DELAWARE RIVERKEEPER NETWORK

May 1, 2014

Terri Tucker
New Jersey Department of Environmental Protection
Office of Science
Trenton, New Jersey
terri.tucker@dep.state.nj.us

Re: Draft Interim Specific Ground Water Criterion for Perfluorononanoic Acid (PFNA, C9)

Dear Ms. Tucker,

Please find enclosed a technical analysis prepared by Fardin Oliaei, MPA, PhD, of Cambridge Environmental Consulting commissioned by Delaware Riverkeeper Network and submitted on behalf of the organization and its membership. Also attached is a Curriculum Vitae for Dr. Oliaei.

Delaware Riverkeeper Network submits these comments advocating that the public be protected from PFNA contamination and that New Jersey's drinking water be required to be treated to a safe level based on the best available scientific evidence.

We support all the recommendations and findings made by Dr. Oliaei in this technical analysis. We advocate that an appropriately protective criterion be applied to include children and should include a more protective Uncertainty Factor (UF) than has been applied in the Department's proposed criterion. We urge the Department to adopt the criterion of 1.7 ng/L based on Dr. Oliaei's analysis.

Thank you for taking this action towards the adoption of an Interim Specific Ground Water Criterion for PFNA, an essential step towards necessary regulation of this toxic compound.

Sincerely,

Maya van Rossum
the Delaware Riverkeeper

Tracy Carluccio
Deputy Director

Attachments:

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Technical Analysis of NJDEP Draft Interim Specific Ground Water Criterion for Perfluorononanoic Acid (PFNA, C9)

Curriculum Vitae - Fardin Oliaei, MPA, PhD.

Technical Analysis of NJDEP Draft Interim Specific Ground Water Criterion for Perfluorononanoic Acid - PFNA (C9)

Prepared by:

Fardin Oliaei, MPA, PhD,
Senior Scientist and President
Cambridge Environmental Consulting
116 Strawberry Hill Road, Concord, MA
Phone: 617-775-5797

Prepared for:
Delaware Riverkeeper Network

April 30, 2014

PREFACE

My opinions in this report are stated to a reasonable degree of scientific probability. The methods and principals I used in forming my opinion are generally accepted in the scientific community. I applied these matters and principles consistently with how these methods and principles are regularly applied in the scientific community.

My qualifications, including my publications, are summarized in the attached resume. I reserve the right to modify or supplement my opinions.

Technical Analysis of NJDEP Draft Interim Specific Ground Water Criterion for Perfluorononanoic Acid - PFNA (C9)

Executive Summary:

We conclude that the proposed NJDEP Groundwater PFNA criterion of 20ng/L would not be protective of adults. We also believe that the criterion should be developed on the basis of a more vulnerable population segment of children. Using the NJDEP serum level data, assuming it was based on the LOAEL dosage related to that serum level, and using the same serum:water method, the criterion value should be reduced from 20 ng/L to 1.7 ng/L . We determine that value by applying a more appropriate and protective uncertainty factor (UF) of 1000, and applying to children exposure parameters.

1. In the proposed NJDEP Groundwater Criterion (20ng/L) for adults, a relatively low UF of 300 is applied. A UF of 3 is given by NJDEP for the "toxicodynamic differences between humans and animals" or extrapolating from valid results of long term studies on experimental animals to humans (interspecies variation). NJDEP provides no basis in applying a UF of 3 for the interspecies variation factor, deviating from a default value of 10 for interspecies variation typically applied when no information for an alternate UF has been developed. We believe that the appropriate default of 10 UF for interspecies variation should be applied. An interspecies UF of 10 along with a UF of 10 for sensitive human populations (intraspecies variation), and a UF of 10 for extrapolation from short-term to chronic studies (LOAEL to NOAEL) produces a total UF product of 1000.

We note that NJDEP includes gaps in the toxicology database for PFNA within the UF 10 for LOAEL to NOAEL. A gap in toxicology database could trigger a separate UF of 10 (default), leading to a default total UF of 10,000, however, we believe that a total UF of 1000 is protective. We also note that the UF of 10 for sensitive human populations

(intraspecies variation) does not accommodate more sensitive groups, such as children, but rather is based on sensitivity within groups

2. Given a total UF of 1000 the criterion calculates to a value of 5.2 ng/L, based on an adult weight of 70 kg, and a water ingestion at 2 L/day, which we determined to be at an approximate 85th percentile of the U.S. adult male and female water ingestion distribution.

3. Perfluorochemicals have been demonstrated to have toxic effects in children. In fact, as NJDEP notes, PFNA has been associated with increased serum glucose and related parameters in adolescents, and increased thyroid hormone levels in children. Given that we are dealing with a toxicant with known toxicity to children that does not require long periods of exposure or latency, the criterion should be applied to this more vulnerable group. Accordingly, we applied calculations to children group ages 1-6, weighting ingestion rates and body weights by age group. We determined a mean body weight of 16.8 kg, and a water ingestion rate of 1.45 L/day at the 95th percentile, to calculate 1.7 ng/L.

Introduction:

This is a summary of analysis and evaluation of the Draft Interim Specific Groundwater Criterion for PFNA developed by the New Jersey DEP. It should be noted that this criterion is evaluated as an Interim measure for immediate elimination of PFNA from water supplies near contaminated areas and is not intended to be a permanent solution to PFNA contamination in drinking water. The ultimate solution would be development of a primary standard such as MCL (Maximum Contaminant Level) to prevent adverse health effects and to provide the maximum protection of public health by limiting the levels of PFNA and other PFCs in drinking water sources. Although a MCL could ultimately be based on this criterion.

The presence of PFNA in New Jersey water supply is of high concern because of unusually high concentrations in groundwater and surface water within the Delaware River Watershed. According to water sampling analysis conducted by the Delaware River Basin Commission (DRBC), PFNA had the highest concentrations of any PFCs sampled during monitoring of 2007-2009. The highest level of PFNA (976 ng/L) was found in the lower part of Delaware River at Paulsboro, near the Solvay plant. To our knowledge, this is the highest level of PFNA ever reported in surface water, worldwide. PFNA was also found at a very high level (96 ng/L) in a raw groundwater sample from Paulsboro Water Department. This is also the highest level of PFNA ever reported in drinking water, worldwide. The highest concentration for PFNA was also reported in a fish tissue sample collected from Lower Delaware River (DRN, July 23, 2013). However, drinking water contamination is one of the most important PFNA human exposure routes.

PFNA is known to be persistent and bioaccumulative with long half-life in humans, and causes similar toxic effects as PFOA, but at lower doses (ATSDR Toxicological Profile, 2009). Human and animal data suggest potential health risks from drinking water exposure.

The NJDEP Ground Water Criterion for PFNA was derived based on the lower bound benchmark dose (BMDL) from a study that unfortunately was not available for review. The BMDL was derived here is based on PFNA serum concentration (5,200 ng/ml) for increased maternal liver weight in a mouse developmental study (Lau et al., 2009).

How NJDEP did the calculation:

In developing the PFNA Ground Water Criterion, NJDEP has applies the BMD methodology (EPA 2012d BMDS) where a lower bound benchmark dose (BMDL) is derived based on the BMDL of 5,200 ng/ml PFNA serum concentration for increased maternal liver weight in a mouse developmental study (Lau et al., 2009) conducted by USEPA. We were unable to get a copy of Lau's unpublished study, thus we do not have information on the body dose that produced a 5200 ng/ml serum. Assuming that the

PFNA serum concentration of 5,200 ng/ml is a valid BMDL, the Reference Dose (RfD) is calculated by dividing the BMDL by uncertainty factors.

NJDEP Reference Dose (RFD) and Criterion Calculation:

A) The NJDEP calculated the reference dose for PFNA based on a UF of 300:

$$\text{RFD} = \frac{5200 \text{ ng/ml}}{300 \text{ UF}} \sim 17 \text{ ng/ml}$$

$$\text{Adult criterion with UF 300} = \frac{17 \text{ ng/ml X 0.2 RSC}}{200 \text{ serum:water ratio}} = 17 \text{ ng/L}$$

Typical default total UF is 1000. The value of 300 used by the NJDEP is low.

B) Using a more appropriate total UF of 1000, we calculated the reference dose for PFNA to less than 1/3 of the RFD value developed by the NJDEP.

For adults only, and applying a more appropriate default UF of 1000, the criterion is reduced to:

$$\text{RFD} = \frac{5200 \text{ ng/ml}}{1000} = 5.2 \text{ ng/ml}$$

$$\text{Adult criterion with UF 1000} = \frac{5.2 \text{ ng/ml x 0.2 RSC}}{200 \text{ serum:water ratio}} = \mathbf{5.2 \text{ ng/L}}$$

NJDEP Exposure Dose Calculation:

To calculate an exposure dosage equivalent to the 17 ng/L for adults, a serum:water ratio of 200:1 and the relative source contribution of 20% (0.2) is used:

A) According to NJDEP ⇒ RFD of 17 ng/ml/200 = 0.085 ng/ml
Relative Source Contribution (RSC) from drinking water is appropriately estimated to be 20% of all PFNA exposure ⇒ 0.085 ng/ml x 0.2 = 0.017 ng/ml or 17 ng/L.

In next step the NJDEP "back calculated" the dose that is equivalent to exposure of 17 ng/L. They do this for adults only, using 70 kg adult default body weight and a 2.0 L/day default water intake. In order to get the adult dose from all sources, they again appropriately included the RSC of 20% to derive the PFNA exposure of adult from all sources:

$$\frac{17 \text{ ng/L} \times 2 \text{ L/day}}{70 \text{ kg} \times 0.2} = 2.42 \text{ ng/kg/day allowable (from all sources) for adults}$$

To get the dose solely from water you would exclude the RSC of 0.2 or

$$\frac{17 \text{ ng/L} \times 2 \text{ L/day}}{70 \text{ kg}} = 0.486 \text{ ng/kg/day (from water only) for adults}$$

The NJDEP analysis therefore appears to show an allowable dose of 2.42 ng/kg/day for adults, based on the criterion developed of 17 ng/L in drinking water. We concur that in assuming a default 20% of PFNA exposure derived from drinking water ingestion.

Exposure Dose for a Vulnerable Population Segment:

The NJDEP criterion did not consider vulnerable segments of the population which, aside from toxicokinetic and physiologic differences, have significantly lower body weights. In order to find the allowable concentration in a more vulnerable group we apply the calculations to children age group 1-6. We determined a mean body weight (BW) value of 16.8 kg (both sexes) weighted by age group, and a water intake value for children 1-6 of 0.60 L/day (mean) to 1.45 L/day (95%).

The following is calculation of a children dose that would occur using the 17ng/L concentration criterion (UF of 300) and equivalent dosage in adults developed by NJDEP. In this calculation we used 95% water intake of 1.45 L/day and a mean body weight of 16.8 kg:

Dose for children 1-6 both sexes grouped (all sources) 95% ingestion ⇒

$$\frac{17 \text{ ng/L} \times 1.45 \text{ L/day}}{16.8\ (0.2)} = 7.34 \text{ ng/kg/day}$$

Dose for children 1-6 both sexes grouped (water only) ⇒

$$\frac{17 \text{ ng/L} \times 1.45 \text{ L/day}}{16.8} = 1.47 \text{ ng/kg/day}$$

For a 50% median in children (all sources) median ingestion:

$$\frac{17 \text{ ng/L} \times 0.60 \text{ L/day}}{16.8\ (0.2)} = 3.03 \text{ ng/kg/day}$$

For a 50% median in children (water only):

$$\frac{17 \text{ ng/L} \times 0.60 \text{ L/day}}{16.8} = 0.61 \text{ ng/kg/day}$$

Both of the dosages (median and 95%) calculated for children group 1-6 from all sources exceeds the allowable dosage for adults of 2.42 ng/kg/day based on the NJDEP criterion of 17 ng/L. Therefore, the criterion of 17 ng/L would not be protective for children even at median water ingestion rates and at a "less than protective" UF of 300.

It could be argued that the criterion should be based on a 95% water intake for children at 1.45 L/day. Using a body weight of 16.8 kg for children ages 1-6 all sexes, weighted according to mean weights in age groups, and the 2.42 ng/kg/day allowable dose in adults developed pursuant to the criterion, we derive an allowable PFNA concentration of:

Using a UF of 1000: children group 1-6

$$\frac{0.74 \text{ ng/kg/day (adult all sources)} \times 0.2 \text{ RSC} \times 16.8 \text{ kg body weight}}{1.45 \text{ L}} = \mathbf{1.7\ ng/L}$$

Summary Recommendation:

An appropriately protective criterion should be applied to include children, which yields a criterion of 1.7 ng/L, based on application of a more protective UF of 1000, a 95th percentile water ingestion rates for children 1-6, and a weighted mean body weight for children group ages 1-6. In the absence of inclusion of protection for children, we believe that the maximum allowable criterion should be 5.2 ng/L, based on a UF of 1000 for protection of adults.

Relevant concerns for a lower criterion:

1) The Uncertainty Factor applied is too low and should be higher. The UF of 300 applied is on the low side of that normally applied in these studies, which is often 1000. Why was a low UF applied here?:

2) Criterion should be calculated on the basis of a more vulnerable group, such as children 1-6. That results in a criterion closer to 5.2 ng/L using a UF of 300, as shown above, and a more protective value of 1.7 ng/L using a UF of 1000.

3) The criterion is sensitive to the serum:water ratio. Continued exposure to low concentration of PFNA in drinking water, significantly increases the total human exposure, even with a serum drinking water ratio of 200:1. However, sing the central tendency (mean of 200) for the serum:water ratio may underestimate risk to a large segment of the population.

4) A probabilistic model would better analyze risk across the population and give us a better understanding of the numbers affected that may exceed allowable dosages.

5) Inhalation and dermal exposures during showering and bathing may be of additional concern and should be examined in calculating water criteria for PFNA.

Current Studies on PFNA Toxicity:

There is good body of scientific data concerning the health effects of PFNA. Several scientific studies on the PFNA toxicity and its impacts on children were available, but not used, at the time of developing NJDEP Draft Interim Specific Ground Water Criterion for PFNA. In a study conducted by Wolf et al (2010), the prenatal exposure of mice to PFNA negatively impacts survival and development of pups. According to Feng et al, (2010), PFNA administration causes male-specific reproductive toxicity in rats.

Recent studies have shown that PFNA may cause immunological, developmental and liver toxicity. Recent studies by Rockwell et al (2013) demonstrate severe immunotoxic effects from a single dose of PFNA, including evident lymphoid organ atrophy, splenic and thymic cellularity, and altered ratios of leukocyte populations. Immunotoxic effects of PFNA were also demonstrated in studies conducted by Fang et al (2008), and DeWitt et al (2009). These studies indicate that PFNA-mediated immunotoxicity is similar to that of other PFCs, in particular, PFOA.

PFNA is found in blood serum of virtually 100% of general population in U.S. The average serum concentration of PFNA in the U.S. population is approximately 1.6 ng/ml. Factors, such as age, race and gender may cause significant variability in PFNA serum levels, ranging from 5 to 50 times higher than the average serum level reported above (CDC, 2012 and Schecter et al., 2012). In a study conducted by Frisbee et al (2009) populations living near PFC manufacturing facilities have PFC blood concentrations reaching as high as 300 times higher than the national mean in the U.S. population. In an epidemiological study conducted by Nelson et al (2010), positive association between human serum levels of PFNA and total cholesterol indicated that PFNA exposure might alter cholesterol metabolism. According to Rockwell et al (2013) PFNA in blood concentrations have doubled during the last 6 years. Numerous health effects have been associated with higher serum concentrations, even within general population exposure range. Based on PFNA serum:water ratio (200:1), even relatively low drinking water concentrations substantially will increase human serum levels of PFNA. According to a

study conducted by Chein-Yu et al (2011) the higher serum PFNA concentration is associated with elevated serum adiponectin concentration. Adiponectin is a protein hormone that modulates a number of metabolic processes.

In short, due to steep dose-response down to the lowest exposures in general population range, PFNA exposure to even relatively low drinking water levels results in elevated body burdens that may increase the risk of health effects (Post, 2013)

References:

CDC (2012) The Fourth National Report on Human Exposure to Environmental Chemicals, National Report on Human Exposureto Environmental Chemicals, Centers of Disease Control, Department of Health and Human Services.

Chien-Yu Lin, Li Li Wen, Lian-Yu Lin, Ting-Wen Wen, Guang-Wen Lien, Chia-Yang Chen, Sandy H J Hsu, Kuo-Liong Chien, Fung-Chang Sung, Pau-Chung Chen, Ta-Chen Su (2011) Associations between levels of serum perfluorinated chemicals and adiponectin in a young hypertension cohort in Taiwan. ES&T 45:10691-10698.

DeWitt JC, Shnyra A, Badr MZ, Loveless SE, Hoban D, (2009) Immunotoxicity of perfluorooctanoic acid and perfluorooctane sulfonate and the role of peroxisome proliferator-activated receptor alpha. Crit Rev Toxicol 39: 76-94

Fang X, Zhang L, Feng Y, Zhao Y, Dai J (2008) Immunotoxic effects of perfluorononanoic acid on BALB/c mice. Toxicol Sci 105: 312-321

Feng Y, Fang X, Shi Z, Xu M, Dai J (2010) Effects of PFNA exposure on expression of junction-associated molecules and secretory function in rat Sertoli cells. Reprod Toxicol 30: 429-43

Frisbee SJ, Brooks AP Jr, Maher A, Flensborg P, Arnold S (2009) The C8 health project: design, methods, and participants. Environ Health Perspect 117: 1873-1882

Nelson JW, Hatch EE, Webster TF (2010) Exposure to polyfluoroalkyl chemicals and cholesterol, body weight, and insulin resistance in the general U.S. population. Environ Health Perspect 118: 197-202

Rockwell CE, Turley AE, Cheng X, Fields PE, Klaassen CD (2013) Acute Immunotoxic Effects of Perfluorononanoic Acid (PFNA) in C57BL/6 Mice. Clin Exp Pharmacol S4:002. doi: 10.4172/2161-1459.S4-002

Schecter A, Malik-Bass N, Calafat AM, Kato K, Colacino JA (2012) Polyfluoroalkyl compounds in Texas children from birth through 12 years of age. Environ Health Perspect 120: 590-594

Wolf CJ, Zehr RD, Schmid JE, Lau C, Abbott BD (2010) Developmental effects of perfluorononanoic Acid in the mouse are dependent on peroxisome proliferator-activated receptor-alpha. PPAR Res 2010

Fardin Zoe Oliaei

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PROFILE

- Accomplished scientist with 25 years experience in creating innovative solutions to challenging environmental problems related to public health, policy development and environmental sustainability.
- Experienced project manager with skills in the application of analytical methods and techniques necessary for working within the framework of state/federal environmental and public health organizations.
- Registered independent consultant in the UNEP and UNIDO experts' roster for U-POPs and New-POPs and implementation of the Stockholm Convention on Persistent Organic Pollutants.
- Rigorous researcher and team leader experienced in spearheading all phases of (planning, budgeting, developing, conducting, and directing) of environmental project management.
- Effective communicator with ability to translate complex scientific data into coherent material in order to inform audiences with varying degrees of knowledge about environmental issues.
- Conscientious professional with experience presenting expert witness testimony in litigation cases involving a wide range of environmental problems and related public health issues.
- Experienced college instructor developing and teaching natural sciences and environmental science and public health policy courses.

EDUCATION

Harvard University School of Public Health, Boston, MA 2010 - 2012
Auditing several courses: Air Pollution; Water Pollution; and Risk Assessment

Harvard University John F. Kennedy School of Government, Cambridge, MA
Master in Public Administration 2009
- Concentration*:* Leadership and International Environmental Health Policy and Management

Bush Foundation Leadership Fellow (MN) to pursue studies at Harvard University 2008 - 2010

Western Michigan University, Kalamazoo, MI
PhD in Environmental Sciences
- Dissertation title: Acid Rain and Lake Acidification Impacts on Aquatic Life

MS in Biology
- Thesis title: Drinking Water Quality and Waterborne Diseases in Rural Iran

National University of Iran, Tehran, Iran
BS in Chemistry Minor in Biology

PROFESSIONAL EXPERIENCE

Cambridge Environmental Consulting, LLC., Boston, MA 2006 - Present
Senior Scientist and President
- "Visiting Professor" at the Iranian National Institute of Oceanography (INIO) - conducted training workshops for INIO staff/scientist and coastal management professionals on the policy aspects of coastal zone management and its implications. The training was tailored to the local cultural characteristics, government structure, resource integrity, and management needs of the country (2012).
- Invited by the Iranian Governor's Officials to visit and evaluate the environmental impacts of a historically contaminated site caused by the largest landfill located near the Caspian Sea. Developed an integrated solid waste management plan for implementation, including an assessment of all

environmental risks, and the development of mitigation efforts required to minimize the adverse impacts on Public health and the environment (2012).

- Participated and presented two papers at Dioxin 2010 - 30th International Symposium on Halogenated Persistent Organic Pollutants (POPs) on 1) Presence of PBDEs in Minnesota Landfills – Environmental Releases and Exposure Potential, and 2) Investigation of PFOS/PFCs Contamination from a PFC Manufacturing Facility in Minnesota – Environmental Releases and Exposure Risks (2010).
- Chaired the "New POPs" Section (Implication of Stockholm Convention of New POPs) of the11th International HCH and Pesticide Forum, Cabala, Azerbaijan (2012).
- Serve as expert witness in environmental litigation pertaining to release of industrial toxic contaminants.
- Conduct evaluations of toxic contaminants (including New POPs) and use dispersion modeling (groundwater, surface water, soils and air) to evaluate contaminants' environmental impacts and public health risks.
- Review and evaluate EPA documents related to the issuance of new source National Pollutant Discharge Elimination System (NPDES) permits to industrial activities.

Women's Environmental Institute (WEI), St. Paul, MN 2006 - 2012
Principal Scientific Consultant

- Served as a WEI Board Member and later, as the principal scientific consultant, developed environmental justice education program to promote environmental awareness, sustainability, and health disparity.
- Directed and managed projects on environmental issues related to public health and environmental quality.
- Analyzed the effectiveness and efficiency of existing environmental and public health programs for the implementation and administration of programs best fit the affected communities. Identified and presented to public policy makers the problems affecting concerned communities.
- Evaluated the impact of toxic pollutants on the growth and development of exposed children. Developed multimedia outreach programs to inform families about toxic exposure and consequences.
- Developed culturally specific environmental training and educational seminars for exposed communities through different radio stations and newspapers.

Mote Marine Laboratory, Sarasota, FL 2007- 2008
Associate Scientist

- Designed health risk assessment framework to evaluate potential exposure pathways and toxicity effects of contaminants in Florida manatees. Contributed to development of research proposals.
- Evaluated public and environmental regulatory policies and proposed effective mitigation tools

Minnesota Pollution Control Agency (MPCA), St. Paul, MN 1989 - 2006
Senior Scientist, Project Manager, and Emerging Contaminants Program Coordinator

- Developed policy, program analysis methods, and multimedia strategy to assess health impact of toxic chemicals.
- Initiated and led the Emerging Contaminants Program for the competent authority (MPCA).
- Prepared Environmental Impact Assessments (EIS) for major projects in MN and communicated the results, including the potential social, and economic impacts of these projects with authorities and public.
- Represented the MPCA as a scientific expert, liaison, and critical state contact in the PCBs, Dioxin, and emerging contaminants activities of the US EPA, Great Lakes Binational Strategy (GLBNS) and in other related national and international programs.
- Worked closely with diverse array of clientele and stakeholders (federal and state governments,

industry, grass root organizations, affected communities, and the state legislators) to develop progressive environmental policies and educational materials.
- Presented at international conferences and gave presentations regarding environmental issues in public meetings, legislative hearings and governmental agencies.
- Managed contracts and secured federal/state grants and awards for health impacts of contaminant in Minnesota.
- Developed statewide air toxics monitoring/bio-monitoring network using mass balance and integrated air exposure-effect models.
- As the technical coordinator and MPCA liaison, built partnership between PCA and other sister agencies (MN Department of Health, MN Department of Natural Resources, and MN Department of Agriculture), USA EPA, and MN university researchers for ongoing efforts to identify, evaluate, control, regulate, and reduce the emerging pollutants with endocrine disruptive characteristics (PFOS and PFOA, PBDEs, and pharmaceuticals).
- Assessed the current regulations and programs already in place that may be addressing reduction of toxic contaminants of concern, identified unregulated emerging contaminants of greatest potential risk to human health and the MN environment, rationale of why these contaminants need to be regulated.

TEACHING EXPERIENCE

Taught/teaching biology, chemistry, diverse environmental science, health and policy-related courses, part-time at:

• **University of Phoenix** – Adjunct Faculty	Boston, MA	2010 - Present
• **Regis College** – Adjunct Professor	Weston, MA	2012 - 2013
• **Hamline University –** Adjunct Assistant Professor	St. Paul, MN	2002 - 2003
• **St. Paul College –** Adjunct Assistant Professor	St. Paul, MN	1998 - 2002
• **Inver Hills Community College** – Adjunct Faculty	St. Paul, MN	1996 - 2002
• **Minnesota Department of Corrections**	Various locations	1998 - 2000
• **Normandale Community College** – Adjunct Faculty	Bloomington, MN	1990 - 1998
• **Northland College** – Assistant Professor	Ashland, WI	1986 - 1989
• **Western Michigan University** – Teaching Assistant	Kalamazoo, MI	1980 - 1985

PROFESSIONAL AFFILIATIONS

• Member, **PCB Elimination Network (PEN)** of the Stockholm Convention	2011 - Present
• Member, **Society of Environmental Toxicology and Chemistry**	1990 - Present
• Member, Board of Directors, **Women's Environmental Institute**	2003 - Present
• Member, **Aquatic Biogeochemistry Research Group,** Harvard University, Harvard School of Public Health (HSPH)	2010 - 2012
• Member, **American Chemical Society**	1992 - 2010
• Member, **Air and Waste Management Association**	1998 - 2010

LANGUAGE SKILLS

- Fluent in English and Farsi (Persian)

PUBLICATIONS

- Oliaei, F., Weber, R., Watson, A., and Kriens, D. Review of Environmental Releases and Exposure Risk of PFOS/PFAS Contamination from a PFOS Production Plant in Minnesota. Under review for publication at the Environmental Science and Pollution Research, 2013.

- Oliaei, F., Weber, R., and Watson, A. Landfills and Wastewater Treatment Plants as Sources and Reservoir of Polybrominated Diphenyl Ether (PBDE) Contamination. Under review for publication at the Environmental Science and Pollution Research, 2012.
- Weber, R., Watson, A., and Oliaei, F. *The Stockholm Convention Listing of New POPs – Implications and Follow Up Activities.* 11th International HCH and Pesticide Forum, Cabala, Azerbaijan, 2011.
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- Weber, R., Watson, A., Forter, M., and Oliaei, F. *Persistent Organic Pollutants and Landfills – A Review of Past Experiences and Future Challenges.* Journal of Waste Management & Research, 29(1), 107-121, 2011.
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- Oliaei, Fardin. *Flame Retardant: Polybrominated Diphenyl Ethers (PBDEs) in Minnesota.* Minnesota Pollution Control Agency (MPCA). Legislative Report 2005. (34 pages).
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- Oliaei, F., and Hamilton, C. *PBDE congener profiles in fish with different feeding behaviors from major rivers in Minnesota.* Organohalogen Comp. 64, 356-359, 2003.
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- Oliaei, Fardin. *Flame Retardants: Persistent, Bioaccumulative and Toxic Chemicals.* The EPA, Federal-State Toxicology and Risk Analysis Committee Meeting (FSTRAC). 2000.
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- Pratt G., Gerbec, P., Livingston S., Oliaei F., Bollweg G., Paterson S., and Mackay D. *An indexing system for comparing toxic air pollutants based upon their potential environmental impacts.* Chemosphere 27(8), 1359-1379, 1993.