New Jersey Department of Environmental Protection Actions to Address PFAS in the Environment

Gloria B. Post, Ph.D., D.A.B.T.

Division of Science & Research
New Jersey Department of Environmental Protection

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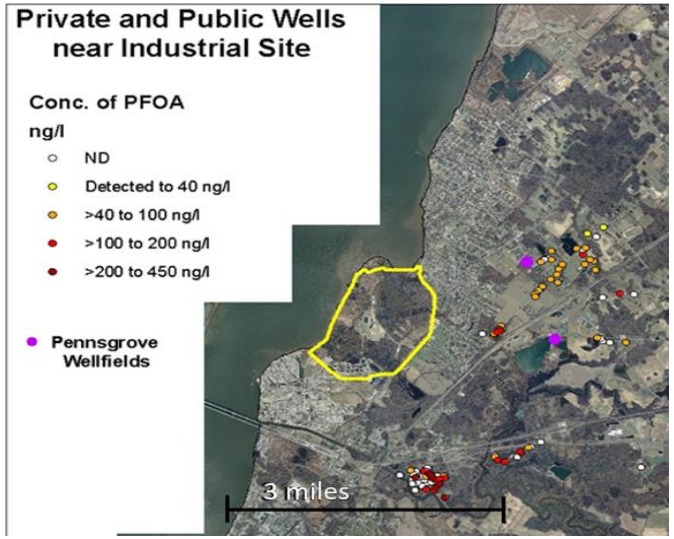
The views expressed in this presentation are those of the author and do not necessarily represent the views or policies of the New Jersey Department of Environmental Protection.

Initial NJDEP Awareness and Actions for PFOA in NJ Waters

- ***2004:*** Reported in **groundwater** at DuPont (now Chemours) facility in southwest NJ.
- ***2006:*** Reported in tap water and supply wells of nearby **public water system.**
  - Later found in nearby **private wells.**

NJ scientists recognized PFOA/PFAS are different and of particular concern.

- Based on previous experience with many other drinking water contaminants.
- Drinking water contaminant that is persistent, bioaccumulative, & toxic (**PBT**).

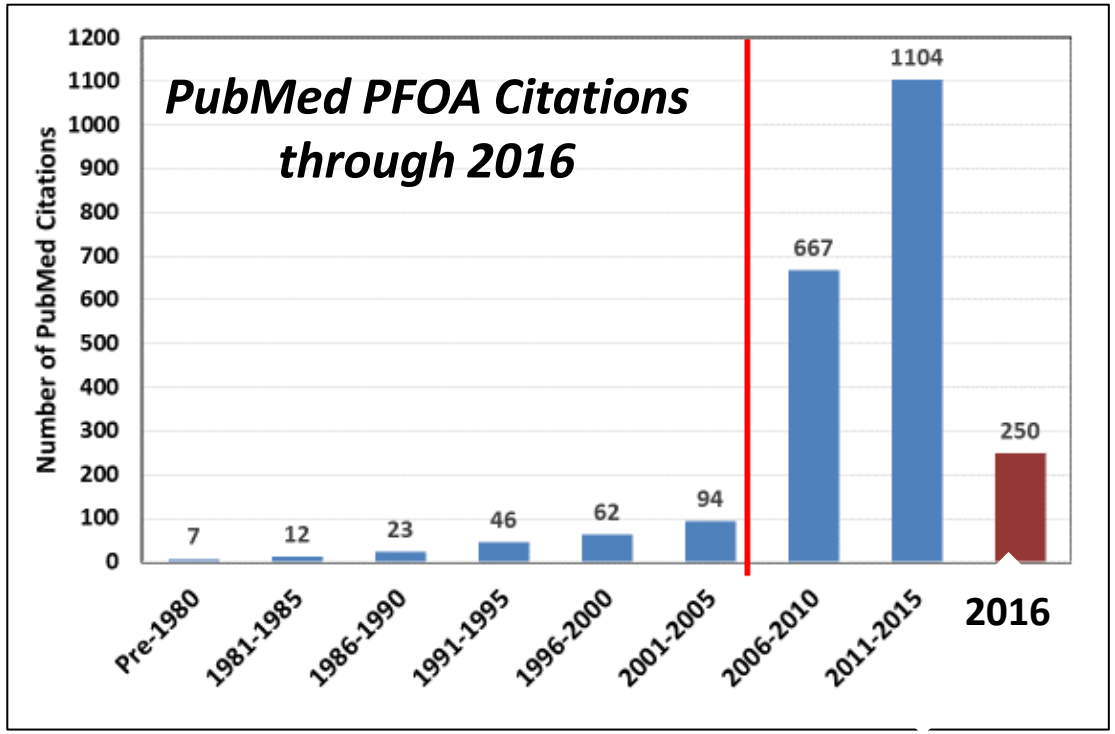


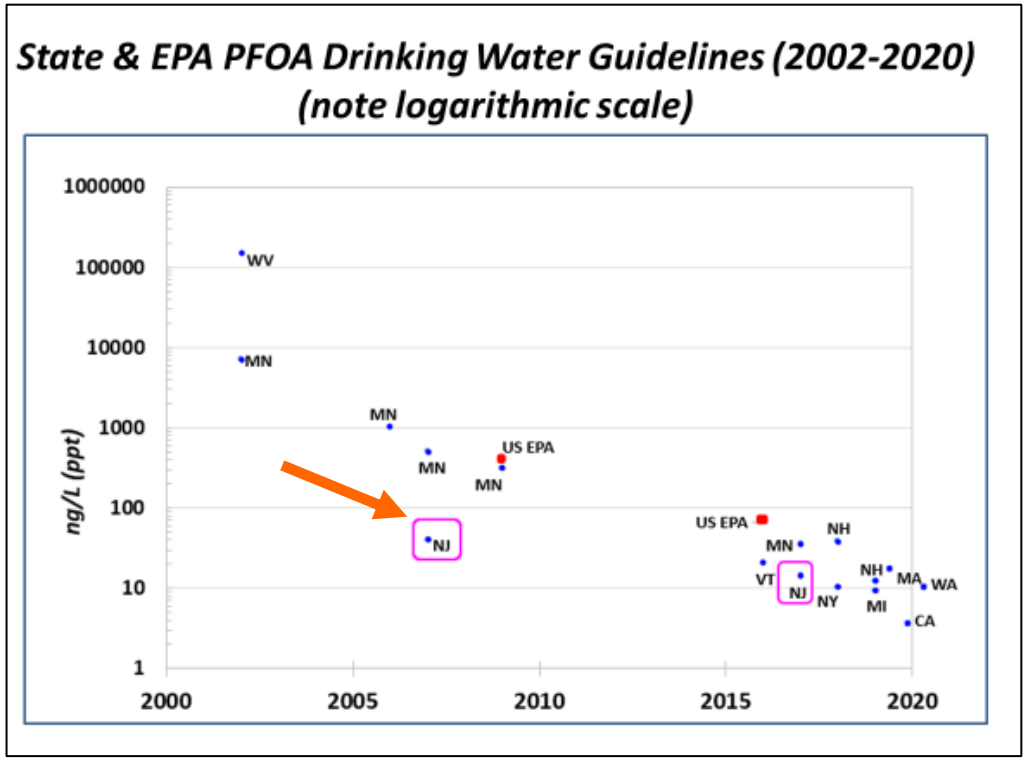
<u>NJDEP Actions</u>:

- Statewide drinking water **occurrence studies (2006; 2009-10).**
- **Drinking water guidance (2007) - 40 ng/L (ppt)**
  - Requested by affected water system.
  - Published in ES&T (Post et al., 2009).

NJDEP (2007) Drinking Water Guidance for PFOA (40 ng/L)

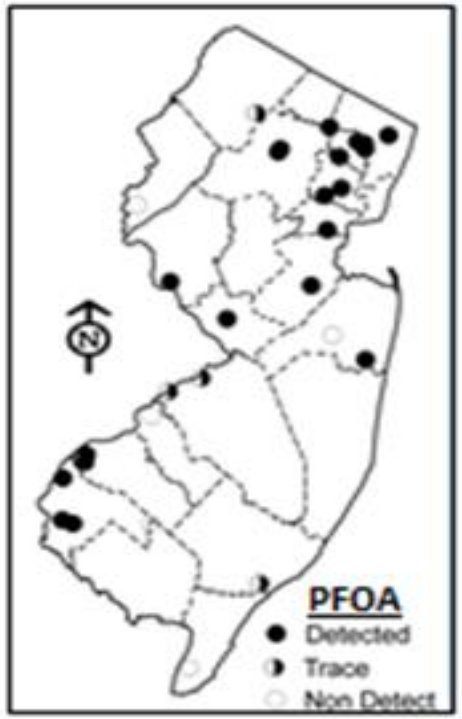
- Based on toxicological endpoints identified in **draft USEPA (2005)** risk assessment.
- Much important information was not yet available, including:
  - *Mouse developmental toxicity.*
  - *Human epidemiology studies.*
- Increased serum PFOA level:drinking water PFOA level. – ratio of ~100:1.
- Far below other guidance values at the time.





NJDEP PFAS Drinking Water Occurrence Studies (2006 and 2009-10)

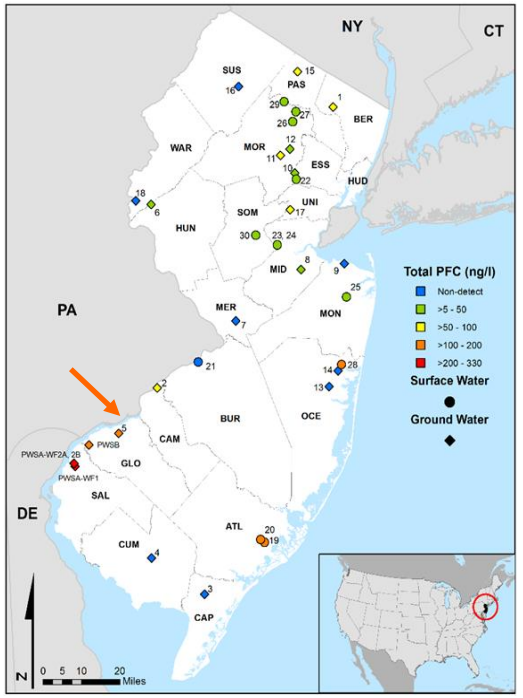
2006 Study



Post et al., 2009

- **First statewide PFAS occurrence studies in U.S.**
  - — ***2006 study*: 23 water systems - PFOA and PFOS.**
  - — ***2009-10 study*: 31 water systems – 10 PFAS.**
  - — ***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 (Southwestern NJ):
  - — **Highest level reported in drinking water worldwide.**
  - — Later found in other public and private wells, and Delaware River water and fish in this vicinity.
  - — Nearby industrial source (Solvay - West Deptford, NJ) was identified.
    - *Released tons/year to air and water for >20 years.*
    - *Use ended in 2010.*
    - *Alternative PFAS used along with and after PFNA.*

2009-10 Study



Post et al., 2013

New Jersey vs. National PFAS Detections in 2013-15 USEPA Unregulated Contaminated Monitoring Rule 3 (UCMR3)

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%

- Finished water at all large (>10,000 customers) and a few small public water systems.
- **PFOA and PFNA - much more frequent in NJ than nationally.**
  - *PFNA – Southwestern NJ.*
  - *PFOA – Various locations statewide.*
- **Reporting Levels much higher** than in NJ occurrence studies.
  — *Much **lower % occurrence** than in NJ occurrence studies.*

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

- ***1980s:*** NJDEP study found volatile organic chemicals in NJ waters.
  - *"Emerging contaminants" of the time - No federal standards.*
- ***1984:*** New Jersey Safe Drinking Water Act Amendments:
  - *Required development of Maximum Contaminant Levels (MCLs) for contaminants of concern.*
  - *Established Drinking Water Quality Institute (DWQI), to recommend MCLs to NJDEP.*
  - *NJDEP Commissioner decides whether to propose recommended MCLs as regulations.*
- ***1980s – present:*** DWQI and NJDEP have evaluated many types of drinking water contaminants.

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
- Cyanotoxins – current evaluation

** MCL adopted by NJDEP in 2018.*
first MCL in the U.S. for any PFAS.

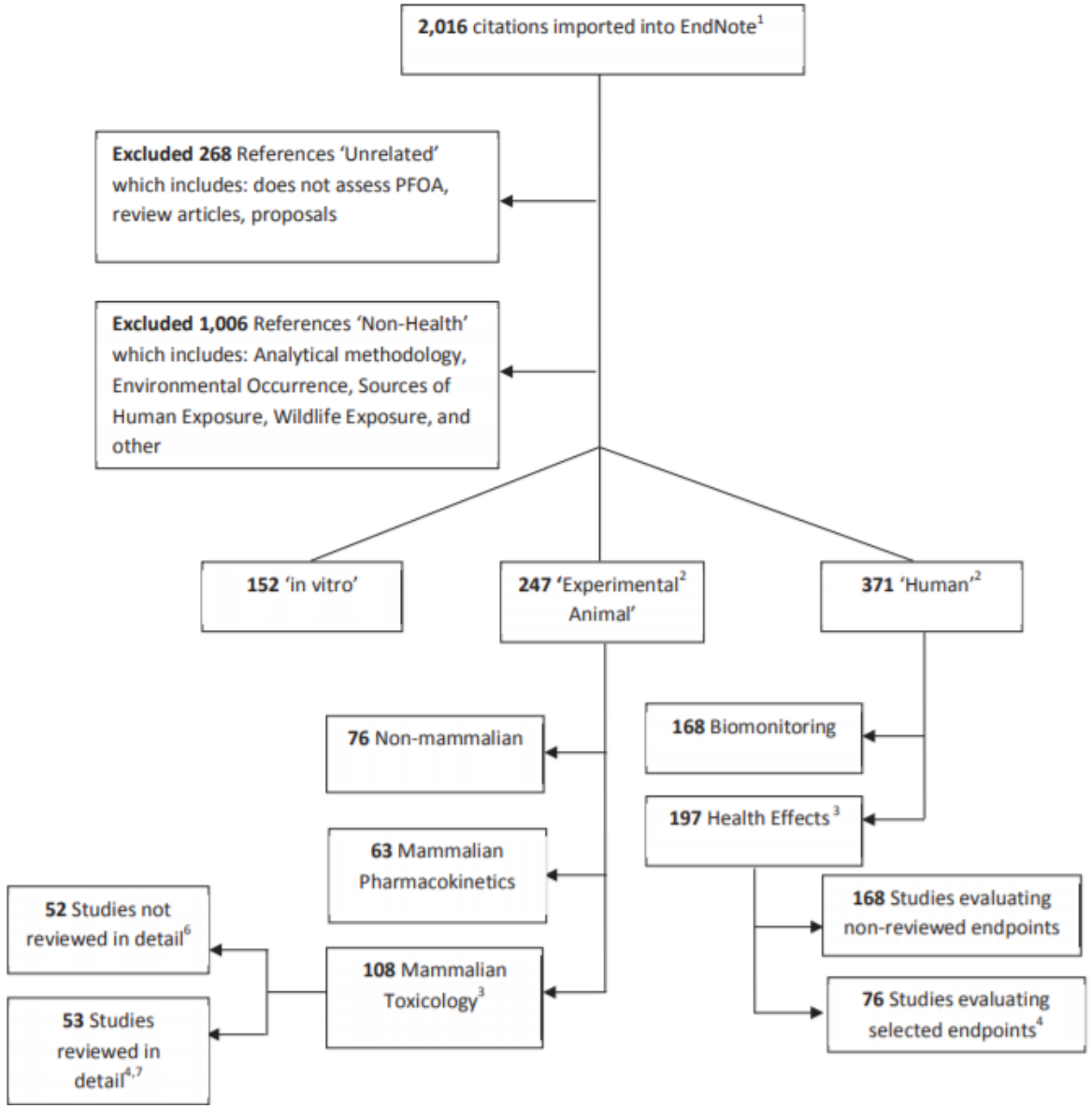
*** MCLs adopted by NJDEP in 2020.*

DWQI Development of PFAS MCL Recommendations

- ***2014:*** NJDEP Commissioner asks DWQI to develop MCL recommendations for PFNA, PFOA, and PFOS.
- ***2018-2020:*** NJDEP adopts three PFAS MCLs recommended by DWQI:
  - PFNA (2018): 13 ng/L; **first MCL in the U.S.** for any PFAS.
  - PFOA - 14 ng/L; PFOS - 13 ng/L (2020).
- ***2018-2020:*** Other PFOA, PFOS, PFNA regulations adopted by NJDEP**:**
  - MCLs adopted as **Ground Water Quality Standards.**
  - Added to **NJ Hazardous Substances List.**
  - Added to **NJ Private Well Testing Act -** Requires well testing upon sale of home and at rental properties.
- ***2022:*** DWQI Health Effects Subcommittee review of Interim USEPA PFOA/PFOS Health Advisories and other relevant information.
  - ***Conclusion: Lower Health-based MCLs are supported by current scientific information.***

DWQI Literature Review Strategy for Health Effects of PFOA

More than 2000 citations identified and screened in 2016.



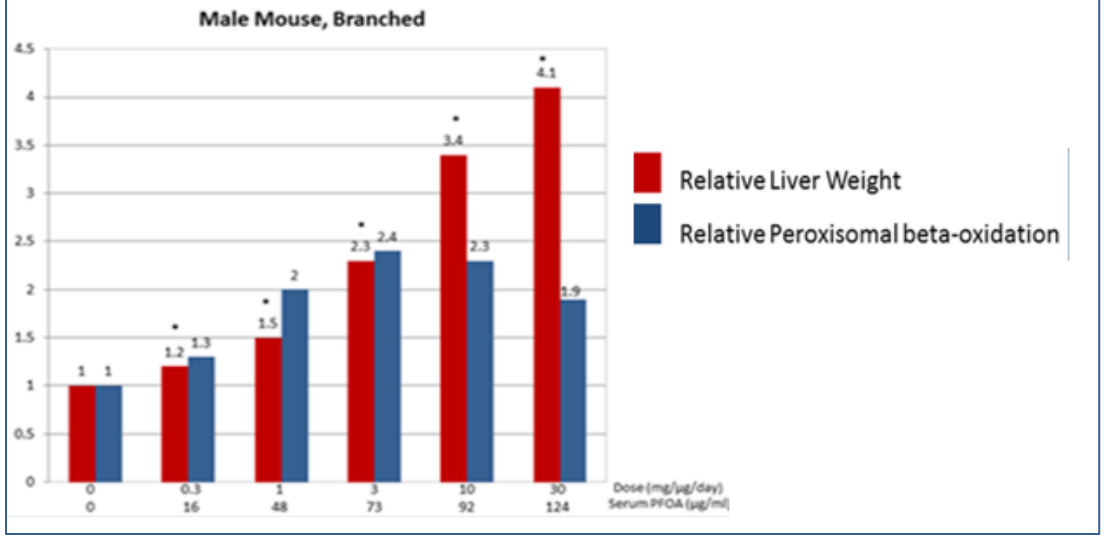
NJ DWQI, 2016

DWQI Health Effects Evaluations of PFOA, PFOS, PFNA - General Conclusions

Overall, indicated need for caution about exposure to these PFAS from drinking water and other sources.

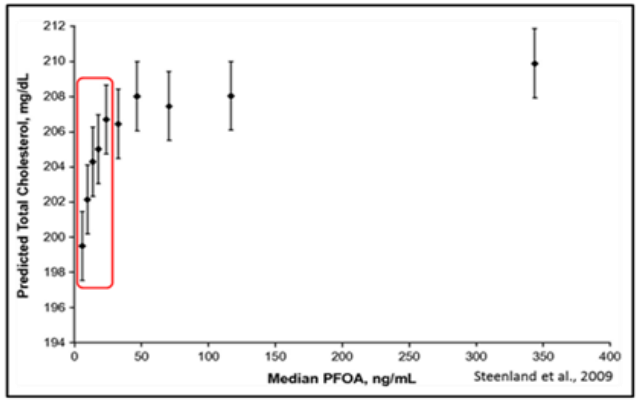
- **Multiple types of toxicity in laboratory animals**, including some at very low doses.
  - Including hepatic, developmental, immune.
- Mode of action (MOA) ***relevant to humans,*** *including hepatic toxicity.*
- Animal data are primary basis of NJ MCLs.

Example of MOA Evaluation for Hepatic Effects of PFOA



- **Multiple human health effects at low exposures:**
  - *Including within general population exposure range.*
- Human data support protective MCLs based on sensitive effects in animals.

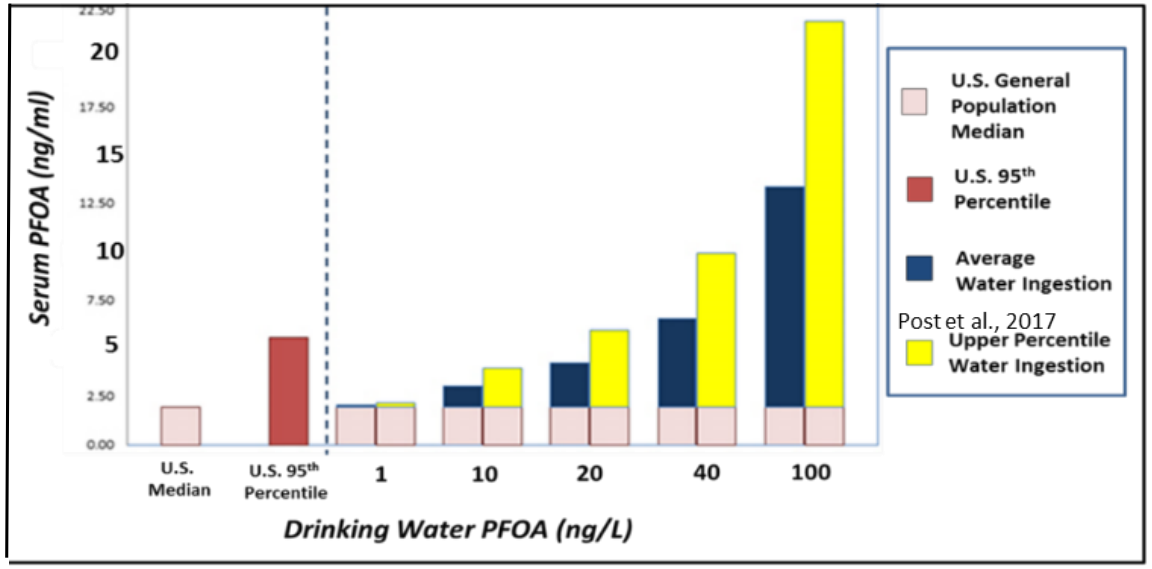
Steep Dose-Response at Low Exposure Levels – Increased Cholesterol and PFOA



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

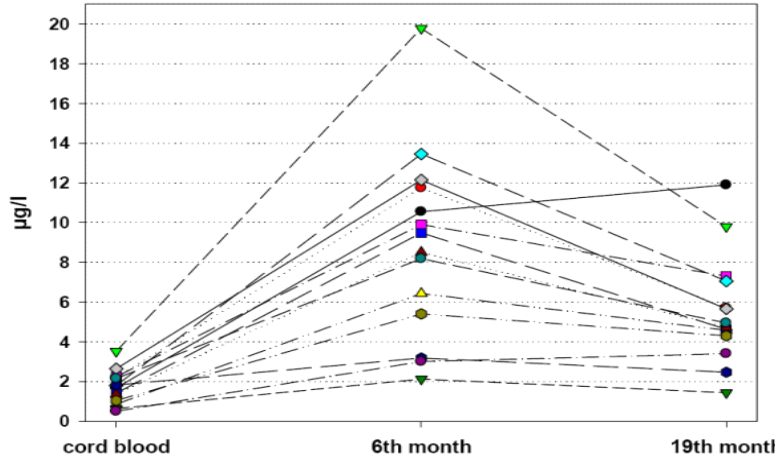
General Conclusions of DWQI Evaluations (continued)

- **Exposures from relatively low drinking water levels exceed exposures from generally prevalent sources** (e.g., food; consumer products).
- Increased serum PFAS levels from drinking water can be predicted with clearance factors and water ingestion rates.



Post et al., 2017

- **Higher exposures to infants (susceptible subpopulation), especially breastfed.**
- Exposures to breastfed infants much higher than mother's, even in general population.
- Infants consume more fluid (prepared formula or breast milk) than older ages on body weight basis.
- PFAS levels in breast milk higher than in maternal drinking water.



Fromme et al., 2010

Basis for NJDEP Health-based MCLs for PFNA, PFOA, and PFOS

- PFNA (2015) – 13 ng/L:
  - Increased liver weight in pregnant mice.
- PFOA (2017) – 14 ng/L :
  - Increased liver weight in mice (primary basis).
  - Delayed mammary gland development in mice at very low doses.
    - *Accounted for by uncertainty factor for potentially more sensitive effects.*
    - *If used as primary basis (i.e., RfD), Health-based MCL would < 1 ng/L.*
- PFOS (2018) – 13 ng/L:
  - Decreased antibody response to foreign antigen in mice (analogous to decreased vaccine response in humans).
- Cancer risk was also evaluated:
  - PFOA and PFOS: "Suggestive evidence of carcinogenicity;" developed cancer slope factors.
    - *MCLs based on non-cancer effects also protective for 1-in-1 million lifetime cancer risk.*
  - PFNA: Carcinogenicity has not been evaluated.
- Animal-to-human comparisons account for much higher internal dose (serum levels)in humans than in animals from the same dose of PFAS.

Factors Considered in Development of NJDEP PFAS MCLs

*** 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.**

(Units: ng/L)	Health-based MCL	Analytical PQL	Treatment Removal	Recommended MCL
PFOA	**14**	**6**	**Not limiting**	**14**
PFOS	**13**	**4**	**Not limiting**	**13**
PFNA	**13**	**5**	**Not limiting**	**13**

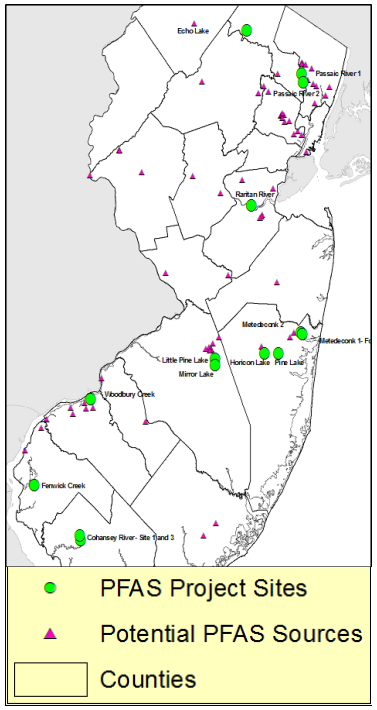
DWQI Health Effects Subcommittee (2022) "Review of Interim USEPA PFOA/PFOS Health Advisories and Other Relevant Information"

- NJDEP Commissioner asked DWQI to review Interim USEPA (2022) PFOA and PFOS Health Advisories.
  - To determine if health-based levels below current NJ analytical Practical Quantitation Levels (PQLs) - 6 ng/L for PFOA and 4 ng/L for PFOS - are supported by current scientific information.
- Additional relevant information was also reviewed:
  - Draft USEPA (2021) PFOA/PFOS assessments and USEPA (2022) Science Advisory Board review.
  - Key recent publications not considered by USEPA.
  - Other PFOA/PFOS evaluations based on human epidemiology data (EFSA, CalEPA, NAS).
  - Draft USEPA (2021) PFAS mixtures risk assessment document.
  - Recent information on higher infant exposures via breastmilk.

Conclusions - DWQI Health Effects Subcommittee (2022) "Review of Interim USEPA PFOA/PFOS Health Advisories and Other Relevant Information"

- DWQI Subcommittee report **agrees with major USEPA and SAB conclusions** including:
  - Use of human data as basis for PFOA and PFOS RfDs and PFOA cancer slope factor.
  - Health endpoints with strongest human evidence for PFOA and PFOS:
    - Increased serum cholesterol
    - Decreased antibody response to vaccination
    - Decreased birth weight
    - Increased serum levels of the liver enzyme ALT
    - For PFOA, increased risk of kidney cancer
  - PFOA is "likely to be carcinogenic to humans."
    - *Note: Basis for subsequent USEPA (2023) conclusion that PFOS is "likely to be carcinogenic to humans" was not available to DWQI.*
- Noted that several earlier DWQI Health Effects Subcommittee conclusions were incorporated into recent USEPA evaluations.
- Overall conclusion:
  - **Multiple lines of scientific evidence support health-based drinking water levels below current NJ analytical PQLs of 6 ng/L for PFOA and 4 ng/L for PFOS.**

NJDEP Study of PFAS in Fish Tissue, Sediments, and Surface Water (Goodrow et al., 2020) and Fish Consumption Advisories



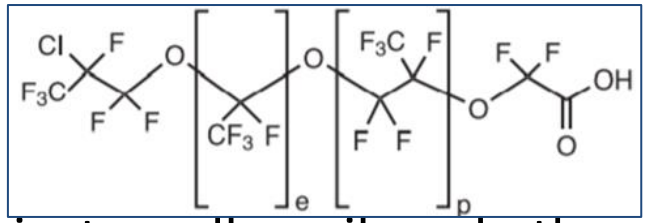
- Fish fillets, sediments, & surface water from 11 sites (2015-16) analyzed for 13 PFAS:
  - Sites selected for proximity to potential PFAS sources and/or recreational fishing activity.
  - 3 fish from each of 2-4 species per site.
- One or more long-chain PFAS detected at almost all species-sites.
- **Fish consumption advisories for PFOS at all study sites.**
  - Consumption triggers for PFOA, PFOS, PFNA based on DWQI RfDs.
  - PFUnA (C11) RfD was developed for advisories.
  - Consumption frequencies for PFOS advisories: 1 meal/week to 1 meal/year, for 1 – 3 species at each site.
- Shorter-chain PFAS detected in almost all surface water samples, but not in fish.
- Study of additional waterbodies currently underway.

Compound	Number of Sites (n=11)	Number 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

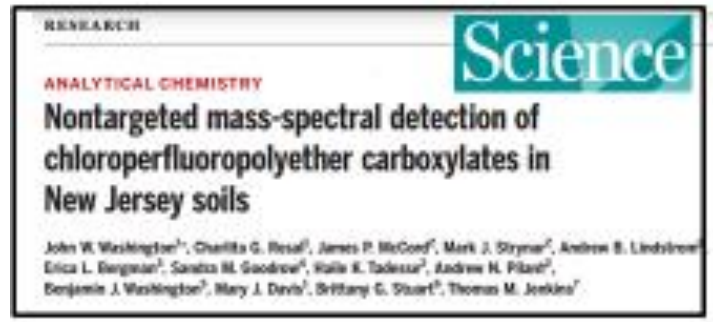
Reporting Levels: 0.5 – 1 ng/g (ppb)

Alternative PFAS used at NJ Solvay Facility

- Two types of PFAS alternatives, used before and after voluntary phaseout of PFNA and PFOA.
  - Large amounts discharged to air and water since late 1990s.
  - Use at the facility has recently ended.
- Unlike other PFAS replacements for long-chain PFAAs, **not** short-chain.
- **Chloroperfluoropolyether carboxylates** (ClPFPECAs; 7 to >14 carbons):



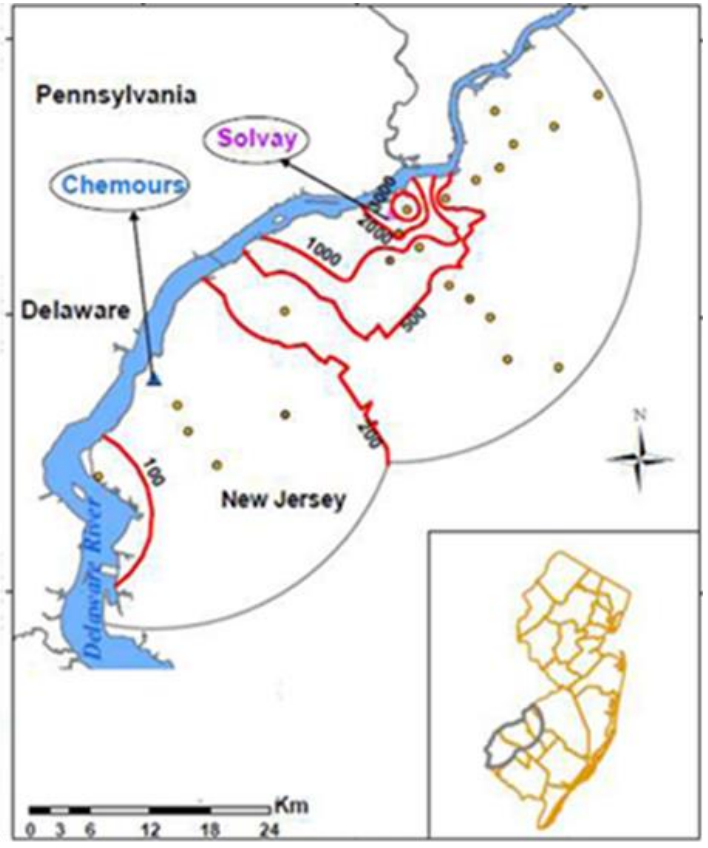
  - Found in private wells, soil, and other media with non-target analysis in joint NJDEP/EPA Office of Research & Development study.
  - Analytical standards provided by Solvay recently became commercially available.
- **Perfluoropolyether dicarboxylic acids:**
  - Structure: HOOC-CF2-$(OCF2CF2)_B$-$(OCF2)_A$-OCF2-COOH
    - where: A = 0 to 4 and B = 1 to 4
  - Found in groundwater monitoring conducted by Solvay.


RESEARCH

Science

ANALYTICAL CHEMISTRY

Nontargeted mass-spectral detection of chloroperfluoropolyether carboxylates in New Jersey soils



NJDEP Evaluation and Regulation of Solvay Alternative PFAS

- Solvay provided **contract lab rat toxicology studies** for both types of alternative PFAS in response to 2019 NJDEP legal directive.
  - Rat toxicology (acute, 4 week, 13 week) and half-life; genotoxicity; ecological toxicity.
  - Previously submitted to EPA as confidential business information (CBI).
  - Now publicly available from NJDEP and EPA.
- **Toxic effects of both types similar to PFOA and PFNA, at similar or lower doses.**
- **ClPFPECA human worker study** – not provided to NJDEP; revealed through EPA Freedom of Information Act (FOIA) request by a reporter.
  - **Long human half-life (2.5 - 3 years)** - similar to PFOA and PFNA.
  - Associated with **multiple health effects**: ↑ serum lipids, ↑ liver enzymes, changes in thyroid hormone levels, ↑ prostate-specific antigen (PSA), ↓ estradiol (estrogen), ↓immune system biomarkers.
- NJDEP performed first publicly available evaluation of health effects of ClPFPECAs.
- Established Interim Specific Ground Water Quality Criterion for ClPFPECAs of 2 ng/L in 2022.

Summary of NJDEP PFAS Standards and Guidance

All current NJDEP PFAS standards and guidance values use consistent toxicity factors (RfDs):

- ***PFOA, PFOS, PFNA:*** Reference Doses (RfDs) developed by NJ DWQI for MCLs
- ***GenX:*** RfD develop by USEPA (2021) Office of Water.

- **MCLs, Ground Water Quality Standards, Private Well Testing Act, Hazardous Substance List** (2018-2020):
  - PFNA, PFOA, PFOS.
- **Interim Specific Ground Water Quality Standard**:
  - ClPFPECAs (2022).
- **Fish consumption triggers for use in fish consumption advisories**:
  - PFOA, PFOS, PFNA (2018).
  - PFUnDA (2022).
- **Inhalation Reference Concentrations** (RfCs; non-regulatory):
  - PFOA, PFOS (2019); GenX (Screening RfC; 2021).
  - Oral-to-inhalation extrapolation from RfDs.

- **Interim Soil Remediation Standards** (2022):
  - *Ingestion-dermal (residential and non-residential)*:
    - PFOA, PFOS, PFNA, GenX.
  - *Migration to groundwater:*
    - PFOA, PFOS, PFNA.
    - Area of concern/site-specific using Synthetic Precipitation Leaching Procedure (SPLP).
- **Surface Water Quality Criteria**:
  - Anticipate proposal of PFAS MCLs as human health freshwater criteria.
  - NJ-specific bioaccumulation factors (BAFs) are under development.
    - To be used for fish consumption pathway for saline water criteria and updated freshwater criteria.

Additional NJDEP PFAS Activities

- Investigation of contaminated sites:
  - *Private well testing near PFAS-contaminated sites where these wells are potentially impacted, and in other areas where clusters of PFAS-contaminated private wells are found.*
  - *POETS or waterline extensions are installed to address PFAS contamination of the private wells.*
  - *Licensed Site Remediation Professionals must evaluate all sites being remediated to determine if PFAS are a contaminant of concern, and, if so, sample to determine if a discharge has occurred.*
- Industrial wastewater dischargers:
  - *Required to complete a survey regarding potential use, storage, and discharge of PFAS.*
  - *Requested to provide PFAS sampling data.*
- NJPDES regulated discharges to groundwater:
  - *Industrial and sanitary discharge permits are being modified to require PFAS sampling.*
- Monitoring of ambient groundwater (water table wells) and surface water networks for PFAS has been conducted and continues.
- Approval of PFAS analytical methods and laboratory certification for PFAS analysis for compliance data submitted to NJDEP.

NJDEP PFAS Research Projects (completed and ongoing)

- Source trackdown for PFOA in surface water source of a public water system (completed 2015).
- Statewide pilot study of PFAS in fish, surface, and sediments (completed 2019; Phase 2 is ongoing).
- Joint NJDEP/USEPA Office of Research & Development multimedia study of "legacy" and newly identified PFAS near industrial sites in southwestern NJ (ongoing).
- Development of NJ-specific PFAS bioaccumulation factors for saline water and freshwater (ongoing).
- Novel PFAS treatment technologies (ongoing):
  - *Plasma*
  - *Electrochemical destruction*
- Anthropogenic background (i.e., non-point source) PFAS levels in NJ soils (ongoing).
- Occurrence, biotransformation, and transport of PFAS in vegetation (ongoing).
- PFAS in NJ precipitation and ambient air (in development).

NJDEP PFAS Websites

- **Main NJDEP PFAS website** – https://www.nj.gov/dep/pfas/
  - Links to PFAS websites of specific NJDEP programs, NJ PFAS regulations and standards, and other NJ PFAS information.
- **NJDEP Division of Science & Research PFAS website** – https://dep.nj.gov/dsr/pfas/
  - Research & technical support, alternative PFAS used in NJ, presentations, peer-reviewed publications.
- **NJ Drinking Water Quality Institute -** https://www.state.nj.us/dep/watersupply/pdf/dwqi-health-effects-pfas-report.pdf
  - Support documents for NJ PFAS MCLs including Health-based MCLs, analytical Practical Quantitation Levels, and treatment removal technologies.
  - Report and presentation on "Review of Interim USEPA Health Advisories for PFOA and PFOS and Other Relevant Information" (2022).
- **NJDEP Site Remediation Program**:
  - Contaminants of Emerging Concern - https://www.nj.gov/dep/srp/emerging-contaminants/
  - Interim Soil Remediation Standards for PFAS - https://www.nj.gov/dep/srp/srra/training/sessions/pfas_interim_soil_slides.pdf

NJDEP Division of Science and Research PFAS Publications

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- Post, G.B. (2022) Invited Perspective: Current Breast Milk PFAS Levels in the United States and Canada Indicate Need for Additional Monitoring and Actions to Reduce Maternal Exposures. Environ Health Perspect. 130(2):21301.
- Rovero, M., Cutt, D., Griffiths, R., Filipowicz, U., Mishkin, K., White, B., Goodrow, S. and Wilkin, R.T. (2021), Limitations of Current Approaches for Predicting Groundwater Vulnerability from PFAS Contamination in the Vadose Zone. Groundwater Monit R, 41: 62-75.
- McCord, J.P., Strynar, M.J., Washington, J.W., Bergman, E.L., Goodrow, S.M. (2020). Emerging Chlorinated Polyfluorinated Polyether Compounds Impacting the Waters of Southwestern New Jersey Identified by Use of Nontargeted Analysis. Environmental Science & Technology Letters 2020 7 (12), 903-908 Post, G.B. (2021), Recent US State and Federal Drinking Water Guidelines for Per- and Polyfluoroalkyl Substances. Environ Toxicol Chem, 40: 550-563.
- Washington, J. W., Rosal, C. G., McCord, J. P., Strynar, M. J., Lindstrom, A. B., Bergman, E. L., Goodrow, S. M., Tadesse, H. K., Pilant, A. N., Washington, B. J., Davis, M. J., Stuart, B. G., Jenkins, T. M. (2020). Nontargeted mass-spectral detection of chloroperfluoropolyether carboxylates in New Jersey soils. Science 368: 1103–1107
- Goodrow, S. M., Ruppel, B., Lippincott, R. L., Post, G. B., Procopio, N. A. (2020). Investigation of levels of perfluoroalkyl substances in surface water, sediment and fish tissue in New Jersey, USA. The Science of the total environment, 729, 138839.
- Pachkowski, B., Post, G.B., Stern, A.H. (2019). The derivation of a Reference Dose (RfD) for perfluorooctane 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.
- 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.

Thank you!

For additional information, contact me at:

gloria.post@dep.nj.gov

Extra Slides

Relationship Between Drinking Water and Serum Concentrations for Long-Chain PFAAs

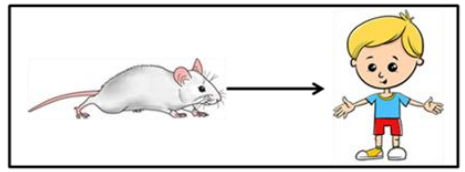
- Clearance factor (CL) - relates dose to blood serum level.
  - *CL (L/kg/day) = Volume of Distribution (L) x (ln 2 ÷ Half-life [days])*
- Combine with water ingestion rate (L/kg/day) to relate water & serum levels.

$$\textit{Dose (µg/kg/day)} = \textit{Serum Conc. (µg/L)} \times \textit{CL (L/kg/day)}$$

$$\textit{Dose (µg/kg/day)} = \textit{Drinking Water Conc. (µg/L)} \times \textit{Ingestion Rate (L/kg/day)}$$

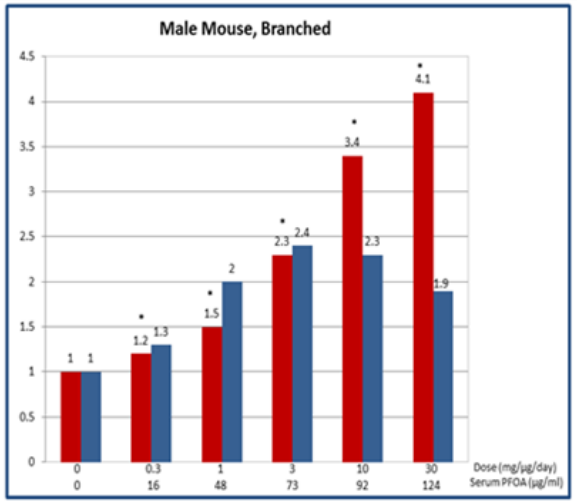
$$\textit{Serum:Water Ratio} = \frac{\textit{Serum Conc. (µg/L)}}{\textit{Drinking Water Conc. (µg/L)}} = \frac{\textit{Ingestion Rate (L/kg/day)}}{\textit{CL (L/kg/day)}}$$

DWQI Mode of Action Analysis for PFOA: Human Relevance of Rodent Hepatic Toxicity

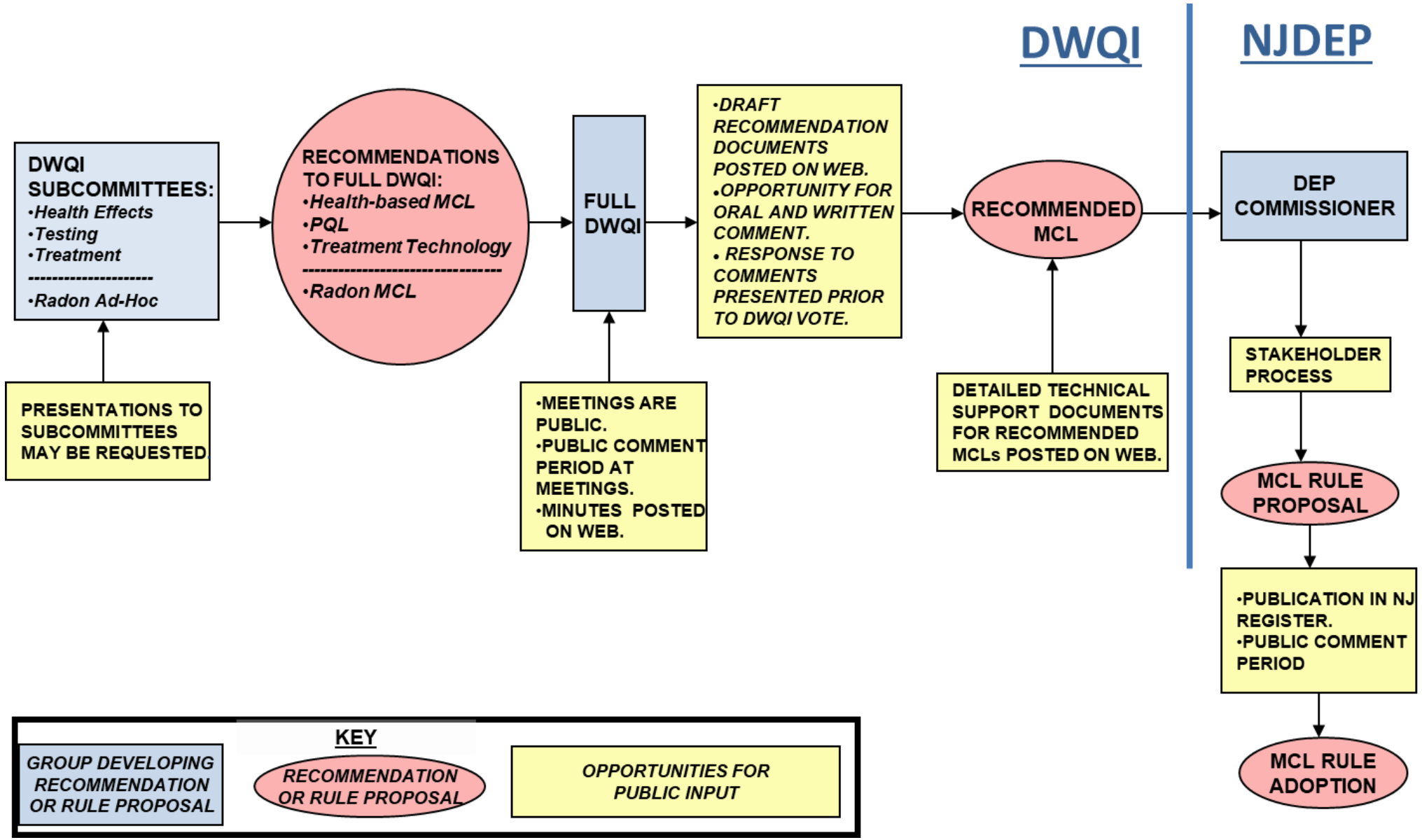


- PFOA activates peroxisome proliferator activated receptor (PPAR-α) and other nuclear receptors.
  - *Involved with hepatic, developmental, and other effects.*
  - *PPAR-α is functional in human liver.*
  - *Rodent liver tumors due to PPAR-α activation may not be relevant to humans.*
- **Are non-cancer hepatic effects of PFOA relevant to humans?**
- Extensive review of data from:
  - *Non-human primates*
  - *Standard rodent strains*
  - *Humanized PPAR-α mice.*
  - *PPAR-α null mice*
  - *Human tissues.*
  - *In vitro studies.*
- ***Overall DWQI conclusion:*** Non-cancer liver toxicity of PFOA in rodents is relevant to humans for the purposes of risk assessment.

Example of Approach Used



Public Participation in NJDEP MCL Development Process



PFAS MCL Violations in NJ Public Water Systems

# of Systems	*PFNA (13 ng/L)*	*PFOA (14 ng/L)*	*PFOS (13 ng/L)*
Submitting results	**1144**		
With MCL violation	**13** (1.1 %)	**44** (3.8 %)	**42** (3.6 %)
Violations of one or more MCLs	**78** (6.8 %)		

- *Data as of April 2022.*
- *Includes community water systems and non-transient non-community water systems.*
- *Monitoring began in 2019-2020 for PFNA, and 2021 for PFOA and PFOS.*
- *Violations are based on running annual average of 4 quarterly monitoring results.*
- *MCL violations were avoided by water systems who addressed PFAS contamination prior to implementation of the MCLs.*