Why source control is key for (some) emerging contaminants of concern

Jochen Mueller on behalf of team

Christie Gallen, Hue Nguyen, Jiaying Li, Emma Knight, Ben Tscharke and others

Christie Gallen

Dr Hue Nguyen

Dr Jiaying Li

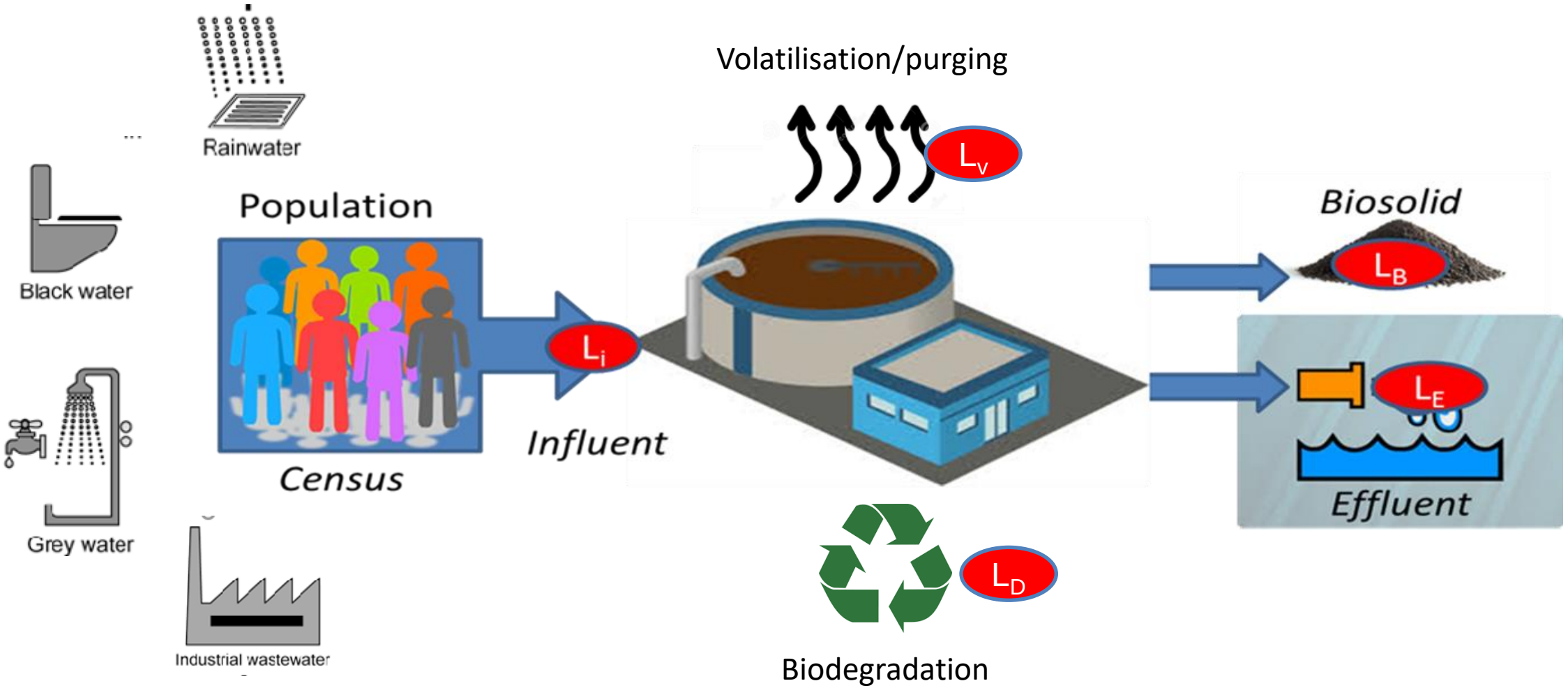
Dr Emma Knight

Dr Ben Tscharke

The University Of Queensland
AUSTRALIA
Create change

What goes in comes out

(or must have gone somewhere)

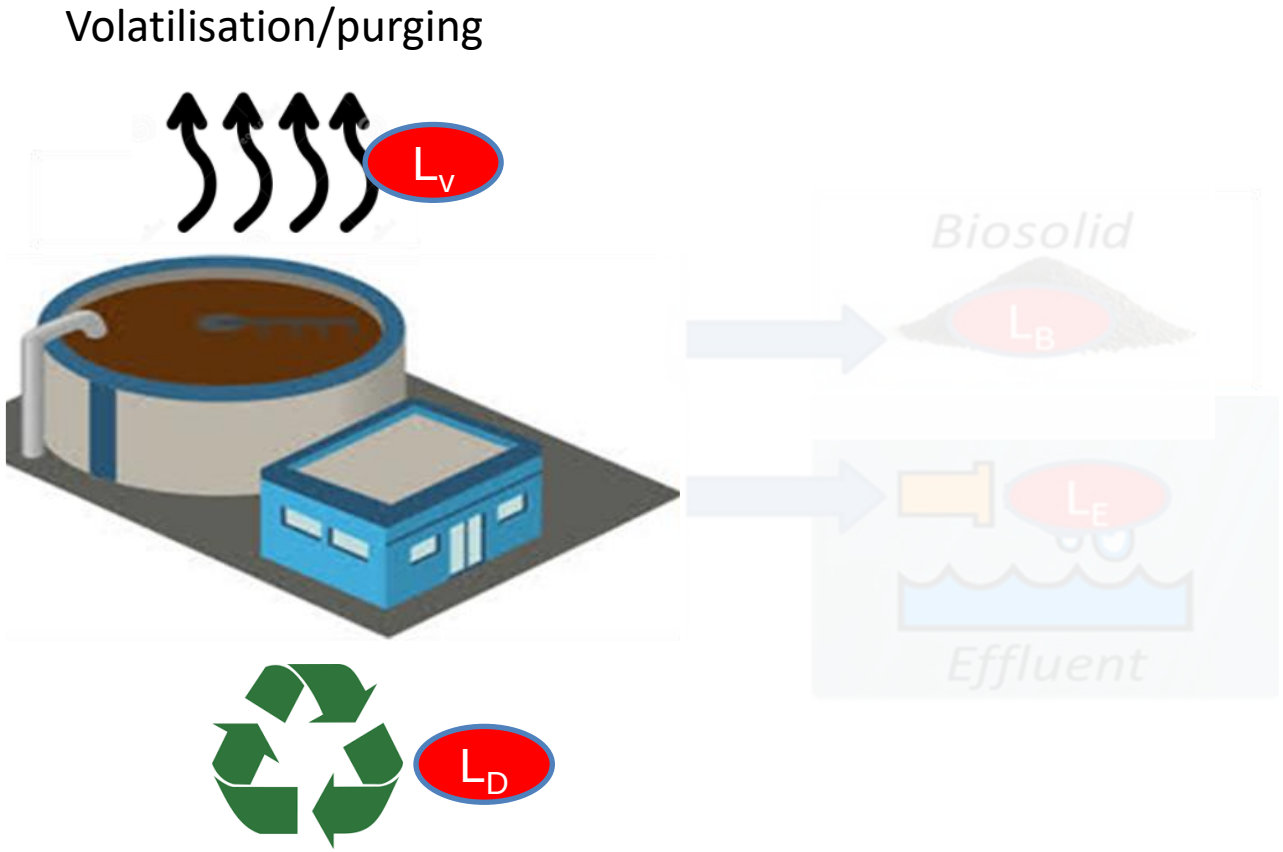


WWTPs are designed to collect and separate chemicals

(but volatilisation and transformation are not a strength)

Biodegradation and volatilisation relevant to limited number of chemicals

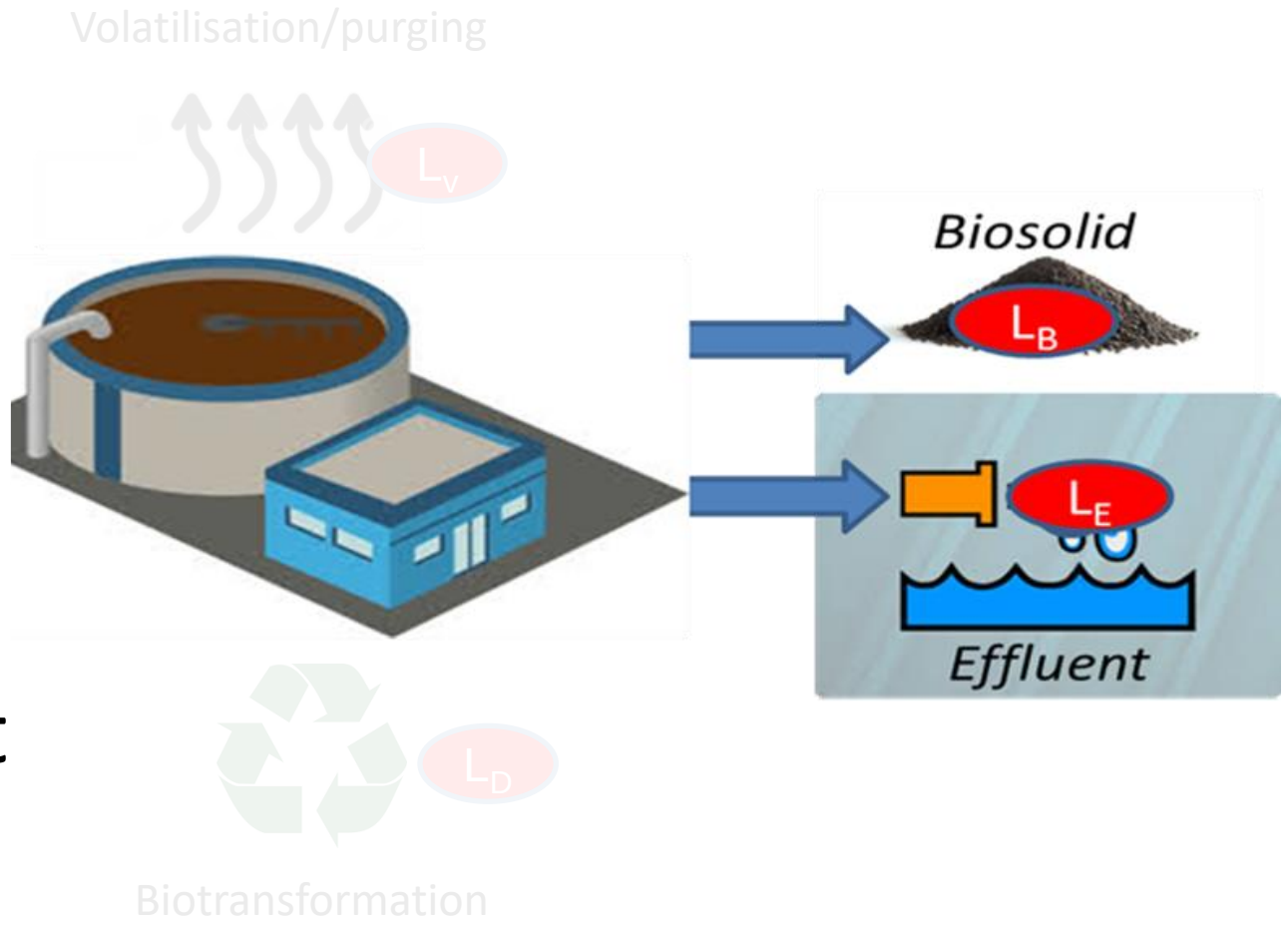
Bioactivity high but time short



What goes in must come out

Separation into biosolids and effluent is a key process – hence:

Effluent and biosolids a key concern for ‘chemicals of concern’

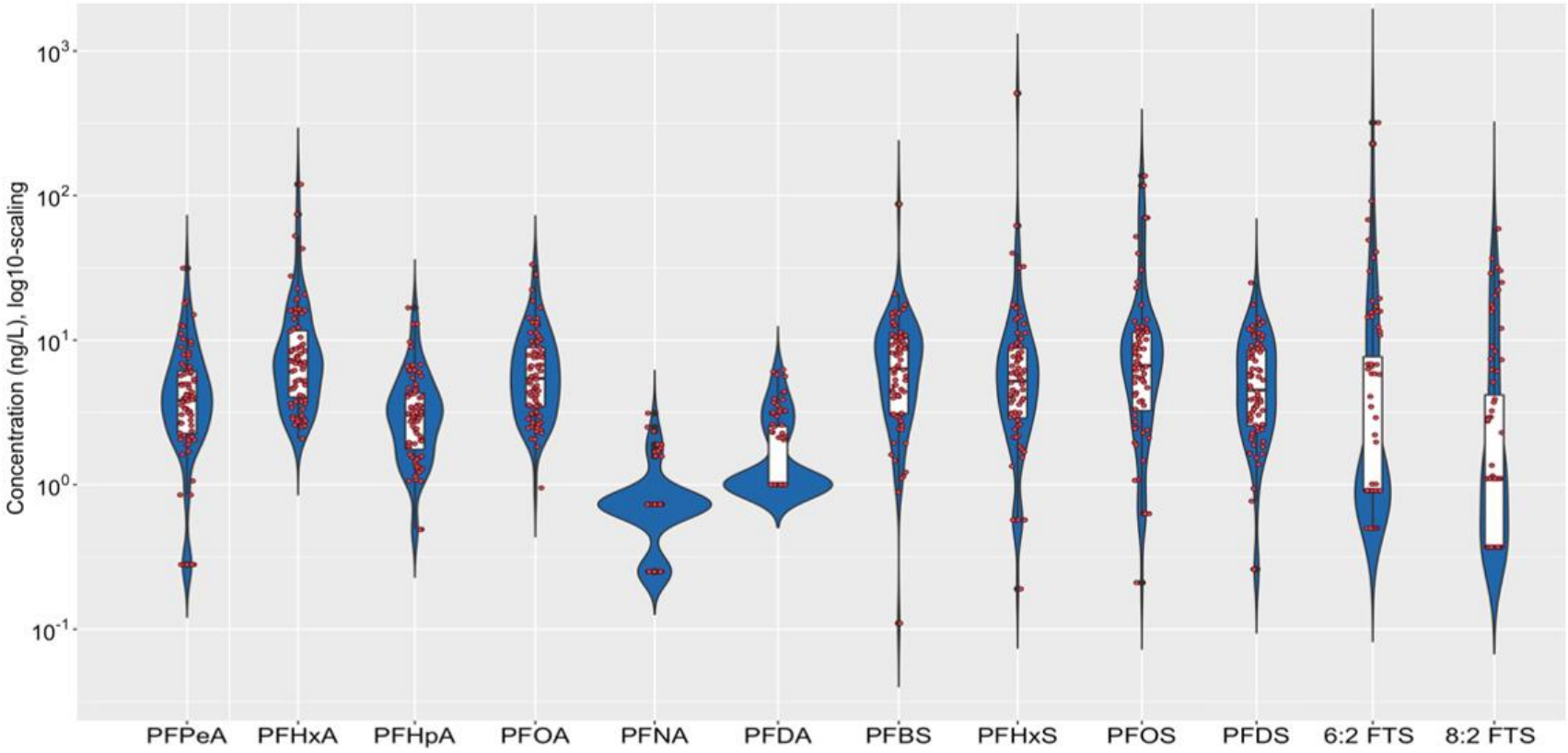


Hydro**philics** --> effluent

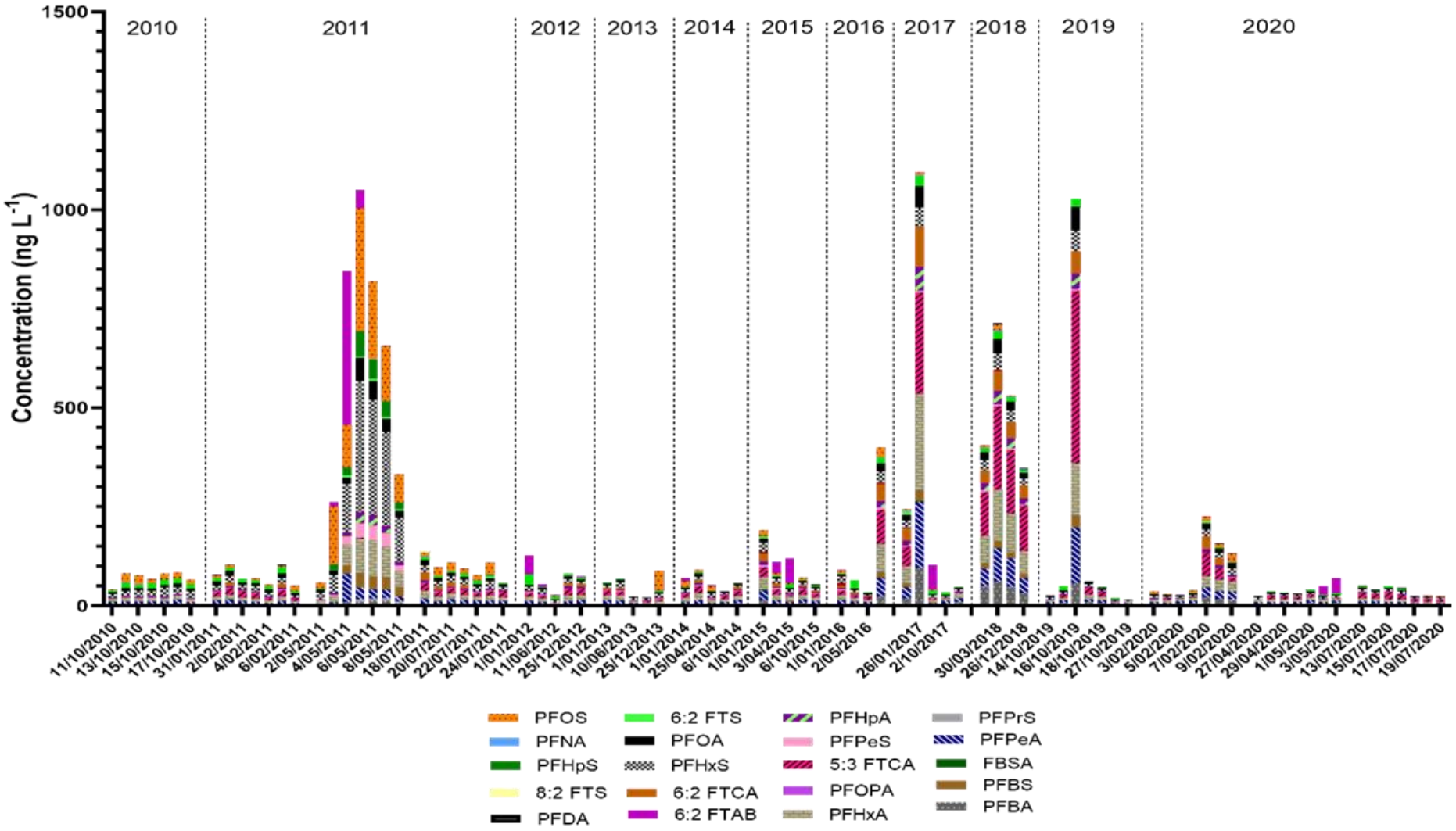
Hydro**phobics** --> biosolids

PFAS in influents from 67 WWTP on Census Day 2016 (PhD of Hue Nguyen)

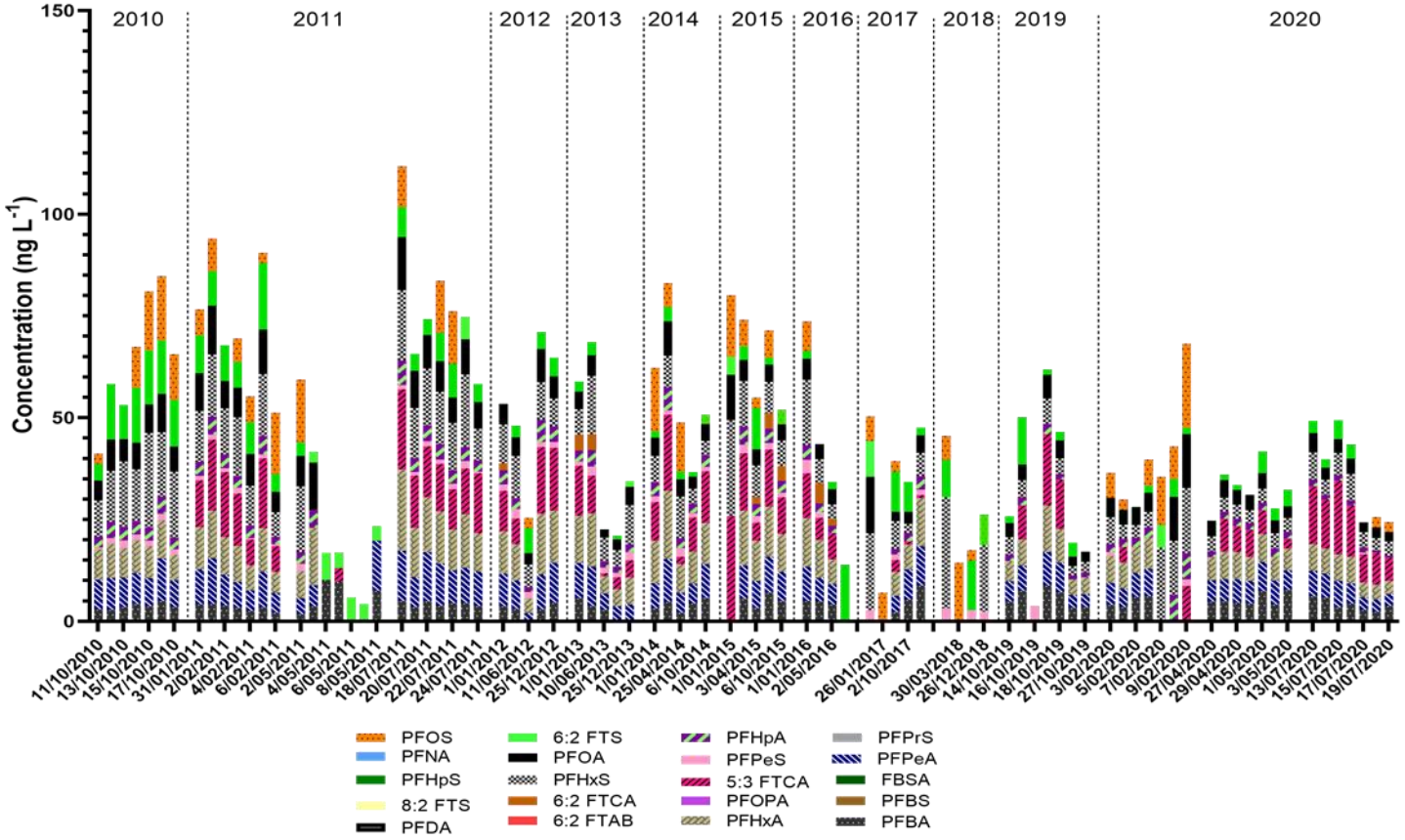
- Several orders of magnitude differences
- Unlikely to reflect differences in release from domestic sources



Temporal trend of PFAS in a WWTP ==> On average one in five days with substantial above average daily load (PhD of Christie Gallen, Gallen et al. STOTEN 2021



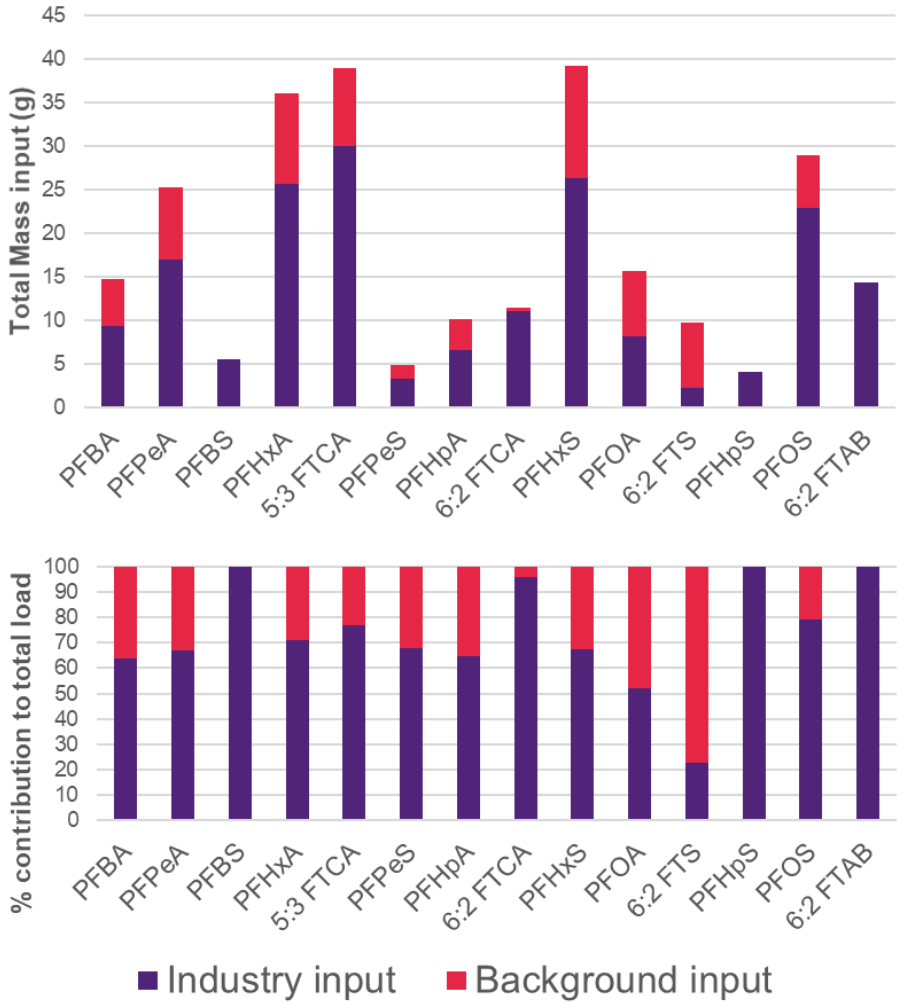
If we remove ‘highs’ background of most PFAS is decreasing (PhD of Christie Gallen, Gallen et al. STOTEN 2021)



PFOS and 6:2FTS decrease > 10% per annum…

PFBA is increasing in background ~3 % per annum

Most PFAS in this catchment from point these peak releases (PhD of Christie Gallen, Gallen et al. STOTEN 2021)



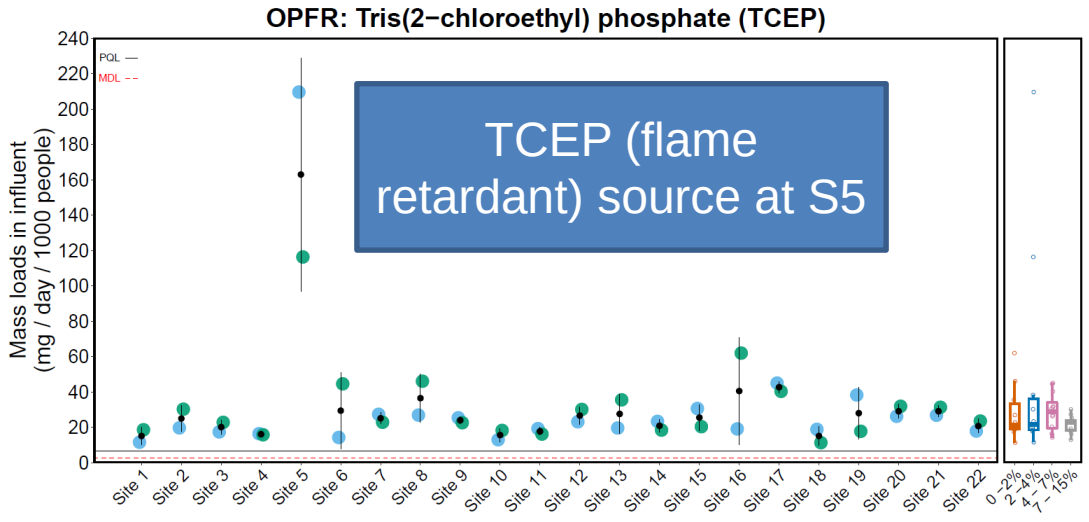
But we were unable to link it to specific trade waste release….

Questions

Do sources release into sewer or does it come to WWTP via registered tradewaste?

Chemical specific sources vary between sewer catchments!!!

(pooled samples (n = 12 per pool) from samples collected in 2019)



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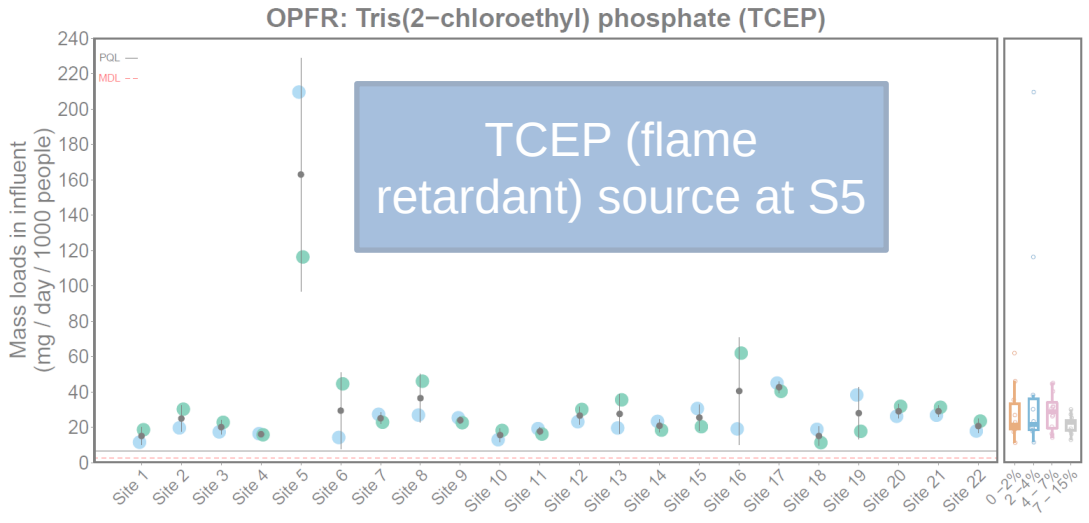

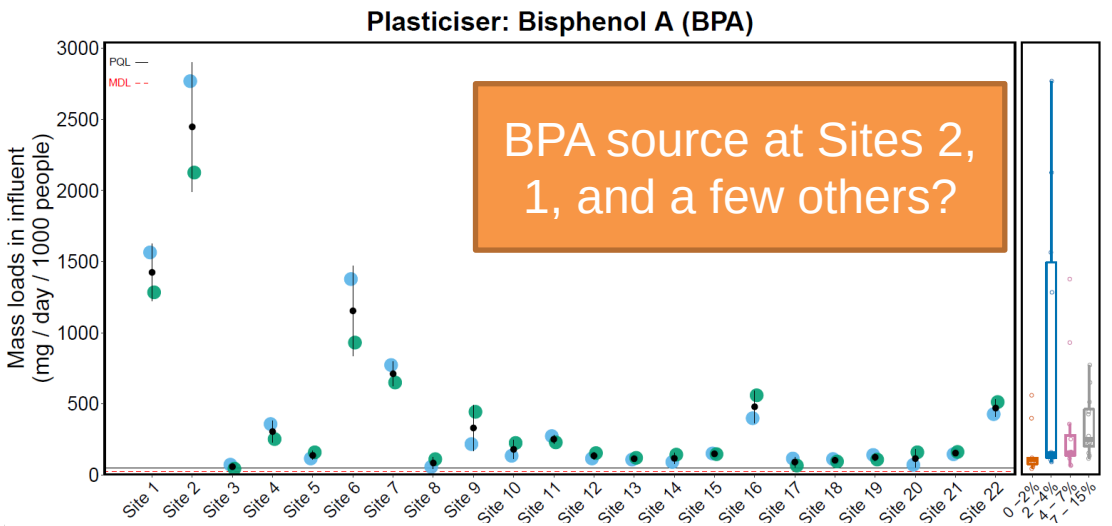

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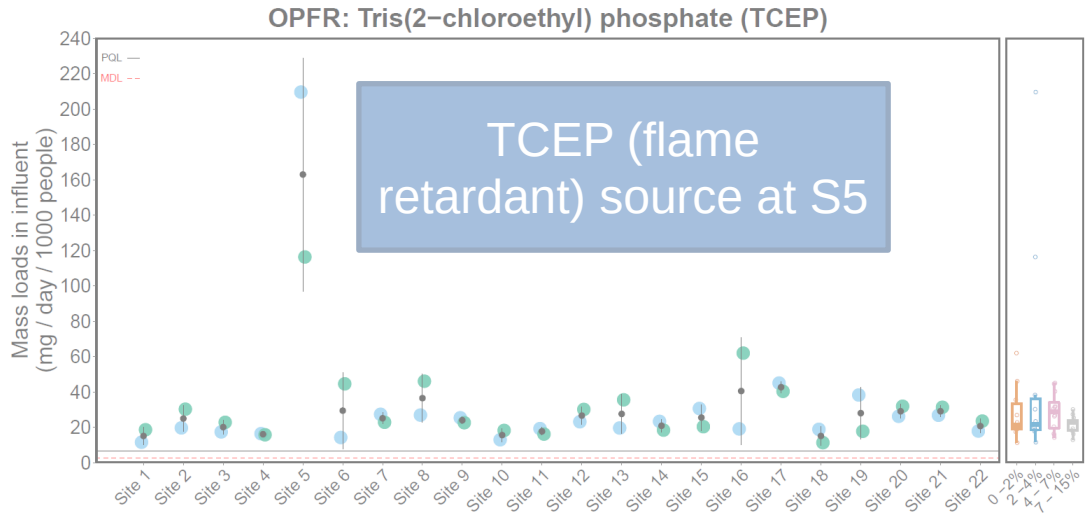

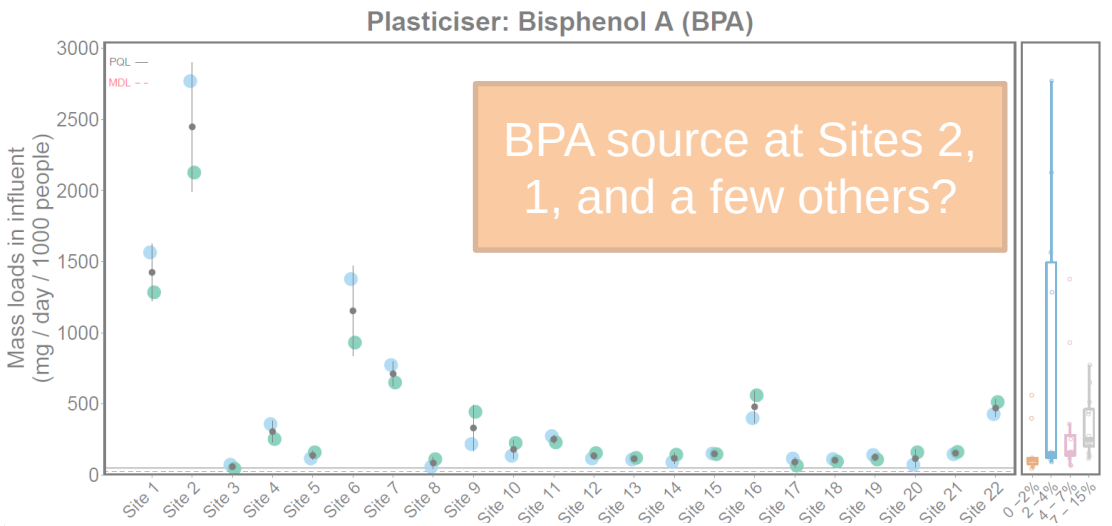

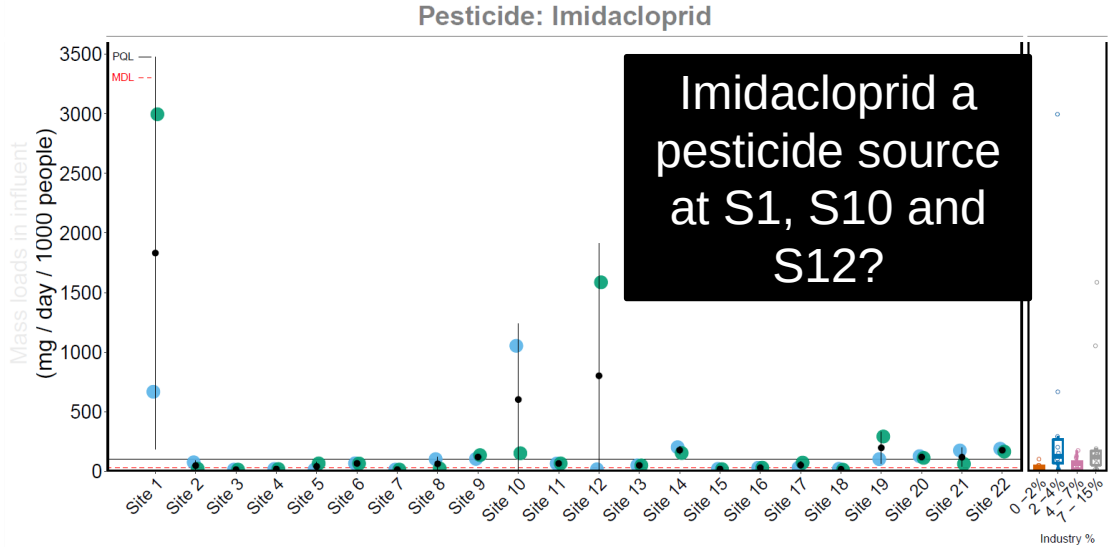

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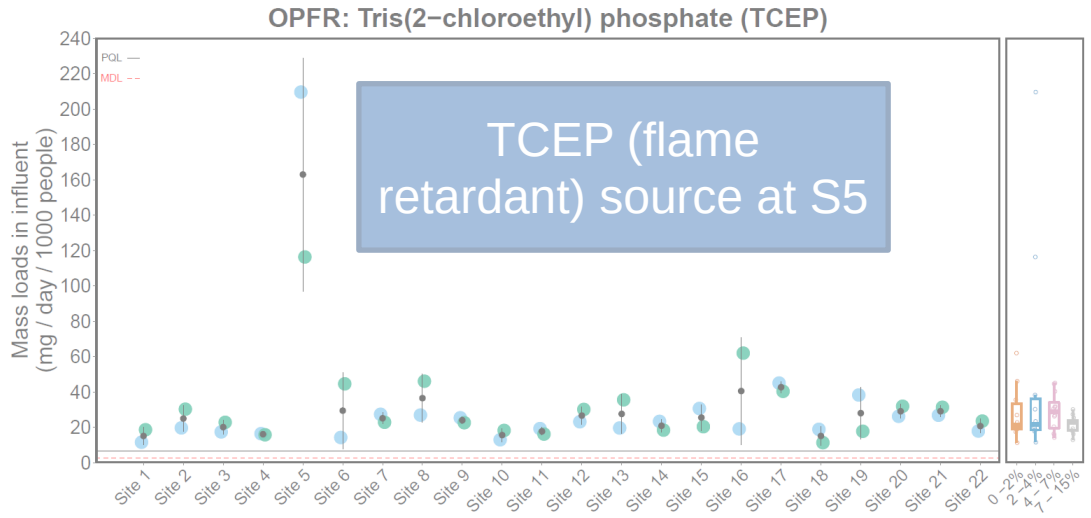

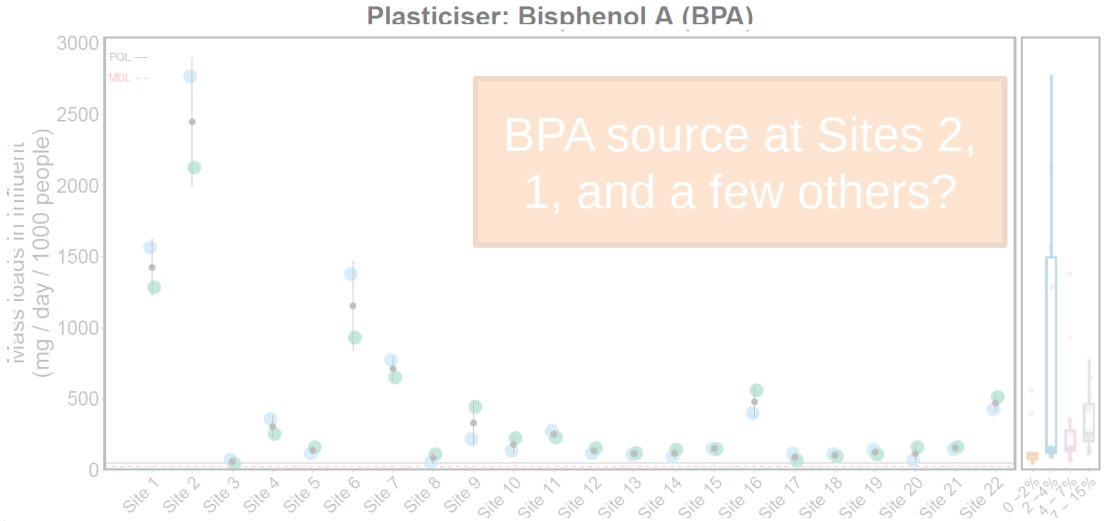

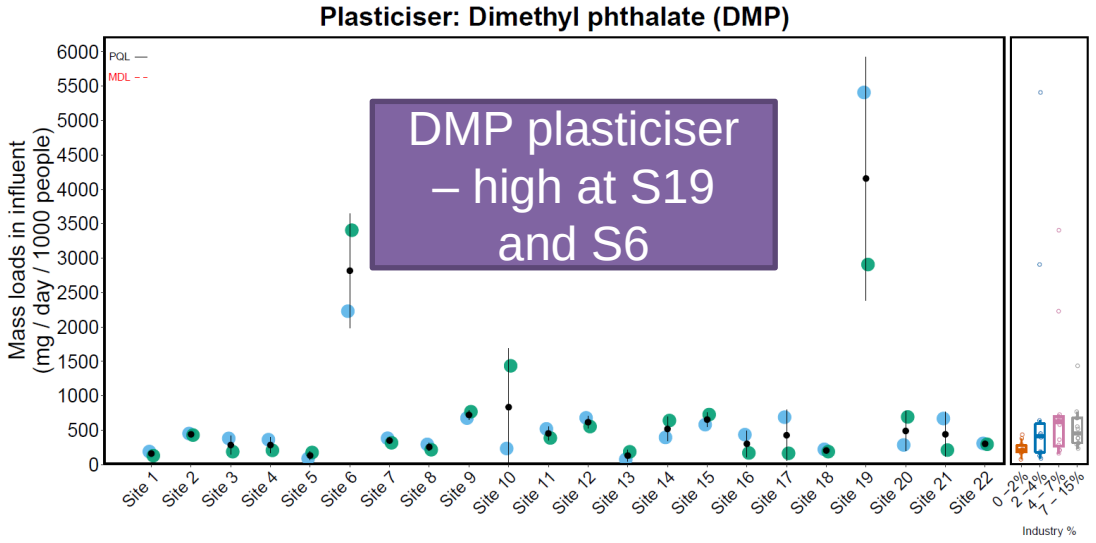

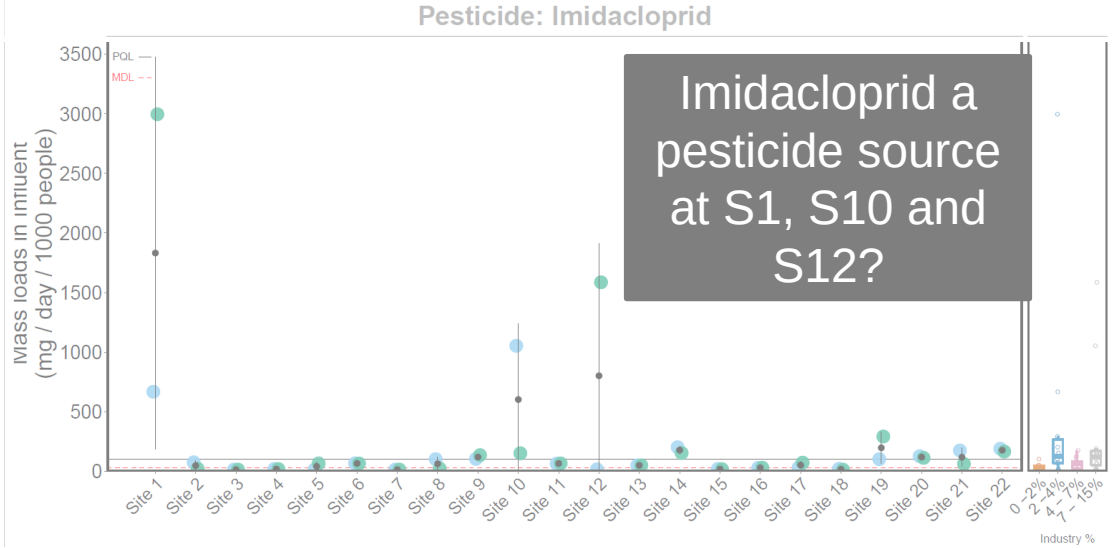

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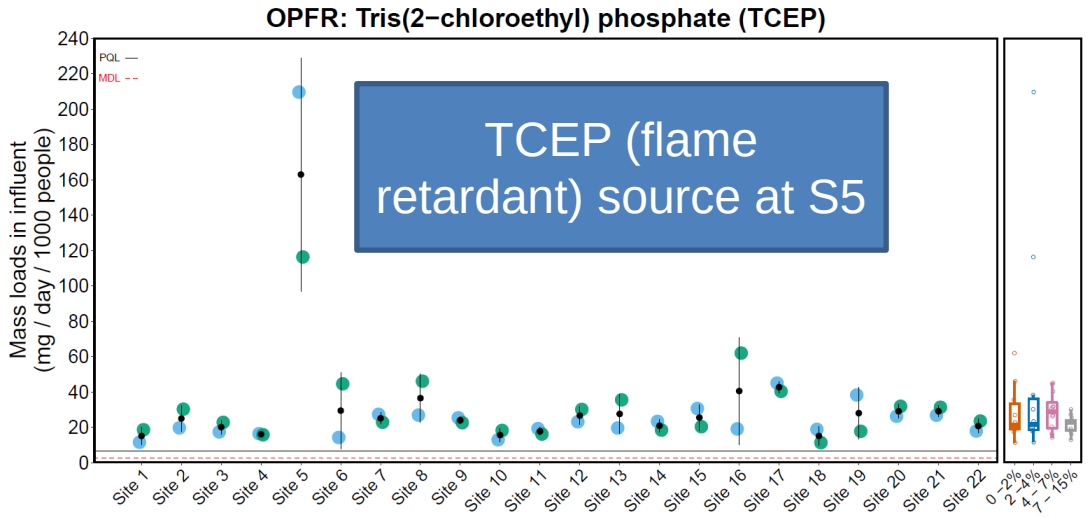
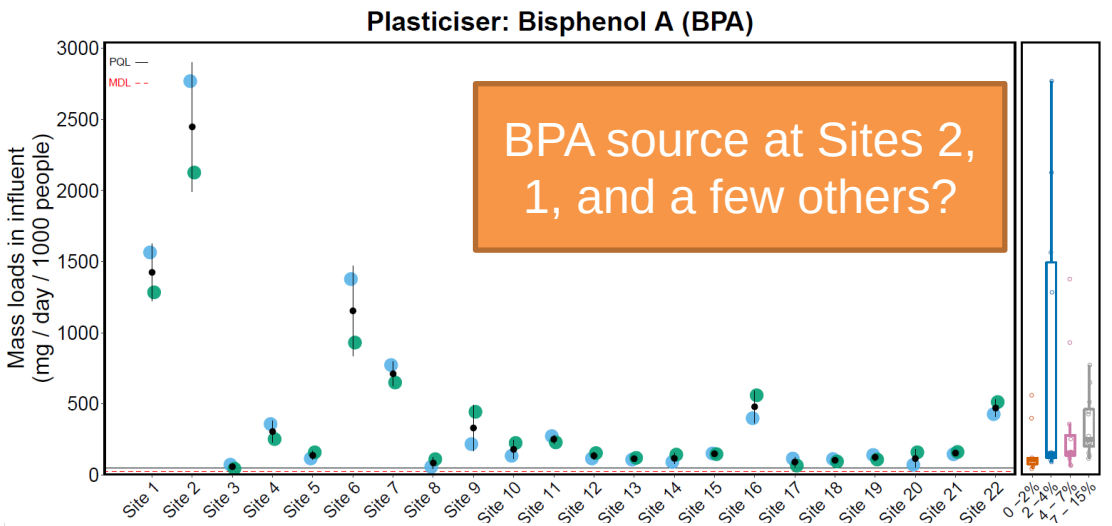
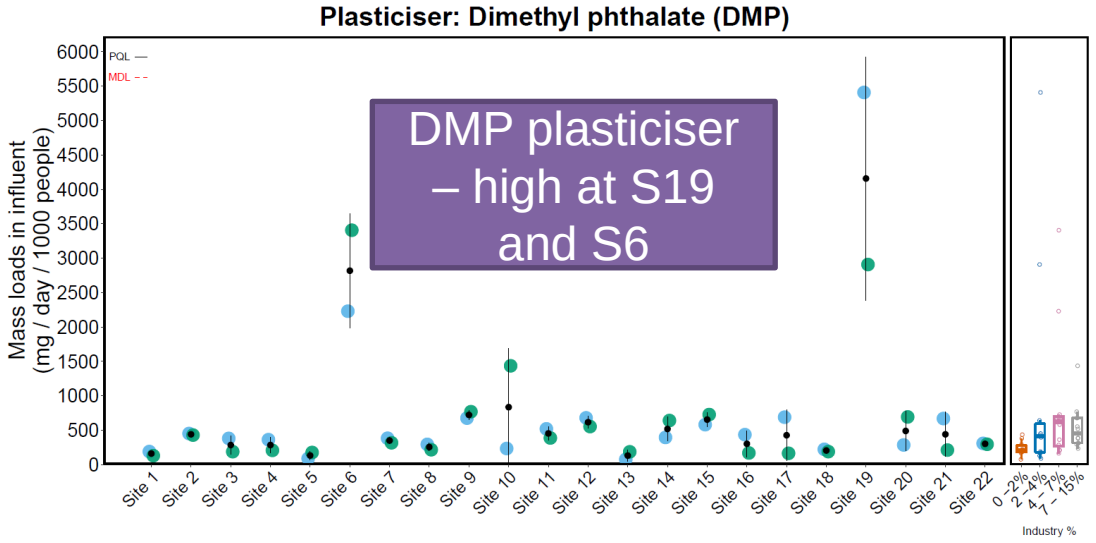
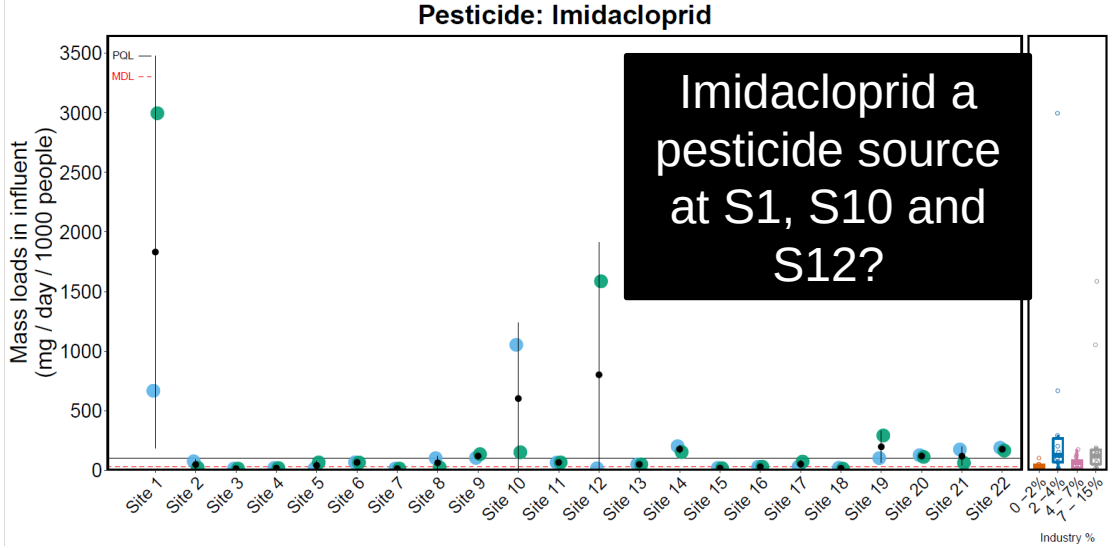
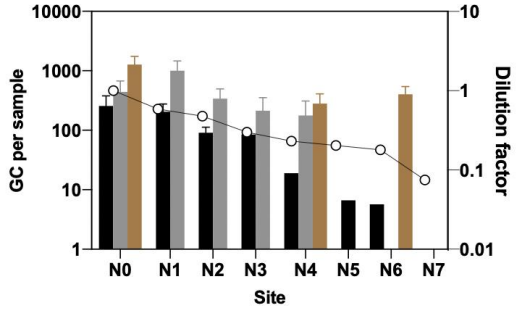




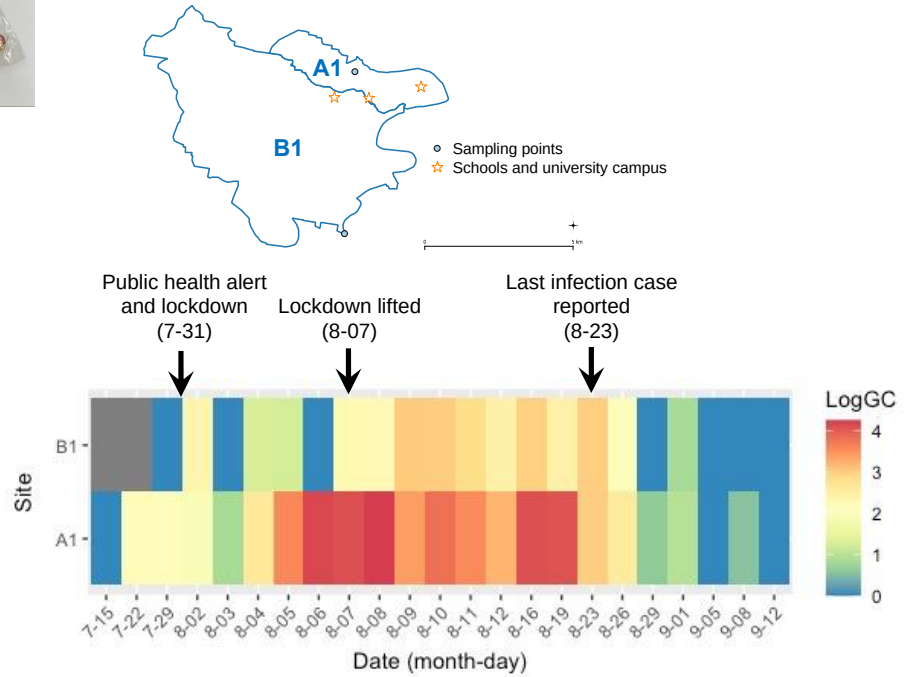




Upstream sampling for SARS-CoV-2: examples of source tracking



Example 1: the fate of virus in sewer systems.
Virus signals decrease with higher flow rates along sewer pipes



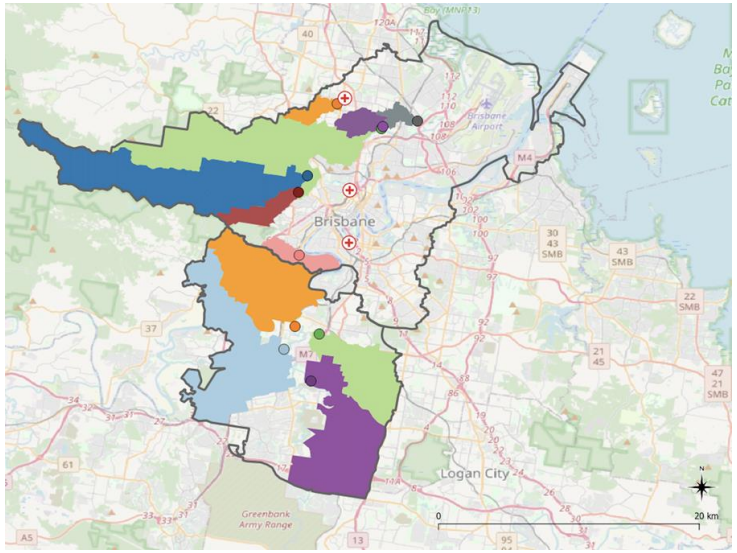
Example 2: tracking the spread of virus within a city.

- Positive detection in wastewater at 2 upstream sewersheds (A1&B1) one week ahead of the public health alert.
- Positive signals lasted for up to 7 weeks, until 2 weeks after the last clinical case reported

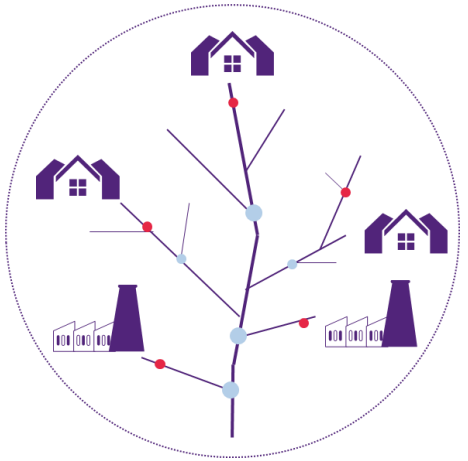
(A1&B1: where the initial outbreak occurred)

Source identification for WW based Covid Surveillance

Understanding the catchment and the sewer maps



Establishing and maintaining strategic upstream sampling has become a routine part of ongoing Covid surveillance program



Advancing portable sampling techniques

Various types of samplers have been developed for easy sample collection from upstream sites and all kinds of sampling points

Identifying sources of emerging contaminants

1. Establish relevant hazards (chemicals & biological) and develop methods ==> also establish hypothesis of relevant sources!

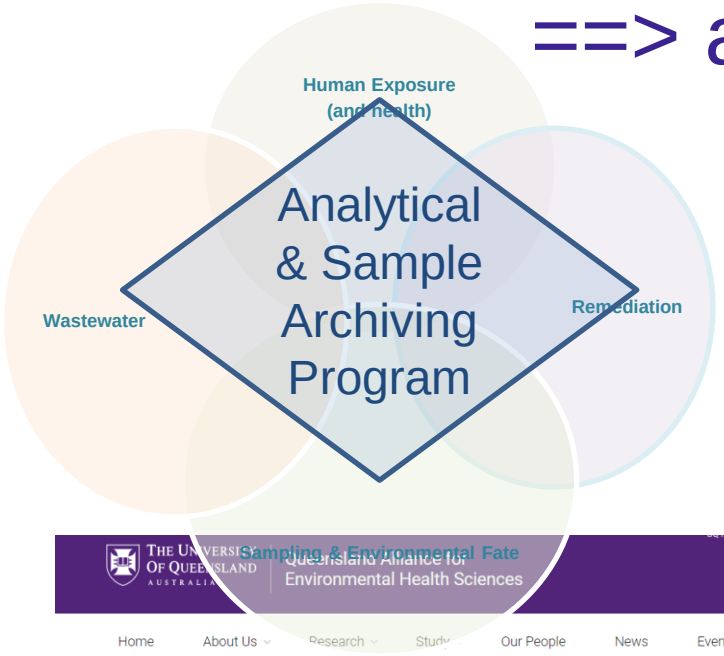
2. Design strategies for sampling – where, when, how… link to hypothesis & sources (include baseline, within catchment sources & tradewaste)

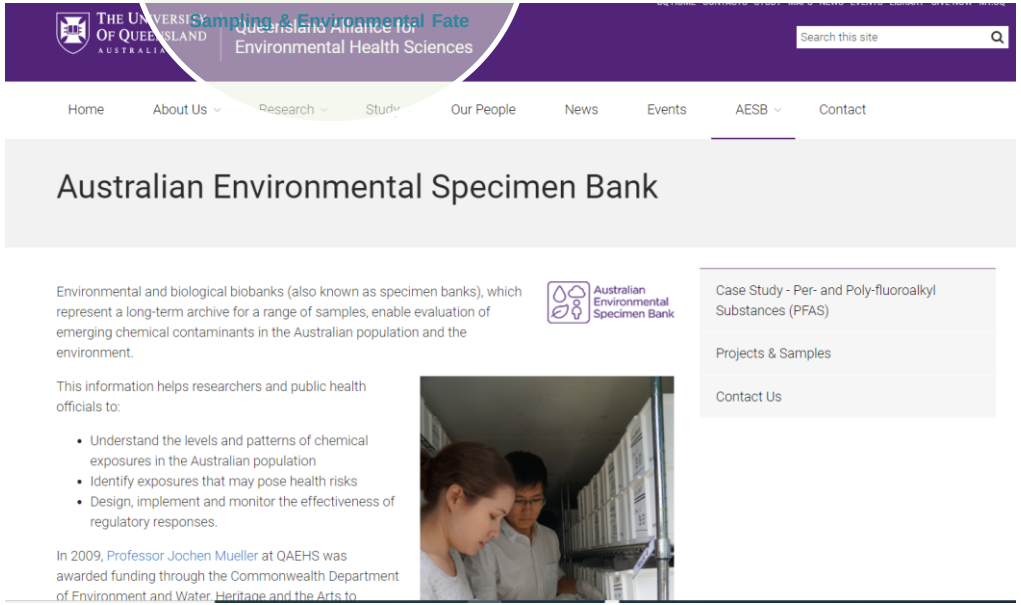
3. Analysis - Target hazards and potential other approaches

4. Estimate contribution of sources to loads --> Assess options for potential intervention (and associated cost benefit)

The Australian Environmental Specimen Bank @ QAEHS

==> all samples are archived!!!





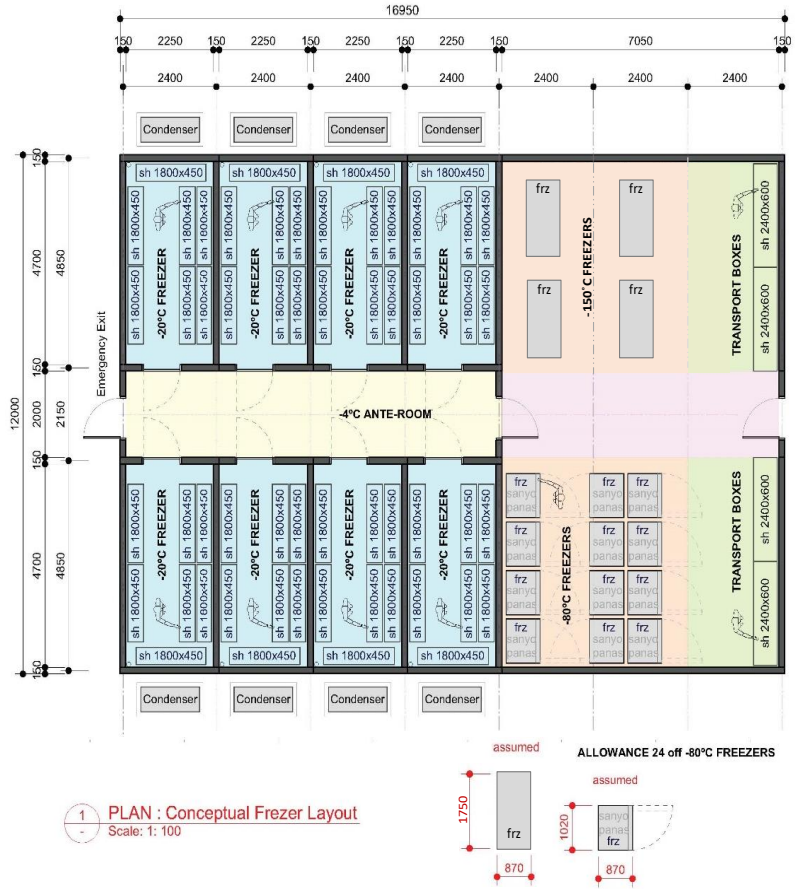


Figure 3. Conceptual AESB layout: -20˚C freezers (blue) opening to a 4˚C anteroom and dedicated -80/-150˚C

Summary

- WWTP are not designed to deal with emerging contaminants

- Effective reduction in the release of contaminants relies on SOURCE CONTROL

- Good time to tackle this (we have learned a lot in the last 18 mths about systematic sampling)

Thank–you: Acknowledgement of original team(s)

- ARC Fellowship (JM), UQ Fellowship (PT), UQRS, UQIRTA & GSITA (FYL), APA (JO'B)
- Australian Crime Commission
- Queensland Crime and Corruption Commission
- Australian Crime & Intelligence Commission

- Australian Future Forensics Innovation Network
- QH & QHFSS
- Australian Tax Office
- Various ARC LIEFs, MEIs and ARC Discovery projects

Water Authorities and Operators

from more than 100 WWTP that have collected more than 20000 samples since 2009.

Each sample has been carefully archived in our Specimen Bank

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