PREVALENCE OF SURFACTANTS IN EFFLUENT FROM ADVANCED ONSITE WASTEWATER TREATMENT SYSTEMS IN CHARLESTOWN, RI

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EUTROPHICATION

Nitrogen Loading

- Nutrients for Growth

Algae Blooms

- Surface Cover

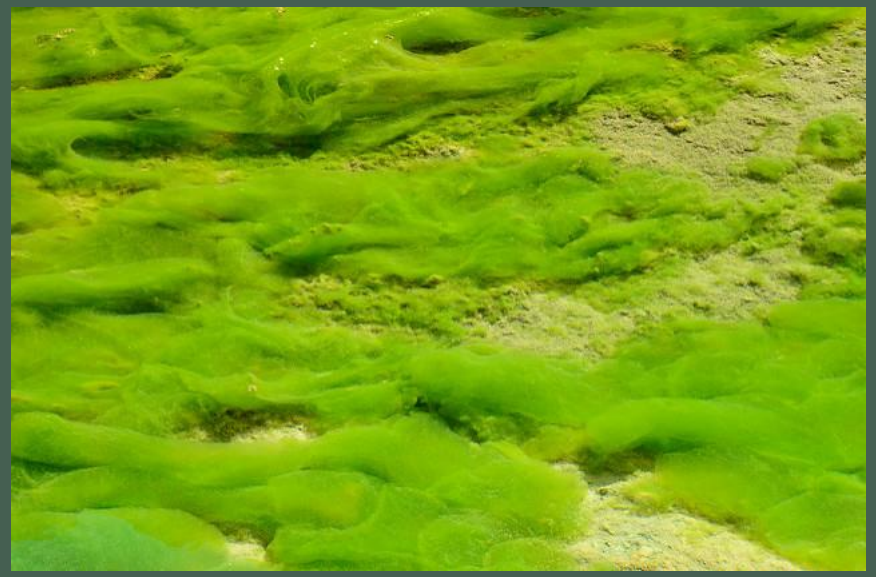
No Sunlight

- Plant Death

Decomposition

- O2 Depletion

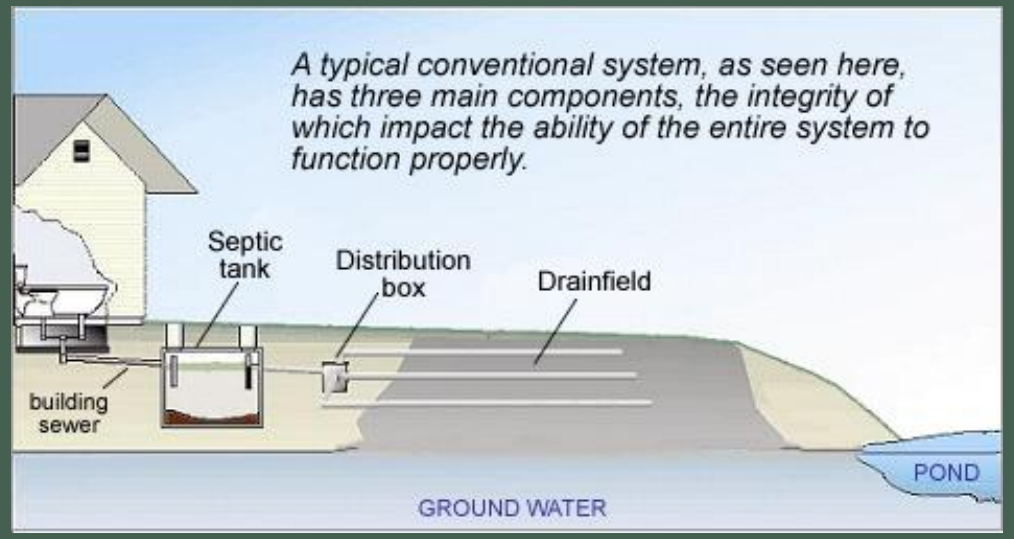
Die Off Events

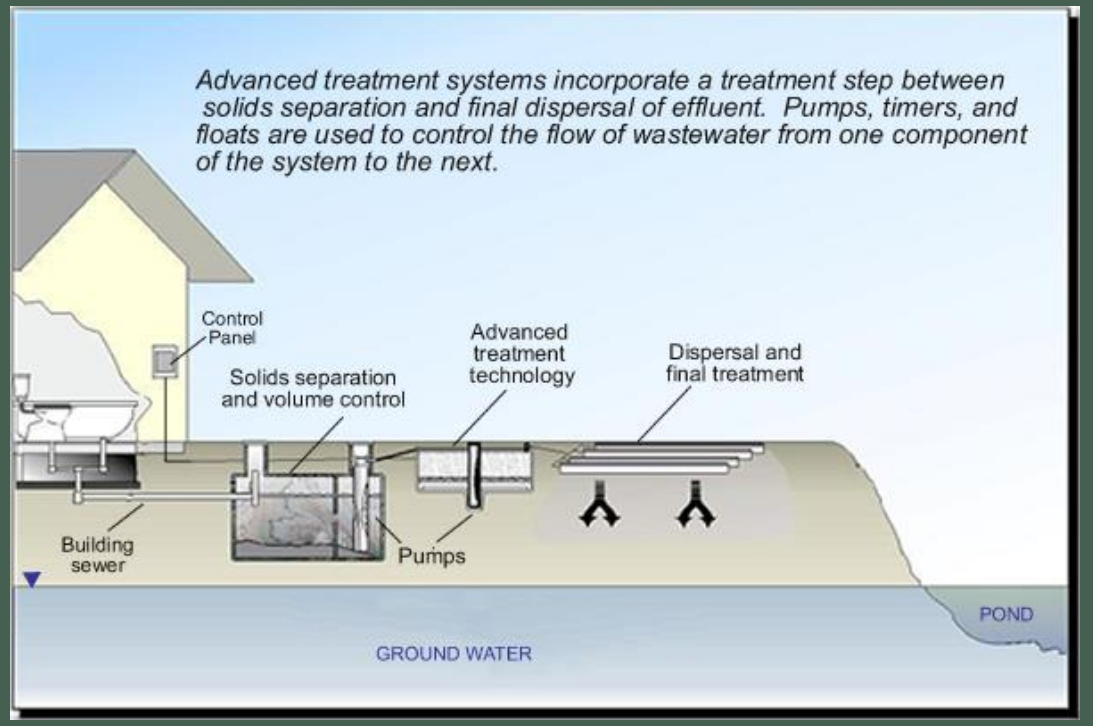


STUDY AREA

- Rhode Island Department of Environmental Management
- Coastal Resources Management Council
- URI LSEM Team

ADVANCED ONSITE WASTEWATER TREATMENT SYSTEMS: **OWTS**





University of Rhode Island, New England Onsite Wastewater Training Program, Advanced Treatment Systems, 2019
https://web.uri.edu/owt/advanced-treatment-systems/

What is the capacity of Advanced Systems to remove emerging contaminants?

SYSTEMS STUDIED

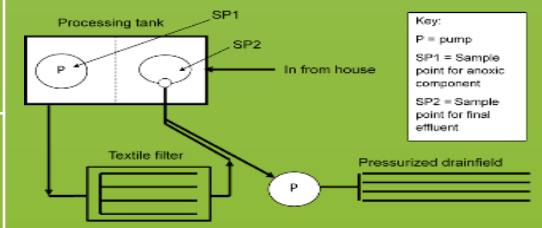
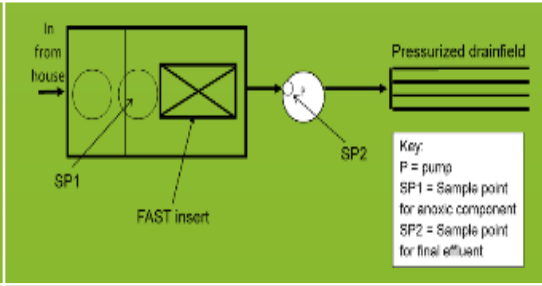
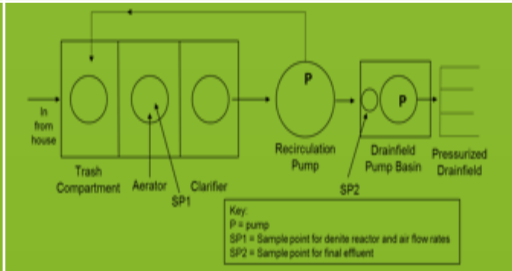
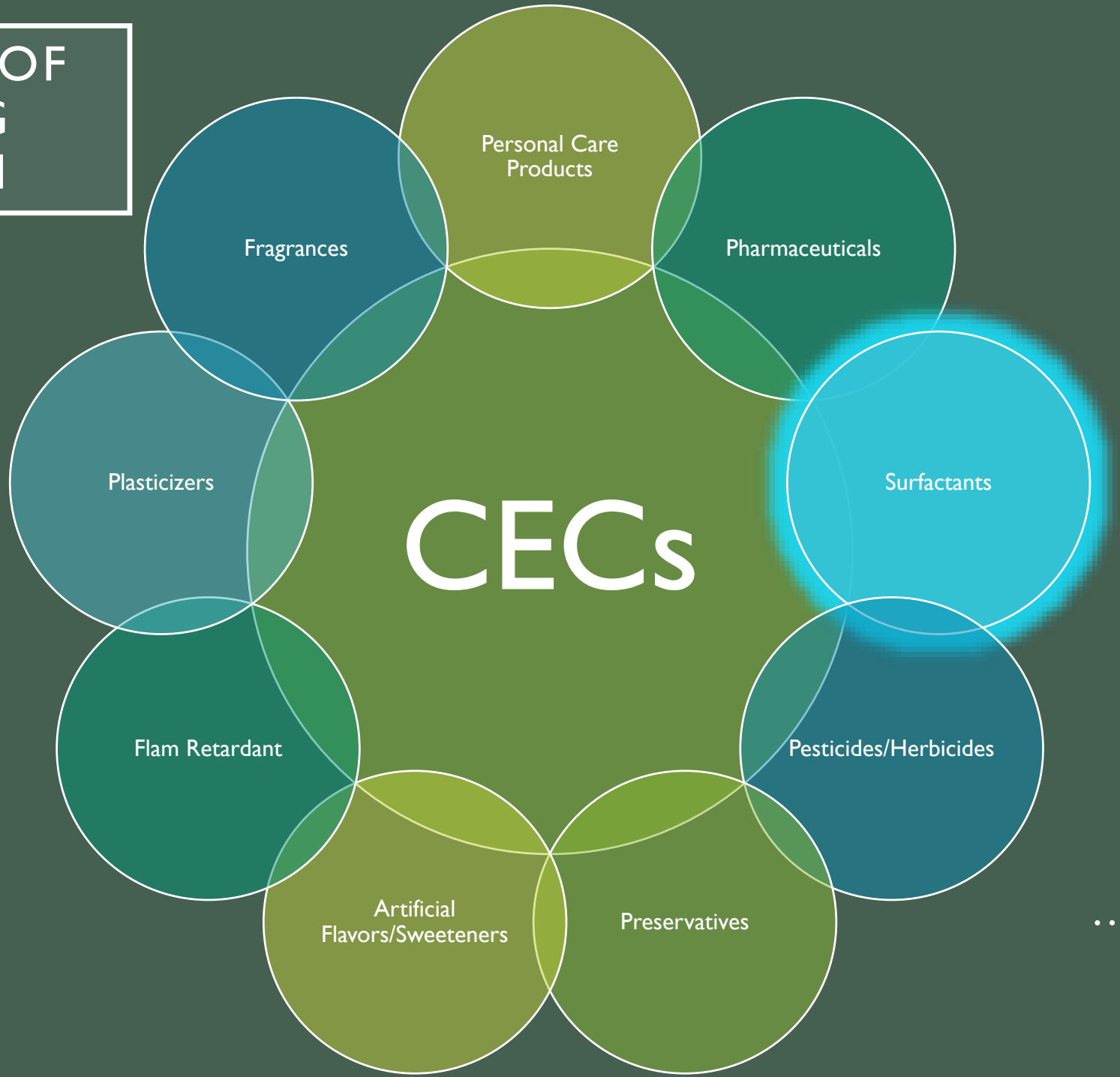
Name	Nitrification/Denitrification	Other	Diagram
Orenco Advantex AX20	Textile sheets/Timed-dosed recirculation into primary processing tank	Rely on recirculation ratio (recirculated flow: forward flow) to store or move wastewater	
Orenco Advantex RX 30	Textile coupons/Timed-dosed recirculation into primary processing tank	Rely on recirculation ratio (recirculated flow: forward flow) to store or move wastewater	
BioMicrobics MicroFAST	Submerged fixed-film activated sludge treatment and block media insert for aeration/Anoxic compartment within tank	Wastewater flows with gravity, no timer or pump	
Noweco Singulair TNT, 960, and DN	Aerated oxic compartment/Anoxic clarification chamber	First compartment separates out solids before alternating wastewater between oxic and anoxic with recirculation pump	

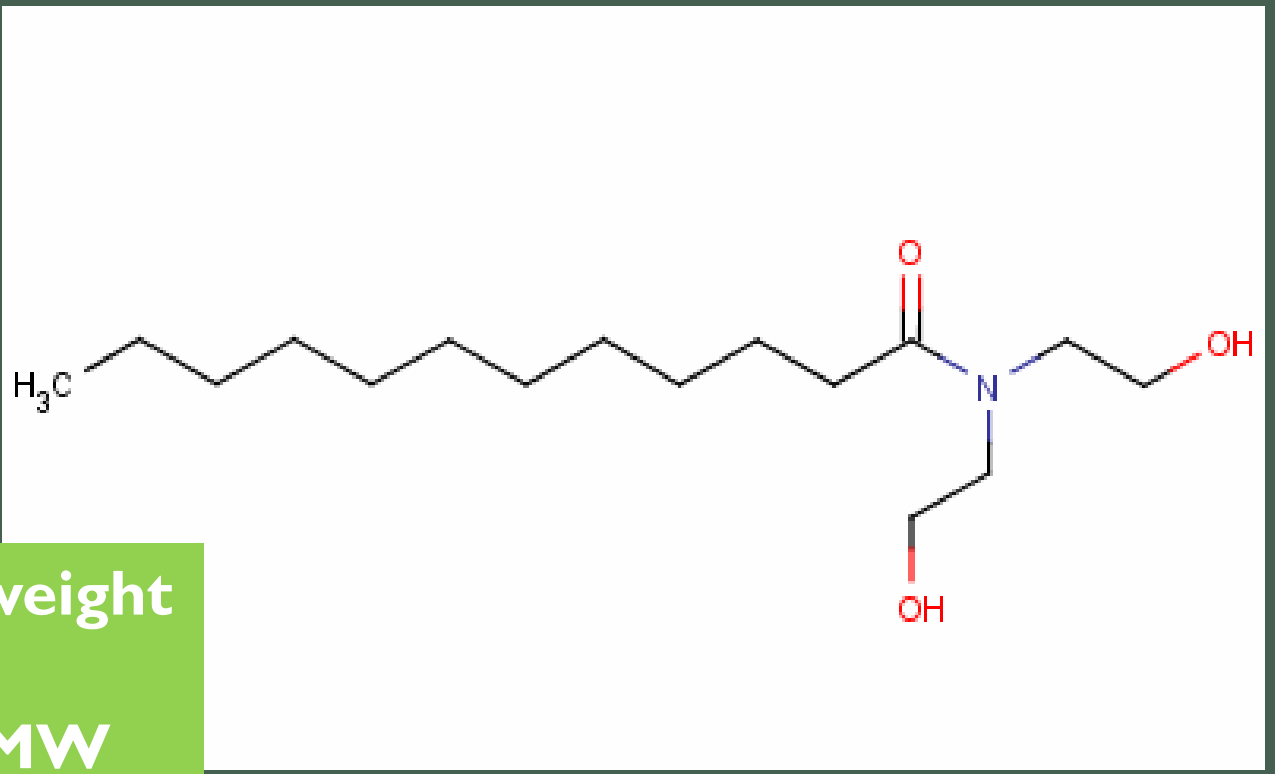
Table 1 provides details from URI on the five advanced OWTSs sampled during this study, as compared to conventional septic systems(URI 2017).

CHEMICALS OF EMERGING CONCERN



…and many more!

SURFACTANTS



Lauramide DEA

$I = 3.199 + a_1f_1 + a_2f_2 \ldots + a_nf_n + \text{molecular weight}$

$I = 3.199 + 1*0.298 + 2*0.16 + 1*-0.173 + MW$

$I = 3.644$ (expected to degrade over weeks-months)

Soaps, cosmetics, cleaning products

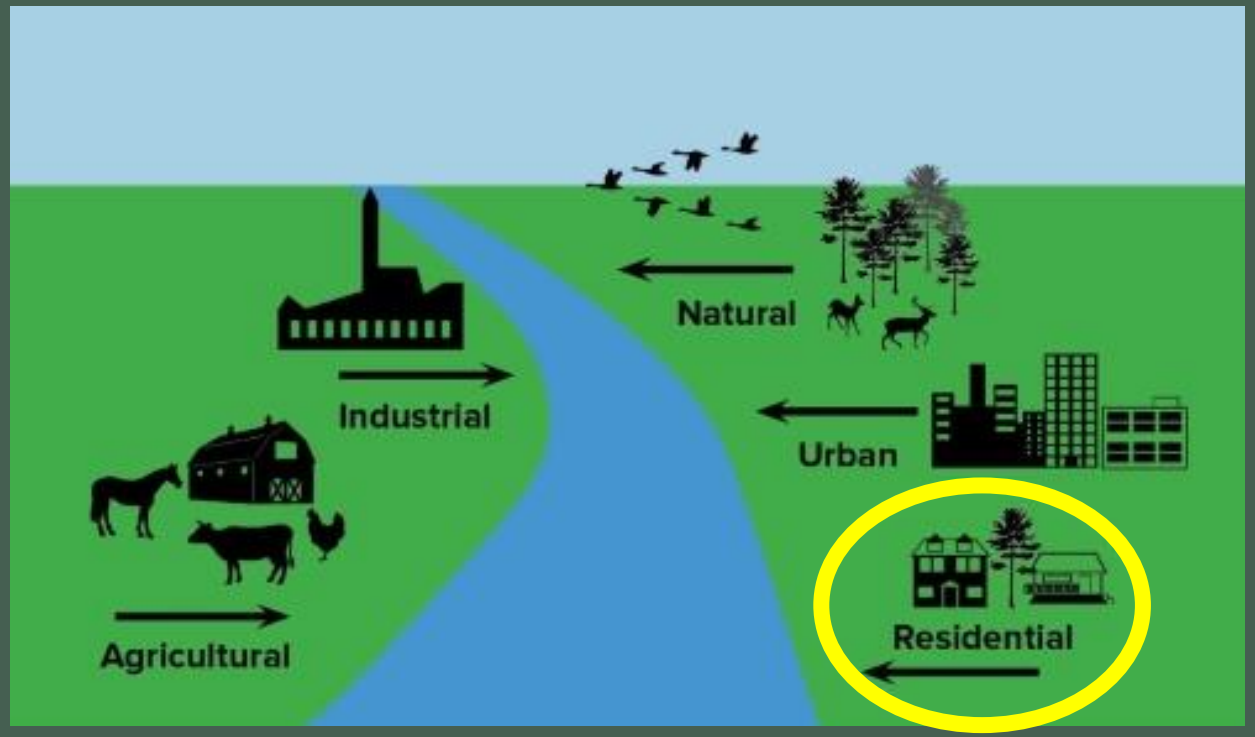
- Hazards and acute toxicity
- Bioaccumulation
- Biodegradation

https://pubchem.ncbi.nlm.nih.gov/compound/5-Chloro-2-methyl-4-isothiazolin-3-one, https://pubchem.ncbi.nlm.nih.gov/compound/23691965, https://pubchem.ncbi.nlm.nih.gov/compound/23691965, Dodecyl diethanol amide=Lauramide DEA, ChemNet, 2019 http://www.chemnet.com/cas/en/120-40-1/Dodecyl-diethanol-amide--=-Lauramide-DEA.html, This Photo by Unknown Author is licensed under CC BY-SA

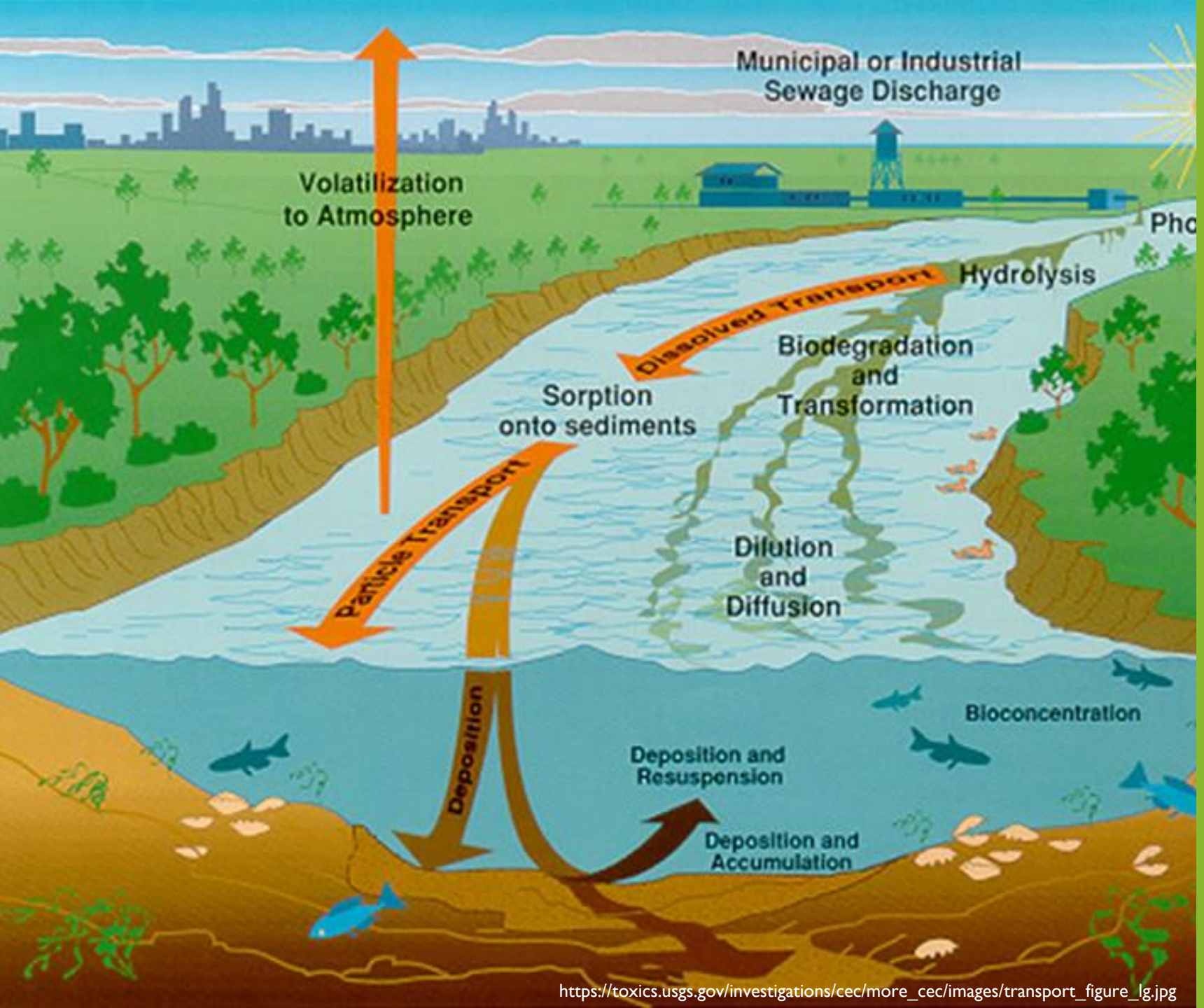
CLIMATE CHANGE AND CHEMICAL PERSISTENCE

Why be concerned with surfactants (and other organic contaminants)?

- Vadose zone limitations
- Persistence
  - Accumulation
  - Combination
  - Low dose and long term exposure
- Need for analytical chemistry!



https://www.dec.ny.gov/chemical/94150.html



https://toxics.usgs.gov/investigations/cec/more_cec/images/transport_figure_lg.jpg

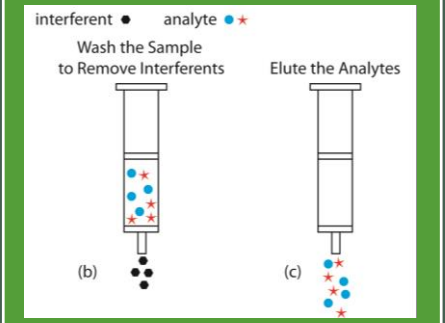
BIOACCUMULATION AND PERSISTENCE

METHODOLOGY

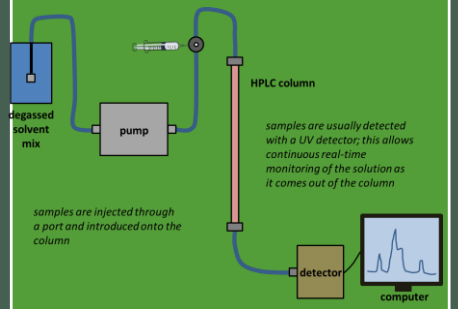
Sample Collection

Transport and Storage

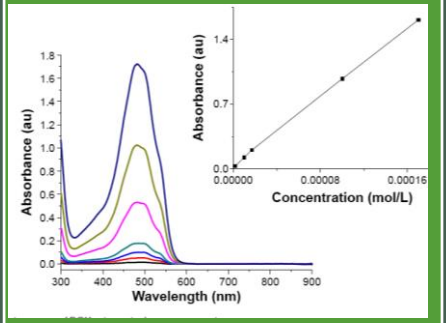
Solid Phase Extraction (SPE)

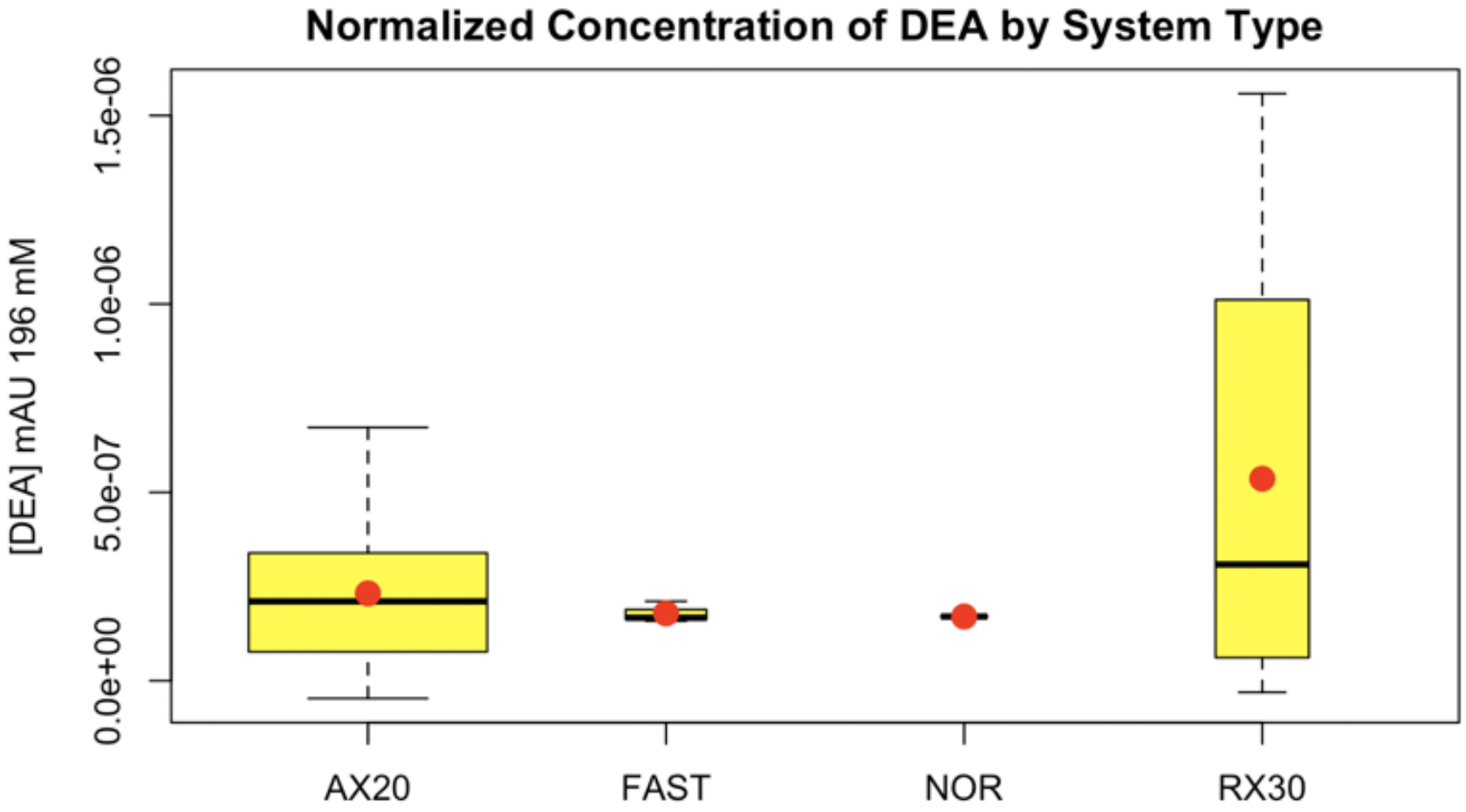


Injection: Liquid Chromatography



Analysis: Ultraviolet Detection

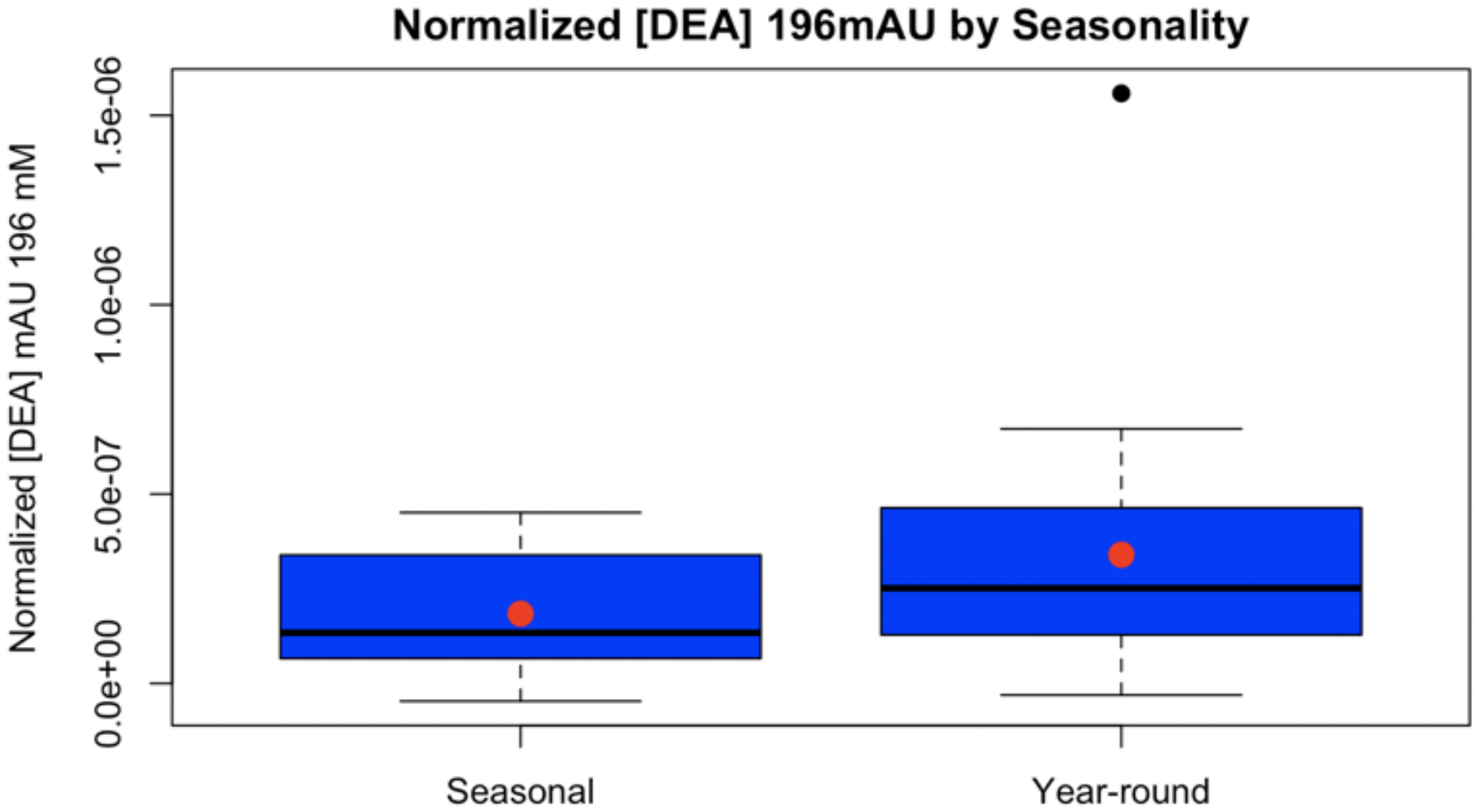




Width of box corresponds to number of samples

P-value: 0.244

RESULTS



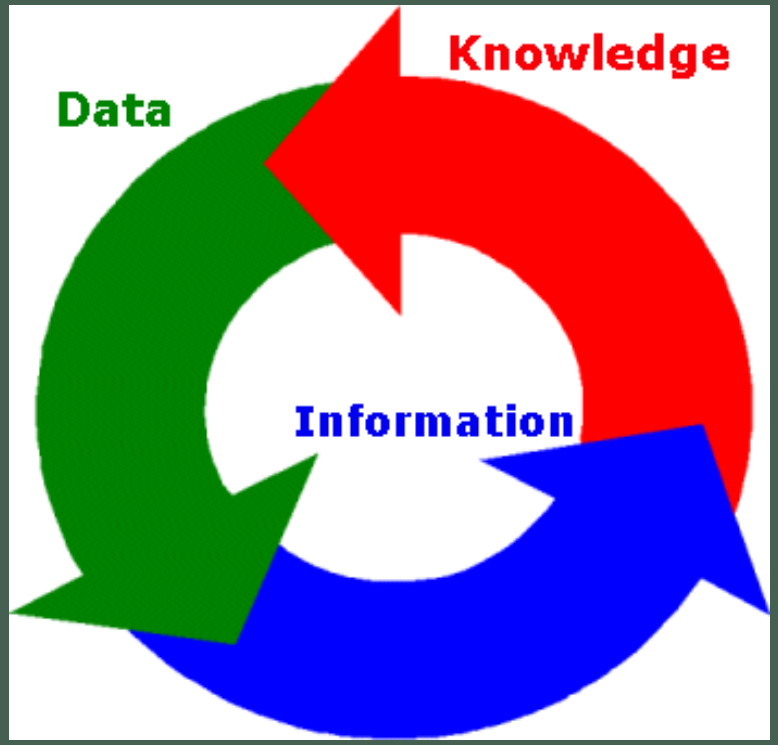
P-value: 0.173

RESULTS

CONCLUSIONS

- PCPs and other organic contaminants represent future contamination concerns
  - Disinfection is not sufficient treatment
  - Chemical design should include disposal/removal mechanism
- Health hazard not well evaluated/understood
  - Bioaccumulation
  - Interaction with other chemicals
- Vadose zone limitations and changing climatic conditions increase urgency

CHALLENGES, AND RESEARCH OPPORTUNITIES



- Instrumentation
- Time constraints
- Limited data
- Trace contaminant plumes

Photo By Lorraine Joubert

ACKNOWLEDGEMENTS

- Julie Zimmerman and Tamara DeWinter
  - Center for Green Chemistry and Engineering at Yale
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  - Yale Institute for Biospheric Studies
- F&ES NEXT Funds
  - Yale School of Forestry and Environmental Studies

QUESTIONS?