TO SAMPLE OR NOT TO SAMPLE?

CONTAMINANTS OF EMERGING CONCERN AT BROWNFIELD SITES AND THE MULTIPLE LINES OF EVIDENCE APPROACH

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Mark S. Heinzelmann, Esq.
Counsel, Lowenstein Sandler LLP

Brian S. Winfield, Esq.
Staff Attorney, Lowenstein Sandler LLP

Rick Shoyer
Senior Project Consultant, Montrose Environmental

Adam Hackenberg, P.G.
Senior Project Scientist, Langan Engineering and Environmental Services

What are CECs?

- Although there is no federal statutory or regulatory definitions of CECs, PADEP defines CECs as "any contaminants that are new to the environment or have been around for a long time but are just now able to be studied due to advances in laboratory techniques." Generally, CECs are **unregulated substances** that may present a risk to human health, aquatic life, or the environment.
- In 2012, PADEP began sampling streams and rivers for a variety of CECs.
- CEC categories in PA:
  - Per- and polyfluorinated alkyl substances ("PFAS")
  - Hormones
  - Pharmaceuticals
  - Pesticides
  - Polybrominated diphenyl ethers (PBDEs)
  - Polycyclic aromatic hydrocarbons (PAHs)
- Other CECs typically include 1,4-Dioxane, Perchlorate, and 1,2,3-TCP
- CECs are covered by PA general, narrative water quality criteria at 25 PA Code § 93.6, which provides that water may not contain "substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant, or aquatic life."

Table 1. Highest CEC time-weighted average (TWA) concentrations for each CEC category.

CEC Category	CEC	Highest TWA Concentration (ng/L)	Location
hormones	total estrogenicity	2.4	Conodoguinet Creek (Cumberland County)
	cholesterol	325.0	Delaware River (Bucks County)
PAHs	fluoranthene	37.0	Chester Creek (Chester County)
PBDEs	PBDE-183	1.4	Quittapahilla Creek (Lebanon County)
pesticides	atrazine	863.0	Mahoning River (Lawrence County)
pharmaceuticals	carbamazepine	1044.0	Chester Creek (Chester County)
wastewater indicator	diethyl phthalate	3088.0	Little Beaver Creek (Lancaster County)

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PA Establishes MCLs for PFOA and PFOS

- On January 14, 2023, PA established maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) for PFOA and PFOS in all public water systems and monitoring requirements for community water systems, nontransient community water systems, and bottled, vended, retail and bulk systems.

	MCLG (ng/L or ppt)	MCL (ng/L or ppt)
PFOA	8	14
PFOS	14	18

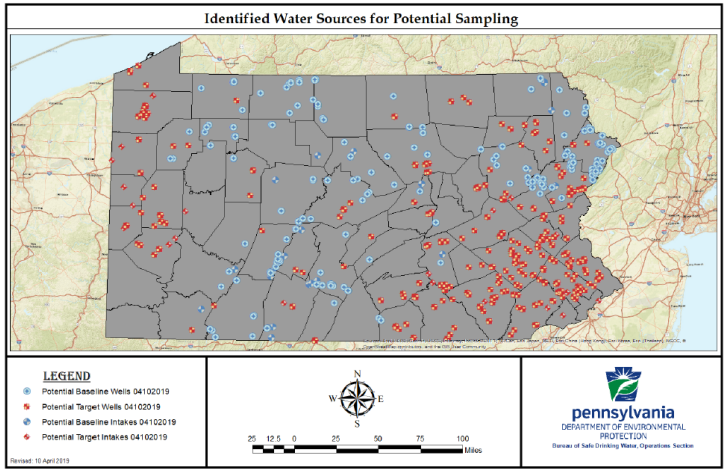
- In March 2023, the U.S. EPA announced proposed MCLs and MCLGs for PFOA, PFOS and 4 other PFAS that are stricter than in PA. Thus, once finalized, PA will have to amend its MCLs and MCLGs for PFOA and PFOS.

Compound	Proposed MCLG	Proposed MCL (enforceable levels)
PFOA	Zero	4.0 parts per trillion (also expressed as ng/L)
PFOS	Zero	4.0 ppt

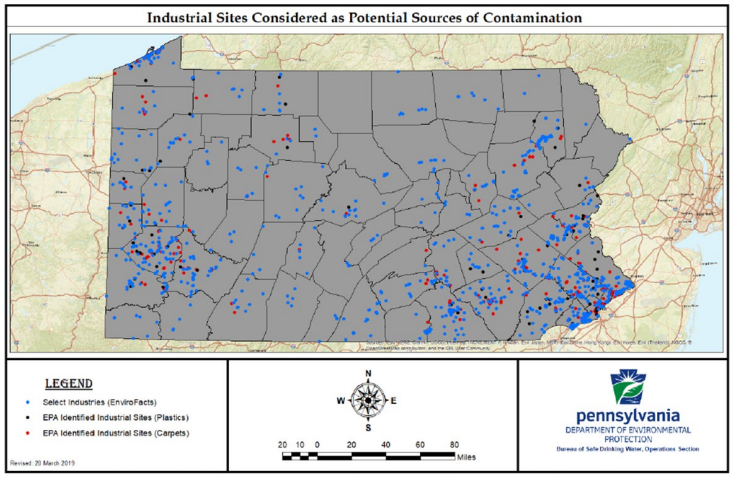
PA Statewide PFAS Sampling Plan

- In 2019, to identify and eliminate sources of PFAS contamination, ensure safe drinking water, and manage PFAS contamination, PADEP identified the following for potential PFAS sampling:
  - Water sources
  - Industrial sites
  - Airports
  - Fire training facilities
  - Military locations
- PADEP also identified known locations of PFAS contamination.

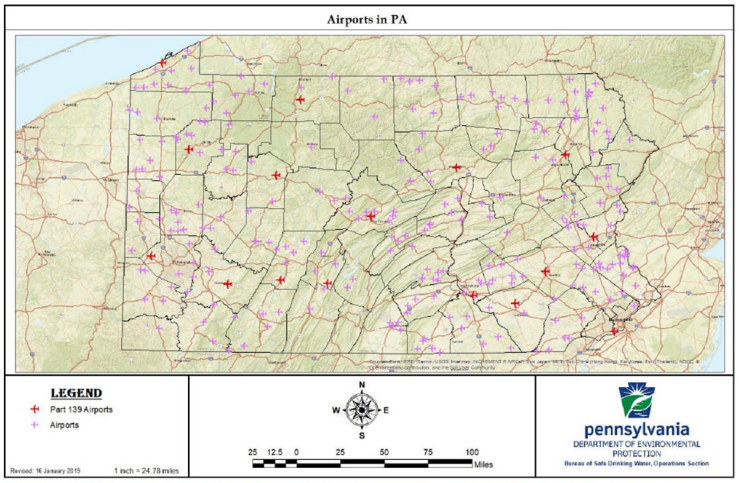
PA Statewide PFAS Sampling Plan



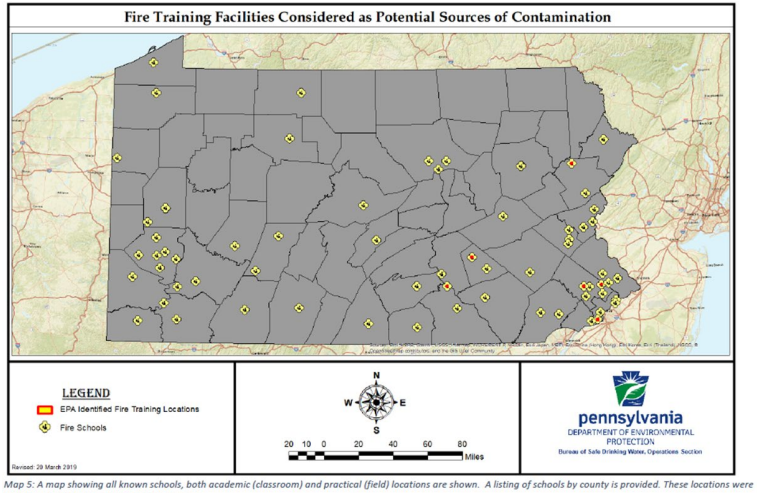
Map 1: Identified wells and intakes to be sampled. Both Target and Baseline selections are shown.



Map 2: A map showing the locations of industrial sites that were considered as part of the total population of Potential Sources of Contamination (PSOC).



Map 3: A map of all known airports, airfields and landing strips in Pennsylvania. Airports known to be regulated by the FAA and 14CFR139 are shown in red.



Map 5: A map showing all known schools, both academic (classroom) and practical (field) locations are shown. A listing of schools by county is provided. These locations were considered when selecting wells for sampling.

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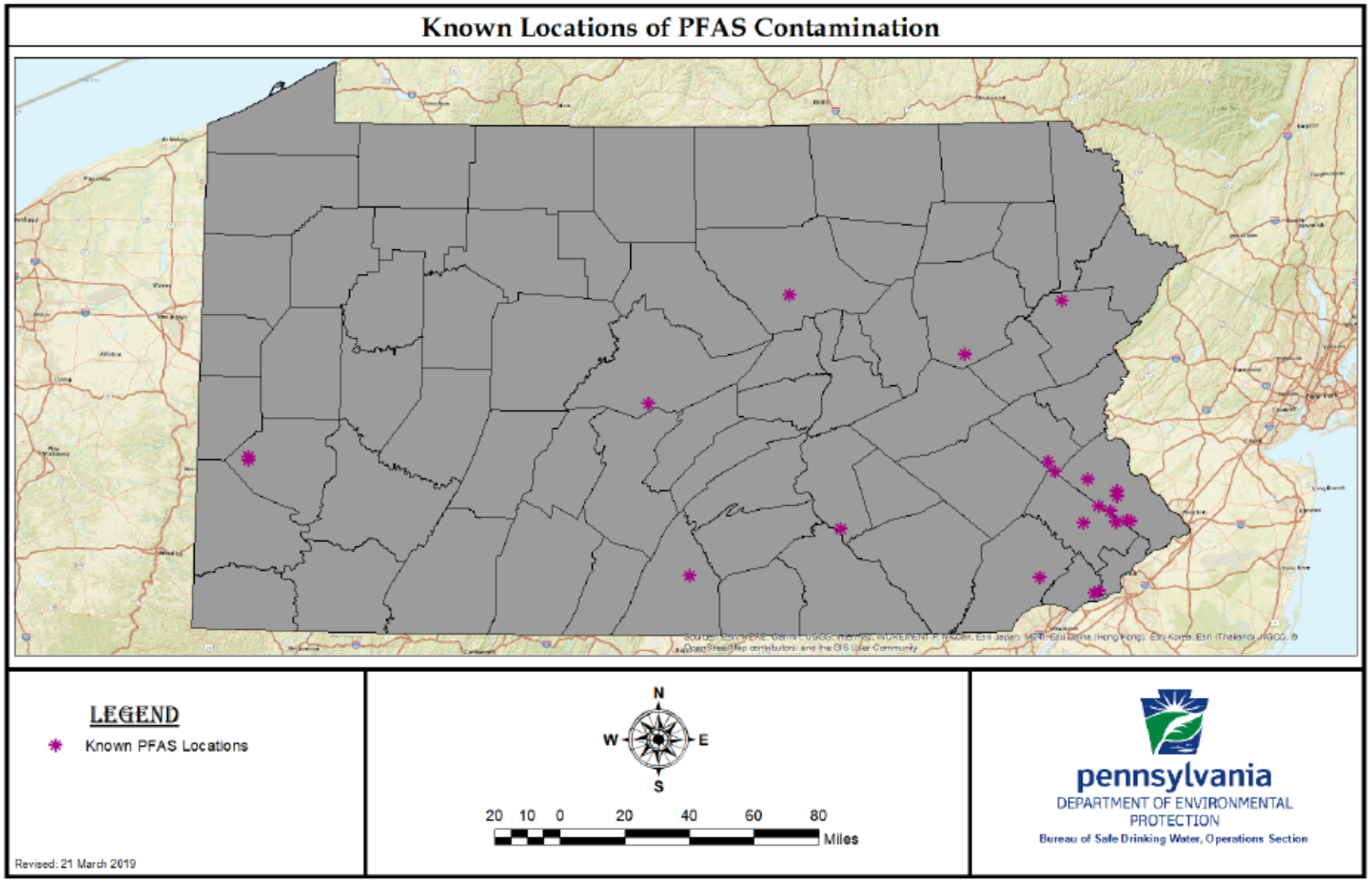
PA Statewide PFAS Sampling Plan



Map 7: A map showing all known locations in PA where PFAS has been found. Wells within ½ mile of these locations were excluded from consideration (if already sampled) when selecting wells for sampling.

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2019 PFAS Surface Water Sampling Results

Water quality network ID	Station Name	PFOA Concentration (ng/L)	PFOS Concentration (ng/L)	Hazard Index	Gen-X Concentration (ng/L)	PFBS Concentration (ng/L)	PFNA Concentration (ng/L)	PFHxS Concentration (ng/L)
WQN0137	Brodhead Creek at Minisink Hills, PA	1.7	4.0	0.2	0	1.5	0	2.0
WQN0224	Frankstown Br Juniata R at RR at Williamsburg, PA	2.5	4.8	0.2	0	3.8	0	1.6
WQN0867	Allegheny River at Kennerdell, PA	2.8	9.7	0.0	0	0	0	0
WQN0285	Quittapahilla Creek near Bellegrove, PA	3.8	4.8	0.3	0	5.5	0.8	1.9
WQN0263	Octoraro Creek near Richardsmere, MD	4.0	0.9	0.1	0	4.1	0	0.9
WQN0313	Lackawanna River at Old Forge, PA	4.1	1.1	0.1	0	11.0	0	1.1
WQN0271	Conodoguinet Creek near Hogestown, PA	4.3	10.0	0.3	0	2.7	0	3.1
WQN0286	Codorus Creek near Saginaw, PA	4.4	7.8	0.5	0	4.7	0.8	3.6
WQN0907	Connoquenessing Creek near Zelienople, PA	4.6	5.2	0.3	0	8.8	0	2.3
WQN0111	Schuylkill River at Pottstown, PA	4.9	3.5	0.3	0	3.6	1.2	1.4
WQN0116	Perkiomen Creek at Arcola near Collegeville, PA	5.1	3.6	0.1	0	3.3	0	1.2
WQN0915	Mahoning River at North Edinburg, PA	5.4	4.7	0.3	0	23.0	1.5	1.3
WQN0105	Brandywine Creek at Chadds Ford, PA	5.8	2.1	0.4	0	2.9	2.5	1.5
WQN0110	Schuylkill R at Falls Bridge, Philadelphia, PA	6.1	3.5	0.5	0	5.0	3.2	1.7
WQN0273	Conestoga River at Conestoga, PA	7.2	3.3	0.4	0	4.4	1.3	2.0
WQN0115	Wissahickon Creek at Mouth, Philadelphia, PA	9.0	6.6	0.6	0	5.1	2.4	3.0
WQN0150	Red Clay Creek near Kennett Square, PA	9.1	1.9	0.4	0	4.6	2.2	1.9
WQN0193	Wissahickon Creek at Fort Washington, PA	11.0	10.0	0.7	0	5.5	2.8	3.5
WQN0121	Neshaminy Creek near Langhorne, PA	11.0	23.0	1.2	0	6.2	1.9	9.1
WQN0154	Valley Creek at Wilson Road near Valley Forge, PA	16.0	9.2	1.9	0	3.2	16.0	2.8

PA Current PFAS MCL Standards for Public Drinking Water **PFOA 14 ppt, PFOS 18 ppt**- January 14, 2023

#Table A9. PFAS concentrations (ng/L) and hazard indices **(in bold)** that exceeded the **proposed USEPA MCL in 161** raw surface water stream observations from Pennsylvania watersheds, September 2019.

#See Table A1 and for PFAS abbreviations.

#Reference: USEPA (U.S. Environmental Protection Agency). 2023. PFAS National Primary Drinking Water Regulation Rulemaking. 40 CFR Parts 141 and 142. EPA-HQ-OW-2022-0114; FRL 8543-01-OW. RIN 2040-AG18. https://www.epa.gov/system/files/documents/2023-03/Pre-Publication%20Federal%20Register%20Notice_PFAS%20NPDWR_NPRM_Final_3.13.23.pdf

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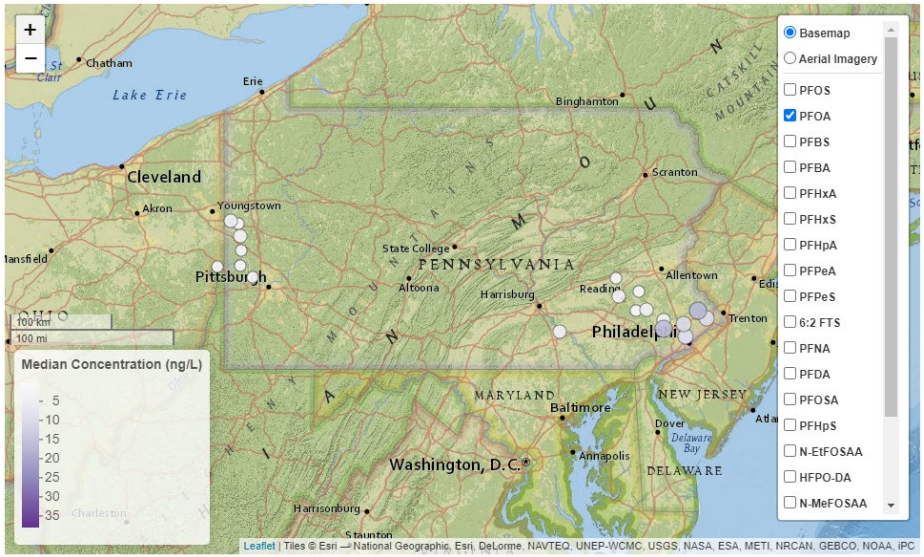
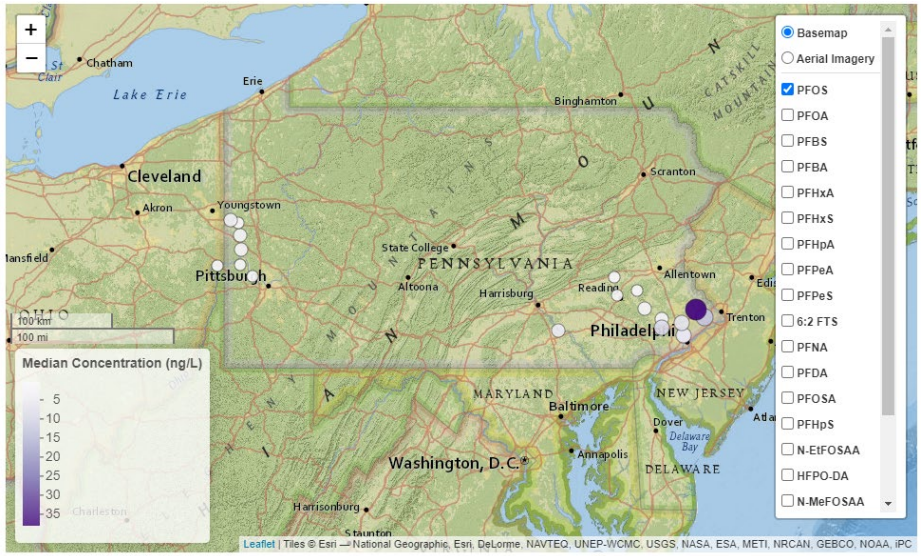
2023 PFOA/PFOS Surface Waters Results Map





CECs – Reasons and Risks of Sampling

- Reasons
  - Due diligence
  - Basis of treatment
  - Forensics
  - Risk assessments
  - Industrial hygiene
  - Upcoming regulation
  - Litigation
  - Proactive risk management
- Risks
  - Probability of detection
  - Identifying sources – commingled plumes
  - "Owning" the contamination
  - Lack of lab standards or analytical methods
  - Data reliability/regulatory acceptance

CECs Evaluation – Multiple Lines of Evidence

- **Multiple lines of evidence = Do your homework, i.e., gather and evaluate relevant site-specific and chemical specific information.**
- **Goal – Build multiple lines of evidence to determine whether to sample for CECs**
- **Information needed for the site includes, but is not limited to**:
  - Ownership
  - History
  - Storage and discharge materials
  - Site operations
  - Permitted discharges
  - Surrounding properties
- **Using gathered information to support decision-making and planning**:
  - Determining if CEC sampling is warranted based on multiple lines of evidence.
  - Developing sampling objectives.
  - Assessing the potential for, and expected magnitude of, background/regional impacts.
  - Identifying potential on-going source so that they can be eliminated or accounted for.
  - Identifying regulatory/legal drivers and implications and making plans for managing related risks.

CECs Evaluation – To Sample or Not to Sample? If so, How?

- **Decision to sample should be based on professional judgment driven by lines of evidence compiled during initial desk top review.**
- **Reasons not to sample:**
  - No known uses of CECs associated with the site and no historic property uses that might indicate CEC use
  - No related or commonly co-occurring constituents that may inform on the presence of CECs at the site
  - Documentation of site activities demonstrate CECs were contained and not released
- **Reasons to sample:**
  - Specific knowledge of CEC use, discharge, or emissions at the site
  - Reasonable suspicion of CEC presence due to site activities. Understanding how different CECs are used. For example:
    - Use of aqueous film forming foam to extinguish fires (PFAS)
- **General sampling/investigation guidelines**:
  - Start small by targeting areas that CECs would likely occur (i.e., AOCs, migration pathways, etc.)
  - Understand background contributions before expanding an investigation
  - **Preparing an appropriate sampling plan**
    - Media to be sampled
    - Sampling locations, depths, and sampling methods
    - CECs to be analyzed, analytical methods, and planned laboratory
    - Quality assurance / quality control (QA/QC) standards and protocols

CECs: Impacts on Brownfield Developments – Practical Impacts

- **Due diligence**
  - Understanding what CECs are present, or potentially present, at a site will guide site reuse options to limit exposure risk.
  - Understanding what CECs are present, or potentially present, will influence legal implications, i.e., liability, indemnifications, insurance, etc.
  - Purchase price negotiation
- **Remediation**
  - May impact remediation already being done by adding additional RI/RA
  - May impact the issuance of a final remedial document/permit
  - There may be certain reporting requirements if CECs are present
  - The presence of CECs may alter any engineering controls currently in place

LSRP/Consultant Considerations

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CECs Evaluation – Case Study #2 – PFAS

- Land redevelopment project at a regional airport
- Township's zoning approval was conditioned on a requirement to sample for PFAS in groundwater
- Targeted due diligence revealed:
  - an off-site source unrelated to the redevelopment project (and unknown to the authorities)
  - prior PADEP sampling showing no impacts in a well at the project site and only limited impacts in wells surrounding the project site
- Result – no additional PFAS sampling

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CECs Evaluation – Case Study #3 – PFAS

- Review of manufacturing process concluded that sampling was not warranted based on multiple lines of evidence:
  - Product composition
    - Did not include PFAS that are being considered for regulation (or that can be analyzed with currently available methods)
    - Some components may transform into PFOA, but at relatively low yields (1 – 10%)
  - History of use
    - Less than 735 pounds used over 2 – 3 years
    - Area of storage and use was well-contained
    - Excess liquid product was recovered and recycled back into the process
    - A small amount of remaining excess "mist" was vented after treatment with a thermal oxidizer, at temperatures that would be expected to destroy key product components (including PFAS) with a > 90% treatment efficiency
    - Preliminary estimates indicated that atmospheric deposition would not have been expected to result in environmental impacts at concentrations at or approaching regulatory significance
- Agency agreed with conclusion not to sample based on lines of evidence presented

CECs Evaluation – Case Study #4 – PFAS

- Manufacturer historically used a product containing fluorotelomer intermediates
- After reviewing manufacturer's product history, agency asked manufacturer to consider sampling for PFAS.

List of Ingredients from the MSDS Sheet

COMPOSITION/INFORMATION ON INGREDIENTS

Components

Material	CAS Number	%
Perfluoroalkylethyl Acrylate Esters	65605-70-1	87-95
Perfluorohexylethyl Acrylate	17527-29-6	1-7
Perfluorooctylethyl Acrylate	27905-45-9	42-56
Perfluorodecylethyl Acrylate	17741-60-5	22-30
Perfluorododecylethyl Acrylate	34395-24-9	6-12
Perfluorotetradecylethyl Acrylate	34362-49-7	1-5
Perfluorohexadecylethyl Acrylate	65150-93-8	0.1-2
Water	7732-18-5	0-1
Perfluoroalkylethyl Alcohol	65530-60-1	0.1-4
1,1,2,2-Tetrahydroperfluoro-1-Decanol	678-39-7	0.1-2
1,1,2,2-Tetrahydroperfluoro-1-Dodecanol	865-86-1	0-1
Perfluoroalkylethyl Acrylate Polymer	NOTAVAIL.	0.1-3
Perfluoroalkylethyl Iodides (Telomer B)	71215-70-8	1-4
Perfluorooctylethyl Iodide	2043-53-0	0.5-2
Perfluorodecylethyl Iodide	2043-54-1	0.2-1

CECs Evaluation – Case Study #4 – PFAS

- Review of manufacturing process concluded that sampling was not warranted based on multiple lines of evidence:
  - Product composition
    - Did not include PFAS that are being considered for regulation (or that can be analyzed with currently available methods)
    - Some components may transform into PFOA, but at relatively low yields (1 – 10%)
  - History of use
    - Less than 735 pounds used over 2 – 3 years
    - Area of storage and use was well-contained
    - Excess liquid product was recovered and recycled back into the process
    - A small amount of remaining excess "mist" was vented after treatment with a thermal oxidizer, at temperatures that would be expected to destroy key product components (including PFAS) with a > 90% treatment efficiency
    - Preliminary estimates indicated that atmospheric deposition would not have been expected to result in environmental impacts at concentrations at or approaching regulatory significance
- Agency agreed with conclusion not to sample based on lines of evidence presented

CECs Evaluation – Overall Considerations

- Must approach this evaluation carefully – if you sample for CECs, you may find them and then potentially "own" the contamination.
- Putting significant resources into a multiple lines of evidence evaluation can pay off in the long run.
  - Despite widespread of PFAS and other CECs in PA, if you can show your site never manufactured or handled them, then that may suffice for regulatory officials.
- There are not limits on the format of a CECs multiple lines of evidence evaluation – it can be as thorough or minimal as suits your case. But the regulatory authority has the last say.
- Involve legal counsel in cooperation with consultant to develop multiple lines of evidence evaluation.
- Have a plan in place if you must sample – limit sampling as much as possible.
- Paper the plan with the regulatory authority overseeing the site when a path is chosen.
- Consider timing – both the evaluation and any eventual investigation/remediation of CECs.
- Consider how the regulatory authority may scrutinize a CEC evaluation and/or investigation/remediation at a later stage, such as the permit review stage.

Panel Q/A

THANK YOU!