May 11, 2015

Terri.tucker@dep.nj.gov
New Jersey Department of Environmental Protection
Office of Science
Trenton, New Jersey

**Re: REVISIONS TO THE DRAFT INTERIM SPECIFIC GROUND WATER QUALITY CRITERION FOR PERFLUORONONANOIC ACID (PFNA)**

Please find enclosed Technical Comments prepared by Fardin Oliaei, MPA, PhD, and Don Kriens, Sc.D., P.E. of Cambridge Environmental Consulting commissioned by Delaware Riverkeeper Network and submitted on behalf of the organization and its membership on the **REVISIONS TO THE DRAFT INTERIM SPECIFIC GROUND WATER QUALITY CRITERION FOR PERFLUORONONANOIC ACID (PFNA)**. Included in the Technical Comments are the Curriculum Vitae for Dr. Oliaei and for Don Kriens, Sc.D., P.E.

Delaware Riverkeeper Network submits these comments advocating that the public be protected from PFNA contamination and that New Jersey's groundwater be cleaned up to a standard that is protective of public health and the environment.

We support all the recommendations and findings made by Dr. Oliaei and Cambridge Environmental Consulting in this technical analysis. We support that revisions be made by the Department to uncertainty factors and relative source contribution factors used in the development of the draft Interim Specific Ground Water Quality Criterion (ISGWQC) for Perfluorononanoic Acid (PFNA, CAS # 375-95-1) that was posted for public comment on April 17, 2014. We support Cambridge Environmental Consulting's proposal that the Interim Specific Ground Water Quality Criterion be set at 5 ng/L.

Thank you for establishing a revised Interim Specific Ground Water Quality Criterion. It is crucially important to effectively clean up PFNA from the State's groundwater and other environmental media.

Sincerely,

Maya van Rossum
the Delaware Riverkeeper

Tracy Carluccio
Deputy Director

DELAWARE RIVERKEEPER NETWORK
925 Canal Street, Suite 3701
Bristol, PA 19007
Office: (215) 369-1188
fax: (215)369-1181
drn@delawareriverkeeper.org
www.delawareriverkeeper.org

Attachments:

Technical Comments to NJDEP re. Revisions to The Draft Interim Specific Ground Water Quality Criterion for Perfluorononanoic Acid (PFNA), May 10, 2015, including Curriculum Vitae for Fardin Oliaei, MPA, PhD. and Don Kriens, Sc.D., P.E.

# Technical Comments to New Jersey Department of Environmental Protection April 9, 2015 Request for Public Input

## REVISIONS TO THE DRAFT INTERIM SPECIFIC GROUND WATER QUALITY CRITERION FOR PERFLUORONONANOIC ACID (PFNA)

Prepared by

Fardin Oliaei MPA, Ph.D.

Don Kriens Sc.D., P.E.

Cambridge Environmental Consulting

May 10, 2015

## PREFACE

The opinions in this report are stated to a reasonable degree of scientific probability. The methods and principles used in forming these opinions are generally accepted within the scientific community, and are consistent with their regular application within the scientific community. Qualifications of the authors, including publications where applicable, are summarized in the attached resumes. We reserve the right to modify or supplement opinions stated in this report.

The following is in response to the New Jersey Department of Environmental Protection (NJDEP) request for public comment on April 9, 2015 regarding revisions to uncertainty factors and relative source contribution factors used in the development of the draft Interim Specific Ground Water Quality Criterion (ISGWQC) for Perfluorononanoic Acid (PFNA), which was posted for public comment on April 17, 2014. The revised uncertainty factors and relative source contribution factors are used by NJDEP to derive a revised interim ground water criterion. The higher of the proposed interim ground water criterion or the practical quantitation limit (PQL) for PFNA will be used as the numerical standard to be applied in New Jersey Class II-A aquifers.

### *Uncertainty Factors (UFs)*

In its interim draft PFNA groundwater criterion (NJDEP 2014) NJDEP proposed a cumulative or composite uncertainty factor (CUF) of 300, now revised to a CUF of 1000 (NJDEP 2015). The revised CUF of 1000 is based on a UF of 10 for intraspecies differences (human variation), a UF of 10 for extrapolation from non-chronic to chronic, a UF of 3 for incomplete database (notably for the lack of carcinogenic studies), and a UF of 3 (3.16) for extrapolation from animal to human (interspecies) for toxicodynamic differences.

We concur that toxicokinetic differences between species (human and test animals) is accommodated since the target tissue in both species is blood serum level. Therefore, no UF is needed for toxicokinetic interspecies extrapolation and the total UF for interspecies is 3, based on the ½ log unit of 10 (square root of 10) for each of toxicokinetic and toxicodynamic interspecies differences, or 3 rounded from 3.16 for toxicodynamic differences alone. This is consistent with EPA's position: "interspecies differences in TK are defined as differences in the external dose producing the same level of the dose metric in the target tissue of interest in test animals" (USEPA 2014a).

We concur with use of a UF of 10 for intraspecies variation in humans and a UF of 10 for extrapolation from non-chronic to chronic, as these UFs are consistent with EPA guidance.

NJDEP uses a UF of 3 for incomplete database although important toxicological endpoint data are missing for PFNA, notably cancer testing in animals. A UF of 10 could also be reasonably applied as the default for incomplete database. If we use a UF of 10 for lack of data then a CUF would be 3000. However, uncertainty values chosen are inherently subject to bias, and therefore a resultant calculation can be manipulated – either towards a conservative or a less conservative result. We have no scientific basis to assign a more conservative UF value for incomplete database, underscoring the use of professional judgment where a UF of 3 and 10 are often equivalently applied in risk assessments for lack of data, as an expression of the range of missing data.

We concur with a CUF of 1000, which is consistent with CUF's commonly applied in other health risk assessments for non-carcinogenic endpoints. We note that although a CUF of 3000 could also be reasonably applied, it generally represents the highest CUF level used in risk assessments.

### *Relative Source Contribution Factor*

Although derivation of a relative source contribution (RSC) factor based on chemical-specific exposure data improves accuracy, we disagree with the basis used in NJDEP's analysis that determined an RSC of 0.50 for PFNA. We find that potential PFNA exposures from local sources other than drinking water, such as locally

grown vegetables, recreationally caught fish, indoor contamination, and soils, in areas and regions with known perfluorochemical (PFC) and PFNA contamination, were not fully taken into account.

NJDEP proposes to use the upper tail (95$^{th}$ percentile) of the U.S. population distribution of PFNA serum concentration (NHANES 2011-2012) as a surrogate for non-drinking water sources, including food, soil, air, water, and consumer products. Although the 95$^{th}$ percentile is an upper percentile of PFNA serum distribution in the normal population (uninfluenced by contaminated drinking water), it is not necessarily representative of serum concentrations of individuals exposed to non-drinking water sources of PFCs, including PFNA, in known "local" PFC contaminated regions/areas. The variability of national PFNA serum levels is as, or more likely, due to within-population pharmacokinetic differences. Humans respond differently to the same or similarly dosed chemical exposures based on exogenous and intrinsic factors, as well as life stages, which would affect PFNA serum levels. Therefore, the 95$^{th}$ percentile serum PFNA may not be singularly representative of an upper level of serum concentrations associated with non-drinking water inputs of PFNA, but rather due to toxicokinetic differences across the population. In addition, the 95$^{th}$ percentile serum as a surrogate for non-drinking water inputs is very unlikely to be representative in areas where PFC contamination has been shown to be present.

NJDEP indicates that PFNA from all non-drinking water sources in the area/region are negligible, and bases this on recent information provided by the Delaware River Basin Commission (DRBC) that shows that PFNA was not detected in two species of fish, white perch and channel catfish, from sampling performed in 2010 and 2012 (NJDEP 2015). Elevated levels of PFNA were found in these two species of fish from the same locations on the Delaware River in the vicinity of communities where ground water is contaminated with PFNA in 2004-2007 (DRBC, 2009). Based solely on analyses of two fish species for PFNA, NJDEP assumes that the 95$^{th}$ percentile U.S. population PFNA serum level of 2.54 ng/mL represents a reasonable and protective estimate of all non-drinking water exposures. This reasoning is not supportable.

First, we note that only two species (white perch and channel catfish) were tested for PFNA in the Delaware River in areas where the highest levels of PFNA in groundwater have been reported, hardly representative of all recreational fish potentially contaminated with PFNA and consumed. Presumably, analysis was limited to white perch and channel catfish (in lower Delaware River "tidal" locations) since they are on fish consumption advisories for other contaminants (PCBs) in the Delaware River. In fact, the DRBC states that data collected for these fish are used to track the progress of PCB TMDLs established by the U.S. EPA in 2003 (DRBC 2012).

Because a wide range of fish are recreationally and commercially consumed, several fish species need to be tested in rivers at various locations to determine the extent of PFC contamination, and enable an evaluation of their risk to consumers. Researchers have found widely varying PFC levels in fish within and between species, and bioaccumulation factors for PFCs (PFOS) vary greatly from study to study and among species within studies (Oliaei 2006; MPCA 2010; Oliaei 2012). Researchers have found that PFC concentrations do not necessarily increase with trophic position. In Minnesota the following levels of increasing levels of PFOS have been found in some of the fish tested: (channel catfish < walleye < carp <bluegill < white bass < smallmouth bass) (McCann 2007). For example, bluegill in Mississippi River locations are generally low in environmental contaminants (PCB, Hg) but have relatively high PFOS levels, generally much higher PFOS levels than fish at higher trophic levels. In Alabama (Bakers Creek and the Tennessee River) PFOS in channel catfish were 7 to 886 times lower than PFOS found in largemouth bass

(Sass). Large differences in PFOS and PFNA concentrations between species would also be expected within the Delaware River.

Second, NJDEP analysis disregards other non-drinking water sources in its calculation of a RSC. In areas with known PFC contamination, researchers have also found a significant positive association between serum PFC (PFOA) levels and home-grown vegetable consumption after adjusting for water (PFOA) concentrations, suggesting that locally grown food may be an important source of exposure (Hoffman 2011). This association was also found in other studies (Bartell 2010; Steenland 2009). We would expect a similar pattern with PFNA.

It cannot be concluded that non-detection of PFNA in only two fish species would be representative of all non-drinking water inputs (locally grown food, all species of fish consumed, indoor air exposures, local soils, etc.) in areas where known PFC and PFNA contamination has occurred. An RSC of 0.50, based solely on an assumption that background U.S. PFNA serum levels (95$^{th}$ percentile) represent non-drinking water sources, is cursory and ignores other potential local PFNA inputs.

We believe that NJDEP has not supported a data-driven RSC alternative to the default RSC of 0.20, and therefore the default RSC of 0.20 should continue to be used in the ISGWQC calculation, until such time data is developed to formulate a data-driven RSC for this region.

### *Derivation of ISGWQC*

We propose that the ISGWQC be derived as follows, using a RSC of 0.20 and a CUF of 1000:

Adults

Summary of variables used and values

| | |
|---|---|
| BMDL | POD of 5200 ng/ml |
| CUF | 1000 |
| RSC | 0.20 |
| Serum:water ratio | 200:1 |
| default adult body weight | 80 kg updated default mean body weight adult (USEPA 2014b) |
| default adult intake | 3L/day 90$^{th}$ percentile updated default intake (USEPA 2014b) |
| children body weight | 16.8 kg mean, weighted by age groups 1-6 |
| children intake | 0.69 L mean, 1.19 L/day 90$^{th}$ percentile following EPA default basis |

$$\text{target serum level} = \frac{5200 \text{ ng/ml}}{1000 \text{ CUF}} = 5.2 \text{ ng/ml}$$

Increase in human serum level that can result from drinking water exposure only:

5.2 ng/ml x 0.20 RSC = 1.04 ng/ml (1040 ng/L)

$$\text{MCL} = \frac{1040 \text{ ng/L}}{} = \textbf{5.2 ng/L (5 ng/L) ADULT}$$

200:1 serum:water

Children

We propose that the ISGWQC be based on protection of a vulnerable group, children age 1-6

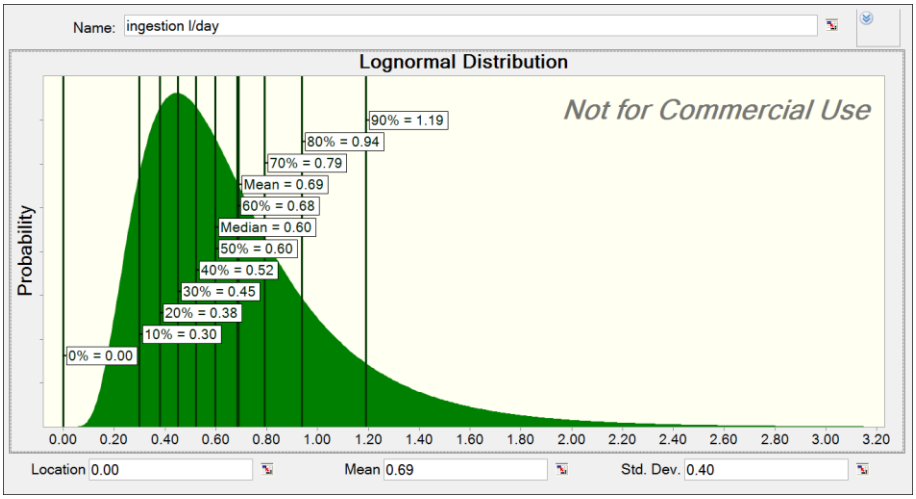
Reference dose (RfD) calculated from adult using updated EPA defaults of 80 kg body weight, 3 L/day water intakes:

5.2 ng/L x 3 L/day = 0.975 ng/kg/day RfD (note: using prior adult defaults is 0.74 ng/kg/d)
80 kg x 0.20 RSC

To extrapolate to children age group 1-6 we use the same allowable mass intake RfD of 0.975 ng/kg/day and calculate a MCL using a mean child body weight of 16.8 kg and mean child water intake of 0.69 L/day. (These values were determined using EPA 2011 Exposure Factor Handbook data (EPA 2011), taking smaller increments of age groups and gender, combined by weighting the means of group increments, and pooling variances to determine means and standard deviations.)

0.975 ng/kg/day x 16.8 kg x 0.20 RSC = **4.75 ng/l MCL (5 ng/L) CHILDREN 1-6**
0.69 L/day (mean value)

Following the EPA's default criteria of the 90th percentile distribution of water intakes for adults, we found a 1.19 L/day water ingestion rate for children 1-6 at the 90th percentile, based on our derivation of a lognormal distribution of water intakes for this combined age group, as shown in the graph below.



Graph: Lognormal Distribution of Water Intakes for Children Group Ages 1-6

Using a 90th percentile water intake rate for children group age 1-6 we find:

0.975 ng/kg/day x 16.8 kg x 0.20 RSC = **2.75 ng/l MCL (3 ng/L) CHILDREN 1-6**
1.19 L/day (90th percentile intake)

**At a minimum we propose that the ISGWQC be 5 ng/L.**

**References**

Bartell S, Calafat A, Lyu C, Kato K, Ryan B, Steenland K (2010). Rate of Decline in Serum PFOA Concentrations after Granular Activated Carbon Filtration at Two Public Water Systems in Ohio and West Virginia. Environmental Health Perspectives, volume 118, number 2, February 2010.

DRBC (2009). Delaware River Basin Commission. Contaminants of Emerging Concern in the Tidal Delaware River Pilot Monitoring Survey 2007−2009. Delaware River Basin Source Water Collaborative Webinar. Source Water Protection and Contaminants of Emerging Concern. September 25, 2012. <http://www.state.nj.us/drbc/library/documents/DRBSWC-MacGillivray-2012.pdf

DRBC (Delaware River Basin Commission) 2012. DRBC Newsletter, Dec. 2012.

Hoffman K, Webster T, Bartell S, Weisskopf M, Fletcher T, Vieira V, (2011). Private Drinking Water Wells as a Source of Exposure to Perfluorooctanoic Acid (PFOA) in Communities Surrounding a Fluoropolymer Production Facility. Environmental Health Perspectives, volume 119, number 1, January 2011.

McCann J, Kelly J, Solem L, (2007), Perflourochemicals in Fish Fillets from Minnesota Poster Presented at the National Forum on Contaminants in Fish, July 2007.

MPCA (Minnesota Pollution Control Agency) 2010. Mississippi River Pool 2 Intensive Study of Perfluorochemicals in Fish and Water: 2009, Mar 2010.
NJDWQI (New Jersey Drinking Water Quality Institute) (2015), Health-Based Maximum Contaminant Level Support Document: Perfluorononanoic Acid (PFNA). March 2015.

Oliaei F, Kriens D, Kessler K, (2006). Investigation of Perfluorochemical (PFC) Contamination in Minnesota Phase One, Report to Minnesota Senate Environmental Committee, 2006.

Oliaei F, Kriens D, Weber R, Watson A, (2012). PFOS and PFC releases and associated pollution from a PFC production plant in Minnesota (USA), Environ Sci Pollut Res, November 2012.

NHANES 2011-2012, CDC, http://wwwn.cdc.gov/nchs/nhanes/search/nhanes11_12.aspx

NJDEP 2015, REQUEST FOR PUBLIC INPUT ON REVISIONS TO THE DRAFT INTERIM SPECIFIC GROUND WATER QUALITY CRITERION FOR PERFLUORONONANOIC ACID (PFNA) APRIL 9, 2015

NJDEP 2014, SUMMARY of DRAFT INTERIM SPECIFIC GROUND WATER CRITERION for PERFLUORONONANOIC ACID (PFNA, C9), NJDEP Office of Science, March 14, 2014

Steenland K, Jin C, MacNeil J, Lally C, Ducatman A, Vieira V, Fletcher T, (2009). Predictors of PFOA Levels in a Community Surrounding a Chemical Plant. Environmental Health Perspectives volume 117, number 7, July 2009.

USEPA 2011, Exposure Factors Handbook, EPA/600/R-090/052F | September 2011 | www.epa.gov

USEPA 2014a. Guidance for Applying Quantitative Data to Develop Data-Derived Extrapolation Factors for Interspecies and Intraspecies Extrapolation. EPA/100/R-14/002F, 2014.

USEPA 2014b. Human Health Ambient Water Quality Criteria: Draft 2014 Update.
EPA-820-F-14-003. May 2014.

**Fardin Zoe Oliaei**
***fardin_oliaei@hks09.harvard.edu***
***Phone: 617-775-5797***

**PROFILE**

- **Accomplished scientist with years of 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**
**Audited several courses: Air Pollution; Water Pollution; and Risk Assessment**

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

**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 Chemistry, Minor 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 the11$^{th}$ 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 1999 - 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

**Teach biology, chemistry, environmental science, health and policy-related courses (Elements of Health and Wellness, Foundations of Research, Public Policy Planning and Implementation), 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

- Brambilla, G., d'Hollander, W. Oliaei, F., Stahl, T., and Weber, R. Pathways and factors for food safety and food security at PFOS contaminated sites within a problem based learning approach, Accepted for publication at Chemosphere, 2014.
- 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. 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. 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.
- Oliaei, F., Weber, R., and Watson, A. *Landfills and Wastewater Treatment Plants as Sources of Polybrominated Diphenyl Either (PBDE) Contamination.* 11th International HCH and Pesticide Forum, Cabala, Azerbaijan, 2011.
- Oliaei, F., Weber, R., and Watson, A. Contamination of Drinking Water and the Environment by Production and Industrial Use of Perfluoroalkyl Compounds (PFCs). 11th International HCH and Pesticide Forum, Cabala, Azerbaijan, 2011.
- 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.
- Oliaei, F., Weber, R., and Watson, A. *Presence of PBDEs in Minnesota Landfills – Environmental Releases and Exposure Potential.* Organohalogen Comp. 72, 1346-1349, 2010. http://www.dioxin20xx.org/pdfs/2010/10-1509.pdf
- Oliaei, F, Kriens, D, and Weber, R. *Investigation of PFOS/PFCs Contamination from a PFC Manufacturing Facility in Minnesota – Environmental Releases and Exposure Risks.* Organohalogen Comp. 72, 1338-1341, 2010. http://www.dioxin20xx.org/pdfs/2010/10-1507.pdf.
- Oliaei (2010), *Update on PFC Investigation and Health Risks*, http://www.w-e-i.org/update-pfc-investigation-and-health-risks-fardin-oliaei-2010
- Oliaei, F., and Kriens, D. *Environmental Releases of Perfluoroalkyl compounds from Two Landfills at the PFOS/PFC Production Site in Minnesota.* EPA – PFAA Day III, 2010.

- Oliaei, F., and Kriens, D. *Discovery of PFOS/PFC Contamination in Fish Near a PFOS/PFC Manufacturing Plant in Minnesota.* EPA – PFAA Day III, 2010.
- Oliaei, F., Kriens, D., and Kessler, K. *Perfluorochemical (PFC) Investigation in Minnesota: Phase One.* Minnesota Pollution Control Agency (MPCA). Legislative Report 2006. (79 pages).
- Oliaei, Fardin. *The presence and Distribution of Perfluorochemicals (PFCs) in Minnesota.* The EPA, Federal-State Toxicology and Risk Analysis Committee Meeting (FSTRAC), 2005.
- Oliaei, Fardin. *Flame Retardant: Polybrominated Diphenyl Ethers (PBDEs) in Minnesota.* Minnesota Pollution Control Agency (MPCA). Legislative Report 2005. (34 pages).
- Oliaei, Fardin. *The Presence and Distribution of PBDEs in MN's Landfills, Wastewaters and the Environment.* Minnesota Pollution Control Agency (MPCA). Annual Report of the Closed Landfill Program (CLP). 2004
- 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.
- Oliaei, F., King, P., and Phillips, L. *Occurrence and Concentrations of Polybrominated Diphenyl Ethers (PBDEs) in Minnesota Environment.* Organohalogen Comp. 58, 185-188, 2002.
- Pratt, G., Oliaei, F., Wu, C., Palmer, K., and Fenske, M. *An Assessment of Air Toxics in Minnesota.* Environmental Health Perspective. 108(9), 815-825, 2002.
- Oliaei, Fardin. *Flame Retardants: Persistent, Bioaccumulative and Toxic Chemicals.* The EPA, Federal-State Toxicology and Risk Analysis Committee Meeting (FSTRAC). 2000.
- Oliaei, Fardin. *Toxic Air Pollutant Update.* Minnesota Pollution Control Agency (MPCA). 1999.
- Oliaei, Fardin. *Minnesota Air: Air Quality and Emissions Trends.* Minnesota Pollution Control Agency (MPCA). 1997, (215 pages).
- 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.

**Don Kriens** **Curriculum Vitae**
4420 Holm Oak Lane (612) 701-9204
Oakdale, MN 55128 dlk810@mail.harvard.edu

## AREAS OF EXPERTISE

- Professional engineer - range of civil and environmental engineering projects, and design.
- Exposure and risk assessments for human health.
- Project manager - toxic contaminant cleanup projects.
- Design of water/wastewater treatment systems, hydro-geologic studies, remediation projects, stormwater control, and hazardous waste cleanups (Superfund).
- Industrial technologies and processes, pollution prevention, industrial process chemistry, and application of emerging treatment technologies to industries.
- HAZMAT trained.
- Regulatory enforcement, civil and criminal. Skilled in technical writing and presentation, and negotiation. Knowledge of federal and state environmental regulatory programs.
- Global water scarcity problems, environmental policy and justice, climate change impacts, energy, and engineering economic analysis.
- Modeling exposure and risk of chemicals, including disinfection byproducts and contaminants in drinking water supplies.

## EDUCATION

HARVARD UNIVERSITY, Cambridge, MA
Sc.D. Environmental Health
Concentration - Exposure Sciences

HARVARD UNIVERSITY, Cambridge, MA
M.S. Environmental Health

UNIVERSITY OF IOWA, Iowa City, Iowa.
M.S. Environmental Engineering

UNIVERSITY OF IOWA, Iowa City, Iowa.
B.S. Sciences

AWARDS
Bush Foundation Leadership Fellow 2008
U.S. EPA Civil and Criminal Investigation Award
Harvard University Andelot Scholarship
Harvard University Water Initiative Fellow

## PROFESSIONAL EXPERIENCE

*1978-2008 MINNESOTA POLLUTION CONTROL AGENCY, St. Paul, MN*

Principal Engineer
- Lead agency technical expert for water projects. Mentor to engineers, hydro-geologists, and other technical staff.
- Research projects to assess ecological and health impacts of contaminants. Evaluated emerging technologies to resolve pollution problems.
- Conducted major civil and criminal environmental investigations with MN Attorney General staff, U.S. Attorney's Office, USEPA Region V. Expert witness.
- Developed major industrial environmental permits, determined technologies required to comply. Assessed economic impact of regulations.

- Technical expert for water/wastewater treatment, remediation and hazardous waste, water supplies.
- Technical expert for emergency response regarding toxics and resolution. Project manager and/or engineer for remediation of various toxic waste sites.

*1996-2008 Kriens Engineering, Oakdale, MN*
Consulting Engineer and Owner
- Design of Individual Sewage Treatment Systems. Groundwater (well) analysis and water consulting.

*Castek Consulting Engineering Services*
Engineer
- Operation, design, and process chemistry evaluations of wastewater treatment plants; air pollution studies; indoor air quality assessments.

**TEACHING EXPERIENCE**

*Harvard University*
- Teaching Assistant in water pollution and risk assessment. Lecturer in water scarcity at Harvard Extension School.

*Kirkwood Community College, Cedar Rapids, Iowa*
- Instructor; wrote courses in chemistry/advanced chemistry of wastewater treatment.

*University of Iowa Department of Civil and Environmental Engineering, Iowa City, Iowa*
Research Scientist and Environmental Engineering Laboratory Supervisor
- Supervised laboratory conducting biological and chemical analyses, including GC and GC/MS. Conducted field studies. Occasional teaching assistant.

**LICENSES AND PROFESSIONAL AFFLILIATIONS**
- Registered Professional Engineer
- Individual Sewage Treatment System Designer (Minnesota)
- Certification in air quality inspections (California Air Resources Board)
- Certification in Stormwater Treatment and Erosion Design
- Member, Minnesota Government Engineers Council
- Member, Society of Professional Engineers

**PAPERS AND PUBLICATIONS**
Listing available on request