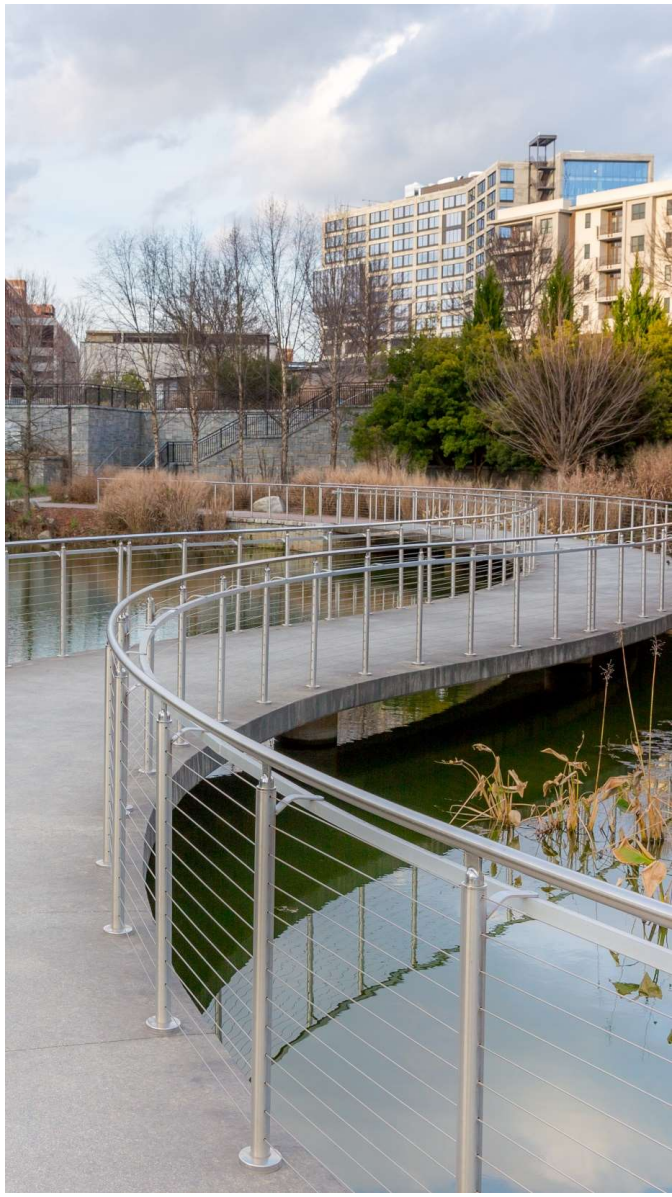
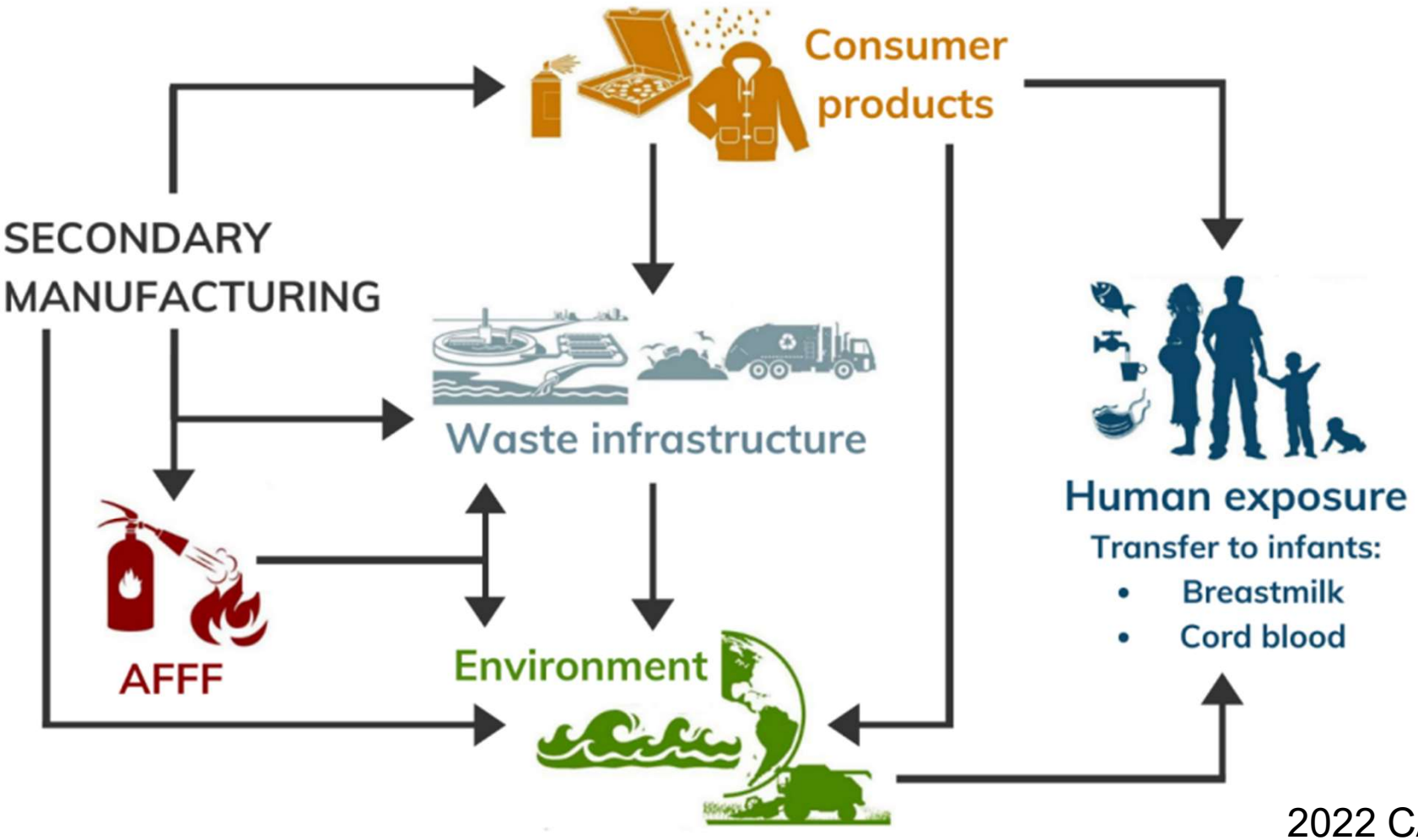


PFAS Treatment: Stormwater

Pierre Kwan, PE
HDR
Seattle, WA

Dec. 6, 2023
NEBC: Business & The Environment

Figure 1. PFAS cycle adapted to presence of PFAS in Washington state outside of occupational settings.



2022 CAP

PFAS in Northwest Stormwaters

- Per WA Dept. of Ecology 2022 Chemical Action Plan, PFAS enters water bodies from:
  - Stormwater runoff
  - Municipal wastewater treatment effluent
  - Uncontrolled release of aqueous film-forming foams

- “Stormwater disposal into injection wells may act as another potential source of groundwater contamination”

PFAS in Northwest Stormwater Runoff

- Precipitation onto contaminated soils
  - Erosion / transport of PFAS-laden soil particles
  - Leaching of PFAS from soils into water
- Transport of PFAS-bearing materials
  - Food wrappers
  - Oil-resistant papers
  - Other such litter
- Runoff from landfills (ex. old carpets)

PFAS in Washington Stormwater

- Clark County Local Source Control Partnership
- Data from 2017, published in 2018

Table 21. Comparison and scoring of PFAAs in stormwater (ng/g), 3/27 and 4/24/2017.

Orange highlighted cells indicate a result above the threshold

Parameter	PFBA	PFBS	PFDA	PFDoA	PFHpA	PFHxA	PFHxS	PFNA	PFOA	PFOS	PFPeA	PFUnA	Total PFAAs	Score*
Mean Reference **	5.06	2.67	2.54	ND	6.16	9.99	4.51	2.74	14.5	6.46	8.59	ND	-	
BB_STJOHNSMIN	1.64	3.96	0.785	0.113	3.42	7.18	14.5	2.01	4.82	37.1	7.12	0.27	81.278	3
CC_CAPT	1.83	2.83	0.634	0.132	2.95	4.72	9.02	1.7	4.37	18.8	4.43	0.238	49.824	3
CC_NE85	1.65	2.82	0.516	0.26	1.52	3	1.44	1.16	2.89	6.03	3.39	0.278	23.304	1
LR_NW3RDCT	1.63	1.99	0.707	0.106	2.33	3.72	0.739	1	4.04	5.52	3.64	0.085	23.877	0
LS_NE102	1.66	3.55	0.43	0.197	1.92	2.52	1.91	1.13	4.38	13.1	2.54	0.263	31.94	1
SCTRIB	1.63	0.409	7.29	3.52	3.15	2.76	0.415	4.03	11.8	3.8	0.816	2.73	40.72	2
WC_NE10NE149	1.63	4.83	0.645	0.17	2.1	6.63	16.1	1.26	5.89	71	5.56	0.207	114.392	3

ND = non-detect

* Exceedance of compared values = 1 point per exceedance.

** (Ecology 2017), Survey of Per- and Poly-Fluoroalkyl Substances (PFAS) in Rivers and Lakes, 2016, Table 3 **mean** values for Spring; Fall values used when ND in spring.

ACS Publications
Most Trusted. Most Cited. Most Read.

Search text, DOI, authors, etc.

My

RETURN TO ISSUE | < PREV **PERSPECTIVE** NEXT >

Outside the Safe Operating Space of a New Planetary Boundary for Per- and Polyfluoroalkyl Substances (PFAS)

Ian T. Cousins*, Jana H. Johansson, Matthew E. Salter, Bo Sha, and Martin Scheringer

Stockholm University EDUCATION RESEARCH ABOUT THE

It's raining PFAS: even in Antarctica and on the Tibetan plateau rainwater is unsafe to drink

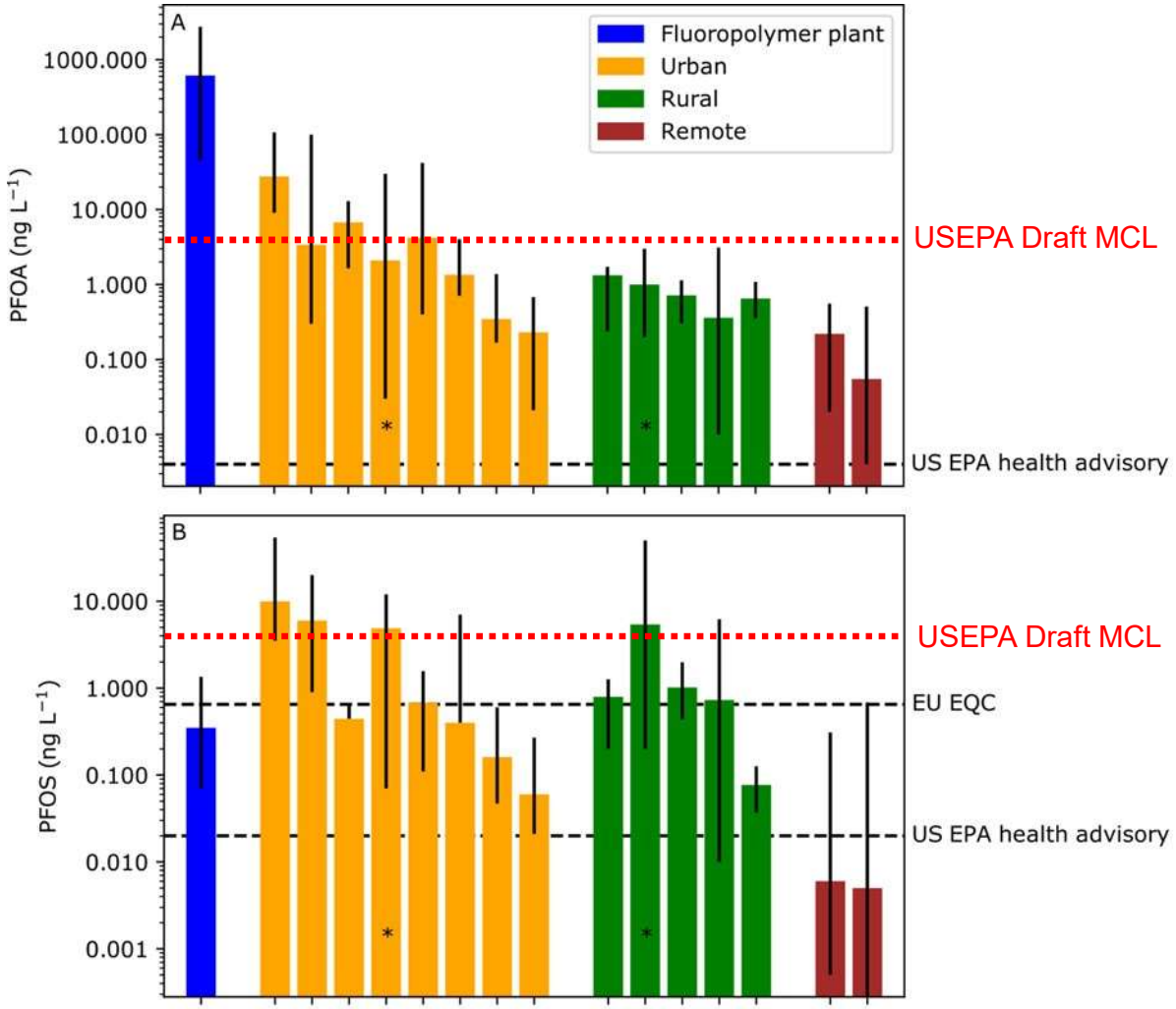
BBC

Home News Sport Business Innovation Culture Travel Earth Video Live

Pollution: 'Forever chemicals' in rainwater exceed safe levels

PFAS Atmospheric Deposition

- Blue bar: Factory in China without emissions control(?)
- Yellow bars: mostly Chinese urban areas, one site in US, Sweden, Malta
- Green bars: US, Canada, Western Europe
- Brown bars: Antarctica and Tibet
- **Not a major contributor in the Northwest**



Source: Cousins, et al. Environ. Sci. Technol. 2022, 56, 16, 11172-11179

What Can Treat PFAS in Stormwater?

Typical Stormwater Treatment BMP

- Focuses on turbidity, metals, oils, nutrients
- Often based on natural, environmental processes
- Mostly passive systems
- Based on:
  - Sedimentation
  - Filtration
  - Infiltration or waterbody discharge

What Will Not Work?

- Oil control BMPs – PFAS does not behave like oil (doesn't coalesce)
- Phosphorus BMPs – Not easy to absorb on to typical stormwater media and coagulants
- Infiltration – causes groundwater contamination
- Wetlands / bioretention – causes PFAS accumulation in the plants and soils

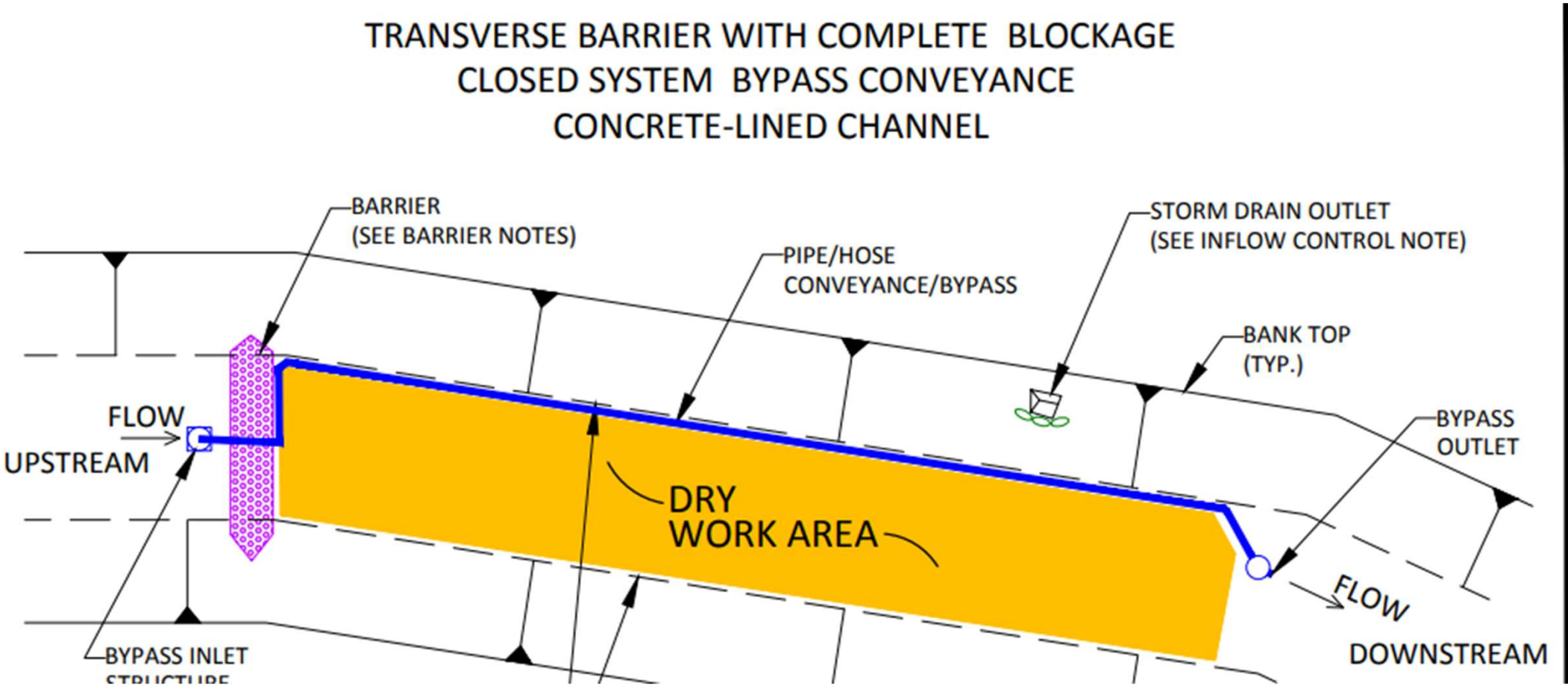
Partially Effective Methods

- Sand filters
- Filter fabric or strips
- Media filter drains

- Removes PFAS-containing solids
  - Trash and debris (ex. food wrappers)
  - PFAS-laden soil particles (if filter is fine enough)

- Does not remove soluble PFAS

Best Stormwater Methods – Remove PFAS Contaminated Soils and Treat Seperately



Divert Stormwater Around Contaminated Area

(Source: LA County Water Diversion Manual)

Industrial Stormwater

- Based on drinking water treatment technologies
  - Activated carbon absorption
  - Ion exchange
  - Reverse osmosis

- Not effective
  - Low-pressure membranes
  - Coagulation
  - Other media – biochar, zero valent iron, activated alumina

Summary

- PFAS in Northwest stormwater is mostly from runoff across contaminated soils
  - Erosion of PFAS-laden soil – particulate contamination
  - Leaching of PFAS into water – dissolved contamination

- Treatment
  - Remove source of PFAS
  - Divert water around high PFAS sites
  - Active treatment
    - Particulate contamination – fine filters
    - Dissolved contamination – drinking water-style technologies

PFAS Treatment: Stormwater

Pierre Kwan, PE
206-826-4735
pierre.kwan@hdrinc.com

Dec. 6, 2023
NEBC: Business & The Environment