

PFAS in New Jersey's Environment - NJDEP Evaluation and Response



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NJ Evaluation & Regulation of Emerging Drinking Water Contaminants since 1980s



- NJDEP studies found volatile organic chemicals in NJ waters in 1980s.
 - New Jersey is densely populated and highly industrialized.
 - “Emerging contaminants” of the time - no federal drinking water standards.
- ***New Jersey Safe Drinking Water Act Amendments (1984)***
 - Required development of ***Maximum Contaminant Levels*** (MCLs).
 - 22 listed contaminants (mostly VOCs).
 - Future additional contaminants based on occurrence & health effects.
 - Established ***Drinking Water Quality Institute (DWQI)*** - Advisory body charged with recommending MCLs to NJDEP Commissioner.
 - Members appointed by Governor (3), Assembly (3), and Senate (3) representing *environmental health community, academia, and water purveyors*.
 - NJDEP (3), NJ Dept. of Health (2), Water Supply Advisory Council (1).
 - NJDEP Commissioner decides whether to propose recommended MCLs as regulatory standards.
- SDWA Amendments also funded drinking water research, including ***occurrence studies***.

DWQI & NJDEP Evaluations (1984-present)

Occurrence studies & recommended/adopted MCLs for many types of drinking water contaminants since the 1980s.

DWQI Evaluations

(1984-2009)

- Volatile Organic Contaminants*
- Methyl tertiary butyl ether (MTBE)*
- Radium*
- Arsenic*
- Perchlorate**
- Radon**

...and many others



Recent DWQI Evaluations

(2009-present)

- 1,2,3-Trichloropropane*
- **PFNA***
- **PFOA & PFOS****

* *MCL adopted by NJDEP*

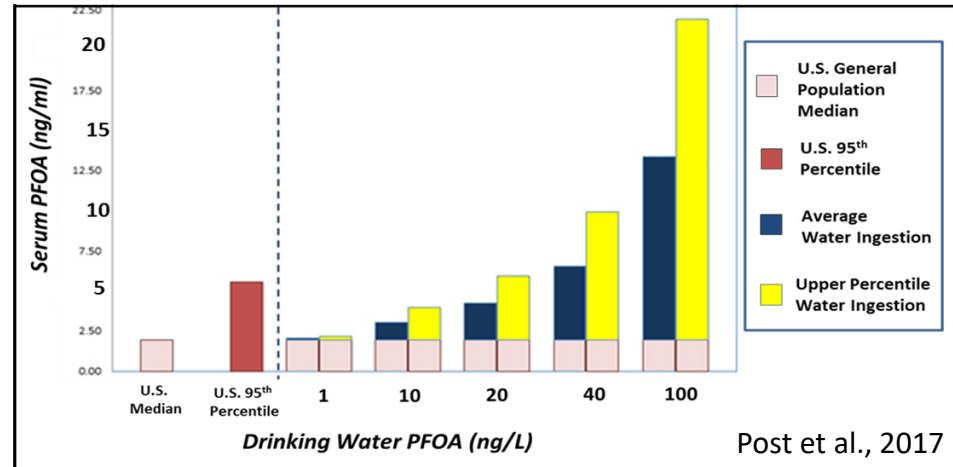
** *Recommended MCL, not yet proposed by NJDEP*

Also - *Periodic reevaluation of basis of previously developed standards.*

Why Are PFAS of Concern as Drinking Water Contaminants?

Long-chain PFAS such as PFOA, PFOS, PFNA, and PFHxS differ from most other drinking water contaminants:

- Widespread drinking water occurrence.
- Do not break down in the environment.
- Ubiquitous in human blood serum.
- Human half-lives of several years.
 - *Remain in the body for many years after exposure ends.*
- **Relatively low drinking water levels can dominate other exposures.**
 - *Unlike other persistent, bioaccumulative & toxic (PBT) chemicals such as PCBs & dioxins.*
- Higher drinking water exposures to infants, a sensitive subgroup.
- Multiple types of toxicity in animals, including some at low doses.
- Associations with human health effects at low exposure levels.
- **Overall - suggests need for caution about exposure from drinking water.**



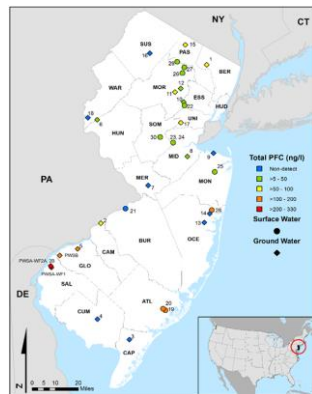
NJDEP Studies of PFAS in NJ Public Water Systems (PWS)

- PFOA detection at up to 190 ng/L in raw and finished water from a NJ PWS **first reported to NJDEP in 2006**.
 - Near industrial source in Salem County.
 - Later also detected in nearby private wells.
- **First state to conduct statewide PFAS occurrence studies.**
 - **2006 study** – 23 PWS (raw or finished water) tested for PFOA and PFOS.
 - **2009-10 study** – 31 PWS (raw water) tested for 10 perfluoroalkyl carboxylates & sulfonates.
 - Included PWS with **surface water** and **ground water** sources.
- Summary of results (Reporting Levels 4-5 ng/L)
 - **Low levels of multiple PFAS** (up to 8) found in many NJ public water systems.
 - **PFOA** – most frequent, found in ~60% of PWS up to 100 ng/L.
 - **PFOS** – found in 30% of PWS up to 43 ng/L.
 - **PFNA (C9)** – found up to 96 ng/L in Paulsboro (SW NJ) PWS; later up to 150 ng/L.
 - Highest level reported in drinking water worldwide.
 - **No extremely high levels** (e.g. µg/L) have been found in NJ PWS.
 - Potential sources identified at some sites and unknown at others.

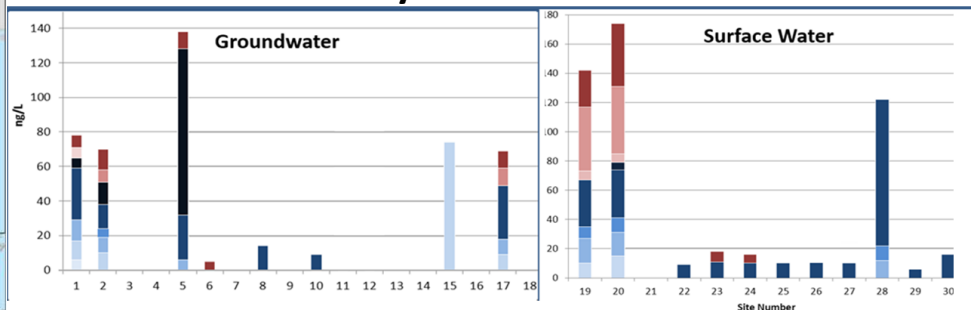
2006 Study
(PFOA & PFOS – 23 PWS)



Post et al., 2009



2009-10 Study: 10 PFAS – 31 PWS



New Jersey vs. National PFAS Detections in 2013-15

USEPA Unregulated Contaminated Monitoring Rule 3 (UCMR3)

<i>Compound</i>	<i>Reporting Level (ng/L)</i>	<i>New Jersey PWS</i>		<i>National PWS other than NJ</i>	
		<i># Detects*</i>	<i>% Detects</i>	<i># Detects**</i>	<i>% Detects</i>
<i>PFOA (C8)</i>	20	<i>18/175</i>	<i>10.2%</i>	<i>90/4734</i>	<i>1.9%</i>
<i>PFNA (C9)</i>	20	<i>4/175</i>	<i>2.3%</i>	<i>10/4734</i>	<i>0.2%</i>
<i>PFOS (C8-S)</i>	40	6/175	3.4%	89/4734	1.9%
<i>PFHxS (C6-S)</i>	30	2/175	1.1%	53/4734	1.1%
<i>PFBS (C4-S)</i>	90	0/175	0%	8/4734	0.2%
<i>PFHpA (C7)</i>	10	6/175	3.4%	79/4734	1.7%

** New Jersey data as of 10/14/16. **USEPA data posted online as of 7/16.*

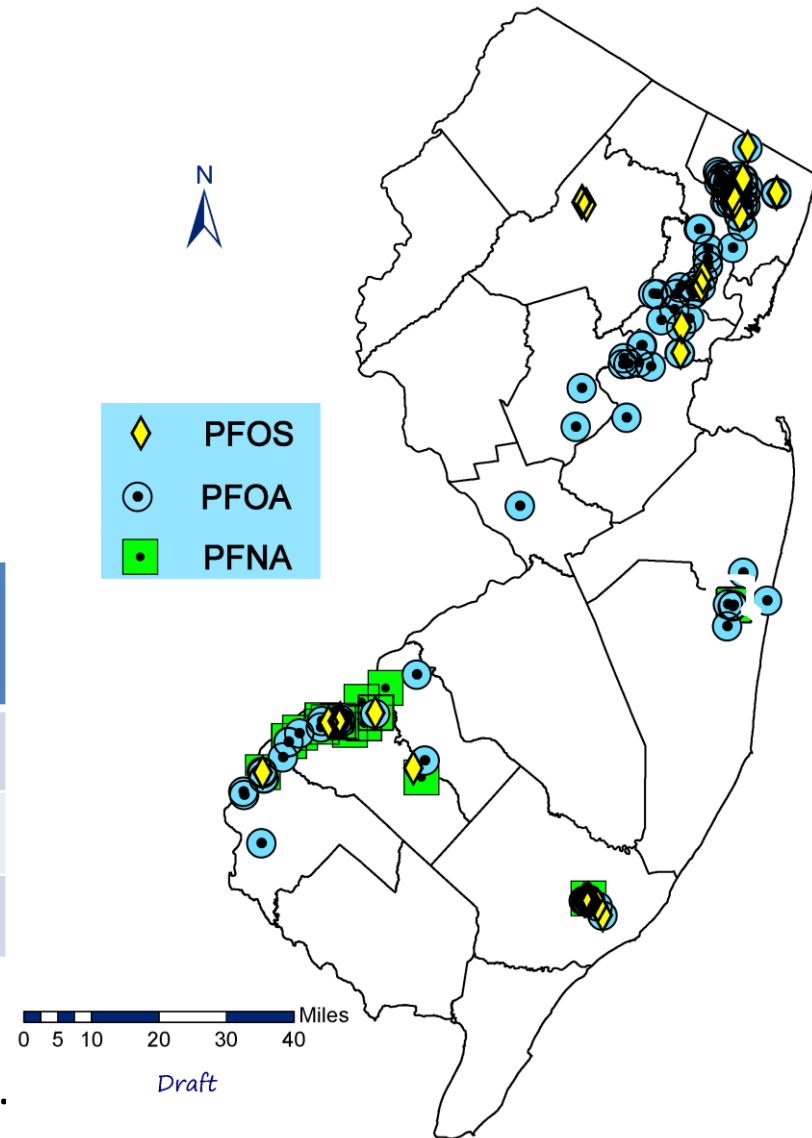
- Tested finished water **at all large** (>10,000 customers) and a **few small PWS**.
- **PFOA and PFNA - much more frequent in NJ than nationally.**
 - *PFNA – Southwestern NJ (Gloucester and Camden Counties).*
 - *PFOA – Various locations statewide.*
- **Other PFAS** – Similar NJ and national occurrence.
- **Reporting Levels higher** than for most other NJ data.
 - *Much lower % occurrence than other NJ data.*
 - *Consistent with reevaluation of large subset of U.S. data at lower RLs (Hartz, 2017).*

Detections above NJ PFAS MCLs* in Raw or Finished Water from NJ PWS

- **Current data** from ~216 of 580 NJ PWS.
 - NJDEP studies, UCMR3, and other data submitted to NJDEP.
 - *Note: UCMR3 RLs (20-40 ng/L) are above NJ MCLs (13-14 ng/L).*
- **Raw water** - wells or surface water intakes.
Finished water - sampling locations.
 - *Multiple data points shown for some PWS.*
- Detected in **48 PWS** above at least one NJ MCL:

PFAA	NJ MCL*	# PWS	Highest Detection
PFOA	14 ng/L	38	280 ng/L
PFOS	13 ng/L	20	330 ng/L
PFNA	13 ng/L	14	150 ng/L

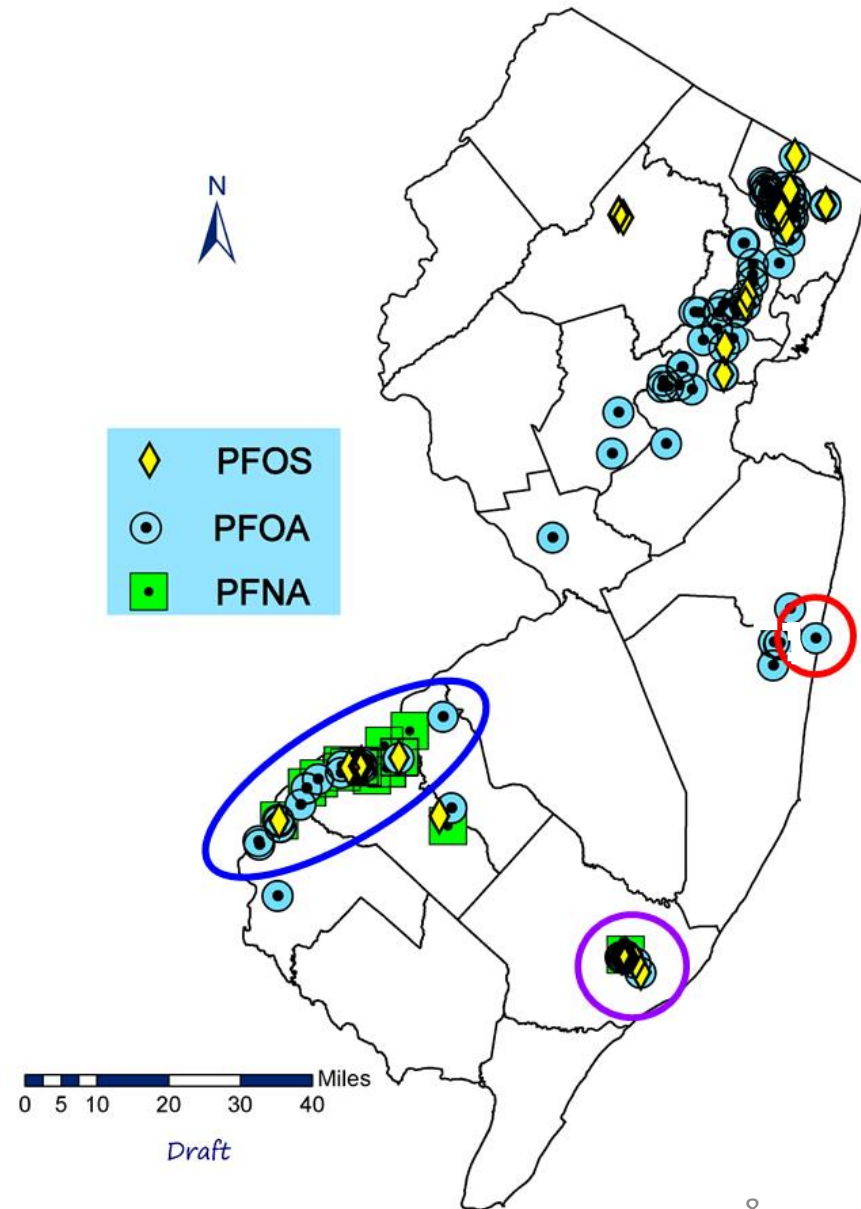
- Most of these PWS, including those with highest levels, **have acted to reduce exposure.**



*PFNA MCL is adopted. PFOA & PFOS MCLs are DWQI recommendations used as guidance.

Some Likely Sources of PFAS in NJ PWS

- **PFOA and PFOS in Northeast NJ & other locations:**
 - Sources are unknown for most sites.
 - Efforts to identify sources are ongoing.
- **PFOA & PFNA in Southwest NJ.**
 - Two large industrial sites - likely sources.
 - Current NJDEP study with USEPA Office of Research & Development using research analytical methods to identify PFAS sources and transport pathways in this vicinity.
- **PFOA (100 ng/L) in surface water at Ocean County PWS.**
 - Small industrial facility upstream of river intake - likely source (Procopio et al., 2017).
- **Mixture of PFAS (carboxylates & sulfonates) in Atlantic County PWS.**
 - Military use of aqueous fire fighting foam - likely source.



(Raw and finished water sampling locations shown;
multiple data points shown for some PWS)

Development of New Jersey Drinking Water Quality Institute (DWQI)

MCL Recommendations

- **DWQI reports** are posted at https://www.state.nj.us/dep/watersupply/g_boards_dwqi.html
- **DWQI Subcommittees** evaluate (1) health effects, (2) analytical limitations, and (3) treatment removal technologies.
 - Conduct detailed reviews of available scientific and technical data.
- **Health-based MCL**
 - *Non-carcinogens – no health effects expected from lifetime exposure.*
 - *Carcinogens – 1 in 1 million lifetime cancer risk.*
- **Practical Quantitation Level (PQL)**
 - *Level that can be reliably measured by drinking water laboratories.*
- Availability of **treatment removal technology**.
- * **Health-based MCL is the goal ***
 - *PFAS MCLs were not limited by analytical or treatment factors.*
- **Therefore, PFAS MCLs were set at Health-based MCLs.**

<i>(Units: ng/L)</i>	Health-based MCL	Analytical PQL	Treatment Removal	Recommended MCL
PFOA	14	6	Not limiting	14
PFOS	13	4.2	Not limiting	13
PFNA	13	5	Not limiting	13

PFOA & PFOS - NJ & USEPA Reference Doses, ATSDR Draft Minimal Risk Levels, NJ Health-based MCLs (HBMCL) & USEPA Lifetime Health Advisories (LHA)

		<i>Toxicological Basis</i>	<i>RfD/MRL (ng/kg/day)</i>	<i>HBMCL or LHA (ng/L)*</i>
PFOA	NJ	Delayed mammary gland development	0.11	(0.77**)
		<i>Not recommended due to lack of precedent as basis for risk assessment.</i>		
		Increased liver weight • Includes database uncertainty factor of 10 for more sensitive developmental effects (e.g. mammary gland development)	2	14
	USEPA	Delayed ossification & accelerated puberty in offspring.	20	70***
	ATSDR	Behavioral & skeletal effects in offspring.	3	--
PFOS	NJ	Immunotoxicity – ↓ plaque forming cell response (Pachkowski et al., 2017)	1.8	13
	USEPA	Decreased offspring body wt.	20	70***
	ATSDR	Decreased offspring body wt; immunotoxicity	2	--

*Assumed water consumption: NJ - 0.029 L/kg/day, default adult upper %. USEPA – 0.054 L/kg/day, 90th % lactating woman. Relative Source Contribution: NJ & USEPA – default, 20%.

***Applies to total of PFOA and PFOS.

New Jersey Reference Dose & Health-based MCL for PFNA (C9)

- **“New Jersey-specific contaminant”** – not evaluated by USEPA.
 - Found in NJ PWS and private wells in vicinity of likely industrial source.
 - Infrequently found nationally in UCMR3.
- Effects (hepatic, developmental, immune, male reproductive) generally **similar to PFOA** but:
 - *More **persistent** in the body.*
 - *Effects at **lower doses**.*
 - *More **severe** effects (e.g. delayed offspring growth persists to adulthood).*
- Accumulation in blood serum from drinking water estimated to be about 2-fold higher than PFOA.
- RfD based on **↑ liver weight** in pregnant mice (Das et al., 2015).
- Uncertainty factor of 3 for **more sensitive effects** at lower doses:
 - ***Hepatic necrosis** – Numerical serum PFNA data needed for Reference Dose development were not provided.*
 - ***Mammary gland development** – potential effect; has not been studied.*
- Health-based MCL is **13 ng/L**.

NJDEP Responses to Detections of PFAS in Drinking Water

Initial detection of PFOA (2006) in PWS near industrial facility:

- In response to request from an affected PWS
 - 2007 - NJDEP developed drinking water guidance of 40 ng/L (later published - Post et al., 2009).
- PWS installed treatment to remove PFAS.

Detection of PFNA in Paulsboro PWS in 2009-10 study:

- PWS well with high PFNA level could not be turned off because its use was needed.
- NJDEP guidance – Infants up to 1 year of age should not drink public water.
- Potential responsible party provided bottled water for infants up to 1 year of age and later installed treatment.

Adopted MCL for PFNA (13 ng/L), and recommended MCLs for PFOA (14 ng/L) and PFOS (13 ng/L), are currently used to advise PWS to take actions to reduce exposure:

- **Also recommend that all PWS with PFAS detections continue to monitor.**

Status of NJDEP PFAS Standards & Regulations

PFNA

- **MCL** – 13 ng/L (adopted Sept. 2018)
- **Ground Water Quality Standard** –
 - Updated to 13 ng/L by reference to MCL (Sept. 2018)
- Added to **NJ Hazardous Substances List** (January 2018)
- PWS to begin monitoring in January 2019

PFOA

- DWQI MCL **recommendation** – 14 ng/L (March 2017)
- NJDEP Commissioner accepted recommended MCL, and stated that MCL will be proposed
- Currently used guidance by **NJDEP**

PFOS

- DWQI MCL **recommendation** - 13 ng/L (June 2018)
- Currently used as guidance by **NJDEP**

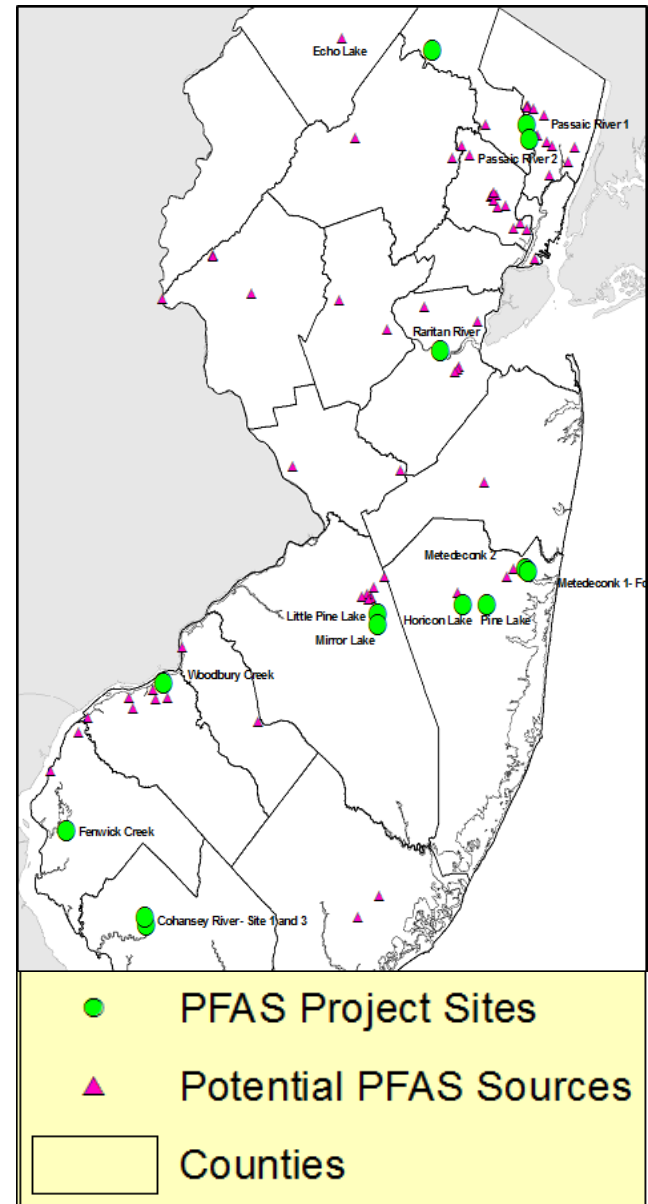
NJDEP Study of PFAS in Fish Tissue, Sediments & Surface Water

(NJDEP Report - Goodrow et al., 2018)

- 11 sites statewide selected for:
 - Proximity of potential source.
 - Recreational and/or subsistence fishing.
- ~100 fish collected.
 - 12 species (2-4 species per site)
 - 3 trophic levels
- Shorter-chain PFAAs detected in almost all surface water samples, but not in fish.
- Phase 2 sampling of additional sites is planned.

Compound	# of Sites (n=11)	# of Species-Sites (n=32)	Maximum conc. (ng/g)
PFOS	11	30	162.5
PFUnA	11	31	27.2
PFDoA	10	28	5.42
PFDA	10	24	3.57
PFOSA	3	5	2.83
PFHxS	3	4	1.66
PFNA	2	4	1.39
PFOA	1	2	0.72

Reporting Levels: 0.5 – 1 ng/g (ppb)



NJ Fish Consumption Advisories for PFAS (2018)



	General Population			High Risk Population*		
	PFOA (ng/g; ppb)	PFNA (ng/g; ppb)	PFOS (ng/g; ppb)	PFOA (ng/g; ppb)	PFNA (ng/g; ppb)	PFOS (ng/g; ppb)
Unlimited	0.62	0.23	0.56	0.62	0.23	0.56
Once/Week	4.3	1.6	3.9	4.3	1.6	3.9
Once/Month	18.6	6.9	17	18.6	6.9	17
Once/3 months	57	21	51	N/A	N/A	N/A
Once/Year	226	84	204	N/A	N/A	N/A
Do Not Eat	>226	>84	>204	>18.6	>6.9	>17

* High risk – infants, children, pregnant & nursing women, women of childbearing age.

- **Consumption Advisory Triggers** based on NJ Reference Doses for PFOS, PFOA, and PFNA.
 - Assume 227 g (8 oz.) meal size, 70 kg body weight.
- **Advisories for PFOS at all study sites.**
 - Consumption frequency ranges from once per week to once per year.
 - For 1 – 3 species at each site.

Thank you!

NJDEP publications and links to NJDEP and NJ DWQI reports on PFAS are listed on the following slides.

NJDEP plans to submit more detailed written comments in response to the request for input from the Pennsylvania PFAS Action Team.

For questions or additional information:

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Links to NJDEP & NJ Drinking Water Quality Institute PFAS Reports

NJ Drinking Water Quality Institute Maximum Contaminant Levels Recommendations

- [Perfluorooctane Sulfonate](#) (PFOS), June 2018
 - [Appendix A](#) – Health-Based Maximum Contaminant Level Support Document for PFOS
 - [Appendix B](#) – Report on the Development of a Practical Quantitation Level for PFOS in Drinking Water
 - [Appendix C](#) – Second Addendum to Appendix C: Recommendation on Perfluorinated Compound Treatment Options for Drinking Water
 - [Appendix D](#) – Responses to Comments on DWQI Health Effects Subcommittee Report: “Public Review Draft - Health-Based Maximum Contaminant Level Support Document: PFOS”
- [Perfluorooctanoic Acid](#) (PFOA), March 2017
 - [Appendix A](#) – Health-Based Maximum Contaminant Level Support Document” PFOA
 - [Appendix B](#) – Report on the Development of a Practical Quantitation Level for PFOA in Drinking Water
 - [Appendix C](#) – Addendum to Appendix C: Recommendation on Perfluorinated Compound Treatment Options for Drinking Water
 - [Appendix D](#) – Responses to Comments on DWQI Health Effects Subcommittee Report: “Public Review Draft- Health-Based Maximum Contaminant Level Support Document: PFOA”
- [Perfluorononanoic Acid](#) (PFNA), July 2015
 - [Appendix A](#) – Health-Based Maximum Contaminant Level Support Document: PFNA
 - [Appendix B](#) – Report on the development of a Practical Quantitation Level for PFNA
 - [Appendix C](#) – Recommendation on Perfluorinated Compound Treatment Options for Drinking Water

NJDEP Studies

- [Investigation of Levels of Perfluorinated Compounds in New Jersey Fish, Surface Water, and Sediment \(2018\)](#)
- Identification of Perfluorinated Carboxylic Acids (PFCAs) in the Metedeconk River Watershed (February 2016)
[Research Project Summary](#) [Full Report](#)
- [Occurrence of Perfluorinated Chemicals in Untreated New Jersey Drinking Water Sources](#) (2009 Study)

NJDEP PFAS Publications

- Pachkowski, B., Post, G.B., Stern, A.H. (2018). The derivation of a Reference Dose (RfD) for perfluorooctane sulfonate (PFOS) based on immune suppression. *Env. Research* (accepted manuscript is online).
- Post, G.B., Gleason, J.A., Cooper, K.R. (2017). Key scientific issues in developing drinking water guidelines for perfluoroalkyl acids: Contaminants of emerging concern. *PLoS Biol.* 15(12):e2002855.
- Procopio, N.A., Karl, R., Goodrow, S.M., Maggio, J., Louis, J.B., Atherholt, T.B.. (2017). Occurrence and source identification of perfluoroalkyl acids (PFAAs) in the Metedeconk River Watershed, New Jersey. *Environ Sci Pollut Res Int.* 24:27125-27135.
- Gleason, J.A., Post, G.B, and Fagliano, J.A. (2015). Associations of perfluorinated chemicals (PFCs) serum concentrations and select biomarkers of health in the US population (NHANES), 2007-2010 *Env. Research* 136: 8-14.
- Post, G.B., Louis, J.B., Lippincott, R.L., and Procopio, N.A. (2013). Occurrence of perfluorinated chemicals in raw water from New Jersey public drinking water systems. *Env. Sci. Technol.* 47 (23):13266-75.
- Post, G.B., Cohn, P.D., and Cooper, K.R. (2012). Perfluorooctanoic acid (PFOA), an emerging drinking water contaminant: a critical review of recent literature. *Env. Res.* 116: 93-117.
- Post, G.B., Louis, J.B., Cooper, K.R., Boros-Russo, B.J., and Lippincott, R.L. (2009). Occurrence and potential significance of perfluorooctanoic acid (PFOA) detected in New Jersey public drinking water systems. *Environ. Sci, Technol.* 43: 4547–4554.