Contaminants of Concern & Emerging Concern

September 27, 2023

Guilford County LEPC – BISE Conference

"With each zero of added sensitivity, myriads of other chemicals are evident…That's alarming to a public whose definition of a trace *hasn't changed since the 1970's and whose ideal remains 'pure' water…It's a tremendous problem when you're interpreting risk for the public."*

– Christian Daughton, EPA National Exposure Laboratory, Las Vegas NV

Background Information
City of Greensboro WWTP

- T. Z. Osborne (TZO) WWTP
  - Design Flow: 56 MGD   Actual Eff Flow: ~33 MGD
  - 26 Significant Industrial Users (SIUs)
- TZO Discharges to: South Buffalo Creek → Buffalo Creek → Reedy Fork Creek → Haw River → Jordan Lake → Cape Fear River → Atlantic Ocean

Greensboro Wastewater Collection System

- 1,600 miles of sewer lines
- 50 Pump stations
- 33,917 manholes
- 100,000+ connections to the sanitary sewer
- 8,000^{+} commercial/industrial connections/accounts
- Daily flow transfer from NB Pump Station to TZO
    - NB Transfer flow enters TZO *after* influent sampling point – WWTP Flow Split: TZO ~55%, NB ~45%

CONTAMINANTS OF CONCERN

“Conventional” Pollutants & Toxics

- June 2020 – Accidental discharge
  - Review Spill Plans & Procedures
    - COVID-19 → New staff & high turnover rates
  - Ensure staff are properly trained
- May 2022 - TZ Osborne Plant Upset
  - Accidental discharge of concentrated biocide

Nutrients - Jordan Lake Rules

- Total Phosphorus
- Total Nitrogen
- T.Z. Osborne upgrade
  - 56 MGD
  - Single-phase activated sludge to 5-Stage BNR
- Haw River Nutrient Compliance Association (HRNCA)

CONTAMINANTS OF EMERGING CONCERN

Emerging Constituents: What Do They Mean to a POTW?

Targeted as "*The*" Source" by Environmentalists

Responsible for "Removing Them" (says Public/DS)

Over-reaction by Political/Regulatory Sectors

Unrelenting Media Coverage

Bulls Eye on Biosolids Land Application

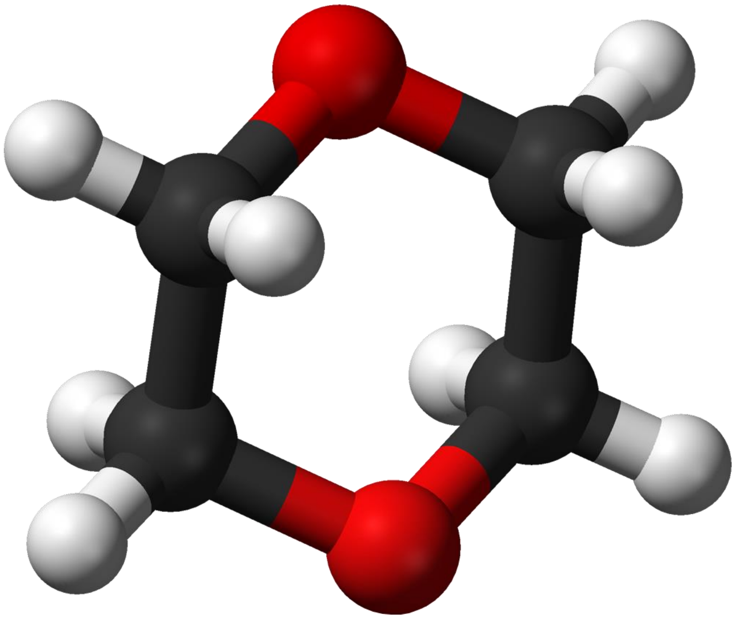
Liability if you try to be proactive

Expensive testing for new chemicals

Nobody Knows the Trouble We've Seen…

Greensboro and 1,4-Dioxane

1,4-dioxane



- “Forever chemical”
- Stabilizer
- Highly miscible in water
- Found in surfactants, cosmetics, hair relaxers
- Not “on the label” – look for:
  - Sodium laureth sulfate
  - PEG compounds
  - -xynols, -ceteareths, -oleths

2014 Background Information City of Greensboro POTWs

- North Buffalo (NB)
  - Design Flow: 16 MGD Actual Eff Flow: ~6 MGD
  - 4 Significant Industrial Users
  - ~6 MGD flow transferred to T. Z. Osborne
  - Waste Activated sludge pumped to TZO
- T. Z. Osborne (TZO)
  - Design Flow: 40 MGD Actual Eff Flow: ~24 MGD
  - 26 Significant Industrial Users (SIUs)
  - Solids dewatering (centrifuges) and incineration (fluidized bed) conducted for both plants at TZO
- Both Discharge to Haw River→Cape Fear River

The Beginning…

- EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3)
  - Sampling from 2013-2015
  - Early results showed several drinking water plants (with Cape Fear River intakes) with 1,4-dioxane detections
  - NCSU Professor sees data…sends students up Cape Fear River
- NCSU presentation to DEQ states Greensboro is 1,4-dioxane hot spot
- June 2014 - TZO NPDES Permit issued with 1,4-dioxane reopener
- Greensboro Position: Let EPA finish UCMR3, review data and see what they decide to do about 1,4-dioxane

Timeline

Apr 2014-Oct 2014: NPDES Permit; Meetings-DEQ, Internal, SIU/IUs

Oct 2014: DEQ & NCSU begin official 1,4-dioxane studies

Mar-Oct 2015: Peer Meeting; Initial POTW Sampling = 58 samples

May-Oct 2015: Trunkline Monitoring = 51 samples

Oct 2015: Significant SIU Source Identified; TZO sampling suspended

Significant Source Found

- Greensboro suspended POTW sampling for a period of time to allow the industry to:
  - Conduct internal facility/processes investigation
  - Perform internal sampling and analyses
  - Determine source of discharge at their facility
  - Research processes for reduction
  - Develop 1,4-dioxane Reduction Plan
- IWS in contact with them continuously
- Everyone working hard…still under the radar

Source and POTW:
"What Do We Do Now?"

- No Federal Drinking Water MCL
- Various 1,4-Dioxane criteria
  - EPA Drinking Water Health Advisory = 35 µg/l
    - Characterized as "likely to be carcinogenic to humans"
  - NC Groundwater standard: 3.0 µg/l
  - NC Human Health surface water criterion with associated estimated lifetime cancer risk of 1/1,000,000**
    - Water Supplies = 0.35 µg/l
    - All other water bodies = 80 µg/l

***Per 15A NCAC 02B .0208*

Reductions Achieved

- POTW sampling resumed and showed significant reduction
- POTW effluent reductions achieved only because SIU/IU achieved reductions
  - As with most new reduction procedures and treatment processes there have been a few blips
- Greensboro verbally shared POTW results with DEQ and downstream utility

EPA Approved WW Method

- *September 2017*: EPA promulgates 40 CFR Part 136 method for 1,4-dioxane
  - EPA 624.1 Purgeable Organics by GC/MS
  - Grab sample in VOA vials
- Greensboro terrified Part 136 WW method would not be comparable to SW method
  - Success might not be real…efforts for naught
  - Splits on both methods for 5 months to confirm
  - Amazingly comparable data (this time!)

DEQ Administrative Letter

- *October 7, 2017*: NB POTW Closed
- *October 31, 2017*: DEQ Administrative Letter to Greensboro TZO POTW
  - Starting *December 2017*, TZO must conduct monthly effluent monitoring for 1,4-dioxane
  - Use EPA WW Method 624.1 (grab sample)
  - Report results on eDMR
- POTW no longer under the radar

Special Order by Consent

- Original Special Order by Consent (SOC) between the City & Environmental Management Commission (EMC) signed in *March 2021* with effective date of *May 1, 2021*.
  - The initial and primary goal was not to cause downstream drinking water supplies to exceed the EPA health advisory 35 ug/L

Amended SOC

- *November 22, 2021*: Amended SOC with an effective date of *December 1, 2021*.
- Amended SOC Compliance Values:
  - Year 1 = 35 ug/L
    - *May 1, 2021 – April 30, 2022*
  - Year 2 = 31.5 ug/L
    - *May 1, 2022 – April 30, 2023*
  - Year 3 = 23 ug/L
    - *May 1, 2023 – April 30, 2024*

Amended SOC

- Amended SOC Sampling Plan includes 60 sites:
  - 7 TZO facility sites
  - 7 Industrial trunkline sites
  - 5 Domestic/Commercial trunkline sites
  - 5 Greensboro Drinking water sources sites
  - 32 Significant Industrial User (SIU) sites
  - 4 Other sites

Greensboro Contaminants of Emerging Concern (CEC) Policy

- *February 1, 2022*: New CEC Policy effective
  - Outlines Greensboro's approach to CECs
  - Purpose, Legal Authority, Definitions
  - Not specific to 1,4-dioxane
- City consulted with environmental attorney
- Provided to SIUs/IUs and posted on website
  - ERP updated as well, comments solicited from SIUs/IUs, will be submitted to NCDEQ soon
  - SUO modifications are also forthcoming in order to completely implement the Policy.

Resources and Costs

- POTW (still counting)
  - Hundreds of samples
  - Thousands of man-hours
  - Tens of thousands of dollars

- SIU/IU (still counting)
  - Hundreds of samples
  - Thousands of man-hours
  - *Hundreds* of thousands of dollars

Results thus Far

- During initial sampling phase of City's 2015 1,4-dioxane study, TZO sand filter effluent composite samples averaged 126ug/L

SOC Year 1	SOC Year 2
• TZO effluent (52 eDMR grab samples) averaged 32.7ug/L • 74% reduction from 2015 effluent concentrations	• TZO effluent (52 eDMR grab samples) averaged 2.96ug/L • 98% reduction from 2015 effluent concentrations

- Source reduction key to success

NC Surface WQS

- *March 2022*: EMC adopted 1,4-dioxane WQS
  - 0.35 ug/L for Water Supply waters
  - 80 ug/L for all other waters.
  - The T. Z. Osborne (TZO) facility would be subject to the 0.35 ug/l standard.
- City (among others) submitted objections
  - Fiscal Note & proper legislative process
- *May 2022*: RRC objected to 1,4-dioxane WQS

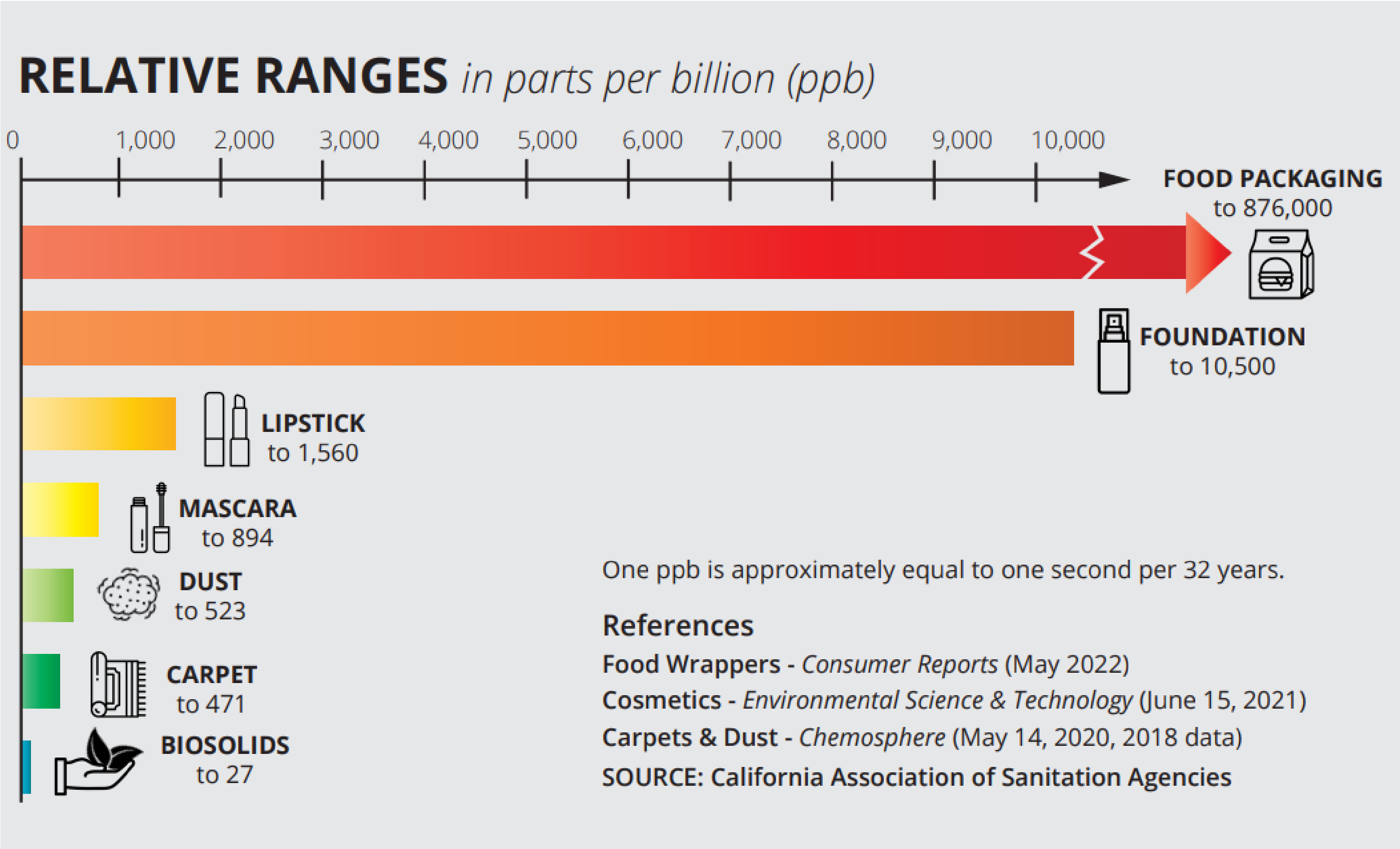
PFAS (Per and Polyfluoroalkyl Substances)

- Manmade fluorinated compounds in commercial use since 1940s
- 9,000+ compounds known as "forever chemicals"
- Widely used for resistance to heat, water, & oil
- Common Uses
  - Non-stick cookware
  - Water-repellant clothing
  - Stain resistant textiles
  - Cosmetics
  - Firefighting foams
  - Electroplating (fume suppressant)

PFAS

- Entities providing essential public services are not "users" or "producers"
  - Drinking water treatment,
  - Wastewater treatment,
  - Biosolids recycling, etc.
- Received by these entities due to abundance in today's society

PFAS by the Numbers



**Credit – Metropolitan Water Reclamation District of Greater Chicago*

PFAS

- NC DEQ addressing PFAS since 2017
  - GenX found in Cape Fear River
- *2019*: NC DEQ requires PFAS, 1,4-dioxane sampling by 25 POTWs with Pretreatment Programs in Cape Fear River basin
- *2021*: PFAS Strategic Roadmap: EPA's Commitments to Action 2021-2024
  - UCMR 5
  - National POTW PFAS sampling
- *2022*: NC DEQ Action Strategy for PFAS

EPA - UCMR 5

- *March 11, 2021*: UCMR 5 published in Federal Register
- Sampling began January 2023 & continue through December 2025
- https://www.epa.gov/system/files/documents/2022-02/ucmr5-factsheet.pdf
- 29 PFAS & Lithium

Contaminant	CASRN[1]	MRL[2] (µg/L)	Additional Information
25 PFAS: EPA Method 533			
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	0.005	PFAS are a group of synthetic chemicals used in a wide range of consumer products and industrial applications including: non-stick cookware, water-repellent clothing, stain-resistant fabrics and carpets, cosmetics, firefighting foams, electroplating, and products that resist grease, water, and oil. PFAS are found in the blood of people and animals and in water, air, fish, and soil at locations across the United States and the world.
1*H*,1*H*, 2*H*, 2*H*-perfluorodecane sulfonic acid (8:2FTS)	39108-34-4	0.005	
1*H*,1*H*, 2*H*, 2*H*-perfluorohexane sulfonic acid (4:2FTS)	757124-72-4	0.003	
1*H*,1*H*, 2*H*, 2*H*-perfluorooctane sulfonic acid (6:2FTS)	27619-97-2	0.005	
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	0.003	
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	0.002	
hexafluoropropylene oxide dimer acid (HFPO-DA)(GenX)	13252-13-6	0.005	
nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	0.02	
perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	0.003	
perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	0.004	
perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	0.003	
perfluorobutanesulfonic acid (PFBS)	375-73-5	0.003	
perfluorobutanoic acid (PFBA)	375-22-4	0.005	
perfluorodecanoic acid (PFDA)	335-76-2	0.003	
perfluorododecanoic acid (PFDoA)	307-55-1	0.003	
perfluoroheptanesulfonic acid (PFHpS)	375-92-8	0.003	
perfluoroheptanoic acid (PFHpA)	375-85-9	0.003	
perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.003	
perfluorohexanoic acid (PFHxA)	307-24-4	0.003	
perfluorononanoic acid (PFNA)	375-95-1	0.004	
perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.004	
perfluorooctanoic acid (PFOA)	335-67-1	0.004	
perfluoropentanesulfonic acid (PFPeS)	2706-91-4	0.004	
perfluoropentanoic acid (PFPeA)	2706-90-3	0.003	
perfluoroundecanoic acid (PFUnA)	2058-94-8	0.002	
4 PFAS: EPA Method 537.1			
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	0.005	See above for PFAS information.
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	0.006	
perfluorotetradecanoic acid (PFTA)	376-06-7	0.008	
perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.007	
Metal/Pharmaceutical: EPA Method 200.7; SM[3] 3120 B (2017); SM[3] 3120 B-99 (1999); ASTM[4] D1976-20			
lithium	7439-93-2	9	Naturally occurring metal that may concentrate in brine waters; lithium salts are used as pharmaceuticals, used in electrochemical cells, batteries, and in organic syntheses.

Draft WW Analytical Methods

- EPA Draft Method 1621
  - Screening Method for the Determination of Adsorbable Organic Fluorine (AOF)
  - Combustion Ion Chromatography (CIC)
  - Aqueous Matrices
- EPA Draft Method 1633
  - Draft Method for 40 PFAS Compounds
  - Liquid Chromatography/Mass Spectrometry (LC-MS/MS)
  - Aqueous, Solid (soil, biosolids, sediment), & Tissue Matrices

EPA Draft Method 1633

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonic acids	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluoropentanesulfonic acid	PFPeS	2706-91-4
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorononanesulfonic acid	PFNS	68259-12-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
	Perfluorododecanesulfonic acid	PFDoS	79780-39-5
Perfluoroalkyl carboxylic acids	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUnA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	376-06-7

EPA Draft Method 1633 cont'd

Group	Chemical Name	Abbreviation	CAS Number
Per-and Polyfluoroether carboxylic acids	Hexafluoropropylene oxide dimer acid (GEN X)	HFPO-DA	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Fluorotelomer sulfonic acids	4:2 Fluorotelomer sulfonic acid	4:2-FTS	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2-FTS	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2-FTS	39108-34-4
Fluorotelomer carboxylic acids	3:3 Fluorotelomer carboxylic acid	3:3 FTCA	356-02-5
	5:3 Fluorotelomer carboxylic acid	5:3 FTCA	914637-49-3
	7:3 Fluorotelomer carboxylic acid	7:3 FTCA	812-70-4
Perfluorooctane sulfonamides	Perfluorooctane sulfonamide	PFOSA	754-91-6
	N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8
	N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2

EPA Draft Method 1633 cont'd

Group	Chemical Name	Abbreviation	CAS Number
Perfluorooctane sulfonamidoacetic acids	N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA	2991-50-6
Perfluorooctane sulfonamide ethanols	N-methylperfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
	N-ethylperfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2
Ether sulfonic acids	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUdS	763051-92-9
	Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7

PFAS

- NC-DWR
  - PFAS addressed in recent draft NPDES permits
    - Monitoring requirements effective when EPA Draft Methods finalized
  - PFAS survey for all new SIUs
- City of Greensboro
  - 2019: added PFOS & PFOA to SIU/IU permit applications
  - Drinking Water Treatment Plant Upgrades
    - Mitchell Water Plant

Source Considerations

- Industrial Activities Identified by EPA as Potential PFAS Sources
  - Airports, including FAA training facilities
  - Aerospace, including aircraft maintenance
  - Fire training facilities
  - Electroplating & Metal Finishing
  - Centralized Waste Treatment
  - Landfills
  - Pharmaceutical mfg.
  - Semiconductor mfg.
  - Organic Chemical & Synthetic Fibers Mfg (OCPSF)

Source Considerations

- Source *at the Source*…
  - Actual Raw Material?
  - Inert by-product in purchased raw materials?
  - Formed during on-site production inadvertently?
- Source *at the Source* Control…
  - Chemical Substitution?
  - Chemical supplier change with ↓ contaminants?
  - Process changes, including process shut-down?
  - Pretreatment System?
  - Zero discharge?
  - Facility shut-down?

What We Need from State/ Federal Regulatory Agencies

- National standards *not* state roulette
  - Developed by pure science not political science
  - Prioritized by actual risk
- Public Relations and Public Education re: Risk Assessment and Risk Communication
  - Education of the public and legislators to prevent knee-jerk reaction to every new detection
- Regulation/health effects research on new chemicals prior to registration

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