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Examples of Health Advisories for PFAS compounds

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A. Federal sources for guidance

1) US EPA (2016) Health Advisory: 70 ppt for PFOA and PFOS (individual or combined levels)

2) ATSDR (2018): Minimum Risk Levels (MRLs) converted into drinking water concentrations

- PFOS – 52 ppt (adult) and 14 ppt (children)
- PFOA – 78 ppt (adult) and 21 ppt (children)
- PFHxS – 517 ppt (adult) and 140 ppt (child)
- PFNA – 78 ppt (adult) and 21 ppt (child)

It is important to note that Health Advisories (HA) and Minimum Risk Levels (MRLs) both are used to assess drinking water contaminants but are not directly comparable. The Health Advisory from the US EPA reports the concentration of a contaminant in drinking water that provides a margin of safety of concentrations that potential increase the risk of adverse health impacts in sensitive populations; in the case of PFAS, the US EPA focused on fetuses and breastfed infants as the target sensitive population. This drinking water advisory includes body weight, contribution of exposure from drinking water, drinking water intake, and calculated reference dose based upon a selected toxicological endpoint to calculate drinking water guidance.

The Minimum Risk Levels is an estimate of the daily human exposure (or dose) expressed in mg/kg/day. These levels are intended to serve as a screening tool and not as a drinking water guidance level due to the degree of uncertainty, lack of toxicological information on sensitive populations, and contribution of drinking water to total exposure. An MRL do not define regulatory or action levels for the ATSDR. Exposure to levels equal to or greater than an MRL does not necessarily translate into an increased risk of an adverse health effect due to the conservative nature of these calculations.

However, basic drinking water and body weight estimates can be used with an MRL to convert to a drinking water concentration as shown above that can provide insight into the development process of drinking water standards.

B. State use of the US EPA values for drinking water PFAS guidance

As outlined by the action plan released by the US EPA in 2019, steps are being taken to key PFAS management actions including the development of maximum containment levels (MCLs) for PFOA and PFOS that are legally enforceable and developing groundwater cleanup recommendations for these two chemicals at contamination sites. Although the US EPA is taking these steps to be regulate specific PFAS substances, the current health advisory of 70 ppt is not enforceable by the federal government.

Although the majority of the states follow the US EPA health advisory of 70 ppt to varying degrees of enforcement, several states including Wisconsin are reviewing the federal drinking water guidance and available peer-reviewed scientific research to evaluate if a more rigorous drinking water standard is appropriate to reduce exposure. Several states, discussed in the following section, have already completed this process and issued drinking water standards that either mirror or are more stringent than the US EPA health advisory. These previous state efforts could provide guidance to the efforts of Wisconsin in developing state level drinking water standards for PFAS compounds.

C. States with PFAS guidance stricter than US EPA

Columns in the table below reflect PFAS compounds that have a Healthy Advisory or MRL determination by the US EPA or ATSDR, respectively. Any other PFAS compound regulated by the selected state is also documented in the information below.

Table 1. Examples of State Drinking Water Guidance

State	Type	PFOA	PFOS	PFHxS	PFNA	Additional information
California	Drinking Water	14 ppt	13 ppt	-	-	Water quality value adopted from guidance issued by New Jersey
Colorado		70 ppt	70 ppt	-	70 ppt	70 ppt based on the sum of PFOA, PFOS, and PFHpA levels
Connecticut		70 ppt	70 ppt	70 ppt	70 ppt	70 ppt based on the sum of PFOA, PFOS, PFNA, PFHxS, PFHpA
Massachusetts		70 ppt	70 ppt	70 ppt	70 ppt	70 ppt based on the sum of PFOA, PFOS, PFNA, PFHxS, PFHpA
Minnesota		35 ppt	27 ppt	27 ppt	-	
New Hampshire		70 ppt	38 ppt	85 ppt	23 ppt	A total of 70 ppt from the sum of PFOA and PFOS would also be non-compliance
New Jersey		14 ppt	13 ppt	-	13 ppt	
North Carolina		70 ppt	70 ppt	-	-	NC follows US EPA PFOA/PFOS guidance. Gen X compounds are also regulated at a concentration of 140 ppt
Vermont		20 ppt	20 ppt	20 ppt	20 ppt	20 ppt based on the sum of PFOA, PFOS, PFNA, PFHxS, PFHpA

The differences in the drinking water standards by the various states listed above is derived from different approaches to assess the risk of PFAS drinking water concentrations found in public drinking water systems. The range of PFAS standards from 13 to 70 ppt (individual and/or combined concentrations) differ based upon a various uncertainties in risk assessment, technical and capacity considerations, and social, political, and economic pressures of the impacted communities.

The differences in the methodology during risk assessment process can result in evaluating the same data but calculating different water standards for identical PFAS compounds. These differences include, but are not limited to, the selection of the toxicological endpoint to calculate the reference dose (RfD), uncertainty factors, drinking water exposure assumptions (e.g. average adult, infant, or lactating woman), and assumed exposure from non-drinking water sources (e.g. 80%, 50%, 0%). This outcome can be demonstrated comparing the drinking water guidelines for PFOS calculated by the US EPA, Alaska, and Vermont as shown in the table and calculations below.

Table 2. Examples of PFOS Drinking Water Guidance Levels

Agency/ State	Advisory Level	Toxicological Endpoint	Reference Dose (ng/kg-day)	Total Uncertainty Factors	Target Population	Water Ingestion Rate	Relative Source Contribution
US EPA	70 ppt*	Reduced rodent pup weight	20	30	Lactating women	0.054 L/kg/day	20%
Vermont	20 ppt*				Infant (0 – 1 yr)	0.175 (L/kg/day)	20%

Notes: *Applies to PFOA and PFOS individually or the sum of PFOA and PFOS
#Alaska follows US EPA's health advisory of 70 ppt

The information above and the differences in the selected relative source contribution rate and the target population and the corresponding water ingestion rate result in differences in the drinking water advisory levels. Using the equation below to calculate drinking water health advisories these slight differences in the information utilized by these selected advisories can be demonstrated; the following equation was utilized by Vermont in the calculation of the drinking water advisory level for that state.

$DWHA = (HQ)(RfD_o)(1/BWIR)(CF)(RSC)$

DWHA = Drinking water health advisory
HQ = Health advisory (HQ less than or equal to 1 indicates adverse impacts are not likely)
RfD_o = Chronic oral reference dose
BWIR = Body weight adjusted water intake rate
CF = Conversion factor from milligrams to micrograms (1000 µg/mg)
RSC = Relative source contribution

US EPA

DWHA = (HQ)(RfD_o)(1/BWIR)(CF)(RSC)

= (1)(0.00002 mg/kg BW-day)(1/0.054 L/kg BW-day)(1000 µg/mg)(0.2)

= 0.07407 µg/L (ppb)

=0.074 µg/L x 1000 ng/µg = 74.1 ng/L (ppt)

~ 70 ppt

Vermont

DWHA = (HQ)(RfD_o)(1/BWIR)(CF)(RSC)

= (1)(0.00002 mg/kg BW-day)(1/0.175 L/kg BW-day)(1000 µg/mg)(0.2)

=0.02285 µg/L (ppb)

=0.02285 µg/L x 1000 ng/µg = 22.85 ng/L (ppt)

~ 20 ppt

As shown above, slight differences in the approach to assess risk can result in a range of potential drinking water health advisories; differences that are deemed appropriate by the specific state or federal agency to prevent exposure to potential harmful levels of PFAS substances in drinking water supplies. Additional states have also selected different toxicological endpoints than the US EPA; differences that would modify the RfD and may change the total uncertainty factors. For example, continuing with the PFOS example, New Jersey selected the potential immune response as its toxicological endpoint that modified the RfD to 1.8 ng/kg-day; adults were used as the target population (e.g. water ingestion rate of 2 L/day, 70kg).

In other words, drinking water healthy advisories may vary between states across the country due to selected methodology and other technical, social, political, and economic considerations.

D. References

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