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Outline

Part I: The Science

- What are PFAS?
- Where are they used?
- How harmful are they?
- How can they be effectively assessed and managed?

Part II: The Law – Europe and the UK

- How are PFAS regulated?
- What is the claims landscape?
- What are the expectations for the future?

Part III: US Claims, Laws and Regulations

- What is the claims landscape in the US?
- How are PFAS regulated in the US?

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Part I: The Science

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Presentation Overview

Part 1: The Science

i. What are PFAS?
ii. Where are they used?
iii. How Harmful are they?
iv. How can they be effectively assessed and managed?
v. UK & Ireland Project Examples

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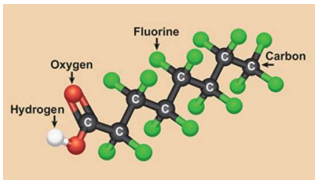
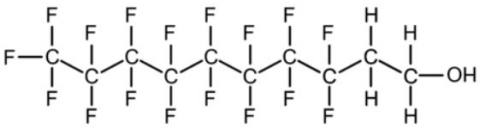
What are PFAS?

- PFAS: Per- and Polyfluoroalkyl Substances.
  - Perfluoroalkyl substances are fully fluorinated (perfluoro-) alkane (carbon-chain) molecules.
  - Polyfluoroalkyl are distinguished from perfluoroalkyl substances by not being fully fluorinated. Instead they have a non-fluorine atom (typically hydrogen or oxygen) attached to at least one, but not all, carbon atoms, while at least two or more of the remaining carbon atoms on the carbon chain are fully fluorinated.
  - Complexity comes with the number of PFAS compounds which have been found; currently more than 4,700 exist. Environmental industry has historically been used to looking at groups of 10 – 30!





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What are PFAS?

- Perfluoroalkyl Substances.
  - Functional groups commonly are carboxylates or sulfonates, but other forms are also detected in the environment.

Family	Class	Group	General Chemical Structure: $C_nF_{2n+1}R$, where R =	Examples	Uses
PERFLUORINATED	Perfluoroalkyl acids (PFAAs)	Perfluoroalkyl carboxylic acids (PFCAs)	-COOH	Perfluorooctanoic acid (PFOA), $C_7F_{15}COOH$	Surfactant
		Perfluoroalkyl carboxylates (PFCAs)	$-COO^-$	Perfluorooctanoate (PFOA), $C_7F_{15}COO^-$	
		Perfluoroalkane sulfonic acids (PFSAs)	$-SO_3H$	Perfluorooctane sulfonic acid (PFOS), $C_8F_{17}SO_3H$	Surfactant
		Perfluoroalkane sulfonates (PFSAs)	$-SO_3^-$	Perfluorooctane sulfonate (PFOS), $C_8F_{17}SO_3^-$	
	Perfluoroalkane sulfonamides (FASAs)	Perfluoroalkane sulfonamides (FASAs)	$-SO_2NH_2$	Perfluorooctane sulfonamide (FOSA), $C_8F_{17}SO_2NH_2$	Major raw material for surfactant and surface protection products

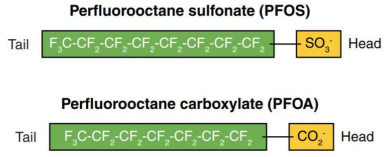

Figure 2-2. The tail and head structure of PFOS and PFOA molecules

Taken from ITRC

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What are PFAS?

- **Physical Properties**
  - Many PFAS are in solid form at room temperature, often as a white powdery or waxy substance though some maybe liquids.
  - Physical property details of PFAS and may relate to the form of the compound, which is not the most environmentally relevant form.

- **Chemical Properties**
  - Some of the key chemical properties of PFAS are directly associated with the carbon-fluorine bonds

Fluorine Characteristic	Description	Result	Resulting Property of PFAS
High electronegativity	Tendency to attract shared electrons in a bond	Strong C-F bond	Thermal stability
			Chemical stability (low reactivity)
		Polar bond with partial negative charge towards F	Strong acidity (low pKa)[1]
Low polarizability	Electron cloud density not easily impacted by the electric fields of other molecules	Weak intermolecular interactions (for example, van der Waals, hydrogen bonds)	Hydrophobic and lipophobic surfactant properties[2]
		Low surface energy	
Small size	Atomic radius of covalently bonded fluorine is 0.72 Å	Shields carbon	Chemical stability (low reactivity)

[1]When paired with an acid functional group such as a carboxylic or sulfonic acid
[2]When paired with a functional group that is hydrophilic (for example, a carboxylate)
Å = Angstrom

Taken from ITRC

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Where are they Used?

- **Common major manufacturing sources of PFAS release to the environment**
  - Cookware
  - Fire fighting foams – Class B foams
  - Textiles and leather – water repellence;
  - Paper products – repellence of grease & moisture
  - Metal plating and etching – Corrosion prevention, surfactant, wetting agent/ fume suppressant for chrome, copper, nickel and tin electroplating
  - Wire manufacturing – coating and insulation
  - Industrial surfactants, resins, molds, plastics – manufacture, plumbing flux agent, coatings, composite resins and fire retardance.
  - Photolithography, semiconductor industry – anti reflective coatings.
  - Leaning agents, polishes, waxes, paints
  - Hydraulic fluids adhesives
  - Medical products
  - Personal care products

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Where are they Used?

- Commercial & consumer products containing PFAS
  - Paper and packaging
  - Clothing and carpets
  - Outdoor textiles and sporting equipment
  - Ski and snowboard waxes
  - Windscreen wipers
  - Paints, varnish's, dyes and inks
  - Adhesives
  - Medical products
  - Waste water treatment plants

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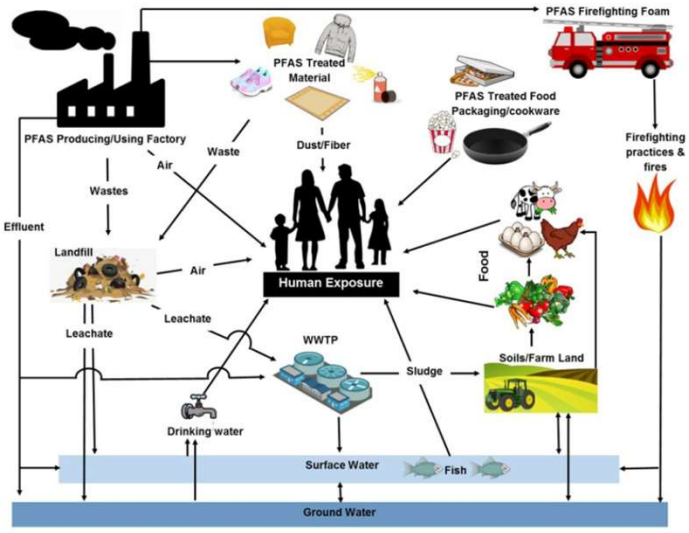
How Harmful Are They?



Human Exposure and sources of PFAS
Image: DWP, adapted from Oliaei et al. 2013.

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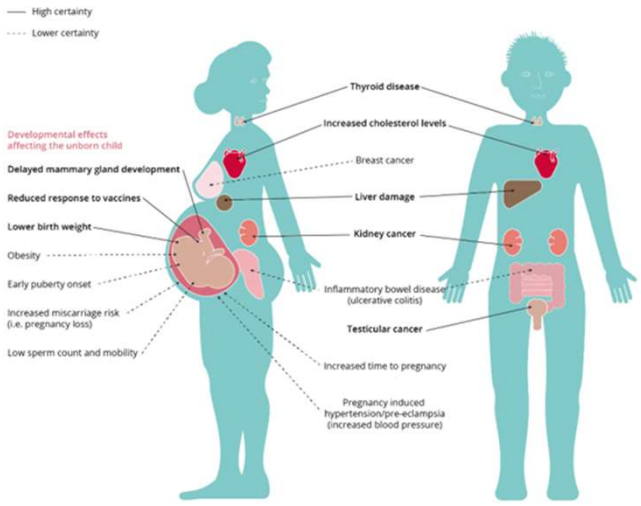
How Harmful Are They?

- Potential Effects of PFAS on Human Health

Figure 1. Effects of PFAS on human health



Taken from https://webdosya.csb.gov.tr/db/aca/icerikler/eea-br-ef-ng-on-pfas-20190905162940.pdf

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PFAS Site Characterization Drivers

- The number of sites required to undergo screening for PFAS is rapidly increasing
- Understand current and proposed regulations and the regulatory drivers specific to your location
- Other potential reasons to characterize PFAS
  - Public pressure
  - Water use/Discharge permitting
  - Cost recovery/Insurance claims
  - Mergers, acquisitions and transactions
  - Litigation

"The only places we're not finding PFAS are places we're not looking"

Heidi Grether, Director, Michigan Department of Environmental Quality

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PFAS Characterization Strategies

- Develop an initial conceptual site model
  - Create your sampling plan assuming you are going to have at least some detections of PFAS
  - Understand the bias created by existing sampling networks
  - Think about what detections at different locations and concentrations would indicate…BEFORE you sample
- Understand what other nearby contributors may exist
- Consider potential for sample contamination from pling and health and safety equipment




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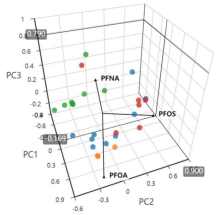
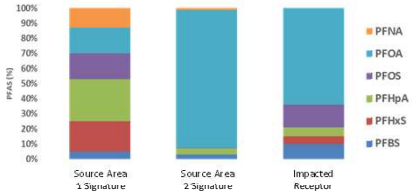
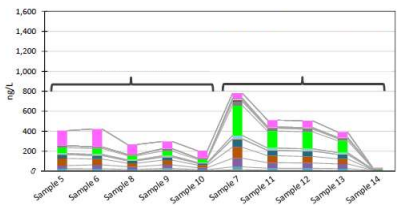
PFAS Forensics in

- Application of specialized analytical tools
  - Total Oxidizable Precursor (TOP) Assay
  - Particle Induced Gamma-Ray Emission (PIGE) Analysis)
  - Adsorbable Organic Fluorine (AOF) Analysis
- PFAS ratio “fingerprints”
- Indicator compounds
- Multivariate analysis
- Fate and transport properties







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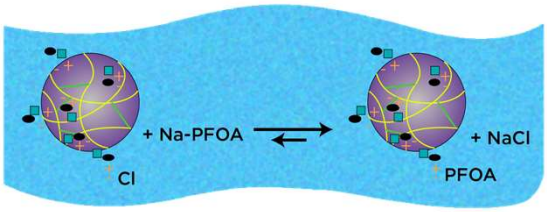
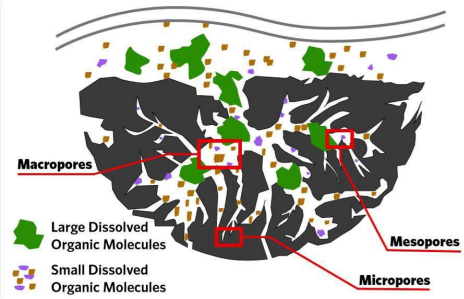
Current Commercialized Treatment Options

Ion Exchange (IX) Resins





Granular Activated Carbon (GAC)

Reverse Osmosis (RO)

evoqua

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USEPA Assessment from September 2020

EPA

Drinking Water Treatment for PFOS

Ineffective Treatments

- Conventional Treatment
- Low Pressure Membranes
- Biological Treatment (including slow sand filtration)
- Disinfection
- Oxidation
- Advanced Oxidation

PAC Dose to Achieve

50% Removal	16 mg/l
90% Removal	>50 mg/L

Dudley et al., 2015

Effective Treatments	Percent Removal	
Anion Exchange Resin (IEX)	90 to 99	- Effective
High Pressure Membranes	93 to 99	- Effective
Powdered Activated Carbon (PAC)	10 to 97	- Effective for only select applications
Granular Activated Carbon (GAC)		
• Extended Run Time	0 to 26	- Ineffective
• Designed for PFAS Removal	> 89 to > 98	- Effective

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https://www.epa.gov/sites/production/files/2020-09/documents/r1-pfas_webinar_day_1_session_3_speth.pdf

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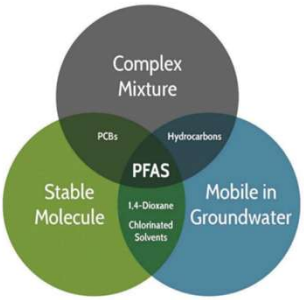
Design Considerations for Successful Treatment

- Technical Considerations
  - Water Quality
    - Temperature
    - Organic carbon
    - Co-contaminants
    - Suite of PFAS compounds
  - System fouling potential
  - System scale (POU/Wellhead/Facility)
- Business Considerations
  - Cost
  - Risk Tolerance
- Disposal cost

Figure 4.2. PFAS comparison to other contaminant classes.



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UK & Ireland – Project Examples

- Scotland - SEPA regulatory system
  - Historical industrial site from 1940's onwards, commercial setting
  - Multi contaminant site – Chlorinated solvents, hydrocarbons, mercury
  - Site was planned for transition to a residential developer
  - SEPA requested as part under planning regime to consider PFAS impact potential
  - Solution: Provision of Phase I Technical EDD auditing approach.
    - SEPA and local council approved approach and findings.

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UK & Ireland – Project Examples

- England – Water Authority
  - Drinking Water Inspectorate guidelines are low for PFAS and PFOA.
  - Production well showing continual increasing PFAS trends to the point that blending will not be a potential solution in 1-2 years time
  - Number of potential industries in the production catchment that could be determined as the *"polluter"* but the correct characterisation approach needs to be adopted.
  - Solution(s):
    - Forensic analysis utilising the EA borehole monitoring network coupling PFAS with other analytes to build a CSM.
    - Understanding potential water treatment options required to meet DWI requirements in the next 1-2years.

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UK & Ireland – Project Examples

- England – Chemical Facility
  - Emergency response situation arose whereby known release of fire fighting foam was release from onsite firefighting infrastructure.
  - Onsite water abstraction well onsite.
  - Permitted facility so formally notified situation to the regulatory authority.
  - No further action required by regulator.

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UK & Ireland – Project Examples

- Ireland – Regulatory Awareness
  - Irish Environmental Protection Agency requested Geosyntec to provide PFAS awareness training
    - Included contaminated land, waste and permitting departments.
  - Early focus is believed to be on landfills and waste management.

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Part II: The Law – Europe and the UK

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Regulation

The Stockholm Convention on Persistent Organic Pollutants 2004

- 152 Signatories
- Includes 30 POPs, including PFOA and PFOS
- Control measures to reduce and, where practicable, eliminate the use of POPs
- Appropriate management of stockpiles of products and waste which contains POPs
- Specific exemptions for the continuing use of POPs for a limited period of time

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Regulation

PFOA and PFOS under the Stockholm Convention

PFOA	PFOS
Parties must **prohibit and/or take measures to eliminate** production, use, import and export, subject to certain specific exemptions for production and use	Parties must **restrict** production, use, import and export, subject to certain specific exemptions
Parties may register for an **exemption for use** (subject to conditions) in: • Photographic coatings applied to films • Textiles for oil and water repellence against dangerous liquids • Medical implants • Firefighting foams for liquid fuel vapour suppression and liquid fuel fires in installed systems • Photolithography or etch processes in semiconductor manufacturing	Parties may register to **produce or use** PFOS for the 'acceptable purpose' or 'specific exemption' in respect of: • Fire-fighting foam for liquid fuel vapour suppression and liquid fuel fires in installed systems (subject to conditions) • Metal plating only in closed-loop systems • Insect baits for control of leaf-cutting ants
Reference to **exemption for production** in firefighting foams	

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Regulation

EU Regulation

- Stockholm Convention ratified in 2004
- The latest iteration of the EU's regulation on POPs is Regulation 2019/1021
- Regulation of:
  - Production, placing on the market and use of POPs
  - Management of stockpiles and wastes
  - Unintentional releases of POPs

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Regulation

PFOA and PFOS under EU Regulation

PFOA	PFOS
General prohibition on the manufacturing, placing on the market and use	General prohibition on the manufacturing, placing on the market and use
This is subject to the following exceptions: • **Use** for laboratory-scale research or as a reference standard • Present as an **unintentional trace contaminant** (defined by reference to specified concentrations) • **Manufacture, placing on the market and use** in; photolithography or etch processes in semiconductor manufacturing, photographic coatings on films, medical implants and textiles for oil and water repellence against dangerous liquids • **Use** in fire-fighting foam for liquid fuel vapour suppression and liquid fuel fire in installed systems (subject to conditions) • **Use** of products already in use in the EU before July 2020	This is subject to the following exceptions: • **Use** for laboratory-scale research or as a reference standard • Present as an **unintentional trace contaminant** (defined by reference to specified concentrations) • **Use** in mist suppressants for non-decorative hard chromium plating in closed loop systems, provided the quantity released into the environment is minimised, and Member States report every 4 years on progress made to eliminate PFOS • **Use** of products already in use in the EU before August 2010
The exceptions are subject to varying time limits	

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Regulation

UK Regulation

- UK Regime mirrors the EU regime
- Persistent Organic Pollutants Regulations 2007 (SI 2007/3106) implement the Stockholm Convention and the EU POPs Regulation in the UK
- The Persistent Organic Pollutants (Amendment) (EU Exit) Regulations 2018 (SI 2018/1405) ensure that regulatory regime on the control of POPs operates after Brexit
- It is an offence to breach the requirements of the EU POPs Regulation relating to:
  - Producing, placing on the market or using POPs
  - Managing stockpiles of specified substances
  - Managing waste that contains or is contaminated by POPs

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Claims Landscape

Claims Outside the US

- UK airport notification
- 2015 – PFAS found in water sources around RAAF Williamstown
- 2017 – Elevated levels of PFOA and PFOS found in the groundwater at two New Zealand air bases
- 2019 - European Environment Agency : *'PFAS water pollution has been identified in countries across Europe, including Austria, Denmark, France, Germany, the Netherlands and Sweden, as well as outside the EU.'* *https://www.eea.europa.eu/publications/emerging-chemical-risks-in-europe*

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The Future

Regulation

- Revised Drinking Water Directive (EU) 2020/2184 sets a limit on PFAS concentrations
- The EU plans to restrict PFAS for all non-essential uses by 2022-24
- The UK's plans are less concrete, but investigation of PFAS planned by the HSE and EA under the UK REACH programme

Claims

- PFAS claims have arrived in the UK
- The number of claims is likely to increase as regulatory engagement increases, although it remains to be seen how soon this might happen

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Part III: U.S. Claims, Laws, and Regulations

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Claims in the U.S.

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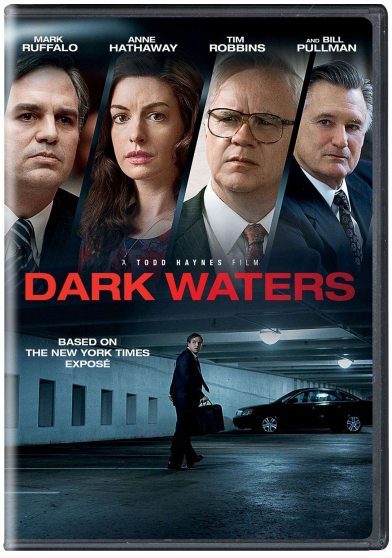
DuPont Litigation ("Dark Waters")

- Claims started 20 years ago
- In 2001, residents of Parkersburg, West Virginia sued DuPont
- Residents claimed their water was contaminated with PFOA
- Case settled in 2005 and lead to creation of a "Science Panel"



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DuPont Litigation ("Dark Waters")

- Science Panel found a "probable link" between PFOA and six diseases
- See website – C8 Science Panel Website
- Residents then filed 3,500 personal injury claims vs. DuPont (MDL in Ohio)
- On Feb. 13, 2017, DuPont settled for $671 million
- Roughly $200k per injury claim
- Not all cases resolved with the settlement…. Recent $50 million verdict.

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Minnesota v. 3M

- In 2010, the State of Minnesota sued 3M re: PFAS
- Minnesota alleged that 3M's PFAS caused environmental pollution
- Minnesota sought $5 billion for clean-up costs
- Case settled on Feb. 20, 2018
- Settlement - $850 million

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AFFF Litigation

- Aqueous Film-Forming Foam ("AFFF")
- Firefighting suppressant
- Mostly used by firefighters, military personnel, and at airports
- In use for 50+ years
- Effective in fighting petroleum-based fires
- AFFF contains PFAS

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AFFF Litigation

- Individual cases started to be filed in 2016
- By Dec. 2018, 75 cases filed around the U.S.
- Defendants filed a motion to create an MDL
- MDL No. 2873 established on 7 Dec. 2018
- MDL pending in South Carolina - Judge Richard Gergel
- MDL 2873 has its own website - www.scd.uscourts.gov/mdl-2873/index.asp

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The MDL

- Over 1,000 cases in the MDL
- Approximately 14,000 plaintiffs
- Approximately 30 defendants in each case
- Defendants are alleged to have designed, manufactured and/or sold AFFF
- Defendants include 3M, Buckeye, Chemguard, Du Pont, Kidde, Tyco, etc.

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Personal Injury Claims in the MDL

- Appear to be majority of cases (about 90%)
- Plaintiffs are often military or civilian firefighters exposed during their work.
- Plaintiffs allege they have been diagnosed with various forms of cancer.
- Common cancers include kidney, testicular, prostate, etc.
- Other Plaintiffs are residents who ingested allegedly contaminated water

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Property Damage Claims in the MDL

- Plaintiffs include cities, counties, towns, and states.
- Plaintiffs also include water companies and airport authorities.
- Plaintiffs allege that AFFF contaminated the surface, groundwater, soil, etc.
- Plaintiffs seek damages for investigation, removal, monitoring, etc.

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Status of the MDL

- 7 Dec. 2018 MDL formed
- 20 Mar 2019 Lead counsel appointed
- 30 May 2019 Discovery commences
- 7 Aug. 2019 "Fact Sheets" approved
- 4 Oct. 2019 Court held "Science Day"

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Status of the MDL

- 1 May 2020 "We now have over 12,000 Plaintiff Fact Sheets."
- 13 Nov. 2020 "There's almost 14,000 Plaintiff Fact Sheets."
- 17 June 2021 Plaintiff Lead Lawyer:
  - Over 24 million pages produced by Defendants
  - Depositions of 56 defense witnesses taken to date

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The Bellwether Process

- The Court issued an Order re: "Initial Bellwether Selection and Protocols"
- The "Water Provider" cases will be pushed to trial first.
- The parties selected 10 "Bellwether Discovery Pool" cases
- These cases are undergoing additional discovery now.
- The parties selected three presumptive finalists to undergo "trial discovery."

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MDL – Bellwether Trial Schedule

- March 2022 Expert reports due
- April 2022 Expert depos completed
- Sept. 2022 Court will select case for trial
- Jan. 2023 First bellwether trial will occur

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One Settlement

- *Campbell v. Tyco, Chemguard, and ChemDesign*
- Class action for property damage and personal injury in Wisconsin
- 300 homes effected; roughly 900 residents; fire college near the town
- Total settlement of $17.5 million
  - $11 million for property damage
  - $4 million for non-manifested injuries
  - $2.5 million for manifested injuries

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Laws and Regulations in the U.S.

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At the Federal Level

- The U.S. signed the Stockholm Convention in 2001 - but did not ratify it.
- However, since the 2000s, various federal, state and international authorities have begun to establish regulations addressing PFAS.
- Regulatory process is in various stages of development

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Federal Regulations

- Starting in 2009, the U.S. Environmental Protection Agency (EPA) and Food and Drug Administration (FDA) have issued regulations and guidelines concerning PFAS.
- EPA has authority to regulate PFAS under several statutes:
  - Toxic Substances Control Act (TSCA), 15 U.S.C. §§ 2601-2629
  - Safe Drinking Water Act (SDWA), 42 U.S.C. § 300f
  - Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9601, *et seq*.
  - Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901, *et seq*.
  - Clean Air Act (CAA), 42 U.S.C. § 7401, *et seq.*
  - Clean Water Act (CWA), 33 U.S.C. §§ 1251-1387
- However, the EPA has yet to classify PFAS as a hazardous waste or substance under these statutes.

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Action by the EPA

- In 2016, the EPA issued "Health Advisories" for PFOA and PFOS
  - Advisories re: drinking water
  - 70 parts per trillion
  - Non-enforceable
- In Feb. 2019, the EPA issued a "PFAS Action Plan"
  - Outlines the tools EPA is developing
  - Attempting to address PFAS in drinking water
  - Attempting to identify and clean up PFAS contamination

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Action by the EPA (cont'd)

- In Feb. 2021, the EPA:
  - Re-proposed a rule to collect new data on PFAS in drinking water
  - Re-issued final regulatory determinations for PFOA and PFOS under the Safe Drinking Water Act (SDWA).
- In April 2021, the EPA announced a new "Council on PFAS"
  - Charged with building on the agency's ongoing work
  - Trying to understand and reduce the potential risks
- In August 2021, the EPA loaned $131 million to Orange County (Los Angeles)
  - To help remove PFAS from drinking water
  - Other similar loans issued totaling nearly $11 billion

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"PFAS ACTION ACT"

- Passed by the U.S. House of Representatives on 21 July 2021
- If passed by the Senate, the Act would:
  - Require the EPA to set drinking water standards for certain PFAS within two years;
  - Designate PFOA as a "hazardous substance" under CERCLA
  - Evaluate whether other PFAS would also qualify within five years;
  - Require testing for toxicity of PFAS under the Toxic Substances Control Act;
  - Require that PFOA and PFOS be designated as "hazardous air pollutants" under the Clean Air Act within six months;
  - Create labelling requirements for consumer products containing PFAS; and
  - Create effluent regulations under the Water Pollution Control Act.

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At the State Level

- State regulations vary
- Recent state regulatory developments:
  - 7 states have established MCLs for PFAS (CT, DE, IL, MD, NV, TX, VT)
  - 7 other states have proposed MCLs (AZ, IN, KY, ME, NC, RI, SC)
  - Several other states have introduced legislation to prohibit, restrict, or require a warning label on food packaging containing PFAS (AZ, CA, CT, IA, MA, MN, OR, RI, VA, VT)
  - Maine and Massachusetts are the first states to have proposed legislation to regulate PFAS in pesticides.
- Other types of state regulations include:
  - State of Washington Chemical Action Plan — requires, inter alia, that manufacturers of PFAS-containing products provide product safety information.
  - Classifying PFAS as hazardous wastes/substances (AK, CO, NJ, NY, VT).
  - Water & Soil Remediation Programs (AK, CA, CT, MN).
  - PFAS Discharge Permits (MI)

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Recent Survey by the FDA

- On 26 August 2021, new survey results released
- FDA surveyed 167 nationally distributed foods, including baby foods
- FDA found no detectable levels of PFAS chemicals in 164 foods
- But the agency did detect PFAS levels in canned tuna, fish sticks, and protein powder.

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Questions

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Presenters

Douglas Horelick
Partner
T: +1 305 329 1798
E: douglas.horelick@clydeco.com

Andrew Morgan
Senior Environmental Consultant
T: +44 (0) 1179 980 5770
E: andrew.morgan@geosyntec.com

Natasha Lioubimova
Senior Associate
T: +44 (0) 20 7876 5980
E: natasha.lioubimova@clydeco.com

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