Something about source control…

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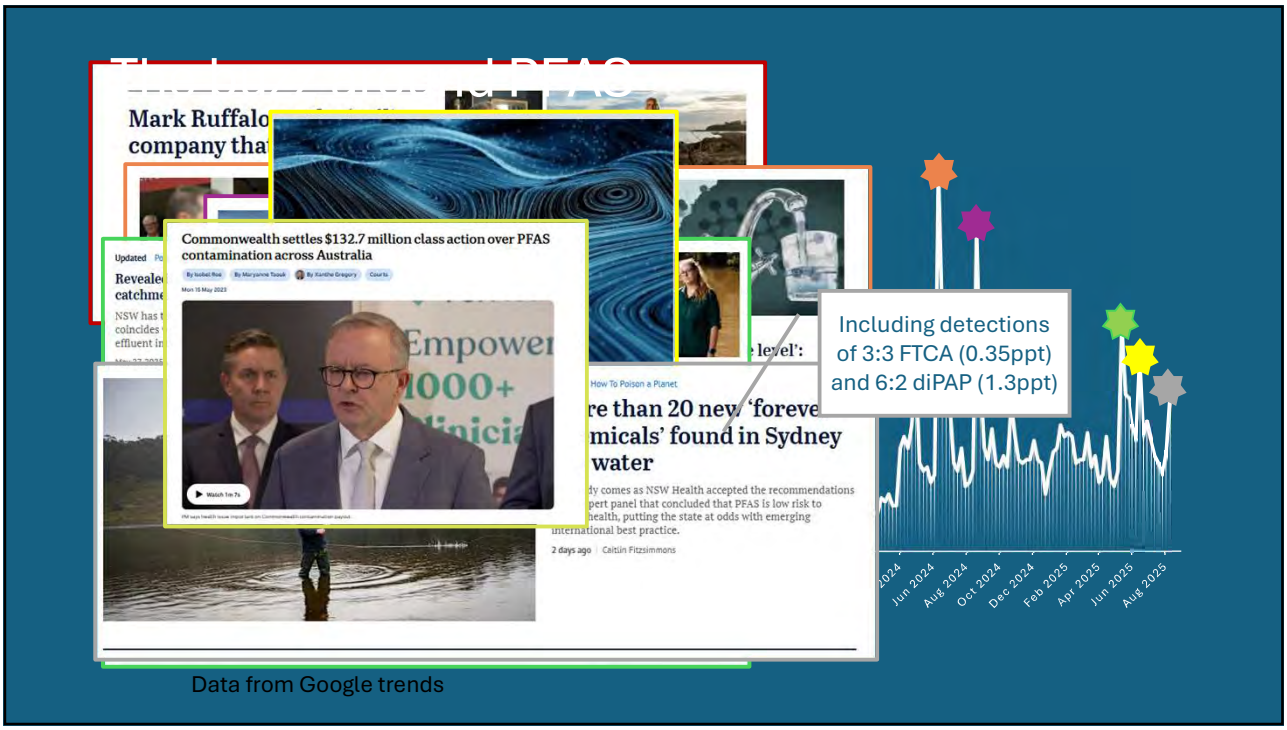
1

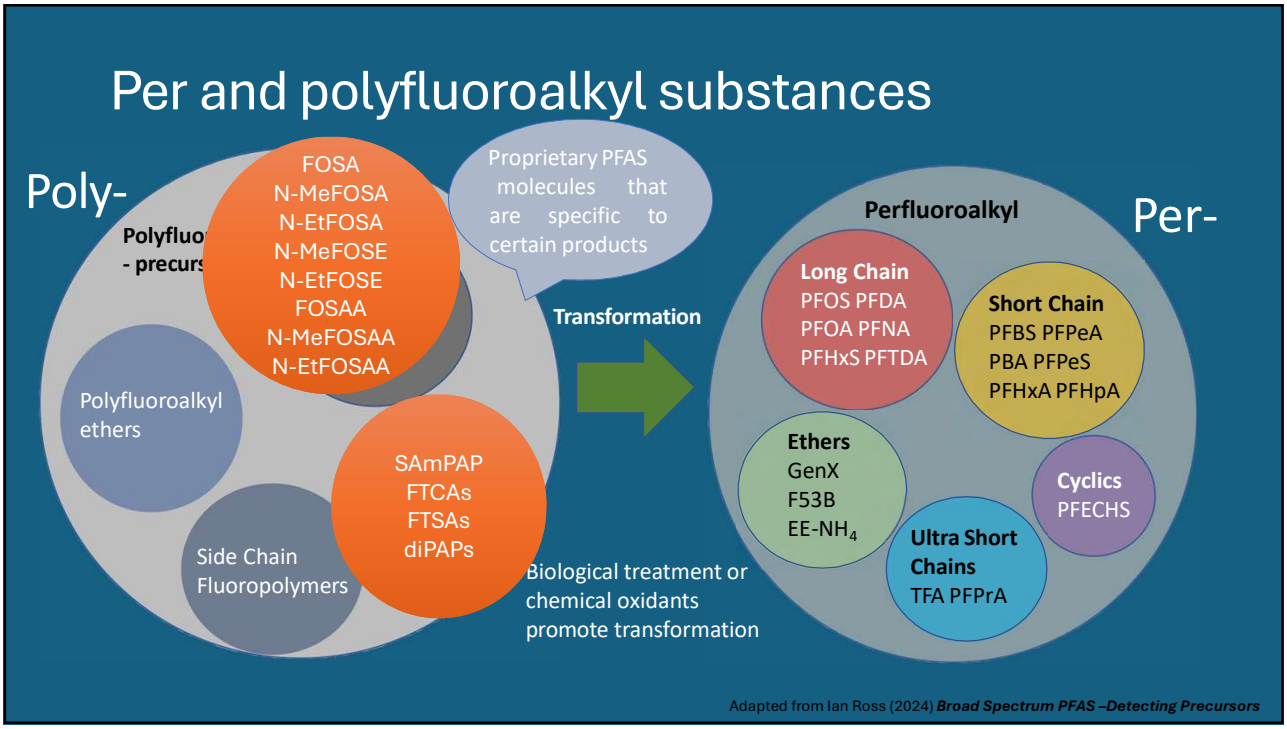
Outline

- A walk through the world of PFAS
- Source control
- Some thoughts for water service providers

2


Commonwealth settles $132.7 million class action over PFAS contamination across Australia
Including detections of 3:3 FTCA (0.35ppt) and 6:2 diPAP (1.3ppt)
Jun 2024
Aug 2024
Oct 2024
Dec 2024
Feb 2025
Apr 2025
Jun 2025
Aug 2025
Data from Google trends

3


Per and polyfluoroalkyl substances
Poly-
Polyfluo
- precurs
FOSA
N-MeFOSA
N-EtFOSA
N-MeFOSE
N-EtFOSE
FOSAA
N-MeFOSAA
N-EtFOSAA
Proprietary PFAS molecules that are specific to certain products
Polyfluoroalkyl ethers
SAmPAP
FTCAs
FTSAs
diPAPs
Side Chain Fluoropolymers
Transformation
Biological treatment or chemical oxidants promote transformation
Perfluoroalkyl
Per-
Long Chain
PFOS PFDA
PFOA PFNA
PFHxS PFTDA
Short Chain
PFBS PFPeA
PBA PFPeS
PFHxA PFHpA
Ethers
GenX
F53B
EE-NH4
Cyclics
PFECHS
Ultra Short Chains
TFA PFPrA
Adapted from Ian Ross (2024) Broad Spectrum PFAS –Detecting Precursors

4

PFAS in Products

Paper and Food Packaging

- Side-chain fluoropolymers
- PAPs/diPAPs
- NEtFOSE, NEtFOSAA, PFBS, PFOA, PFHxA

Textile and Leather

- Polymers
- Polymer raw materials
- PFOA, FTOHs

Firefighting

- PFOA, PFOS, PFHxS, PFHxSaAm
- C8/C6 fluorotelomers e.g 8:2FTAoS; 6:2FTAB
- PFECHS

WWTPs and Landfills

- n:2 FTUCA
- n:3 FTCA (5:3 FTCA)
- n:2 FTSA
- EtFOSA

Metal Plating

- PFOS
- 6:2 FTS, 8:2 FTS
- F53B
- PFECHS

Adapted from Ian Ross (2024) ***Broad Spectrum PFAS –Detecting Precursors***

5

The scale of the issue

Projected fluorotelomer production in 2019 of 42,500 tonnes.
After Global Market Insights, 2016. Projected compound annual growth rate of 12.5% from 26,500 tonnes in 2015.

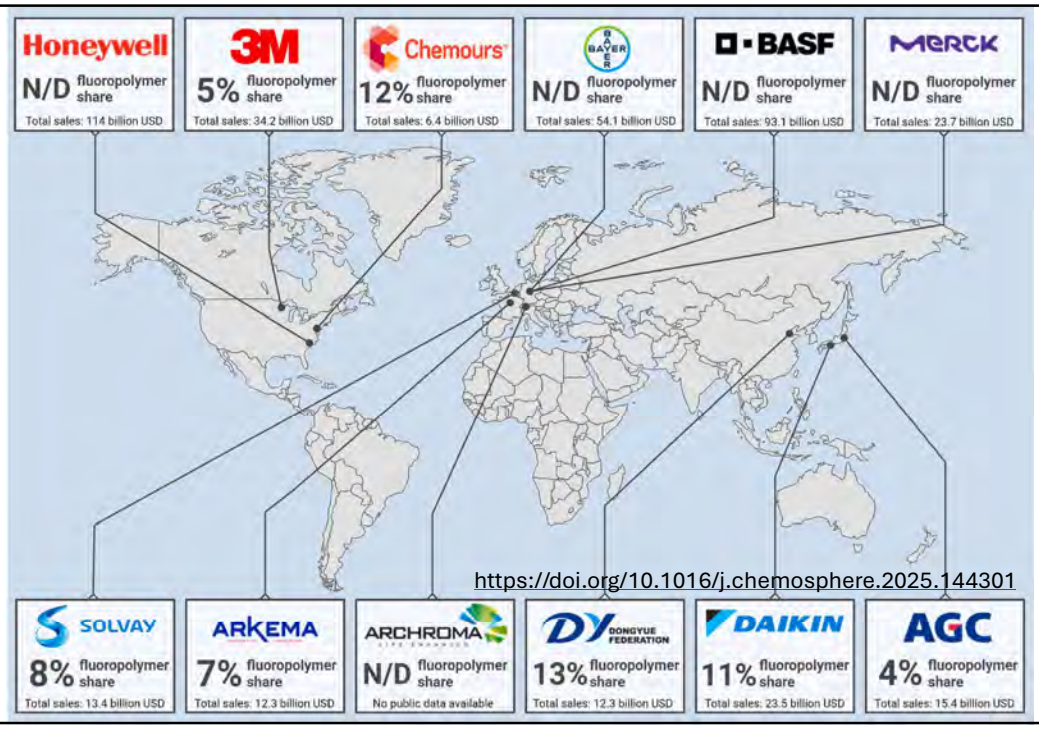
https://ipen.org/sites/default/files/documents/the_global_pfa s_problem-v1_5_final_18_april.pdf

- Fluorotelomer production

SAmPAP
FTCAs
FTSAs
diPAPs

Precursors

6



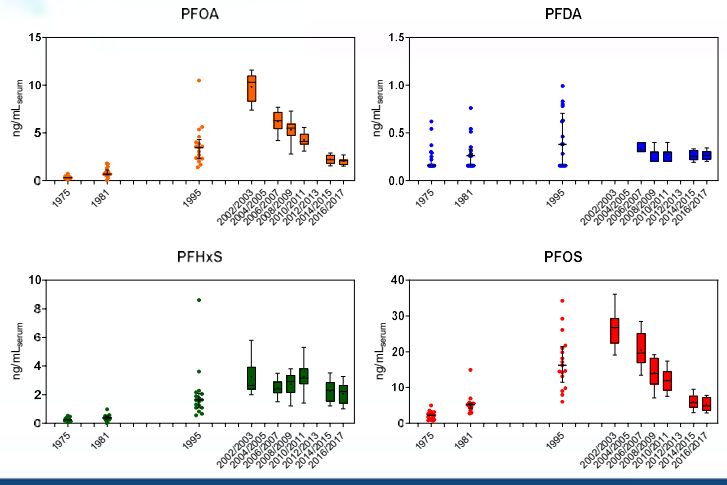
7

IChEMS as a source control measure

- Incomplete coverage
  - Covers 3 PFAS plus precursors
  - 25 ppb threshold for trace
- Inadequate labelling
  - Industrial chemicals
  - SDS do not cover PFAS compounds as “proprietary ingredients”

8

Source control effectiveness



- Australian PFAS serum data
- Bans on AFFF
  - Qld phase out from 2003

Source control works... on the timeframe of 15-20 years

https://doi.org/10.1016/j.jhazmat.2022.130307

9

NZ ban on PFAS Cosmetic Products Group Standard

- **Must not contain** which has a precise legal meaning.
- **Total prohibition**
  Any component listed in **Schedule 4** (e.g. PFAS) **cannot be intentionally added** to cosmetic products. This means formulators, importers, and manufacturers must ensure their product contains **zero of that substance**.
- **Exception only for unavoidable traces**
  The only allowed presence is that which is **technically unavoidable** in good manufacturing practice — such as a trace contaminant stemming from raw materials. Even then, manufacturers must verify that it truly can't be removed practically.
- **No threshold levels**
  Unlike "restricted" ingredients where small amounts may be permitted, **"must not contain" means exactly zero**, apart from extremely low traces that meet the "technically unavoidable" qualification. Any intentional addition or presence above background contamination is non-compliant.

10

NZ definition of PFAS

- PFAS that meet the following definition:
  - any substance that contains at least one fully fluorinated methyl (CF3-) or methylene (-CF2-) carbon atom (without any H/Cl/Br/I attached to it).
- Regulatory guidance aligns New Zealand's definition with categories recognized internationally, such as those by the OECD and ECHA, which explicitly classify **mono-, di-, and tri-PAPs** as PFAS.

11

Example: The joy of diPAPs

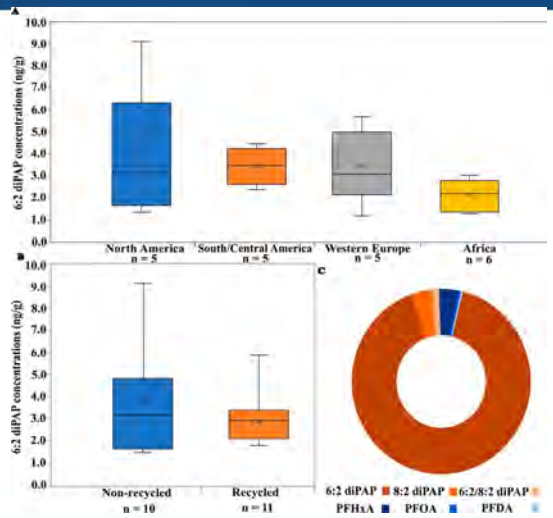
- Australian biosolids
- 17 WWTP in Vic, SA and WA.
- Three diPAPs measured
  - 6:2, 8:2 and 6:2/8:2 diPAPs
- diPAPs contributed **56%** of the total measured 44 PFAS mass.

More than half of the PFAS in biosolids was just three diPAPs

https://doi.org/10.1016/j.chemosphere.2020.129143

12

A source of diPAPs



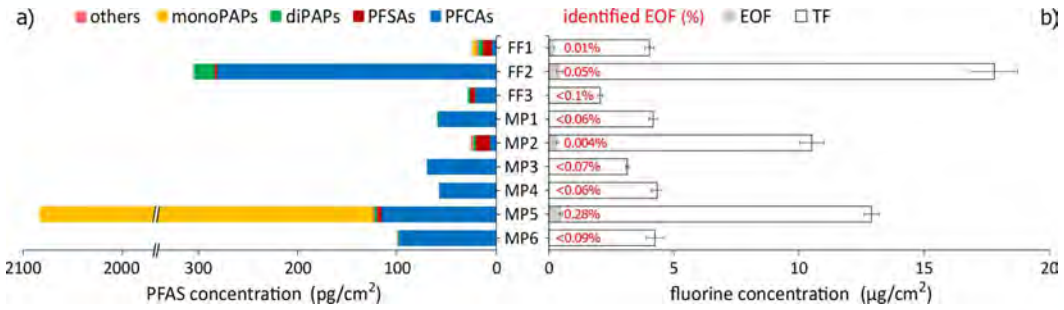
"Toilet paper should be considered as a potential significant source of PFAS entering wastewater treatment systems."

In Australia, toilet paper contributed 7.2% of all diPAPs

https://doi.org/10.1021/acs.estlett.3c00094

13

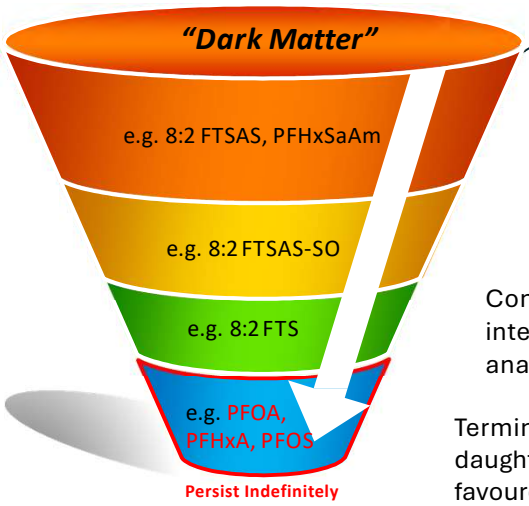
Example: Food contact materials



DOI: (10.1021/acs.estlett.8b00700)

14

PFAS Biotransformation Funnel



Proprietary PFAS molecules that are specific to certain products

Parent **polyfluorinated** precursors in products e.g. inAFFF

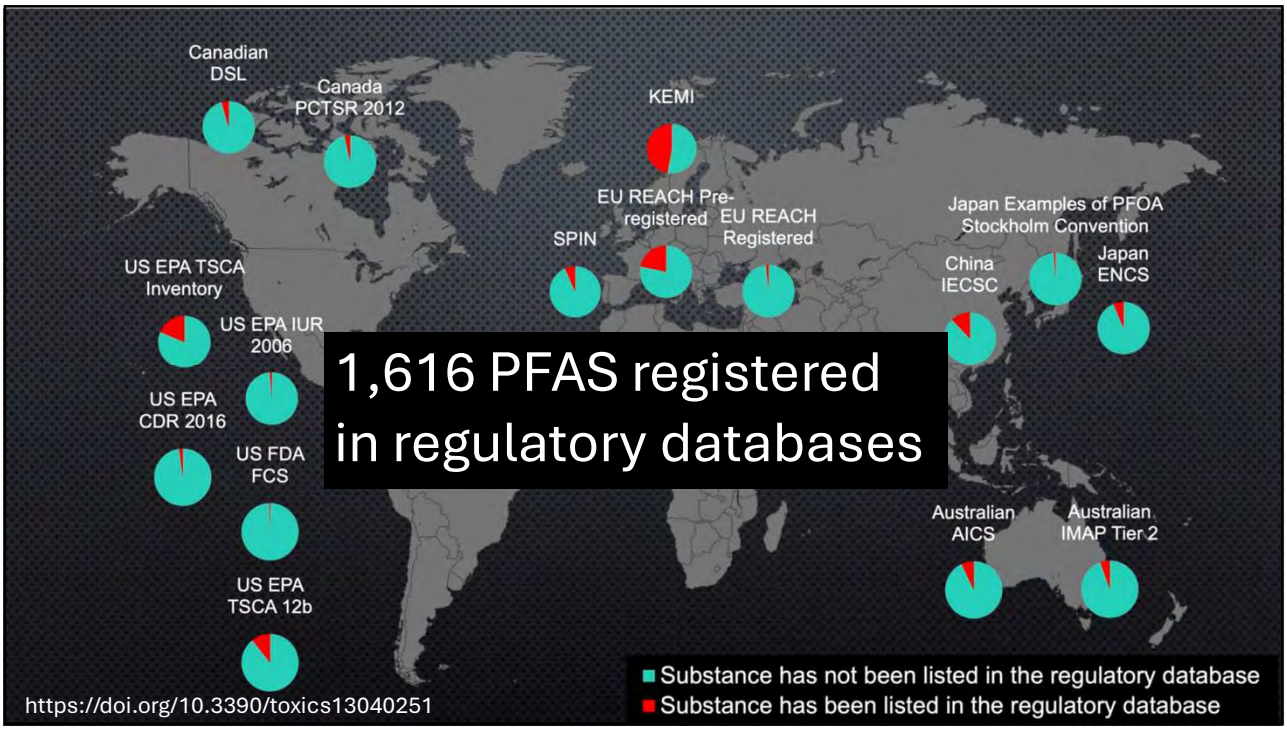
Polyfluorinated daughter biotransformation intermediates

Common semi-stable **polyfluorinated** daughter intermediates accumulating (especially under anaerobic conditions)

Terminal common **perfluorinated** daughter products (PFAAs) (formation favoured under aerobic conditions)

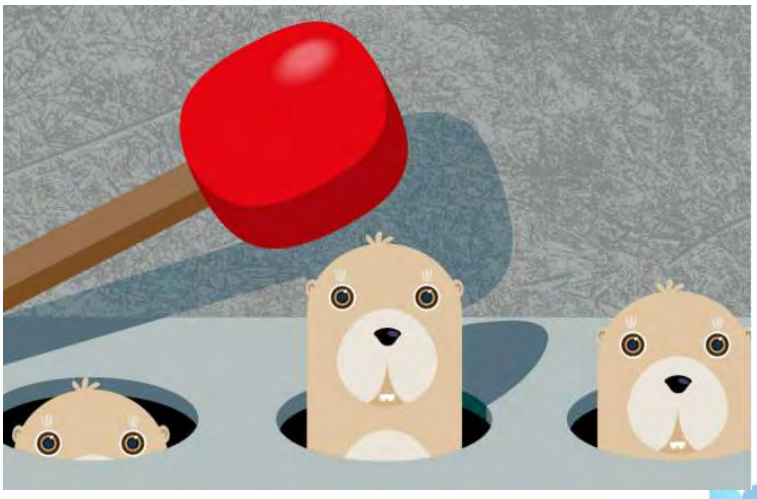
Adapted from Ian Ross (2024) ***Broad Spectrum PFAS –Detecting Precursors***

15



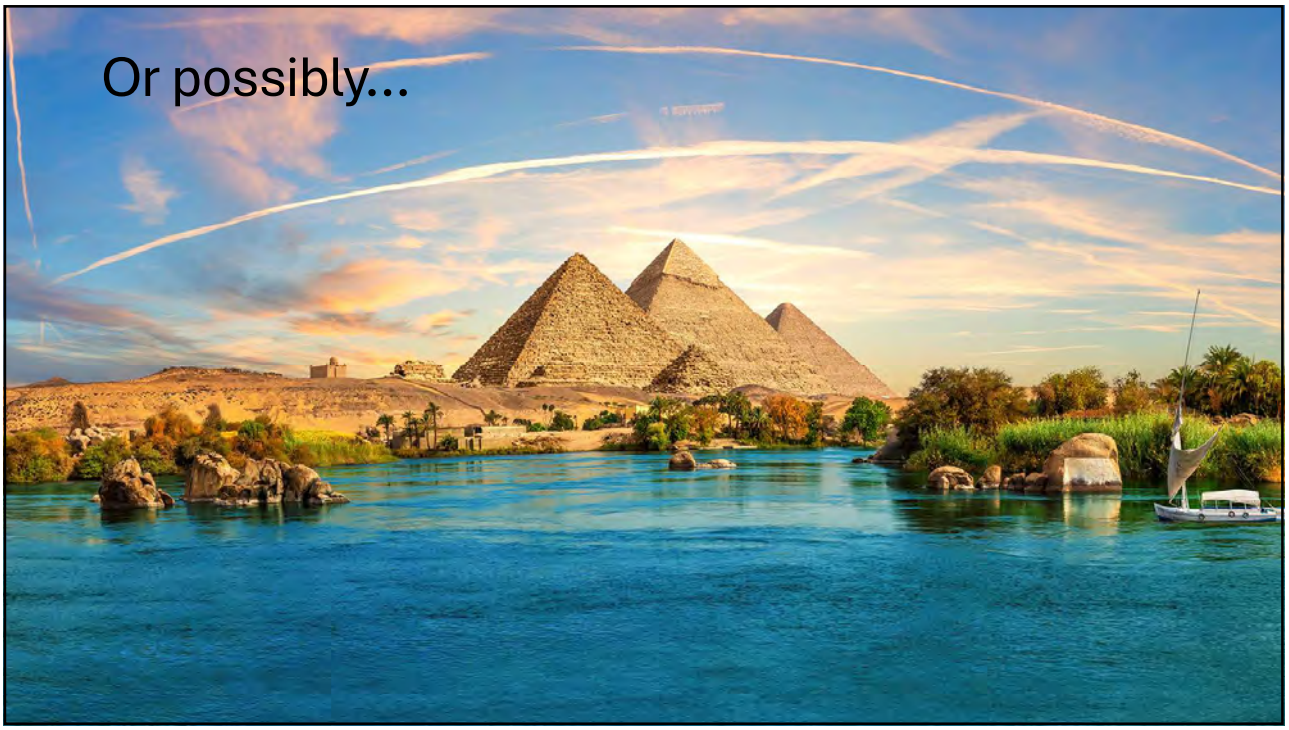
16

How it feels to regulators…



17

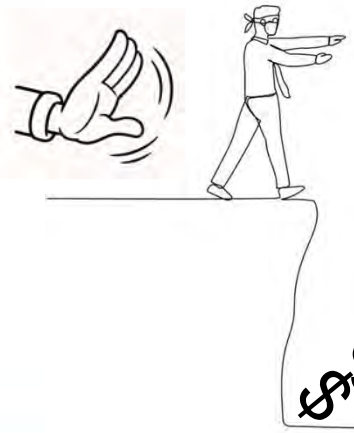
Or possibly…



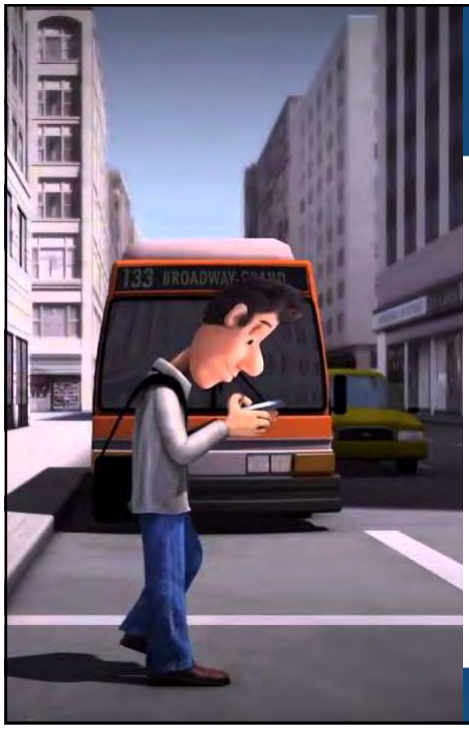
18

How it feels to WSPs…

regulation
community expectations
risk management



19



Other contaminants of concern

- Other PFAS compounds
  - Ultrashort PFAS, novel and new
- Microplastics
- Legacy compounds
  - Chlordane
- PPCP
  - Galaxolides and tonalides
  - AMR

20

NOW WHAT?

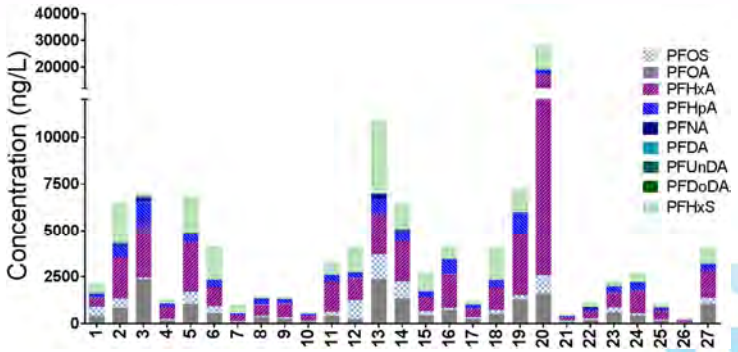
21

Landfill leachate

- Extremely high PFAS concentrations…

Note scale

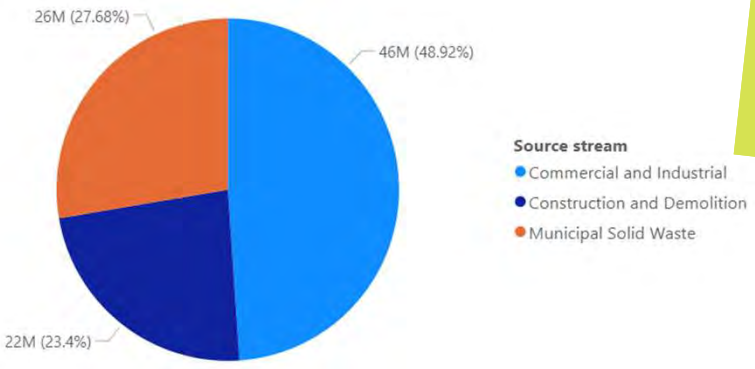
Only 9 PFAS analytes



http://dx.doi.org/10.1016/j.jhazmat.2017.02.006

22

Inputs to landfill



Australian data for 2022-23

23

Construction and demolition waste

Mean concentrations and standard deviations (SD) of PFASs in landfills/landfill cells grouped by operational status and dominant waste type accepted.

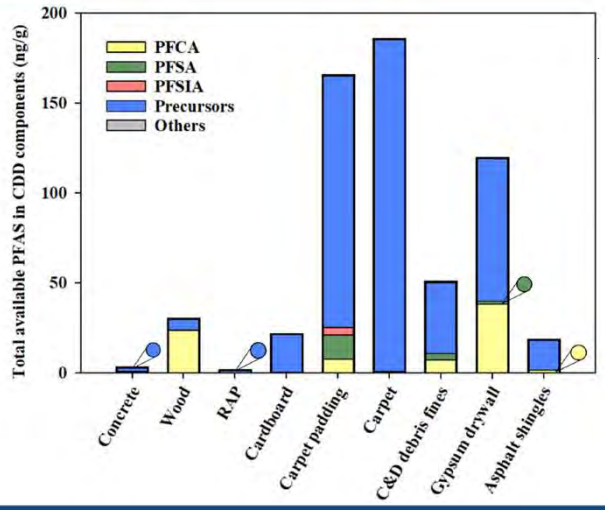
		PFOA	PFOS	PFHxA	PFHpA	PFNA	PFDA	PFUdA	PFDoDa	PFHxS
Operating landfills (>50% MSW) n = 12	Mean	510	300	1300	360	29	22	3.0	1.8	940
	SD	410	330	1700	360	24	36	4.7	3.5	1000
Operating landfills (>50% C&D) n = 7	Mean	1400	1100	5000	760	98	46	4.6	1.1	3700
	SD	1200	910	8100	760	110	83	3.4	1.6	5100
Closed landfills (>50% MSW) n = 7	Mean	390	180	660	220	13	11.0	2.2	2.7	740
	SD	170	250	300	110	6.8	14	1.9	3.3	490

Results rounded to two significant figures.

http://dx.doi.org/10.1016/j.jhazmat.2017.02.006

24

Construction and demolition waste

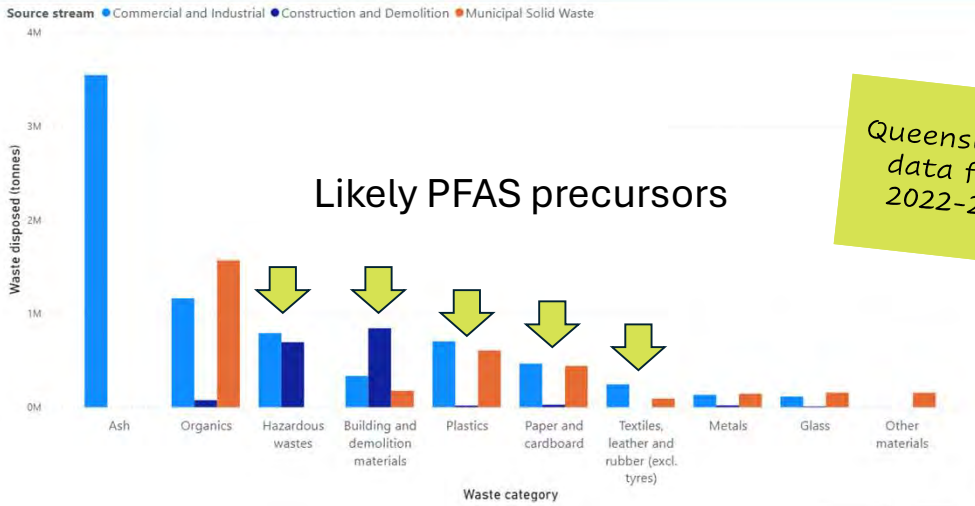


crushed concrete, mixed wood, asphalt shingles, gypsum drywall, carpet/foam padding, carpet, CDD fines, metals, cardboard, and reclaimed asphalt pavement (RAP)—

https://doi.org/10.1016/j.jhazmat.2024.134567

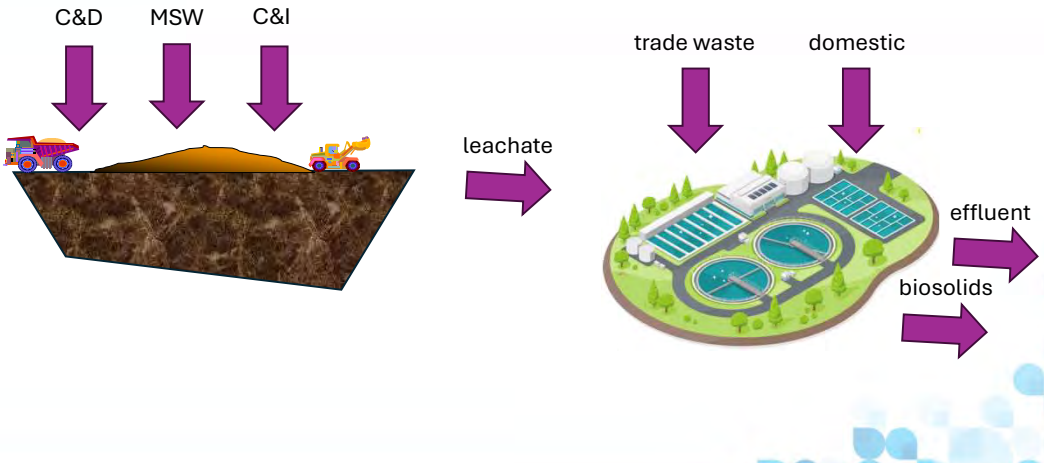
25

Landfill disposal



26

Landfill PFAS flow



27

Landfill PFAS flow

28


Questions
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29