



Update: Perfluoralkyl Substances

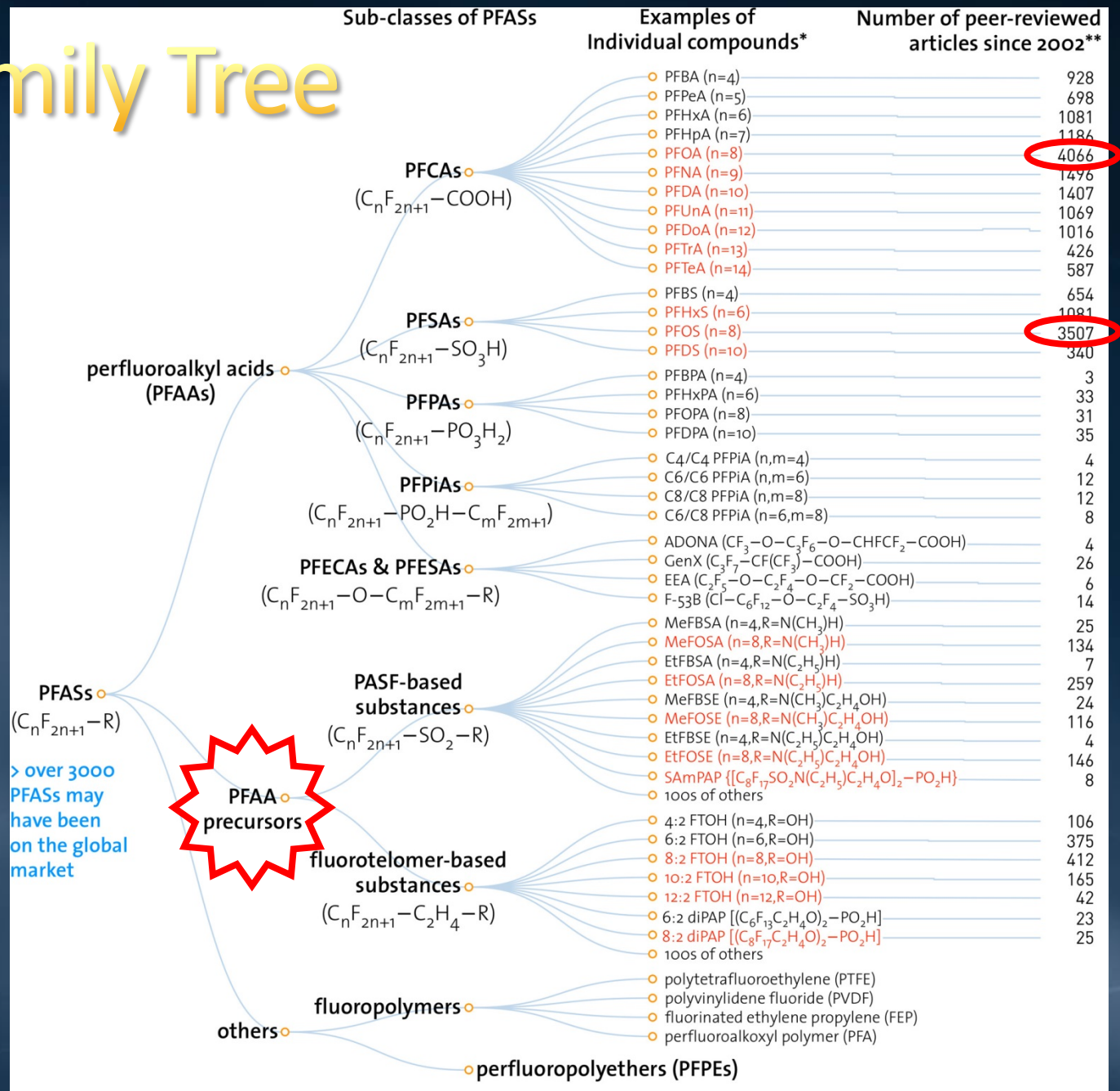
Theresa R. Slifko

Water Quality Laboratory Manager: Chemistry

May 10, 2018

PFAS Family Tree

It's not just
PFOS and
PFOA



Wang et al. 2017, ES&T.

Slide courtesy of A. Eaton, Eaton Analytical Laboratory via C. Higgins (CSM) and J. Field (OSU).

Why interested in PFCs

- Global distribution and detection of PFCs
- Perfluoroalkyl acids, including perfluorooctane sulfonate (PFOS), have been found in human serum and umbilical blood
- Science Advisory Board to EPA recommends PFOA be classified as a “likely human carcinogen”
- EPA health advisory for finished drinking water (2016)
 - 70 ng/L
 - PFOA or PFOS or combined

The World Changed on May 19, 2016



EPA US Environmental Protection Agency

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Ground Water and Drinking Water

Drinking Water Health Advisories for PFOA and PFOS

Health Advisories

EPA has established health advisories for PFOA and PFOS based on the agency's assessment of the latest peer-reviewed science to provide drinking water system operators, and state, tribal and local

they can take the appropriate actions to protect their residents. EPA is committed to supporting states and public water systems as they determine the appropriate steps to reduce exposure to PFOA and PFOS in drinking water. As science on health effects of these chemicals evolves, EPA will continue to evaluate new evidence.

To provide Americans, including the most sensitive populations, with information on the health effects of PFOA and PFOS, EPA has established health advisories for PFOA and PFOS at levels at 70 parts per trillion.

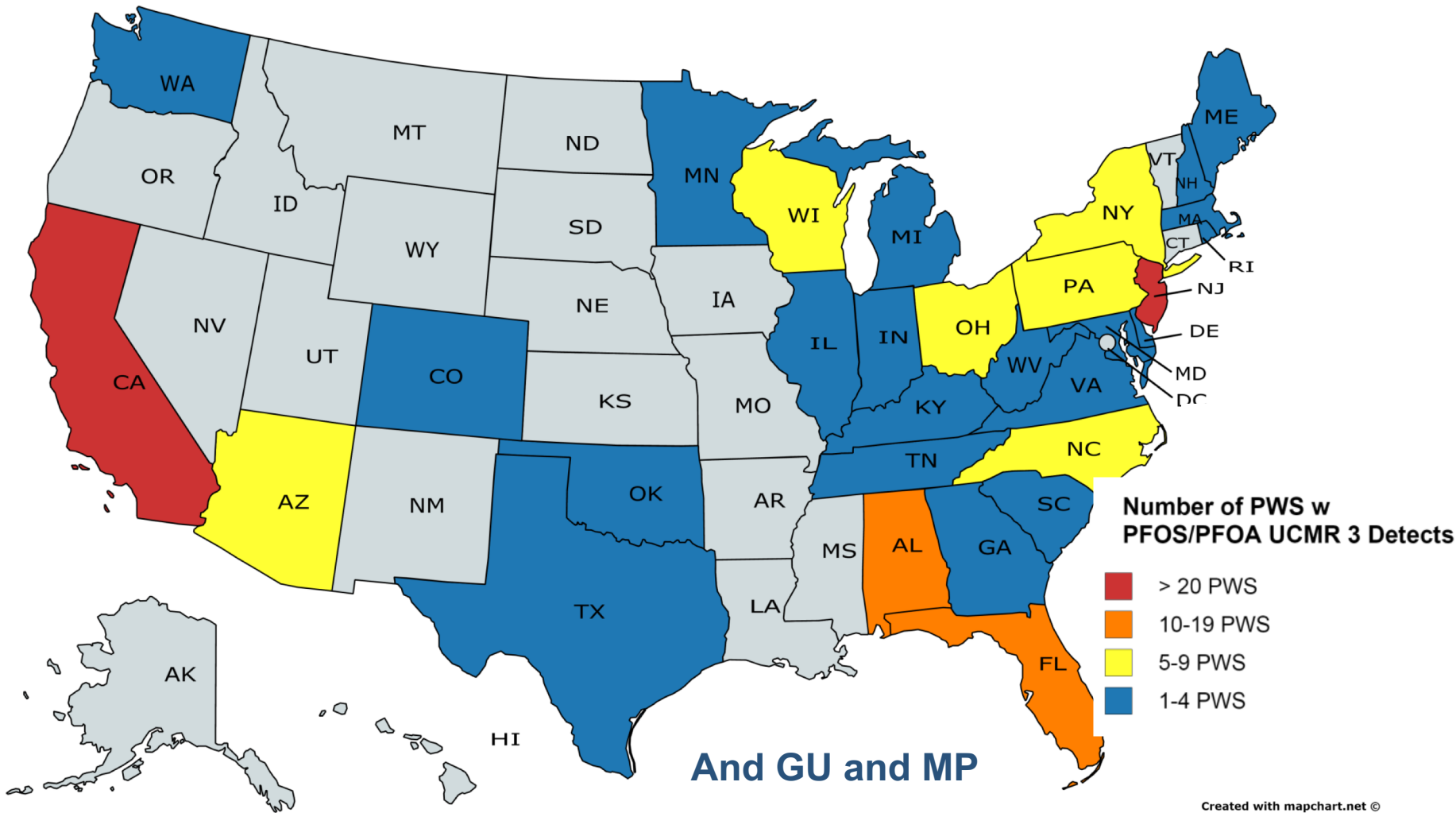
> What's a health advisory?

non-enforceable and non-regulatory

Additional PFOA and PFOS Information

PFOA	70 ng/L
PFOS	70 ng/L
PFOA + PFOS	70 ng/L

UCMR 3 NCOD - 36 States with Detections of PFOS and/or PFOA at UCMR3 MRLs



Here's the Bottom Line: If You Look Lower You See a Lot More Detection



Compound	Official NCOD Database samples with detection (UCMR 3 MRLs)	EEA Subset of Samples with detection using UCMR 3 MRLs	EEA Subset of Samples with detection using 5 ng/L MRL	EEA Subset of Samples with detection using 2.5 ng/L MRL
N	~37,000	~10,500	~10,500	~10,500
PFOS	0.8%	1.3%	11.5%	20.5%
PFOA	1.0%	1.8%	12.5%	23.5%
PFNA	0.1%	0.1%	0.6%	1.9%
PFHxS	0.6%	1.0%	6.0%	12.3%
PFHpA	0.6%	1.5%	3.3%	8.8%
PFBS	<0.1%	0.2%	5.3%	11.9%

We Can Look At These Results By Overall Detection Frequency

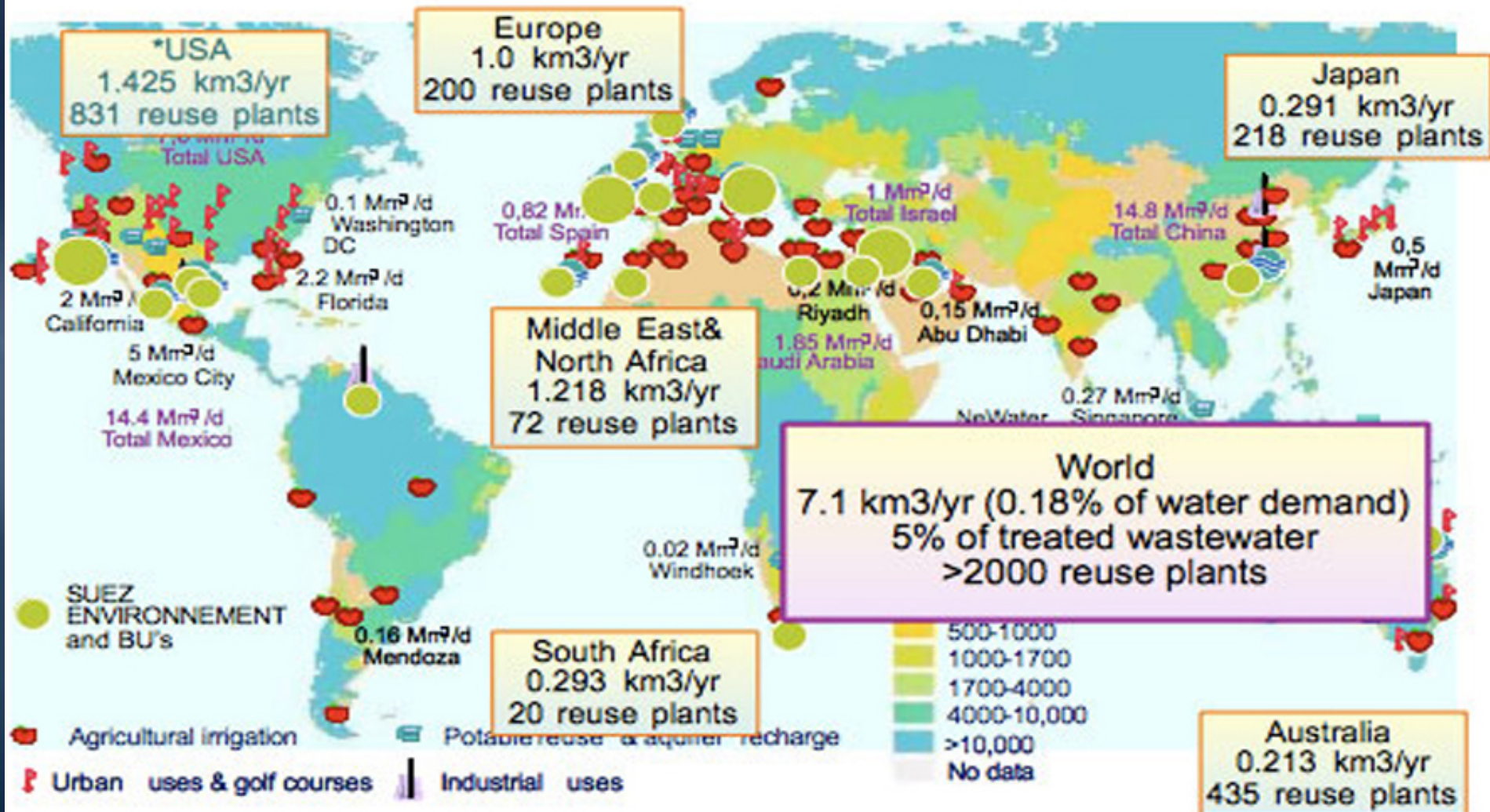


	Compound	Detection Frequency
UCMR 3 PFAS	PFBS	>30%
	PFHpA	>30%
	PFHxS	>30%
	PFNA	10%
	PFOS	>40%
	PFOA	>45%
Other 537 Analytes	PFDA	2%
	PFDoA	trace
	PFTA	0%
	PFUnA	trace
	PFHxA (Perfluorohexanoic acid)	>30%
	PFTTrDA	0%

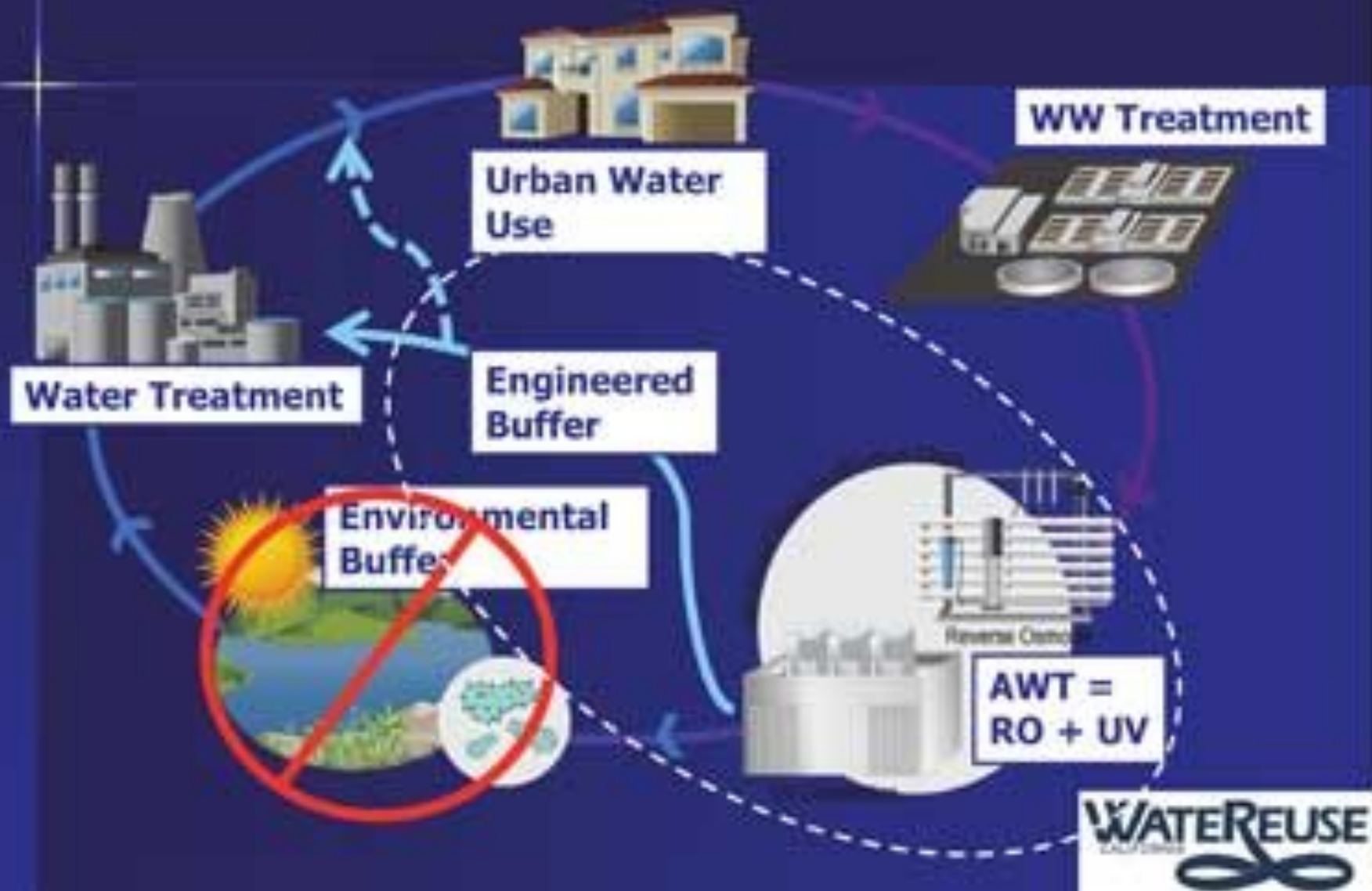
Removal of PFCs

Ineffective	Effective depending on structures	Mostly Effective
Coagulation	Anion exchange	RO
MF/UF	GAC	
Aeration		
Oxidation (KMnO ₄ , UV/H ₂ O ₂)		
Disinfection (O ₃ , Cl ₂ , ClO ₂)		

Wastewater Reuse in the world



~~Indirect~~ Potable Reuse Concept

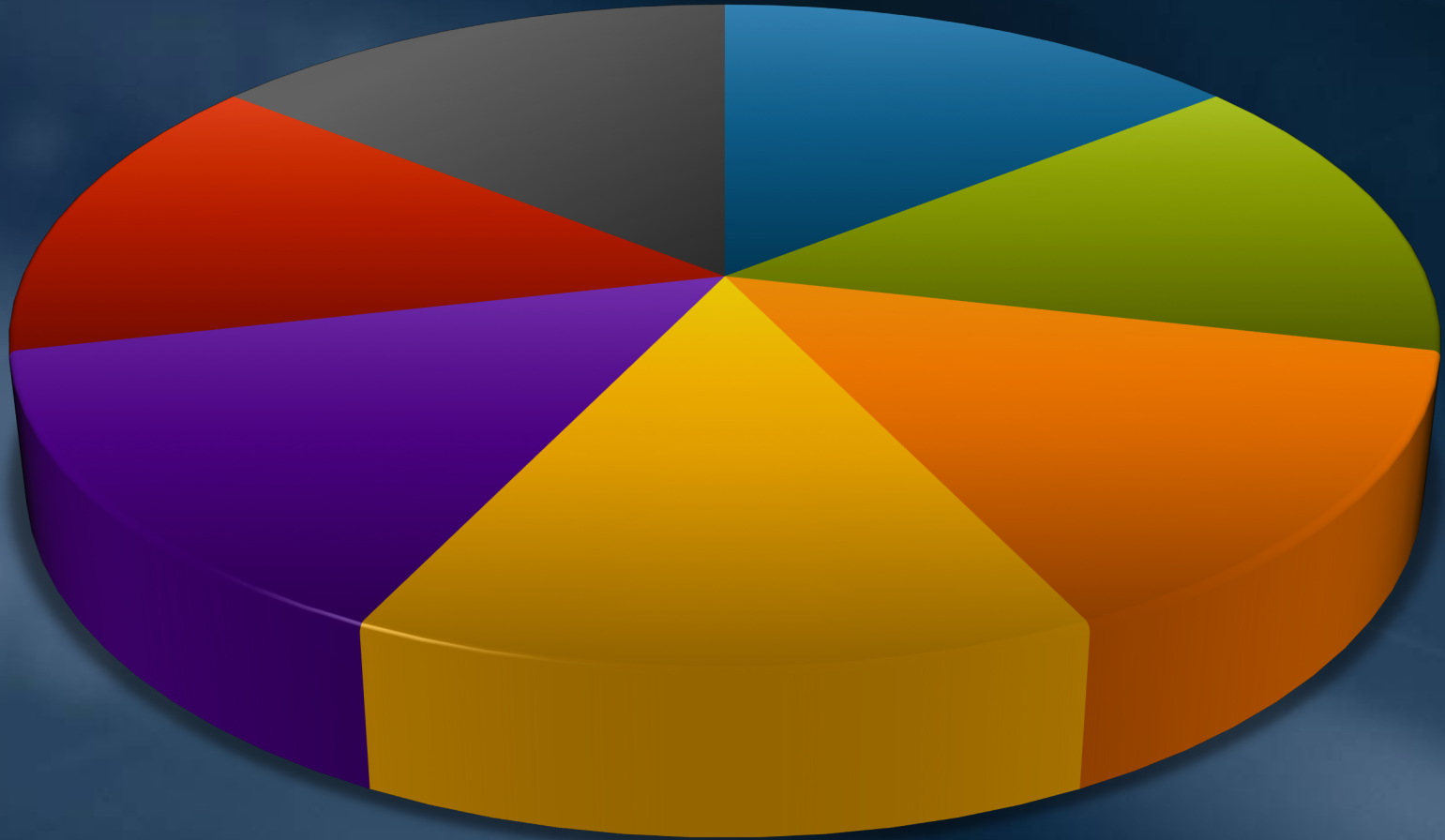




Recommended Fill Colours



Sample Pie Chart



Sample Bars

