



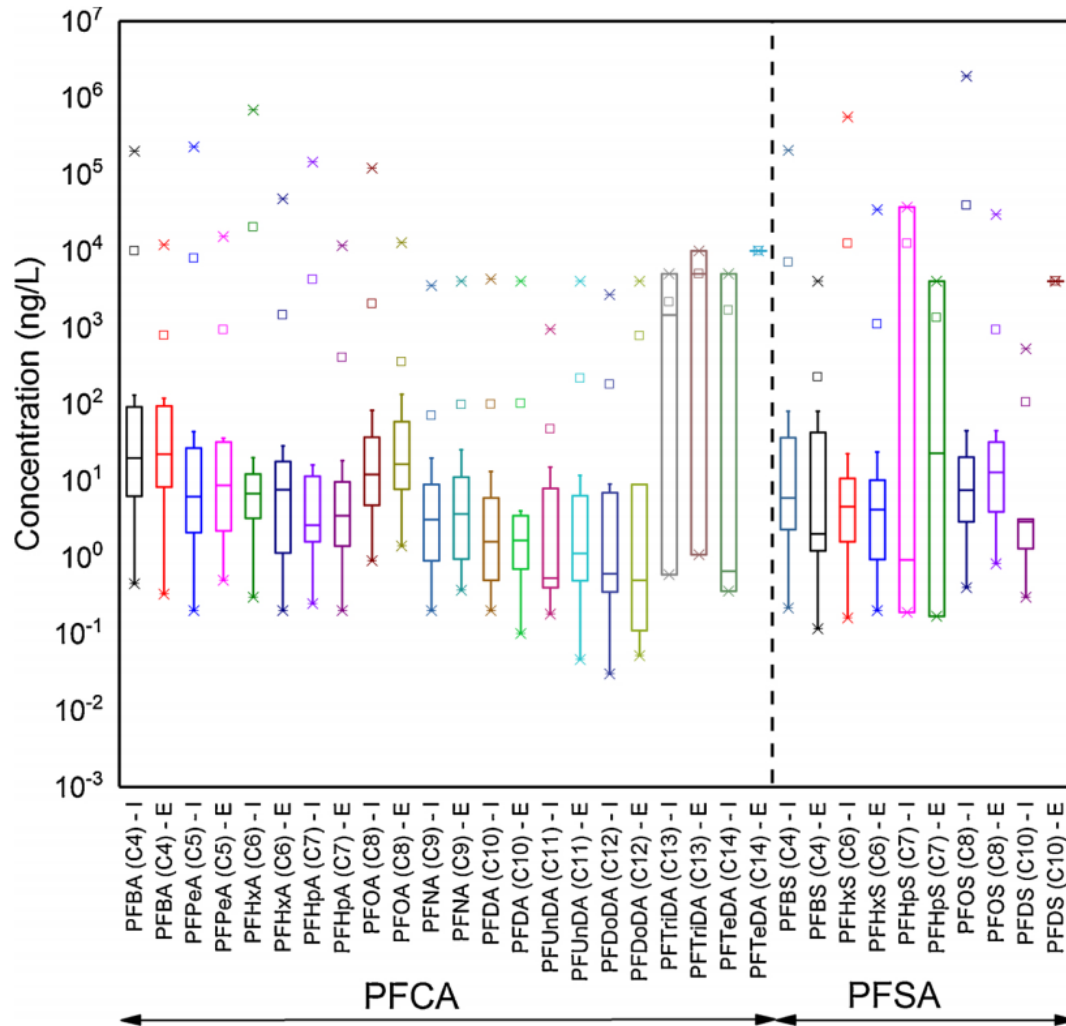
PFAS Monitoring at Wastewater Treatment Plants

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GLOBAL ESTIMATE OF PFAS IN WASTEWATER

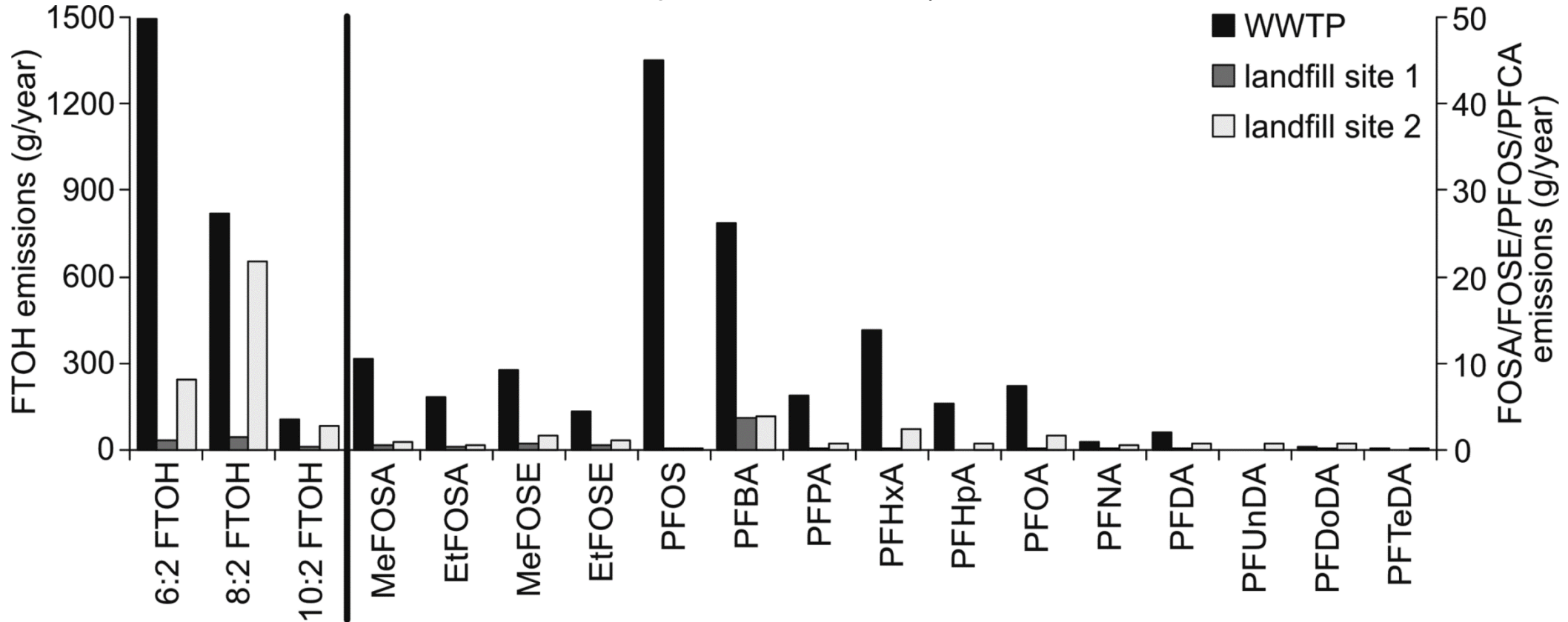


Source	Range (ng/L)	Product inputs
Domestic	>100	Food packaging, dust, household equipment
PFAS non-intensive industry	100-1000	Chrome plating, hospital, etc.
PFAS intensive industry	>1000 ng/L	Waterproofing, polymer manufacture, AFFF

Phong Vo et al., 2020. PFAS in water and wastewater: A comprehensive review from sources to remediation. Journal of Water Process Engineering 36, 101393.

PFAS AIR EMISSIONS FROM WWTP AERATION TANKS

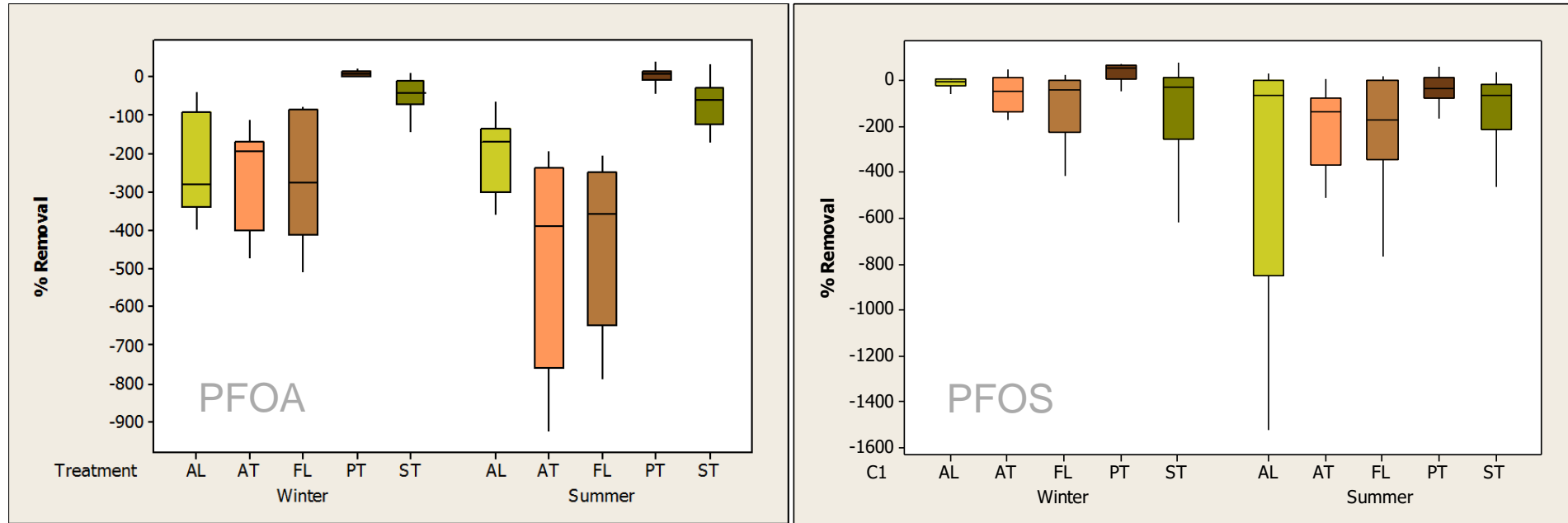
Ahrens et al. [dx.doi.org/10.1021/es1036173](https://doi.org/10.1021/es1036173) | Environ. Sci. Technol. 2011



2.5 kg PFAS/year for the WWTP tested, mostly FTOHs. Compared with 0.2-15 kg/year from effluent + biosolid (Guerra et al. 2014),

CREATION OF PFAA IN TREATMENT

Guerra et al. 2014 Journal of Hazardous Substances 272: 148-154

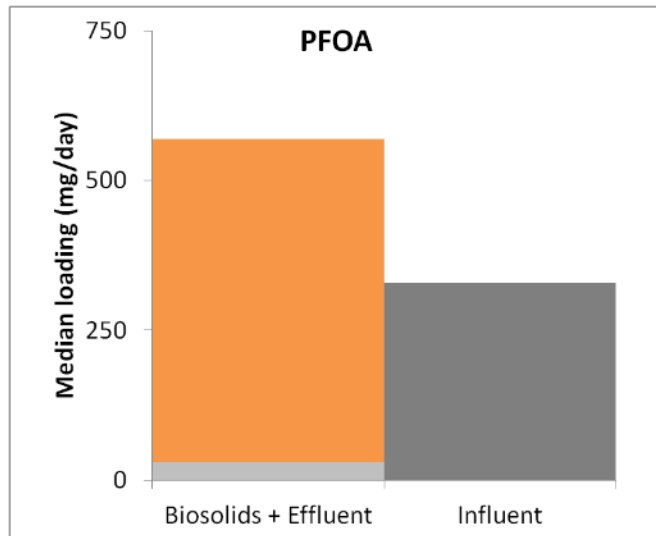
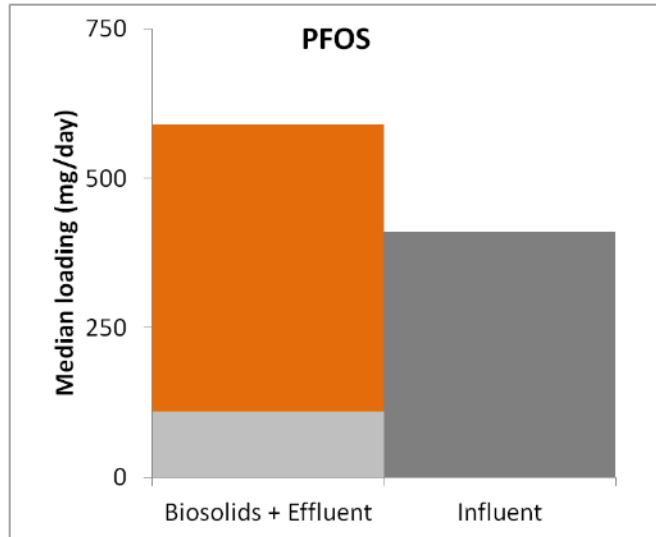


AL - Aerated lagoon, AT - Advanced biological nutrient treatment, FL - Facultative Lagoon, PT - Chemical assisted primary, ST - Secondary aerobic biological

Images from Shirley Anne Smyth Environment Canada

- PFOS and PFOA form during wastewater treatment
- The more extensive the treatment/residence time, higher the formation
- The precursors not measured drive final PFCA/PFSA levels

PFOS AND PFOA MASS BALANCE



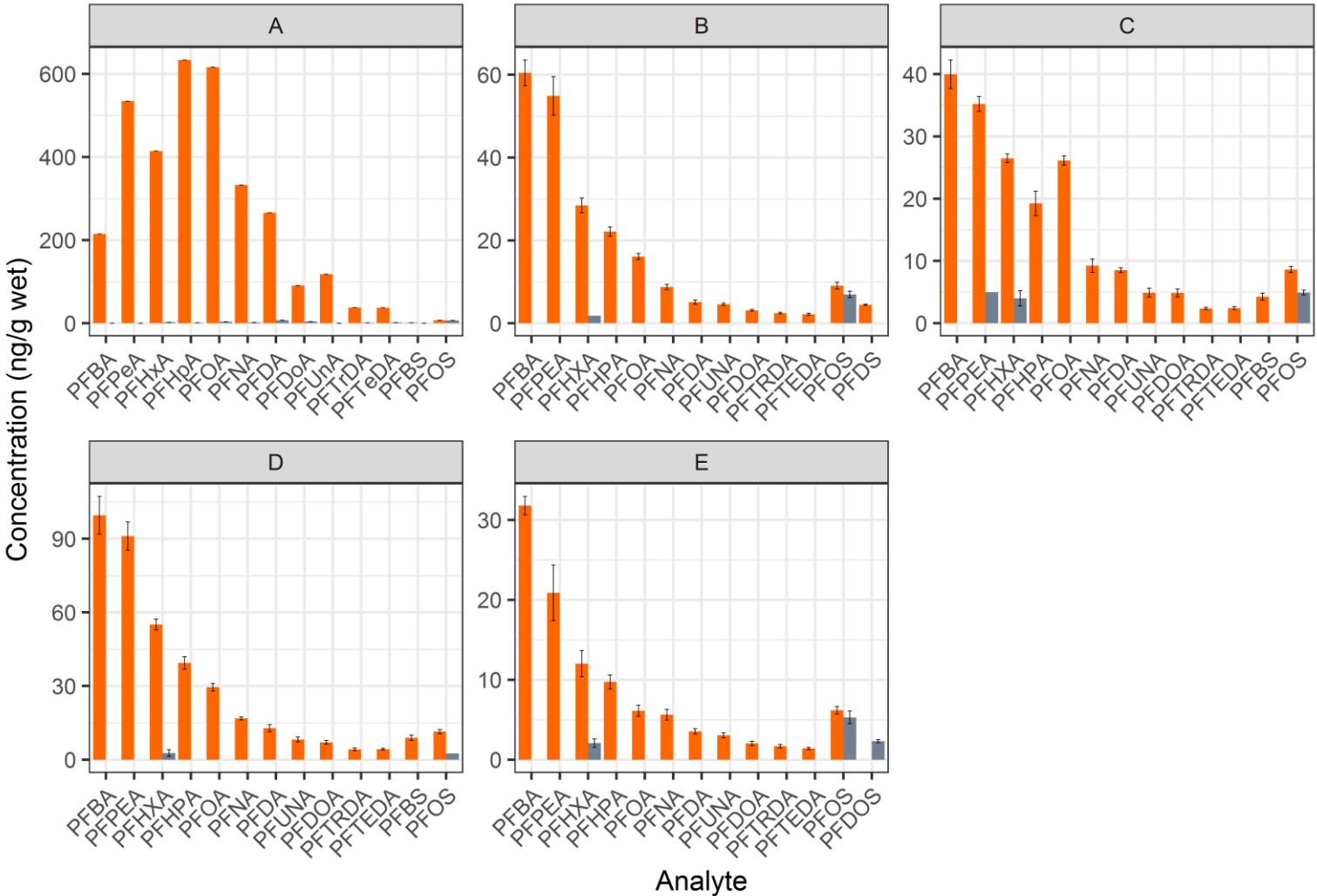
- Effluent + Biosolid > Influent
- Total Median PFAA Effluent (1.97 kg/year) > Biosolids (0.06 kg/year)
- But does target analysis provide a complete picture?

Guerra et al. 2014 Journal of Hazardous Substances 272: 148-154



BIOSOLIDS SHOW LARGE “DARK MATTER” PFAS

Analysis ■ Post-TOP ■ Pre-TOP



- Total Oxidizable Precursor (TOP) technique for estimating unknown PFAS (orange) versus known (grey)
- Most of the PFAS in biosolids not captured by targeted analysis
- Land application may result in slow leaching/transformation to carboxylates

- Targeted Isotope-dilution PFAS analysis by LC-MS/MS is the current standard

40 PFAS in Non potable water, solids, wastewater, biosolids and tissue

