Fish Consumption Advisory Triggers for PFOS, PFNA, and PFOA

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Fish consumption advisory triggers were developed for PFOS, PFNA, and PFOA; these are the three perfluoroalkyl acids (PFAAs; part of the larger group of per- and polyfluoroalkyl substances, PFAS) found in New Jersey fish for which toxicity factors are available (Table 1). These triggers were based on the standard exposure assumptions used for other New Jersey fish consumption advisories of a 227 gram (8 ounce) meal size and 70 kg body weight. Trigger levels were developed for the following consumption frequencies: unlimited consumption; consumption once per week, once per month, once every 3 months, and once per year; and do not eat.

PFOS, PFNA, and PFOA cause developmental toxicity in laboratory animals, and the developing fetus and infant/young child are considered susceptible subpopulations for the developmental effects of these PFAS (DWQI, 2015; DWQI, 2016; DWQI, 2018; USEPA, 2016a; USEPA, 2016b). Because long-chain PFAS such as PFOS, PFNA, and PFOA have long human half-lives (several years), body burdens remain elevated for many years after exposure ends. Therefore, if women have elevated body burdens when they become pregnant, these body burdens will remain elevated during pregnancy and lactation. PFOS, PFNA, and PFOA are present in human breast milk, and serum levels of breast-fed infants are typically higher than maternal serum levels. For these reasons, it is not advisable for subgroups of concern for developmental effects (pregnant women, young children, women of childbearing age) to receive large doses of PFOS, PFNA or PFOA, even if infrequent. Therefore, the advisory triggers for consumption "Once Every 3 Months" or "Yearly" are not considered to be protective for individuals in these high-risk groups. For the General population (i.e., all others not in the high-risk group) these meal frequencies are

allowed (Table 1). This approach has also been used for fish consumption advisories for other contaminants that cause developmental toxicity such as mercury and PCBs.
For the PFOS fish consumption advisory triggers, the RfD developed by the NJ DWQI, with support from NJDEP DSREH, of 1.8 ng/kg/day (DWQI, 2018) is used as the toxicity basis. This RfD is based on decreased immune response, as indicated by decreased plaque forming cell response, in mice (Dong et al., 2009). It is also expected to be protective of cancer risk at close to the one-in-one-million (10^{-6}) risk level.

For PFNA, the RfD of 0.74 ng/kg/day from the NJDEP Ground Water Quality Standard for PFNA (NJDEP, 2017) is used as the toxicity basis. This RfD is based on increased liver weight in pregnant mice (Das et al., 2015), and it includes an uncertainty factor for potentially more sensitive effects including developmental effects. PFNA has not been shown to cause carcinogenic effects.

For PFOA, the Reference Dose (RfD) developed by the NJ DWQI of 1.8 ng/kg/day (DWQI, 2017), is used as the toxicity basis. This RfD is based on increased liver weigh in mice (Loveless et al., 2006), and it includes an uncertainty factor for potentially more sensitive low-dose developmental effects. It is also expected to be protective of cancer risk at the one-in-one-million (10^{-6}) risk level.

It should be noted that available information indicates that some of the target organs and modes of action are similar for PFAS in general, including PFOS, PFNA, PFOA, and other PFAS detected in New Jersey fish. Therefore, the toxicity of these PFAS may be additive. However, the potential for additive toxicity of PFAS was not considered in development of the fish consumption advisory triggers.

The consumption triggers were calculated as recommended in USEPA (2000). For daily (unlimited) consumption, the following equation was used:

$$\text{Daily trigger concentration (ng/g)} = \frac{\text{RfD (ng/kg/day) x Body Weight (kg)}}{\text{Meal size (g)}}$$

Where: Body weight = 70 kg

Meal size = 227 g

For consumption triggers that are less frequent than daily (e.g. weekly, monthly, yearly), the daily (unlimited) consumption triggers were multiplied for the appropriate timeframe (e.g. 7-fold for weekly; 30-fold for monthly; 365-fold for yearly).

Table 1. PFAS Fish Consumption Advisory Triggers (ng/g; µg/kg; ppb): PFOS and PFOA based on DWQI RfDs; PFNA based on NJDEP RfD*

Consumption Frequency	PFOS *(RfD – 1.8 ng/kg/day)*		PFNA *(RfD – 0.74 ng/kg/day)*		PFOA *(RfD – 2 ng/kg/day)*	
	General Population	High Risk Population	General Population	High Risk Population	General Population	High Risk Population
Unlimited (based on daily)	0.56	0.56	0.23	0.23	0.62	0.62
Weekly	3.9	3.9	1.6	1.6	4.3	4.3
Monthly	17	17	6.9	6.9	19	19
Once every 3 months**	51	NA	21	NA	57	NA
Yearly**	204	NA	84	NA	226	NA
Do not eat	>204	>17	>84	>6.9	>226	>19

These calculations are based on a meal size of 8 oz. (227 g), and a body weight of 70 kg.

* Note that the reporting level in the NJDEP study of PFAS in fish was approximately 1 ng/g.
** Advisories based on consumption frequency of "Once Every 3 Months" or "Yearly" are not applicable to individuals in high-risk groups (pregnant women, young children, women of childbearing age).

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