Basis of NJDEP MCLs for PFOA, PFOS & PFNA

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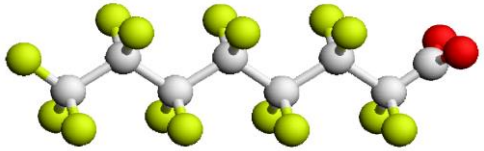
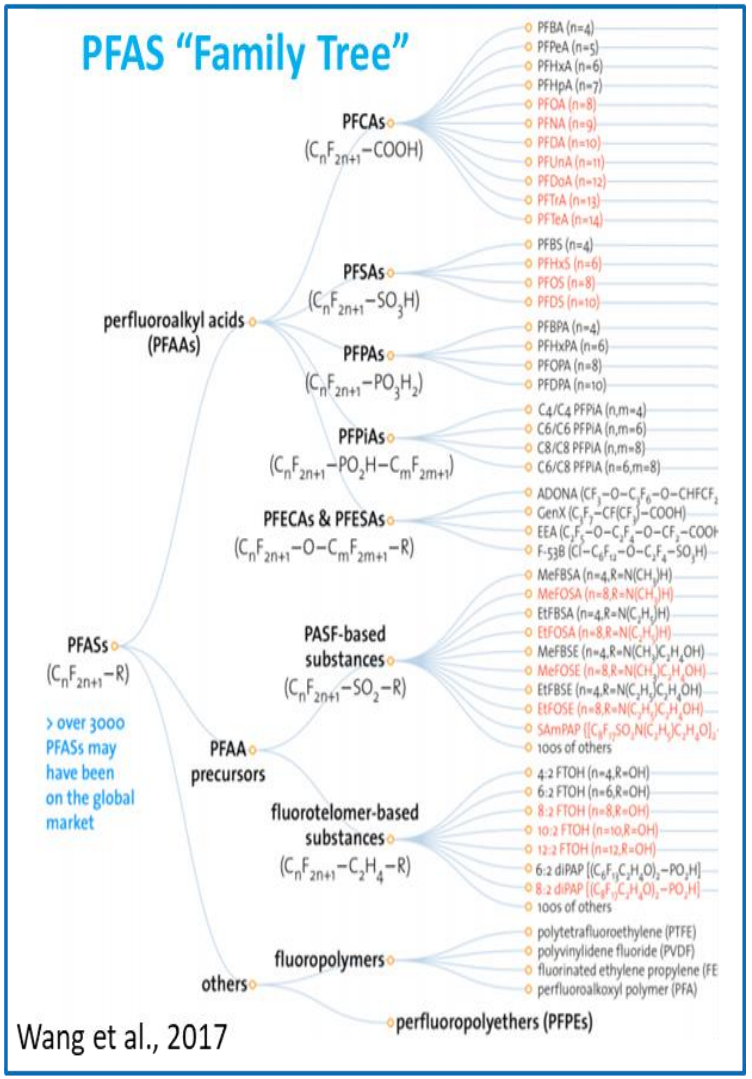
Schuykill Action Network - 2020 Water Utility Forum
Albright College
January 28, 2020

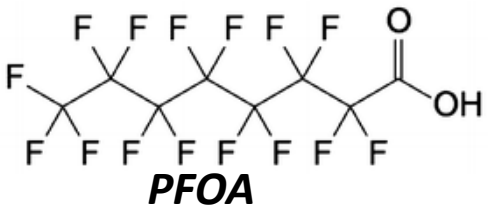
What are Per- and Polyfluoroalkyl Substances (PFAS)?



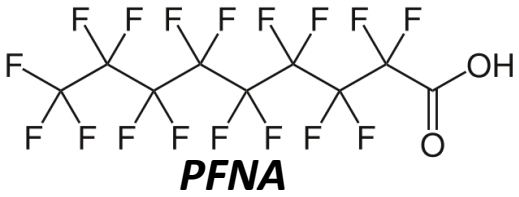
- 1000s of manufactured compounds.
  - *Aliphatic compounds with **at least one totally fluorinated carbon atom**.*
  - *Produced for over 70 years.*
- Due to structure of molecule:
  - *Repel oil & water.*
  - *Highly water soluble.*
- C-F bond is one of strongest known.
  - *Chemically & thermally non-reactive.*
- Unique properties are the basis for:
  - *Commercial & industrial uses.*
  - *Extreme environmental persistence.*
- Most have little or no health effects data.
- Most not detected by routine lab methods.



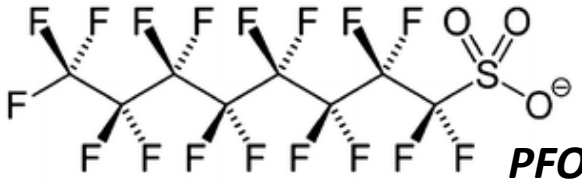
NJ Focus (so far…) Primarily on Long-Chain Perfluoroalkyl Acids (PFAAs)



PFOA



PFNA



PFOS

- Most well-known PFAS subgroup.
- **Charged functional group & totally fluorinated carbon chain**
  - *Long chain:*
    - *≥ 8 carbons - carboxylates*
    - *≥ 6 carbons - sulfonates.*
  - *More bioaccumulative & toxic than short-chain.*
- Considerable health effects data.
- Detected by commercial lab methods.
- Although use in U.S. by major manufacturers has ended…..
  - ***Do not break down.***
  - ***Environmental contamination persists indefinitely.***
  - ***Some replacements are of concern.***

Long-chain PFAAs found in blood serum of almost all U.S. residents:

- ***PFOA:*** *Perfluorooctanoic acid, C8*
- ***PFNA:*** *Perfluorononanoic acid; C9*
- ***PFOS:*** *Perfluorooctane sulfonate, C8-S*
- ***PFHxS:*** *Perfluorohexane sulfonate, C6-S*

Environ. Sci. Technol. **2009**, *43*, 4547–4554

Occurrence and Potential Significance of Perfluorooctanoic Acid (PFOA) Detected in New Jersey Public Drinking Water Systems

GLORIA B. POST,*,† JUDITH B. LOUIS,† KEITH R. COOPER,‡ BETTY JANE BOROS-RUSSO,§ AND R. LEE LIPPINCOTT†

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Review

Perfluorooctanoic acid (PFOA), an emerging drinking water contaminant: A critical review of recent literature ☆, ☆ ☆

Gloria B. Post [a,*], Perry D. Cohn [b], Keith R. Cooper [c]

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Environmental Science & Technology

Article

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Occurrence of Perfluorinated Compounds in Raw Water from New Jersey Public Drinking Water Systems

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Contents lists available at ScienceDirect

Environmental Research

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Associations of perfluorinated chemical serum concentrations and biomarkers of liver function and uric acid in the US population (NHANES), 2007–2010

Jessie A. Gleason [a,*], Gloria B. Post [b,1], Jerald A. Fagliano [a,2]

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Environ Sci Pollut Res
DOI 10.1007/s11356-017-0309-3

RESEARCH ARTICLE

Occurrence and source identification of perfluoroalkyl acids (PFAAs) in the Metedeconk River Watershed, New Jersey

Nicholas A. Procopio [1] · Robert Karl [2] · Sandra M. Goodrow [1] · Joseph Maggio [2] · Judith B. Louis [1] · Thomas B. Atherholt [1]

PLOS BIOLOGY

PERSPECTIVE

Key scientific issues in developing drinking water guidelines for perfluoroalkyl acids: Contaminants of emerging concern

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Review article

The derivation of a Reference Dose (RfD) for perfluorooctane sulfonate (PFOS) based on immune suppression

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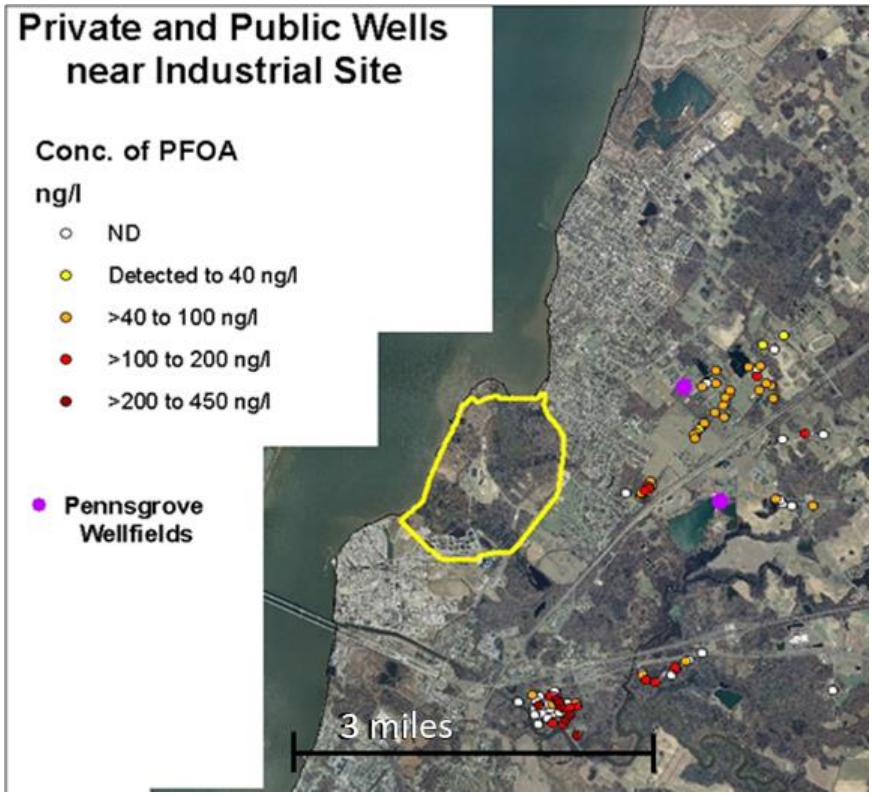
Initial NJDEP Awareness & Actions on PFOA in NJ Waters in 2004-07

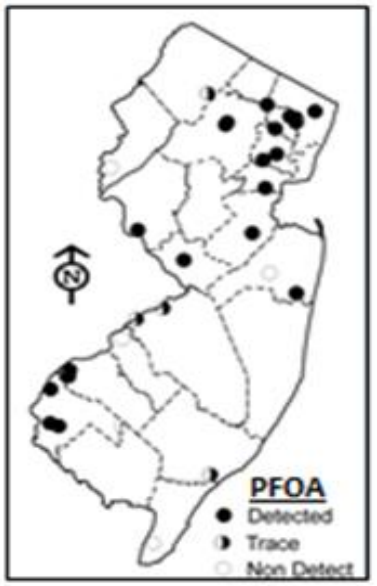
- ***2004:*** Reported in **groundwater** at large industrial site in Southwest NJ.
- ***2006:*** Nearby **public water system.**
  - Found in **tap water** by Delaware Riverkeeper Network.
  - Found in **supply wells** by potential industrial source.
  - Found later in nearby **private wells.**
- ***2006-2007:*** **NJDEP Actions:**
  - Statewide drinking water **occurrence study** of PFOA and PFOS (2006).
  - **Drinking water guidance** (NJDEP, 2007; Post et al., 2009) **– 40 ng/L (ppt)**
    - *Requested by affected water system.*



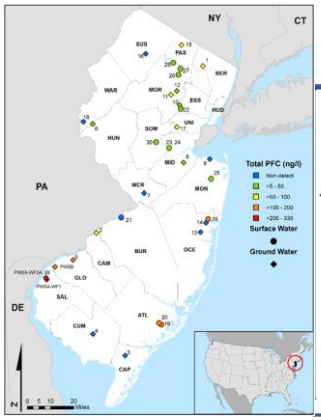
NJDEP Studies of PFAS Occurrence in NJ Public Water Systems

- **First state to conduct statewide PFAS occurrence studies.**
  - ***2006 study:*** 23 water systems - PFOA and PFOS.
  - ***2009-10 study:*** 31 water systems – 10 PFAAs.
  - Reporting Levels 4-5 ng/L (ppt)
- **Multiple PFAS** (up to 8) found in many water systems.
  - **PFOA** – most frequent, ~60% of systems.
  - **PFOS** – 30% of systems.
  - **PFNA** – Paulsboro, Gloucester County
    - *Highest level reported in drinking water worldwide.*
    - *Industrial source was identified.*
- Many NJ water systems took voluntary action.

2006 Study
(PFOA & PFOS – 23 PWS)

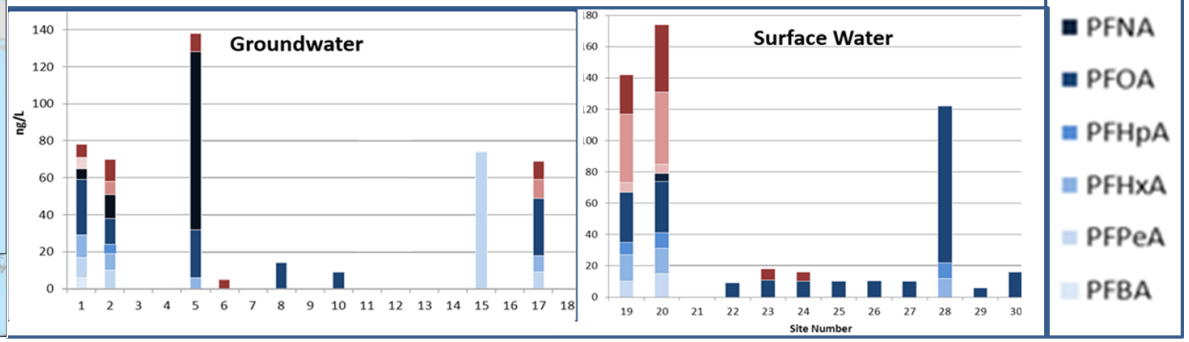


Post et al., 2009



Post et al., 2013

2009-10 Study: 10 PFAS – 31 Water Systems



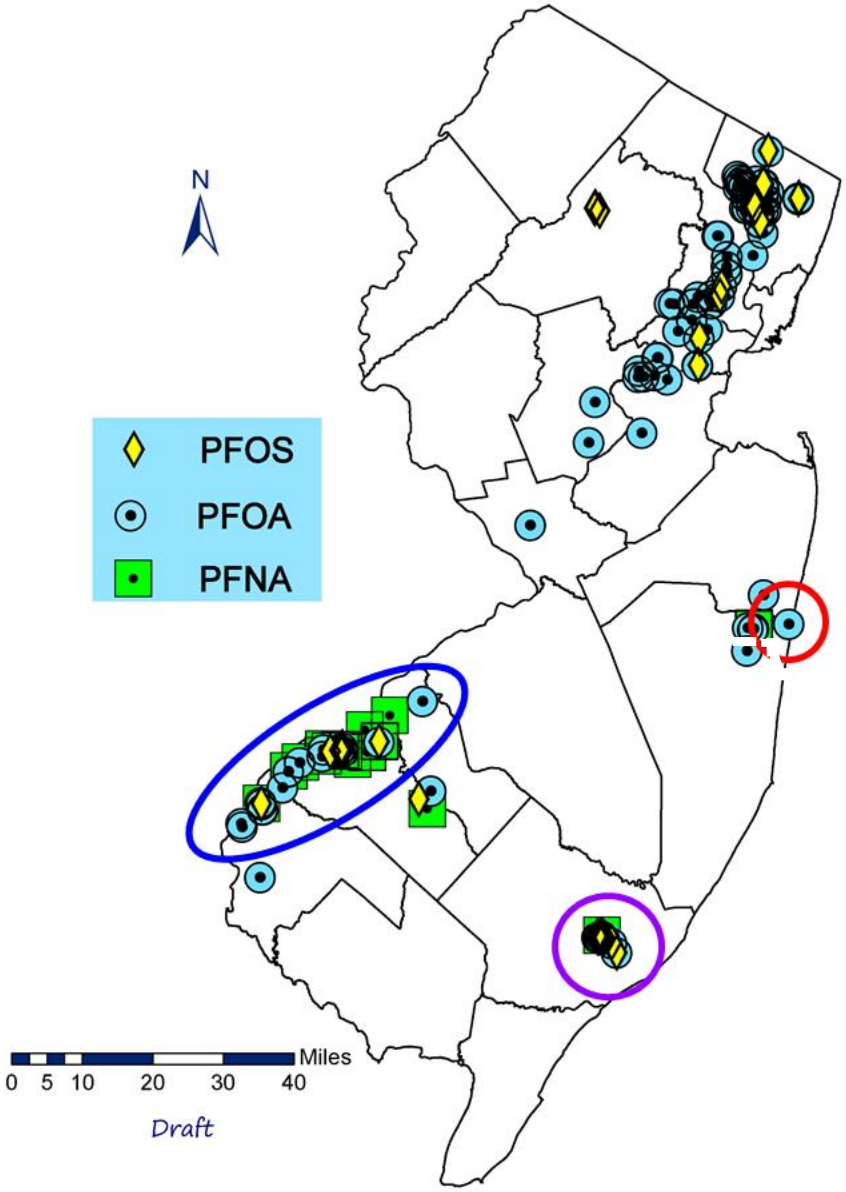
New Jersey vs. National PFAS Drinking Water Occurrence: 2013-15 USEPA Unregulated Contaminated Monitoring Rule 3 (UCMR3) Study

Compound	*Reporting Level (ng/L)*	*New Jersey Public Water Systems*		*U.S. Public Water Systems Other than NJ*	
		*# Detects**	*% Detects*	*# Detects*	*% Detects*
PFOA (C8)	20	**19/175**	**10.9%**	**98/4745**	**2.1%**
PFNA (C9)	20	**4/175**	**2.3%**	**10/4745**	**0.2%**
PFOS (C8-S)	40	6/175	3.4%	89/4745	1.9%
PFHxS (C6-S)	30	2/175	1.1%	53/4745	1.1%
PFBS (C4-S)	90	0/175	0%	8/4745	0.2%
PFHpA (C7)	10	6/175	3.4%	80/4745	1.7%

- All large (>10,000 users) and a few small public water systems in U.S.
- Much higher reporting levels than NJDEP studies, but allow for comparison of NJ and national occurrence on same basis.
- **PFOA and PFNA - much more frequent in NJ than nationally.**
  - *PFNA – Southwestern NJ (Gloucester and Camden Counties).*
  - *PFOA – Various locations statewide.*

Some Likely Sources of PFAS in NJ Public Water Systems

- **PFOA and PFOS in Northeast NJ**
  - *Sources unknown for most sites.*
  - *Efforts to identify sources are ongoing.*
- **PFOA & PFNA in Southwest NJ.**
  - *Two large industrial sites.*
  - *Current NJDEP multi-media study of PFAAs & newly identified PFAS with USEPA ORD using non-target.*
- **PFOA in surface water source**
  - *Small industrial facility upstream of river intake (Procopio et al., 2017).*
- **Multiple PFAAs (carboxylates & sulfonates)**
  - *Military use of aqueous film forming foam.*



(Raw and finished water sampling locations shown; multiple data points shown for some public water systems. Does not include 2019 PFAS MCL monitoring data that has been reported to NJDEP)

NJ PFAS Evaluation & Regulation Continues NJ Work on Emerging Drinking Water Contaminants since 1980s

- ***1980s*** - Volatile organic chemicals found in NJ waters in NJDEP study.
  - *"Emerging contaminants" of the time - No federal standards.*
- ***1984 -*** New Jersey Safe Drinking Water Act Amendments
  - Required NJ Maximum Contaminant Levels (standards; MCLs) for:
    - *23 listed contaminants.*
    - *Additional future contaminants based on occurrence & health effects.*
  - Established Drinking Water Quality Institute (DWQI) to recommend MCLs to NJDEP.
    - *Members from environmental health community, academia, and water purveyors appointed by Governor, Senate, and Assembly.*
    - *Also – Members from NJDEP and NJ Dept. of Health.*
- NJDEP Commissioner decides whether to propose MCLs as regulatory standards.
- NJ scientists have evaluated many types of drinking water contaminants since 1984.

DWQI & NJDEP Evaluations (1984 – Present)

Earlier Evaluations
(1984 - 2009)

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

…and many others

Recent Evaluations
(2014 - present)

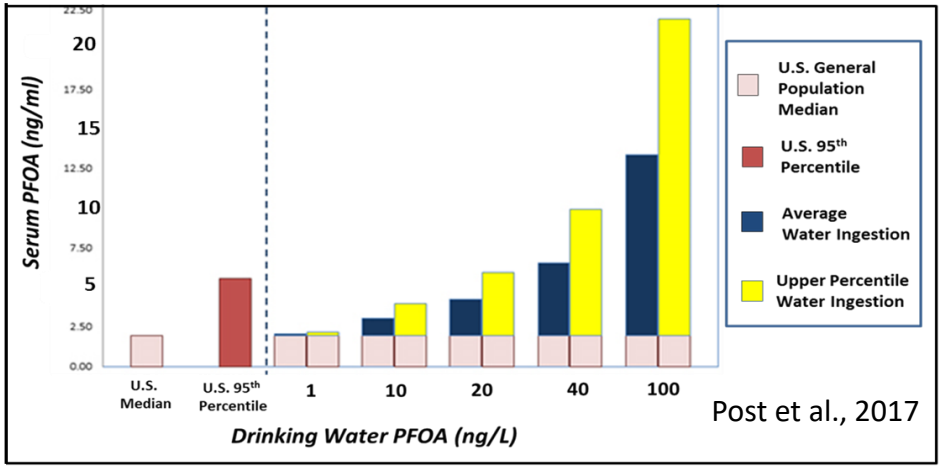
- **1,2,3-Trichloropropane***
- **PFNA***
- **PFOA & PFOS****
- 1,4-Dioxane – currently underway

** MCLs adopted by NJDEP in September 2018.* ***FIRST MCL IN THE U.S. FOR ANY PFAS***

*** MCLs proposed by NJDEP on April 1, 2019.*

Why Are Long-Chain Perfluoroalkyl Acids (PFAAs) of Particular Concern as Drinking Water Contaminants?

- Widespread drinking water occurrence.
- Do not break down in the environment – "Forever Chemicals".
- Ubiquitous in human blood serum.
- Long human half-lives (~2-8 years).
  - *Bioaccumulate over time.*
  - *Remain in the body for many years after exposure ends.*
- Multiple types of animal toxicity, some at low doses.
- Evidence for multiple human health effects from low exposures.



Post et al., 2017

- **Low drinking water levels can dominate other exposures (e.g. food/food packaging, consumer products).**
  - *Unlike other persistent, bioaccumulative, and toxic (PBT) chemicals (PCBs & dioxins) – Drinking water is not an important exposure route for these.*
- Higher drinking water exposures to infants, a sensitive subgroup.
- **Overall - suggests need for caution about exposure from drinking water.**

Factors Considered in NJ DWQI PFAS MCL Recommendations

- **Health-based MCL (similar to USEPA MCLG).**
- **Practical Quantitation Level (PQL)**
  - Level reliably measured by drinking water laboratories.
- Availability of **treatment removal technology.**

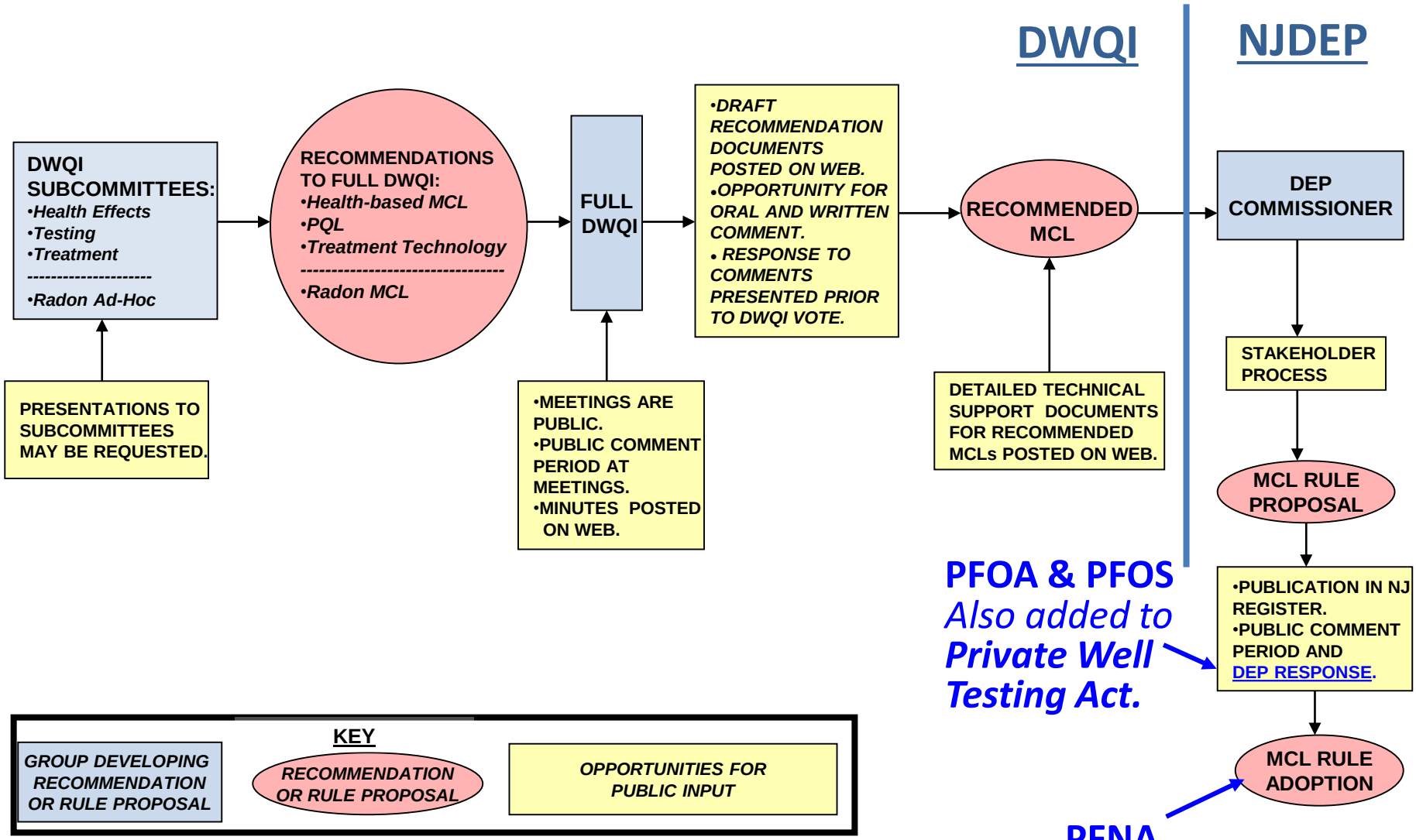
*** Health-based MCL is the goal ***

  - PFAS MCLs not limited by analytical or treatment factors.

- **Therefore, PFAS MCLs are set at Health-based MCLs.**

(Units: ng/L)	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**

Public Participation in NJ DWQI & DEP MCL Development Process



Current Status of NJDEP PFAS Regulations

PFNA:

- **MCL & Ground Water Quality Standard** – 13 ng/L (*2018*).
- **First MCL in the nation for any PFAS.**
- Quarterly monitoring by public water systems has begun:
  - *2019*: ~1100 systems: small groundwater systems (~400); nontransient noncommunity systems (~700).
    - Most are also voluntarily reporting PFOA & PFOS.
  - *2020*: 145 systems: Large groundwater systems (118); all surface water systems (27).
- Added to **NJ Hazardous Substances List** (*2018*).

PFOA & PFOS:

- **Interim Ground Water Quality Standards:** PFOA-10 ng/L; PFOS-10 ng/L (*March 2019*).
- Rule proposal (*April 2019*):
  - **MCLs** & **Ground Water Quality Standards:** PFOA – 14 ng/L; PFOS – 13 ng/L.
    - Monitoring by all community and nontransient noncommunity systems to start in 1st quarter of 2021.
  - Add to **NJ Hazardous Substances List.**
  - Add to **NJ Private Well Testing Act**.
- In New Jersey, rule adoptions must occur within one year of proposal (*April 2020*).

NJDEP PFNA, PFOA & PFOS MCL Monitoring Framework & Requirements

- Quarterly samples at each point of entry (POE).
  - *MCL violations based on running annual average (RAA) of 4 consecutive quarters.*
- Future monitoring frequency depends on levels detected:
  - *Annual monitoring if RAA for 4 consecutive quarters "reliably & consistently" below MCL (< 50% of MCL).*
  - *Triennial monitoring if three consecutive annual samples have no detections.*
  - *Quarterly monitoring required if treating for PFNA, PFOA, or PFOS.*
- EPA Method 537 detects PFNA, PFOA, & PFOS.
  - *Systems are encouraged to report data for PFOA and PFOS in 2019 and 2020.*
  - *"Grandfathering" – Frequency may be reduced based on 2019 and 2020 data when anticipated PFOA and PFOS monitoring is required in 2021.*
- MCL Violation:
  - *Public notification within 30 days.*
  - *Compliance with MCL within one year.*
  - *Required notification in Consumer Confidence Report (CCR).*
  - *Financial resources available through DWSRF.*
  - *May be eligible for hazardous substance-based funding*.

For more info: https://www.state.nj.us/dep/wms/bears/docs/2019-4-15-FAQs_PFOS-PFOA-websites-OLA%204-24-19SDM-(003).pdf

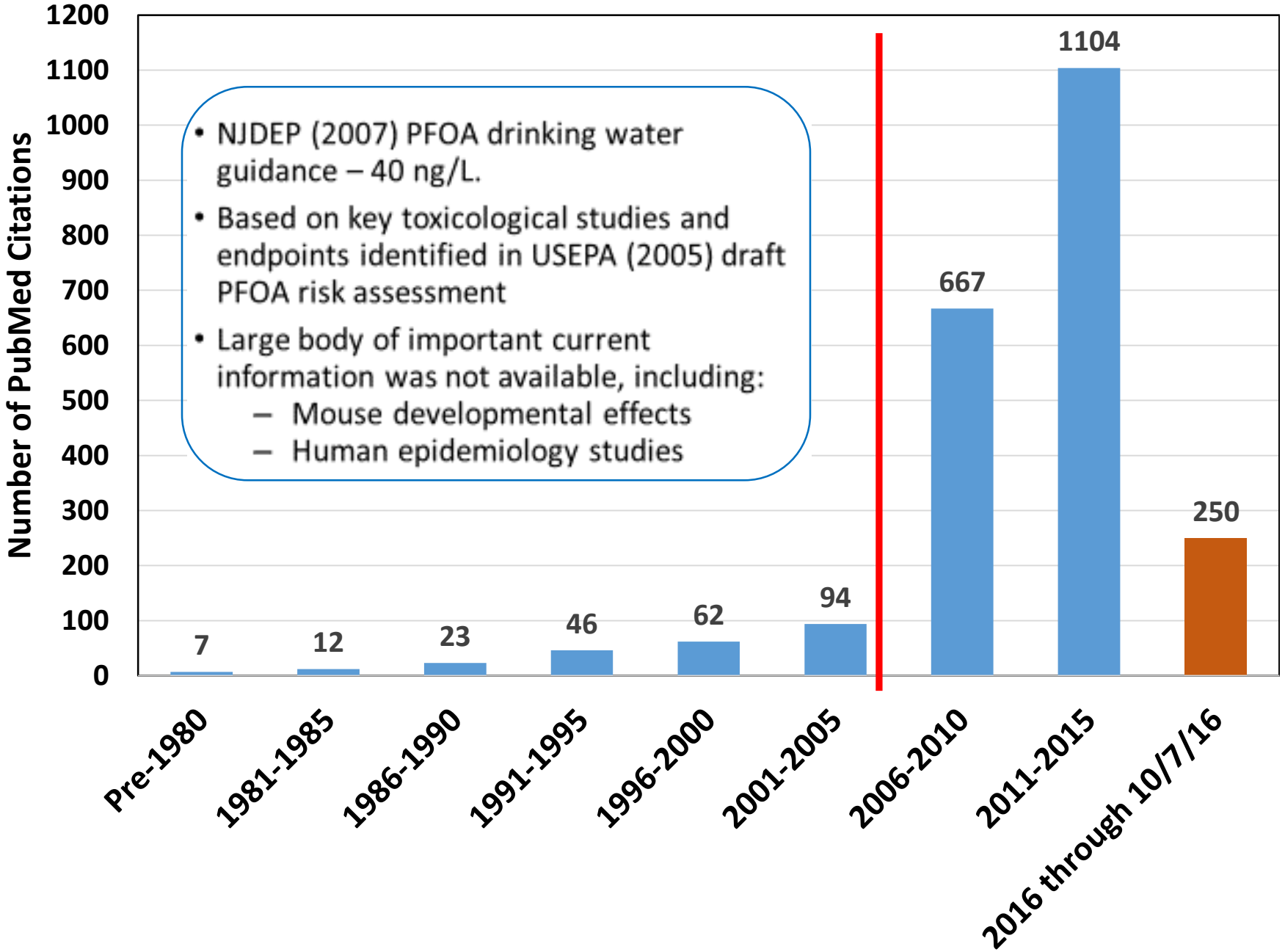
*2019 PFNA, PFOA & PFOS Public Water System Monitoring Data Received by NJDEP as of 1/15/20**

# of Systems	*PFNA (13 ng/L)*	*PFOA (14 ng/L)*	*PFOS (13 ng/L)*
Submitting results	**1108**	**1094**	**1094**
Detection(s) > final/proposed MCL	**12** (1.1 %)	**100** (8.5%)	**80** (7.1%)
Detection(s) > final/proposed MCL(s)	**131** (11.7%) *(52 CWS; 78 NTNC; 1 TNC)*		
MCL violations	**9** (0.8%) *(1 CWS; 8 NTNC)*	NA	NA
Detection(s) > USEPA PFOA/PFOS HA (70 ng/L), singly or combined	NA	**13** (1.2%) *(7 CWS; 6 NTNC)*	

**Some systems began treating for PFNA, PFOA and/or PFOS prior to 2019.*

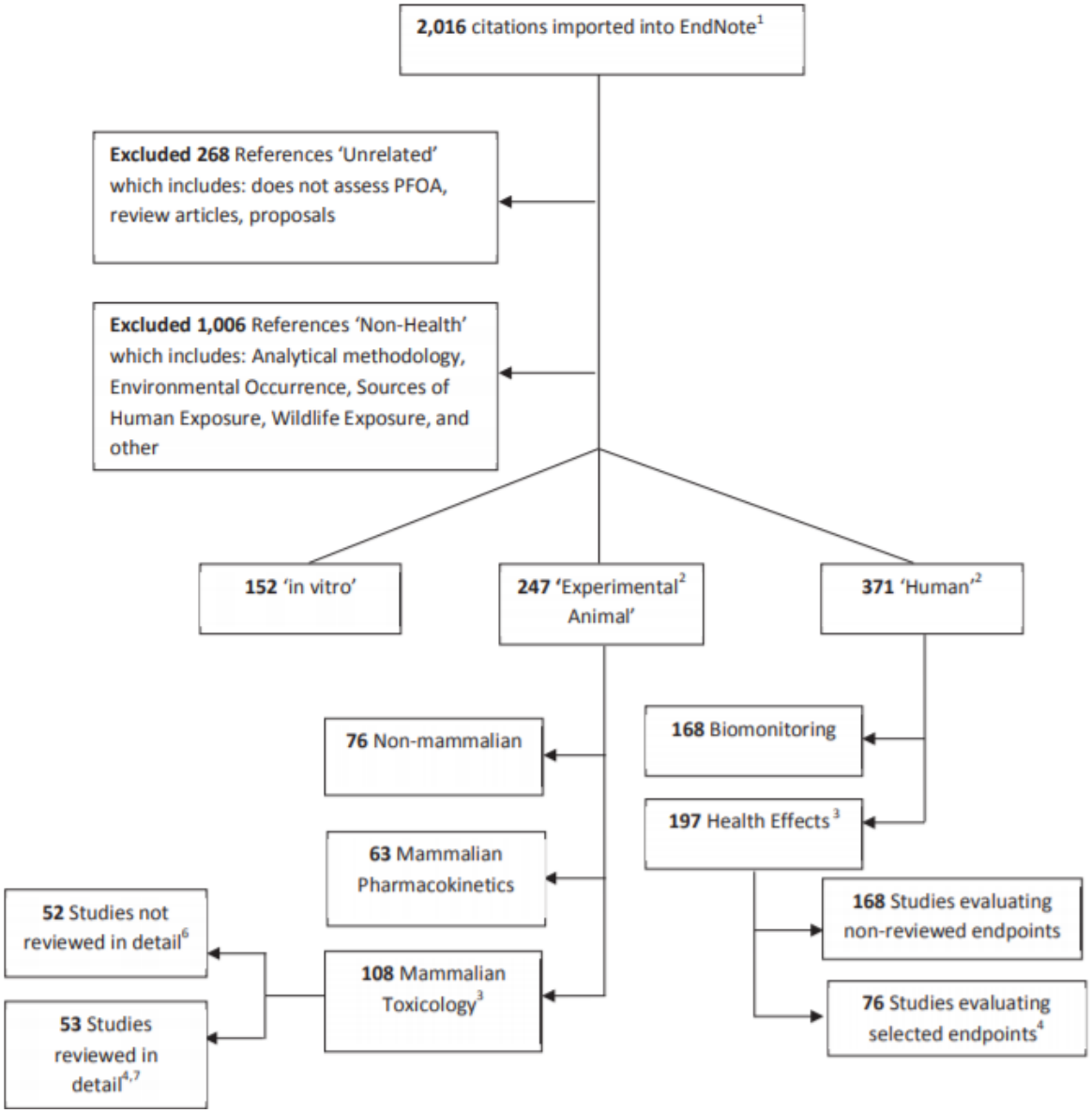
Human Health Basis for NJ PFAS MCLs

Great Increase in PFAS Research in Recent Years: Example-PFOA



DWQI PFOA Literature Review Strategy

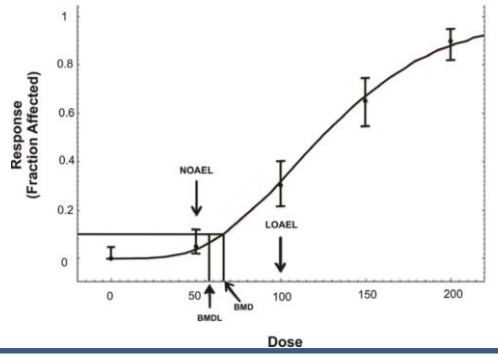
More than 2000 citations identified and screened in 2016.



NJ DWQI, 2016

New Jersey Risk Assessment Approach for PFAS

Based on **Reference Doses** for most sensitive **non-cancer** endpoints from animal studies that are well-established, adverse, and relevant to humans.



Reference Dose (ng/kg/day) = Point of Departure / Uncertainty Factors

Definition: "Daily oral dose to humans (including sensitive subgroups) likely to be **without appreciable risk** of deleterious effects during a lifetime."

Carcinogenicity evaluation:

- **PFOA** & **PFOS:** *"Suggestive evidence for carcinogenicity in humans"*
  - Cancer risk (at 1-in-1 million risk level used by NJ) was not driving factor.
- **PFNA:** No chronic studies evaluating carcinogenicity.

***NOTE*: New NTP (2019) chronic rat PFOA study** was not considered.

- *"Clear evidence"* in males; *"Some evidence"* in females.
- Much higher tumor incidence than in earlier chronic studies.

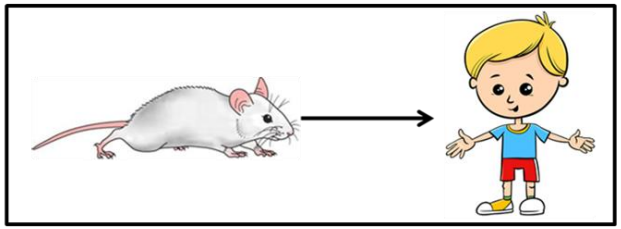
New Jersey Conclusions: Human Epidemiology Data in Risk Assessment of Long-Chain PFAAs

- Human data preferred for risk assessment, if suitable.
- Evidence for multiple human health effects at low exposures:

↑ *cholesterol* (PFOA, PFOS, PFNA)
↑ *uric acid* (PFOA)
↑ *liver enzymes* (PFOA, PFNA)
↓ *birth weight* (PFOA)
↓ *vaccine response* (PFOA, PFOS)
↑ *infectious disease* (PFOS)
↑ *testicular & kidney cancer* (PFOA)

- Generally concordant with toxic effects in animal studies.
- However, limitations preclude human data as basis for risk assessment.
  - *Exposures to multiple PFAS are correlated, so dose-response for each PFAS cannot be determined.*
- **Conclusion: Human data provide support for public health protective approach based on animal toxicology data.**
  - *More human data than for many other drinking water contaminants.*
  - *Justify concern about additional exposure from drinking water*

Animal-to-Human Comparison in New Jersey PFAS Risk Assessment



- Based on **internal dose (blood serum level),** not administered dose.
- Because half-life much longer in humans than animals → **Same dose results in much higher internal dose (serum level) in humans than animals.**
- NJ Reference Doses are based on animal studies that provide **blood serum PFAS data.**

	# of Carbons	Mouse	Rat		Human
			M	F	
PFOA	8	18 days	5 days	3 hours	~2-3 years
PFNA	9	50 days	30 days	1-2 days	Estimated as twice PFOA
PFOS	8	37 days	50 days		~3-5 years

Development of New Jersey PFAS Reference Doses

Serum Level Point of Departure (POD) for animal endpoint

(ng/ml; BMDL, NOAEL, or LOAEL)

↓

Apply Uncertainty Factors

(Note: Animal-to-Human – 3; Toxicokinetic differences accounted for by use of serum level as dose metric)

Target Human Serum Level (ng/ml; µg/L)

↓

Apply Clearance Factor:

Target Human Serum Level (µg/L) x ***Clearance (L/kg/day)*** *= RfD (µg/kg/day)*

Reference Dose (µg/kg/day)

NOTE: Order of application of Uncertainty Factors and Clearance Factors may be reversed in some other states' processes - ***Does not affect resulting Reference Dose.***

Reference Dose is Combined with Drinking Water Exposure Assumptions to Derive Health-based MCL

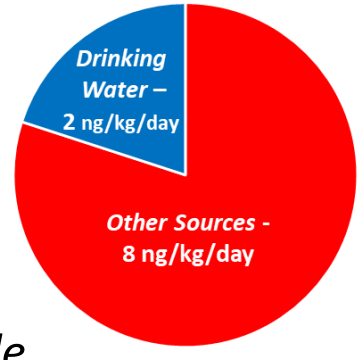
Health-based MCL =

$$\frac{\text{Reference Dose (mg/kg/day)} \times \text{Body Wt. (kg)} \times \text{Relative Source Contribution (\%)}}{\text{Drinking Water Consumption (L/day)}}$$

Drinking Water Ingestion Rate *(L/kg/day)*

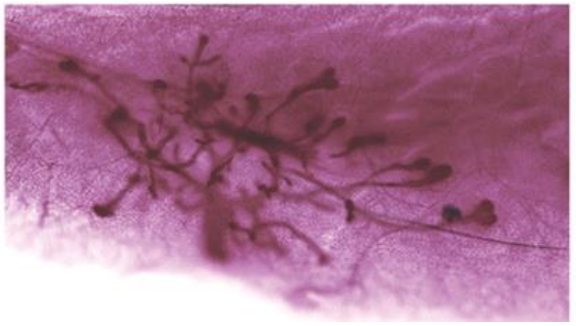
- NJ – Default adult assumptions (70 kg body wt.; 2 L/day)
- Other assessments use higher rates → lower drinking water levels:
  - *Higher default adult rate - CA*
  - *Rates for sensitive subgroups.*
    - *Lactating women (higher) – USEPA, MA.*
    - *Infants (highest) - VT.*
  - *Minnesota Dept. of Health model for prenatal and infant exposure – MN,NH,MI.*

Relative Source Contribution (RSC):



- Accounts for non-drinking water exposures (e.g. food, consumer products, air). Higher RSC → higher drinking water level:
  - *Default RSC: 20% of Reference Dose from drinking water; 80% from other sources.*
  - *Higher chemical-specific RSCs when chemical-specific data available.*

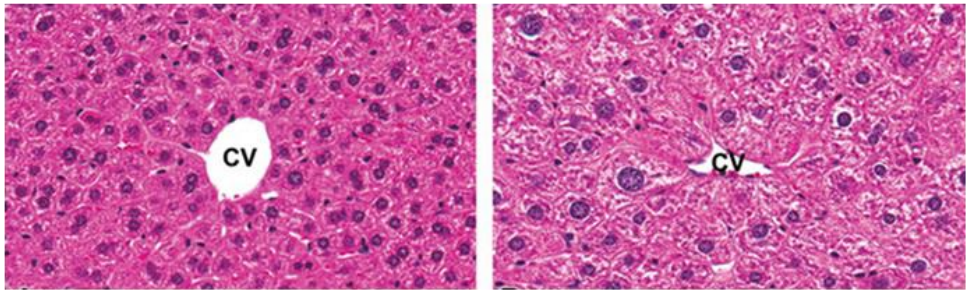
NJ PFOA Reference Dose: Delayed Mammary Gland Development



- **Most sensitive effect with serum PFOA data.**
- **Well established** - 9 mouse studies
  - *Only 1 negative study with problematic issues.*
- **Adverse** - Structural changes persist until adulthood.
- **Considered relevant to humans:**
  - *Based on Mode of Action evaluation.*
  - *PFOA associated with ↓ duration of breastfeeding in several human studies.*
- **Reference Dose: 0.11 ng/kg/day; *below general population exposure*.**
  - Benchmark Dose (Post et al., 2012; data from Macon et al., 2011).
    - ↓ *mammary gland developmental score*
    - ↓ *number of terminal end buds.*
- **Health-based MCL would be 0.77 ng/L - <u>Not recommended</u>** although scientifically valid**:**
  - ***Rationale:*** *No precedent for this effect as primary basis for risk assessment.*
- **Uncertainty Factor** for more sensitive effects, including on mammary gland.

NJ PFOA Reference Dose: Increased Liver Weight

- **Increased liver weight and hepatocellular hypertrophy (enlarged liver cells) -** well-established effects in monkeys and rodents.
- **Most sensitive effect** with serum PFOA data, except mammary gland.



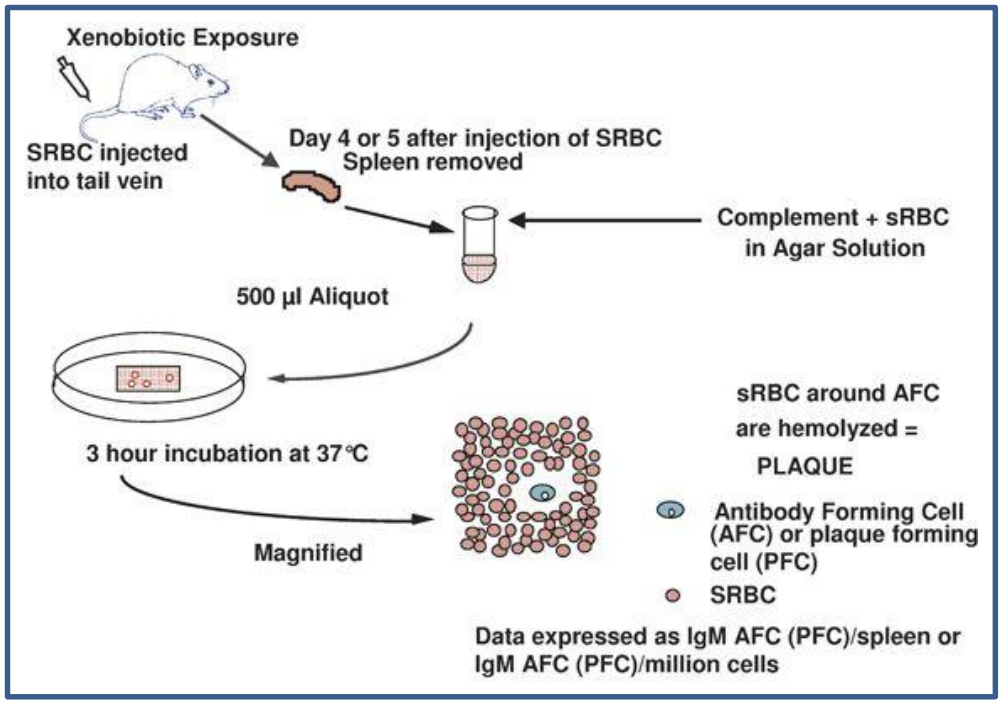
Pregnant mice dosed on GD 1-17. Quist et al., 2014

- **Co-occur with and/or progress** to more severe liver effects (*e.g. necrosis – liver cell damage).*
- **Considered relevant to humans** based on detailed Mode of Action evaluation.
- Reference Dose (2 mg/kg/day)
  - *Based on increased liver weight in mice (Loveless et al., 2007).*
  - *Includes **additional uncertainty factor** for delayed mammary gland development and other low-dose developmental effects.*

NJ PFOS Reference Dose: Decreased Immune Response
(Pachkowski et al. 2019. Env. Research)

- Based on **decreased plaque forming cell response** in mice (Dong et al., 2009).
  - *Measures antibody response to foreign antigen.*

- Well established – 4 positive studies; only 1 negative study.
- Considered relevant to humans.
- Consistent with human data:
  - *↓ response to vaccination – analogous effect.*
  - *↑ incidence of infectious disease.*
- Reference Dose – 1.8 ng/kg/day.



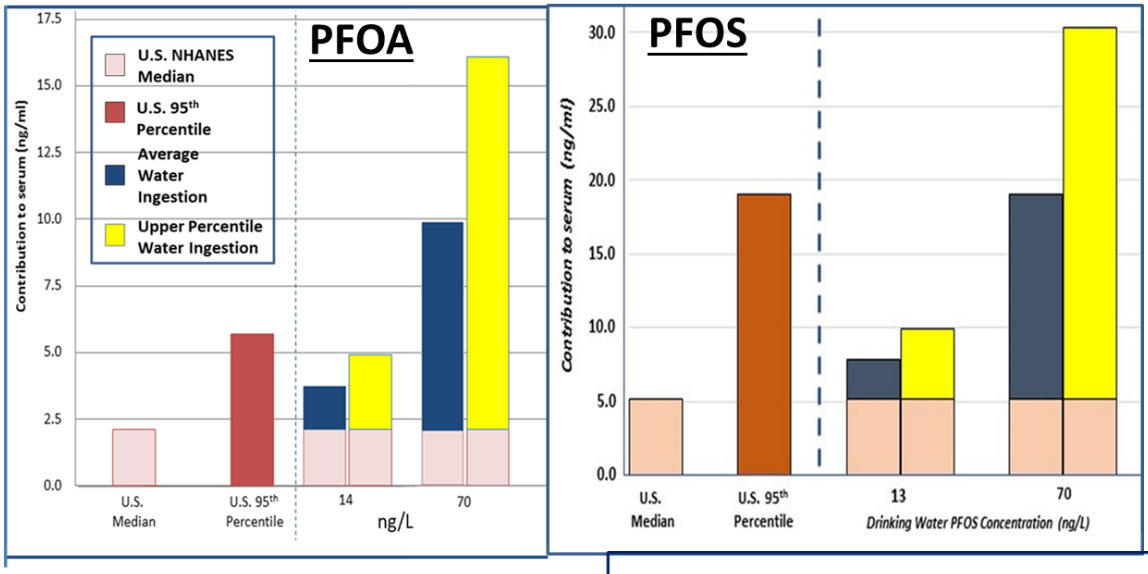
- Other federal and state PFOS evaluations:
  - *National Toxicology Program (2016) systematic review: Presumed human immune hazard.*
  - *ATSDR (2018 draft) and at least 5 other states (CA, MI, MN, NH, NY): PFOS assessments also based on decreased immune response.*

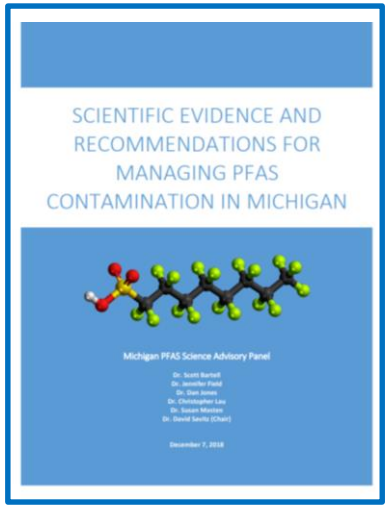
NJ, USEPA, ATSDR & European Food Safety Authority (EFSA) Toxicity Factors (ng/kg/day) for PFOA & PFOS

Agency	*Species*	PFOA		PFOS	
		Basis	*Tox. Factor*	*Basis*	*Tox. Factor*
USEPA Reference Dose	Animal	**Developmental: Delayed bone development & earlier male puberty (mouse)**	**20**	**Developmental: ↓ offspring body wt. (rat)**	**20**
NJ Reference Dose		**↑ Liver weight (mouse):** • **Uncertainty factor of 10 - Mammary gland delay.**	**2**	**Immune suppression (mouse)**	**1.8**
ATSDR *Draft* Minimal Risk Level		**Developmental: Behavioral & skeletal changes (mouse)**	**3**	**↓ Offspring body weight (rat);** • **With uncertainty factor for immune toxicity (mouse)**	**2**
EFSA Tolerable Daily Intake	**Human**	**↑ cholesterol (also ↑ liver enzyme ALT, ↓ birth weight)**	**0.8**	**↑ cholesterol; ↓ vaccine response; ↓ birth weight**	**1.8**

Increases in Serum PFOA & PFOS Predicted from New Jersey MCLs (13-14 ng/L) & USEPA Health Advisories (70 ng/L)

"NJ Drinking Water Quality Institute Health Effects Subcommittee concludes that these [blood serum PFAS] increases [at 70 ng/L] are **not desirable and may not be protective of public health."**

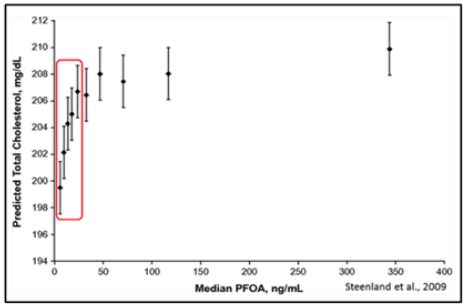




Michigan PFAS Science Advisory Panel Report (Dec. 2018)

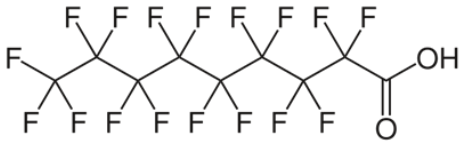
"If one accepts the probable links between PFOA exposure and adverse health effects detected in the epidemiological literature as critical effects for health risk assessment**, then 70 ppt in drinking water might not be sufficiently protective for PFOA."**

Steep Dose-Response at Low Exposure Levels – Increased Cholesterol and PFOA



Other associations at low serum levels include ↑ liver enzymes, ↓ vaccine response, and ↓ birth weight.

New Jersey PFNA Reference Dose: Increased Liver Weight



- "NJ-specific contaminant" – not evaluated by USEPA.
- Toxicity (hepatic, developmental, immune, male reproductive) generally **similar to PFOA** but:
  - *More bioaccumulative – human half-life estimated at twice PFOA's.*
  - *Effects at lower doses.*
  - *Some effects are more severe.*
- Reference Dose based on ↑ **liver weight** in pregnant mice (Das et al., 2015)
  - *Only study at the time with necessary **serum PFNA data.***
- **Liver damage (necrosis) - much more sensitive effect,** but could not be used:
  - *Numerical serum PFNA data needed for risk assessment exists, but was not provided by study sponsors.*
  - *Uncertainty factor of 3 for more sensitive effects.*
- Reference Dose - 0.74 ng/kg/day (3-fold lower than PFOA)
- NJ conclusions supported by recent National Toxicology Program 28-day rat study.

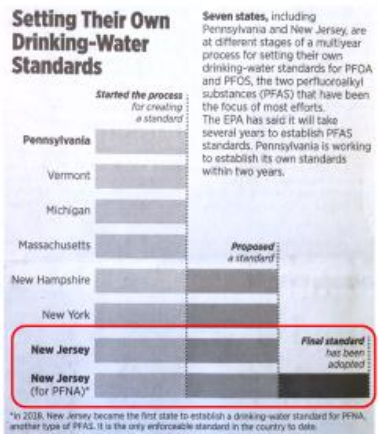
USEPA & State PFAS Drinking Water Guidelines (ng/L; ppt)

(Includes Standards & Guidance Values - Proposed, Recommended & Final)

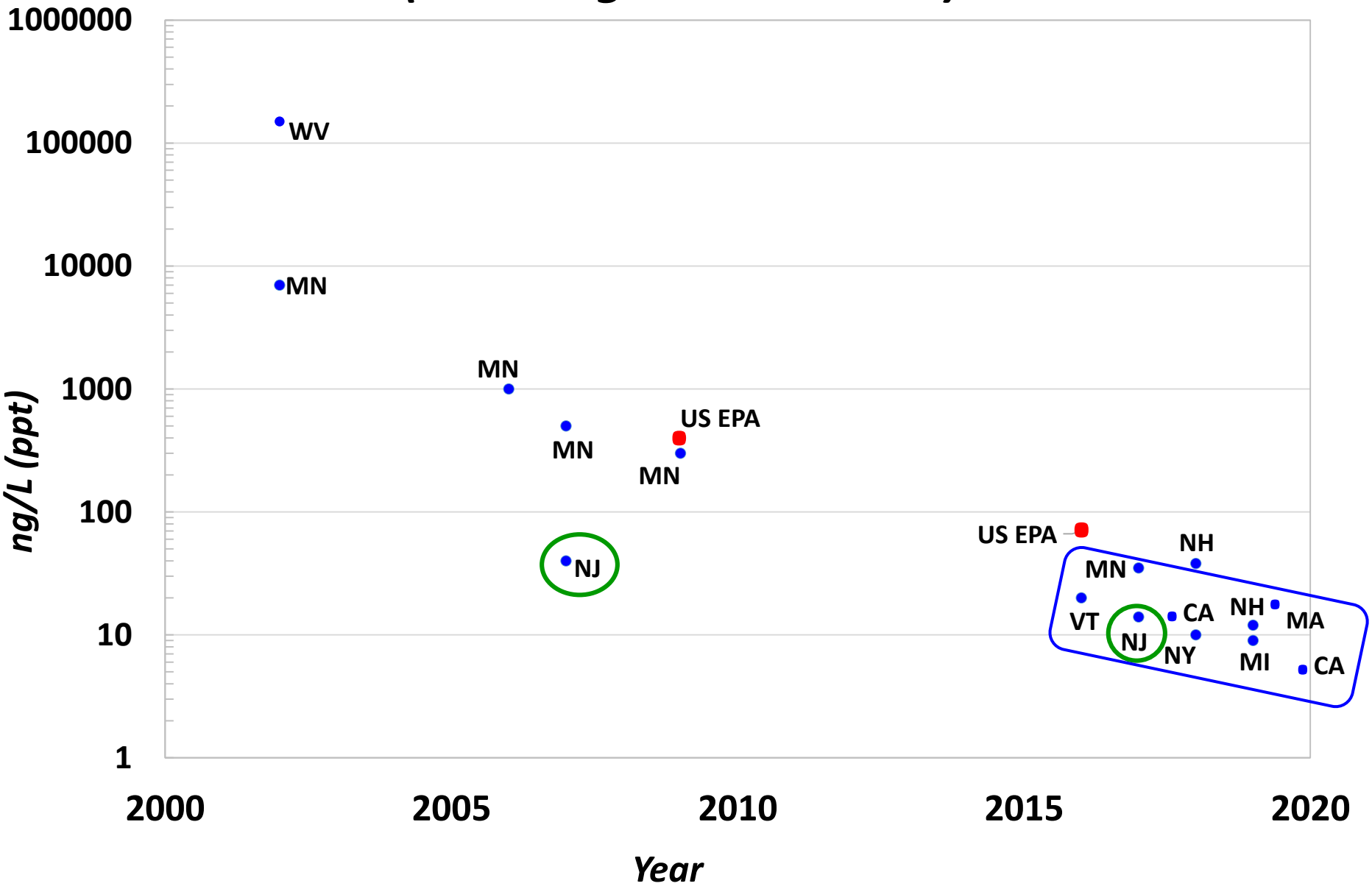
	PFOA	PFOS	PFNA	PFHxS	PFHpA	PFDA	*Total?*	PFBA	PFHxA	PFBS	GenX
EPA	70	70	---	---	---	---	*Yes (2)*	---	---	---	---
CA*	5.1	6.5	---	---	---	---	*No*	---	---	---	---
CT	70	70	70	70	70	---	*Yes (5)*	---	---	---	---
MA**	20	20	20	20	20	20	*Yes (6)*	---	---	2000	---
MI**	8	16	6	51	---	---	*No*	---	400,000	420	370
MN	35	15	---	47	---	---	*No*	7000	---	2000	---
NH	12	15	11	18	---	---	*No*	---	---	---	---
NJ	14**	13**	13	---	---	---	*No*	---	---	---	---
NY**	10	10	---	---	---	---	*No*	---	---	---	---
NC	---	---	---	---	---	---	---	---	---	---	140
VT	20	20	20	20	20	---	*Yes (5)*	---	---	---	---

States not listed generally use USEPA Health Advisories of 70 ng/L for PFOA and PFOS as guidance.

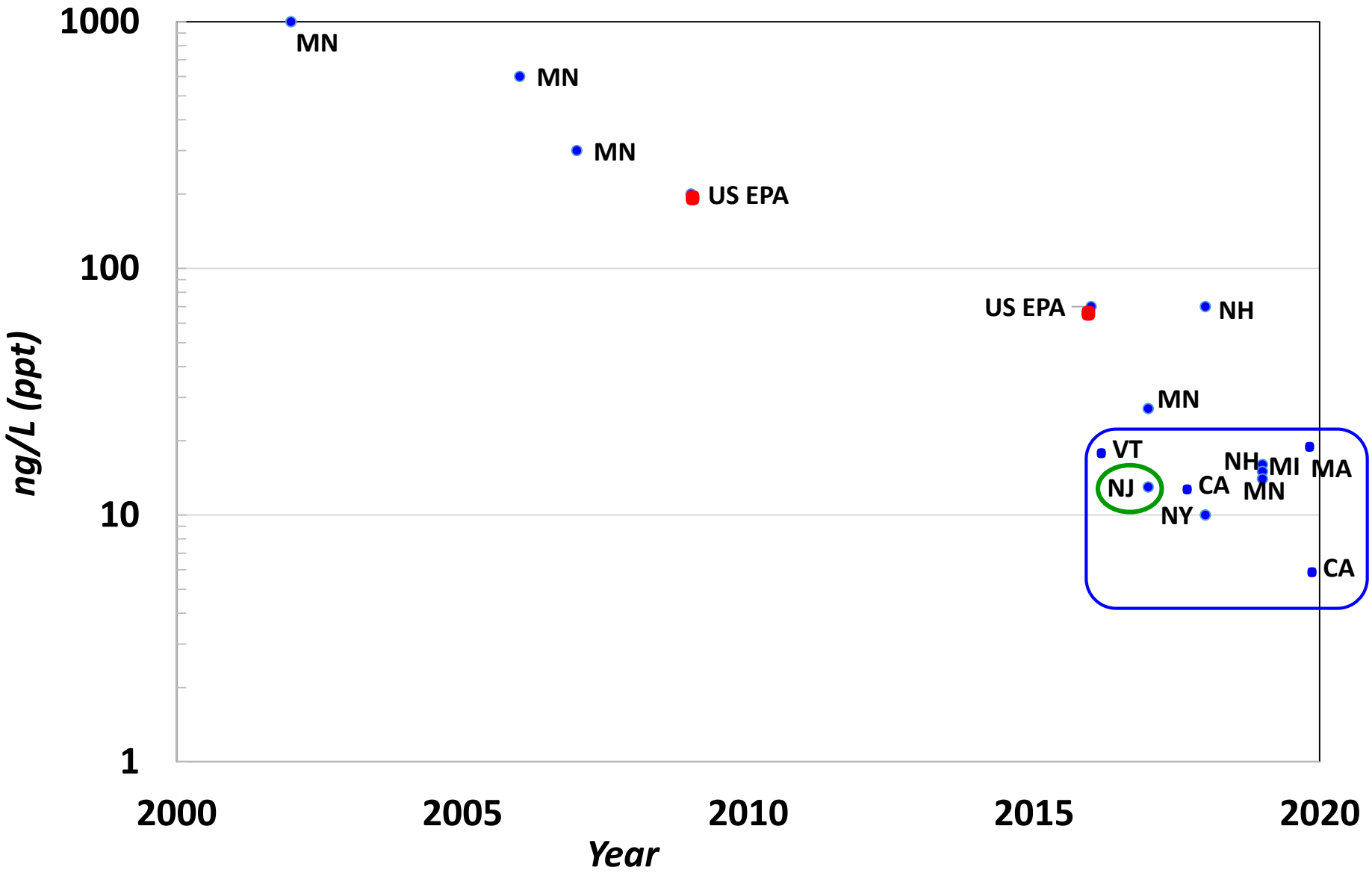
**Notification Levels: based on analytical limits; health-based levels < PQLs. **Proposed, recommended, or draft.*



State & USEPA PFOA Drinking Water Guidelines: 2002-2020 (Note Logarithmic Scale)



State & USEPA PFOS Drinking Water Guidelines: 2002-2020 (Note Logarithmic Scale)



Interstate Technology & Regulatory Council (ITRC) Tables of PFAS Standards & Guidance Values

Section 4 Tables Excel file (updated December 2019)

- Table 4-1 presents the available **PFAS water values** established by the USEPA, each pertinent state, or country (Australia, Canada and Western European countries).
- Table 4-2 presents the available **PFAS soil values** established by the USEPA, each pertinent state, or country (Australia, Canada and Western European countries).

Section 5 Tables Excel file (updated January 2019)

- Table 5-1 summarizes the differences in the **PFOA values for drinking water** in the United States.
- Table 5-2 summarizes the differences in the **PFOS values for drinking water** in the United States.

Posted at: https://pfas-1.itrcweb.org/fact-sheets/

Many current and former colleagues from:

New Jersey Department of Environmental Protection

New Jersey Department of Health

and the

New Jersey Drinking Water Quality Institute

contributed to the work presented here.

Thank you!

For questions or additional information:

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NJDEP Rules and Regulations Websites

- Adopted rules: https://www.nj.gov/dep/rules/adoptions.html
- Proposed rules: https://www.nj.gov/dep/rules/notices.html

NJDEP Drinking Water Program PFAS Q&As

- https://www.state.nj.us/dep/wms/bears/docs/2019-4-15-FAQs_PFOS-PFOA-websites-OLA%204-24-19SDM-(003).pdf

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 (2009-10 Study)
- Determination of Perfluorooctanoic Acid (PFOA) in Aqueous Samples (2006 Study). https://www.nj.gov/dep/dsr/dw/final_pfoa_report.pdf

NJDEP PFAS Publications

- Pachkowski, B., Post, G.B., Stern, A.H. (2019). The derivation of a Reference Dose (RfD) for perfluoroctane sulfonate (PFOS) based on immune suppression. Env. Research 171:452-469
- 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. Open access at https://journals.plos.org/plosbiology/article/file?id=10.1371/journal.pbio.2002855&type=printable
- 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.