Vermont:
PFAS Into and Out Of Landfills

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AGENCY OF NATURAL RESOURCES

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Thanks:

- Vermont Landfill and Wastewater Treatment Facility Owners and Operators
- Consultants
- Vermont Department of Environmental Conservation Staff

SANBORN HEAD

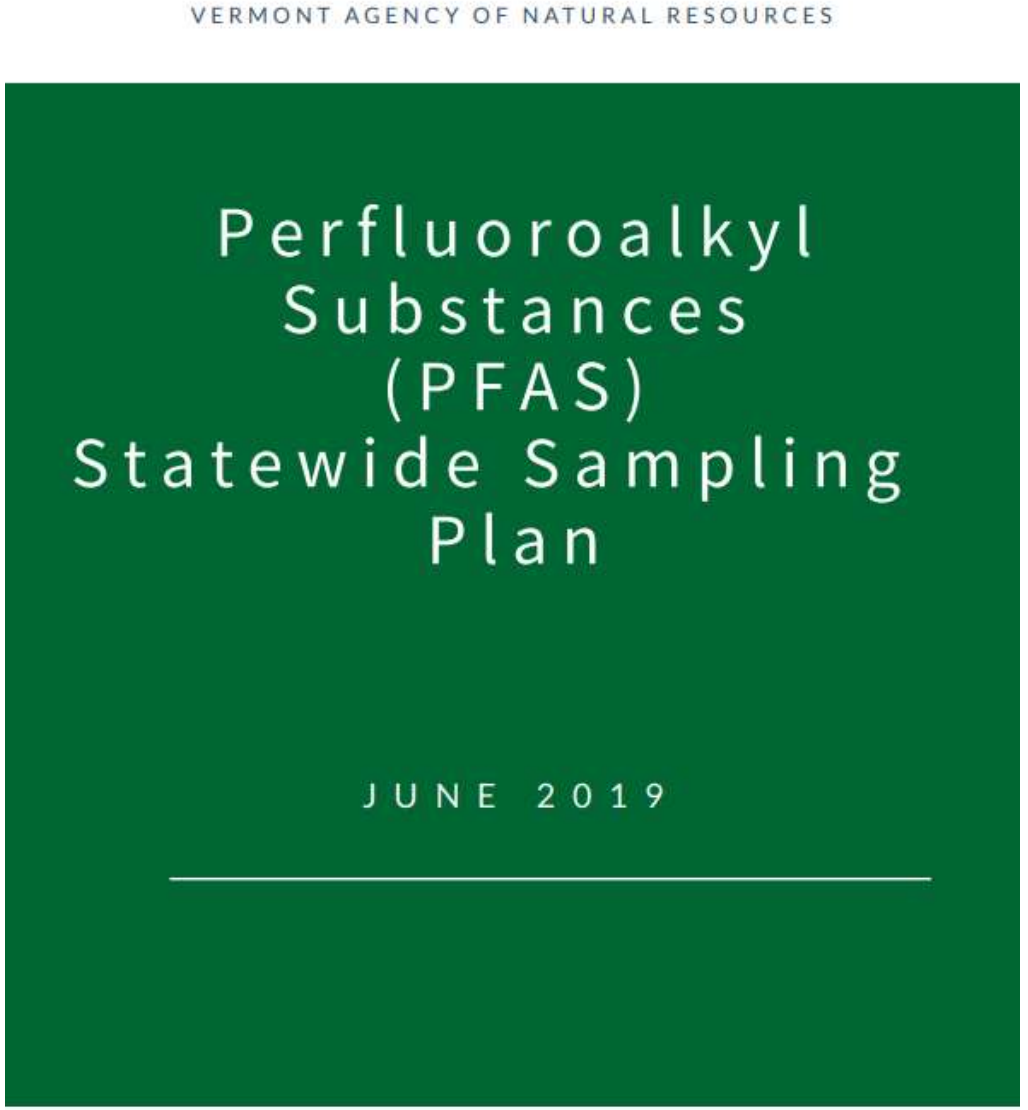
Weston & Sampson

Brown AND Caldwell

PFAS Impact Monitoring
Public Water Supply Sampling
Surface Water Plan

PFAS in Waste Streams
Landfills
Wastewater Treatment Facilities

Industrial or Intensive Uses
Electroplating
Car Washes



PFAS in Waste Streams - Reports

dec.vermont.gov/pfas

- Evaluation of PFAS within the waste streams disposed of at the New England Waste Services of Vermont (NEWSVT) landfill
  - -Sanborn Head: PFAS Waste Source Testing Report, dated October 2019

- Statewide evaluation of PFAS within landfill leachate, wastewater treatment facility (WWTF) influent, effluent, biosolids and sludges
  - -Weston and Sampson: Wastewater Facility and Landfill PFAS Sampling Summary report, dated January 2020

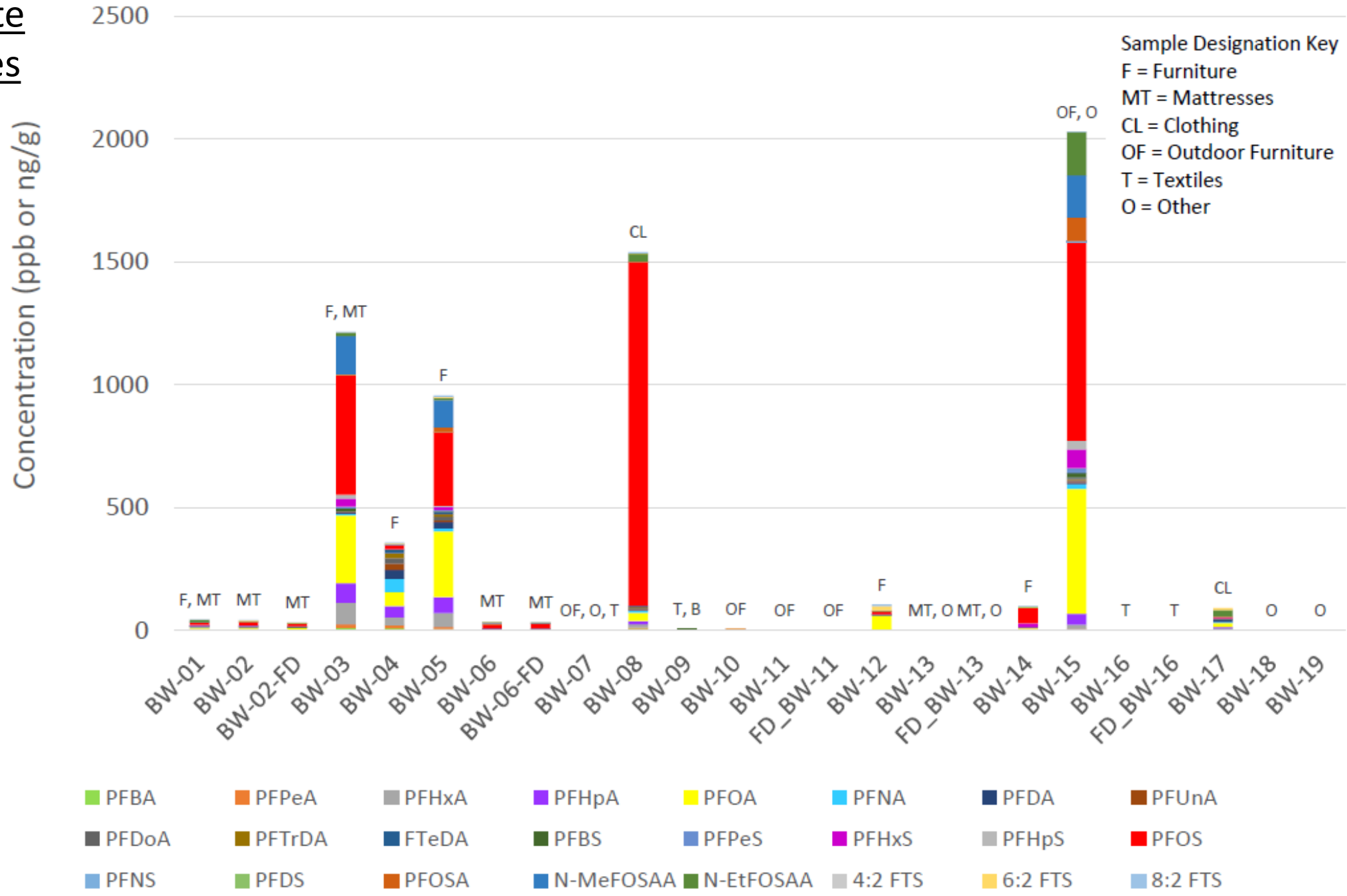
- Assessment of treatment options that would reduce or eliminate PFAS within landfill leachate
  - -Brown and Caldwell: Conceptual Leachate Treatment Scoping Study for New England Waste Services of Vermont Landfill, dated October 2019

PFAS Going into the Landfill

Bulk analysis of materials being disposed

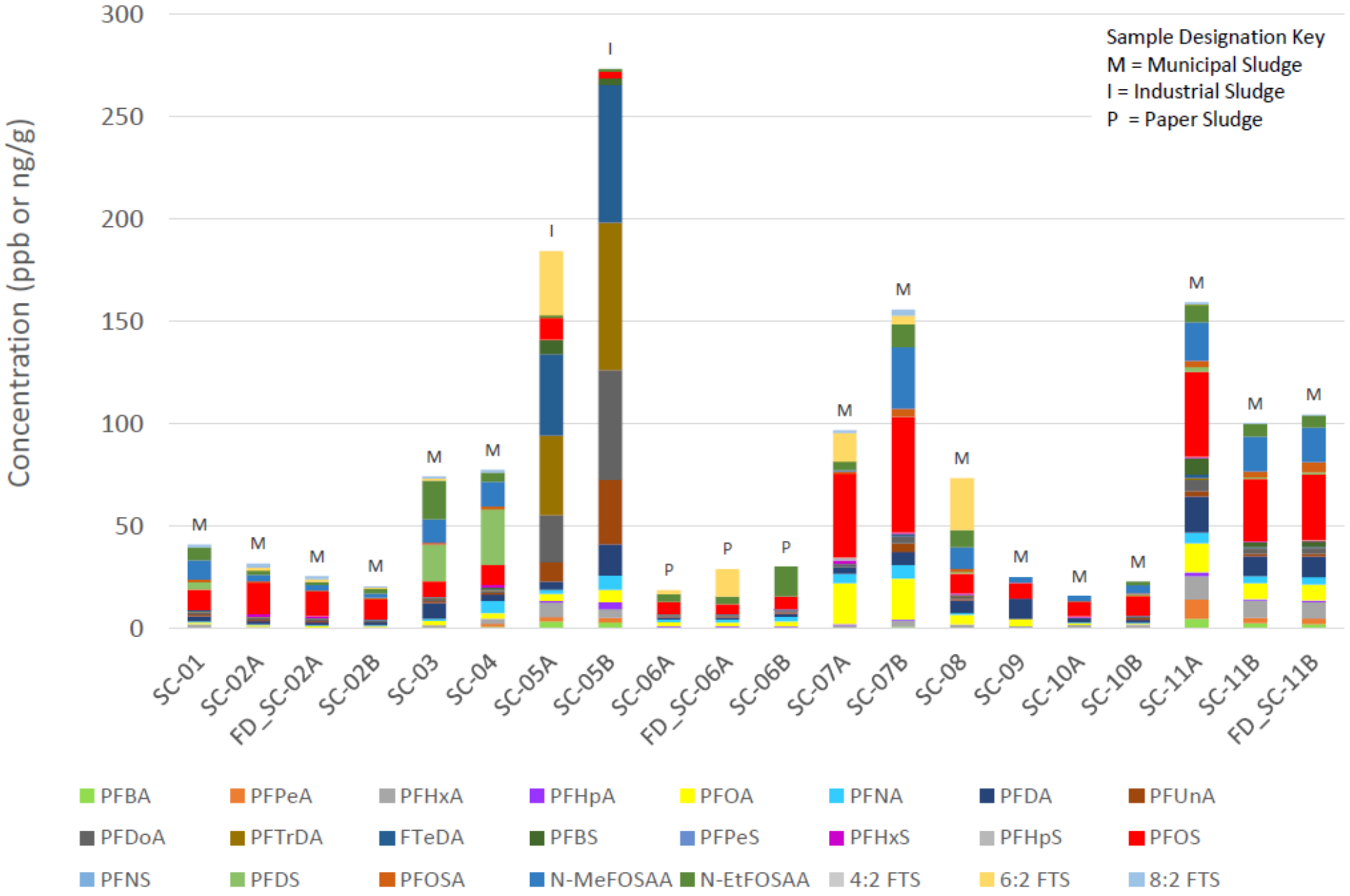
Sanborn Head: PFAS Waste Source Testing Report, October 2019

Bulky Waste and Textiles



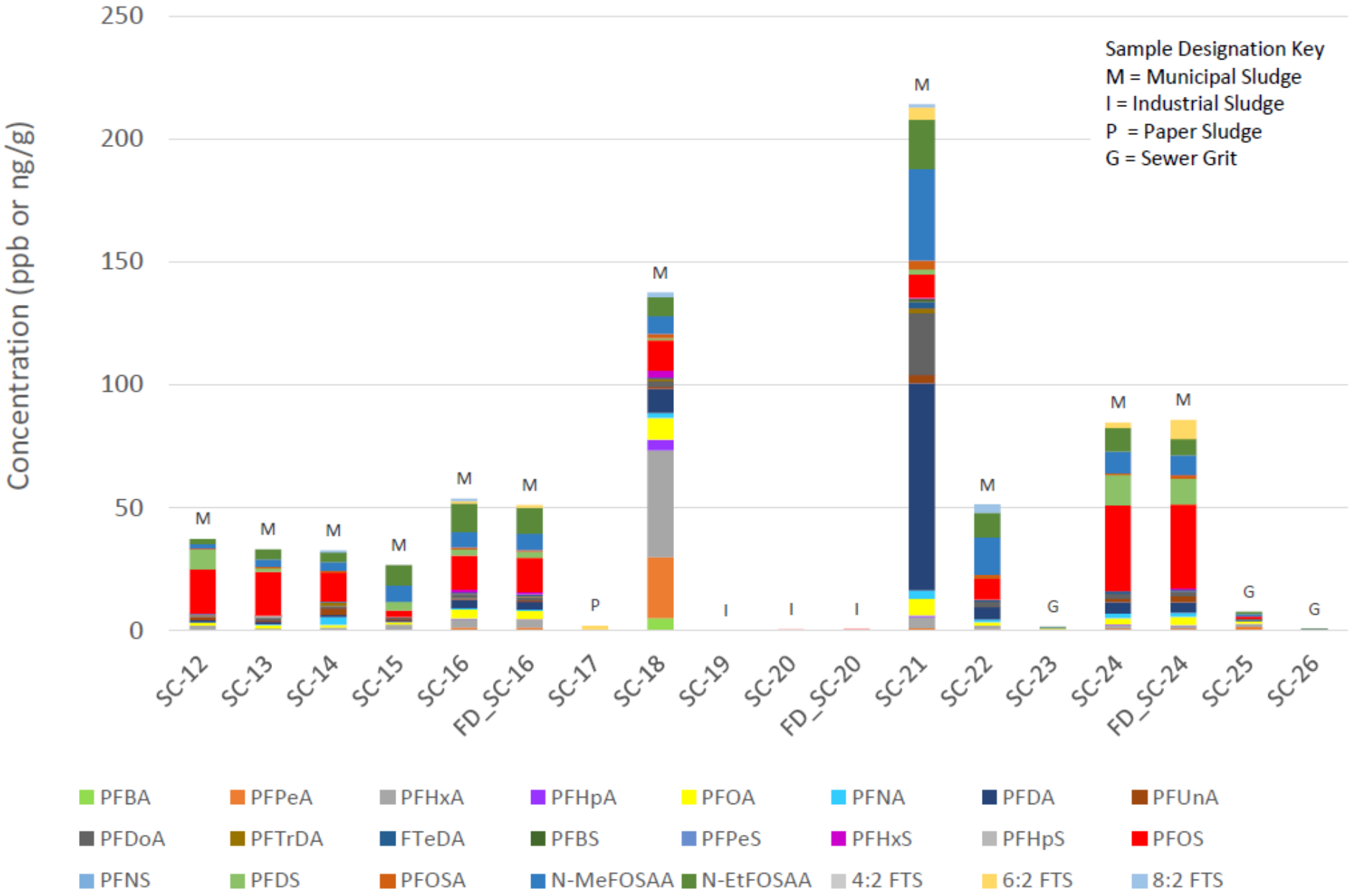
Sludges: Industrial and Municipal

Fig. 1 of 2

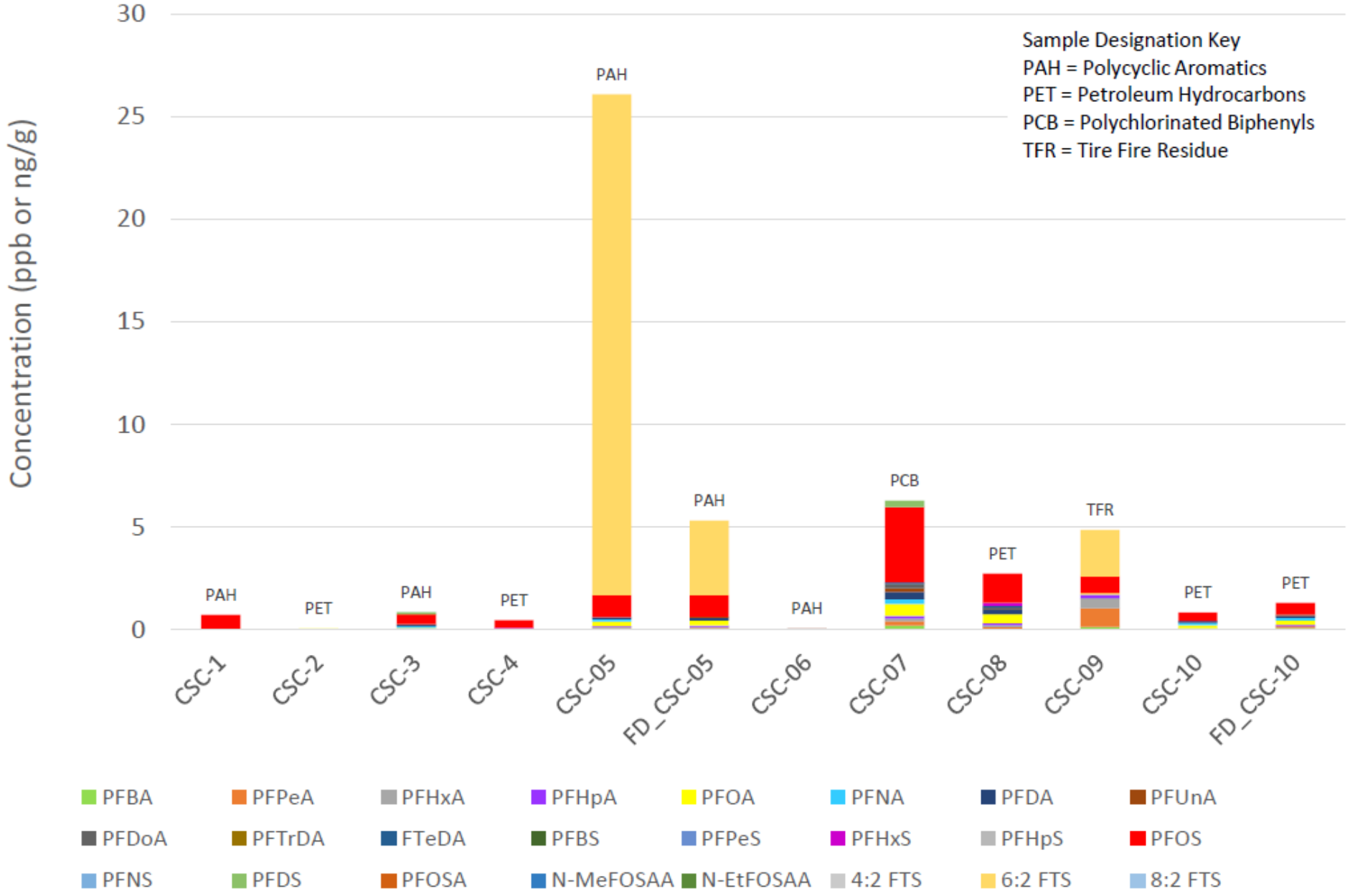


Sludges: Industrial and Municipal

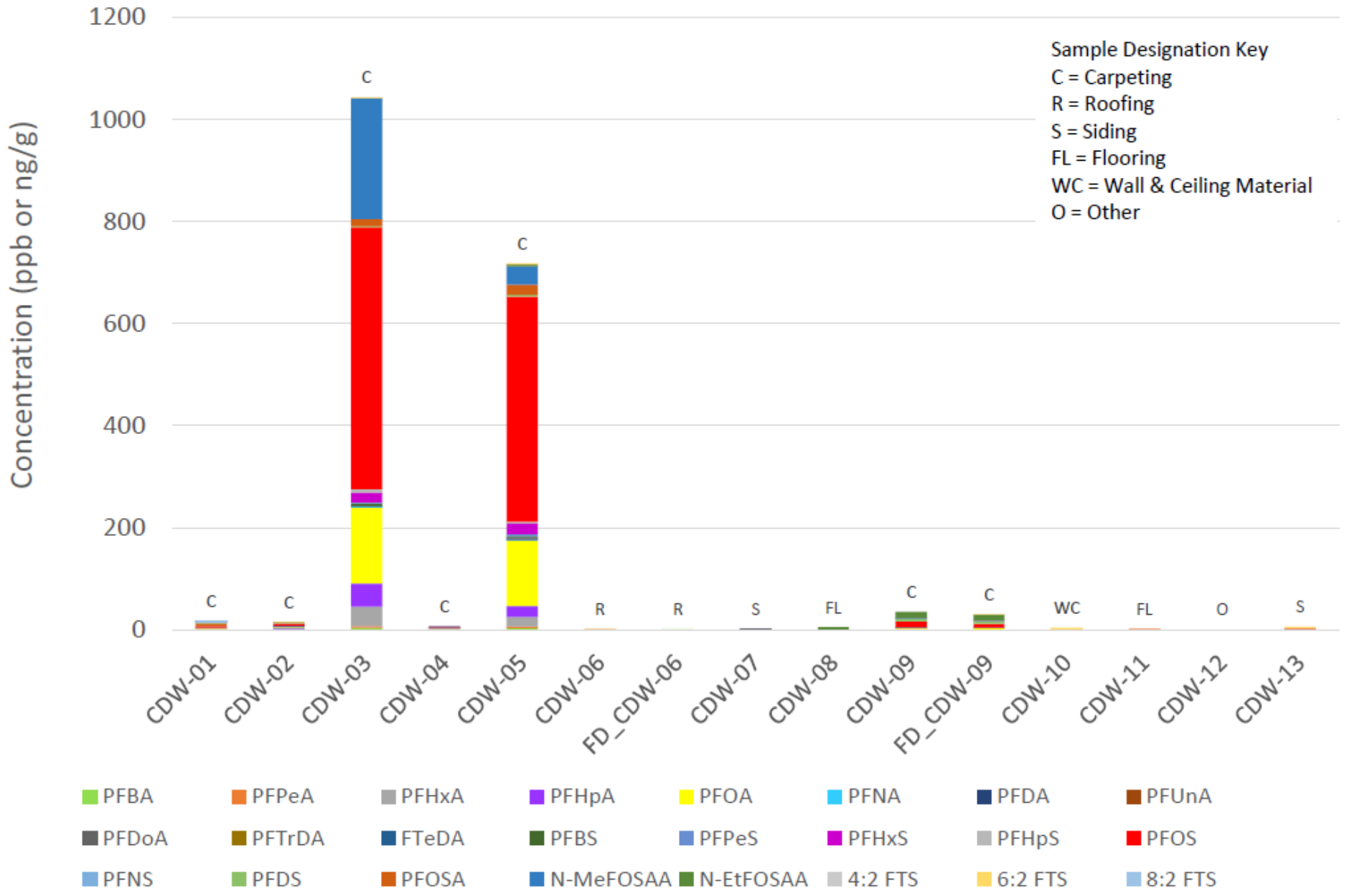
Fig. 2 of 2



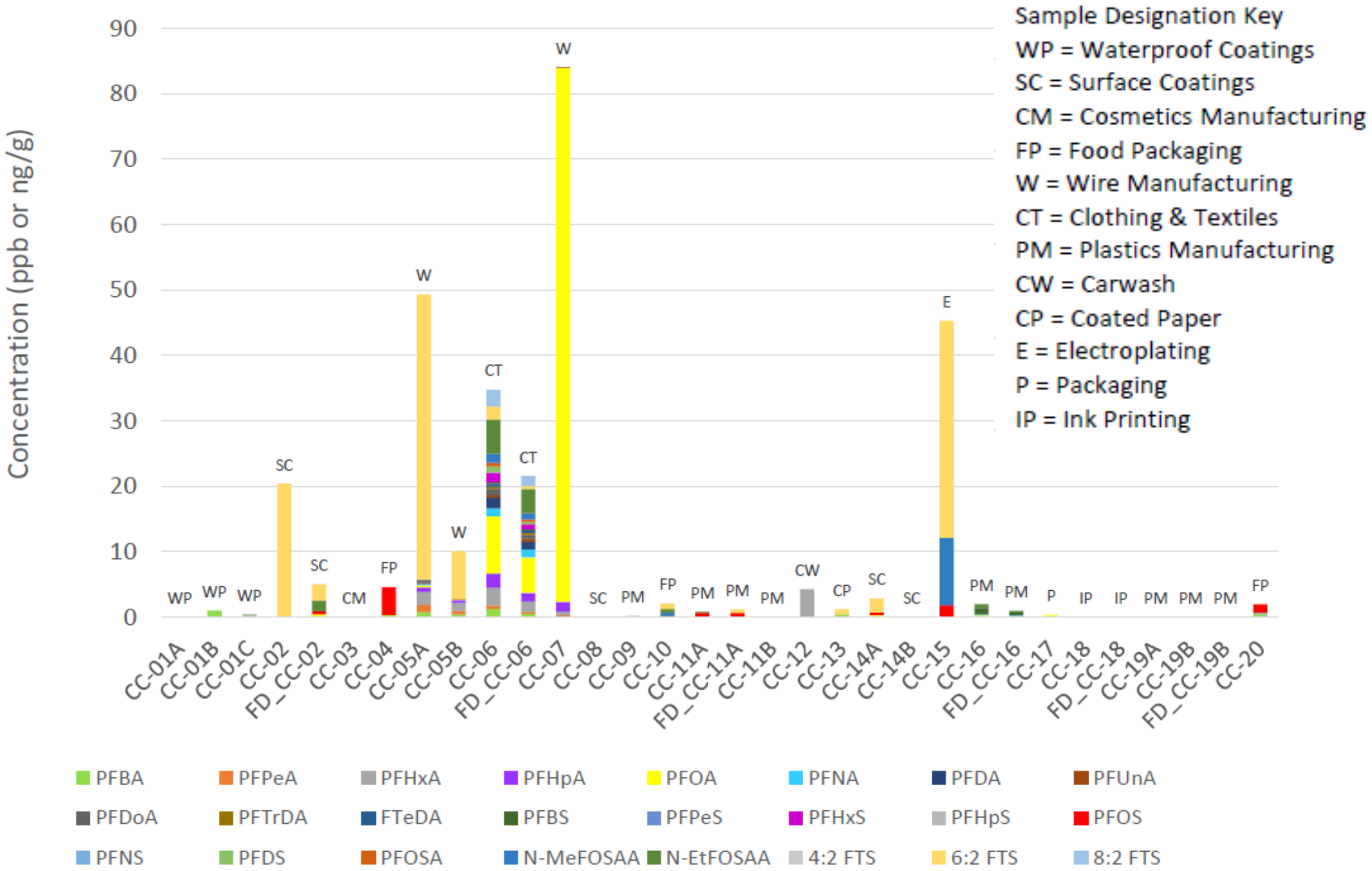
Contaminated Soils



Construction and Demolition (includes carpeting)



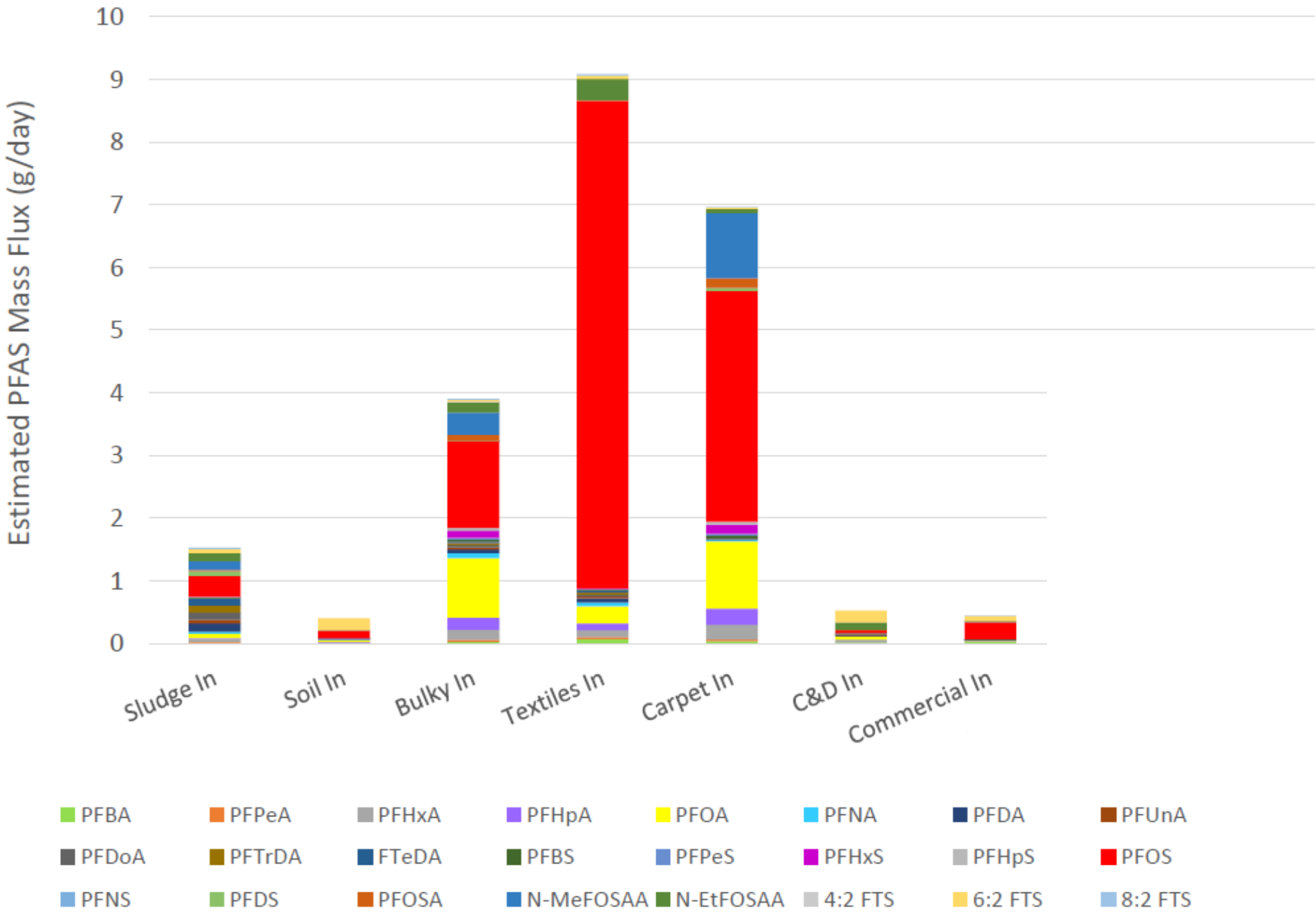
Commercial Wastes

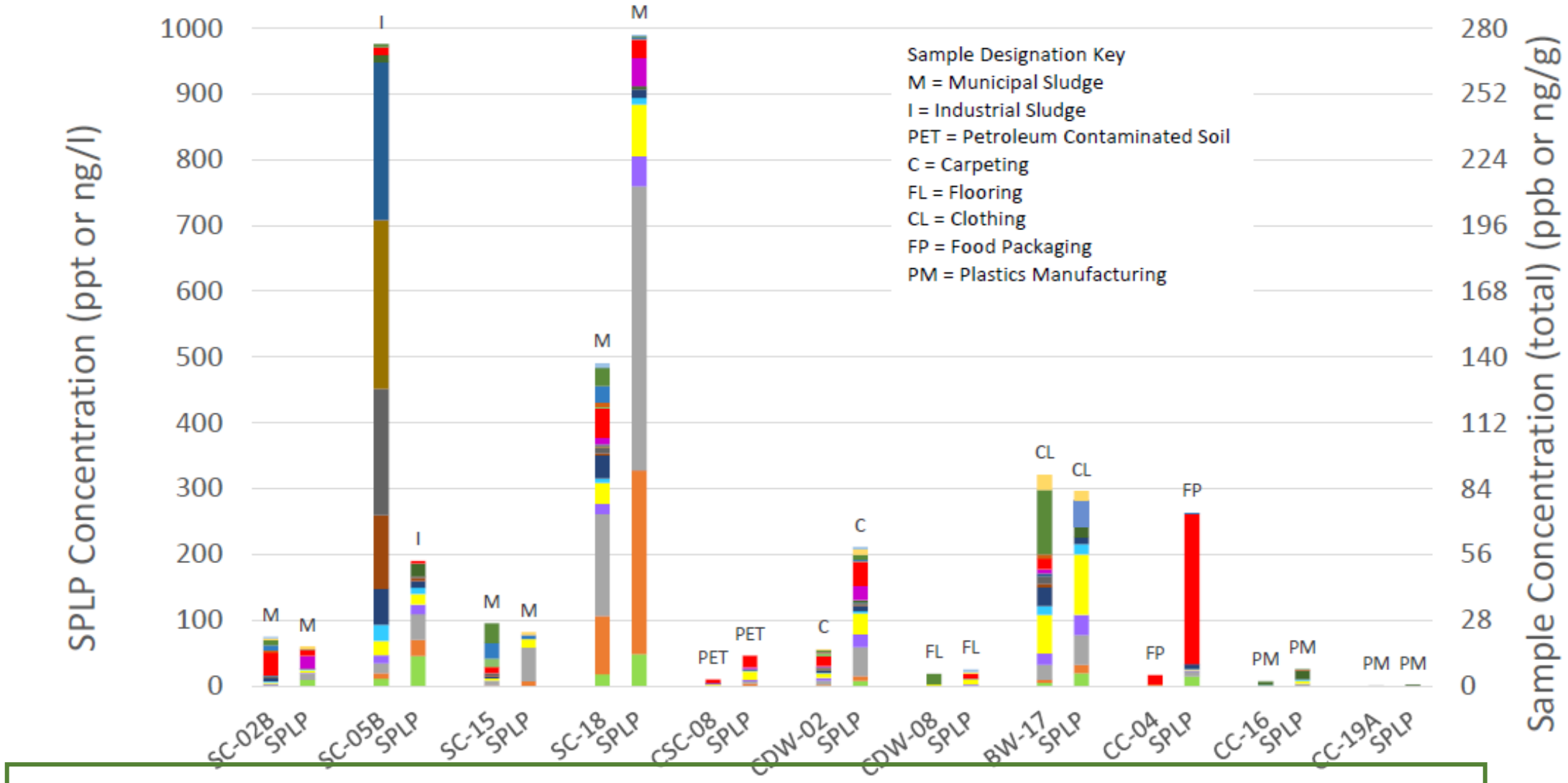


PFAS Loading into the Landfill

Based on:

- concentrations detected; and
- estimates of the tonnage of each waste type disposed





Leached %	6%	1%	6%	14%	34%	27%	10%	7%	114%	26%	53%

Leached % = SPLP Concentration × 20 ÷ (Sample Concentration × 1,000)

PFAS Coming Out of Landfills

Preliminary Analysis of Leachate

Preliminary Lined Landfill Leachate Evaluation (2017-2018)

Leachate Concentration Guidelines: October 2017

PFAS analyte:	Landfill Leachate concentration requiring no restrictions	Landfill Leachate concentration which may require restrictions	Landfill Leachate concentration requiring pretreatment
PFOA	0.120 mg/L	0.120 mg/L to 1.2 mg/L	>1.2 mg/L
PFOS	0.001 mg/L	0.001 mg/L to 0.010 mg/L	>0.010 mg/L

Discharge of leachate through a wastewater treatment facility (with no reduction in concentration) was calculated to achieve Vermont drinking water standards and surface water standards established by other states within the receiving body of water

Leachate Results

- Two different analysis methods utilized (MLA 110, modified EPA 537) with comparable results in duplicates
- No leachate sample exceeded guideline concentrations

MLA 110

ng/l	Closed 1997	Closed 1997 (duplicate)	Closed 1992	Closed 1995	Operating
Perfluorooctanoic acid (PFOA)	2,110	2,030	110	379	1,850
Perfluorooctane sulfonate (PFOS)	278	217	99.1	22.5	244

Modified EPA Method 537

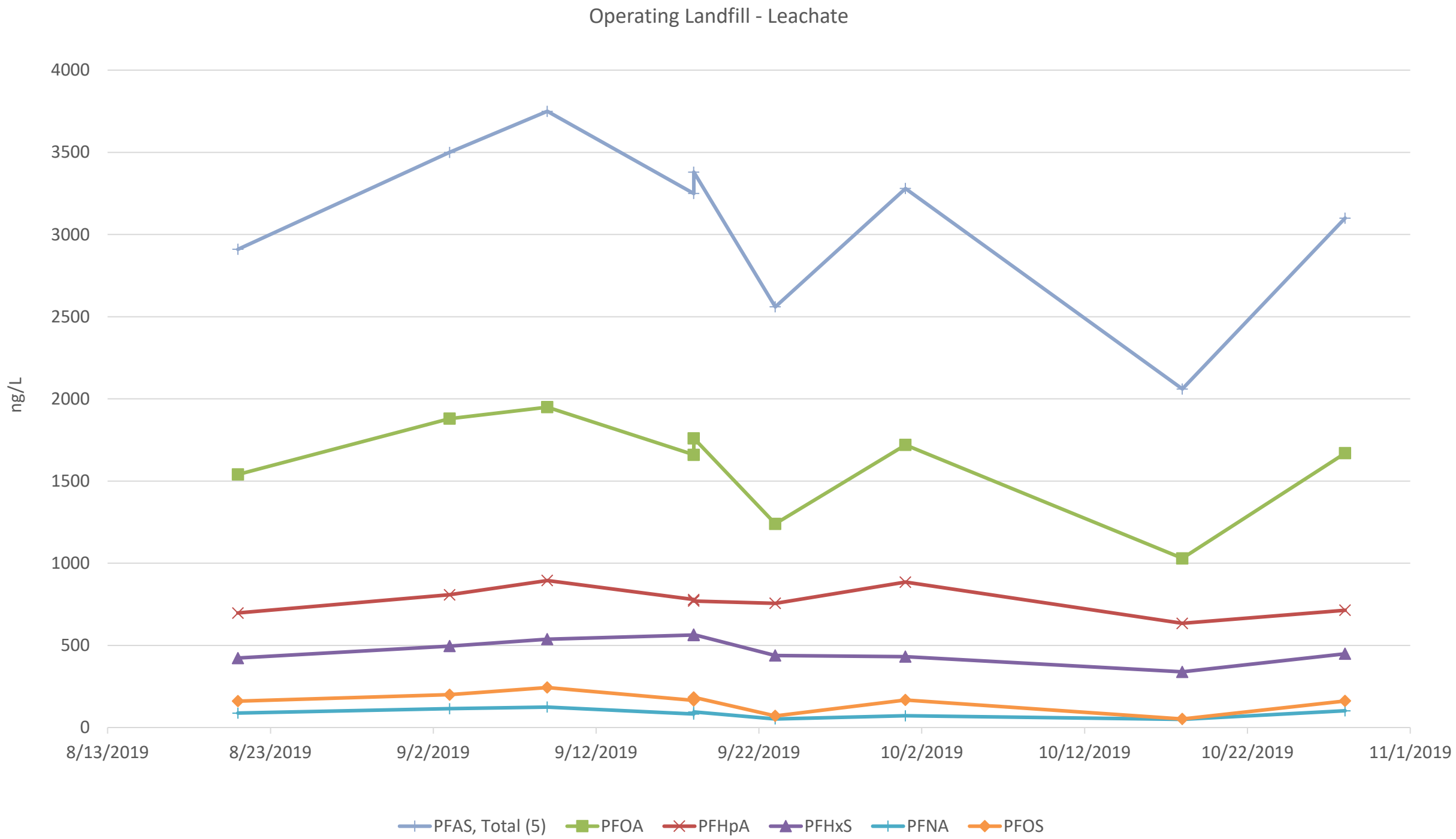
	Closed 2013: Cell 1 *	Closed 2013: Cell 2 *	Closed 2013: Cell 3 *	Closed 1995 *	Operating
Perfluorooctanoic acid (PFOA)	1,400	2,800	1,900	418	1,050
Perfluorooctane sulfonate (PFOS)	250	300	270	ND	110

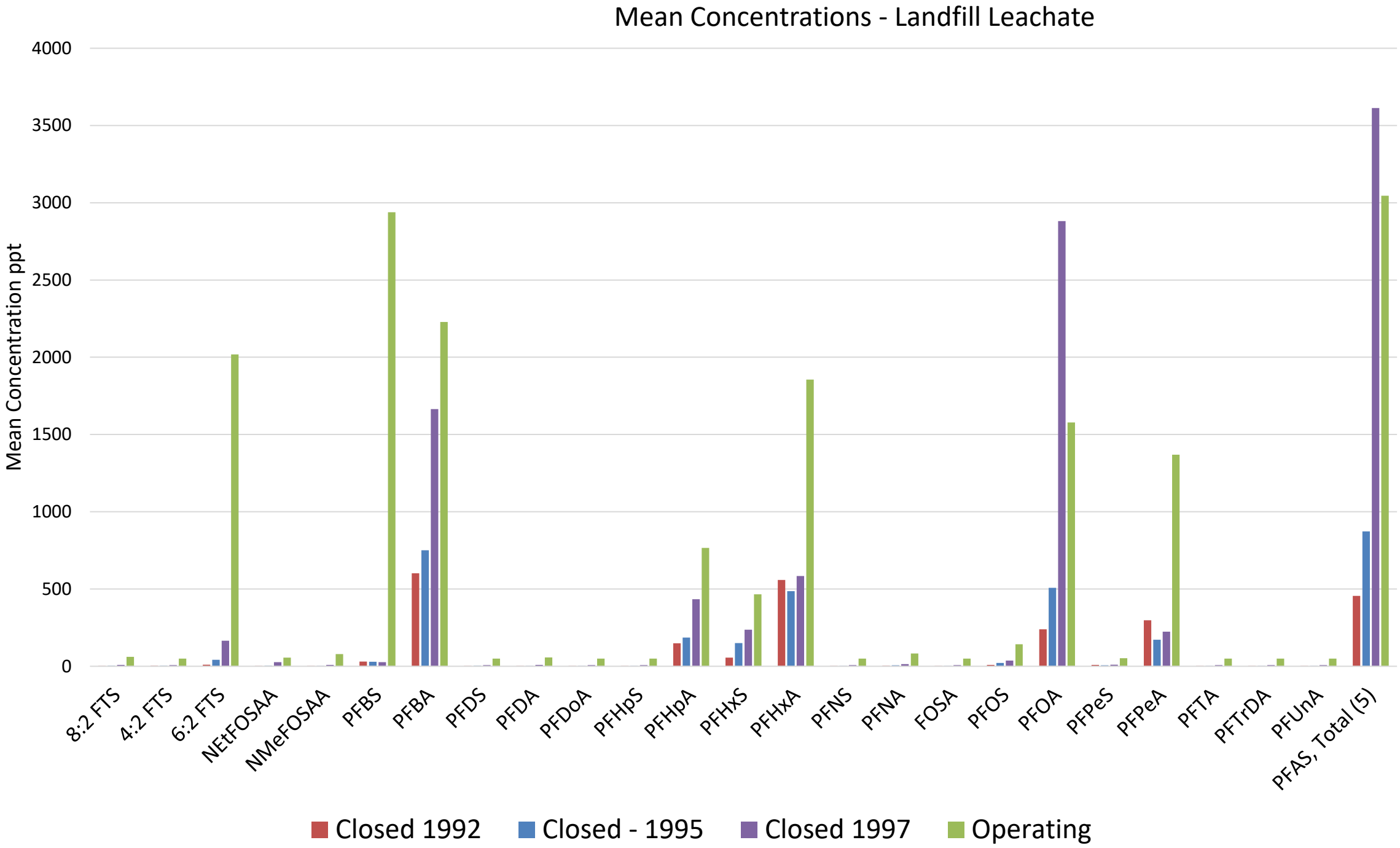
*** denotes a sample that was taken and analyzed independently by the landfill owner and reported to the SWMP**

PFAS Coming Out of Landfills

Analysis of Leachate

Weston and Sampson: Wastewater Facility and Landfill PFAS Sampling Summary, January 2020


Operating Landfill - Leachate
4000
3500
3000
2500
2000
1500
1000
500
0
ng/L
8/13/2019
8/23/2019
9/2/2019
9/12/2019
9/22/2019
10/2/2019
10/12/2019
10/22/2019
11/1/2019
PFAS, Total (5)
PFOA
PFHpA
PFHxS
PFNA
PFOS


Mean Concentrations - Landfill Leachate
Mean Concentration ppt
4000
3500
3000
2500
2000
1500
1000
500
0
8:2 FTS
4:2 FTS
6:2 FTS
NEtFOSAA
NMeFOSAA
PFBS
PFBA
PFDS
PFDA
PFDoA
PFHpS
PFHpA
PFHxS
PFHxA
PFNS
PFNA
FOSA
PFOS
PFOA
PFPeS
PFPeA
PFTA
PFTrDA
PFUnA
PFAS, Total (5)
Closed 1992
Closed - 1995
Closed 1997
Operating

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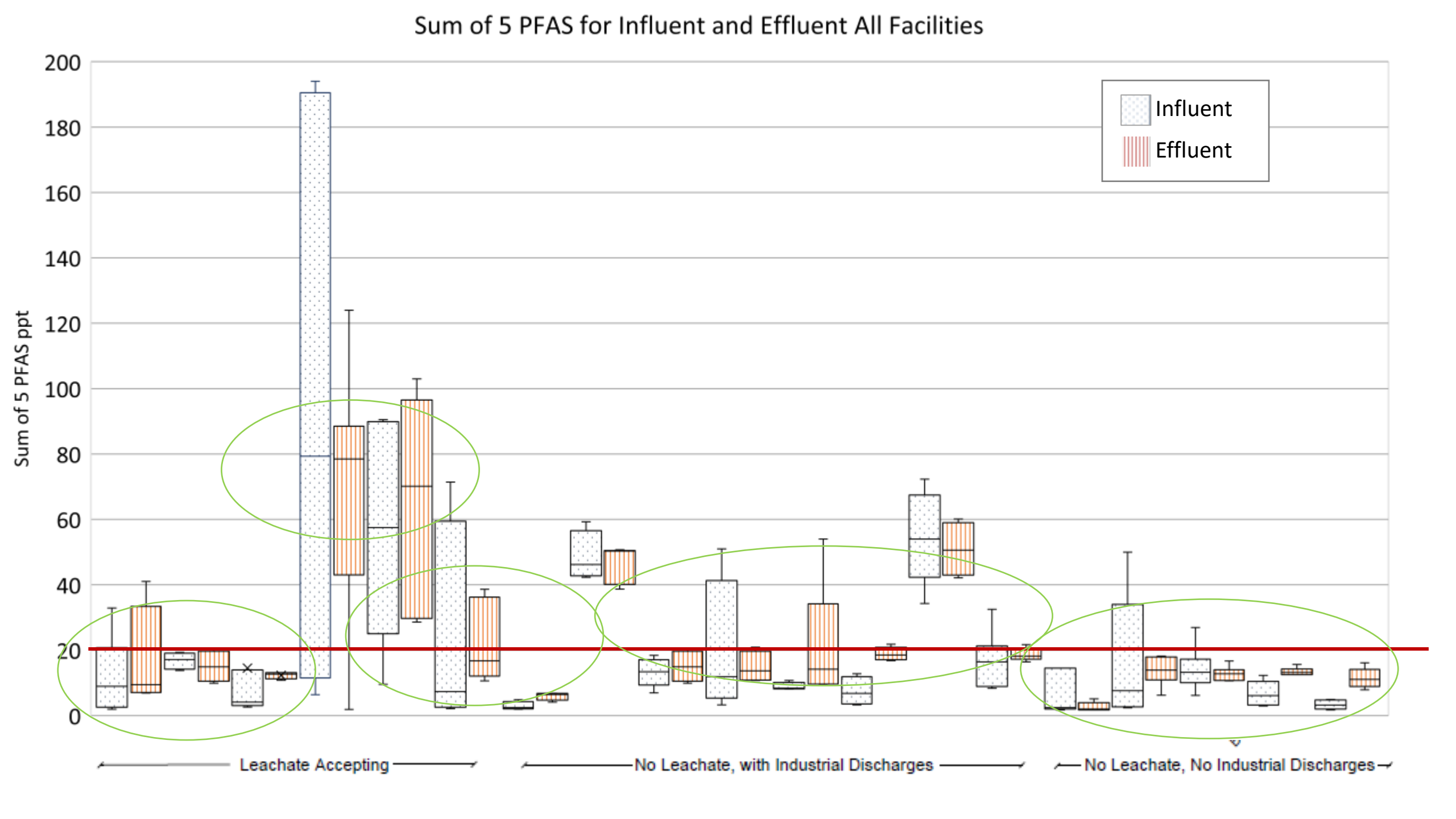
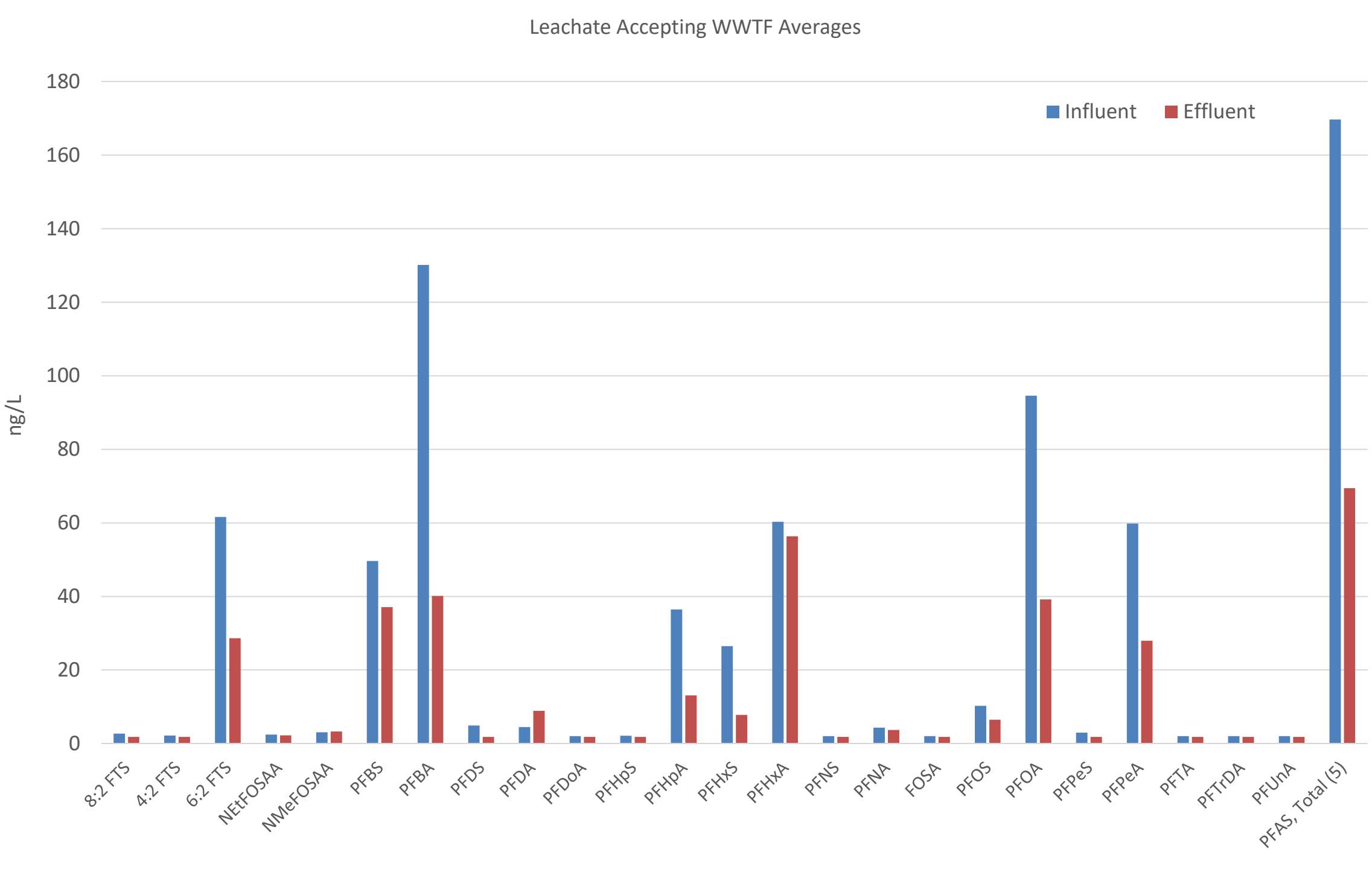
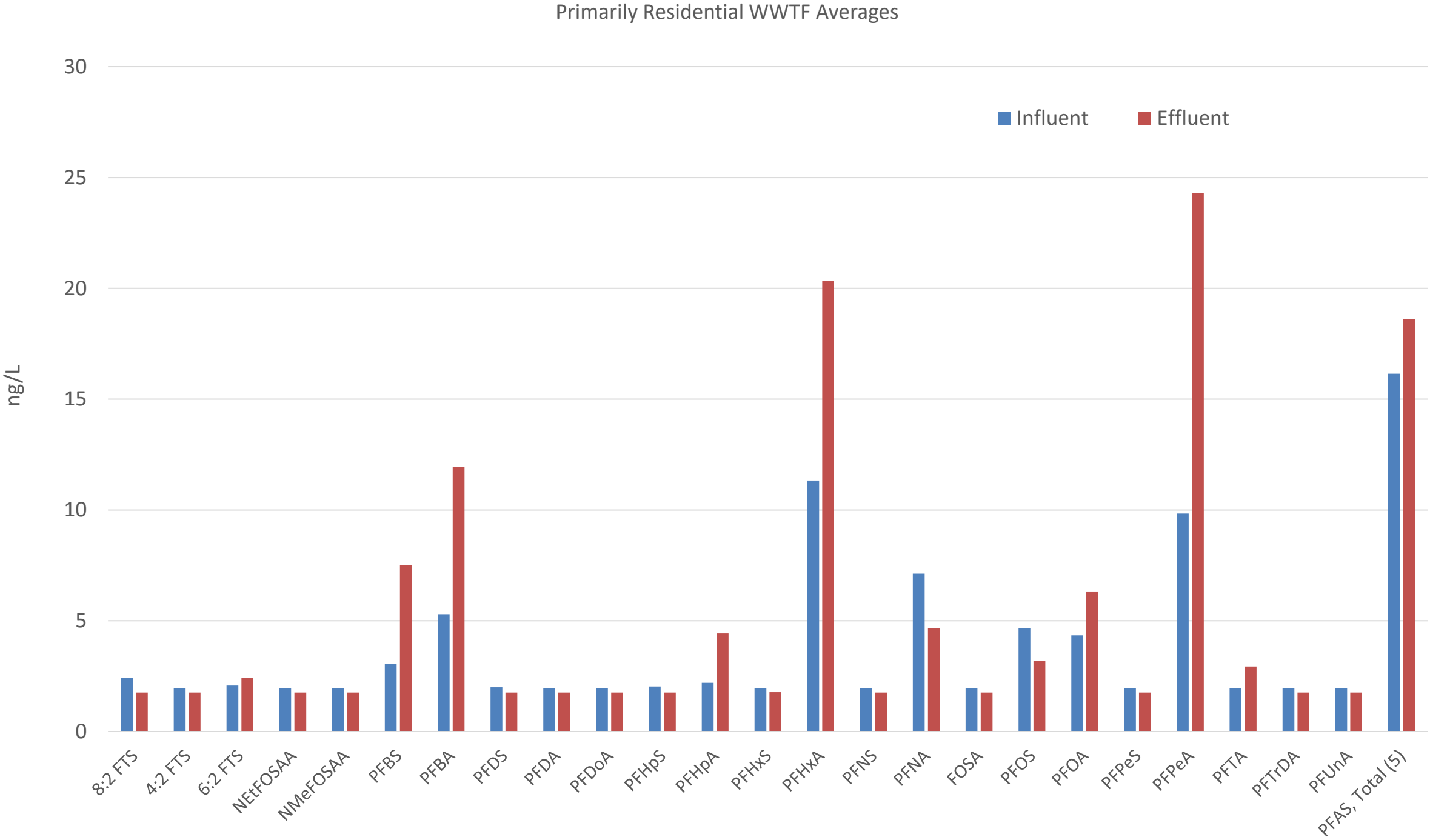
PFAS in Wastewater

Analysis of Influent and Effluent at Wastewater Treatment Facilities (WWTF)

Weston and Sampson: Wastewater Facility and Landfill PFAS Sampling Summary, January 2020


Sum of 5 PFAS for Influent and Effluent All Facilities
Sum of 5 PFAS ppt
200
180
160
140
120
100
80
60
40
20
0
Influent
Effluent
Leachate Accepting
No Leachate, with Industrial Discharges
No Leachate, No Industrial Discharges


Leachate Accepting WWTF Averages
Influent
Effluent
ng/L
180
160
140
120
100
80
60
40
20
0
8:2 FTS
4:2 FTS
6:2 FTS
NEtFOSAA
NMeFOSAA
PFBS
PFBA
PFDS
PFDA
PFDoA
PFHpS
PFHpA
PFHxS
PFHxA
PFNS
PFNA
FOSA
PFOS
PFOA
PFPeS
PFPeA
PFTA
PFTrDA
PFUnA
PFAS, Total (5)


Primarily Residential WWTF Averages
Influent
Effluent
ng/L
30
25
20
15
10
5
0
8:2 FTS
4:2 FTS
6:2 FTS
NEtFOSAA
NMeFOSAA
PFBS
PFBA
PFDS
PFDA
PFDoA
PFHpS
PFHpA
PFHxS
PFHxA
PFNS
PFNA
FOSA
PFOS
PFOA
PFPeS
PFPeA
PFTA
PFTrDA
PFUnA
PFAS, Total (5)

Evaluation of Leachate Treatment Options

Request: Evaluate available leachate treatment options for PFAS and recommend two on-site and two off-site options

Challenges and Assumptions:

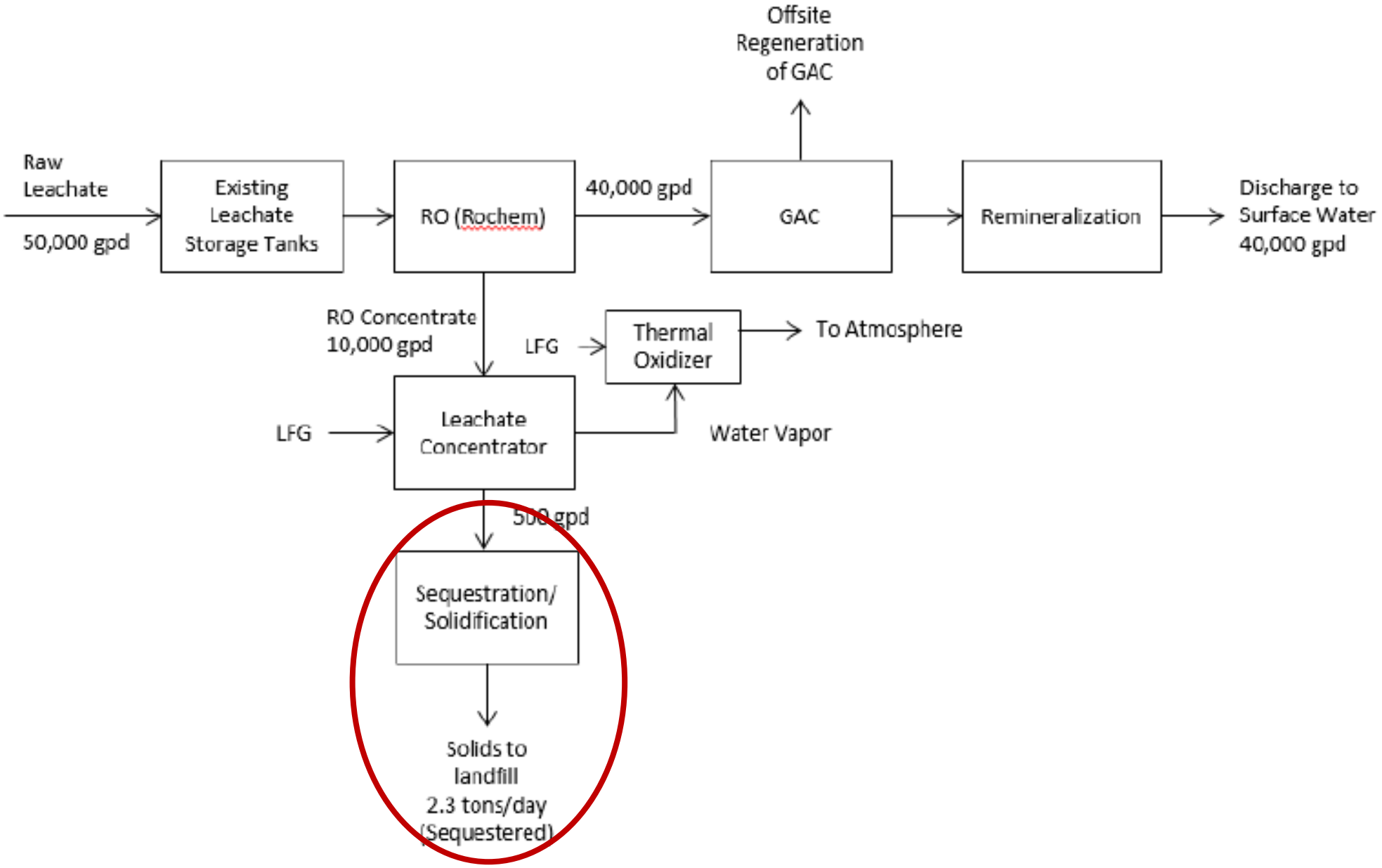
1. No promulgated treatment or discharge standard

2. Research on PFAS treatment predominantly focused on 'clean' liquids and PFOA or PFOS – leachate is a complex matrix, requiring pre-filtrations

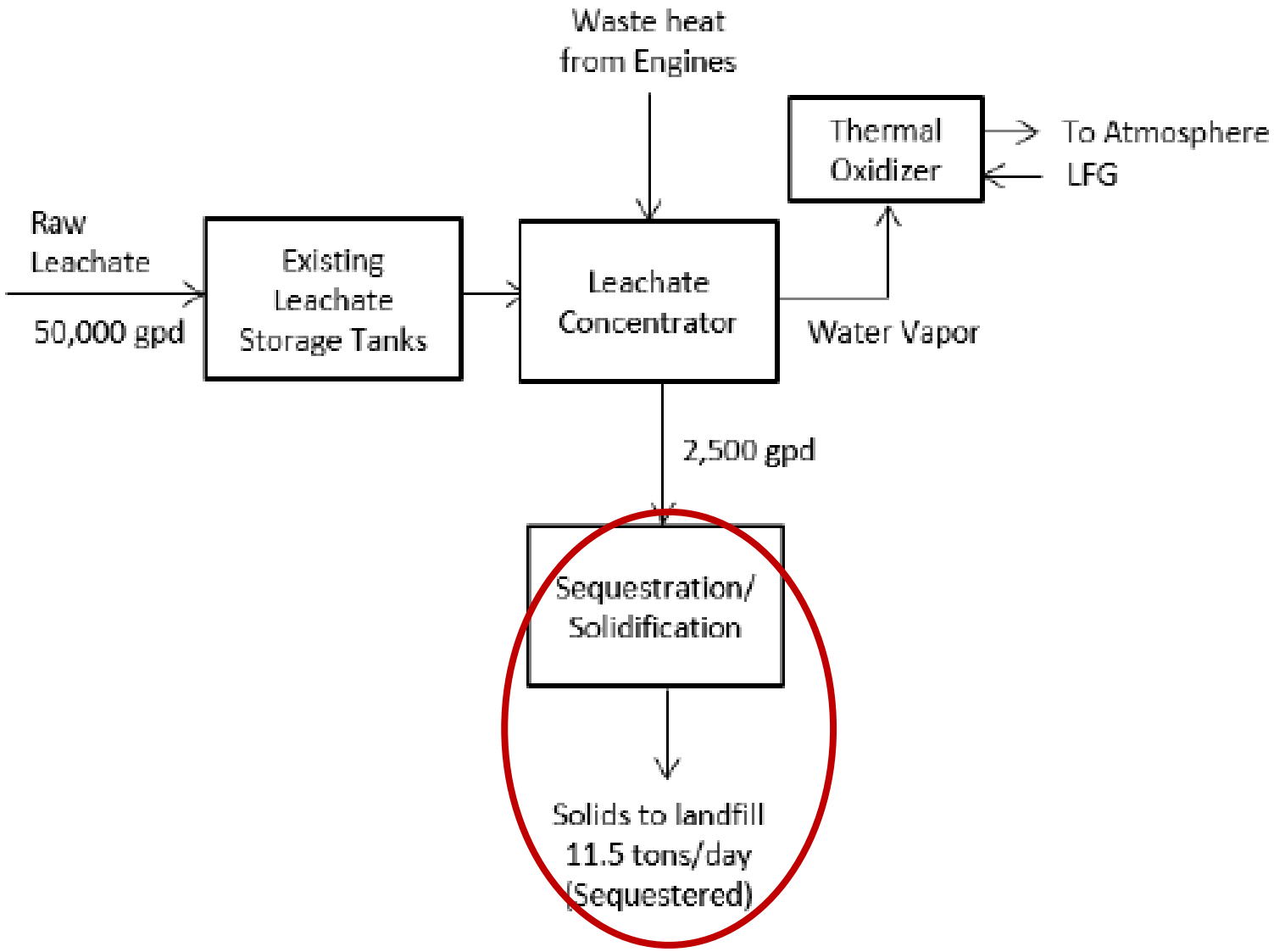
3. All commercially available treatment options for leachate either concentrate or capture PFAS – residuals must be stabilized or destroyed off-site

Brown and Caldwell: Conceptual Leachate Treatment Scoping Study for New England Waste Services of Vermont Landfill, October 2019

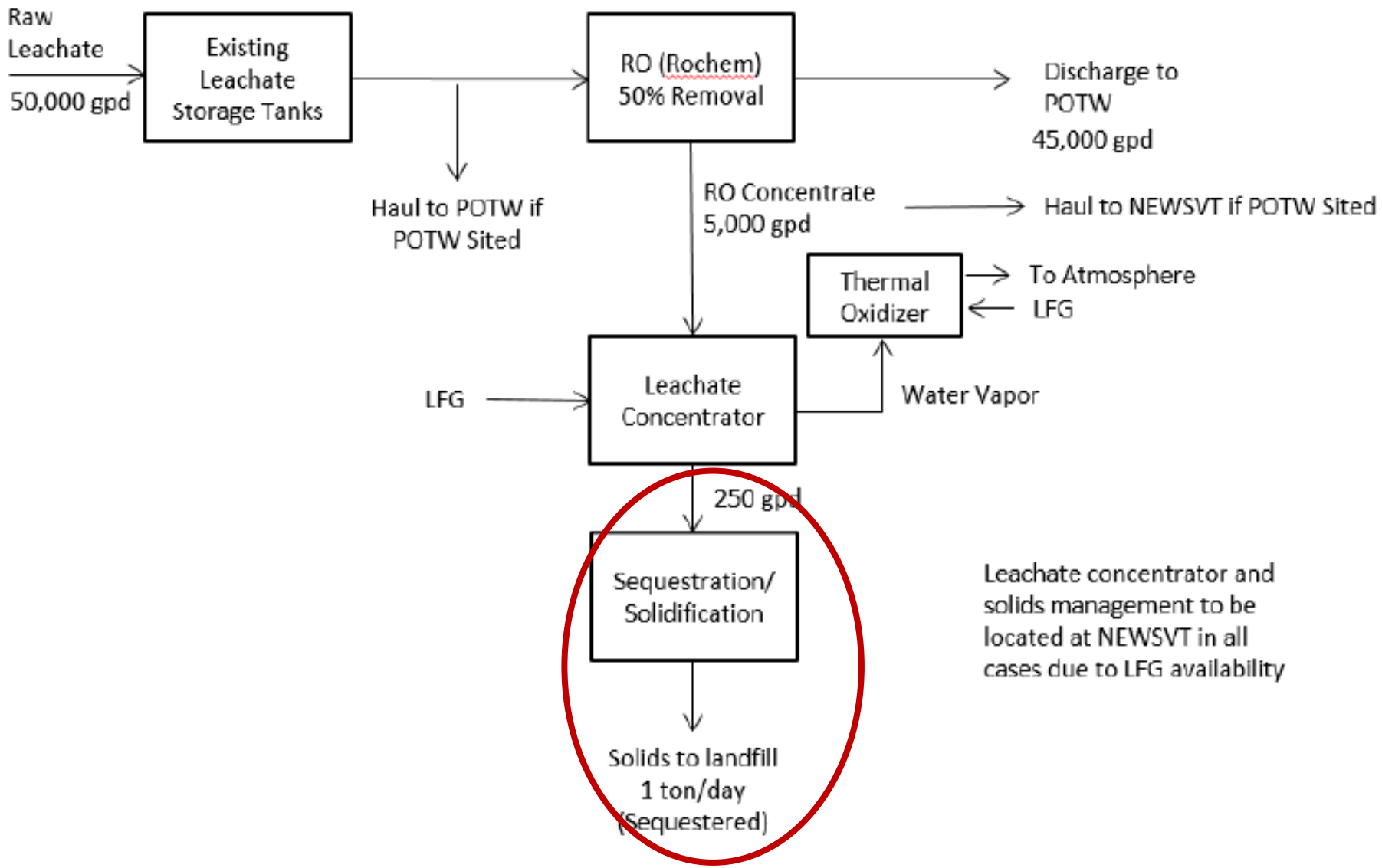
Preferred On-Site Options: Direct Discharge to Surface Water



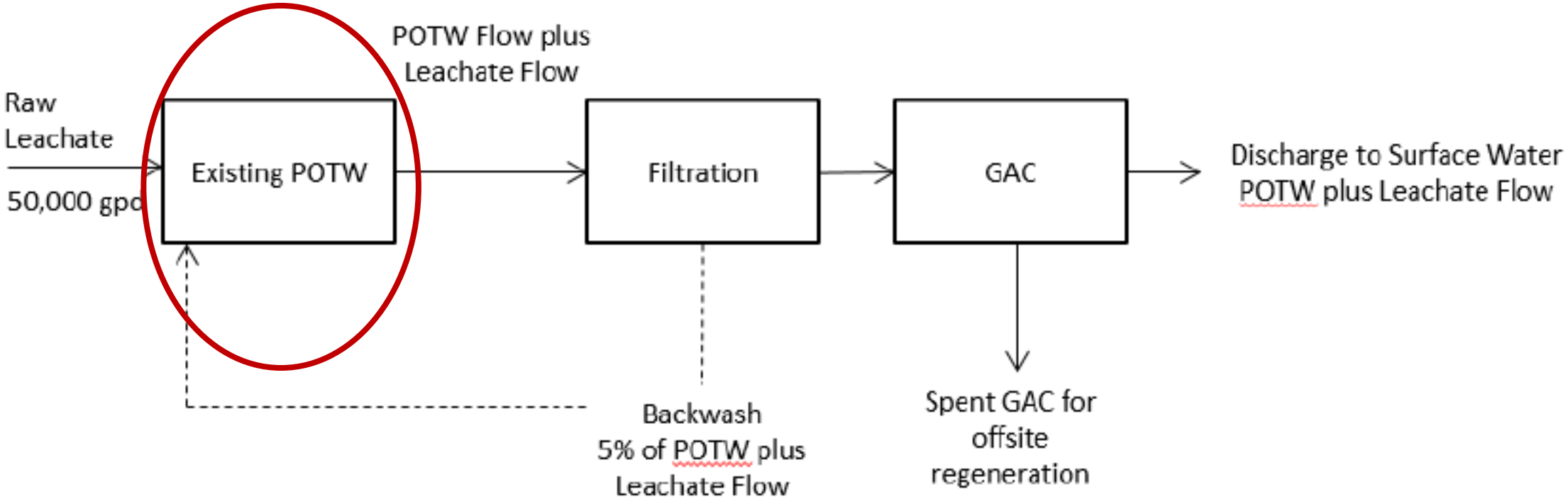
Preferred On-Site Options: Zero Liquid Discharge



Preferred Off-site Options: 50% reduction Pretreatment at WWTF



Preferred Off-site Options: WWTF Enhancement



PFAS in Waste Streams

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1. PFAS detected in nearly all wastes sampled, with large loading likely from residentially source materials. There is no ‘easy’ source of PFAS that can be removed from the waste stream.

2. PFAS detected at all WWTFs, even those not accepting landfill or industrial discharges

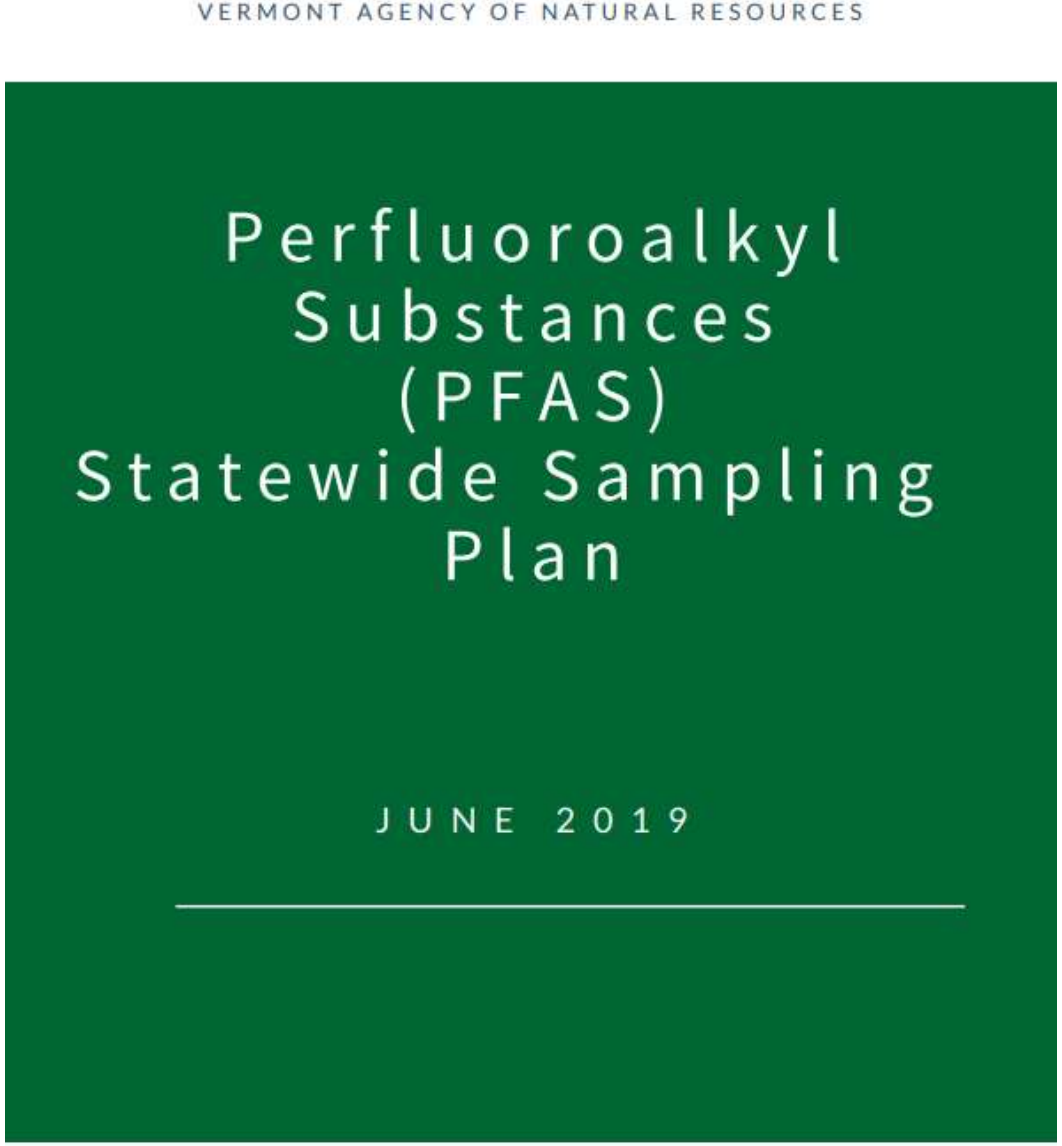
but…

PFAS concentrations at WWTFs that accept significant volumes of leachate are elevated.

3. Treatment of leachate for PFAS is feasible using proven technologies

but….

it would come with a cost and still has significant challenges with the management of treatment residuals.



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