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From: Zapata, Cesar
Sent: Thur 9/14/2017 5:14:30 PM
Subject: Revised State Water Directors Meeting Agenda (Sep 19-21)
State Water Directors Meeting Agenda Sep 2017.docx
WPD - Org. Chart September 2017.pdf

I hope you are all safe after Hurricane Irma passed through our region. We are still preparing for our upcoming EPA/State Water Director's Meeting in Atlanta that will be held **September 19-21 at the Wyndham Atlanta Galleria Hotel**. As explained in our Director's email yesterday, we have decided to scale back the meeting to only include the Surface Water portion in deference to those who may be responding to Hurricane Irma. Thursday morning is available for you to meet one-on-one with our Director or with any Branch Chief to discuss specific issues. Please let me know if you are interested in having a one-on-one meeting so we can schedule those meetings.

Attached is the revised agenda. Per the request of several State Directors, I am also attaching our most recent organization chart. We are looking forward to welcoming each of you for our first meeting with our new Division Director, Mary Walker. For those of you who are making presentations during the meeting, we ask that you provide **your PowerPoint slides to Wesley Lambert (lambert.wesley@epa.gov) no later than this Monday, September 18th by Noon.** If that is not possible, please bring the presentation in a thumb drive so we can load it into our computer.

Thanks for your cooperation to make this a successful meeting. If you have any questions, please don't hesitate to call me at the number listed below.

Best regards,

César A. Zapata

Deputy Director, Water Protection Division

United States Environmental Protection Agency, Region 4

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Agenda

State Water Directors Meeting

Wyndham Atlanta Galleria

Tuesday, September 19, 2017 **Plenary Session** Berkshire Ballroom		
12:30 pm	**Registration**	
1:00 pm	**Welcome and Opening Remarks**	Mary Walker (EPA)
1:10 pm	**Administration and Division Leadership Updates** *Present information about the administrative transition process, and status of the Water Protection Division leadership transition.*	Mary Walker (EPA)
1:30 pm	**NPM Guidance, EPA Strategic Plan, Budget and Grants Update** *Present information about the FY18 NPM Guidance and EPA Strategic Plan and how it is different from previous years, FY17 EPA Budget, Continuing Environmental Program grants, schedules, and FY18 Budget.*	César Zapata (EPA) / Stacey Bouma (EPA)
2:00 pm	**Enforcement Update** *Status of National Enforcement Initiatives, FY18 enforcement priorities, accomplishments.*	César Zapata (EPA)
2:30 pm	**Break**	
2:45 pm	**Legal Update** *Update on the following topics: Waters of the U.S., Power Plant ELGs, Recent Court Decisions, other legal topics of interest.*	TBD (EPA)
3:30 pm	**Perfluorinated Chemicals (PFAs) Update and Discussion about unregulated contaminants** *Discuss recent issues related to PFAs and unregulated contaminants. Open discussion about how R4 states are addressing unregulated contaminants and how EPA can support the states.*	Becky Allenbach (EPA) / States
4:30 pm	**NPDES Rules Updates** *KY will provide an updated based on the last ACWA meeting discussions.*	Pete Goodman (KY)
5:00 pm	**Adjourn**	
5:15 pm	**Social** *Everyone is invited to get together at the hotel bar.*	

Wednesday, September 20, 2017 **Surface Water Session** Berkshire Ballroom		
8:30 am	**MS4 Discussions** *Open discussion about the MS4 Remand rule and permitting implications. Discussions about MS4 jurisdiction in private owned land (FL DEP)*	Glen R. Behrend (GAEPD) / Mark Nuhfer (EPA)
9:15 am	**Water Quality Program Update** *Update on ATTAINS and NARS and Q&A.*	Gracy Danois (EPA) / Johnnie Purify (EPA)
10:00 am	**Break**	
10:30 am	**State Roundtable: Issues and Legislative Actions in Each State** *Each state provides ~10-minute update on hot programmatic issues and any significant state laws/bills that affect/may affect water resources in their respective state*	States
12:00 pm	**Lunch**	
1:15 pm	**Municipal Infrastructure Challenges** *Open discussion about Sanitary Sewer Overflows issues, lessons learned, successes, and other states plans to address them. SSO notifications in AL.*	Maurice Horsey (EPA) / Daphne Lutz (ADEM)
2:00 pm	**Electronic Reporting Rule Update** *Update about Electronic Reporting Rule implementation and open discussion about states challenges in implementing the rule, and Q&A.*	Molly Davis (EPA) / States
2:30 pm	**Break**	
3:00 pm	**Surface Water State Caucus** *This session is for State Water Directors and key staff only and provides a time for the states to talk among themselves about common challenges.*	States
4:00 pm	**Surface Water Report Out**	States
4:30 pm	**Wrap Up**	
4:45 pm	**Adjourn**	

Thursday, September 21, 2017 **Surface Water Session** Berkshire Ballroom		
8:30 am	**States One-on-One** *States may request an individual meeting with the Director or Branch Chiefs to discuss specific issues.*	States / EPA
10:30 am	**Adjourn**	

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The Clean Water Act Sections 320, 312, 403(c), 319, 104(b)(3), 314, 404, 309, 308
Marine Protection Research & Sanctuaries Act Sections 102 and 103
Coastal Zone Act Reauthorization Amendments of 1990
The Shore Protection Act
Florida Keys National Marine Sanctuary and Protection Act of 1990
National Marine Sanctuaries Program Amendments Act of 1992
Riverside Harbors Act, Section 10
The Oceans Act

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9/8/2017

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9/8/2017

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From: Buckley, Timothy
Sent: Thur 9/7/2017 12:39:02 PM
Subject: RE: Non-Targeted Lab Results Briefing to NC DEQ
NC DEQ nontargeted results f2f RTP report08282017.pdf

Now that our official report has been provided to NC DEQ and Region 4, I am able to share the presentation from our August 28th meeting. Thank you for your patience and understanding.

Tim Buckley

Timothy J. Buckley, PhD

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-----Original Appointment-----
From: Buckley, Timothy
Sent: Monday, August 14, 2017 2:19 PM
To: Buckley, Timothy; Strynar, Mark; Lindstrom, Andrew; Medina-Vera, Myriam; Biales, Adam; Newton, Seth; McCord, James; Watkins, Tim; Orme-Zavaleta, Jennifer; Culpepper, Linda; Allenbach, Becky; Smith, Emily J.; Crofton, Kevin; Guiseppi-Elie, Annette; Goode, Teresa; Oshima, Kevin; Tong-Argao, Sania; Hoffman, Brian; Goldfarb, Steven; Grevatt, Peter; Behl, Betsy; Henry, Tala; Raffaele, Kathleen; Sinks, Tom; Ann Grimm; Kenneke, John; Maguire, Megan; Carolyn Hubbard; Gilliland, Alice; jordan.whichard@nc.gov
Cc: Walker, Mary; Flaherty, Colleen; Johnson, Chris; Moore, Zack; Shehee, Mina; Aubee, Catherine; Risen, Amy J; Pritchett, Jamie R; michael.devito@nih.gov; Cox, Heidi; Kritzer, Jamie; Zimmerman, Jay; Grzyb, Julie; Midgette, Robert; Holman, Sheila; Mclain, Jennifer; Tiago, Joseph; Tricas, Marisa; Speth, Thomas; Burneson, Eric; Thompkins, Anita; Strong, Jamie; Satterwhite, Dana; Godreau, Jessica; Lincoln, Larry; Campbell-Dunbar, Shawneille; Staley, Danny; Kemker, Carol; Gettle, Jeaneanne; Adams, Glenn; Flowers, Lynn; Impellitteri, Christopher; Scott, Michael; Tarr, Jeremy M; Talley, Noelle S; Karoly, Cyndi; Gregson, Jim; Dittman, Elizabeth; Allen, Trent; Fenton, Suzanne (NIH/NIEHS) [E]; Carroll, Gregory; France, Danny; Mort, Sandra L; Grantham, Nancy; Christopher Lau; Munger, Bridget; Hines, Erin; Andrew Gillespie; Hall, Renea; Davis, Molly; Shell, Karrie-Jo; Schwartz, Paul; Bush, William; Mancusi-Ungaro, Philip; Janovitz, Sara; Ravenscroft, John (Ravenscroft.John@epa.gov); Tilson,

Betsey; Gordon, Scott; Rubini, Suzanne; Detlef knappe; Mattas-Curry, Lahne; Young, Sarah
Subject: Non-Targeted Lab Results Briefing to NC DEQ
When: Monday, August 28, 2017 9:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: EPA RTP C111A-B; Agenda attached.

The primary goal of this briefing is to communicate lab results to NC DEQ and address their questions. Becky Allenbach in Region 4 and Linda Culpepper NC DEQ will extend invitation to others in their organization as appropriate. I am expanding invite list to include other labs and Centers and EPA Program Offices with potential interest.

A webinar link has been provided for remote access.

http://epawebconferencing.acms.com/ncdeq/

[redacted]

Agenda

Fall 2017 EPA / State Directors Meeting

Wyndham Atlanta Galleria

Wednesday, September 20, 2017 **Drinking** Water Session **Manchester I**		
8:30 am	**Welcome, Introductions, and Opening Remarks**	Becky Allenbach Shawneille Campbell-Dunbar
8:45 am	**State Round Table (~10 min/State)** *Each state is asked to share program highlights including the following: (1) FY17 successes, (2) FY18 priorities, (3) Upcoming challenges.*	States
10:00 am	**Update on Unregulated Contaminants** *Updates and discussion about Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS), Gen X, and the Unregulated Contaminant Monitoring Rule (UCMR) 4.*	Becky Allenbach, Renea Hall, Allison Humphris (EPA)/States
10:45 am	**Break**	
11:00 am	**Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR)** *Open discussion about Stage 2 DBPR implementation.*	Richard Elliot (EPA)/George Cox (ADEM)
12:00 pm	**Lunch**	
1:00 pm	**Revised Total Coliform Rule (RTCR)** *Open discussion about RTCR implementation.*	Dale Froneberger, Pamela Riley (EPA)/States
1:30 pm	**Water Infrastructure for Improvements to the Nation (WIIN) Act** *Updates and discussion about funding changes and opportunities and "EPA's Strategic Plan for Targeted Outreach to Populations Affected by Lead."*	Sheryl Parsons, S. Campbell-Dunbar (EPA)/ States
2:00 pm	**State Oversight** *EPA will share information on the upcoming changes to the state oversight process for Public Water System Supervision (PWSS) programs.*	S. Campbell-Dunbar (EPA)
2:45 pm	**Break**	
3:00 pm	**Laboratory Certification** *EPA will share information on what to consider when choosing a certified contract laboratory and discuss challenges concerning laboratories conducting radiochemical analyses.*	Pamela Riley, Jeannie Williamson (EPA)
3:30 pm	**Individual Breakout Discussions** *This time will be used for State Administrators and EPA State Program Managers to have one-on-one discussions on topics including but not limited to Lead and Copper Rule (LCR) implementation and special efforts focused on schools, etc.*	EPA/States
4:30 pm	**Adjourn**	

Thursday, September 21, 2017 **Drinking** Water Session Manchester I		
8:30 am	**Drinking Water State Caucus** *This session is for State Drinking Water Administrators to talk among themselves about common challenges.*	States
9:30 am	**Break**	States
9:45 am	**EPA Training for States** **Lead and Copper Water Quality Parameter Training** November 29 – 30, 2017; EPA Region 4 Office 1. *How many people would your state send to this training?* 2. *What other rule would your state like to receive training on?* **Area-Wide Optimization Program (AWOP)** 1. *What would your state like the workshop to cover?*	Paul Lad (EPA)/ States
10:15 am	**Drinking Water Enforcement** *Open discussion about elements to be included in an MOA between EPA and the States. Demo of the Resource Center being used for the Potentially Intractable PWS Pilot.*	Amanda Driskell (EPA) / States
10:45 am	**Challenges with Responding to Public Inquiries** *Open discussion about challenges states face when responding to public inquiries related to data and information published by other organizations such as the Environmental Working Group's (EWG's) Tap Water Database. What would states like to see included in EPA's public message regarding this kind of information?*	S. Campbell-Dunbar/ Brian Thames (EPA)
11:15 am	**Drinking Water Report Out to Mary Walker**	States
11:45 am	**Wrap up**	
12:00 pm	**Adjourn**	

Agenda

State Water Directors Meeting

Wyndham Atlanta Galleria

Tuesday, September 19, 2017 **Plenary Session** Berkshire Ballroom		
12:30 pm	**Registration**	
1:00 pm	**Welcome and Opening Remarks**	Mary Walker (EPA)
1:10 pm	**Administration and Division Leadership Updates** *Present information about the administrative transition process, and status of the Water Protection Division leadership transition.*	Mary Walker (EPA)
1:30 pm	**NPM Guidance, EPA Strategic Plan, Budget and Grants Update** *Present information about the FY18 NPM Guidance and EPA Strategic Plan and how it is different from previous years, FY17 EPA Budget, Continuing Environmental Program grants, schedules, and FY18 Budget.*	TBD (EPA)
2:30 pm	**Break**	
2:45 pm	**Legal Update** *Update on the following topics: Waters of the U.S., Power Plant ELGs, Recent Court Decisions, other legal topics of interest.*	TBD (EPA)
3:45 pm	**Perfluorinated Chemicals (PFAs) Update and Discussion about unregulated contaminants** *Discuss recent issues related to PFAs and unregulated contaminants. Open discussion about how R4 states are addressing unregulated contaminants and how EPA can support the states.*	Becky Allenbach (EPA) / States
4:45 pm	**Adjourn**	
5:00 pm	**Social** *Everyone is invited to get together at the hotel bar.*	

Wednesday, September 20, 2017 **Underground Injection Control** Session UIC Breakout Room		
8:30 am	**Welcome and EPA Update**	Brian Smith (EPA)
9:30 am	**National Database/Reporting Update**	Brian Smith (EPA)
10:00 am	**Break**	
10:15 am	**State Roundtable: Issues and Legislative Actions in Each State** *Each state provides ~10-minute update on short and long-term priorities and any significant state laws/bills that affect/may affect the UIC Program.*	States
11:30 pm	**Primacy Authorization and State Oversight Protocol Development** *Review the process and expectations for revisions to primacy programs and share draft Class II oversight protocol developed in response to GAO audit.*	Brian Smith
12:00 pm	**Lunch**	
1:30 pm	**Class II** *Discuss permitting and compliance challenges and identify best implementation practices: evaluating cement plan, setting appropriate Area of Review, overcoming poor historic records of older wells.*	Scotty Sorrels (TN) and Jason Meadows (EPA)
2:45 pm	**Break**	
3:00 pm	**Class V** *Share state approaches and concerns associated with permitting and operation of aquifer storage and recovery wells and aquifer recharge wells*	Joe Haberfeld (FL)
4:00 pm	**State Caucus**	States
5:00 pm	**Adjourn**	

Thursday, September 21, 2017		
Underground Injection Control Session UIC Breakout Room		
8:30 am	**Class V (continued)** *Permitting of stormwater drainage into the subsurface and regulation of improved sinkholes.*	Scotty Sorrels (TN) and Robert Olive (EPA)
10:00 am	**Break**	
10:15 am	**State Report Out to EPA Division Director**	States
11:00 am	**EPA's Study of Hydraulic Fracturing for Oil and Gas: Impacts on Drinking Water Resources** *Overview of the final report and short discussion on impacts of conclusions*	Richard Hall (EPA)
11:45 am	**Wrap up** *Present action items and discuss next meeting.*	Brian Smith (EPA)
12:00 pm	**Adjourn**	

Agenda

State Water Directors Meeting

Wyndham Atlanta Galleria

Tuesday, September 19, 2017 **Plenary Session** Berkshire Ballroom		
12:30 pm	**Registration**	
1:00 pm	**Welcome and Opening Remarks**	Mary Walker (EPA)
1:10 pm	**Administration and Division Leadership Updates** *Present information about the administrative transition process, and status of the Water Protection Division leadership transition.*	Mary Walker (EPA)
1:30 pm	**NPM Guidance, EPA Strategic Plan, Budget and Grants Update** *Present information about the FY18 NPM Guidance and EPA Strategic Plan and how it is different from previous years, FY17 EPA Budget, Continuing Environmental Program grants, schedules, and FY18 Budget.*	TBD (EPA)
2:30 pm	**Break**	
2:45 pm	**Legal Update** *Update on the following topics: Waters of the U.S., Power Plant ELGs, Recent Court Decisions, other legal topics of interest.*	TBD (EPA)
3:45 pm	**Perfluorinated Chemicals (PFAs) Update and Discussion about unregulated contaminants** *Discuss recent issues related to PFAs and unregulated contaminants. Open discussion about how R4 states are addressing unregulated contaminants and how EPA can support the states.*	Becky Allenbach (EPA) / States
4:45 pm	**Adjourn**	
5:00 pm	**Social** *Everyone is invited to get together at the hotel bar.*	

Wednesday, September 20, 2017		
Surface Water Session Berkshire Ballroom		
8:30 am	**MS4 Discussions** *Open discussion about the MS4 Remand rule and permitting implications. Discussions about MS4 jurisdiction in private owned land (FL DEP)*	TBD (GAEPD) / Chris Thomas (EPA) / (FLDEP)
9:30 am	**Enforcement Update** *Status of National Enforcement Initiatives, FY18 enforcement priorities, accomplishments.*	TBD (EPA)
10:15 am	**Break**	
10:30 am	**State Roundtable: Issues and Legislative Actions in Each State** *Each state provides ~10-minute update on hot programmatic issues and any significant state laws/bills that affect/may affect water resources in their respective state*	States
12:00 pm	**Lunch**	
1:15 pm	**Municipal Infrastructure Challenges** *Open discussion about Sanitary Sewer Overflows issues, lessons learned, successes, and other states plans to address them.*	TBD (EPA) / States
2:00 pm	**Electronic Reporting Rule Update** *Update about Electronic Reporting Rule implementation and open discussion about states challenges in implementing the rule, and Q&A.*	TBD (EPA) / States
2:45 pm	**Break**	
3:00 pm	**Water Quality Program Update** *Update on programmatic water quality issues and Q&A.*	TBD (EPA)
4:00 pm	**Topic** *Description*	TBD (EPA)
5:00 pm	**Adjourn**	

Thursday, September 21, 2017		
Surface Water Session Berkshire Ballroom		
8:30 am	**Surface Water State Caucus** *This session is for State Water Directors and key staff only and provides a time for the states to talk among themselves about common challenges.*	States
9:30 am	**Surface Water Report Out**	States
10:00 am	**Break**	
10:30 am	**Topic** *Description*	TBD
11:00 am	**Topic** *Description*	TBD
11:45 am	**Wrap up** *Present action items and discuss next meeting.*	Mary Walker (EPA)
12:00 pm	**Adjourn**	

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Cc: Lambert, Wesley[Lambert.Wesley@epa.gov]
From: Zapata, Cesar
Sent: Tue 10/10/2017 8:43:18 PM
Subject: Power Point Presentations from EPA/State Water Director's Meeting
State Water Directors Meeting-Day 1.zip
State Water Directors Meeting-Day 2.zip

Please find attached the power point files from the last State Water Directors Meeting. If you have any questions, please contact Wesley Lambert at lambert.wesley@epa.gov or 404-562-9374.

César A. Zapata

Deputy Director, Water Protection Division

United States Environmental Protection Agency, Region 4

Tel: 404-562-9744

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State Water Directors' Meeting

PFAS UPDATE

September 2017

Becky B. Allenbach
Chief
Grants and Drinking Water Protection Branch - Region 4

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EPA

Cross-Agency Coordination of PFAS Activities

- **PFAS coordination is led through the Office of the Science Advisor**
- **PFAS is a cross-Agency issue, but also multifaceted:**
  - Human health toxicity
  - Exposure
  - Analytical methods
  - Risk management
  - Risk communication
- **Currently there are three cross-Agency workgroups:**
  - Human health toxicity
  - Analytical Methods
  - Data Quality
- **This broad array of issues requires coordination of each individual aspect, but also overarching coordination of all issues to ensure that the Agency has an awareness of all ongoing and proposed activities.**

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Current PFAS Activities: OLEM

- **EPA Federal Facility Superfund Program**
  - Program is actively engaged in a PFAS cleanup process at 30 Federal Facility National Priority List (NPL) Sites.
  - PFAS detections in groundwater range from non-detect (based on analytical method limitations) or slightly exceeding the Drinking Water Health Advisory of 70 parts per trillion (ppt; PFOA and PFOS combined) to 2,000,000 ppt.
  - Drinking water has been impacted at 13 of these Federal Facility NPL Sites.
- **Office of Superfund Remediation and Technology Innovation (OSRTI)**
  - 12 known impacted NPL sites, including one proposed for listing (St. Gobain Hoosick Falls, NY)
  - 100s potential NPL sites (e.g. 100 metal plating sites, 300 landfills)
- **Regional Assistance**
  - Holding site specific consultations with Regions on investigations of PFAS contamination.

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EPA

Current PFAS Activities: ORD

- **EPA has been studying exposure and health effects of PFAS for more than 15 years.**
- **Health Effects**
  - Compiling considerable knowledge on the toxicological effects of PFOA and PFOS, including studies on the fate of PFAS in the body, and
  - Conducting research to study the potential hazards of PFAS in the environment using computational toxicology modeling.
- **Analytical Methods/Exposure Assessment**
  - Ongoing research on analytical methods, in collaboration with program and regional offices, for measurement of PFAS in environmental media, and
  - Evaluating sources, environmental fate and transport, and exposure to human and non-human receptors.
- **Risk assessment**
  - EPA's Provisional Peer-Reviewed Toxicity Value (PPRTV) program completed a health assessment for perfluorobutane sulfonate (PFBS), a substance similar to PFOA and PFOS, in 2014.
  - EPA identified PFAS as a chemical class of interest to the Agency in the 2015 multi-year agenda for the Integrated Risk Information System (IRIS) program.
- **Risk Management**
  - Characterize PFAS contamination in the soil, surface water, and groundwater at military installations where aqueous film forming foams (AFFF) have been used extensively
  - With the Air Force Institute of Technology (AFIT), test in situ remediation technologies to remove PFAS at contaminated sites.

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EPA

Current PFAS Activities: OW

- **Published Drinking Water Health Advisories (HA) in 2016 for PFOA and PFOS**
  - HAs are non-regulatory information for federal, state and local officials to consider when addressing drinking water contamination.
  - Identified 0.07 µg/L (70 parts per trillion) as the HA level for PFOA and PFOS combined and provided information about treatment and monitoring.
- **Evaluating PFOA and PFOS for regulatory determination under the Safe Drinking Water Act (SDWA).**
  - PFOA and PFOS are on the fourth Contaminant Candidate List (CCL 4) published in November 2016. OW is assessing PFOA and PFOS against the three SDWA regulatory determination criteria:
    - *may have an adverse effect on the health of persons;*
    - *is known to occur or there is a substantial likelihood that it will occur in public water systems with a frequency and at levels of public health concern;*
    - *In the sole judgment of the Administrator, regulating the contaminant presents a meaningful opportunity for health risk reductions for persons served by public water systems.*
  - OW is planning to brief the Administrator in 2018 to obtain option selection for a preliminary regulatory determination.
  - EPA must decide whether or not to regulate at least 5 CCL4 contaminants by January, 2021.
  - Preliminary regulatory determinations for public comment expected in 2019 (to enable final regulatory determinations by January 2021).

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Current PFAS Activities: Regions

- **PFAS have been identified as an important issue in the Regions. Below are the general, ongoing efforts in the Regions.**
  - Working collaboratively with states, local and federal partners, particularly DOD, to address concerns with PFAS contamination of public and private drinking water wells and legacy contamination at Superfund sites.
  - Providing support to states on different issues, including direct analytical support for sites, method improvement, method validation studies and quality assurance protocols.
  - Assisting states, local agencies and federal facilities with public messaging regarding risks.
  - Regions have had to issue Safe Drinking Water Act Administrative Orders to federal facilities (Pease AFB, NH and Warminster Navy Base, PA) in order to protect public supply wells given the emergent nature of this class of chemicals and the slow reaction time of other federal agencies.
- **Regional laboratory representatives participate in national and regional programmatic meetings offering technical advice with expertise in analytical methodology and quality acceptability.**

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EPA

Current PFAS Activities: Cross-Agency

- **ORD and OLEM lead a cross-EPA workgroup on characterizing human health hazards**
  - to characterize the available toxicity information for approximately 31 PFAS of interest to various program offices or regions;
  - to develop quantitative toxicity values for multiple PFAS, other than PFOA and PFOS; and
  - to inform evidence-based decisions by EPA offices and regions regarding potential human health risks from ongoing or future exposures.

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Category	Draft Final PFAS List	Acronym
Perfluoro carboxylic acids	Perfluorododecanoic acid	PFDoA
	Perfluoroundecanoic acid	PFUnA
	Perfluorodecanoic acid	PFDA
	Perfluorononanoic acid	PFNA
	Perfluorooctanoic acid	PFOA
	Perfluoroheptanoic acid	PFHpA
	Perfluorohexanoic acid	PFHxA
	Perfluoropentanoic acid	PFPeA
	Perfluorobutyric acid	PFBA
Perfluoro sulfonates	Perfluorodecanesulfonate	PFDS
	Perfluorononanesulfonate	PFNS
	Perfluorooctanesulfonate	PFOS
	Perfluoroheptanesulfonate	PFHpS
	Perfluorohexanesulfonate	PFHxS
	Perfluoropentansulfonate	PFPeS
	Perfluorobutanesulfonate	PFBS
Perfluoro sulfonamide	Perfluorooctanesulfonamide	PFOSA
Fluorotelomer sulfonates	Fluorotelomer sulfonate 8:2	FtS 8:2
	Fluorotelomer sulfonate 6:2	FtS 6:2
Perfluoro sulfonamidoacetic acids	N-ethyl-N-((heptadecafluorooctyl)sulfonyl)glycine	NEtFOSAA
	N-(Heptadecafluorooctylsulfonyl)-N-methylglycine	NMeFOSAA
Fluorotelomer alcohols	Fluorotelomer alcohol 8:2	FtOH 8:2
	Fluorotelomer alcohol 6:2	FtOH 6:2
Perfluoro ether carboxylic acids	Perfluoro(2-methyl-3-oxahexanoic) acid	GenX
	4,8-dioxa-3H-perfluorononanoic acid	ADONA
Fluorotelomer phosphates	6:2 Fluorotelomer phosphate monoester	6:2 monoPAP
	6:2 Fluorotelomer phosphate diester	6:2 diPAP
	8:2 Fluorotelomer phosphate monoester	8:2 monoPAP
	8:2 Fluorotelomer phosphate diester	8:2 diPAP
	6:2/8:2 Fluorotelomer phosphate diester	6:2/8:2 diPAP
Fluorotelomer carboxylic acid	5:3 Polyfluorinated acid	5:3 acid

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EPA

Current PFAS Activities: Cross-Agency (cont'd)

- **OLEM/Region 3/ORD lead a cross-EPA workgroup on method development and validation**
  - to develop multi-laboratory validated methods for analyzing sample types other than drinking water (waters and solids) and quantifying 31 PFAS. Currently performing a multi-lab validation of a method for the 31 PFAS which was developed by the Region 5 Chicago Regional; and
  - to develop sampling protocols to address PFAS analytical data quality issues Regions have identified.
- **Region 10 and Region 3 lead a cross-EPA workgroup on evaluating data quality issues**
  - to develop guidelines for data deliverables and assessment criteria.

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Production of PFAS

- PFAS production occurs by two primary production methods: Electrochemical Fluorination and Telomerization.

- During production of the intended products, many residuals and precursors are carried forward into the final formulations (e.g., FTOHs and PFOA may be found in fluoropolymers).

- Many PFAS are used as processing aids in production of other PFAS products. This results in:
  - primary production facilities that synthesize PFAS chemicals, e.g. chemical plants, and
  - secondary production facilities that produce products using PFAS, e.g. textile and paper facilities, fluorocarbon plastics production.

- Industry is changing formulations in response to regulatory drivers and mounting toxicity and persistence data. However, replacement chemicals are unknown as to persistence, toxicity, and bioaccumulation.

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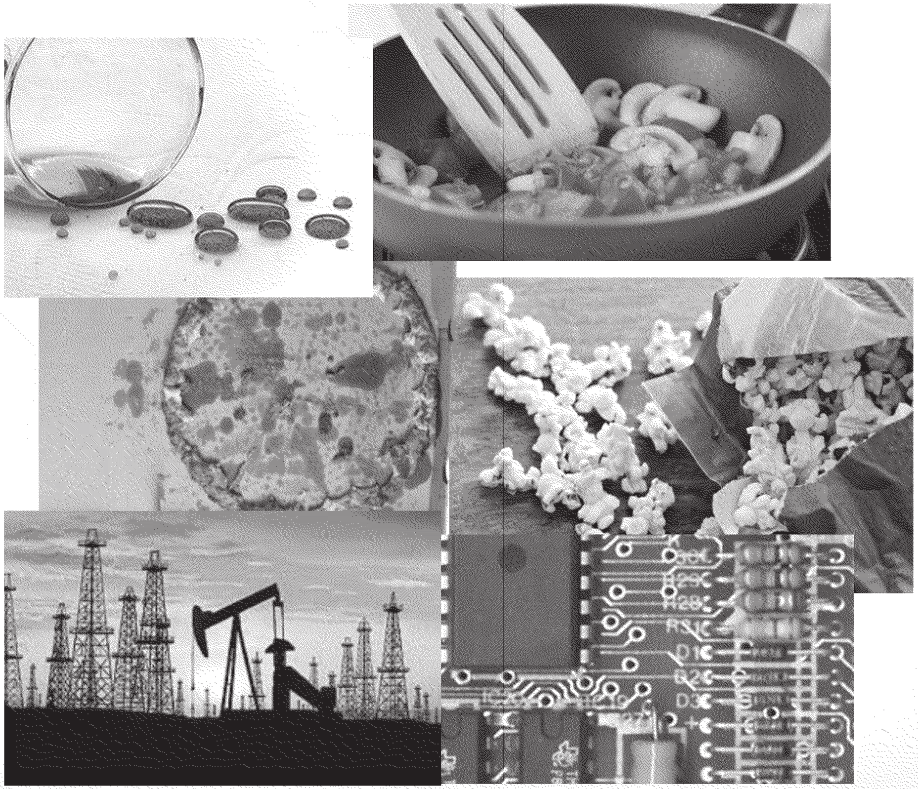
Uses of PFAS

- Food contact surfaces such as cookware[1], pizza boxes, fast food wrappers, popcorn bags, etc.
- Polishes, waxes, and paints
- Stain repellants for carpets, clothing, upholstered furniture, etc.
- Cleaning products
- Dust suppression for chrome plating
- Electronics manufacturing
- Oil and mining for enhanced recovery
- Performance chemicals such as hydraulic fluid, fuel additives, etc.



[1] PFOA has been phased out, however there is little evidence that the chemicals that have replaced PFOA are much safer.

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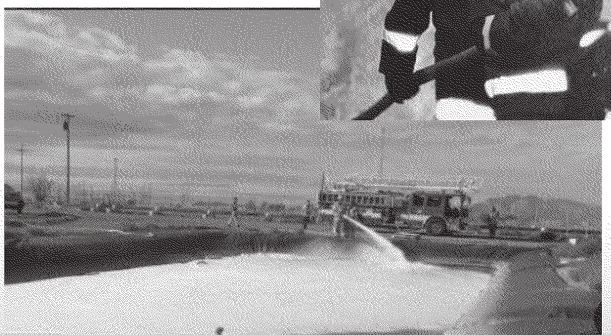
Sources of PFAS



- Landfills and leachates from disposal of consumer and industrial products containing PFASs
- Land where wastewater treatment plant biosolids was applied
  - Note: Biosolids applied following regulations should be protective to human exposure via ingestion of crops (Blaine et al. 2013 and 2014)
- Direct release of PFAS products into the environment – such as use of AFFF in training and emergency response

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EPA

PFAS of Concern/Health - TSCA

- From 2006-2016, companies have submitted the following types of new PFAS chemicals for review:
  - Predominantly C6 compounds, with some C4, C3, and C2
  - Some requests have been submitted for C7 and higher for low production volume uses, and
  - Predominantly carboxylates, with some ethers, phosphates and sulfonates.
- EPA has regulated PFAS by requiring testing and restricting the following: production volume, consumer uses, disposal, and C8 impurities in the products.
- EPA may require certain toxicity tests for new PFAS compounds: toxicokinetic, repeated-dose and modified reproductive toxicity (to include direct dosing of offspring through sexual maturation), cancer bioassays.

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EPA

Exposure/Monitoring – OW and OLEM

- EPA's Office of Land and Emergency Management (OLEM) and regional offices are working closely to address site-specific contamination from various PFAS sources.
- PFOA and PFOS are part of the Office of Water's Contaminant Candidate List 4 (CCL4). https://www.epa.gov/ccl/contaminant-candidate-list-4-ccl-4-0
- EPA collected occurrence data from public water systems (PWS) for six PFAS (PFOA, PFOS, PFNA, PFHxS, PFHpA, PFBS) under the third Unregulated Contaminant Monitoring Regulation (UCMR 3). https://www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule
- Monitoring took place from January 2013 through December 2015 and results were reported through 2016.
- Monitoring was conducted by all large PWS [i.e., those serving >10,000] and a statistically selected subset of 800 small PWS.
- A total of 4,920 PWS reported PFAS results.
- 1.3% of PWS had one or more results that exceeded the HA (i.e., sum of PFOA + PFOS > 0.07 ug/L, or 70 ppt).
- The results above the HA are from PWS in 25 different states/territories/tribal

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EPA

Cross-EPA Efforts to Characterize the Potential Toxicity of Multiple PFAS

- EPA has begun an effort to focus on characterizing the potential toxicity of PFAS that are commonly found in the environment - other than PFOA and PFOS which currently have health advisories in place.
- The Agency is working to develop a list of PFAS of most importance to inform decision-making.
- This effort will likely use some of the technologies being developed by ORD's computational toxicology research program, along with other approaches to improve our understanding of PFAS toxicity in the near term.
- ORD researchers are also working to develop automated chemical toxicity screening experiments and computational models to provide estimates to describe and predict the biological effects and characteristics of PFAS for which animal studies have not been conducted.

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EPA

Cross-EPA PFAS Method Development Workgroup

- EPA established Method 537 for analyzing PFAS in drinking water. In 2016, a technical advisory was released describing how laboratories should quantitate PFOA using Method 537 to account for linear and branched isomers. https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods
- EPA is currently developing analytical methods for ground, surface, and wastewater and for solids including soils, sediments, and biosolids through a cross-EPA workgroup.
- Some United States laboratories are using modified methods for non-drinking water samples based on a validated EPA Method 537, which is routinely used to analyze for PFOA and PFOS.
- These modified methods have no consistent sample collection guidelines and have not been validated nor systematically assessed for data quality.
- A cross-EPA PFAS Method Development and Analytical workgroup is drafting sampling SOP(s) and has initiated testing and multi-lab validation of three EPA-developed methods for 31 PFAS analytes in environmental matrices other than finished drinking water.
- OLEM is compiling technical information, including analytical and sampling methods, focused on a variety of topics that may be useful to states and stakeholders. Resources will be made available through Clu-In.org and other venues.

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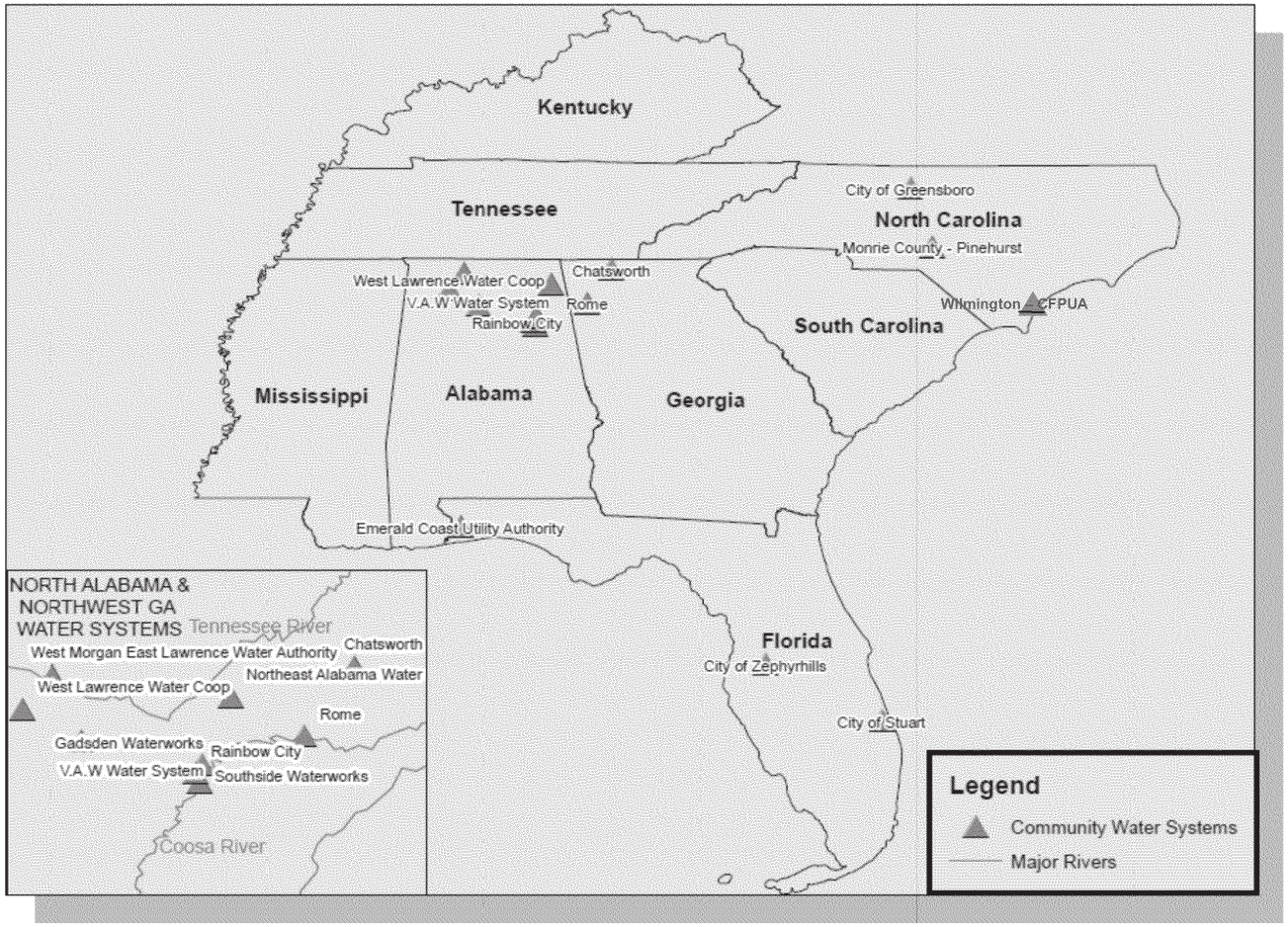
Community Water Systems of Concern with Final PFOA and PFOS Health Advisories



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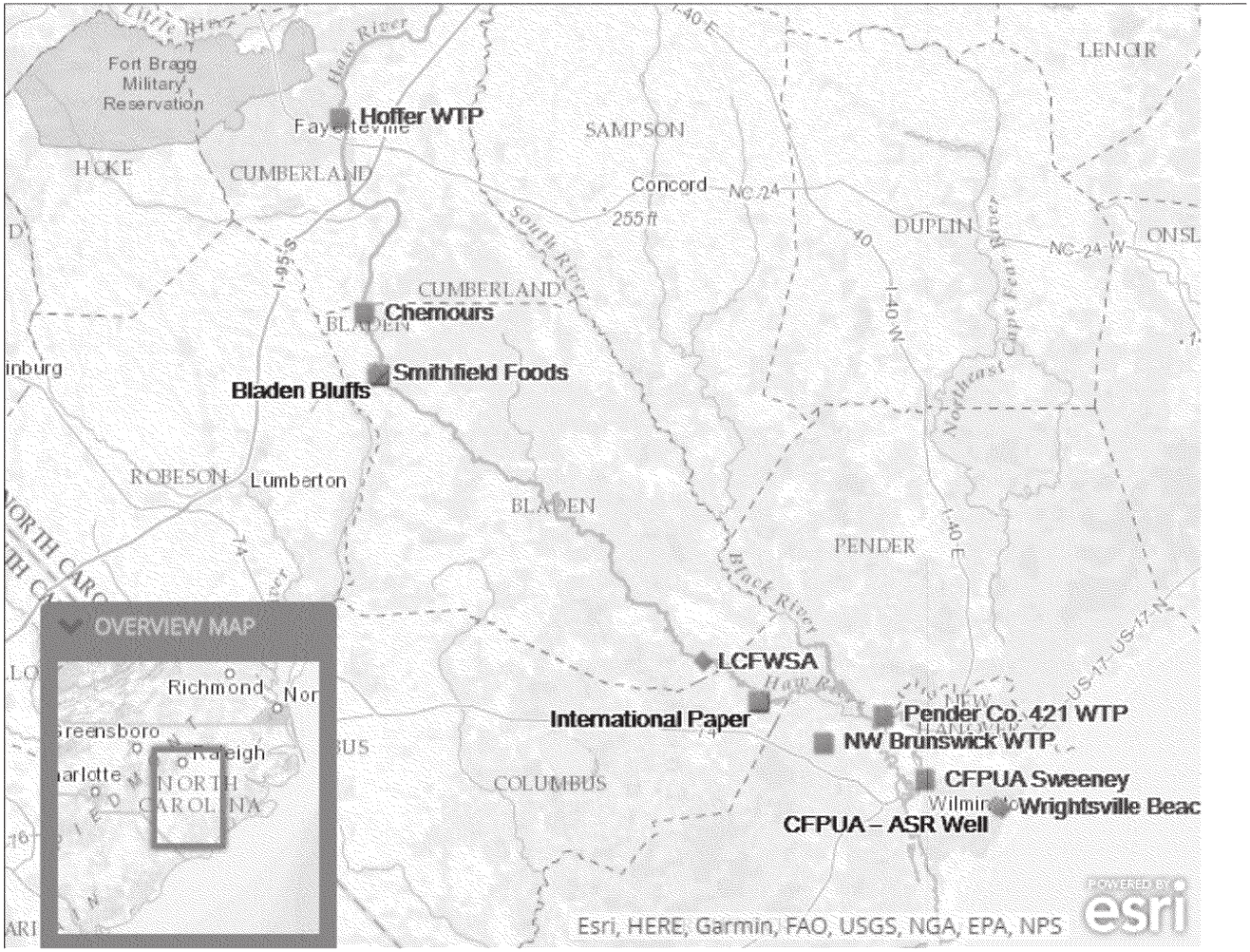
NC DEQ GenX Sample Sites



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State Directors Meeting
Legal Update

Philip Mancusi-Ungaro
Acting Chief
Office of Water Legal Support

The information and opinions expressed in this presentation are those of the author and do not reflect the positions of the USEPA

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Issues Covered Today

- Waters of the United States Update
- California Water Quality Standards Litigation
- State Section 404(g) Assumption

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Waters of the US Update

- Quick History of Definition of Waters of the US
- Status of Litigation
  - Remaining District Court cases stayed.
  - Court of Appeals cases remain stayed.
  - Supreme Court case regarding proper venue to challenge a rule is pending.
    - Oral argument is Wednesday, October 11.
    - Expect a decision a few months later

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WUS Update Continued

- On February 28, 2017, the President signed the "Executive Order on Restoring the Rule of Law, Federalism, and Economic Growth by Reviewing the 'Waters of the United States' Rule." The EO calls on the EPA Administrator and the Assistant Secretary of the Army for Civil Works to review the final Clean Water Rule and "publish for notice and comment a proposed rule rescinding or revising the rule…." The EO directs that the EPA and the Department of Army "shall consider interpreting the term 'navigable waters'" in a manner "consistent with Justice Scalia's opinion" in *Rapanos v. United States (2006)*.
- The Environmental Protection Agency and Department of Army have Selected a Two Step Process
  - Step One - On June 27, 2017, the EPA and Army proposed a rule to rescind the Clean Water Rule and re-codify the regulatory text that existed prior to 2015 defining "waters of the United States" or WOTUS.
  - The public comment period has been extended to September 27, 2017.
  - Step Two - The agencies plan to propose a new definition that would replace the approach in the 2015 Clean Water Rule, taking into consideration the principles that Justice Scalia outlined in the *Rapanos* plurality opinion.

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WUS Update Continued

- To provide the opportunity for public involvement the EPA and the Corps are holding ten teleconferences to hear from stakeholders their recommendations on revising the definition of WUS.
- Starting today, 9/19, the teleconferences will be on Tuesdays from 1:00 – 3:00 pm.
- Each session will focus on a segment of interested parties including Environment and public advocacy groups, Conservation, Construction and Transportation, Agriculture, Industry, Mining, Scientific Organizations and Academia, Stormwater, and Wastewater Management and Drinking Water Agencies.
- There will also be an in-person meeting with small groups on October 23, 2017, from 9:00 – 11:00 am.
- More details on registering are on the EPA WOTUS Rulemaking web page.
- www.epa.gov/wotus-rule

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California Temporary Urgency Change Petition Orders

Are they new or revised State Water Quality Standards

Background

- This is another case addressing when EPA must review state provisions of law as de facto new or revised WQS. This case involves interpreting and applying EPA's 4-part test for identifying new or revised WQS, first expressed in guidance issued in 2012.

- Four-Part test:
  - Is it a legally binding provision adopted or established pursuant to state or tribal law?
  - Does the provision address designated uses, water quality criteria (narrative or numeric) to protect designated uses, and/or antidegradation requirements for waters of the United States?
  - Does the provision express or establish the desired condition (e.g., uses, criteria) or instream level of protection (e.g., antidegradation requirements) for waters of the United States immediately or mandate how it will be expressed or established for such waters in the future?
  - Does the provision establish a new WQS or revise an existing WQS?

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TUCP Continued

- The Sacramento and San Joaquin Rivers merge to form the Bay Delta, a large hydrological system that receives 70% of CA annual rainfall.
- The Central Valley Authority (federal) and the CA State Water Project are authorized to withdrawal and transfer certain quantities of water from the Bay Delta to water users throughout Southern California.
- The water withdrawals and transfers from the projects are not regulated under the Clean Water Act. However, CA law normally requires the withdrawals to attain WQS.
- During the California drought, Governor Brown issued an Executive Order temporarily waiving the state law that required state water right withdrawal permits to be operated to attain WQS.
- The state then issued “temporary urgency change petition orders”, or “TUCP Orders”, which allowed these two large water projects to withdrawal and transfer larger volumes of water from the San Francisco Bay Delta than would otherwise have been permitted under their state law water rights permits.
- It is likely that some WQS were not attained during those withdrawals.

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TUCP Continued

- **Plaintiffs**: A coalition of environmental organizations sued EPA demanding the Agency determine the TUCP Orders constitute revisions to state water quality standards and then review and approve/disapprove them under section 303(c) of the Act.
- The enviro's pleadings appear to confuse whether allowing water quality to be degraded (by sources not regulated under the CWA) with changing the water goals (WQS) for the waterbody.
- **EPA's Position**: EPA argues the only thing that changed was whether the withdrawal orders had to attain WQS. The withdrawals are akin to nonpoint sources in that the CWA does not require that they meet WQS. The underlying WQS themselves were not changed.

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TUCP Continued

- **Status**:
  - In February, the court denied EPA's motion to dismiss, appearing sympathetic to Plaintiffs' arguments.
  - The court's legal basis was the EPA had not determined whether the TUCP's were or were not WQS, the Plaintiffs' made a non-frivolous argument that they were WQS, so the Court needed briefs on the subject so he could decide whether the TUCP's were or were not WQS (similar to Miccosukee and FL IWR cases).
  - Following that order, EPA made a formal determination that the TUCPs were not WQS.
  - This summer, the parties filed motions/cross motions for summary judgement which are still pending.

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Section 404 Assumption

- Under Section 404 (g), states can assume some portion of the Section 404 permitting program.
- Only two states currently have taken that step.
- Recently, other states have inquired about the process.
- One issue that has always comes up in these discussions is the scope of waters that can be assumed.

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National Advisory Council for Environmental Policy and Technology Assumable Waters Subcommittee Recommendations (May 2017)

- Group formed to explore the scope of assumable waters under Section 404(g).
- Operates as a Federal Advisory Committee Act Group.
- Several process recommendations were supported by all.
- Majority recommendations:
  - *Waters to be retained* – Primary Dependence on Rivers and Harbors Act Section 10 Lists of Navigable Waters to Define USACE Retained Waters. *(Waters Alternative B)* .
  - *Wetlands to be retained* -- USACE Retains All Wetlands Landward to an Administrative Boundary Established During the Development of the Memorandum of Agreement with the USACE, with a 300-foot National Administrative Boundary as a Default. (Wetlands *Alternative C3).*
- USACE recommendations:
  - *Waters to be retained* – Section 10 waters plus CWA (a)(1) TNW Waters as Retained Waters. *(Alternative C).*
  - *Wetlands to be retained* – USACE Retains All Adjacent Regardless of Furthest Reach. (wetlands *Alternative A).*
- August 1, 2017, letter from ECOS, ACWA and ASWM requested the Administrator adopt the majority's recommendations.

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Authority

- CWA §404(g)
  - States, including Tribal Nations, may assume administration of the permit and enforcement program for certain waters.
- CWA §404(h) and 40 CFR part 233
  - Lists state requirements for assumption.
  - Lists EPA responsibilities: approval and oversight of assumed program.
  - Lists requirements and process for review and modification of state program.

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Requirements for Assumption

Governor transmits request to the Regional Administrator

- Complete assumption request package must include:
  - Letter from Governor
  - Complete program description
  - Attorney General's statement
  - MOA with EPA Regional Administrator
  - MOA with Secretary of Army (through Chief USACE)
  - All applicable state statutes and regulations administering the program

Criteria for Assumption

- State or Tribal programs must be consistent with and no less stringent than the Act and implementing regulations
- State or Tribal programs must:
  - Have equivalent scope of jurisdiction
  - Regulate at least the same activities
  - Provide for sufficient public notice and allow public participation
  - Ensure compliance with the CWA 404(b)(1) guidelines
  - Have adequate enforcement authority

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Questions?

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Steam-Electric ELG Current Status

September 19, 2017

Paul Schwartz
Associate Regional Counsel
EPA REGION 4

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Activity Following Steam Electric ELG Rule Issued November 3, 2015

- 7 Petitions Filed in Court For Review of Rule
- Petitions Consolidated in 5th Circuit Court of Appeals
- Utility Water Act Group and SBA Filed Petitions for Reconsideration with EPA, March and April 2017
- April 2017 EPA announced Decision to Reconsider and Requested Stay of Litigation
- April 2017 Under Admin Procedure Act, EPA Postponed Compliance Deadlines to preserve status quo pending recon and litigation

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Activity Following Issuance Of ELG (Continued)

- June 2017, EPA Proposed Rule Postponing Compliance Deadlines Pending Reconsideration, Sought Comments
- August 11, 2017 EPA letter announces decision to Conduct new Rulemaking to Potentially Revise Limits (FGD and Bottom Ash Only)
- Aug 14, 2017, EPA requests Court sever and hold in abeyance review of FGD wastewater and bottom ash transport water (waste streams subject to planned rulemaking)

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Last Week's Rulemaking Regarding ELG for Steam-Electric Plants

- Signed by Administrator on Sept 12, 2017
- Announces Intent to Conduct Rulemaking to Revise FGD and Bottom Ash ELG limits
- Final Rule Delays Earliest Compliance Deadline From the 2015 Final Rule from November 2018 to November 2020 For Those Two Waste Streams
- Final Compliance Deadline of 2023 is unchanged
- Delay only applies to FGD and Bottom Ash Wastewater Streams In Light of Uncertainty Regarding Future Change to Limits
- Lifts Administrative Stay on 2015 ELG

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CURRENT STATUS OF 2015 ELG

- Administrative Stay On ELG Lifted
- Litigation Over 2015 ELG Continues (EPA has requested that FGD and Bottom Ash Portion of Rule be Severed from Litigatio and Held in Abeyance)
- Only Change in ELG is Delay of Earliest "as soon as possible" Compliance Deadline from Nov. 1, 2018 to Nov. 1, 2020
- Latest "as soon as possible" Compliance Deadline Remains Dec. 31, 2023
- Agency Estimate is that it will take 3 years to Proposed and Finalize Rulemaking On FGD and Bottom Ash Limits

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Requirements for Permits While Rulemaking On FGD and Bottom Ash Transport Water is Pending

- Permits Written While Rulemaking Process For FGD and Bottom Ash Wastewater is Underway Must Reflect 2015 ELG Limits, Which Are No Longer Stayed
- Permits May Set Compliance Deadline as Late as Dec. 31, 2023, and May Include Reopeners to Allow Change for New ELG Limits Established Pursuant to Rulemaking
- Modification To Reflect New ELG Limits Allowed Under 40 CFR 122.62(a)(3)(New Regulations)

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Steam Electric ELG Flow Chart

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QUESTIONS?

- I probably can’t answer them!

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CWA Jurisdiction Over Discharges to Surface Waters through Groundwater with a Direct Hydrological Connection

- Multiple Emerging Cases
- Longstanding EPA Position: Discharge to Surface Water Through Groundwater is a NPDES Regulated Discharge
- Filed Amicus Brief in Hawaii 9th Circuit Case
- Recent Cases in 4th, 6th, and 9th Circuits Likely to Lead to Appellate Decisions, May Result in Split among Circuits, Supreme Court Consideration if they go different ways

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Recent Hydrologic Connection Cases

- VEPCO v. Sierra Club (4th Circuit)(appeal from District Court holding that discharge from coal ash impoundment is regulated)
- Other District Court cases in 4th Circuit
- Hawaii Wildlife Fund v. County of Maui (EPA filed amicus brief)
- Tenn Clean Water Network v. TVA (Tenn. District Court held to be regulated discharge)
- Upstate Forever v. Kinder Morgan (gas pipeline breach contaminated creek through seeps and hydro connections– dismissed by district court – now on appeal to 4th Circuit

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Additional Recent Hydrologic Connection Cases

- Yadkin Riverkeeper v. Duke Energy (NC District Courtin 2015 decision holds seeps through gw to surface water from coal ash impoundment regulated)
- Ohio Valley Envtl. Coal. Inc. v. Pocahontas Land Corp. (W. Va. District Court in 2015 decision holds that valley fill discharges to surface wáter through hydrologically connected groundwater are regulated)

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EPA Preambles

- 66 Fed. Reg. 2960, 3015-16 (Jan. 12, 2001) (EPA "interprets the Clean Water Act to apply to discharges of pollutants from a point source via ground water that has a direct hydrologic connection to surface water"
- 63 Fed. Reg. 7858, 7881 (Feb. 17, 1998) ("EPA interprets the CWA's NPDES permitting program to regulate discharges to surface water via groundwater where there is a direct and immediate hydrologic connection"
- 56 Fed. Reg. 64876, 64892 (Dec. 12, 1991) ("the Act requires NPDES permits for discharges to groundwater where there is a direct hydrological connection between groundwaters and surface waters. In these situations, the affected groundwaters are not considered 'waters of the United States' but discharges to them are regulated because such discharges are effectively discharges to the directly connected surface waters.

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Potential Implications

- Unlined Lagoons
- Surface Impoundments
- Pipeline Breach
- Septic Tanks
- Underground Injection

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Present Status

- No indication EPA intends to change long-standing position on this issue
- Waiting for Circuit Court Decisions – may solidify majority position or may create conflict among courts for resolution by Supreme Court

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Proposal for Changes to the National Aquatic Resource Surveys (NARS 2.0)

Increasing the Power to Detect Trends

State Water Directors Meeting
September 2017

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NARS Overview

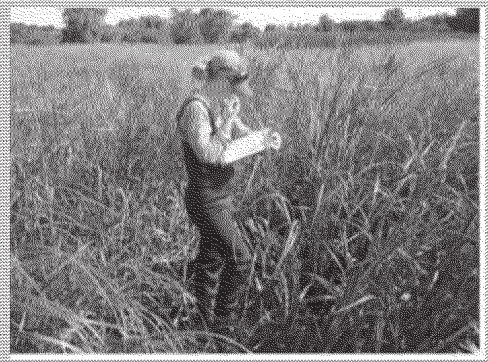
- Started in early 2000s.
- Developed to form a consistent approach to answer key questions about water quality.
- Collaboration on a series of statistically based surveys to provided improved, statistically-valid environmental information.
- Four individual surveys:

National Coastal Condition Assessment

National Rivers & Streams Assessment

National Lakes Assessment

National Wetlands Condition Assessment



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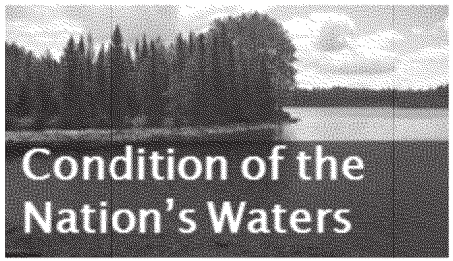
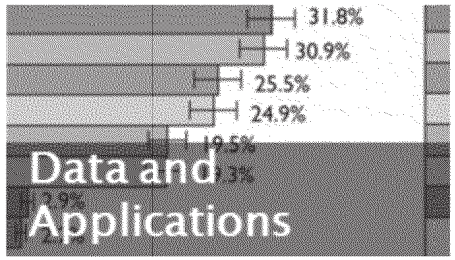
Surveys design questions?

- What percent of waters support healthy ecosystems and recreation?
- What are the most common water quality problems?
- Is water quality improving or getting worse?
- Are investments in improving water quality focused appropriately?

- Background
- Indicators
- Manuals
- Map of Sampled Sites



- National Coastal Condition Assessment (NCCA)
- National Lakes Assessment (NLA)
- National Rivers and Streams Assessment (NRSA)
- National Wetland Condition Assessment (NWCA)



- NARS Data
- Journal Articles
- Applying the Data
- Related Studies and Tools

https://www.epa.gov/national-aquatic-resource-surveys

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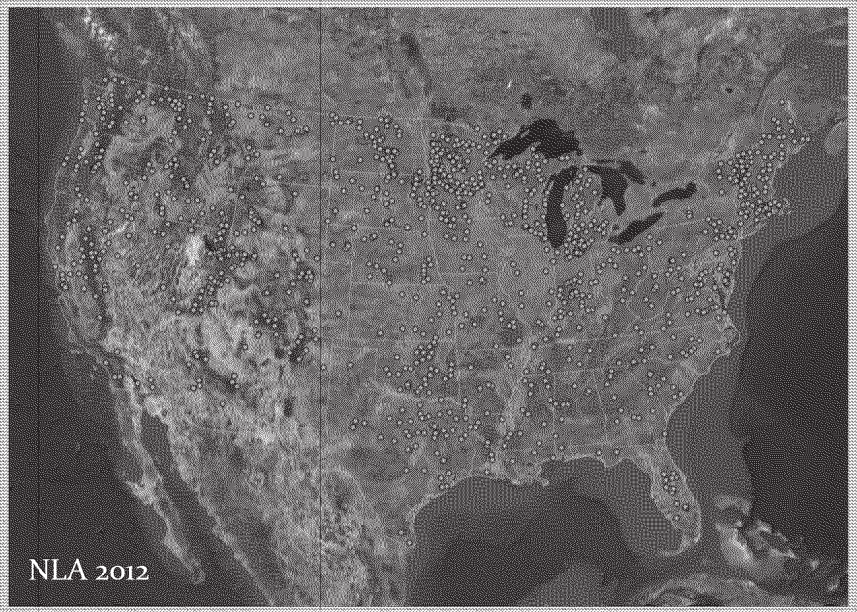
Current Situation



- Survey Design – stratified random design with regional resolution
- Implementation Approach – one waterbody type sampled each year, repeat every 5 years (except NRSA, over 2 years)
  - National Coastal Condition Assessment: 2010, 2015
  - National Lakes Assessment: 2007, 2012, 2017
  - National Rivers & Streams Assessment: 2008-2009, 2013-2014, 2018-2019
  - National Wetlands Condition Assessment: 2011, 2016

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Southeastern State Participation

NARS State Funding Allocations by Year

State	2018-NRSA	2017-NRSA	2016-NLA	2015-NWCA	2014-NCCA
Alabama	$128,000	$120,000	$80,000	$151,003	$152,000
Florida	$96,000	$96,000	$144,000	$500,695	$800,000
Georgia	$128,000	$136,000	$104,000	$214,584	$64,000
Kentucky	$156,000	$146,000	$88,000	$119,213	$0
Mississippi	$104,000	$104,000	$128,000	$151,003	$64,000
North Carolina	$120,000	$128,000	$120,000	$182,794	$328,000
South Carolina	$96,000	$96,000	$88,000	$182,794	$192,000
Tennessee	$120,000	$120,000	$88,000	$87,423	$0

Red indicates state participation

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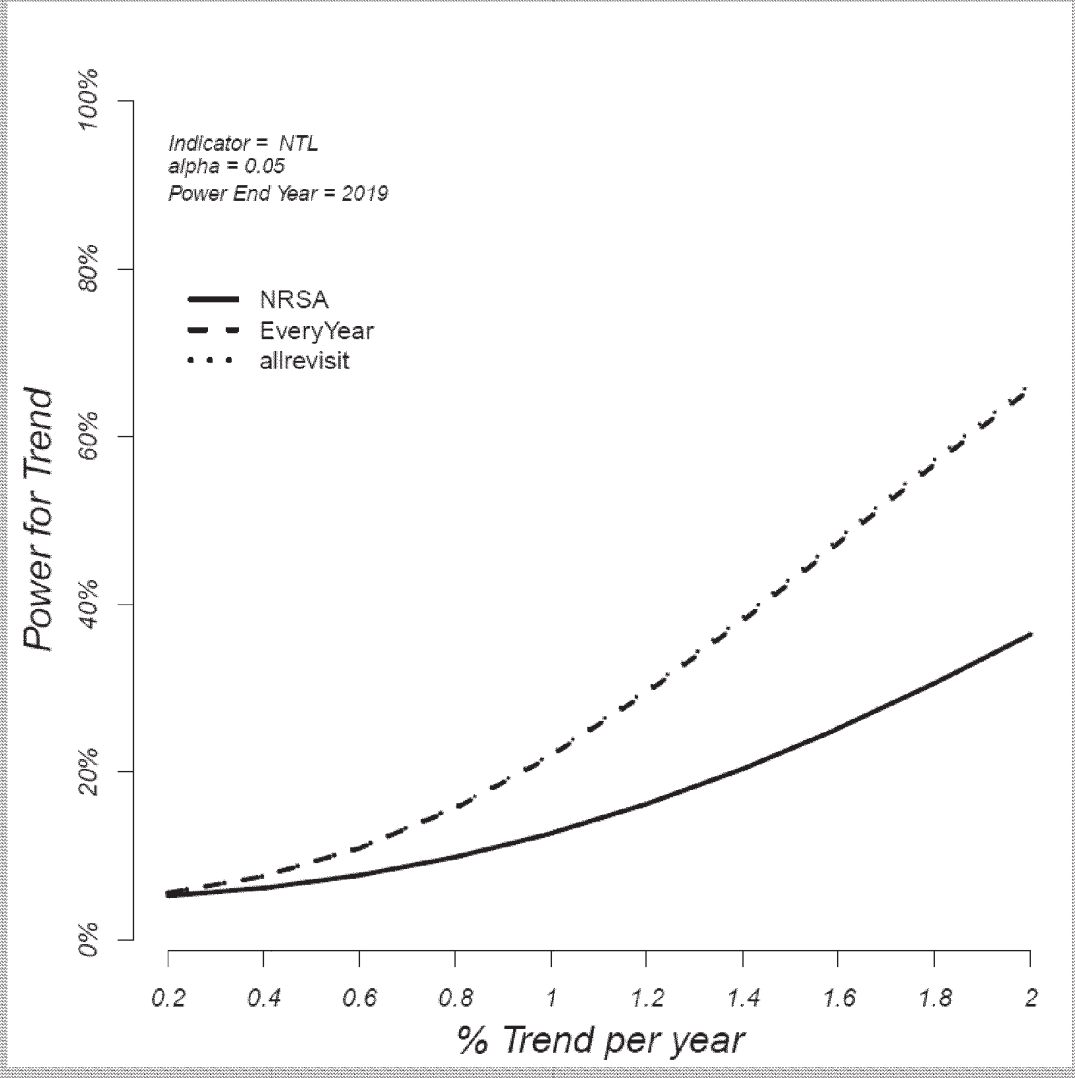
Proposed NARS 2.0

- Sample every waterbody type every year
- No increase in the number of samples
- No Change in Survey Design
  - stratified random design with regional resolution
- <u>Results in an increase in statistical power</u>



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Sampling Effort Differences

Current Implementation

South Carolina	2022	2023	2024	2025	2026
Lakes	9				
Rivers & Stream		10	10		
Coastal				22	
Wetlands					21
Total Samples	9	10	10	22	21

Tennessee	2022	2023	2024	2025	2026
Lakes	9				
Rivers & Streams		13	13		
Coastal				0	
Wetlands					9
Total Samples	9	13	13	0	9

Proposed Implementation

South Carolina	2022	2023	2024	2025	2026
Lakes	1	2	2	2	2
Rivers & Stream	4	4	4	4	4
Coastal	5	5	4	4	4
Wetlands	4	4	5	4	4
Total Samples	14	15	15	14	14

Tennessee	2022	2023	2024	2025	2026
Lakes	2	2	2	2	1
Rivers & Streams	6	5	5	5	5
Coastal	0	0	0	0	0
Wetlands	1	2	2	2	2
Total Samples	9	9	9	9	8

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Sampling Effort Differences

Current Implementation

Alabama	2022	2023	2024	2025	2026
Lakes	8				
Rivers & Stream		14	13		
Coastal				17	
Wetlands					17
Total Samples	8	14	13	17	17

Florida	2022	2023	2024	2025	2026
Lakes	16				
Rivers & Streams		10	10		
Coastal				91	
Wetlands					61
Total Samples	16	10	10	91	61

Georgia	2022	2023	2024	2025	2026
Lakes	11				
Rivers & Streams		15	14		
Coastal				8	
Wetlands					25
Total Samples	11	15	14	8	25

Proposed Implementation

Alabama	2022	2023	2024	2025	2026
Lakes	2	2	1	1	2
Rivers & Stream	5	5	6	6	5
Coastal	3	3	3	4	4
Wetlands	4	4	3	3	3
Total Samples	14	14	13	14	14

Florida	2022	2023	2024	2025	2026
Lakes	3	3	3	3	4
Rivers & Streams	4	4	4	4	4
Coastal	18	19	18	18	18
Wetlands	13	12	12	12	12
Total Samples	38	38	37	37	38

Georgia	2022	2023	2024	2025	2026
Lakes	3	2	2	2	2
Rivers & Streams	6	6	6	5	6
Coastal	1	2	2	2	1
Wetlands	5	5	5	5	5
Total Samples	15	15	15	14	14

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Sampling Effort Differences

Current Implementation

Kentucky	2022	2023	2024	2025	2026
Lakes	9				
Rivers & Stream		16	17		
Coastal				0	
Wetlands					13
Total Samples	9	16	17	0	13

Mississippi	2022	2023	2024	2025	2026
Lakes	14				
Rivers & Streams		11	11		
Coastal				8	
Wetlands					17
Total Samples	14	11	11	8	17

North Carolina	2022	2023	2024	2025	2026
Lakes	13				
Rivers & Streams		13	14		
Coastal				37	
Wetlands					21
Total Samples	13	13	14	37	21

Proposed Implementation

Kentucky	2022	2023	2024	2025	2026
Lakes	1	2	2	2	2
Rivers & Stream	6	6	7	7	7
Coastal	0	0	0	0	0
Wetlands	3	2	2	3	3
Total Samples	10	10	11	12	12

Mississippi	2022	2023	2024	2025	2026
Lakes	3	3	3	3	2
Rivers & Streams	4	4	4	5	5
Coastal	2	2	2	1	1
Wetlands	4	4	3	3	3
Total Samples	13	13	12	12	11

North Carolina	2022	2023	2024	2025	2026
Lakes	2	2	3	3	3
Rivers & Streams	6	6	5	5	5
Coastal	7	7	7	8	8
Wetlands	4	4	4	5	4
Total Samples	19	19	19	21	20

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Potential Advantages

- Greater power for trend detection
- Trend estimates available every year
- Potential for reports every year
- Potential for more equal and consistent funding from year to year
- Provides more flexibility for reacting to budgets
- Provides more flexibility for responding to environmental issues
- More consistent with most Fed., State and Tribal monitoring implementation
- Easier to maintain sampling technique proficiency
- May be more easily implemented by some states

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Potential Disadvantages

- Any change takes getting use to it
- Staff (Fed., State, and Tribal) needs to handle all resources all the time
  - Impact on Funding Allocations
  - Impact on Contracting
  - Impact on Training
  - Impact on Staff
  - How to handle reporting
- May have an adverse effect on sampling technique
- May be more difficult to implement for some states

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EPA is Requesting State Input

The Future of NARS: Building on Our Shared Successes
National Workshop/Conference
December 5-7, 2017
NOAA Training Center
Silver Spring, MD

Pre-workshop Webinars
NARS 2.0
August 16, 2017
http://www.ctic.org/NARS/Upcoming%20Workshops/2017National/webinars

Steering Committee Participation

Sends Questions/Comment to:
Sarah Lehmann (EPA HQ): lehmann.sarah@epa.gov
Chris Decker (EPA R4): decker.chris@epa.gov
Chris McArthur (EPA R4): mcarthur.christopher@epa.gov
Johnnie Purify (EPA R4): purify.johnnie@epa.gov

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MS4 General Permit Remand Rule

STATE DIRECTORS' MEETING
SEPTEMBER, 2017

CHRIS THOMAS, EPA

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Phase II Remand (*EDC v. EPA*, 2003)

Ninth Circuit found deficiencies in the Phase II stormwater regulations regarding the procedures to be used for providing coverage to small MS4s under general permits

The court vacated the relevant portions of the Phase II regulations, and remanded to EPA to fix the deficiencies:

1. Lack of permitting authority review:
   - "In order to receive the protection of a general permit, the operator of a small MS4 needs to do nothing more than decide for itself what reduction in discharges would be the maximum practical reduction."
   - "No one will review that operator's decision to make sure that it was reasonable, or even good faith."

2. Lack of public participation in permit process:
   - "… we conclude that … EPA's failure to make NOIs available to the public or subject to public hearings contravene the express requirements of the Clean Water Act."

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Ninth Circuit Order

Dec. 2014 – Petitioners (NRDC and EDC) asked the Ninth Circuit to require EPA to take action to address the 2003 *EDC v. EPA* remand

Aug. 2015 – EPA and the petitioners signed a settlement agreement to establish a schedule for addressing the remand

Sept. 2015 – Ninth Circuit entered an order granting the joint motion and setting forth the following schedule to promulgate changes to the Phase II stormwater regulations

Dec. 2016 – EPA publishes final rule in Federal Register

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Final Rule: Permitting Authority Choice

Under the final rule, the permitting authority determines what type of general permit to use for its small MS4s:

- **Comprehensive** general permit – All necessary permit terms and conditions are established up front in the general permit itself, using one permit issuance procedure
- **Two-step** general permit – Necessary permit terms and conditions are established in two steps, using two issuance procedures.

Permitting authority can change approaches in subsequent permit terms

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Commonalities Among Two Permit Types

Permit content

- Permitting authority is responsible for determining what is needed to meet the statutory and regulatory standard
- Terms and conditions need to implement the MS4 permit standard “to reduce the discharge of pollutants from the MS4 to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the CWA”
- Permit requirements must be “clear, specific, and measurable”

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Commonalities Among Two Permit Types

Permitting procedures - CWA procedures for issuing NPDES permits must be followed for all terms and conditions that are needed to implement the MS4 permit standard:

- Public notice of proposed terms and conditions of the permit
- Opportunity to comment and request a public hearing
- Permitting authority review and final determination on permit coverage and applicable terms and conditions
- EPA oversight

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Comprehensive General Permit

Basic Approach: All terms and conditions needed to meet the MS4 permit standard must be established within the final general permit

- No additional permit terms are established during the authorization process

Permitting Process: same as for other traditional general permits

Other Key Attributes:

- NOI – no more than the simple general permit NOI is necessary, although permitting authority can request additional information
- SWMP – each MS4 required to develop SWMP under their permit, but the document contains no enforceable permit terms or conditions; can be changed without necessarily requiring a permit modification

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Two-Step General Permit

Basic Approach: after issuing the base general permit, the permitting authority carries out a second permitting process in order to establish for each MS4 additional permit requirements necessary to meet the MS4 permit standard

Permitting Process:

- Step 1 – Issue the base general permit using same process as other traditional general permits
- Step 2 – Propose for comment and then finalize additional permit requirements that apply to individual MS4s covered under the general permit

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Two-Step General Permit

Other Key Attributes:

- NOI – in addition to the basic required information for all general permit NOIs, the NOI requires other information the permitting authority determines is needed to establish clear, specific, and measurable requirements that meet the MS4 permit standard for each MS4
- SWMP – each MS4 required to develop SWMP under their permit; the specific details of the SWMP are not themselves enforceable, unless they are incorporated into the permit during "Step 2"
- Hybrid approach – the permitting authority may choose which requirements to establish in the general permit (in Step 1), and which to establish under the Step 2 process

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Thoughts Moving Forward

- Can States continue to enforce SWMPs developed under a permit issued prior to Remand Rule?
- Can States enforce SWMPs under State law?

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NPDES Electronic Reporting Rule

EPA R4 State Water Director Meeting Update

CWA-NPDES
electronic reporting

David Apanian, P.E., MSCEE
R4 ICIS-NPDES Data Administrator

r4icis@epa.gov
R4icis.Zendesk.com

20 September 2017

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eRule Agenda

- Overview
- eRule Readiness Dashboard
- State Specific – Readiness Letters
- Biosolids
- Resources
- Challenges

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eRule Overview

- 12/21/15: Effective
- 04/19/16: State Initial Recipient Determination
- 09/21/16: All Basic Permit & Facility Information in ICIS
- 12/21/16: All DMRs submitted electronically
  BioSolids Annual Report (EPA administered)
- 06/30/17: Initial State Readiness Assessment
- 09/01/17: Data Group field populated in ICIS
- 12/21/17: State Statutory Changes Completed
- 06/30/18: Second State Readiness Assessment
- 09/21/20: States Transmit Initial Phase II Data
- 12/21/21: NNCR Published

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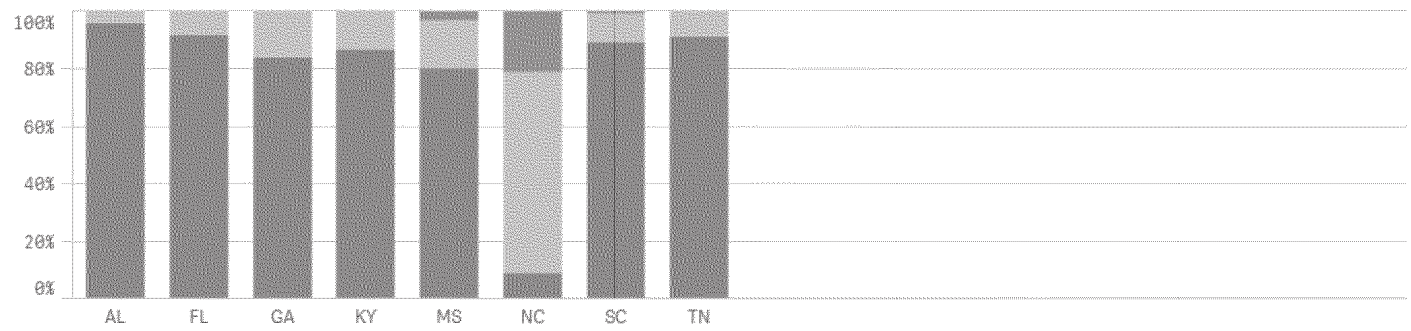
eRule Readiness Dashboard

NPDES eRule Readiness and Data Completeness Dashboard

Percentage of Permits in Evaluation Categories by State

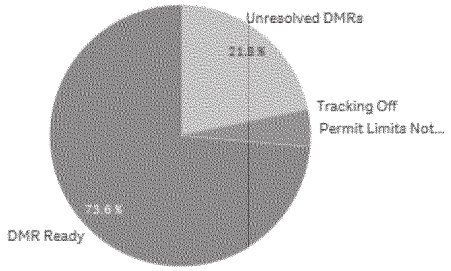


Permitting State
Region
Major/Minor
Evaluation Category
Components
Issuing Agency

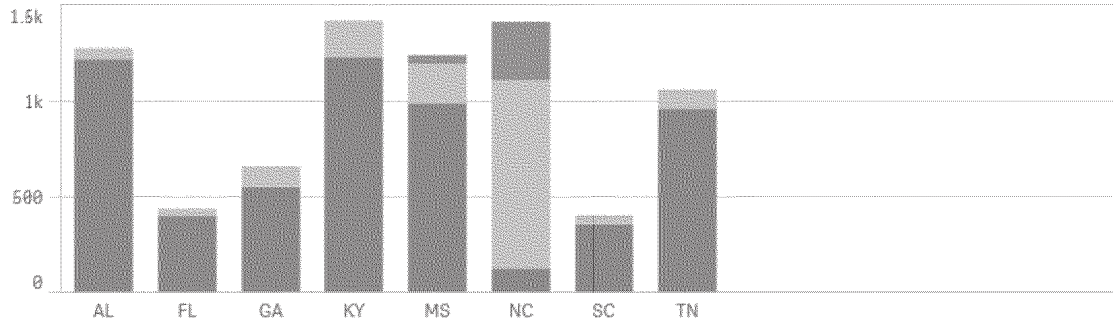
Number of Permits in Selection

7.86k

Per... State	DMR Ready	Unresolved DMRs	Tracking Off	Permit Limits Not in ICIS
Total	**5783**	**1713**	**5**	**354**
AL	1211	58	0	0



Number of Permits in Evaluation Categories by State



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Readiness Letters

- EPA Initial Assessment of Phase I Implementation
- Any Unresolved CROMERR Issues
- Comments on Phase II Implementation Plans
- Summary of Resources Available to States

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Biosolids

Per existing rule [40 CFR Parts 9, 122, 123, 124, and 501 National Pollutant Discharge Elimination System Permit Application Requirements for Publicly Owned Treatment Works and Other Treatment Works Treating Domestic Sewage; Final Rule (64 FR 42438; 4 August 1999)]: (Form 2S)

When states *are not* the authorized program for sewage sludge –

TWTDS…

"…will obtain…sewage sludge permits from EPA (by submitting Form 2S to the EPA Regional Office)."

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Biosolids

- Appendix A to Part 127
  - 8 Data Elements from Permit Application

- Options For Capturing/Collecting Information:

  - State NPDES Permit Application Has Language Requiring Inclusion of 2S
    - States Enter Data into State DB – Transmit to EPA
  - State NPDES Permit Application Has Language Requiring Inclusion of 2S
    - States Mail Forms to EPA
  - State NPDES Permit Application Has Language Reminding Utilities to Submit Form 2S to EPA Directly
  - State Does Nothing
    - EPA Reaches Out to Facilities
  - Other???

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eRule Resources

- HQ – Contractor Support for Data/Flow Issues
- Exchange Network Grants
  - Draft Distributed – Comments Period Closed 09/11/2017
  - Final Solicitation October 2017
- Region 4 –

4icis@epa.gov

r4icis.zendesk.com

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eRule Resources

ICIS Region 4 ICIS-NPDES Support Portal

R4 ICIS-NPDES Data Administr...

Welcome to the EPA Region 4 ICIS-NPDES Support Portal

This site is intended to support R4 Regional and State users. Requests for assistance can be made through the portal, or by sending an email directly to the R4 ICIS-NPDES Data Administrator at: r4icis@epa.gov

NOTE: this site does not provide support for ICIS-Air.

Content will be updated as time allows - so check back now and then.

ANNOUNCEMENTS

Registration Instructions and Forms (Updated January 26, 2017)

R4 ICIS-NPDES Help Portal - URL and Email Address

REFERENCE TABLES

** NEW ** NPDES Data Groups (2017-08-29)

Facility Type of Ownership (2017-05-10)

Frequency of Analysis (2017-03-14)

MGP Industrial Category (2017-03-14)

Narrative Conditions & Schedule Events (Updated 2017-08-29)

NODI Codes & Descriptions (2017-04-13)

See all 17 articles

TECHNICAL RESOURCES

Date Calculator for Permits and Schedules (2017-02-22)

ECHO Data Dictionary (Updated 2016-04-25)

Final NPDES Electronic Reporting Rule

ICIS Data Element Dictionary

ICIS User Manual

WENDB Data Elements

FAQ

"Unterminate" NPDES Permit

Change Permit Expiration Date

ICIS Related Links (Update 2017-03-21)

R4 ICIS System Contacts

TRAINING AND/OR WEBINARS

AGENTS ONLY

********** TEMPLATE - ICIS NEW USER ACCOUNT **********

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eRule Challenges

- Resources…
  - Resources…
    - Resources…
      - Resources…
        - Resources…
          - Resources..
            - Resources…
              - Resources…

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Questions……

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To: kristy.richardson@state.co.us[kristy.richardson@state.co.us]; Nicole Lugli[Nicole.Lugli@ct.gov]; robert.kaliszewski@ct.gov[robert.kaliszewski@ct.gov]; kerri.malinowski@maine.gov[kerri.malinowski@maine.gov]; douglas.fine@state.ma.us[douglas.fine@state.ma.us]; c.mark.smith@state.ma.us[c.mark.smith@state.ma.us]; delaneyr@michigan.gov[delaneyr@michigan.gov]; krukowskim@michigan.gov[krukowskim@michigan.gov]; remusm@michigan.gov[remusm@michigan.gov]; clark.freise@des.nh.gov[clark.freise@des.nh.gov]; Brandon.kernen@des.nh.gov[Brandon.kernen@des.nh.gov]; Steve.Maybury@dep.nj.gov[Steve.Maybury@dep.nj.gov]; eileen.murphy@dec.ny.gov[eileen.murphy@dec.ny.gov]; robert.schick@dec.ny.gov[robert.schick@dec.ny.gov]; Fagel, Jason R (DEC)[jason.fagel@dec.ny.gov]; Holman, Sheila[sheila.holman@ncdenr.gov]; linda.culpepper@ncdenr.gov[linda.culpepper@ncdenr.gov]; craig.butler@epa.ohio.gov[craig.butler@epa.ohio.gov]; nik.dzamov@epa.ohio.gov[nik.dzamov@epa.ohio.gov]; susan.kessler@epa.ohio.gov[susan.kessler@epa.ohio.gov]; jenyfer.allen@epa.ohio.gov[jenyfer.allen@epa.ohio.gov]; MASTERSON.Kevin@deq.state.or.us[MASTERSON.Kevin@deq.state.or.us]; marz.nicole@deq.state.or.us[marz.nicole@deq.state.or.us]; steven.jetter@state.or.us[steven.jetter@state.or.us]; Heidi.Hales@vermont.gov[Heidi.Hales@vermont.gov]; Chuck Schwer[Chuck.Schwer@vermont.gov]; kzar461@ecy.wa.gov[kzar461@ecy.wa.gov]; janice.willey@navy.mil[janice.willey@navy.mil]; aroberson@asdwa.org[aroberson@asdwa.org]; chanson@ecos.org[chanson@ecos.org]; slongsworth@ecos.org[slongsworth@ecos.org]; Bowe, Patrick[Patrick.Bowe@ct.gov]; Iwenofu, Samuel (ECY[siwe461@ECY.WA.GOV]; Ottaway, William (DEC[william.ottaway@dec.ny.gov]; betsey.wingfield@ct.gov[betsey.wingfield@ct.gov]; Gloria.Post@dep.nj.gov[Gloria.Post@dep.nj.gov]; elizabeth.lewis-michl@health.ny.gov[elizabeth.lewis-michl@health.ny.gov]; Impellitteri, Christopher[Impellitteri.Christopher@epa.gov]; Caporale, Cynthia[Caporale.Cynthia@epa.gov]; Fitz-James, Schatzi[Fitz-James.Schatzi@epa.gov]; Raffaele, Kathleen[raffaele.kathleen@epa.gov]; Flowers, Lynn[Flowers.Lynn@epa.gov]; Sinks, Tom[Sinks.Tom@epa.gov]; Orme-Zavaleta, Jennifer[Orme-Zavaleta.Jennifer@epa.gov]; Watkins, Tim[Watkins.Tim@epa.gov]; Buckley, Timothy[Buckley.Timothy@epa.gov]; Sonich-Mullin, Cynthia[Sonich-Mullin.Cynthia@epa.gov]; Gilliland, Alice[Gilliland.Alice@epa.gov]; McDonald, James[McDonald.James@epa.gov]; Gettle, Jeaneanne[Gettle.Jeaneanne@epa.gov]; Carter, Bobbi[Carter.Bobbi@epa.gov]; Behl, Betsy[Behl.Betsy@epa.gov]; Strong, Jamie[Strong.Jamie@epa.gov]; Foster, Stiven[Foster.Stiven@epa.gov]; Deener, Kathleen[Deener.Kathleen@epa.gov]; Barbery, Andrea[Barbery.Andrea@epa.gov]; Scheuer, Amy[Scheuer.Amy@epa.gov]; MARZ Nicole[nicole.marz@state.or.us]; Karoly, Cyndi[cyndi.karoly@ncdenr.gov]; Mundrick, Doug[Mundrick.Doug@epa.gov]; France, Danny[France.Danny@epa.gov]; Walker, Mary[walker.mary@epa.gov]; Zapata, Cesar[Zapata.Cesar@epa.gov]; Allenbach, Becky[Allenbach.Becky@epa.gov]; Heard, Anne[Heard.Anne@epa.gov]; Lapierre, Kenneth[Lapierre.Kenneth@epa.gov]; Shehee, Mina[mina.shehee@dhhs.nc.gov]; Hall, Renea[Hall.Renea@epa.gov]; Campbell-Dunbar, Shawneille[Campbell-Dunbar.Shawneille@epa.gov]; Mitchell, Ken[Mitchell.Ken@epa.gov]; Jessica Godreau[Jessica.godreau@ncdenr.gov]; Kemker, Carol[Kemker.Carol@epa.gov]; Dean, Glenda[GLD@adem.alabama.gov]; efp@adem.alabama.gov[efp@adem.alabama.gov]; Harrison, Dennis[DDH@adem.alabama.gov]; Hays, Lewis[Lewis.Hays@dnr.ga.gov]; Capp, James[James.Capp@dnr.ga.gov]; Carnley, Keith[keith.carnley@dnr.ga.gov]; Booth, Elizabeth[Elizabeth.Booth@dnr.ga.gov]; Justin B. Green[justin.b.green@dep.state.fl.us]; Zimmerman, Jay[jay.zimmerman@ncdenr.gov]; Kinard, Doug[KINARDDB@dhec.sc.gov]; Bird, Joel (ECY[jbir461@ECY.WA.GOV]; Yaquian-Luna, Jose[yaquian-luna.josea@epa.gov]; Taylor, Dawn[Taylor.Dawn@epa.gov]; Sassman, Hannah[sassman.hannah@epa.gov]; Braverman, Carole[braverman.carole@epa.gov]; O'shea, Marie[OShea.Marie@epa.gov]; Harris, Kimberly[harris.kimberly@epa.gov]; Nwogu, Peter[Peter.Nwogu@dnr.ga.gov]; Azzam, Nidal[Azzam.Nidal@epa.gov]; Maddaloni, Mark[Maddaloni.Mark@epa.gov]; Cutt, Diana[Cutt.Diana@epa.gov]; mmaddalo22@gmail.com[mmaddalo22@gmail.com]; Recer, Gregg M

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Cc: Kavlock, Robert[Kavlock.Robert@epa.gov]; Robbins, Chris[Robbins.Chris@epa.gov]; Rodan, Bruce[rodan.bruce@epa.gov]; Yamada, Richard (Yujiro)[yamada.richard@epa.gov]
From: Matthews, Lisa
Sent: Fri 10/20/2017 3:26:09 PM
Subject: agenda for Oct 30 ECOS-EPA PFAS Call
Oct 30 2017 Call Agenda.docx

ECOS-EPA PFAS Call

October 30, 2017

4:00-5:00 pm ET

Call-in number: 866-299-3188, code 202-564-6669

Webinar link: http://epawebconferencing.acms.com/pfasoctober/

Agenda

1. Welcome and Introductions – Jennifer Orme-Zavaleta, EPA's Office of Research and Development (ORD) (5 mins)

2. Amended TSCA: How implementation could influence actions around PFAS – Jeff Morris, Director, EPA's Office of Pollution Prevention and Toxics (15 mins)

3. GenX in the Cape Fear River Basin

- State update – Sheila Holman, NC DEQ Assistant Secretary for Environment (10 mins)

- PFAS methods work to support NC – Tim Buckley, EPA ORD National Exposure Research Laboratory (5 mins)

4. Overview of the PFAS Investigation at Wright-Patterson AFB

- Including the sampling of a sentinel well network designed to detect contamination before it impacts the city of Dayton's downgradient wellfields – Bonnie Buthker, Chief, Southwest District Office, Ohio EPA (10 mins)

5. Ohio EPA Progress on Analytical Methods

- Drinking water and direct injection method for other waters – Nik Dzamov, Chief, Division of Environmental Services, Ohio EPA (5 mins)

6. Updates from the EPA PFAS Workgroups

- Methods Development – Chris Impellitteri, EPA ORD Co-Chair (5 mins)

- Toxicity – Lynn Flowers, EPA ORD Co-Chair (5 mins)

7. Open forum to share info (states)

8. Wrap-up and Adjourn – Jennifer Orme-Zavaleta, EPA ORD

These calls are held every other month for states and EPA to share information on PFAS methods, toxicity and treatment work. Please send any suggestions for December agenda topics to Lisa Matthews (matthews.lisa@epa.gov) and Sarah Grace Longsworth (slongsworth@ecos.org). Thank you.

Lisa Matthews

Senior Advisor and State Liaison

US EPA Office of Research and Development

202-564-6669 office

202-577-4035 mobile

ECOS-EPA PFAS Call
October 30, 2017
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To: Wu, Qian (HEALTH)[qian.wu@health.ny.gov]; Matthews, Lisa[Matthews.Lisa@epa.gov]; GLD@adem.alabama.gov[GLD@adem.alabama.gov]; EFP@adem.alabama.gov[EFP@adem.alabama.gov]; DDH@adem.alabama.gov[DDH@adem.alabama.gov]; jim.polisini@dtsc.ca.gov[jim.polisini@dtsc.ca.gov]; Loveriza.Sarmiento@dtsc.ca.gov[Loveriza.Sarmiento@dtsc.ca.gov]; Claudio.Sorrentino@DTSC.ca.gov[Claudio.Sorrentino@DTSC.ca.gov]; kristy.richardson@state.co.us[kristy.richardson@state.co.us]; Nicole Lugli[Nicole.Lugli@ct.gov]; robert.kaliszewski@ct.gov[robert.kaliszewski@ct.gov]; shannon.pociu@ct.gov[shannon.pociu@ct.gov]; betsey.wingfield@ct.gov[betsey.wingfield@ct.gov]; gary.ginsberg@ct.gov[gary.ginsberg@ct.gov]; Justin B. Green[justin.b.green@dep.state.fl.us]; keith.carnley@dnr.ga.gov[keith.carnley@dnr.ga.gov]; peter.nwogu@dnr.ga.gov[peter.nwogu@dnr.ga.gov]; Alexander, Shanna[shanna.alexander@dnr.ga.gov]; elizabeth.booth@dnr.ga.gov[elizabeth.booth@dnr.ga.gov]; Lewis.Hays@dnr.ga.gov[Lewis.Hays@dnr.ga.gov]; James.Capp@dnr.ga.gov[James.Capp@dnr.ga.gov]; kerri.malinowski@maine.gov[kerri.malinowski@maine.gov]; pamela.wadman@maine.gov[pamela.wadman@maine.gov]; christina.s.zabierek@maine.gov[christina.s.zabierek@maine.gov]; douglas.fine@state.ma.us[douglas.fine@state.ma.us]; c.mark.smith@state.ma.us[c.mark.smith@state.ma.us]; delaneyr@michigan.gov[delaneyr@michigan.gov]; krukowskim@michigan.gov[krukowskim@michigan.gov]; remusm@michigan.gov[remusm@michigan.gov]; todd.johnson@state.mn.us[todd.johnson@state.mn.us]; tmavencamp@mt.gov[tmavencamp@mt.gov]; clark.freise@des.nh.gov[clark.freise@des.nh.gov]; Brandon.kernen@des.nh.gov[Brandon.kernen@des.nh.gov]; Steve.Maybury@dep.nj.gov[Steve.Maybury@dep.nj.gov]; Gloria.Post@dep.nj.gov[Gloria.Post@dep.nj.gov]; Murphy, Eileen (DEC)[eileen.murphy@dec.ny.gov]; Schick, Robert (DEC)[robert.schick@dec.ny.gov]; Fagel, Jason R (DEC)[jason.fagel@dec.ny.gov]; Deming, Justin H (HEALTH)[justin.deming@health.ny.gov]; Tuohy, Dolores A (DEC)[dolores.tuohy@dec.ny.gov]; Bower, Caryn I (DEC)[caryn.bower@dec.ny.gov]; Stoner, Scott (DEC)[scott.stoner@dec.ny.gov]; Johnson, Jason D (DEC)[Jason.Johnson@dec.ny.gov]; Lewis-Michl, Elizabeth L (HEALTH)[elizabeth.lewis-michl@health.ny.gov]; Malone, Kevin M (HEALTH)[kevin.malone@health.ny.gov]; Recer, Gregg M (HEALTH)[gregg.recer@health.ny.gov]; Leach, James F (HEALTH)[james.leach@health.ny.gov]; Deming, Justin H (HEALTH)[justin.deming@health.ny.gov]; Parsons, Patrick J (HEALTH)[patrick.parsons@health.ny.gov]; Spink, David C (HEALTH)[david.spink@health.ny.gov]; sandy.mort@ncdenr.gov[sandy.mort@ncdenr.gov]; cyndi.karoly@ncdenr.gov[cyndi.karoly@ncdenr.gov]; Jessica Godreau[Jessica.godreau@ncdenr.gov]; jay.zimmerman@ncdenr.gov[jay.zimmerman@ncdenr.gov]; mina.shehee@dhhs.nc.gov[mina.shehee@dhhs.nc.gov]; amy.risen@dhhs.nc.gov[amy.risen@dhhs.nc.gov]; dana.satterwhite@ncdenr.gov[dana.satterwhite@ncdenr.gov]; sheila.holman@ncdenr.gov[sheila.holman@ncdenr.gov]; linda.culpepper@ncdenr.gov[linda.culpepper@ncdenr.gov]; craig.butler@epa.ohio.gov[craig.butler@epa.ohio.gov]; nik.dzamov@epa.ohio.gov[nik.dzamov@epa.ohio.gov]; susan.kessler@epa.ohio.gov[susan.kessler@epa.ohio.gov]; jenyfer.allen@epa.ohio.gov[jenyfer.allen@epa.ohio.gov]; MASTERSON.Kevin@deq.state.or.us[MASTERSON.Kevin@deq.state.or.us]; marz.nicole@deq.state.or.us[marz.nicole@deq.state.or.us]; steven.jetter@state.or.us[steven.jetter@state.or.us]; kschlauder@pa.gov[kschlauder@pa.gov]; KINARDDB@dhec.sc.gov[KINARDDB@dhec.sc.gov]; Heidi.Hales@vermont.gov[Heidi.Hales@vermont.gov]; Chuck Schwer[Chuck.Schwer@vermont.gov]; kzar461@ecy.wa.gov[kzar461@ecy.wa.gov]; samuel.iwenofu@ecy.wa.gov[samuel.iwenofu@ecy.wa.gov]; kari.trumbull@ecy.wa.gov[kari.trumbull@ecy.wa.gov]; jbir461@ECY.WA.GOV[jbir461@ECY.WA.GOV]; Adam.DeWeese@Wisconsin.gov[Adam.DeWeese@Wisconsin.gov];

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From: Impellitteri, Christopher
Sent: Mon 9/11/2017 12:40:05 PM
Subject: Re: PFAS Call - August 7 materials

Hi Qian,

We are finalizing a formal letter to send out to APHL and ECOS. This should be sent out this week.

Best Regards,

Chris

From: Wu, Qian (HEALTH) <qian.wu@health.ny.gov>
Sent: Friday, September 8, 2017 9:54 AM
To: Matthews, Lisa; GLD@adem.alabama.gov; EFP@adem.alabama.gov; DDH@adem.alabama.gov; jim.polisini@dtsc.ca.gov; Loveriza.Sarmiento@dtsc.ca.gov; Claudio.Sorrentino@DTSC.ca.gov; kristy.richardson@state.co.us; Nicole Lugli; robert.kaliszewski@ct.gov; shannon.pociu@ct.gov; betsey.wingfield@ct.gov; gary.ginsberg@ct.gov; Justin B. Green; keith.carnley@dnr.ga.gov; peter.nwogu@dnr.ga.gov; Alexander, Shanna; elizabeth.booth@dnr.ga.gov; Lewis.Hays@dnr.ga.gov; James.Capp@dnr.ga.gov; kerri.malinowski@maine.gov; pamela.wadman@maine.gov; christina.s.zabierek@maine.gov; douglas.fine@state.ma.us; c.mark.smith@state.ma.us; delaneyr@michigan.gov; krukowskim@michigan.gov; remusm@michigan.gov;

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Subject: RE: PFAS Call - August 7 materials

Is there any update on calling state labs to participate the method validation?

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Sent: Friday, September 01, 2017 1:44 PM
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Subject: PFAS Call - August 7 materials

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Dear PFAS Call Participants,

Thank you for participating in the EPA-ECOS PFAS Call Monday, August 7, 2017. The purpose of this

call was to share information on PFAS work, including analytical methods, toxicity and treatment. Updates about the US EPA Cross-Agency Coordination of PFAS Activities, the EPA PFAS Analytical Methods Workgroup, and the Interstate Technology & Regulatory Council (ITRC) PFAS Team were provided as well as updates from the states.

Attached please find the materials that were requested during the discussion, including the Blaine et al papers and PowerPoint presentation (with revised images).

Please let us know if we can help provide additional information. Enjoy the holiday weekend.

Best,

Lisa

Lisa Matthews

Senior Advisor and State Liaison

US EPA Office of Research and Development

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Requested materials:

- Blaine et al papers (attachments)
- PowerPoint presentations

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Lisa Matthews

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From: Matthews, Lisa
Sent: Fri 9/1/2017 5:43:49 PM
Subject: PFAS Call - August 7 materials
ITRC PFAS Team_Aug 7.pdf
PFAS_Overview presentation_Aug 7.pptx
Blaine et al PFAA Distribution in Various Plant Compartments 2014.pdf
Blaine et al Uptake of PFAA in Edible Crops 2013.pdf

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Perfluoroalkyl Acid Distribution in Various Plant Compartments of Edible Crops Grown in Biosolids-Amended soils

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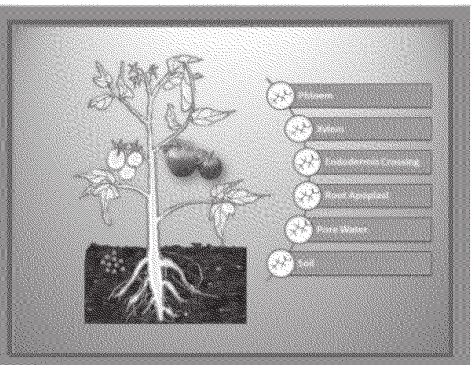
[*] Supporting Information

Crop uptake of perfluoroalkyl acids (PFAAs) from biosolids-amended soil has been identified as a potential pathway for PFAA entry into the terrestrial food chain. This study compared the uptake of PFAAs in greenhouse-grown radish (Raphanus sativus), celery (Apium graveolens var. dulce), tomato (Lycopersicon lycopersicum), and sugar snap pea (Pisum sativum var. macrocarpon) from an industrially impacted biosolids-amended soil, a municipal biosolids-amended soil, and a control soil. Individual concentrations of PFAAs, on a dry weight basis, in mature, edible portions of crops grown in soil amended with PFAA industrially impacted biosolids were highest for perfluorooctanoate (PFOA; 67 ng/g) in radish root, perfluorobutanoate (PFBA; 232 ng/g) in celery shoot, and PFBA (150 ng/g) in pea fruit. Comparatively, PFAA concentrations in edible compartments of crops grown in the municipal biosolids-amended soil and in the control soil were less than 25 ng/g. Bioaccumulation factors (BAFs) were calculated for the root, shoot, and fruit compartments (as applicable) of all crops grown in the industrially impacted soil. BAFs were highest for PFBA in the shoots of all crops, as well as in the fruit compartment of pea. Root-soil concentration factors (RCFs) for tomato and pea were independent of PFAA chain length, while radish and celery RCFs showed a slight decrease with increasing chain length. Shoot-soil concentration factors (SCFs) for all crops showed a decrease with increasing chain length (0.11 to 0.36 log decrease per CF_2 group). The biggest decrease (0.54−0.58 log decrease per CF_2 group) was seen in fruit-soil concentration factors (FCFs). Crop anatomy and PFAA properties were utilized to explain data trends. In general, fruit crops were found to accumulate fewer long-chain PFAAs than shoot or root crops presumably due to an increasing number of biological barriers as the contaminant is transported throughout the plant (roots to shoots to fruits). These data were incorporated into a preliminary conceptual framework for PFAA accumulation in edible crops. In addition, these data suggest that edible crops grown in soils conventionally amended for nutrients with biosolids (that are not impacted by PFAA industries) are unlikely a significant source of long-chain PFAA exposure to humans.



INTRODUCTION

Perfluoroalkyl acids (PFAAs) are used extensively both in industrial and consumer products,[1] but resist degradation by conventional wastewater treatment plants (WWTPs) and persist in both aqueous effluent and treated biosolids.[2,3] Land-application of biosolids on crops can therefore facilitate the entry of PFAAs into the terrestrial food web. Although PFAAs are regulated in biosolids used as fertilizer for agriculture in some parts of Europe (e.g., Bavaria),[4] currently, there are no federal regulations in the U.S. that govern the use and application of biosolids based on PFAA concentrations.[5] Land-application of biosolids primarily occurs on grain crops; however, sustainability movements are encouraging more liberal use of biosolids on home gardens by consumers.

While several studies have demonstrated uptake of PFAAs into plants, the majority of these studies used either spiked systems or hydroponics which both differ from aged field soils.[4,6−8] Blaine et al.[9] have shown that edible crops can uptake PFAAs from authentic biosolids-amended soils. Both lettuce

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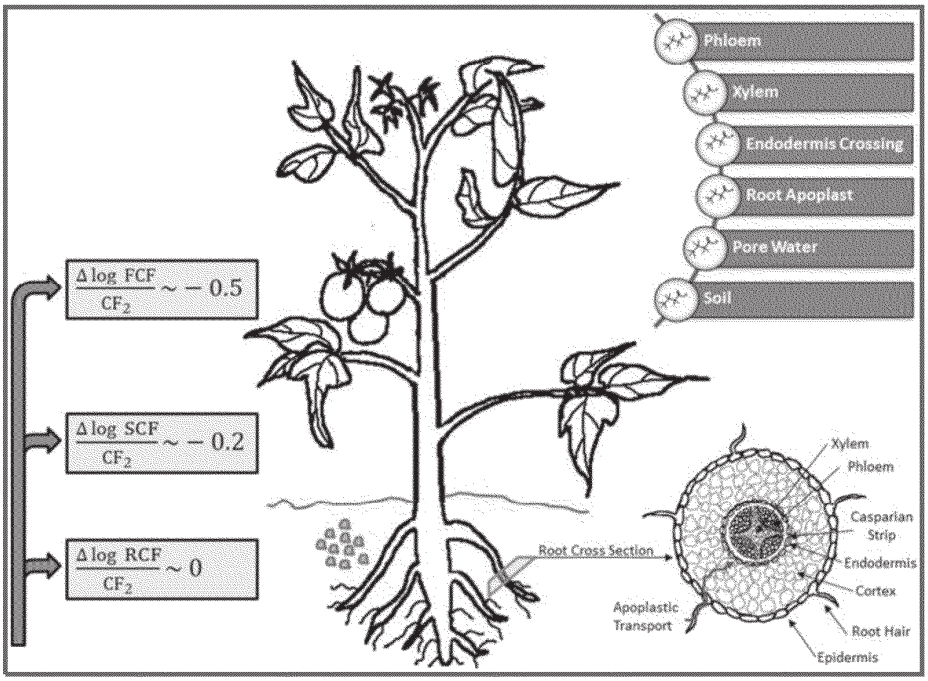

Figure 1. Conceptual model of perfluorocarboxylate uptake as exhibited in a tomato plant. Approximate values are shown for change in log bioaccumulation factor per CF_2 group. Root, shoot, and fruit concentration factors are RCF, SCF, and FCF, respectively. Uptake pathway is shown in the top right corner. Root cross-section modified from Taiz and Zeiger.[16]

leaves and tomato fruit had bioaccumulation factors (BAFs) greater than one for short-chain perfluorocarboxylates (PFCAs).[9] In addition, carbon chain length dependent trends were seen in lettuce leaves, resulting in an approximately 0.3 log decrease for each CF_2 group.[9] However, as only the edible portions were analyzed, more general correlations between plant compartment and PFAA accumulation were not made. In another recent greenhouse study, an inverse relationship between BAF and carbon chain length was also seen for PFCAs in alfalfa plants.[10] Felizeter et al.[8] studied accumulation of PFAAs in hydroponic lettuce and found that long-chain PFAAs accumulated more in the roots than in the foliage, whereas for short-chain compounds, there was more translocation from the roots to the foliage.[8] A more mechanistic study by Wen et al.[11] determined that PFOA and PFOS may have different uptake mechanisms in maize; potential active uptake and entry by anion channels were suggested for PFOA, while entry by aquaporins (water channels) or anion channels (different than the ones used by PFOA) were suggested for PFOS.

The translocation and partitioning behavior of a chemical in a plant is highly varied and complex. Various plant uptake models have been explored over the years with the majority focusing on uptake of neutral hydrophobic chemicals based on the octanol−water partition coefficient (K_{ow}).[12−14] In these models, chemical uptake from soil is usually driven by passive diffusion, as only natural or structurally similar chemicals are actively transported,[13] and small, neutral substances are most easily carried into the roots.[15] Although early models indicated that plant uptake of hydrophilic (low log K_{ow}) chemicals was limited, a more recent empirical model indicates that hydrophilic chemicals are extensively taken up by plants.[14] Although there are some discrepancies among the various plant uptake models, the basic pathway of chemicals within a plant is fairly well-defined. Chemicals can travel across the root cortex through the apoplast (extracellular space) or symplast (intracellular space) until they reach the Casparian strip at the endodermis.[16] At this point, they must cross through a cell membrane (Figure 1). While neutral, hydrophobic chemicals may easily pass through a membrane, hydrophilic and/or ionized chemicals may have to pass through as neutral salts, through anion channels, or through water pores in the membrane.[11,17] The Casparian strip acts as an ion trap, allowing for higher concentrations of solutes in the xylem than in the pore water.[16]

While nonpolar chemicals are mostly confined to the surface of root membranes due to lipid partitioning, polar chemicals can enter the transpiration stream and migrate throughout the plant.[18,19] Once within the transpiration stream, a chemical can be transported throughout the plant, first to the shoot (i.e., stem and leaves) via the xylem and then to storage organs (e.g., fruit) via the phloem. The xylem and phloem are separated by the vascular cambium, a single row of cells. Accumulation of solutes in plant cells near the leaves helps drive translocation from source (e.g., leaf) to sink (e.g., fruit) via a pressure-flow[16] model. As the concentration in a cell escalates, water is absorbed osmotically thus building up hydrostatic pressure. The subsequent movement of the water and solutes through the system of phloem sieve tubes equalizes the pressure. The sieve tubes are separated by sieve plates which allow flow through transport pores (plasmodesmata). Eventually, chemicals may be stored in cell vacuoles or in intercellular spaces. Neutral and ionized polar chemicals with low lipophilicity, low volatility, and high persistence are particularly prone to accumulation in the leaves and other sinks by phloem transport.[20] PFAAs generally meet these criteria. In particular,

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PFAAs, being anionic at environmental pH values,[21] are generally nonvolatile, thereby eliminating potential release into the air from the leaf stomata.

This study evaluated the PFAA distribution in various plant structural compartments by examining both the edible and nonedible portions of radish (Raphanus sativus), celery (Apium graveolens var. dulce), tomato (Lycopersicon lycopersicum), and sugar snap pea (Pisum sativum var. macrocarpon) grown in biosolids-amended soils. Radish represents an edible root crop (i.e., below ground crop), although radish tops are also edible. Celery represents an edible shoot crop (i.e., stem and leaf crop) although certain varieties of celery are also harvested for the bulb and seeds. Tomato represents an edible fruit crop. Sugar snap pea, a legume, also represents a fruit and edible seed crop. Bioaccumulation factors for the root, shoot, and fruit portions were calculated. To our knowledge, this is the first study to examine PFAA uptake in celery, snap pea, and radish; in addition, it is one of the most detailed studies addressing intercompartmental translocation of PFAAs in edible crops to date.

MATERIALS AND METHODS

Chemicals. Native perfluorinated standards and stable isotopes were obtained from Wellington Laboratories (Guelph, ON, Canada) and prepared as per established methods.[9] Analytes studied include perfluorobutanoate (PFBA), perfluoropentanoate (PFPeA), perfluorohexanoate (PFHxA), perfluoroheptanoate (PFHpA), perfluorooctanoate (PFOA), perfluorononanoate (PFNA), perfluorodecanoate (PFDA), perfluorobutanesulfonate (PFBS), perfluorohexanesulfonate (PFHxS), and perfluorooctanesulfonate (PFOS; Supporting Information (SI) Table S1). HPLC-grade methanol (MeOH), high purity Chromasolv dichloromethane (DCM), and all other reagent grade solvents were obtained from Sigma-Aldrich (St. Louis, MO). A Milli-Q system (Millipore, Billerica, MA) was used to provide water for extractions, and HPLC-grade water was used for liquid chromatography tandem mass spectrometry (LC-MS/MS) analysis. Chromabond diamino from Macherey-Nagel Inc. (Bethlehem, PA) and Supelclean ENVI-Carb from Sigma-Aldrich were used in extract cleanup.

Greenhouse Study. Two biosolids-amended soils as well as an unamended control soil were used in this study: a soil amended with industrially impacted biosolids (industrially impacted soil), a soil receiving multiple applications of municipal biosolids over a span of 20 years (municipal soil), and an unamended control soil. Although the control soil was obtained from an unamended field, its proximity to biosolids-amended fields likely led to minor cross-contamination resulting in the detection of trace levels of PFAAs. Details on all three soils can be found in Blaine et al.;[9] PFAA concentrations in the soils are reported in the SI Table S2. In general, soils were sieved (6.3 mm) for homogeneity and pots were filled on a dry weight basis. Four edible crops including radish, celery, tomato, and pea were grown from seed. Five pot replicates were grown for each crop in each soil. Pots were randomly arranged to account for any spatial variations in light and temperature within the greenhouse. Additional information about propagation and greenhouse environmental conditions are given in the SI. Both edible and nonedible parts of all crops were harvested (SI Table S3) at maturity and frozen at −20 °C in sealed plastic bags until extraction.

Extraction and Analysis. Sample Extraction. Prior to sample preparation, plant material was homogenized using a food processor. Aliquots (0.5−2 g) of soil or plant material were transferred to 50 mL polypropylene vials. To each vial, 2 ng of isotopically labeled surrogate standard was added. Plant samples were then extracted with a 50/50 (v/v) solution of DCM and 99:1 (v/v) MeOH with ammonium hydroxide as detailed elsewhere;[9] soil samples obtained prior to planting were extracted based on the protocol from Sepulvado et al.[3] Results for both plants and soils are presented on a dry weight basis.

PFAA Analysis. All PFAAs were analyzed with isotope dilution using LC-MS/MS under conditions outlined in previous work,[9] though the method was validated for the wide variety of plant matrices included in the present study (SI Figure S1). Chromatography was performed using a Shimadzu LC-20AD unit (Kyoto, Japan). Samples were injected onto a Gemini C18 Column with a 3-μm particle size (Phenomenex, Torrance, CA). Two transitions for each analyte were observed using an MDS Sciex Applied Biosystems API 3200 (MDS Sciex, Ontario) with negative electrospray ionization operating in scheduled multiple reaction mode. No attempt to analytically differentiate between branched and unbranched isomers was made.

Data Analysis. Quality Control. The software Analyst was used for quantitation in this study. For each matrix, a minimum of 20 percent of the samples were extracted and analyzed in triplicate. The relative standard deviation for analytical replicates was less than 18%. Sample values are presented as the mean experimental replicate value (n = 3 to 5). One extraction blank with surrogate standard and one double blank without surrogate standard were prepared with each batch of samples. Limits of quantitation (LOQ) ranged from 0.03 to 0.71 ng/g; they were determined by the lowest calibration standard calculated to be within 30% of its actual value and were analyte, matrix, and run-dependent. LOQs were also required to be at least twice as high as the highest concentration in the corresponding blanks and have signal-to-noise ratios greater than 30. To account for any loss during the extraction process, each sample was fortified with isotopically labeled surrogate standards. PFBS was the only analyte that did not have a corresponding surrogate; therefore, PFHxS was used (SI Table S1). Surrogate recoveries for the samples averaged 35% for root tissues, 36% for shoot tissues, and 40% for fruit tissues across all analytes. While lower than typical soil surrogate recoveries,[3] this range is typical in plant matrices[8,22] due to matrix ion suppression. Native spike-recovery experiments (which account for surrogate losses) showed an average native recovery of 73% in root tissues, 80% in shoot tissues and 71% in fruit tissues for all analytes (SI Figure S1). PFBS showed lower native recovery than PFHxS despite the use of the same surrogate; this indicates that PFHxS may not have corrected for additional matrix suppression of PFBS and thus PFBS values in this study may be slightly underestimated. All data presented in this study are reported in terms of surrogate-corrected concentrations.

Statistical Analysis. Data are shown as means with standard errors. Statistical analyses and regression lines were calculated using OriginPro 9.0. Statistical difference of means was established by an analysis of variance (ANOVA) with Tukey's Test ($\alpha = 0.05$); homogeneity of variance was assessed by Levene's Test ($\alpha = 0.05$).

Bioaccumulation Metrics. Bioaccumulation factors (BAFs), ratios between the chemical determined on a dry weight basis in the respective plant tissue and soil, were

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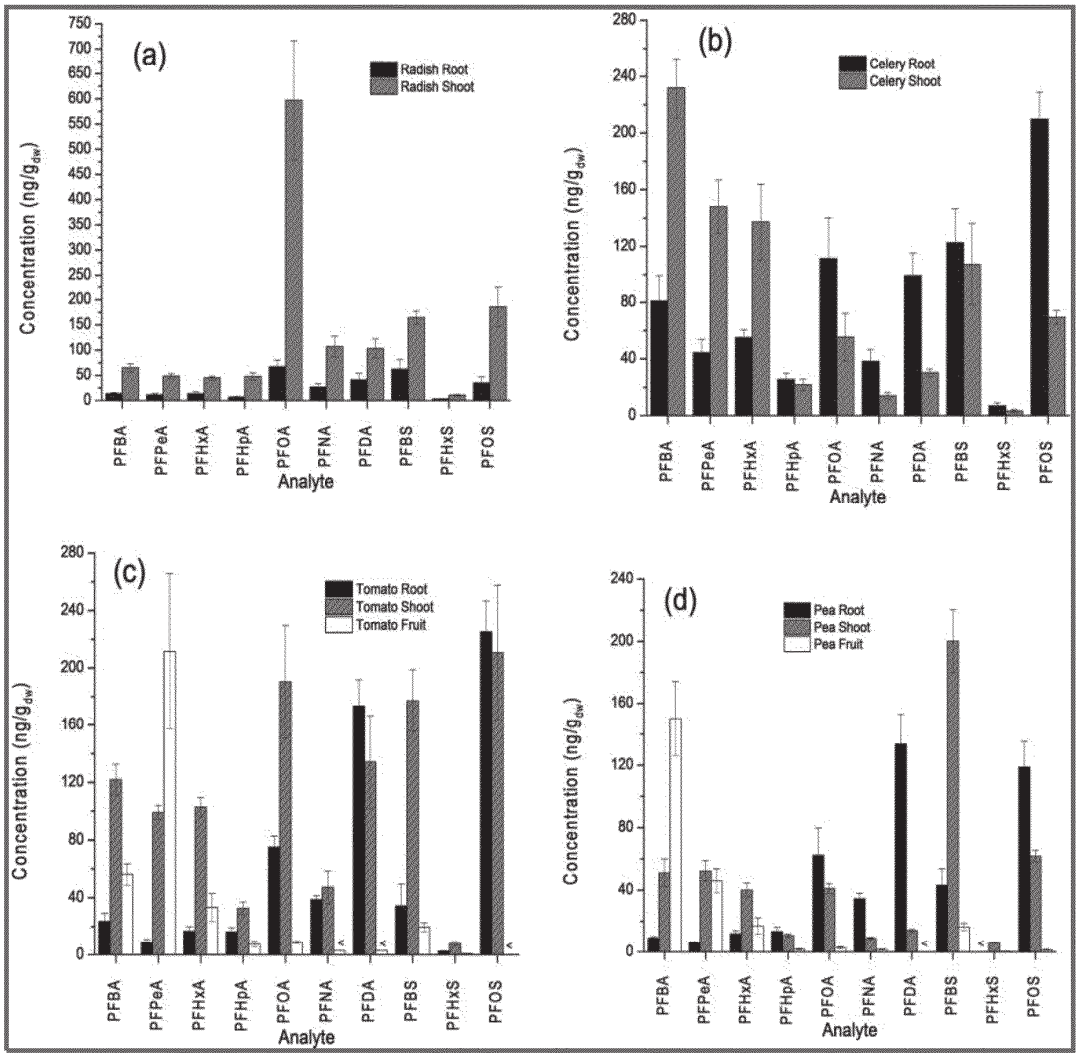

Figure 2. Concentrations of PFAAs in greenhouse radish (a), celery (b), tomato (c), and pea (d) grown in industrially impacted soil. Values for tomato fruit are from a previous study.[9] Bars represent means and standard errors of five determinations. Values less than the LOQ are denoted by <; LOQs for respective matrix and analyte are listed in SI Table S4 and Table S5.

calculated (eq 1) leading to estimations of root concentration factors (RCFs; SI eq S1), shoot concentration factors (SCFs; SI eq S2), and fruit concentration factors (FCFs; SI eq S3).

$$\text{BAF} = \frac{\text{PFAA concentration in plant tissue}(\text{ng g}^{-1})}{\text{PFAA concentration in soil}(\text{ng g}^{-1})} \quad (1)$$

Due to the ionized nature of PFAAs at environmental pH values (i.e., ~4 to 9), plant entry into the stomata from the air was assumed to be insignificant compared with uptake through the roots. BAFs were calculated using crops grown in the industrially impacted soil for each PFAA that had concentrations in the plant tissues above the LOQ.

Root-pore water concentrations (RCF_{pw}) were calculated (SI eq S4) by dividing the concentrations in the roots (ng/g) by the pore water concentrations (ng/mL) derived in previous work.[9] Briefly, pore water concentrations were obtained by dividing soil concentrations by the fraction of organic carbon in the soil and soil-water equilibrium partitioning coefficients obtained from Guelfo and Higgins.[23]

In addition, intercompartmental concentration factors (ratio of concentrations on a dry weight basis) were calculated for shoot to root (SRCFs; SI eq S5) and fruit to shoot (FSCFs; SI eq S6).

RESULTS AND DISCUSSION

Edible Portions. In the radish root grown in the industrially impacted soil, PFAA concentrations were highest for PFOA (67 ng/g), PFBS (62 ng/g), PFDA (41 ng/g), and PFOS (35 ng/g) (Figure 2a); these four analytes also had the highest concentrations in the soil. In the municipal and control soils, PFBS concentrations in the radish root were the highest at 24 ng/g and 22 ng/g, respectively (SI Table S4). For celery grown in the industrially impacted soil (Figure 2b), concentrations of PFAAs in the shoot were greatest for the short-chain (i.e., C6 and below) compounds, PFBA (232 ng/g), PFPeA (148 ng/g), PFHxA (137 ng/g), and PFBS (107 ng/g). Comparatively,

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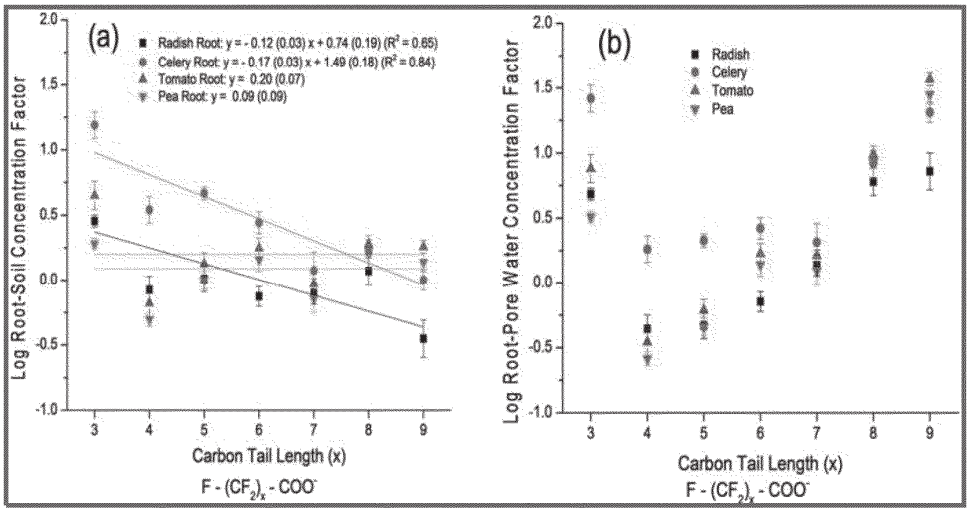

Figure 3. Correlations between log RCF for PFCAs based on soil (a) and calculated pore water (b) concentrations and carbon tail length in greenhouse radish, celery, tomato, and pea grown in industrially impacted soil. Means and standard errors are shown (n = 3 to 5). Linear regressions with slopes (if significantly different than zero at α = 0.05) and intercepts are shown; associated error values are shown parenthetically after each coefficient.

lettuce grown in the same soil had similar concentrations of the short-chain compounds: PFBA (266 ng/g), PFPeA (236 ng/g).[9] In the municipal soil, PFAA celery concentrations were all less than 8 ng/g with the exception of PFOS (17 ng/g), which is most likely due to the relatively high concentration of PFOS and low concentrations of short-chain PFAAs in the soil (SI Table S4). All PFAA concentrations in the celery grown in control soil were less than 6 ng/g (SI Table S4). Concentrations of PFAAs in the pea fruit grown in industrially impacted soil were highest for PFBA (150 ng/g) and PFPeA (46 ng/g); all PFAAs were below LOQ (0.03−0.71 ng/g) for pea fruit grown in municipal and control soils (SI Table S4). Although no quantifiable data was collected to measure overall plant health in each of the three soils, qualitatively, more robust growth was observed for the plants grown in biosolids-amended soils versus the control soil. This increased vigor, in turn, likely led to increased transpiration, which may have promoted additional uptake of PFAAs. PFAA concentrations in the crops grown in the industrially impacted and municipal soils were compared to the control (unamended) treatments by an ANOVA test; statistical differences are shown in SI Figure S2. Low PFAA concentrations in the municipal and control soils limited the ability to determine accumulation trends, and thus the remainder of the results and discussion focuses on the crops grown in the industrially impacted soil.

Plant Compartments. PFAA concentrations in nonedible plant compartments grown in the industrially impacted soil were also analyzed and plotted alongside edible compartment concentrations in Figure 2. The concentrations of PFAAs in the radish shoot follow the same trends as in the radish root (and the soil), but are approximately 5−10 times higher. Physiologically, radishes lack the typical barrier (Casparian strip) between the edible bulb and the above ground shoot.[24] The swollen edible portion of the radish is actually formed at the intersection of the hypocotyl (embryonic stem) and the fine roots below; as the fine roots below the bulb are not generally eaten, they were not analyzed as part of the edible root portion. Therefore, although the analytes accumulate in the same proportions, more accumulation is seen in the shoot, perhaps due to the unrestricted upward flow of PFAAs. For celery, the shoot and root portions do not have parallel concentration trends. The celery shoot has higher concentrations of short-chain PFCAs while the celery root has higher concentrations of long-chain PFCAs and perfluoroalkyl sulfonates (PFSAs). The tomato plant has three compartments: root, shoot, and fruit. Within the tomato plant, the root has the highest concentrations of PFDA and PFOS, the longest chain compounds analyzed, whereas the tomato shoot has the highest concentrations of all the other PFAAs except PFPeA. The majority of PFAAs in the tomato fruit, as reported in Blaine et al.,[9] are short-chain compounds. Pea roots and shoots exhibit similar results to the celery and tomato in that long-chain compounds are highest in the roots while short-chain compounds are highest in the shoots. Pea fruit is similar to tomato fruit in that it accumulates primarily the short-chain compounds.

Bioaccumulation. PFCAs. Root to soil concentration factors plotted versus carbon chain length of PFCAs for the four crops grown in the industrially impacted soil are shown in Figure 3a; linear trend lines with equations and associated errors are also shown. In general, the RCF values of celery are greater than the other three crops, indicating more overall accumulation in celery root. This could be due to the greater surface area of celery roots or could be correlated to the total water transpired during the duration of the crop. Tomato and pea have very similar RCF values, most likely resulting from similar root physiology and crop duration times. The slopes of the trend lines for tomato and pea root are not statistically different from zero (α = 0.05), indicating no preferential accumulation of short- or long-chain PFCAs in the root tissues as compared to soil. Both of these crops have thicker tap root systems which may allow larger contaminants to cross the epidermis into the apoplast and yet be retained in the root tissue.[17] The trend line for radish shows a slope of −0.12, indicating a slight preference for uptake of the short-chain compounds. Taking into consideration that the edible portion of the radish root exhibits characteristics of both root and stem as a hypocotyl, this difference could reflect the prior impeded

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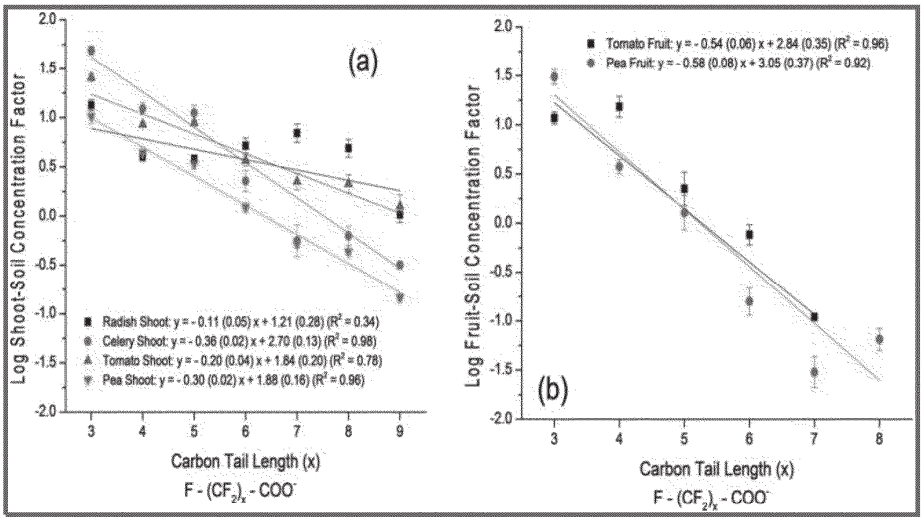

Figure 4. Correlations for PFCAs between log SCF (a) and log FCF (b) and carbon tail length in greenhouse radish, celery, tomato, and pea grown in industrially impacted soil. Means and standard errors are shown (n = 3−5). Linear regressions with slopes and intercepts; associated error values are shown parenthetically after each coefficient.

movement of long-chain compounds by the Casparian strip during translocation from the fine roots to the bulb. In this way, the radish data resemble more of a shoot trend than the expected root trend. However, other entryways into the hypocotyl may be possible (aquaporins or direct diffusion through hypocotyl endodermis) thus allowing more long-chain compounds than seen in the other crops.[24] The trend line for celery has a more obvious downward slope of −0.17, showing preferential entry for short-chain PFCAs. This could be due to the fact that celery has a very finely branched root system that is more likely to filter out larger contaminants by the Casparian strip at an early entry point. RCF_{pw} values were also calculated for PFCA accumulation in the four crops (Figure 3b). When plotted versus chain length, all four crops exhibit a U-shape that is consistent with the trend reported by Felizeter et al.[8] for hydroponically grown lettuce and by Krippner et al.[7] for maize. PFBA as well as the long-chain PFCAs have higher sorption tendencies to organic carbon,[23] thus reducing their concentrations in the pore water and driving up the RCF_{pw}.

Shoot to soil concentration factors plotted versus PFCA chain length are shown in Figure 4a with corresponding linear trend lines, equations and associated errors. Comparing among crops, celery shoots have higher accumulation of the short-chain PFCAs, likely due to exclusion of long chain PFCAs by the roots, while radish and tomato shoots have higher accumulation of the long-chain PFCAs. Pea shoots have the least amount of accumulation; perhaps the woody, dry characteristics of its stem and its minimal leaves reduce the available accumulation area in the shoots. Celery, tomato and pea SCFs show a decrease of 0.36, 0.20, and 0.30 log units, respectively, per CF_2 moiety. As these SCFs encompass the movement of PFCAs traveling from soil through the root to the shoots, the slightly larger value for celery (0.36) may reflect the fact that the preferential accumulation of short-chain length compounds in the celery root is compounded by additional increased selectivity from the root to shoots. When shoot-to-root (intercompartmental) factors are compared (SI Figure S3a), relative PFCA accumulation from roots to shoots are similar for celery and tomato; pea shows the greatest log decrease per CF_2 moiety. Overall, the preferential exclusion of long-chain PFCAs seen in celery, tomato, and pea shoots is consistent with the trend found for lettuce shoots (decrease of 0.3 log units) in Blaine et al.[9] and for maize shoots in Krippner et al.[7] Relative PFCA accumulation in radish shoots, however, is an exception: the trend of log SCF vs chain length is significantly flatter and the slope is statistically equivalent ($\alpha = 0.05$) to the log RCF trend line (Figure 4a), resulting in no preferential accumulation of long- or short-chain PFCAs in the radish shoot as compared to the root (SI Figure S3a). Considering that once PFCAs are in the radish root (hypocotyl), no Casparian strip prevents upward translocation to the shoot; this lack of a trend is consistent with the Casparian strip serving as an important barrier to the interplant movement of long-chain PFCAs. Although, trend-wise, the radish root and shoot accumulation patterns correlate, more overall accumulation is seen in the shoot since after entry into the edible bulb, contaminants are subsequently transported upward with the flow of xylem and then accumulate in the leaves. There is potential for some of the smaller PFCAs to return to the bulb via the phloem as the plant stores nutrients for the winter in the bulb; however, this translocation is likely insignificant as radish is harvested before dormancy. In addition, small increases of PFAA concentration in the bulb may be obscured by growth dilution.

Fruit to soil concentration factor values for tomato and pea fruits for each PFCA are generally similar (i.e., on the same order of magnitude); however, variations in the values still exist due to the myriad of differences in the physiology of the roots and shoots encountered during translocation. In both tomato and pea plants, contaminants encounter additional membrane barriers (e.g., the cambium) in order to be loaded into the phloem and transported to their final destination (i.e., the fruit compartment). Additional chain length exclusion is evidenced by the decrease of 0.2 to 0.3 log units per carbon chain length for fruit to shoot concentration factors (SI Figure S3b) resulting in cumulative decreases of 0.54 and 0.58 log units per carbon chain length for fruit to soil accumulation factors (Figure 4b).

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PFSAs. Bioaccumulation factors for PFSAs were also calculated (SI Table S6); however, as only three analytes were studied, chain length trends were not calculated with linear regressions. Differences between PFCAs and PFSAs seem to magnify from the roots upward. In the roots, all analyte RCFs are below 5, with the exception of PFBA. Values for SCFs for PFSAs are all below 8, compared to the SCFs for the short-chain PFCAs which reach up to 50. In tomato and pea, values of FCFs for PFSAs are all below 1, while values for short-chain PFCAs are primarily greater than 1. A more direct comparison can be made by comparing similar chain length analytes (e.g., PFPeA to PFBS or PFNA to PFOS). PFPeA has significantly higher values than PFBS for the celery and tomato SCFs as well as for both tomato and pea FCFs; PFNA compares fairly well to PFOS with the only significant difference being slightly higher SCF values in celery, tomato, and pea for PFOS. As the core structures of PFCAs and PFSAs are almost identical, the larger size of the sulfonate headgroup may be a contributing factor to the accumulation differences in the shoots and fruits for short-chain analytes. For larger analytes that are already restricted based on size, the larger headgroup may not matter as much. Other differences in accumulation patterns may be due to differing uptake mechanisms between PFCAs and PFSAs.[11]

Conceptual Model and Implications. Figure 1 shows a conceptual model of PFCA accumulation in tomato, a typical three compartment crop. The primary translocation pathway for PFCAs is illustrated via an enlarged root cross section and an outline showing movement of PFCAs from the soil all the way to the phloem. In addition, approximate bioaccumulation factors are shown for a tomato plant indicating increasing discrepancy in PFCA accumulation per CF_2 moiety with acropetal movement. Although the scope of this study was not fully mechanistic, uptake and distribution factors likely include specific plant physiology and transpiration rate parameters.

In general, chain length dependent accumulation is seen as PFCAs translocate upward from the roots. Each crop is anatomically different, presenting unique biological barriers in the translocation process; however, some common barriers do exist, namely the Casparian strip and in general, the permeation of membranes. To effectively model plant uptake of PFAAs, these various crop-specific factors as well as contaminant-specific factors must be considered. Plant factors examined in this paper were root structure and number of compartments, while the contaminant-specific factors examined included chain length and headgroup. Without plant-specific data, the best prediction that can be made consists of a generalization about plant compartment accumulation. In general, the data presented here suggest edible fruit crops accumulate fewer long-chain PFCAs than do edible shoot or root crops. For example, one would expect that 5 g of peas or tomatoes would contain roughly 5−25 times less PFOA than 5 g of celery or radish grown in the same soil. With a good understanding of plant physiology, it may be possible to extrapolate these generalizations to other crops; however, caution is warranted since visually similar crops can have anatomical or physiological differences that can significantly alter uptake potential. In terms of analytes, there is a much larger discrepancy; one could expect that shoot and fruit crops may have 1−3 orders of magnitude more PFBA than PFOA if these two analytes are present in equal concentrations in the soil. With industry trends shifting toward the use of short-chain PFAAs, it is important to recognize this increased potential of PFAA entry into the terrestrial food chain via plants.

With respect to overall exposure, it is unlikely that edible crops grown in soils conventionally amended for nutrients with biosolids (that are not impacted by PFAA industries) are a primary source of long-chain PFAA exposure to humans; this has also been suggested from recent food basket studies.[25] However, in the absence of comprehensive toxicological data on short-chain PFAAs, precaution may be warranted for production of fruit or shoot crops grown in PFAA contaminated soils. More work is needed to discern all applicable factors needed to comprehensively mechanistically model PFAA uptake in plants.

ASSOCIATED CONTENT

* Supporting Information

Additional details are available regarding analytical methods, greenhouse experiment details, experimental design, PFAA concentrations in soils and crops, and plots of intercompartmental concentration factors. This material is available free of charge via the Internet at http://pubs.acs.org.

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Notes

The authors declare no competing financial interest.

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Uptake of Perfluoroalkyl Acids into Edible Crops via Land Applied Biosolids: Field and Greenhouse Studies

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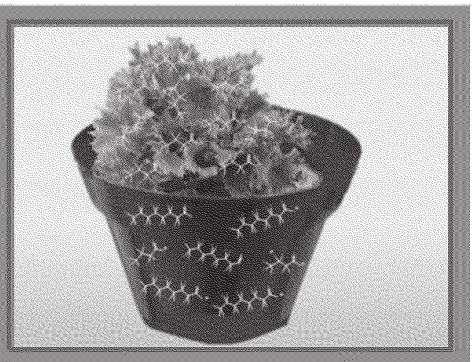
* Supporting Information

The presence of perfluoroalkyl acids (PFAAs) in biosolids destined for use in agriculture has raised concerns about their potential to enter the terrestrial food chain via bioaccumulation in edible plants. Uptake of PFAAs by greenhouse lettuce (Lactuca sativa) and tomato (Lycopersicon lycopersicum) grown in an industrially impacted biosolids-amended soil, a municipal biosolids-amended soil, and a control soil was measured. Bioaccumulation factors (BAFs) were calculated for the edible portions of both lettuce and tomato. Dry weight concentrations observed in lettuce grown in a soil amended (biosolids:soil dry weight ratio of 1:10) with PFAA industrially contaminated biosolids were up to 266 and 236 ng/g for perfluorobutanoic acid (PFBA) and perfluoropentanoic acid (PFPeA), respectively, and reached 56 and 211 ng/g for PFBA and PFPeA in tomato, respectively. BAFs for many PFAAs were well above unity, with PFBA having the highest BAF in lettuce (56.8) and PFPeA the highest in tomato (17.1). In addition, the BAFs for PFAAs in greenhouse lettuce decreased approximately 0.3 log units per CF_2 group. A limited-scale field study was conducted to verify greenhouse findings. The greatest accumulation was seen for PFBA and PFPeA in both field-grown lettuce and tomato; BAFs for PFBA were highest in both crops. PFAA levels measured in lettuce and tomato grown in field soil amended with only a single application of biosolids (at an agronomic rate for nitrogen) were predominantly below the limit of quantitation (LOQ). In addition, corn (Zea mays) stover, corn grains, and soil were collected from several full-scale biosolids-amended farm fields. At these fields, all PFAAs were below the LOQ in the corn grains and only trace amounts of PFBA and PFPeA were detected in the corn stover. This study confirms that the bioaccumulation of PFAAs from biosolids-amended soils depends strongly on PFAA concentrations, soil properties, the type of crop, and analyte.



INTRODUCTION

Perfluoroalkyl acids (PFAAs), which have been used in a myriad of consumer and industrial products (e.g., stain repellents, nonstick food packaging, and fire-fighting foams),[1] are ubiquitous and persistent in the environment; they have been detected in air, house dust, water, sediment, soil, wildlife, and humans.[2−4] In addition, longer chain PFAAs are poorly eliminated by many higher trophic level organisms, with elimination half-lives of more than five years in humans for some PFAAs.[5] Toxicity to wildlife and laboratory animals is well established for perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA), including adverse effects such as reduced survival rates, infertility, and abnormal maturation.[3] The toxicity of shorter-chain PFAAs is less well documented. The persistence, bioaccumulation, and potential toxicity of PFAAs make them high priority contaminants of emerging concern.

PFAAs entering conventional wastewater treatment plants (WWTPs) or produced from precursors during treatment can exit the plant in either the aqueous or sludge phase.[6] The presence of PFAAs in municipal biosolids is well documented.[7−9] The land application of biosolids has been practiced for decades; in the United States, approximately 60% of biosolids are land applied.[10] Nutrient-rich biosolids are particularly attractive as a fertilizer for crop production. Currently, the United States Environmental Protection Agency (U.S. EPA) regulates the land application of biosolids based on pathogen, metal, and nutrient content under the U.S. 40 Code of Federal Regulations Part 503.[11] However, PFAAs in biosolids are not currently regulated in the U.S.[10] Furthermore, due to the persistence of PFAAs, repeated agricultural applications of PFAA-contaminated biosolids may present a potential exposure route for terrestrial food webs if PFAAs contaminate surface or groundwater destined for animal or

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human consumption[12] or are transferred to (i.e., bioaccumulate in) the edible portion of crops.

Previous studies have documented the potential for PFAA bioaccumulation into crops, particularly for PFOS and PFOA.[13,14] While growing corn, wheat, potato, and oats in PFAA-spiked soils, Stahl et al. found PFOA and PFOS in the vegetative plant portions,[13] a finding that was confirmed in follow-up studies.[15] In a similar study using PFAA-spiked soils, Lechner and Knapp found carryover of PFOA and PFOS in carrots, cucumbers, and potato, with the highest transfer factors for the vegetative portions.[14] Both studies found higher PFOA than PFOS levels; however, spiked soil systems are known to be problematic with respect to contaminant bioavailability,[16,17] and thus these studies may not adequately describe PFAA uptake from nonspiked, biosolids-amended soils. Wen et al. conducted hydroponic studies with corn, which revealed that there are potentially different uptake mechanisms for PFOA and PFOS.[18] In a more relevant study, the transfer of PFAAs from industrially contaminated biosolids-amended soils into grass was observed,[19] with PFOA again bioaccumulating more than PFOS. Although grass may be consumed by animals, thereby enabling PFAA entry into the terrestrial food chain, it does not represent a direct human exposure scenario. PFAA uptake in hydroponically grown lettuce has also been observed,[20] though again, this does not likely describe the bioavailability of PFAAs to plants grown in biosolids-amended soils.[21,22]

Concerns about the potential bioaccumulation of PFAAs into crops grown in biosolids-amended soils are also supported by limited data on their plant uptake and transport behavior.[13,19,20] While some predictions about plant uptake and transfer potential can be made based on plant physiology models[23−25] and contaminant parameters such as octanol−water partition coefficients (K_{ow}),[26] a very limited number of plant uptake studies have focused specifically on PFAAs. Initial models correlating the transpiration stream concentration factor[25] (TSCF), or the concentration ratio of the compound in the xylem to the solution around the roots, to K_{ow} suggested maximal TSCFs for compounds with log K_{ow} values of 1.8. However, a more recent model[24] suggests hydrophilic compounds (e.g., sulfolane) may actually be preferentially accumulated. Moreover, ionized contaminants are very soluble and nonvolatile and thus have the potential to accumulate high concentrations in plants.[27]

The objective of this study was to examine PFAA bioaccumulation in lettuce (Lactuca sativa) and tomato (Lycopersicon lycopersicum) grown in biosolids-amended soils using a combination of greenhouse and field-scale experiments. Plant bioaccumulation was studied with unspiked biosolids-amended soils known to contain residual PFAAs. In addition, corn (Zea mays) samples were also collected from several biosolids-amended farm fields. Lettuce and tomato were chosen because they represent common edible crops eaten fresh. This scenario represents the most direct route of human exposure from plants, thus avoiding complicating factors from processing and packaging. Although lettuce and tomato are not commonly grown in biosolids-amended soils, they represent crops from the scenario of a home gardener using commercial biosolids as fertilizer. Greenhouse studies were conducted to avoid confounding environmental factors, and pilot-scale field studies were performed to verify greenhouse results. Data from an existing full-scale system were also collected for comparison; however, the crop availability was limited to corn. To our knowledge, this study is the first to look at PFAA uptake in lettuce and tomato from biosolids-amended soils.

MATERIALS AND METHODS

Chemicals. Perfluorinated standards as well as stable-isotope labeled standards (Supporting Information (SI) Table S1) were obtained from Wellington Laboratories (Guelph, ON, Canada). Analytes in this study include perfluorobutanoate (PFBA), perfluoropentanoate (PFPeA), perfluorohexanoate (PFHxA), perfluoroheptanoate (PFHpA), PFOA, perfluorononanoate (PFNA), perfluorodecanoate (PFDA), perfluorobutane sulfonate (PFBS), perfluorohexane sulfonate (PFHxS), perfluoroheptane sulfonate (PFHpS), PFOS, and perfluorodecane sulfonate (PFDS). All standards were prepared in a 70/30 (v/v) methanol/water with 0.01% ammonium hydroxide solution. HPLC-grade methanol and high purity Chromasolv dichloromethane from Sigma Aldrich (St. Louis, MO) were used for extractions. All other solvents were reagent grade from Sigma Aldrich. Water used in extractions was obtained from a Milli-Q system (Millipore, Billerica, MA), and HPLC-grade water was used for liquid chromatography tandem mass spectrometry (LC-MS/MS) analysis. For extraction cleanup, Chromabond diamino from Macherey-Nagel Inc. (Bethlehem, PA) and Supelclean ENVI-Carb from Sigma-Aldrich were used.

Greenhouse Study. Accumulation was studied from three soils: industrially impacted soil (soil amended with PFAA contaminated biosolids), municipal soil (soil receiving a long-term field application of municipal biosolids), and an unamended control soil. The industrially impacted soil was created by mixing composted biosolids from a small municipal (but impacted by PFAA manufacturing) WWTP with the control soil on a 10% mass basis. Composted biosolids were prepared at the utility by mixing dewatered biosolids with woody material (e.g., woodchips, saw dust, etc.) to achieve a 30:1 carbon to nitrogen ratio. Although this application rate is 10 times higher than an average recommended agronomic rate (approximately 25 Mg/ha, on dry weight basis) of biosolids application, it was chosen to represent multiple applications or industrially impacted PFAA-contaminated soil. The municipal soil came from a reclamation site in Illinois where municipal biosolids were applied at reclamation rates for 20 years, reaching the cumulative biosolids application rate of 1654 Mg/ha. This field was planted with rotations of cereal crops such as corn, wheat, and sorghum. The control soil was taken from a nearby field that had a similar cropping system to the reclamation site but only received commercial fertilizers. Both the amended and control soils were classified as Lenzburg silt loams. All three soils were sieved (6.3 mm), and pots were filled on a dry weight basis. The fraction of organic carbon (f_{oc}), determined by the Walkley−Black Method (SI Table S2), and other soil characteristics (SI Table S3) measured by Agvise Laboratories (Northwood, ND) can be found in the SI.

Pots were seeded with either leaf lettuce (Lactuca sativa 'Multy') or tomato (Lycopersicon lycopersicum 'Stupice') to achieve a density of two lettuce plants/pot and one tomato plant/pot. Edible portions (lettuce leaves or tomato fruits) from each pot were combined as one experimental replicate. Each of the three soils was evaluated for each crop with five replicates. Pots were randomly arranged to account for any spatial variations in light and temperature within the greenhouse. Crops were harvested at maturation and frozen at −20 °C in sealed plastic bags until extraction. Detailed information

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about propagation, environmental conditions, and sampling are given in the SI.

Field Studies. A limited-scale field study was conducted in the Midwestern U.S. Eighteen plots (3.0 m × 4.6 m) were established, and each was planted with lettuce (Lactuca sativa 'Black-Seeded Simpson') and tomato (Lycopersicon lycopersicum 'Burpee Big Boy Hybrid'). Fertilization via biosolids occurred at five application rates (plus control) with three replicate plots per application rate. The soil treatments included an unamended control (CTRL), one-half of the agronomic rate of biosolids application to meet nitrogen (N) requirements of the crop (0.5×), agronomic rate (1×), two times the agronomic rate (2×), and four times the agronomic rate (4×). Crops were grown and harvested following normal agricultural practices. Lettuce and tomato were harvested at maturity (lettuce ~45 days; tomato ~100 days) using a sample collection protocol (detailed in the SI) developed to minimize cross-contamination. Duplicate soil samples as well as lettuce and tomato samples from each plot were collected, placed on ice, and shipped to the laboratory where they were frozen at −20 °C until extraction.

In addition, a full-scale field sampling campaign was conducted in the Midwestern U.S. Because corn (Zea mays) is the most commonly grown crop in this region, several paired samples of corn grain, corn stover, and soil were collected from three agricultural fields amended (0.5×, 1×, and 2×) with municipal biosolids (rural or urban). Rural biosolids (0.5× field) were from a WWTP receiving domestic waste only, and urban biosolids (1×, 2× fields) were from a WWTP receiving both domestic and industrial waste. In addition, control samples of corn plant tissues and soil were collected from two nonamended fields (each proximal to the rural and urban amended field sites). All samples were collected in triplicate using the above-mentioned protocol, placed on ice after collection, and shipped to the laboratory where they were frozen at −20 °C until extraction. A summary of both the greenhouse and field studies is shown in Table 1.

Extraction and PFAA Analysis. Sample Extractions. Plant material was homogenized prior to extraction using a food processor. An aliquot of the homogenized plant tissue (0.5−2 g) was transferred to a 50 mL polypropylene vial, to which a surrogate spiking solution containing 2 ng of each isotopically labeled surrogate standard was added. A solvent mixture of 50/50 dichloromethane (DCM) and 99:1 (v/v) methanol (MeOH) and ammonium hydroxide was chosen based on the exhaustive extraction results of Yoo et al.[19] The solvent mixture (7 mL) was added to the sample and heated (30 °C) in a sonication bath (Fisher Scientific FS110H, Pittsburgh, PA) for 30 min followed by shaking (VWR 5000 STD 120 V, West Chester, PA) for 1 h. The sample was centrifuged (Eppendorf 5810, Hamburg, Germany) at 2700 rpm (1467 RCF) for 20 min, and the extract was decanted into a separate 50 mL tube. This procedure was repeated twice for a total of three extraction cycles. The combined extract was evaporated at 50 °C under nitrogen (Organomation Associates Inc. N-EVAP 112, Berlin, MA) to dryness. To minimize matrix effects, the extract was cleaned up via oxidation with 1 mL of a basic hydrogen peroxide solution (20 µL ammonium hydroxide and 980 µL 30% hydrogen peroxide), vortexed, and sonicated in a heated (30 °C) bath for 2 h. An additional aliquot (7 mL) of the basic DCM/MeOH mixture was added to each oxidized extract, vortexed, and heated in a sonication bath for 30 min. The extract was centrifuged at 2700 rpm (1467 RCF) for 20 min and decanted into a glass 20 mL scintillation vial. This re-extraction procedure was repeated twice for a total of three cycles. The combined extract was evaporated at 50 °C under nitrogen to dryness and reconstituted with 1 mL of 99:1 (v/v) MeOH and acetic acid. The extract was run through a cleanup column packed with 100 mg of diamino and 100 mg of ENVI-Carb. To analyze, 105 µL of the cleaned extract was transferred to an autosampler vial, along with 1350 µL of water and 45 µL of dilution water consisting of 0.01% ammonium hydroxide. All results are reported on a dry weight basis, which was determined by drying separate aliquots of plant tissue at 70 °C overnight (at which time no additional change in mass was observed). Soil samples were extracted as per established protocols.[28] Additional details as to the soil extraction procedure can be found in the SI.

Table 1. Summary of Experimental Framework for Each Phase of Study

study phase	soils and amendment rates	plant tissue analyzed for each soil condition
greenhouse experiments	field-collected control (unamended) soil (5 replicate pots)	lettuce leaves; tomato fruit
	field-collected control + industrially impacted biosolids (10%) (5 replicate pots)	
	field-collected amended municipal soil (£1654 Mg/ha) (5 replicate pots)	
field-scale trial plots	control (unamended) (3 replicate plots)	lettuce leaves; tomato fruit
	0.5× agronomic rate for nitrogen (N) (12.5 Mg/ha) (3 replicate plots)	
	1× agronomic rate for N (25 Mg/ha) (3 replicate plots)	
	2× agronomic rate for N (50 Mg/ha) (3 replicate plots)	
	4× agronomic rate for N (100 Mg/ha) (3 replicate plots)	
full-scale field study	urban site (control) (3 replicate samples)	corn stover; corn grain
	urban site (1× agronomic rate for N) (3 replicate samples)	
	urban site (2× agronomic rate for N) (3 replicate samples)	
	rural site (control) (3 replicate samples)	
	rural site (0.5× agronomic rate for N) (3 replicate samples).	

PFAA Analysis. All PFAAs were analyzed using isotope dilution LC-MS/MS under conditions similar to those previously described.[28] Briefly, chromatography was performed using an aqueous ammonium acetate (10 mM) and MeOH (10 mM) gradient delivered at a flow rate of 800 µL/min by a Shimadzu LC-20AD unit (Kyoto, Japan). Samples and standards were injected (1 mL) by a Shimadzu SIL-5000 auto injector onto a 50 mm × 4.6 mm Gemini C18 column with a 3 µm particle size (Phenomenex, Torrance, CA) also equipped with a C18 guard column and cartridge. Initial eluent conditions were 50% MeOH and 50% water. The percent MeOH was ramped to 95% over 4 min, held at 95% over 4 min, ramped back down to 50% over 1.5 min, and re-equilibrated at 50% until 13 min. An MDS Sciex Applied Biosystems API 3200 (MDS Sciex, Ontario) operating in negative electrospray ionization scheduled multiple reaction monitoring (MRM)

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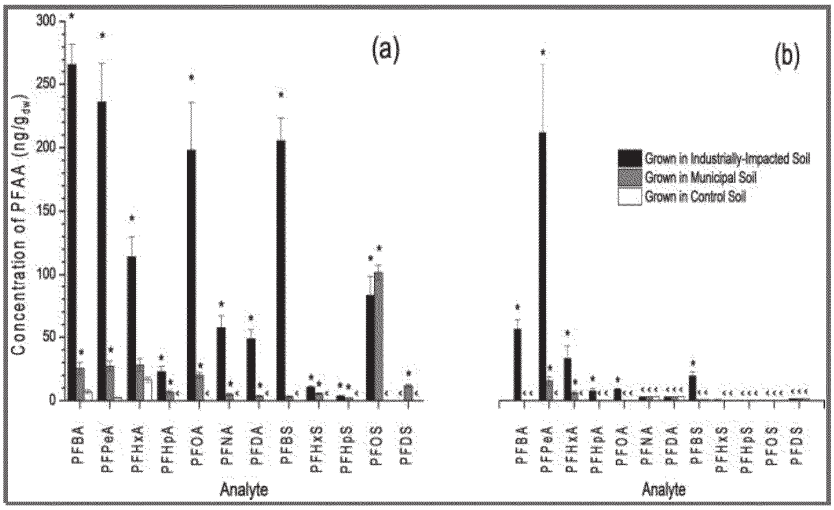

Figure 1. Concentrations of PFAAs in greenhouse lettuce (a) and tomato (b) grown in biosolids-amended soils. Mean and standard error are shown (n = 5). Values marked with an asterisk are significantly different (α = 0.05) than the control. Values less than the LOQ are denoted by <; LOQs for respective matrix and analyte are listed in SI Table S5.

mode was used to monitor two MRM transitions for all analytes.

Quality Control. Quantitation was performed using the software Analyst. A minimum of 20% of all samples in each matrix were extracted and analyzed in triplicate. In general, the relative standard deviation for analytical replicates was less than 25%. Values presented in this study are averages of experimental (greenhouse) or field (outdoor) replicates (n = 3−18). Limits of quantitation (LOQs) were derived from the lowest calibration standard calculated to be within 30% of its actual value and were analyte, matrix, and run-dependent. LOQs, in general, ranged from 0.01 to 1.5 ng/g$_{dw}$. Field, experimental, and analytical blanks were employed to monitor contamination. Sample values that were not at least twice the level of the highest concentration in a blank were reported as <LOQ. Internal surrogate standards were used for each analyte (SI Table S1) to correct for any losses during extraction. Plant surrogate recovery varied with matrix and analyte but typically ranged from 10% to 60%, and samples with less than 8% were excluded from any calculations. These recoveries are low in comparison to soil recoveries,[28] however, are somewhat typical in plant matrices[19,20] due to matrix ion suppression.

The results of additional spike-recovery experiments (accounting for surrogate losses) resulted in an average of 85% recovery for all analytes across all matrices (SI Figure S1) with no clear chain length dependent trends among analytes.

Bioaccumulation Metrics. To enable meaningful comparisons across soils and crops, bioaccumulation factors (BAFs) were calculated for each crop and PFAA for which plant tissue concentrations were above the LOQ. The BAF[29] was calculated by dividing the concentration in the plant tissue on a dry weight basis by the concentration in the soil on a dry weight basis:

$$\mathrm{BAF} = \frac{\text{PFAA concentration in plant } (\mathrm{ng\,g_{dw}^{-1}})}{\text{PFAA concentration in soil } (\mathrm{ng\,g_{dw}^{-1}})} \quad (1)$$

When calculating BAFs, several assumptions were made including (1) absence of any chemical transformation in the plant or plant extraction process and (2) negligible atmospheric exchange, thereby presuming the dominant uptake pathway for PFAAs was from the soil via the roots. As PFAAs are extremely stable and generally ionized at environmental pH values,[30] these assumptions appear quite reasonable. In addition, given the propensity of PFAAs to sorb to organic carbon,[30] organic-carbon normalized BAFs (i.e., $\mathrm{BAF_{oc}}$) were calculated by normalizing the PFAA soil concentrations to the soil f_{oc} to explore the impacts of soil organic carbon on bioaccumulation:

$$\mathrm{BAF_{oc}} = \mathrm{BAF} \times f_{oc} \quad (2)$$

Because TSCFs are a widely used plant uptake parameter, for comparative purposes, BAFs were also converted to TSCFs. Briefly, TSCFs were obtained by converting concentrations in plant tissues to concentrations in the xylem using an average rate of water transpired per mass of plant tissue and by converting the soil concentrations to pore water concentrations using soil-water partitioning coefficients and soil f_{oc} values. Detailed information concerning the TSCF calculations can be found in the SI.

Statistical Analysis. Data are presented as means with standard errors. Statistical analysis, including calculation of regression equations, was completed using OriginPro 8.6. Statistical difference was determined by using an analysis of variance (ANOVA) with Tukey's Test (α = 0.05); homogeneity of variance was assessed by Levene's Test (α = 0.05). Regression equation slopes were compared by first fitting a line across the difference of values for each analyte and then comparing the slope of the resulting line to zero at an α of 0.05.

RESULTS AND DISCUSSION

Greenhouse Study. Although the control soil was obtained from an unamended field, trace levels of PFAAs (<0.5 ng/g; SI Table S5) were observed. Biosolids have long been applied in the surrounding area, and minor cross-contamination may have resulted from cultivation practices such as plowing and planting or from atmospheric deposition.[31] In contrast, the industrially impacted soil resulting from combining industrially impacted biosolids with the control soil had a total of 335 ng/g PFAAs, with the largest contributors being PFDA (93.5 ng/g), PFOA (78.5 ng/g), PFOS (49.7 ng/g), and PFBS (48.6 ng/g). The

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Table 2. Summary of Bioaccumulation Factors (BAFs) for PFAAs in All Three Phases of This Study and Previous Study (Values Not Measured Are Designated as NM)[a]

analyte	greenhouse lettuce (municipal soil)	greenhouse lettuce (industrially impacted soil)	field trial lettuce (4× soil)	greenhouse tomato (industrially impacted soil)	field trial tomato (4× soil)	field corn stover (2× soil)	previous study [19] grass
PFBA	28.4 ± 5.21	56.8 ± 3.45	40.0 ± 2.41	12.2 ± 1.71	18.2 ± 5.34	64.8 ± 15.35	NM
PFPeA	10.2 ± 1.52	20.4 ± 2.70	16.3 ± 2.35	17.1 ± 3.74	14.9 ± 1.96	41.1 ± 9.00	NM
PFHxA	11.7 ± 2.11	9.90 ± 1.37	<LOQ	2.90 ± 0.87	6.84 ± 0.81	<LOQ	3.40 ± 1.84
PFHpA	3.33 ± 0.72	2.66 ± 0.47	<LOQ	0.86 ± 0.23	<LOQ	<LOQ	0.90 ± 0.30
PFOA	1.34 ± 0.14	2.52 ± 0.48	<LOQ	0.11 ± 0.01	<LOQ	<LOQ	0.25 ± 0.10
PFNA	0.77 ± 0.15	2.85 ± 0.47	<LOQ	<LOQ	<LOQ	<LOQ	0.12 ± 0.04
PFDA	0.34 ± 0.05	0.52 ± 0.08	<LOQ	<LOQ	<LOQ	<LOQ	0.10 ± 0.04
PFBS	14.5 ± 3.84	4.22 ± 0.37	2.02 ± 0.32	0.42 ± 0.08	<LOQ	<LOQ	NM
PFHxS	1.08 ± 0.11	7.56 ± 0.86	1.51 ± 0.11	0.50 ± 0.04	<LOQ	<LOQ	NM
PFHpS	1.03 ± 0.02	6.57 ± 0.94	<LOQ	<LOQ	<LOQ	<LOQ	NM
PFOS	0.32 ± 0.02	1.67 ± 0.32	0.10 ± 0.01	<LOQ	<LOQ	<LOQ	0.07 ± 0.02
PFDS	0.19 ± 0.02	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	NM

[a]BAFs were not calculated if analyte concentrations were below LOQ and are denoted by < LOQ. Data are shown as means and standard errors (n = 3−5).

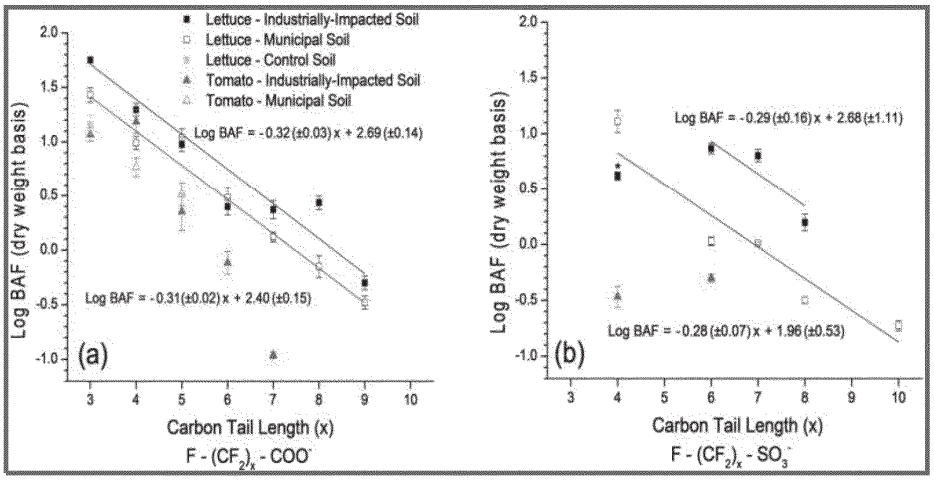

Figure 2. Correlations between log BAF for PFCAs (a) and PFSAs (b) and carbon tail length in greenhouse lettuce and tomato grown in biosolids-amended and control soils. Means and standard errors are shown (n = 5). Linear regressions with slopes, intercepts, and associated error values are shown for lettuce in industrially impacted and municipal soils; the data point marked with an asterisk is excluded from the regression calculation. Regressions for tomato BAFs were not performed.

municipal biosolids-amended soil had a total of 434 ng/g PFAAs, consisting primarily of PFOS (319.5 ng/g) and PFDS (61.2 ng/g). Both biosolids-amended soils had comparatively low levels of the shorter chain carboxylates (PFBA, PFPeA, PFHxA, PFHpA): <12 ng/g of each in the industrially impacted soil and <3 ng/g in the municipal biosolids-amended soil (SI Table S5).

Despite the relatively low soil concentrations of the short chain PFAAs, elevated levels were observed in the greenhouse lettuce for all soil treatments. For lettuce grown in the industrially impacted soil, concentrations were greatest for PFBA (266.1 ng/g), PFPeA (236.0 ng/g), and PFBS (205.2 ng/g), respectively (Figure 1a). Lettuce grown in the municipal soil had the highest concentrations of PFOS (101.6 ng/g), PFHxA (28.0 ng/g), PFPeA (27.2 ng/g), and PFBA (25.5 ng/g), respectively (Figure 1a). The preferential uptake of shorter chain PFAAs as has been previously observed[19,20] was also exemplified in this study, with the lettuce concentration of PFOS being only roughly 4-fold larger than the lettuce concentrations of the short chain perfluorocarboxylates (PFCAs) even though the initial soil concentration of PFOS was more than 100× greater than the soil concentrations of the short chain PFCAs. Even though control soil levels were below 0.5 ng/g for each PFAA, the lettuce grown in the control soil accumulated low levels of some PFAAs, notably PFHxA (16.4 ng/g) and PFBA (6.9 ng/g). The levels of all other PFAAs in the control lettuce were each less than 2.5 ng/g (Figure 1a). An ANOVA test was used to compare concentrations of PFAAs in the different lettuce treatments. Concentrations of PFAAs in lettuce grown in the industrially impacted soil were significantly different ($\alpha = 0.05$) than the control for all 11 analytes detected above the LOQ (SI Table S5), and lettuce grown in the municipal soil was different than the control for 10 of the 12 analytes (Figure 1a).

In contrast to the lettuce results, only seven and two PFAAs were detected above the LOQs for tomatoes grown in industrially impacted soil and municipal soil, respectively. PFAAs in the control tomatoes were all less than LOQ (Figure 1b). In the tomatoes grown in industrially impacted soil, the highest levels were measured for PFPeA (211.4 ng/g), PFBA

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(56.1 ng/g), and PFHxA (33.2 ng/g). For tomatoes grown in the municipal soil, PFPeA (15.5 ng/g) and then PFHxA (5.9 ng/g) were present at the highest levels. Very little accumulation of any of the perfluoroalkyl sulfonates (PFSAs) was observed in tomatoes (only 19.4 ng/g PFBS and 0.8 ng/g PFHxS in the industrially impacted soil, respectively), despite the fact that the soil concentration of PFOS in the municipal soil was 319 ng/g (SI Table S5).

Bioaccumulation Factors. Average BAFs for lettuce grown in the industrially impacted soil ranged from 56.8 for PFBA to 0.5 for PFDA, while values for the municipal soil lettuce ranged from 28.4 for PFBA to 0.2 for PFDS (Table 2). When log BAFs were plotted versus carbon chain length for PFCAs (Figure 2a) and PFSAs (Figure 2b), a linear correlation was evident, as was previously observed for PFCAs.[19] Within lettuce, the slopes of the regression equations are consistent in both biosolids-amended soils (Figure 2). The BAF decreases by approximately 0.3 log units per CF_2 group for PFCAs and PFSAs in both biosolids-amended soils, with no statistical differences between the slopes ($\alpha = 0.05$). However, the BAF for PFBS in lettuce grown in industrially impacted soil was excluded from the regression calculation, as its value did not conform to the pattern displayed by the other data points. An increase in soil−water distribution coefficient of 0.5−0.6 log units per CF_2 group[30,32] could point to reduced bioavailability for plant uptake as chain-length increases. The linearity of the plant uptake response to soil concentration of PFAAs suggests that passive transport may be the primary mechanism for uptake and translocation. However, the lower than expected BAF for PFBS of 4.2 (Table 2) versus the calculated one of 33.1 (equation in Figure 2b) for lettuce grown in the industrially impacted soil where PFBS concentrations were much higher than in the municipal soil indicates that bioaccumulation capacity for some PFAAs may be limited.[27]

As is also apparent in Figure 2, BAFs for PFCAs and PFSAs in lettuce were, in general, slightly higher in the industrially impacted soil than in the municipal soil (~0.3−0.8 log units). Although the oxidation step in the plant extraction process could have potentially transformed precursors in one of the soils to several PFCAs,[33] the consistency of the chain length trend among all of the PFCAs suggests this is not a significant contributing factor. Given that neither soil was spiked with PFAAs, differences in this apparent bioavailability to the lettuce was likely due to differences in soil properties and/or aging of the biosolids−soil mixture. In an effort to examine whether the f_{oc} of the soils could account for the differences, organic-carbon normalized BAFs were calculated. While for PFCAs, normalizing the BAFs more than compensated for the difference between the two soil treatments, for PFSAs, normalizing only accounted for about half the log difference (SI Figure S2). It is possible that the difference in bioavailability of PFAAs may have also been due to the nature of the organic carbon, as the industrially impacted soil contained carbon from fresh biosolids-based compost, whereas organic carbon in the municipal soil was derived primarily from aged soil organic matter rich in recalcitrant clay−humic complexes. While organic carbon is likely a contributing factor to differences in PFAA bioaccumulation, other geochemical factors may be important as well.

Tomato BAFs in the industrially impacted soil ranged from 17.1 for PFPeA to 0.1 for PFOA (Figure 2a). No other studies have measured the uptake of PFAAs in tomato. However, the BAF for PFOA in a fruit (cucumber) estimated at 0.75 using the value reported on a wet weight basis of 0.03[14] and correcting for water content (assumed to be 96% for cucumber)[34] is on the same order of magnitude. Linear trends were not as apparent for PFAA log BAFs in tomato. However, for PFCAs in tomato grown in industrially impacted soil, the BAF decreases approximately 0.5−0.9 log units if PFBA is excluded. Again, the shortest chain PFAAs (PFBA and PFBS) may be slightly less bioaccumulative than would be expected from trends in BAFs for their longer chain homologues, particularly if there is a concentration ceiling on the passive transport process or if there are other contributing barriers to transport. Furthermore, the difference in uptake patterns of lettuce and tomato suggest that the type of crop, or perhaps more importantly, the type of vegetative structure, may play an important role in PFAA bioaccumulation. Contaminants must be transported much further in the plant to reach a fruit crop (tomato) than a stem/leaf crop (lettuce).

Transpiration Stream Concentration Factors. As no other studies have reported PFAA BAFs for lettuce grown in biosolids-amended soil, comparable TSCFs were calculated to enable comparisons with results from a hydroponic lettuce study.[20] Calculated TSCFs are plotted in Figure 3 alongside literature values.[20] As organic-carbon derived partition coefficients were used to estimate soil pore water concentrations, the strong agreement between the TSCFs generated from the present study and those published previously reiterates the importance of f_{oc} in affecting the bioavailability of PFAAs in biosolids-amended soils. These results also support the passive transport mechanism as, in general, PFAAs are taken up at a rate much lower than water (less than unity).[24]

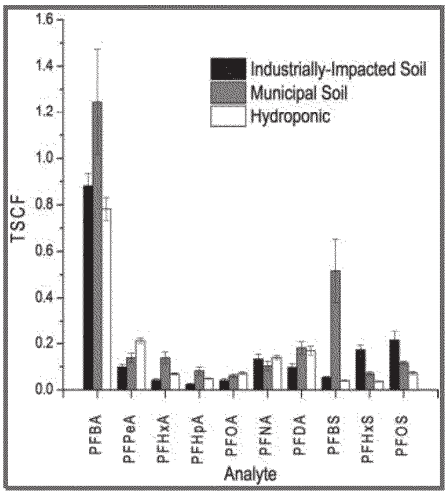

Figure 3. Comparison of transpiration stream concentration factors (TSCFs) for lettuce calculated from this study compared to TSCFs from a previous hydroponic lettuce study.[20] Mean and standard error (n = 5) are shown.

Pilot-Scale Field Trial. The five biosolids treatments used in the pilot-scale field trial plots were selected to represent increasing application rates; however, PFAA soil concentrations above background (i.e., >1.5 ng/g) were only observed for PFOA, PFNA, PFDA, PFOS, and PFDS (SI Table S6). The two highest concentrations were for PFOS (13.9 ng/g) and PFOA (5.2 ng/g) in the 4× amended soil. Soil concentrations of shorter chain PFAAs did not significantly increase with

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increased biosolids amendment rate (SI Table S6). These field soil values of PFAAs were significantly lower (3−20 times) than the levels found in the soils used in the greenhouse study. As a result of low initial soil concentrations, limited plant uptake data from the field trials were obtained, restricting the comparisons that could be made. PFAA concentrations in field crops were averaged for the three replicate soil plots only if all three replicate values were above the LOQ (SI Table S6). In the lettuce, the highest concentrations found were for PFBA (27.5 ng/g) and PFPeA (16.4 ng/g) in the 4× amended soil plot. For tomato, the highest concentrations were for PFBA (17.0 ng/g) in the 0.5× plot and PFPeA (15.0 ng/g) in the 4× plot. Minimal accumulation was found in crops grown in the 1× and 2× plots; all lettuce and tomato PFAA concentrations can be found in SI Table S6. For the analytes that had concentrations above the LOQ in the 4× amended soil, lettuce and tomato BAFs were calculated. These values are shown alongside the respective greenhouse grown lettuce and tomato BAFs in Table 2.

A trend suggesting an inverse relationship between BAFs and chain length was seen for PFCAs in both the field trial lettuce and tomato (SI Figure S3). Although the field data are limited, the difference between the log BAFs (1.6 for PFBA and 1.2 for PFPeA) for the field trial lettuce is a decrease of 0.4, which correlates well with the greenhouse grown lettuce decrease of 0.3 per CF_2 moiety. In addition, the field BAF values for tomato decrease approximately 0.1−0.3 log units per CF_2 moiety, similarly but less closely correlated to the greenhouse grown tomatoes (0.5−0.9 log units per moiety).

Full-Scale Field Study. Soil concentrations of PFAAs for the full-scale crop−soil system were similar to concentrations in the field trial plots. All PFAAs were individually less than 2 ng/g except for PFOA (4.4 ng/g), PFDA (2.6 ng/g), and PFOS (4.3 ng/g) from the rural 0.5× field, and PFOS (2.8 ng/g) from the urban 2× field (SI Table S7). All PFAA corn grain concentrations were below the LOQ (SI Table S7). In the corn stover, only PFBA (4.2 ng/g) and PFPeA (0.3 ng/g) were above the LOQ for the Urban 2× plot (SI Table S7). This preferential accumulation in the vegetative compartment is consistent with the findings of Stahl et al.[13] In addition, the findings reiterate the consistent bioaccumulation of the short chain PFCAs as found in the greenhouse and field trial studies. From these limited data, BAFs for PFBA and PFPeA were calculated and are shown in Table 2 along with grass-soil accumulation factors from Yoo et al.[19] In the absence of other studies for comparison, the similarity of corn stover to grass was used to compare results. However, the longest PFCA detected in this study was PFPeA and the shortest PFCA that Yoo et al. reported was PFHxA, so no direct comparisons are possible. Trendwise, Yoo et al. reported a decrease of 0.2 log units per CF_2 group increase;[19] the limited log BAF data found for corn stover in the present study (1.8 for PFBA and 1.6 for PFPeA) also shows a decrease by 0.2 log units per CF_2 group. Stahl et al.[13] studied corn straw in spiked soil systems, and BAFs can be calculated from the data reported. BAFs for the only two PFAAs studied were 0.24 for PFOA and 0.16 for PFOS, which are in line with corn stover and grass trends provided in Table 2.

Implications. While some PFAA crop accumulation data are available from the literature, this is the first study examining PFAA accumulation in food crops grown in unspiked, biosolids-amended soils, although amendment rates were generally above typical agronomic application rates. From this study, it is clear that there is preferential uptake of PFCAs over PFSAs and accumulation of shorter chain PFAAs over longer chain PFAAs. In addition, uptake differences in crops suggest that the vegetative structure of the crop may affect the amount of bioaccumulation. In both the field and greenhouse studies, BAFs for shorter chain PFAAs were greater than than unity (i.e., 1), indicating accumulation in the plant tissues. In the context of the U.S. EPA's risk assessment framework for potential contaminant accumulation in crops from biosolids-amended soils, the default "conservative" value for BAFs is 1;[35] clearly, in light of these results, this estimate is not truly conservative for short chain PFAAs. This finding points to the need for more thorough research before full risk assessments can be completed for PFAAs. These results may also have important implications with respect to the potential routes of PFAA exposure in humans who might have repeatedly used biosolids to fertilize their home gardens, particularly if the biosolids were from a WWTP receiving industrially impacted wastewater with elevated levels of PFAAs. More work is needed to verify the trends observed in this study as plant accumulation of PFAAs varies with soil properties, crop type, biosolids application rate, and analyte.

ASSOCIATED CONTENT

* Supporting Information

Additional details are available regarding analytical methods, soil characteristics, greenhouse experiment details, sampling details, the soil extraction procedure, PFAA concentrations in soils and crops, log and normalized plots of BAFs, and TSCF calculations. This material is available free of charge via the Internet at http://pubs.acs.org.

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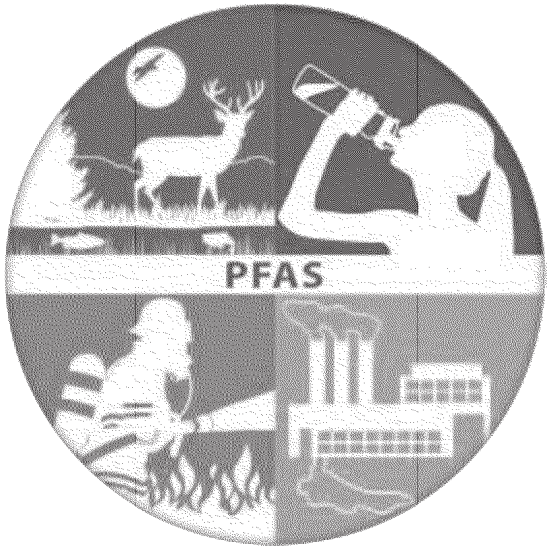

Technical Resources to Respond to Environmental Releases of Poly- and Perfluoroalkyl Substances (PFAS)

Patricia Reyes, Director
Interstate Technology & Regulatory Council

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What Is ITRC?

- Public-private coalition working to reduce barriers to the use of innovative environmental technologies that reduce compliance costs and maximize cleanup efficacy.
- Produces documents and training that broaden and deepen technical knowledge and expedite quality regulatory decision-making while protecting human health and the environment.
- Technical teams composed of environmental professionals from state & federal agencies, industry, academia, and community stakeholders.
- Program of the Environmental Research Institute of the States (ERIS) and managed by the Environmental Council of the States (ECOS).
- To learn more: www.itrcweb.org

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Why A PFAS Team?

- The volume of information regarding PFAS sources, site characterization, fate and transport, and remediation is growing rapidly
- PFAS compounds in the environment have become an emerging, worldwide priority
- State and federal environmental regulators need easily accessible information to aid them in evaluating risks and selecting appropriate response actions at PFAS release sites

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Who Is On The PFAS Team?

- ITRC has assembled a team of over 290 PFAS experts from all sectors:
  - Academics, stakeholders and international – 15+
  - State and local – 60+ (30 states, including D.C.)
  - Federal (DOD, DOE, EPA, Other) – 40+
  - Industry and consulting – 160+
- The team is led by:
  - Bob Mueller, NJ DEP
  - Ginny Yingling, MN DOH
  - Lesley Hay Wilson, Sage Risk Solutions LLC

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PFAS Team Goals

- The ITRC PFAS team will produce concise technical resources for project managers – regulators, consultants, responsible parties, and stakeholders
- 2017:
  - Series of six PFAS Fact Sheets
- 2018-2019:
  - Web-based Technical and Regulatory Guidance Document
  - Internet-based Training

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2017: PFAS Fact Sheets

- Summarize key information in the following areas:
  - History, Use, and Environmental Sources
  - Nomenclature & Physical and Chemical Properties
  - Environmental Fate & Transport
  - Site Characterization Tools, Sampling Techniques, & Laboratory Analytical Methods
  - Remediation Technologies & Methods
  - Regulatory Summary
- Tailored to the needs of state regulatory program staff
  - Concise (10-12 pages or less)
  - Current references
  - Web-based, updated information tables

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Web-based information tables

- Updatable as information evolves
- Standards and guidance values for PFAS in groundwater, drinking water, and surface water or effluent
- Residential soil standards and guidance values for PFAS
- Basis information for key standards and guidance values
- Physical and chemical properties of key PFAS compounds
- Remediation technologies comparison

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Project Overview: 2018-2019

- Publish a web-based technical and regulatory guidance document:
  - More in-depth technical information on PFAS
  - Links to scientific literature
  - Regulatory information and links
  - Stakeholder perspectives
- Develop web-based training modules

US EPA Cross-Agency Coordination of PFAS Activities

Outline

- Introduction to PFAS
- US EPA Cross-Agency Coordination
- Overview of US EPA PFAS Activities
- Additional Slides

Introduction to PFAS

- A class of man-made chemicals that are ubiquitous due to:
  - Wide variety of industrial and consumer uses
  - Not known to degrade in the environment
  - High mobility
- They are a concern due to:
  - Known or suspected toxicity, especially for PFOS and PFOA
  - Bioaccumulation
  - Can persist in humans for several years
  - Shorter PFAS tend to be highly mobile, longer PFAS less mobile
- Information on PFAS is rapidly evolving

Cross-Agency Coordination of PFAS Activities

- **PFAS coordination is led through EPA's Office of the Science Advisor**
- **PFAS is a cross-Agency issue, but also multifaceted:**
  - Human health toxicity
  - Exposure
  - Analytical methods
  - Risk management
  - Risk communication
- **Currently there are three cross-Agency workgroups:**
  - Human health toxicity
  - Analytical methods
  - Data quality
- **This broad array of issues requires coordination of each individual aspect, but also overarching coordination of all issues to ensure that the Agency has an awareness of all ongoing and proposed activities**

Current PFAS Activities: OCSPP

- **EPA's New Chemicals Program**
  - Review hundreds of pre-market alternatives for PFOA and related chemicals since 2000 before they enter the marketplace.
- **Significant New Use Rule (SNUR)**
  - Proposed on January 21, 2015 to require manufacturers, importers, and processors of PFOA and related chemicals (including as part of articles), to notify EPA at least 90 days before starting or resuming new uses of these chemicals in any products.
  - Notification provides EPA opportunity to conduct risk assessment/management for the new use
- **PFOA Stewardship Program**
  - Eight companies participated in the program and successfully eliminated production of PFOA.
  - Designed to phase out PFOA and related per- and polyfluoroalkylated substances (PFAS) including potential PFOA precursors by these companies by the end of 2015.

Current PFAS Activities: OLEM

- **EPA Federal Facility Superfund Program**
  - Program is actively engaged in a PFAS cleanup process at 32 Federal Facility National Priorities List (NPL) sites.
  - It is anticipated that this number will grow since there are known or suspected contaminations of PFAS at many of the 140 DOD Federal Facility NPL Sites.
  - PFAS detections in groundwater range from non-detect (based on analytical method limitations) or slightly exceeding the Drinking Water Health Advisory of 70 parts per trillion (ppt; PFOA and PFOS combined) to 2,000,000 ppt.
  - Drinking water has been impacted at 17 of these Federal Facility NPL sites.
- **Office of Superfund Remediation and Technology Innovation (OSRTI)**
  - 14 known impacted non-Federal NPL sites, including one proposed for listing (St. Gobain Hoosick Falls, NY)
  - 100s potential NPL sites (e.g. 100 metal plating sites, 300 landfills)
- **Regional Assistance**
  - Holding site specific consultations with EPA regions on investigations of PFAS contamination

Current PFAS Activities: ORD

- **EPA has been studying exposure and health effects of PFAS for more than 15 years.**
- **Health Effects**
  - Compiling considerable knowledge on the toxicological effects of various PFAS, including studies on the fate of PFAS in the body
  - Conducting research to study the potential hazards of PFAS in the environment using computational toxicology modeling
- **Analytical Methods/Exposure Assessment**
  - Ongoing research on analytical methods, in collaboration with program and regional offices, for measurement of PFAS in environmental media
  - Evaluating sources, environmental fate and transport, and exposure to human and non-human receptors
- **Risk Assessment**
  - EPA's Provisional Peer-Reviewed Toxicity Value (PPRTV) program completed a health assessment for perfluorobutane sulfonate (PFBS), a substance similar to PFOA and PFOS, in 2014
  - EPA identified PFAS as a chemical class of interest to the Agency in the 2015 multi-year agenda for the Integrated Risk Information System (IRIS) program
- **Risk Management**
  - Characterize PFAS contamination in the soil, surface water and groundwater at military installations where aqueous film forming foams (AFFF) have been used extensively
  - With the Air Force Institute of Technology (AFIT), test in situ remediation technologies to remove PFAS at contaminated sites

Current PFAS Activities: OW

- **Published Drinking Water Health Advisories (HA) in 2016 for PFOA and PFOS**
  - HAs are non-regulatory information for federal, state and local officials to consider when addressing drinking water contamination.
  - Identified 0.07 µg/L (70 parts per trillion) as the HA level for PFOA and PFOS combined and provided information about treatment and monitoring.
- **Evaluating PFOA and PFOS for regulatory determination under the Safe Drinking Water Act (SDWA)**
  - PFOA and PFOS are on the fourth Contaminant Candidate List (CCL 4) published in November 2016. EPA's Office of Water is assessing PFOA and PFOS against the three SDWA regulatory determination criteria:
    - *May have an adverse effect on the health of persons*
    - *Is known to occur or there is a substantial likelihood that it will occur in public water systems with a frequency and at levels of public health concern*
    - *In the sole judgment of the Administrator, regulating the contaminant presents a meaningful opportunity for health risk reductions for persons served by public water systems*
  - EPA must decide whether or not to regulate at least five CCL4 contaminants by January 2021.
  - Preliminary regulatory determinations for public comment expected in 2019 (to enable final regulatory determinations by January 2021).

Current PFAS Activities: Regions

- **PFAS have been identified as an important issue in the EPA regions. Below are the general, ongoing efforts in the regions:**
  - Working collaboratively with states, local and federal partners, particularly DOD, to address concerns with PFAS contamination of public and private drinking water wells and legacy contamination at Superfund sites.
  - Providing support to states on different issues, including direct analytical support for sites, method improvement, method validation studies and quality assurance protocols.
  - Assisting states, local agencies and federal facilities with public messaging regarding risks.
  - Regions have had to issue Safe Drinking Water Act Administrative Orders to federal facilities (Naval Air Warfare Center, Warminster, PA, Naval Air Station Joint Reserve Base Willow Grove, Horsham, PA and Former Pease Air Force Base in Portsmouth, NH) in order to protect public supply wells given the emergent nature of this class of chemicals and the slow reaction time of other federal agencies.
- **Regional laboratory representatives participate in national and regional programmatic meetings offering technical advice with expertise in analytical methodology and quality acceptability.**

Current PFAS Activities: Cross-Agency

- **EPA ORD and the Office of Land and Emergency Management (OLEM) lead a cross-EPA workgroup on characterizing human health hazards**
  - To characterize the available toxicity information for approximately 30 PFAS of interest to various program offices or regions
  - To develop quantitative toxicity values for multiple PFAS, other than PFOA and PFOS
  - To inform evidence-based decisions by EPA offices and regions regarding potential human health risks from ongoing or future exposures

Category	Draft Final PFAS List	Acronym
Perfluoro carboxylic acids	Perfluorododecanoic acid	PFDoA
	Perfluoroundecanoic acid	PFUnA
	Perfluorodecanoic acid	PFDA
	Perfluorononanoic acid	PFNA
	Perfluorooctanoic acid	PFOA
	Perfluoroheptanoic acid	PFHpA
	Perfluorohexanoic acid	PFHxA
	Perfluoropentanoic acid	PFPeA
	Perfluorobutyric acid	PFBA
Perfluoro sulfonates	Perfluorodecanesulfonate	PFDS
	Perfluorononanesulfonate	PFNS
	Perfluorooctanesulfonate	PFOS
	Perfluoroheptanesulfonate	PFHpS
	Perfluorohexanesulfonate	PFHxS
	Perfluoropentansulfonate	PFPeS
	Perfluorobutanesulfonate	PFBS
Perfluoro sulfonamide	Perfluorooctanesulfonamide	PFOSA
Fluorotelomer sulfonates	Fluorotelomer sulfonate 8:2	FtS 8:2
	Fluorotelomer sulfonate 6:2	FtS 6:2
Perfluoro sulfonamidoacetic acids	N-ethyl-N-((heptadecafluorooctyl)sulfonyl)glycine	NEtFOSAA
	N-(Heptadecafluorooctylsulfonyl)-N-methylglycine	NMeFOSAA
Fluorotelomer alcohols	Fluorotelomer alcohol 8:2	FtOH 8:2
	Fluorotelomer alcohol 6:2	FtOH 6:2
Perfluoro ether carboxylic acids	Perfluoro(2-methyl-3-oxahexanoic) acid	GenX
	4,8-dioxa-3H-perfluorononanoic acid	ADONA
Fluorotelomer phosphates	6:2 Fluorotelomer phosphate monoester	6:2 monoPAP
	6:2 Fluorotelomer phosphate diester	6:2 diPAP
	8:2 Fluorotelomer phosphate monoester	8:2 monoPAP
	8:2 Fluorotelomer phosphate diester	8:2 diPAP
	6:2/8:2 Fluorotelomer phosphate diester	6:2/8:2 diPAP
Fluorotelomer carboxylic acid	5:3 Polyfluorinated acid	5:3 acid

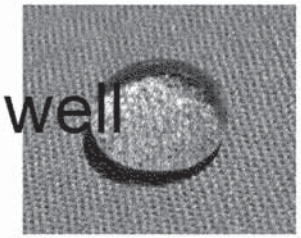
Current PFAS Activities: Cross-Agency (cont'd)

- **OLEM/Region 3/ORD lead a cross-EPA workgroup on method development and validation**
  - To develop multi-laboratory validated methods for analyzing sample types other than drinking water (waters and solids) and quantifying 24 PFAS. Currently performing a multi-lab validation of a method for the 24 PFAS which was developed by the Region 5 Chicago Regional Lab
  - To develop sampling protocols to address PFAS analytical data quality issues Regions have identified
- **Region 10 and Region 3 lead a cross-EPA workgroup on evaluating data quality issues regions have identified**
  - To develop guidelines for data deliverables and assessment criteria

ADDITIONAL SLIDES

Chemical and Physical Properties

- Properties of PFAS range depending on carbon chain lengths and functional groups.
- PFAS generally occur as mixtures and are not well characterized.



- PFAS provide desirable performance because they repel both oil and water:
  - The fluorinated carbon tail is both lipophobic/oleophobic (repelled by fats and oils) and hydrophobic (repelled by water).
  - The functional group head can vary but is often hydrophilic (attracted to water).
- As a result of these unique surfactant properties and their stability, they are common surfactants and stain preventers.

Production of PFAS

- PFAS production occurs by two primary production methods: Electrochemical Fluorination and Telomerization.

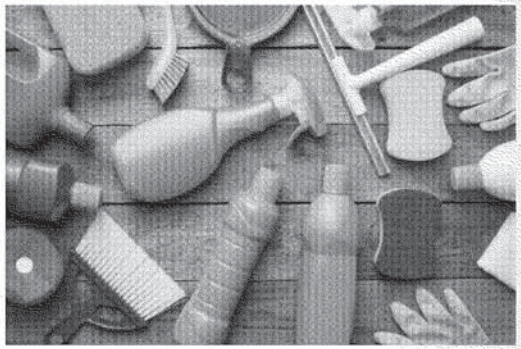
- During production of the intended products, many residuals and precursors are carried forward into the final formulations
(e.g., FTOHs and PFOA may be found in fluoropolymers).

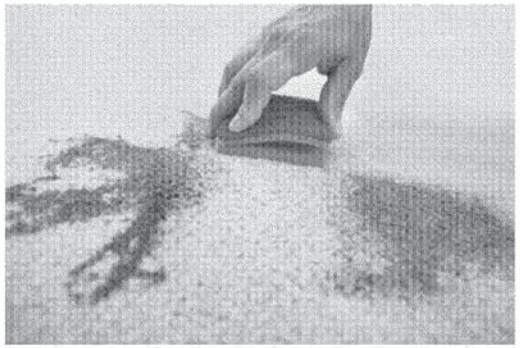
- Many PFAS are used as processing aids in production of other PFAS products. This results in:
  - Primary production facilities that synthesize PFAS chemicals, e.g. chemical plants
  - Secondary production facilities that produce products using PFAS, e.g. textile and paper facilities, fluorocarbon plastics production

- Industry is changing formulations in response to regulatory drivers and mounting toxicity and persistence data. However, replacement chemicals are unknown as to persistence, toxicity and bioaccumulation.

Uses of PFAS

- Food contact surfaces such as cookware[1], pizza boxes, fast food wrappers, popcorn bags, etc.
- Polishes, waxes and paints
- Stain repellants for carpets, clothing, upholstered furniture, etc.
- Cleaning products
- Dust suppression for chrome plating
- Electronics manufacturing
- Oil and mining for enhanced recovery
- Performance chemicals such as hydraulic fluid, fuel additives, etc.





[1] PFOA has been phased out, however there is little evidence that the chemicals that have replaced PFOA are much safer.

Sources of PFAS

- **Landfills and leachates from disposal of consumer and industrial products containing PFAS**
- **Land where wastewater treatment plant biosolids was applied**
  - Note: Biosolids applied following regulations may be protective to human exposure via ingestion of crops (Blaine et al. 2013 and 2014), but much more research is needed.
- **Direct release of PFAS products into the environment – such as use of aqueous film forming foam (AFFF) in training and emergency response**

Analytical Methods

- Only PFOS, PFOA and PFBS have vetted toxicity values at this time. Therefore, for initial investigations these would be the primary PFAS contaminants of concern.
  - Drinking Water: EPA Method 537 Version 1.1
  - Media other than drinking water: Each contract lab has their own method (most loosely based on EPA 537) since a standard HW method does not exist
- ORD, Region 5 and others are developing methods for PFAS precursors and PFAS in non-DW matrices (surface waters, groundwater, wastewater, biosolids, soils, sediments, etc).
- OLEM, OW, ORD, and Regional Labs currently conducting a multi-lab validation effort to establish an EPA method(s) for non-DW media.
- ORD and others are developing methods to identify unknown PFAS in environmental samples due to transformations, degradation, new formulations, etc.

To: linda.culpepper@ncdenr.gov[linda.culpepper@ncdenr.gov]
Cc: Gettle, Jeaneanne[Gettle.Jeaneanne@epa.gov]; France, Danny[France.Danny@epa.gov]; Sivertsen, Scott[Sivertsen.Scott@epa.gov]; Allenbach, Becky[Allenbach.Becky@epa.gov]; Kemker, Carol[Kemker.Carol@epa.gov]; Walker, Mary[walker.mary@epa.gov]; Banister, Beverly[Banister.Beverly@epa.gov]; Lapierre, Kenneth[Lapierre.Kenneth@epa.gov]; Heard, Anne[Heard.Anne@epa.gov]
From: Mundrick, Doug
Sent: Fri 8/25/2017 12:01:46 PM
Subject: Fwd: Chemours - sampling update and lab support

Linda, we have run into some issues getting the analysis up and running. See below for the technical explanation. Scott's best guess right now looks like it would be 9/9 at the earliest before we could accept samples and have confidence our analysis would produce valid results.

We're working on it as hard as we can. We want to be in a position to support you and will keep you posted as things progress.

Doug

Doug Mundrick, P.E., Deputy Director

Science and Ecosystem Support Division

EPA Region 4 – Athens, GA

706/355-8704

Mundrick.Doug@epa.gov

Begin forwarded message:

From: "Sivertsen, Scott" <Sivertsen.Scott@epa.gov>
Date: August 24, 2017 at 6:00:49 PM EDT
To: "France, Danny" <France.Danny@epa.gov>
Cc: "Mundrick, Doug" <Mundrick.Doug@epa.gov>
Subject: RE: Chemours - sampling update and lab support

I apologize up-front for not just providing a date, but there are issues with the analysis. Sample acceptance depends on our ability to generate a valid calibration curve, DOC and

To: bud.mcCarty@ncdenr.gov[bud.mccarty@ncdenr.gov]
Cc: Anderson, Meredith[Anderson.Meredith@epa.gov]; Merizalde, Carlos[Merizalde.Carlos@epa.gov]
From: Johnston, John E.
Sent: Wed 2/17/2016 2:21:13 PM
Subject: FW: Data Call to Update Missing Permit Expiration Dates in RCRAInfo by March 17
Request correction of missing permit expirations (2-3-16) H.xlsx

Bud,

I just received this request to update missing permit expiration dates and other permit-related data in RCRAInfo. The instructions for the data updates are on the first sheet in the attached MS Excel file and the "Facility-Level List" sheet shows the facilities needing updates.

Let me know if you have any questions or need additional information, though I'm not sure how much help I can be on this one. Amanda's message below says you can contact Tab Sommer if you have questions about the data.

Thanks for your assistance in this.

John

John E. Johnston

RCRA Corrective Action and Permitting Section

RCRA Cleanup and Brownfields Branch

Resource Conservation and Restoration Division

USEPA Region 4 - Atlanta

Tel: 404-562-8458

Fax: 404-562-8439

johnston.john@epa.gov

From: Merizalde, Carlos
Sent: Wednesday, February 17, 2016 8:59 AM
To: Morris, Robert <Morris.Robert@epa.gov>; Johnston, John E. <Johnston.John@epa.gov>
Cc: Anderson, Meredith <Anderson.Meredith@epa.gov>
Subject: FW: Data Call to Update Missing Permit Expiration Dates in RCRAInfo by March 17

Good morning,

Yesterday afternoon, I received the email below from the EPA HQs. Please forward to the permitting contacts in your States. Details and instructions are included in the email and the excel file.

HQs is asking for RCRAInfo updates to permit related data by **March 17.** I looked at the excel file and these are the facilities for Region 4 (facility units are detailed in the file):

AL	CAMMCO INC	AL0000998013
AL	TVA POWER SERVICE CENTER	AL2640090005
AL	ANNISTON ARMY DEPOT	AL3210020027
AL	CHEMICAL WASTE MANAGEMENT	ALD000622464
AL	ARKEMA INC.	ALD000827154
AL	BASF CORP	ALD001221902
AL	US STEEL FAIRFIELD WORKS	ALD002904506
AL	AMERICAN CAST IRON PIPE COMPANY	ALD003397569
AL	HUNT REFINING COMPANY	ALD004009320
AL	BEAZER EAST INC & KOPPERS INC	ALD004009403
AL	OSP, LLC	ALD004017869
AL	US PIPE AND FOUNDRY COMPANY NORTH BIRMINGHAM PLANT	ALD004017901
AL	SOLUTIA INC	ALD004019048
AL	NICHOLS ALUMINUM- ALABAMA LLC	ALD004023180

AL	AKZO NOBEL FUNCTIONAL CHEMICALS LLC	ALD008161176
AL	TR MILLER MILL COMPANY, INC	ALD008161416
AL	HUXFORD POLE AND TIMBER COMPANY, INC.	ALD008185407
AL	ADDIVANT USA, LLC	ALD010394021
AL	RENTOKIL INITIAL ENVIRONMENTAL SERVICES, LLC	ALD021257951
AL	BALDWIN POLE & PILING CO INC	ALD031490501
AL	STELLA - JONES CORPORATION	ALD034046730
AL	SANDERS LEAD COMPANY, INC	ALD046481032
AL	OPELIKA FOUNDRY CO DIVISION OF VIRGINIA INDUSTRIES INC	ALD049699366
AL	CAVENHAM FOREST INDUSTRIES, LLC	ALD057226904
AL	DE NORA TECH, INC.	ALD067110676
AL	GIANT RESOURCE RECOVERY- ATTALLA, INC.	ALD070513767
AL	NATIONAL COPPER & SMELTING	ALD079109013
AL	BEAZER EAST & KOPPERS INC WOODWARD TAR FACILITY	ALD085765808
AL	ALLWORTH, LLC	ALD094476793
AL	LP LOCKHART	ALD095687786
AL	FUELS AND CHEMICALS, INC.	ALD980559850
AL	EWS ALABAMA INC.	ALD981020894
AL	ALDOT TRACT 92 FORMER SPLENDID CLEANERS	ALD982111494
AL	EQ ALABAMA, INC.	ALD983177015
AL	OXFORD MACHINE & FAB INC	ALD983180597
FL	VEOLIA ES TECHNICAL SOLUTIONS LLC	FL0000207449
FL	PATRICK AFB	FL2570024404
FL	CAPE CANAVERAL AFS	FL2800016121
FL	KEY WEST NAS DEMOLITION KEY	FL3170500000
FL	JACKSONVILLE NAS	FL6170024412
FL	JOHN F KENNEDY SPACE CENTER	FL6800014585
FL	EGLIN AIR FORCE BASE	FL8570024366
FL	USN - MAYPORT	FL9170024260
FL	EXIDE TECHNOLOGIES	FLD000608083
FL	UNITED TECHNOLOGIES CORPORATION - PRATT & WHITNEY	FLD001447952
FL	TRIAD INTERNATIONAL MAINT CORP DBA HAECO AMERICAS AIRFRAME	FLD004073177
FL	ENVIROFOCUS TECHNOLOGIES LLC	FLD004092839
FL	K C INDUSTRIES PROPERTIES LLC	FLD004106811
FL	AOC LLC	FLD041495441
FL	WESTSHORE APARTMENTS LLC	FLD042468355
FL	ST MARKS POWDER INC	FLD047096524
FL	CHEMRING ORDNANCE INC	FLD047966593
FL	SAFETY KLEEN CORP 3-163-01	FLD049557408
FL	NEXEO SOLUTIONS LLC	FLD059861344
FL	SAFETY KLEEN CORPORATION - 3-130-01	FLD097837983
FL	TRIUMVIRATE ENVIRONMENTAL INC	FLD980559728
FL	CLEAN HARBORS FLORIDA LLC	FLD980729610

FL	SAFETY - KLEEN SYSTEMS INC	FLD980847214
FL	SAFETY-KLEEN SYSTEMS INC	FLD980847271
FL	PRECISION FABRICATING & CLEANING COMPANY INC	FLD981471121
FL	SAFETY-KLEEN SYSTEMS INC	FLD984171165
FL	SAFETY-KLEEN SYSTEMS INC	FLD984171694
FL	AERC COM INC	FLD984262782
GA	FORT BENNING	GA3210020084
GA	ENSCO ENVIRONMENTAL SERVICES	GAD000222083
GA	YORK CASKET HARDWARE	GAD003265030
GA	BON L MANUFACTURING COMPANY	GAD003273224
GA	INTERNATIONAL PAPER	GAD003275252
GA	CHEMICAL PRODUCTS CORPORATION	GAD003275468
GA	PINOVA, INC. (FORMERLY HERCULES INCORPORATED)	GAD004065520
GA	DELTA AIR LINES INC	GAD006924872
GA	ALTERNATE ENERGY RESOURCES INC	GAD033582461
GA	ASHLAND INC ENVIRONMENTAL REMEDIATION - SAVANNAH	GAD041007063
GA	SOUTHERN WOOD PIEDMONT CO	GAD051034387
GA	GULFSTREAM AEROSPACE CORPORATION	GAD061022216
GA	SOUTHERN WOOD PIEDMONT CO	GAD067560870
GA	POLYNT COMPOSITES USA INC	GAD084823301
GA	CITY OF ATLANTA, DEPT OF AVIATION (FRMR NORTHWEST AIRLINES)	GAD097392971
GA	CHEMICAL SPECIALTIES LLC	GAD980843155
GA	WOODBURY BOX CO INC	GAD981270416
GA	ARIZONA CHEMICAL COMPANY	GAR000050013
KY	US DOE PADUCAH GASEOUS DIFFUSION PLANT AND FLUOR FEDERAL SERVICES, INC.	KY8890008982
KY	UNIVERSITY OF KENTUCKY- ENVIRONMENTAL MGMT.	KYD000830851
KY	THE CHEMOURS COMPANY FC, LLC	KYD003924198
KY	AK STEEL CORPORATION- WEST WORKS	KYD005003181
KY	CALGON CARBON CORPORATION	KYD005009923
KY	DUNAWAY TIMBER COMPANY, INC.	KYD006369557
KY	POLYONE CORPORATION AND GOODRICH CORPORA	KYD006370167
KY	ATKEMIX TEN INC.	KYD006372197
KY	PMC ORGANOMETALLIX, INC.	KYD006373922
KY	KOPPERS INC.	KYD006383392
KY	YKK (USA) INC.	KYD044914356
KY	FLORIDA TILE INC.	KYD045735305
KY	COLLIS INC	KYD057591133
KY	OWENSBORO RIVERPORT PROPERTIES INC	KYD062951801
KY	LUVATA FRANKLIN, INC.	KYD062969290
KY	HALLMACK, DIVISION OF NUTONE, INC.	KYD081017667
KY	GREDE FOUNDRIES, INC., GREDE PERM CAST	KYD093903862
KY	WALD LLC	KYD980600043
KY	IPSCO TUBULARS (KENTUCKY)INC.	KYD991277112

MS	FXI INC.	MSD000648329
MS	CENTREVILLE LANDFARM	MSD083543009
MS	THE CHEMOURS COMPANY FC LLC - DELISE PLANT,	MSD096046792
NC	SINGER FURNITURE CO PLT 1	NCD000604330
NC	FORMER BORDEN/SMITH-DOUGLAS FACILITY	NCD001725464
NC	PARKER HANNIFIN CORPORATION (PNEUMATICS DIVISION)	NCD002591014
NC	A B CARTER INC.	NCD003154010
NC	DOW CORNING CORPORATION	NCD003221546
NC	BRENNTAG MID-SOUTH	NCD003471158
NC	FORMER ASHLAND INC	NCD024599011
NC	INGERSOLL-RAND COMPANY	NCD041414772
NC	DSM PHARMACEUTICALS, INC	NCD047373766
NC	CHEMICAL SPECIALTIES LLC	NCD048467427
NC	TREX PROPERTIES LLC	NCD049773245
NC	TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC - COMPRESSOR STATION 155	NCD060299765
NC	GE DURHAM ENGINE FACILITY	NCD072018252
NC	INTERNATIONAL PAPER	NCD072022726
NC	CLARIANT CORPORATION - MOUNT HOLLY WEST	NCD085074821
NC	NACCO MATERIALS HANDLING GROUP, INC.	NCD089158323
NC	RADIATOR SPECIALTY COMPANY	NCD091245969
NC	METALLIX REFINING INC.	NCD095119210
SC	DOE/WSRC SAVANNAH RIVER SITE	SC1890008989
SC	JOINT BASE CHARLESTON WEAPONS	SC8170022620
SC	T&S BRASS & BRONZE WORKS INC	SCD002038545
SC	GREENVILLE PROPERTIES LLC	SCD002267490
SC	GREENS OF ROCK HILL	SCD003159928
SC	ELISKIM INC.	SCD003342938
SC	EI DUPONT DE NEMOURS & CO (MAY PLANT LUGOFF)	SCD003344363
SC	TIMKEN US CORP PLANT	SCD003345683
SC	BLACKMAN UHLER SPECIALTIES SANTOLUBES MA	SCD003349065
SC	GIANT CEMENT COMPANY	SCD003351699
SC	CAPSCO INC	SCD003351996
SC	KOPPERS INC	SCD003353026
SC	CMC STEEL SOUTH CAROLINA PLANT 1500	SCD003353760
SC	TIMKEN US LLC	SCD041387796
SC	PETRO CHEM SC	SCD044442333
SC	COOPER RIVER PARTNERS LLC	SCD048373468
SC	SOUTHERN WOOD PIEDMONT COMPANY	SCD049690001
SC	IWG HIGH PERFORMANCE CONDUCTORS	SCD061523098
SC	HSL INC	SCD065053217
SC	GE HEALTHCARE	SCD067002147
SC	MEDICAL UNIVERSITY OF SC PHYSICAL PLANT	SCD069316271
SC	PHIBRO TECH INC	SCD070371885
SC	SIEMENS INDUSTRY INC	SCD078065117
SC	ROEBUCK DISPOSAL LLC	SCD981467616

SC	GEORGETOWN COUNTY	SCD982120107
SC	WOLVERINE BRASS INC	SCD990704470
TN	U.S. DOE, OAK RIDGE NATIONAL LABORATORY	TN1890090003
TN	U.S. DOE, Y-12 NATIONAL SECURITY COMPLEX	TN3890090001
TN	101ST AIRBORNE DIVISION (AIR ASSAULT) & FT CAMPBELL	TN5210020140
TN	UNIVAR USA INC.	TND000737445
TN	TRADEBE TREATMENT & RECYCLING OF TENNESSEE, LLC	TND000772186
TN	UNIVAR USA INC.	TND000822973
TN	OLIN CHLOR ALKALI PRODUCTS	TND003337292
TN	EASTMAN CHEMICAL COMPANY, TENNESSEE OPERATIONS	TND003376928
TN	VELSICOL CHEMICAL	TND007024664
TN	NEXEO SOLUTIONS, LLC	TND048319644
TN	SAFETY-KLEEN SYSTEMS INC. (3-109-01)	TND981474125
TN	PERMA-FIX ENVIRONMENTAL SERVICES, INC.	TND991279480

Thank you,

Carlos E. Merizalde

RCRA Corrective Action and Permitting Section
RCRA Cleanup and Brownfields Branch
Resource Conservation and Restoration Division - US EPA Region 4

Phone: (404) 562-8606 - Fax: (404) 562-8439

From: Kohler, Amanda
Sent: Tuesday, February 16, 2016 4:00 PM
To: Regional RCRA Program Branch Chiefs <Regional_RCRA_Program_Branch_Chiefs@epa.gov>
Cc: Leitch, Sharon <Leitch.Sharon@epa.gov>; Hanifan, Lynn <Hanifan.Lynn@epa.gov>; Lopez, Betsy <Lopez.Betsy@epa.gov>; Pratt, Stacie <Pratt.Stacie@epa.gov>; Barbieri, Andrea <Barbieri.Andrea@epa.gov>; Merizalde, Carlos <Merizalde.Carlos@epa.gov>; Greenberg, Judith <greenberg.judith@epa.gov>; Powell, Sontina <Powell.Sontina@epa.gov>; Murrow, Patricia <Murrow.Patricia@epa.gov>; Brown, Terry <Brown.Terry@epa.gov>; Zabaneh, Mahfouz <Zabaneh.Mahfouz@epa.gov>; McCullough, Barbara <McCullough.Barbara@epa.gov>; Gleaton, Gwendolyn <gleaton.gwen@epa.gov>; Roach, Mike <Roach.Michael@epa.gov>; Martin, Jan <Martin.Jan@epa.gov>; McGoldrick, Catherine <McGoldrick.Catherine@epa.gov>; Abdul-Malik, Norma <Abdul-Malik.Norma@epa.gov>;

Sommer, Tab <Sommer.Tab@epa.gov>; Goodwin, Debbie <Goodwin.Debbie@epa.gov>; Charbonneau, David <charbonneau.david@epa.gov>
Subject: Data Call to Update Missing Permit Expiration Dates in RCRAInfo by March 17

Hi all,

This is a request to please update missing permit expiration dates and other permit-related data in RCRAInfo by March 17. Please share this request with regional and state staff with responsibilities for managing this data.

As many of you know, we've been working with a team of regional representatives to plan and set our future GPRA permitting goals. During the course of this work, we've encountered some data gaps that are making it difficult to determine reasonable workloads and the current status of the permits (up to date, backlog, etc). Thus, we are issuing this request to update missing permit data in RCRAInfo which will allow us to:

- Identify the accurate list of permitted facilities

- Obtain permit expirations for all of the permitted facilities (not just those with near-term expirations)

- Recognize permitted facilities that have permits that are being kept up to date

- Identify the full renewals workload

- Update the GPRA baseline renewal workload

Attached is a file that identifies those facilities which need permit expiration date updates (or other related data). If you have questions about the data, please contact Tab Sommer of my staff sommer.tab@epa.gov or 703-605-0636. The instructions for the data updates are on the first sheet in the attached MS Excel file and you may refer to the "Facility-Level List" sheet to see the overview of the facilities needing updates.

Many thanks for your assistance in maintaining this data! Our analyses will be better for it!

Amanda Kohler

Acting Chief, Permits Branch

Office of Resource Conservation and Recovery

U.S. Environmental Protection Agency

703-347-8975

To: bud.mcCarty@ncdenr.gov[bud.mccarty@ncdenr.gov]
Bcc: Johnston, John E.[Johnston.John@epa.gov]
From: Johnston, John E.
Sent: Fri 2/5/2016 11:52:02 AM
Subject: EPA HQs Request - Individual Facility Assessment - COB 2/16/16
IFA Update for Nov 2015 RDD Meeting.docx
2016-2-1 - GPRA2020 CA Barriers Facility Inventory REVISED - Region 4.xlsx

Bud,

We have been asked by HQ to identify barriers that may prevent a facility from achieving their GPRA 2020 goal. They have provided a nice dropdown menu of potential barriers in the Excel spreadsheet so it makes choosing the barrier quite easy. We did this for our EPA-lead facilities and I must say this is one of the few HQ requests that does seem to be helpful.

Please let me know if you have any questions or would like additional information.

John

John E. Johnston

RCRA Corrective Action and Permitting Section

RCRA Cleanup and Brownfields Branch

Resource Conservation and Restoration Division

USEPA Region 4 - Atlanta

Tel: 404-562-8458

Fax: 404-562-8439

johnston.john@epa.gov

Background: The region has received a request from EPA HQs for information on those GPRA 2020 facilities that have not met any of the 3 GPRA 2020 Goals as of EOY FY2015 (see attached Word file titled *"IFA Update…"* for more information). Specially, EPA HQs is looking to identify facility specific challenges or barriers on an individual facility basis.

Attached is an excel spreadsheet that summarizes a RCRAInfo pull showing those facilities believed to have not yet met all 3 GPRA 2020 Goals (see attached excel file titled *"2016-2-1 – GPRA 2020…"*).

Instructions: For your State, please fill out the yellow highlighted cells contained in the attached excel file. Note the presence of dropdown boxes that provide a pick list of set response options. Specifically, for each facility listed in the attached excel file, please:

1. Indicate whether the facility is expected to meet each of CA725, CA750, and CA550 by 2020. Possible responses include Y/N/Met.

2. Provide up to three barriers affecting the facility. A set list of 16 possible barriers can be selected from a dropdown menu contained in each excel cell (e.g., Orphan Site (OS), Financial – Bankrupt (FB), Financial – Inability to Pay (FI), Indoor Air/Vapor Intrusion (TIA), etc.).

If any errors are found to have crept into the excel file, please make the necessary corrections (e.g., Maybe a facility should have been listed as not meeting all 3 GPRA 2020 Goals, but isn't present in your State's list; please add the missing facility and supply the requested facility information).

Finally, review of this list might identify RCRAInfo errors or the need for updates. Of course, please make any necessary corrections/updates. Responses are due to EPA-R4 by 2/12/16, but if you need more time, please let me know.

Barriers to Progress on 2020 Goals

Individual Facility Assessments Update

During the June 2015 RDD meeting, the Directors discussed the barriers to progress in meeting the 2020 goals. The branch chiefs prepared a draft table of site issues and programmatic issues, which identified the data needs and recommendations to address each issue (see next page). The table was summarized during the discussion.

One of the points made during the discussion was the importance of identifying the challenges faced by each remaining site that has not yet met the site-wide remedy construction (CA550) goal and the environmental indicators.

The branch chiefs were tasked with refining the table and identifying priorities for action as a follow up item from the session. ORCR management also had follow up discussions with Barnes Johnson on 2020 progress in which he re-emphasized the need to identify facility challenges on an individual basis.

There was a good fit with the branch chiefs' follow up item and performing the suggested individual facility assessments (IFAs). For instance, performing the IFAs would provide the necessary data whereby the issues and recommendations identified earlier could be refined and prioritized for action.

So during the August 2015 RCRA Branch Chiefs a small workgroup of ORCR and regional representatives was established to develop an approach to perform the IFAs. The workgroup's efforts were guided by the following principles discussed during the Branch Chiefs meeting:

- The approach should be flexible such that Regions can utilize information from existing strategic plans, state work plans, or other existing planning tools without placing significant burden on corrective action program and project managers.
- The approach should be readily implementable such that the first phase – identifying the major barrier(s) at individual facilities, can be initiated by October 1, 2015 and completed by December 31, 2015.
- The approach should provide clear, understandable results such that the workgroup can compile facility information from across Regions, identify trends or clumps of similar challenges, and prepare a draft summary report of findings by January 31, 2016.

The workgroup was made up of reps from ORCR and Regions 1, 2, 3, 5, 8, 9, and 10. A kick-off call was held in mid-August, during which Regions that had either performed similar analyses directly or whose state(s) did shared information on these efforts. An Excel spreadsheet was drafted in September which incorporated consistent themes of these Region/state efforts. Following incorporation of comments, the spreadsheet was presented to the Branch Chiefs during their October call. **The current agreement is that Regions on IFA workgroup will**

perform the IFAs for facilities not that have not met all 3 GPRA 2020 goals as of EOY FY2015.

The spreadsheet requests basic facility information, including acreage and a federal facility indicator. Also requested is information on whether the facility is expected to meet each of CA725, CA750, and CA550 by 2020.

For each facility up to three barriers can be selected from a dropdown menu. The barrier selections are as follows:

- Orphan Site (OS)
- Financial – Bankrupt (FB)
- Financial – Inability to Pay (FI)
- Indoor Air/Vapor Intrusion (TIA)
- Groundwater – not causing vapor intrusion (TG)
- Surface Water (TSW)
- Sediment (TSE)
- Soil (TSO)
- Eco (TE)
- Enforcement Pending (REP)
- Enforcement Not Pending but Candidate (REC)
- Enforcement Not Evaluated (REN)
- Enforcement Evaluated but not Pursued (REE)
- Federal Agency Resources Needed for Cleanup Oversight (FAR)
- State Agency Resources Needed for Cleanup Oversight (SAR)
- Other (OTH)

The spreadsheet also provides columns to identify anything which the Region or state could use help with to improve progress (e.g., tech support, other examples, etc.), and also to provide any other comments.

Currently the Regions on the IFA workgroup are working on completing the spreadsheet with a soft target completion date of December 31, 2015. Subsequently a summary report of findings will be provided to the RCRA Branch Chiefs by end of January – mid February 2016. **It's expected that the branch chiefs will report to the RCRA Directors in February or March 2016, e.g., during their monthly call.** It has also been proposed that the final product be shared with the states so that there's a better understanding of how these information requests are used.

To: Johnston, John E.[Johnston.John@epa.gov]; Bud.mccarty@ncdenr.gov[Bud.mccarty@ncdenr.gov]
Cc: Anderson, Meredith[Anderson.Meredith@epa.gov]; Kohler, Amanda[Kohler.Amanda@epa.gov]
From: Sommer, Tab
Sent: Wed 2/22/2017 8:42:55 PM
Subject: RE: Identify the Correct list of Permitted Facilities
request corrections to pmt fac list K.xlsx

Bud

With the state of the data I understand the delay.

Can I look at each of the 26 NC units identified with notes of potential data conflicts and see if it seems there are really any big discrepancies that need to be addressed? I have done this for a couple other states. I think I could do this within a few days.

Sorry about the typo on the type of data being compared. I noticed the typo and resent it to the regions, but it didn't necessarily make it to the states – and maybe it should not have considering they already started. I am rather sure the actual data was really from PC380 CA not DA.

- The column AE should have said "Units without clean-closed operating status, but have CL380 CA clean-closed verification recorded on Closure track report (included in file) but there are a number of false positives."

- In a standard "permit progress and data gap" closure report, it listed several events that should signify clean-closure (CL380CA) at a unit level for another states, but I could not see those events in the comprehensive permitting report for the same units. This issue (or others) may be present for NC too.

FYI

I was looking to see which units had events that seemed to indicate clean closure but those units were not coded with "clean-closed" operating status (as the most recent status) in order to see if some needed updates in order to be removed for the list of permitted facilities to be tracked for GPRA in the next cycle.

In addition I was also looking for situations where the facility had permit issuance events but not on the list.

Revised file is attached and sorted for NC. I will be assessing this in conjunction with additional data if it is OK with you.

From: Johnston, John E.
Sent: Wednesday, February 22, 2017 2:58 PM
To: Bud.mccarty@ncdenr.gov; Sommer, Tab <Sommer.Tab@epa.gov>
Cc: Anderson, Meredith <Anderson.Meredith@epa.gov>
Subject: RE: Identify the Correct list of Permitted Facilities

Bud,

The February 28 date was set by HQ so I will defer to Tab on whether or not the fix has to be completed by then. If it does, then please let me know and I will do all I can to help you and your staff correct the identified facilities.

John

John E. Johnston

RCRA Corrective Action and Permitting Section

RCRA Cleanup and Brownfields Branch

Resource Conservation and Restoration Division

USEPA Region 4 - Atlanta

Tel: 404-562-8458

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johnston.john@epa.gov

From: Mccarty, Bud [mailto:bud.mccarty@ncdenr.gov]
Sent: Wednesday, February 22, 2017 2:50 PM
To: Sommer, Tab <Sommer.Tab@epa.gov>; Johnston, John E. <Johnston.John@epa.gov>
Subject: Identify the Correct list of Permitted Facilities

Tab and John;

I hope things are well in both HQ and Region 4.

As I started to look at Tab's list of NC facilities I realized that we had been using CL380xx and PC380xx incorrectly. It seems most of our problems are CL380 or PC380 problems. Because of that it will take me more than February 28 to correct the identified facilities. That being said we can probably get things fixed up by March 30.

If that is not acceptable let me know and I will see what we can do.

Bud McCarty, CPM

Branch Head

Facility Management Branch

Hazardous Waste Section

Division of Waste Management

Department of Environmental Quality

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Email correspondence to and from this address is subject to the

North Carolina Public Records Law and may be disclosed to third parties.

To: bud.mcCarty@ncdenr.gov[bud.mccarty@ncdenr.gov]
From: Johnston, John E.
Sent: Tue 2/14/2017 12:00:23 PM
Subject: FW: follow up on efforts to identify the correct list of permitted facilities (and correction)
request corrections to pmt fac list K.xlsx

Bud,

I just got this and was asked to forward it to you.

John

John E. Johnston
RCRA Corrective Action and Permitting Section
RCRA Cleanup and Brownfields Branch
Resource Conservation and Restoration Division
USEPA Region 4 - Atlanta
Tel: 404-562-8458
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johnston.john@epa.gov

From: Merizalde, Carlos
Sent: Monday, February 13, 2017 9:59 AM
To: Morris, Robert <Morris.Robert@epa.gov>; Johnston, John E. <Johnston.John@epa.gov>; John.Jump@ky.gov; Jamie.Burroughs_tn.gov <Jamie.Burroughs@tn.gov>; BOWERSJB_dhec.sc.gov <BOWERSJB@dhec.sc.gov>; yeageref@dhec.sc.gov; Bryan.Baker@DEP.State.FL.US
Cc: April.Webb@ky.gov; William.Krispin_tn.gov <William.Krispin@tn.gov>
Subject: FW: follow up on efforts to identify the correct list of permitted facilities (and correction)

Good morning,

Sorry for delay in forwarding the message from Tab Sommer (EPA HQs) below, regarding the Feb 28 request to identify list of permitted facilities.

Tab (703-605-0636) is available to assist in working through the unit data in the excel file.

Thank you,

Carlos E. Merizalde
RCRA Corrective Action and Permitting Section

RCRA Cleanup and Brownfields Branch
Resource Conservation and Restoration Division - US EPA Region 4
Phone: (404) 562-8606 - Fax: (404) 562-8439

From: Sommer, Tab
Sent: Friday, February 03, 2017 10:24 AM
To: Greenberg, Judith <greenberg.judith@epa.gov>; Ainoa, Ian <ainoa.ian@epa.gov>; Hanifan, Lynn <Hanifan.Lynn@epa.gov>; Loesel, Matthew <loesel.matthew@epa.gov>; Lopez, Betsy <Lopez.Betsy@epa.gov>; Martin, Jan <Martin.Jan@epa.gov>; McGoldrick, Catherine <McGoldrick.Catherine@epa.gov>; Merizalde, Carlos <Merizalde.Carlos@epa.gov>; Murrow, Patricia <Murrow.Patricia@epa.gov>; Powell, Sontina <Powell.Sontina@epa.gov>; Roach, Mike <Roach.Michael@epa.gov>; Zabaneh, Mahfouz <Zabaneh.Mahfouz@epa.gov>
Subject: follow up on efforts to identify the correct list of permitted facilities (and correction)

Permitting data contacts

This is follow up to the e-mail requesting assessment of potential data anomalies by Feb 28. The intent is to be able to accurately identify the list of permitted facilities. This is important for future goal tracking (in order to count ALL permit reissuances). Disregard this email if you have already addressed the data issues.

Updates:

- After I worked through the permitting data issues with one state, I see that, in many cases, the potential conflicts between the legal and operating status and the supporting events are often not an issue after reviewing the full facility info in the Comprehensive Permitting Report.
- I do not need to know the status for each unit that was flagged with potential data conflict, eventually we just ensure that each facility that is actually permitted (not clean-closed etc) has legal and operating status to support it. Regardless, I have been keeping notes (in the attached file) for units that could show up as data conflicts in the future (but have a reason for the existing coding).
- I did not do a fresh pull of the data for the attached file, but made some corrections and updated notes.

Corrections or issues with the first file I sent:

1. The event for clean-closure should have been listed as CL380 CA (not DA) "Closure Verification - clean-closure acceptable".
2. I flagged units that were not coded with an operating status as clean-closed, but seemed to have had an event signifying clean-closure. The report I used to identify the closure events ("Permit Progress and Data Gaps Report") show the clean-closure event linked to the unit, but in some cases that event is NOT linked to the unit according to other reports (like the "Comprehensive Permitting Report.") Maybe it is an issue with my assessment, not the report functioning.
3. There were other issues with the data used for permit expiration dates, so I deleted the expiration assessment from the XL file and refer you to use the dedicated report for those issues. The report you should use is called "Missing Permit Expiration Date (OP/PC270) Report).

Clarification:

The priority for this assessment is to check just the units with notes on column B of the attached file. For each unit prioritized in the file, you can scroll over to the column to the right to understand the basis for the issue.

All units were listed in the file in order to be able to see the other units at the facility and get a better understanding of the entire facility status.

I am available to look through the unit notes and do follow up with Regional/State contacts.

Please give me a call or e-mail if you would like to discuss it with me or for me to try to help weed out ones that may not be an issue (by doing additional review with RCRAInfo data).

Tab Sommer - *703-605-0636 - EPA / Office of Resource Conservation and Recovery / Permits Branch*