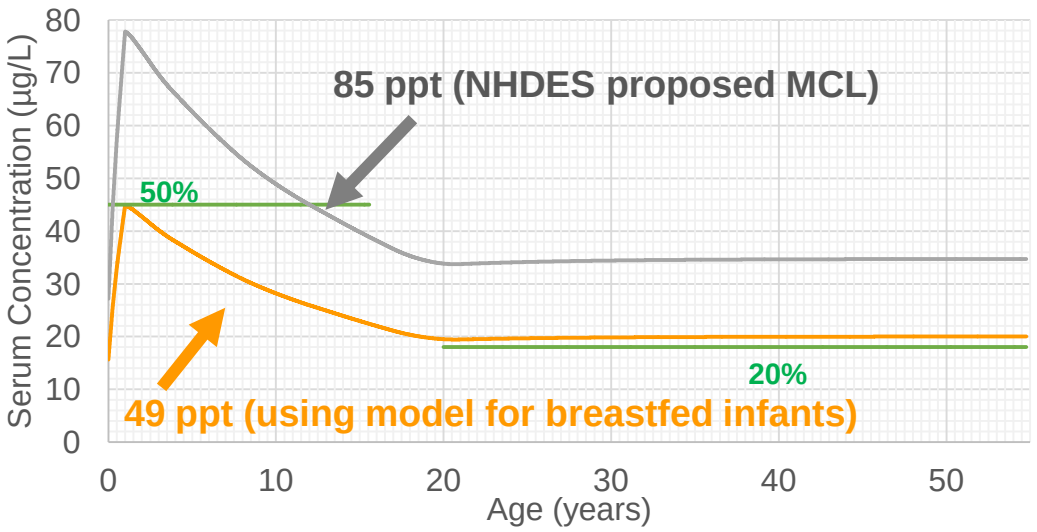
Modeled Serum PFOS Concentrations



>50% for 8.5 years

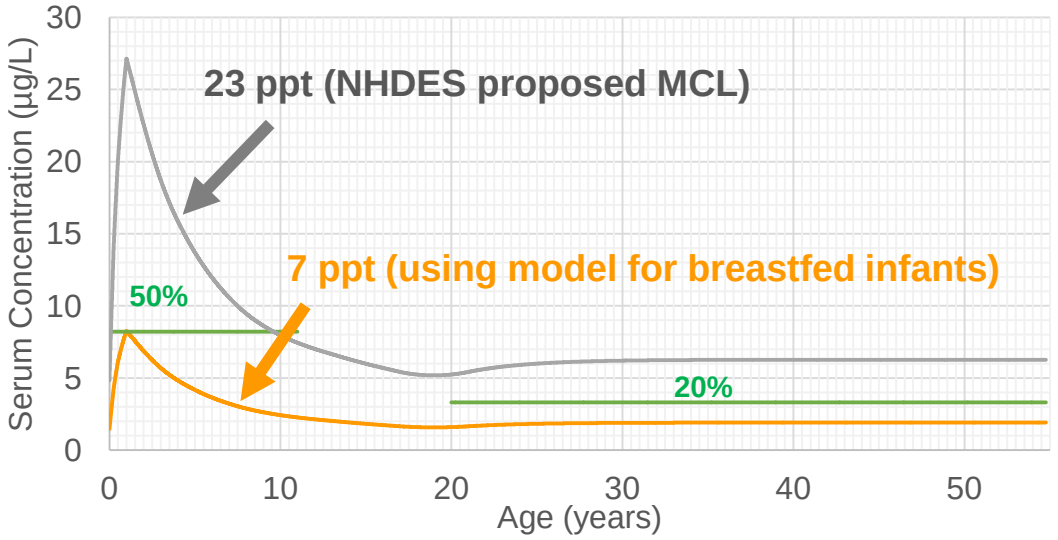
Impacts of Exposure Assumptions in NHDES MCL Calculations

Modeled Serum PFHxS Concentrations



>50% for 11.5 years

Modeled Serum PFNA Concentrations



>50% for 9.5 years

Conclusions

- 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.

www.tedx.org

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- Tides Foundation

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