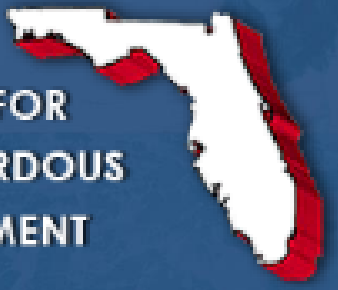
UF Herbert Wertheim College of Engineering
UNIVERSITY of FLORIDA

HINKLEY CENTER FOR SOLID AND HAZARDOUS WASTE MANAGEMENT



PFAS in Municipal Public Works Waste Streams

Kickoff Meeting

Technical Advisory Group Meeting

August 16th, 2022

POWERING THE NEW ENGINEER TO TRANSFORM THE FUTURE

https://www.hinkleycenter.org/

https://faculty.eng.ufl.edu/timothy-townsend/pfas-public-works/

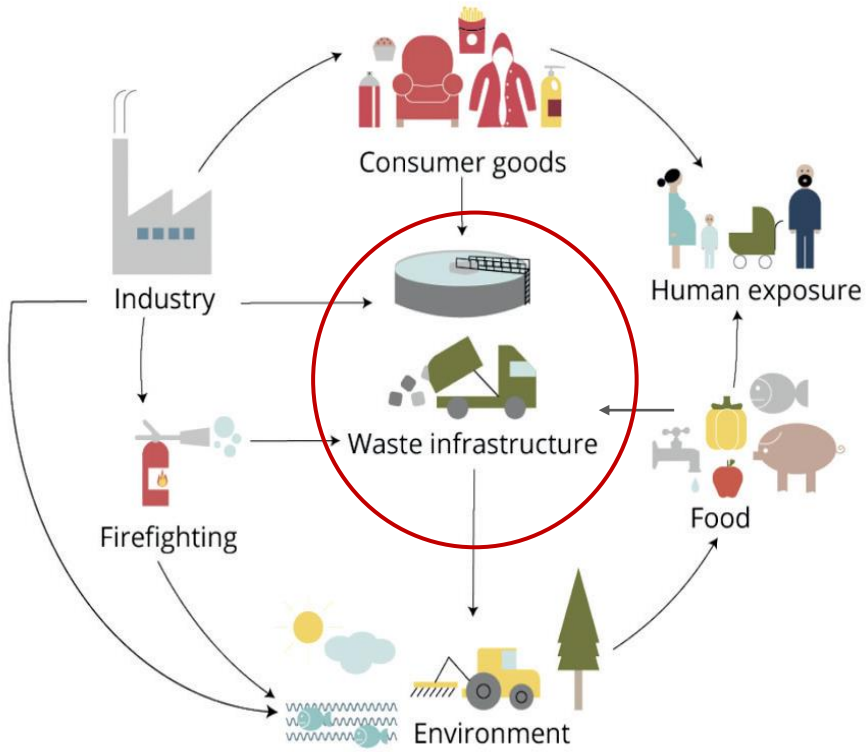
Meeting Overview and Agenda

- PFAS background
- Summary of our group's previous work on PFAS
- Introduction of PFAS in municipal public works waste streams
- Preliminary findings
- Open the floor for discussion

PFAS background and project relevance

Per- and Polyfluoroalkyl Substances (PFAS)

- Family of compounds characterized by presence of a carbon-fluorine chain
- 7,000+ known PFAS species
- Hydrophobic, lipophobic, surfactant properties
- Ubiquitous in consumer and industrial goods, subsequently ubiquitous in the waste streams and the environment
- Persistent, with varying, largely unknown, levels of toxicity



Source: https://www.maine.gov/dacf/ag/pfas/index.shtml

Regulation

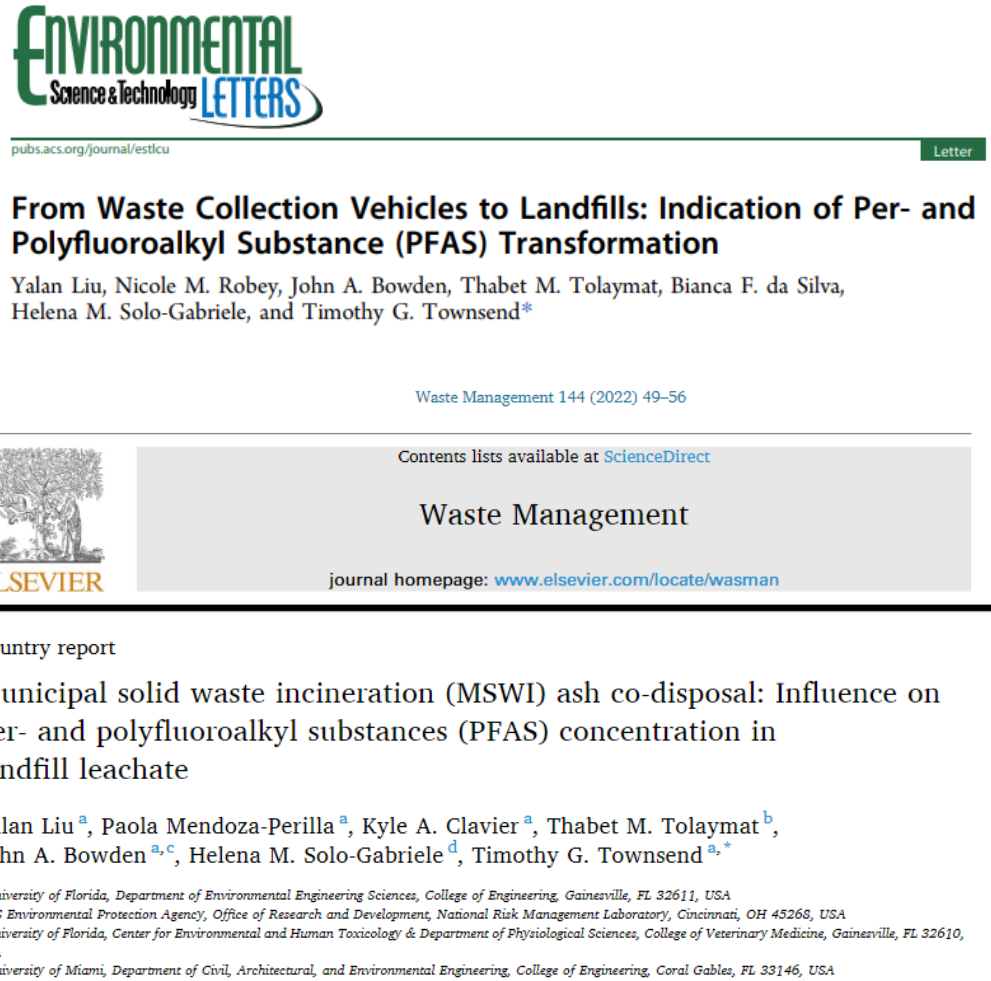
- In the last five years, regulations or advisories have been developed for PFAS in soils, drinking water, and groundwater
- This year EPA released Reginal Screening levels (RSLs) for six PFAS (PFOS, PFOA, PFBS, PFHxS, PFNA, and GenX)
- FDEP Provisional Cleanup Target Levels (PCTLs) for PFOS and PFOA in groundwater, soil, and surface water
- New regulations important to characterize PFAS in different waste streams so they can be properly managed

Compound	RSL Residential (mg/kg)	RSL Industrial (mg/kg)	FDEP Provisional SCTL Residential (mg/kg)	FDEP Provisional SCTL Industrial (mg/kg)
HFPO-DA (Gen-X)	**0.23**	**3.5**		
PFBS	**19**	**250**		
PFHxS	**1.3**	**16**		
PFNA	**0.19**	**2.5**		
PFOS	**0.13**	**1.6**	**1.3**	**25**
PFOA	**0.19**	**2.5**	**1.3**	**25**

Previous PFAS work

Previous assessments of PFAS in waste

- Total and leachable PFAS in
  - MSW components and leachate
  - Waste to energy ash
  - AFFF-impacted soils
- Previous PFAS related Hinkley Center Projects
  - Characterization of PFAS in Landfill Leachate (2019)
  - Characterization and Management of PFAS Remediation Residuals (2021)



Environmental Science & Technology Letters

pubs.acs.org/journal/estlcu

Letter

From Waste Collection Vehicles to Landfills: Indication of Per- and Polyfluoroalkyl Substance (PFAS) Transformation

Yalan Liu, Nicole M. Robey, John A. Bowden, Thabet M. Tolaymat, Bianca F. da Silva, Helena M. Solo-Gabriele, and Timothy G. Townsend*

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Waste Management

journal homepage: www.elsevier.com/locate/wasman

ELSEVIER

Country report

Municipal solid waste incineration (MSWI) ash co-disposal: Influence on per- and polyfluoroalkyl substances (PFAS) concentration in landfill leachate

Yalan Liu [a], Paola Mendoza-Perilla [a], Kyle A. Clavier [a], Thabet M. Tolaymat [b], John A. Bowden [a,c], Helena M. Solo-Gabriele [d], Timothy G. Townsend [a,*]

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[c] University of Florida, Center for Environmental and Human Toxicology & Department of Physiological Sciences, College of Veterinary Medicine, Gainesville, FL 32610, USA
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PFAS in municipal public works waste streams

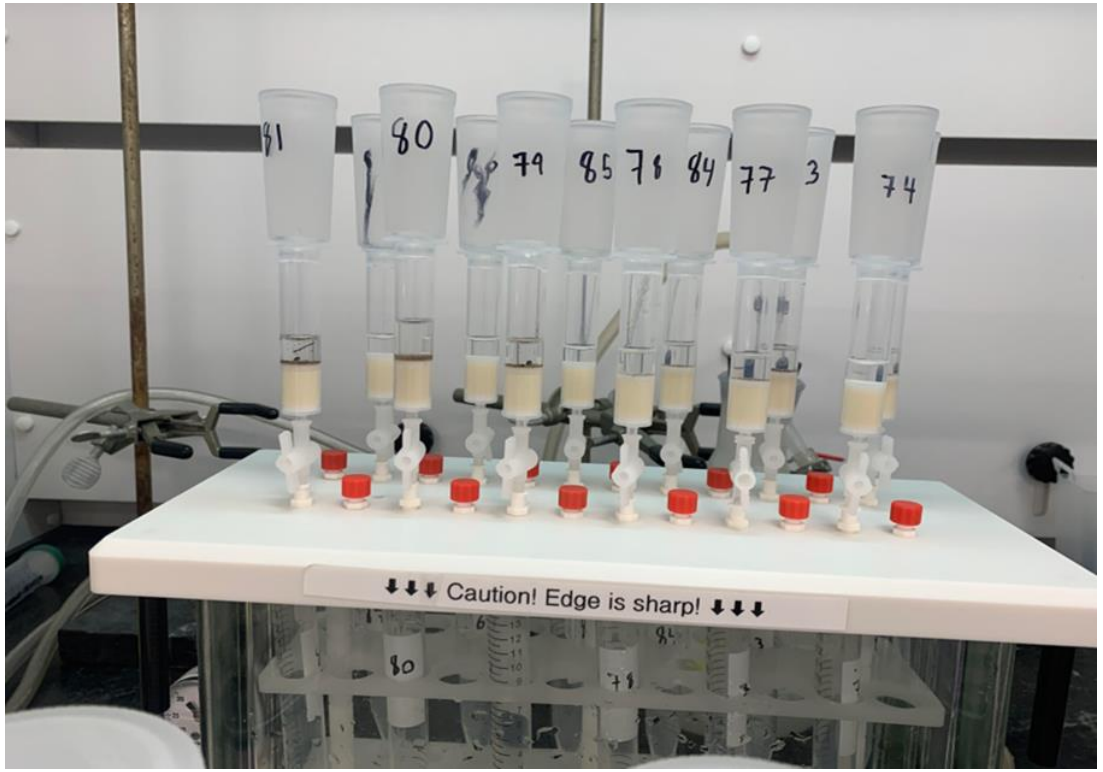
Project Introduction

- Municipalities or local governments generate specific types of waste (e.g., biosolids, C&D residual screened material (RSM), street sweepings, drinking water sludge, etc.)
- PFAS in municipal public works waste streams remain largely unstudied
- Significant fractions of these residual streams are beneficially reused as landfill daily cover or land applied as soil amendments
- Currently management strategies for public work waste steams focus on limiting the risk of exposure to historical contaminants of concern (e.g., heavy metals, PAH's, hydrocarbons)
- Goal is to provide municipalities with information about PFAS in these waste streams so they can make informed management decisions

Project objectives

Task I: Screening process

- Based on relevance in the literature and previous findings, samples of the following waste streams were collected/will be collected from municipalities across Florida and screened for PFAS
  - Wastewater biosolids
  - Drinking water treatment sludge
  - C&D RSM
  - Street sweepings
  - Compost



- Samples are extracted for total PFAS and analyzed via UHPLC-MS/MS

- Can quantify 92 PFAS

Task II: Detailed Investigation of Suspect Waste Streams

- All waste streams from Task I will go under further analysis to determine factors that might impact PFAS or if there is a risk of PFAS leaching
- Based on these findings, we will conduct more detailed investigations
- Additional sample collection underway to reveal impact of variables specific to each waste stream
  - Regional differences (rural vs urban areas)
  - The effect of processing these waste streams
- Finalize waste streams of interest for Task III: Partitioning Studies

Task III: Partitioning Studies

- Leaching simulations are designed to estimate the extent to which selected waste streams may leach PFAS to the environment under different disposal scenarios

- Protocols may include batch and column tests:
  - Toxicity Characteristic Leaching Procedure (TCLP), EPA method 1311
  - Synthetic Precipitation Leaching Procedure (SPLP), EPA method 1312
  - EPA Leaching Environmental Assessment Framework (LEAF):
    - Method 1313
    - Method 1316
  - Lysimeter models

Project Status

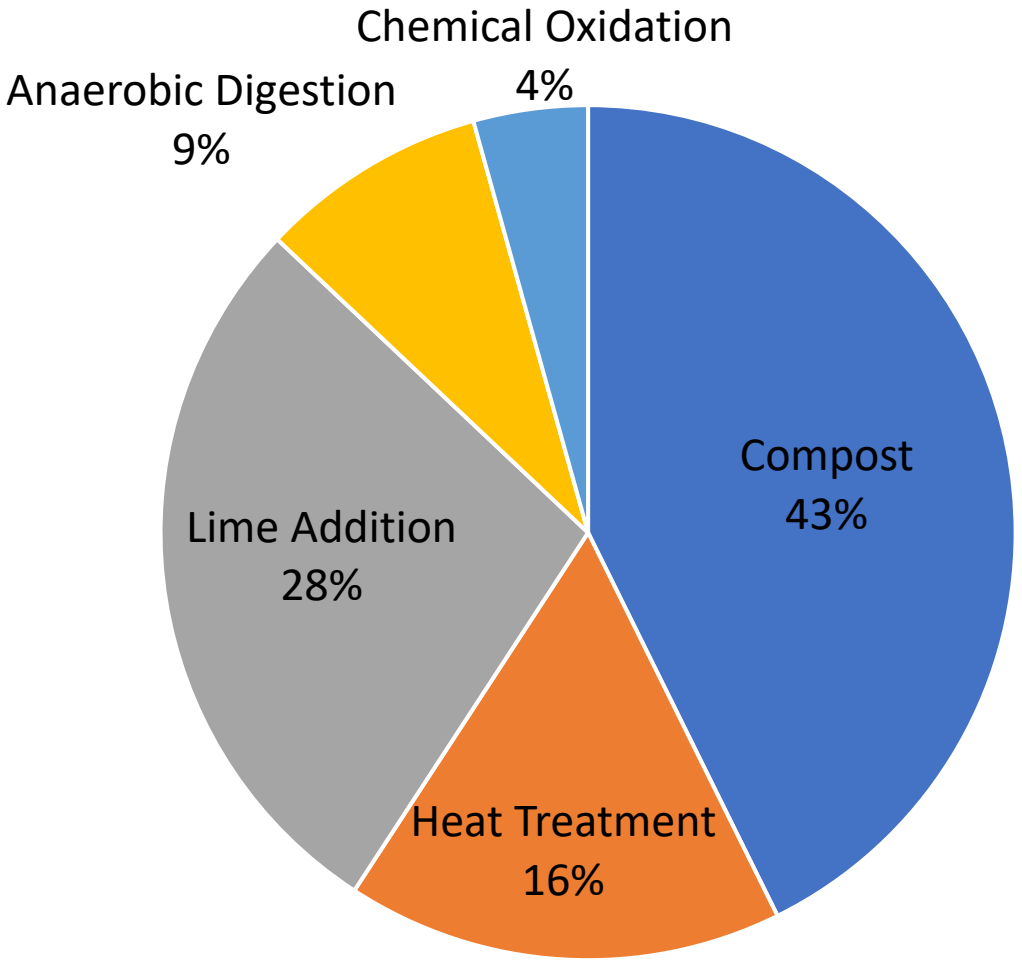
Objectives	1	2	3	4	5	6	7	8	9	10	11	12
PFAS Characterization	X	X	X	X	X	X	X	X	X			
Detailed Investigation	X	X	X	X	X	X	X	X	X			
Leaching Studies				X	X	X	X	X	X	X		
Deliverables												
Quarterly Reports			X			X			X			
Final Report												X

Findings:
Wastewater biosolids

Wastewater Biosolids

- Biosolids have already been identified to contain relatively high concentrations of PFAS by previous research
- Municipalities in the U.S. typically beneficially reuse biosolids (66% is land applied)
- Biosolids must be treated for pathogens before being beneficially reused and there is limited research on how treatment effects PFAS

Most common Pathogen Removal Options for Biosolids in Florida by Tonnage (2019)



Wastewater Biosolids

- Collected biosolids from 8 different biosolids processing facilities getting representation from composting, lime addition, heat treatment, and anaerobic digestion
- Total PFOS ranged from 4 to 40 ng/g dry-wt (majority of samples above leachability based provisional SCTL's of 7 ng/g)
- Treatment types had different impacts on PFAA-precursor transformation
- Manuscript to be submitted August 2022

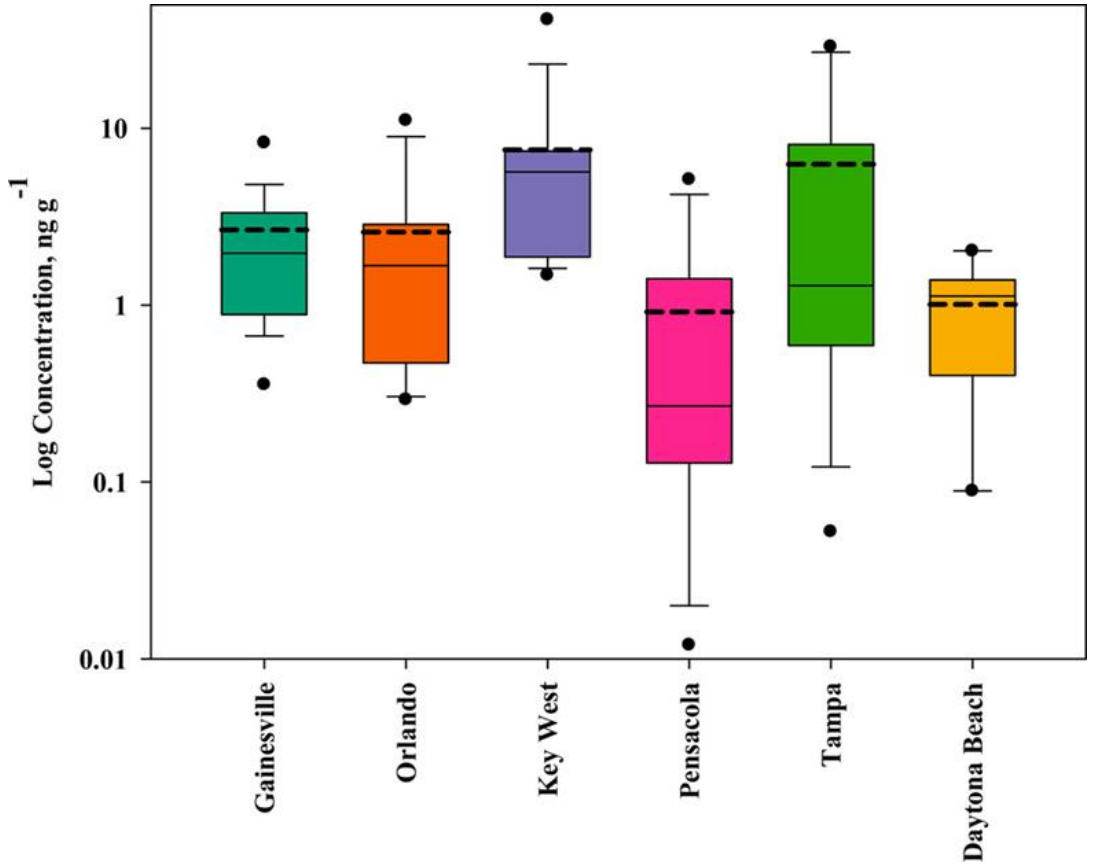
Findings:
Street Sweepings

Street Sweepings

- A city the size of Gainesville produces ~ 5,900 tons of street sweepings each year
- This waste stream is commonly used as daily cover for landfills
- Previously no research was done to characterize PFAS in street sweepings (do municipalities need to worry about PFAS in street sweepings?)

Street Sweepings

- A total of 117 street sweeping samples from across Florida were collected and analyzed for PFAS
- All samples measured were below Florida's Soil Cleanup Target Levels (SCTLs) based on leaching risk (2 ng/g PFOA and 7 ng/g PFOS)
- Highest concentrations were reported in industrial areas
- Manuscript published and available upon request

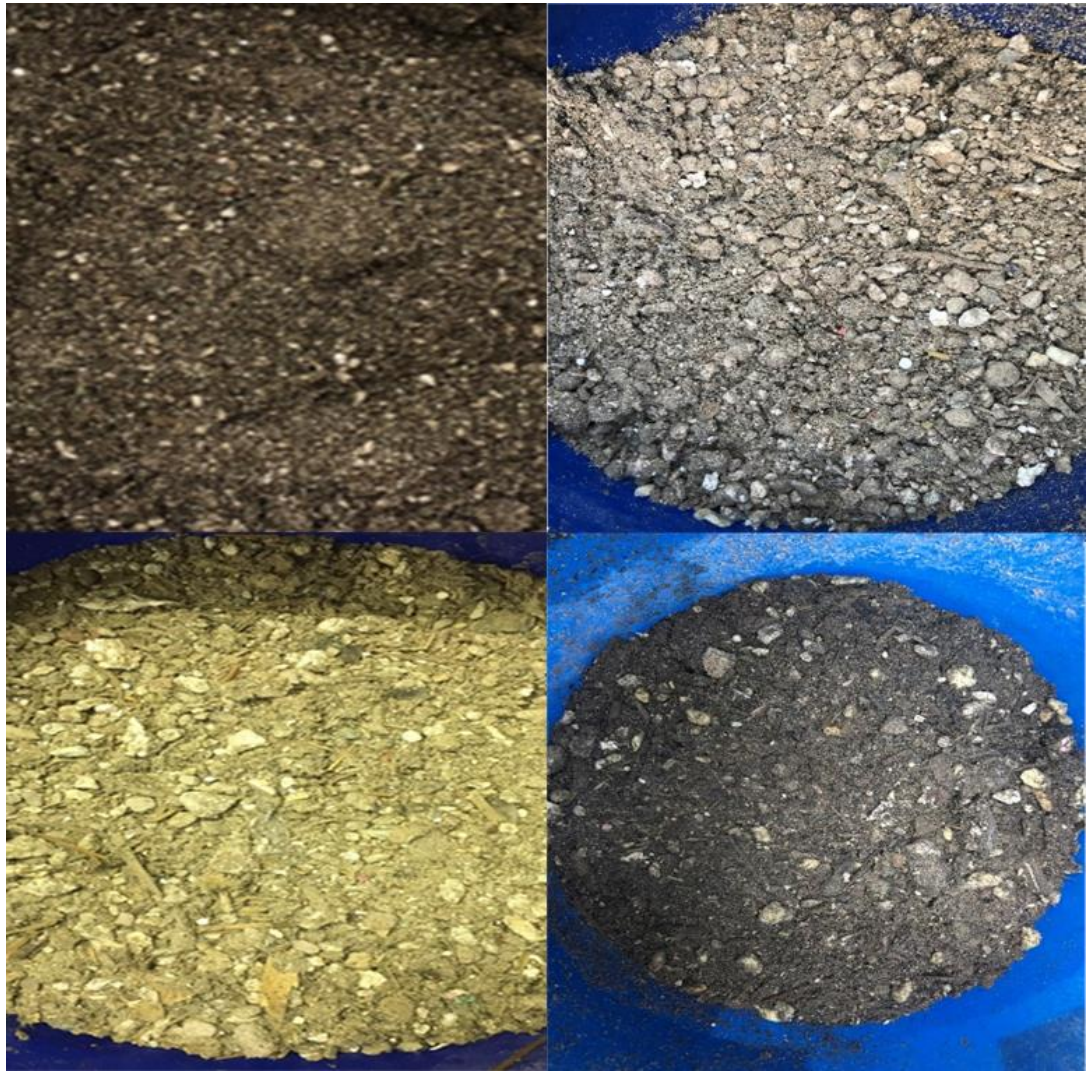


Ahmadireskety, A., Da Silva, B. F., Robey, N.M., Douglas, T., Aufmuth, J., Solo-Gabriele, H. M., Yost, R. A., Townsend, T. G., & Bowden, J. A. Per- and Polyfluoroalkyl Substances (PFAS) in Street Sweepings. Accepted by *Environmental Science and Technology*.

Findings: C&D RSM

C&D Recovered Screen Material (RSM)

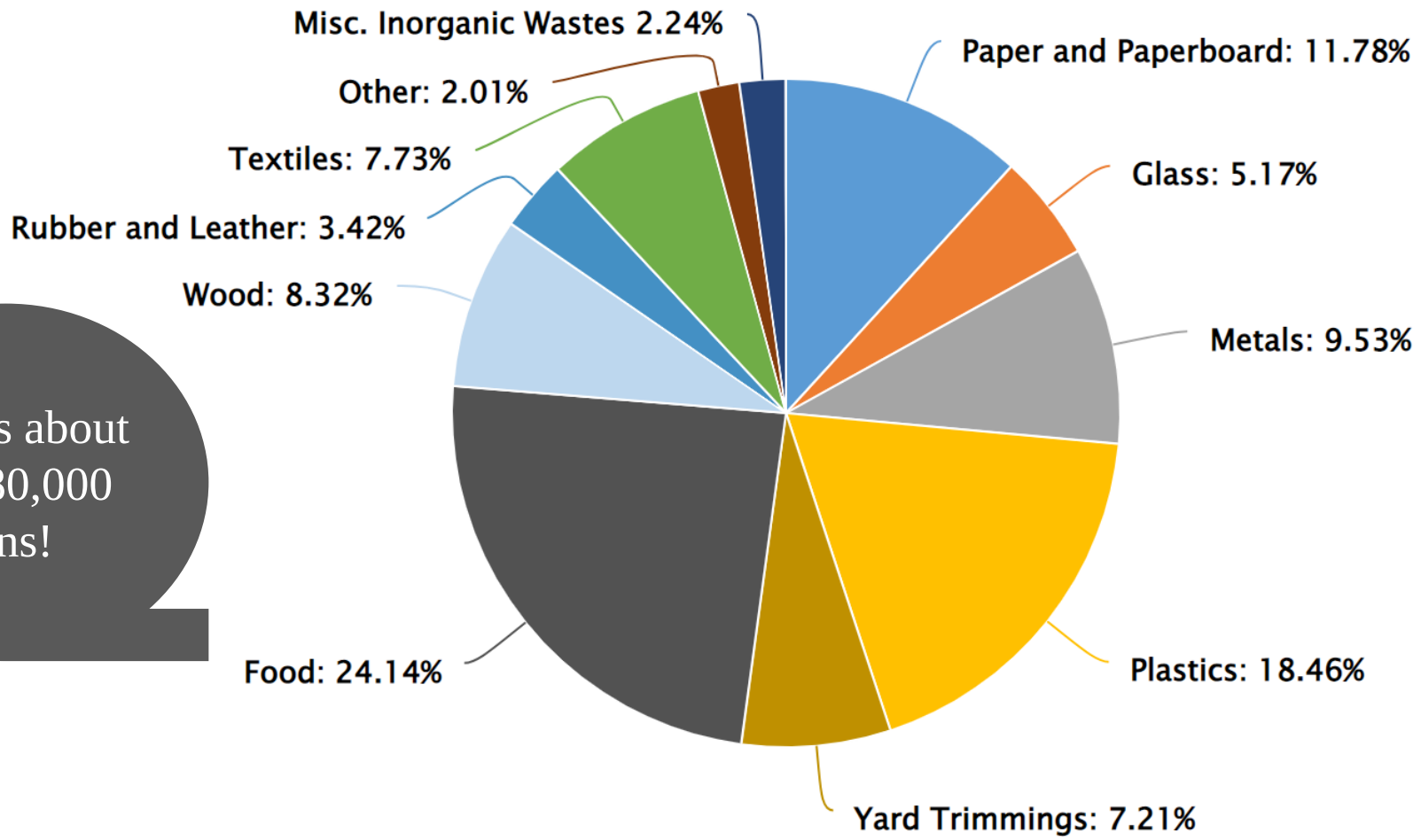
- C&D RSM is a soil-like material generated during the screening of other C&D wastes (typically consists of soil, wood, drywall)
- C&D RSM is not often targeted for PFAS research even though, components of the C&D debris waste stream often contain PFAS (e.g., engineered wood)
- Collected and have preformed PFAS analysis on two samples of C&D RSM sourced in Florida
- Plan to investigate more sources



Findings: Compost

Total MSW Landfill by Material, 2018

146.1 million tons



That is about 35,280,000 tons!

"National Overview: Facts and Figures on Materials, Wastes and Recycling." *EPA*, Environmental Protection Agency, 31 July 2022, https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#:~:text=In%202018%2C%20about%20146.1%20million,less%20than%2010%20percent%20each.

- Beneficial reuse of food-waste via composting:

1. Diverts methane-producing organic matter from landfills
2. Creates a nutrients-rich soil amendment and carbon sink

- However, if compost contains PFAS, land-application will cycle PFAS into the environment
- Data on the sources and fate of PFAS in food-waste compost is lacking

"National Overview: Facts and Figures on Materials, Wastes and Recycling." *EPA*, Environmental Protection Agency, 31 July 2022

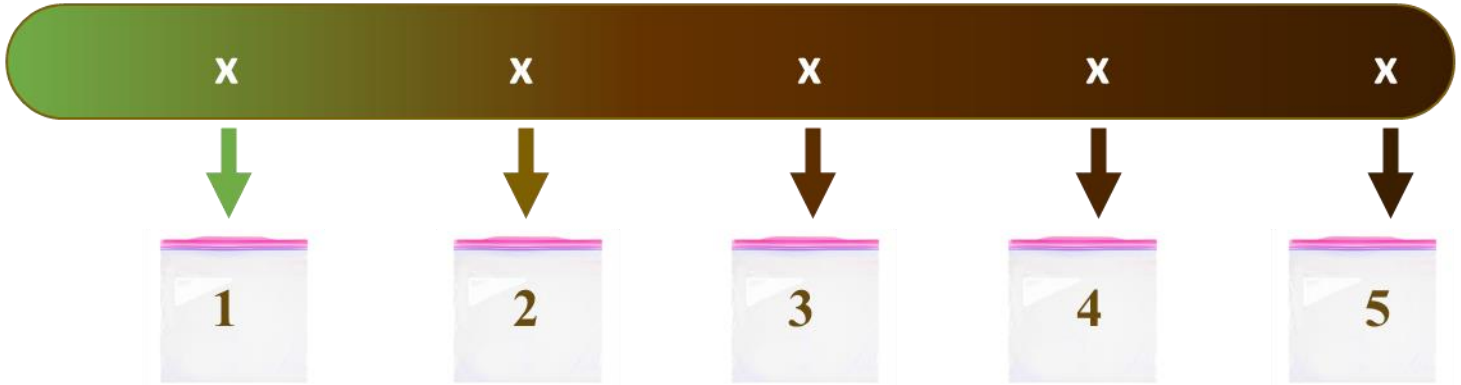
Mulch

Compostable products

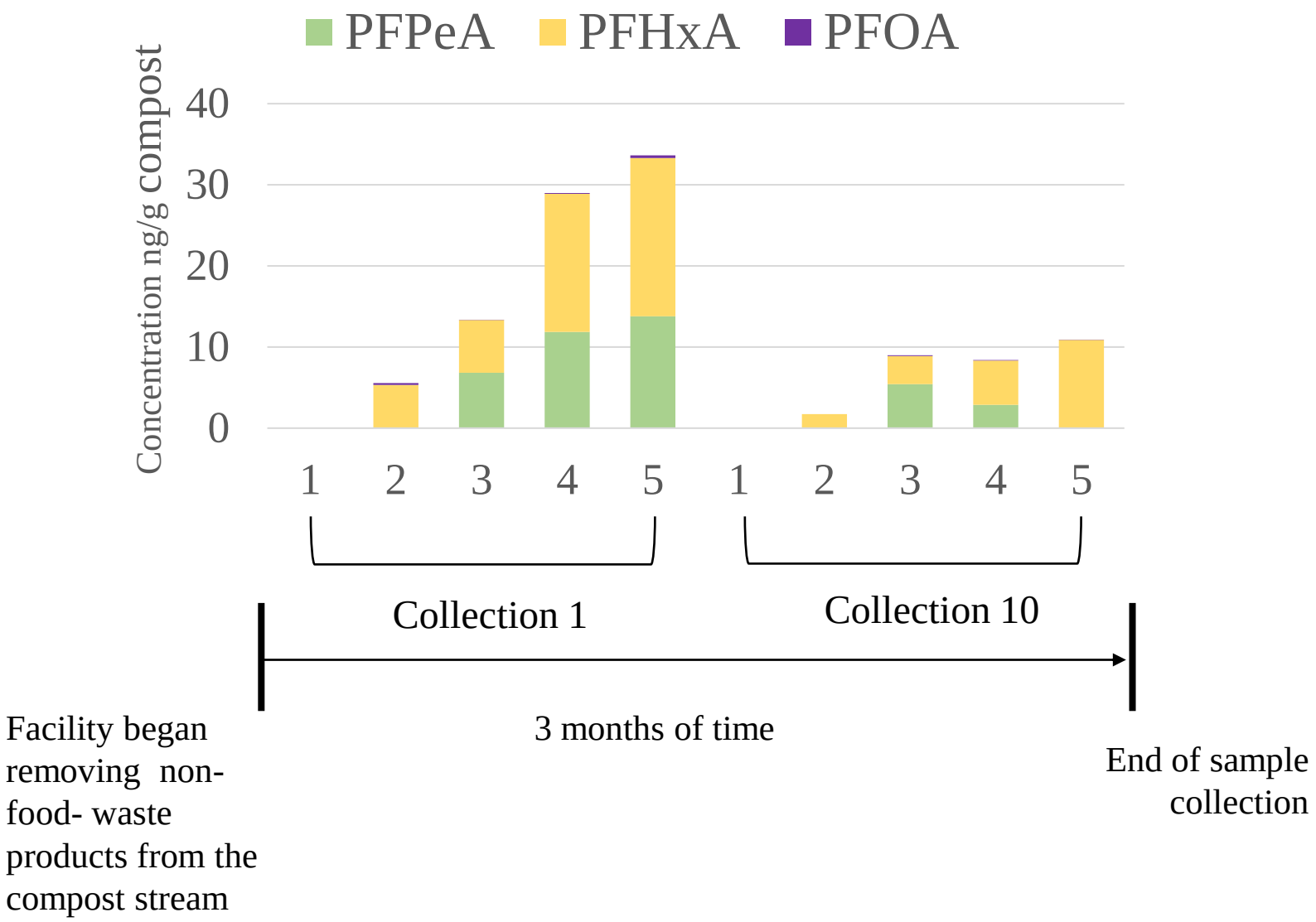
Food scraps

Mature compost stockpiles

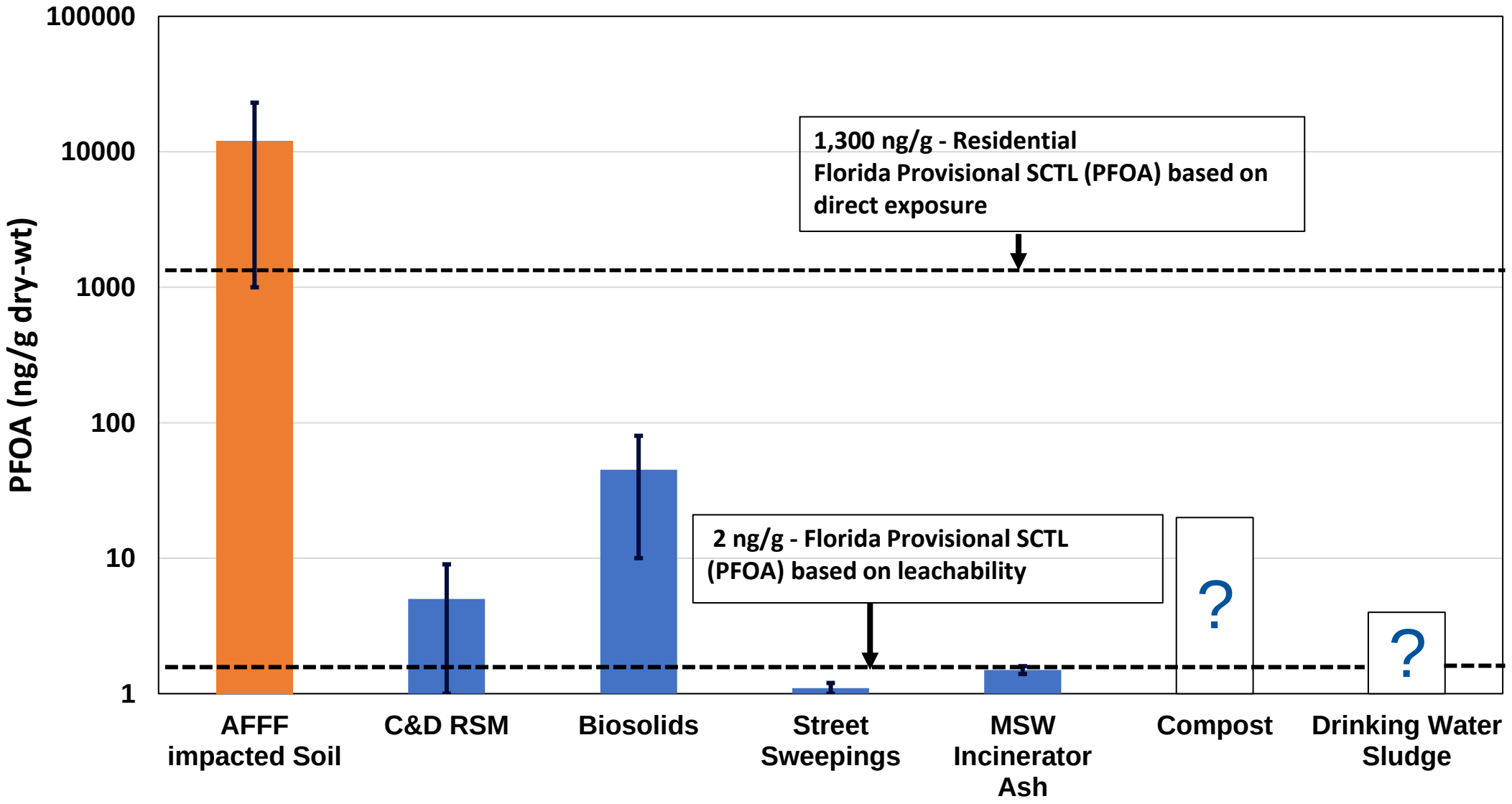
Fresh Waste ---> Time + Mixing ---> 3-Month-Old Compost



PFAS concentrations in leachates from sequential compost collections along the windrow



Conclusions

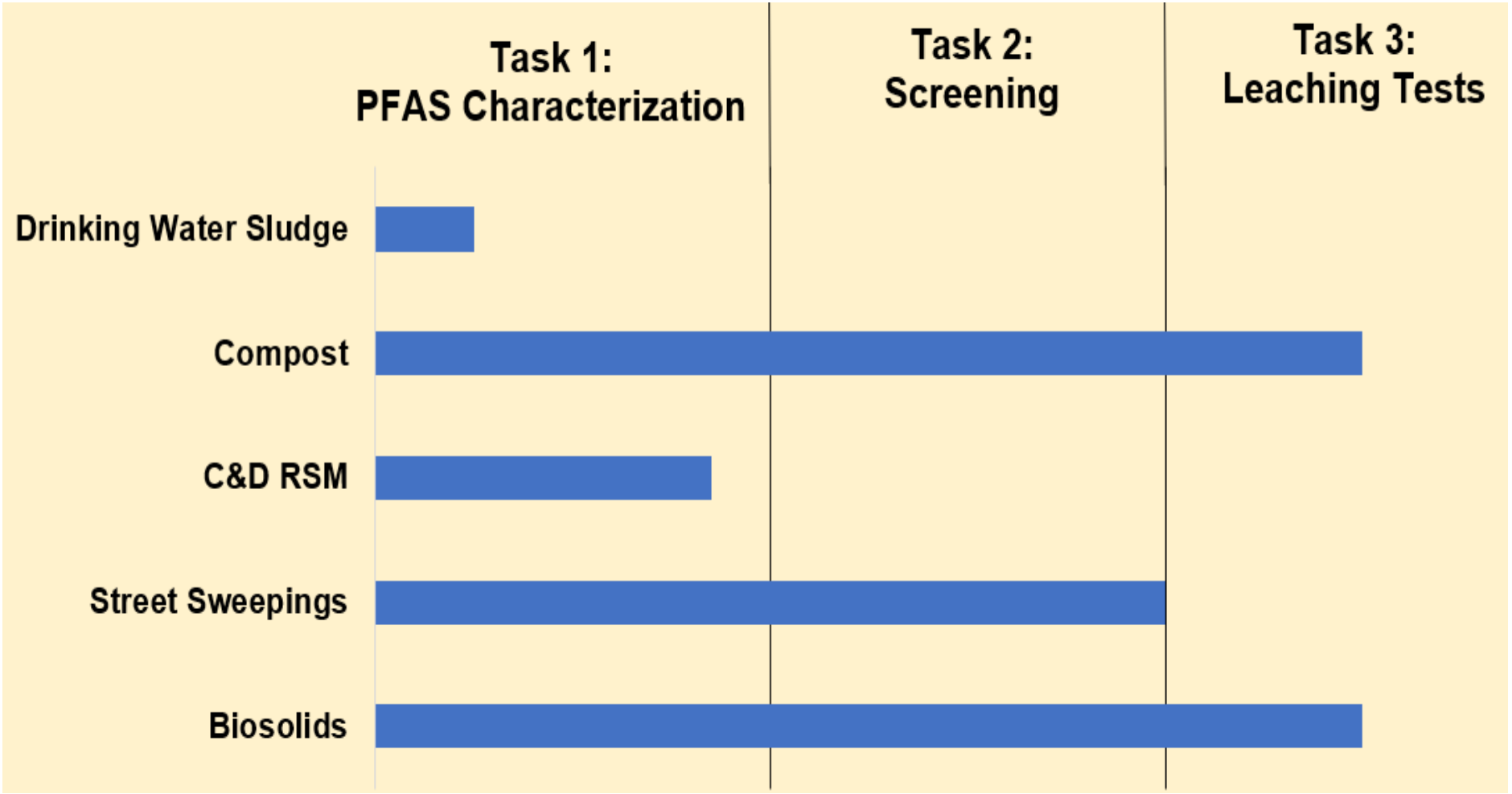

100000
10000
1000
100
10
1
PFOA (ng/g dry-wt)
1,300 ng/g - Residential
Florida Provisional SCTL (PFOA) based on
direct exposure
2 ng/g - Florida Provisional SCTL
(PFOA) based on leachability
?
?
AFFF impacted Soil
C&D RSM
Biosolids
Street Sweepings
MSW Incinerator Ash
Compost
Drinking Water Sludge

Ongoing Work

- Total analysis on compost, drinking water sludge, and additional C&D materials
- Identify suspect public work waste streams for additional testing
- Continued investigations on biosolids and compost through partitioning studies (i.e., leaching tests)

Project Status

- Currently in Q3, and on track to complete laboratory work by November 2022
- Final TAG meeting and project report to be completed by January 2023



Let's Discuss

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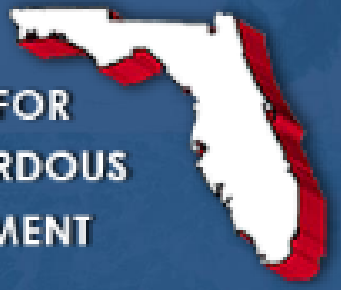

Thank you

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