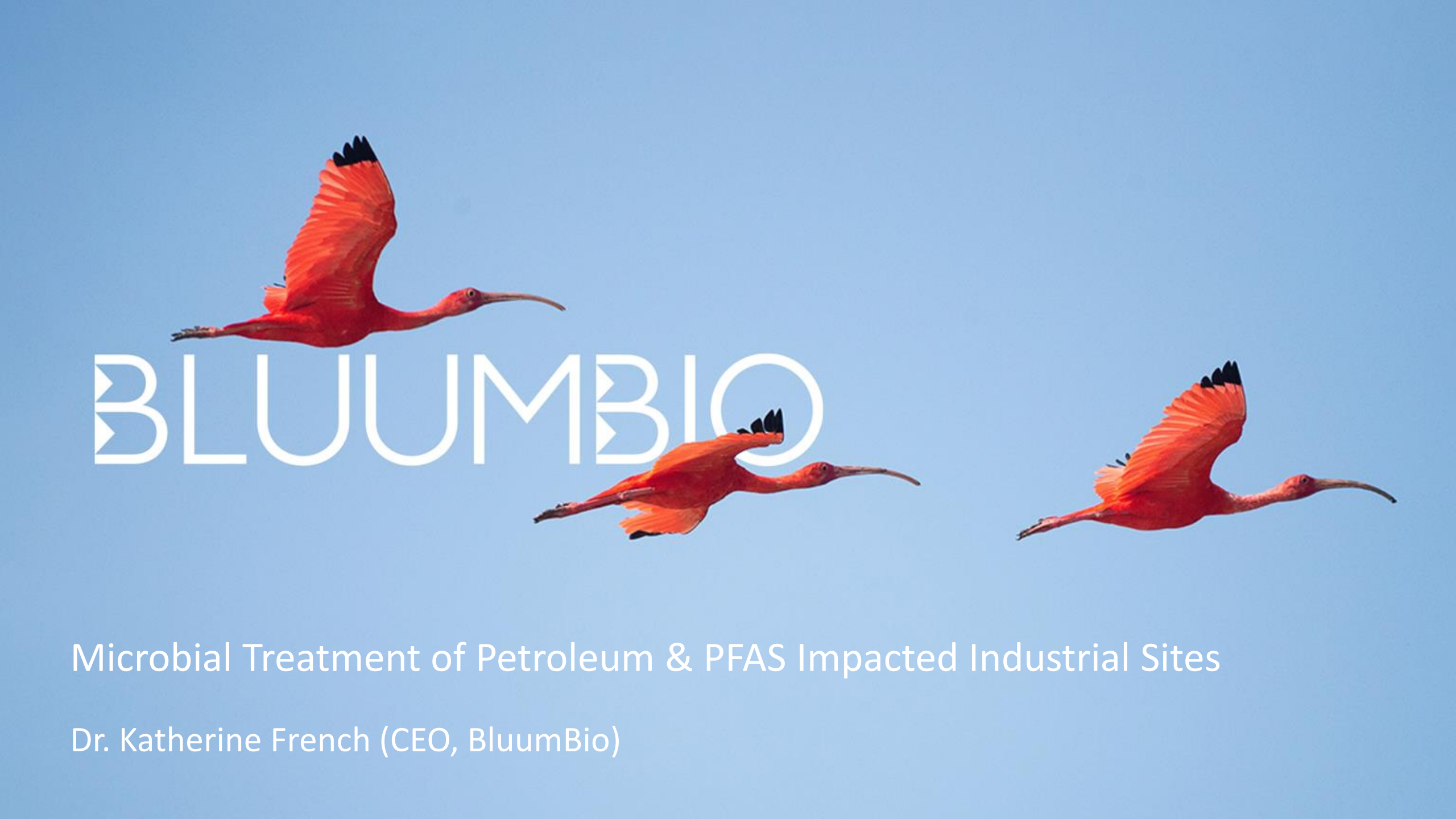


Microbial Treatment of Petroleum & PFAS Impacted Industrial Sites

Dr. Katherine French (CEO, BluumBio)

OUR MICROBIAL PRODUCTS QUICKLY AND EFFECTIVELY CLEAN UP INDUSTRIAL SOIL AND WATER

> RELY ON THE POWER OF ENZYMES

Use oxygen and electrons to break up carbon backbones

> 3 PRODUCT LINES

Petroleum, PFAS, PCBs

> EASY TO USE

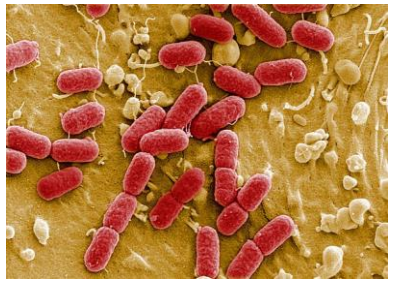
Just add water

OVERVIEW

- How we developed our products
- Microbial metabolism of petroleum and PFAS
- Case studies w/ industrial partners
- Takeaways

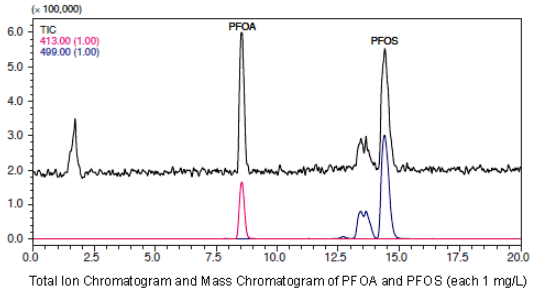
OUR PLATFORM

ORGANISM DISCOVERY



Collect organisms, sequence genomes, and discover enzymes

ASSAY DEVELOPMENT



Develop analytical protocols to identify toxic chemicals and any byproducts of their destruction

PRODUCT DEVELOPMENT

Calculate the right amount of bacteria, nutrients, and electron donors needed for the product to work in the field

SCALE UP

Develop protocols for growing each microbe at scale and making them shelf-stable

HOW THEY DO IT

Petroleum

- Compounds go through central metabolism
- Enzymes involved: p450 oxygenase, dioxygenases, hydrolases, reductases
- A clean process, like eating dead algae

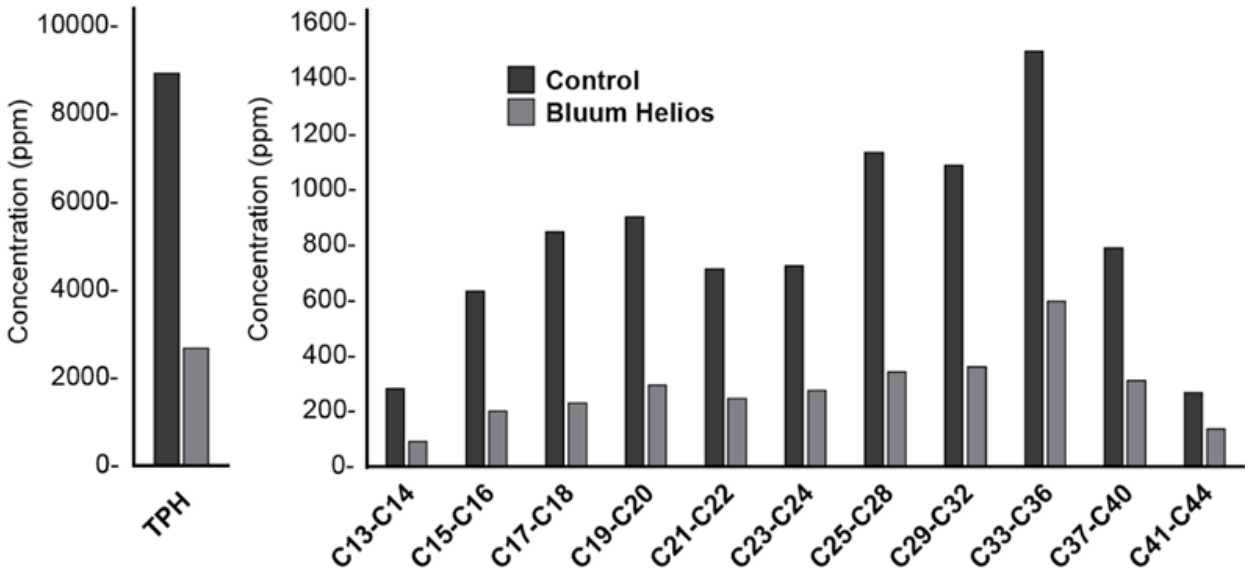
PFAS

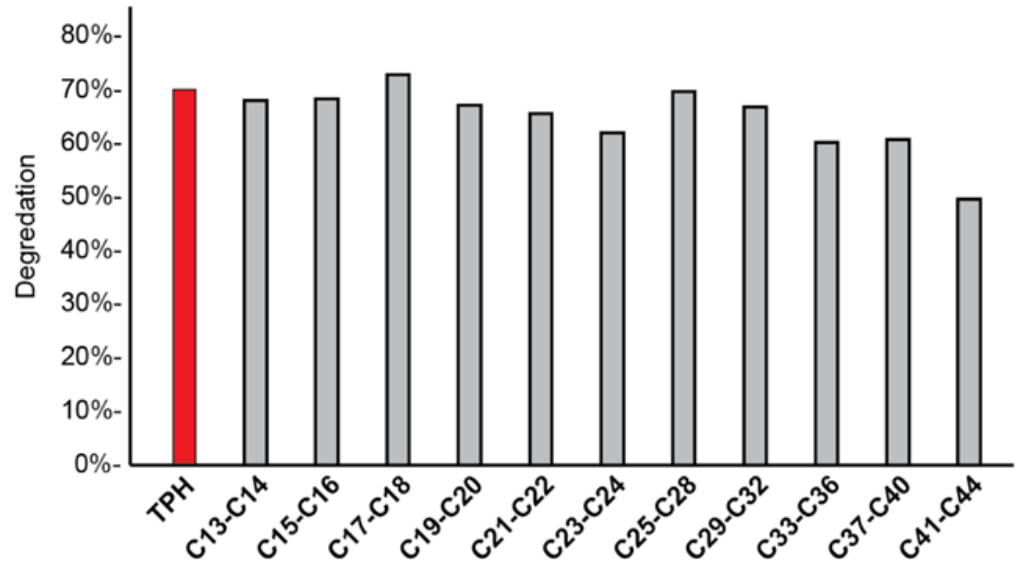
- Compounds go through central metabolism
- Backbones cut up and defluorinated
- Multiple classes of enzymes involved
  - oxidases, reductases, hydrolases, desulfonases
- Multiple genes/metabolic pathways upregulated
  - Transporters, redox proteins, fatty acid biosynthesis

BLUUM HELIOS &DELTA

CASE STUDIES FROM INDUSTRIAL PARTNERS

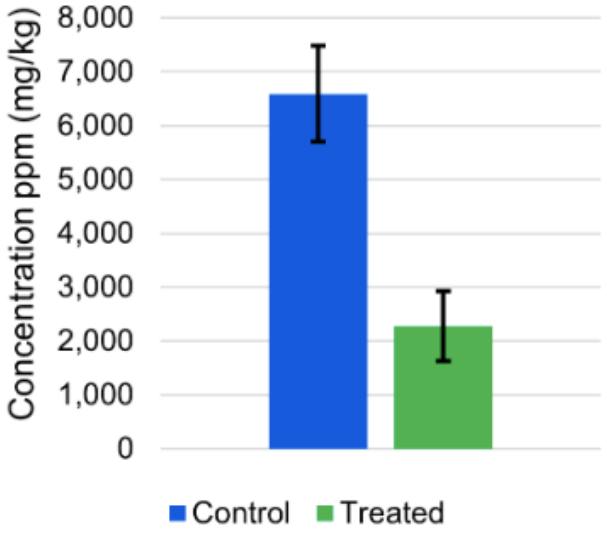
Oil Refinery in northern CA

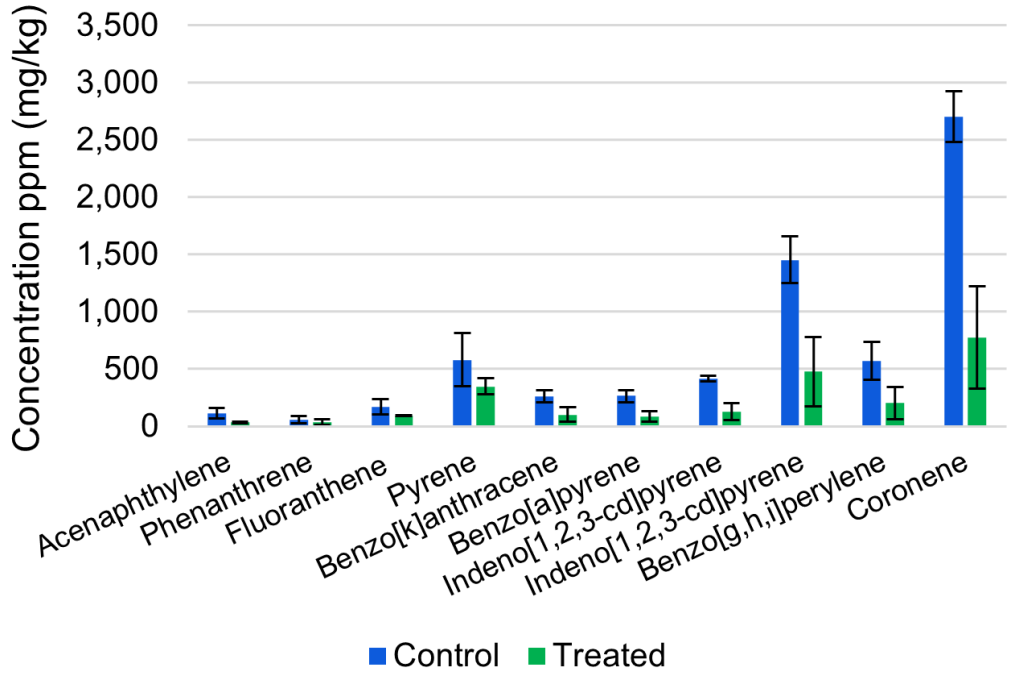




One month treatability study

PAH fieldtrial (Oct-Dec 2024)

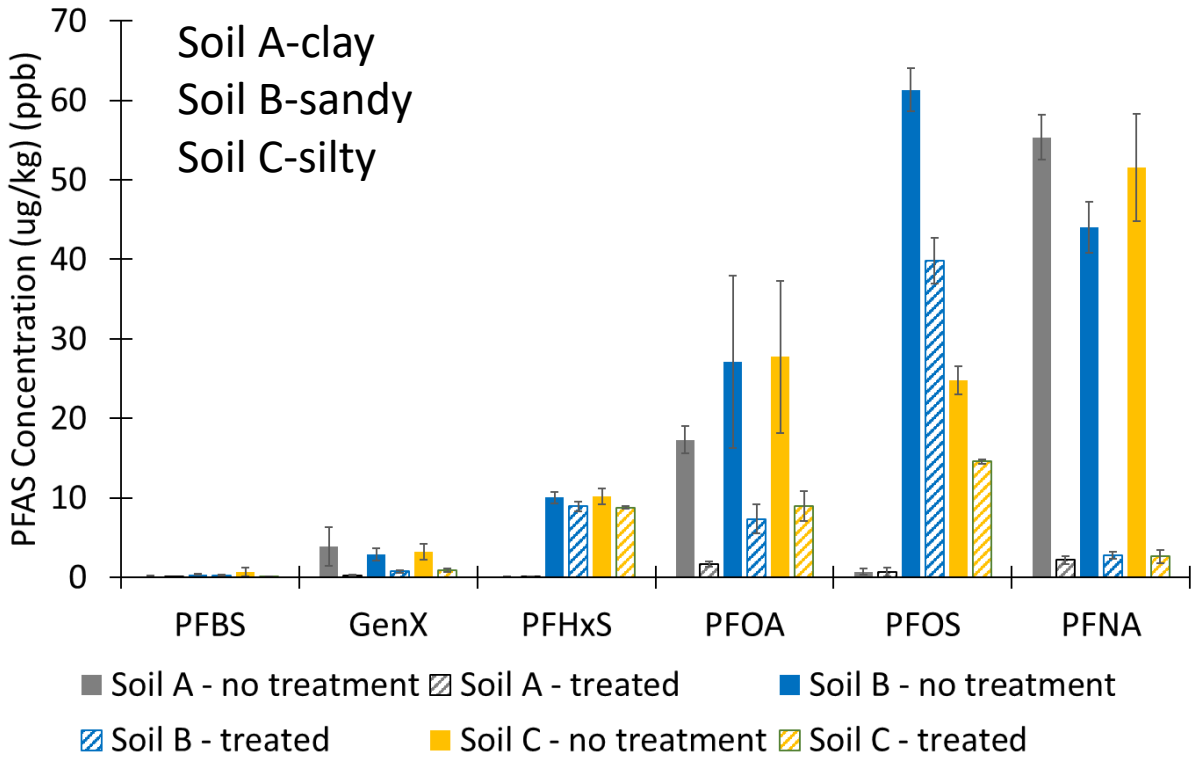




Co-Treatability Studies : Two Oil Refineries in northern CA

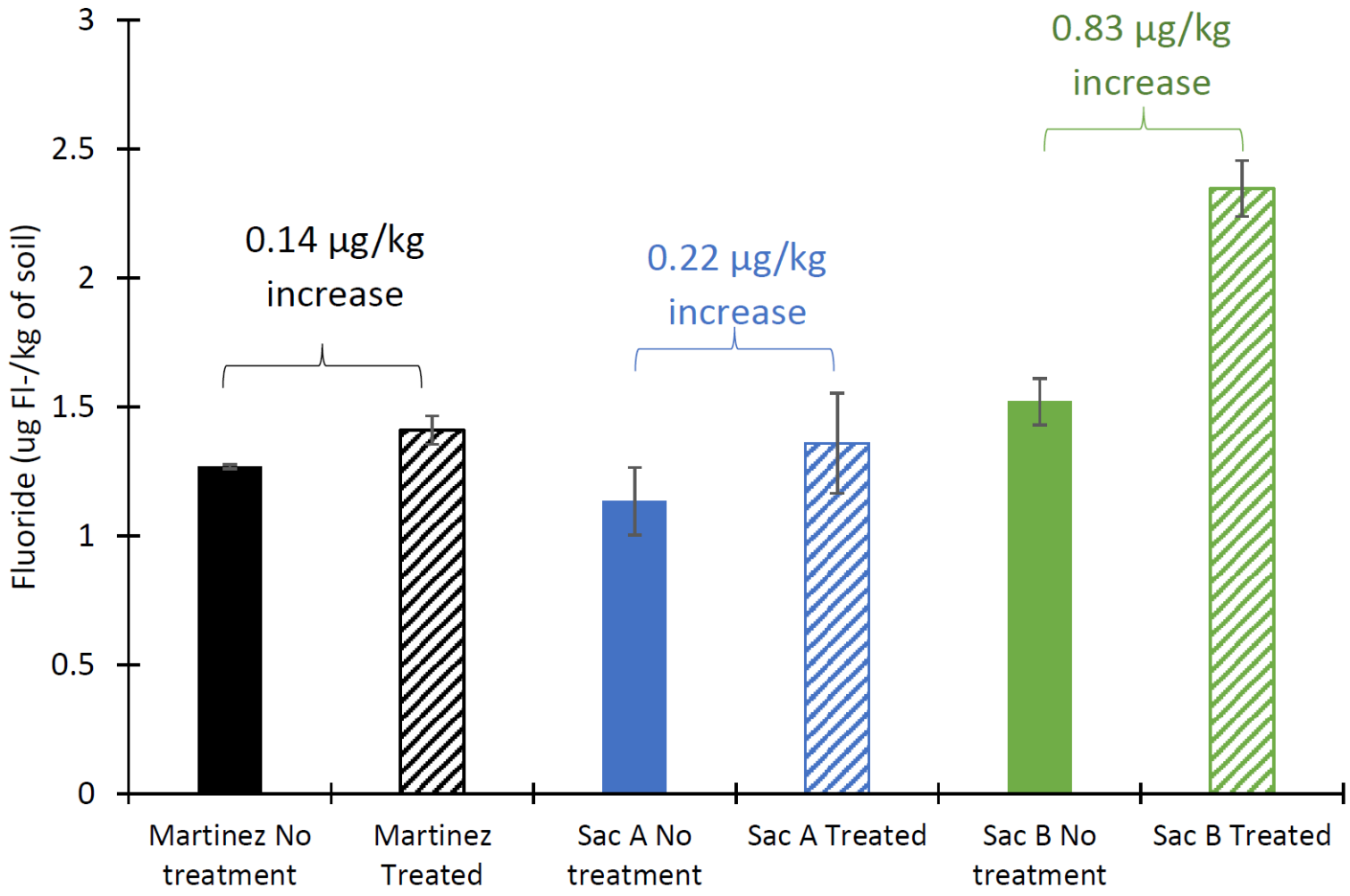
Treated three locations

Hydrocarbons
Control: 62 ppm
Treated: 41 ppm after treatment
-86% degradation of TMB from 34 to 4.7 ppm



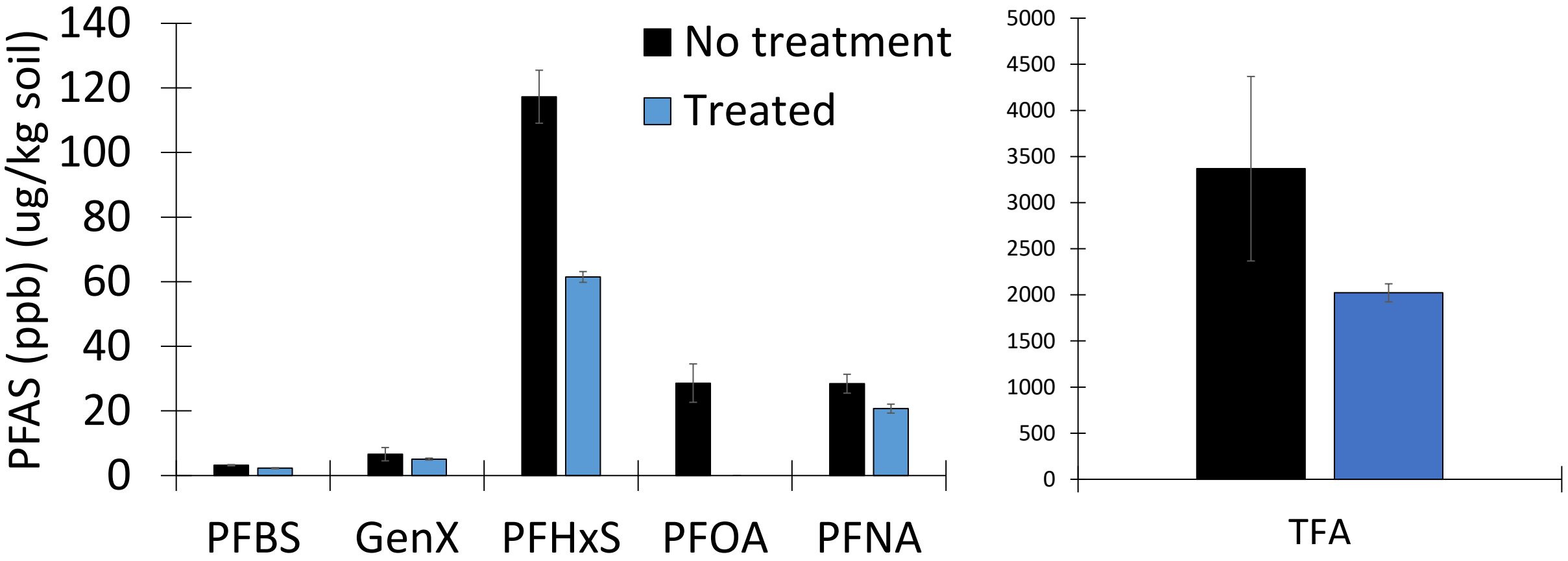
% Degraded	Soil A	Soil B	Soil C
PFBS	98.7	38.4	79.0
GenX	93.5	74.7	72.5
PFHxS	42.5	10.8	13.9
PFOA	90.2	72.9	67.5
PFOS	ND	35.1	41.2
PFNA	96.0	93.7	94.9

Fluoride release



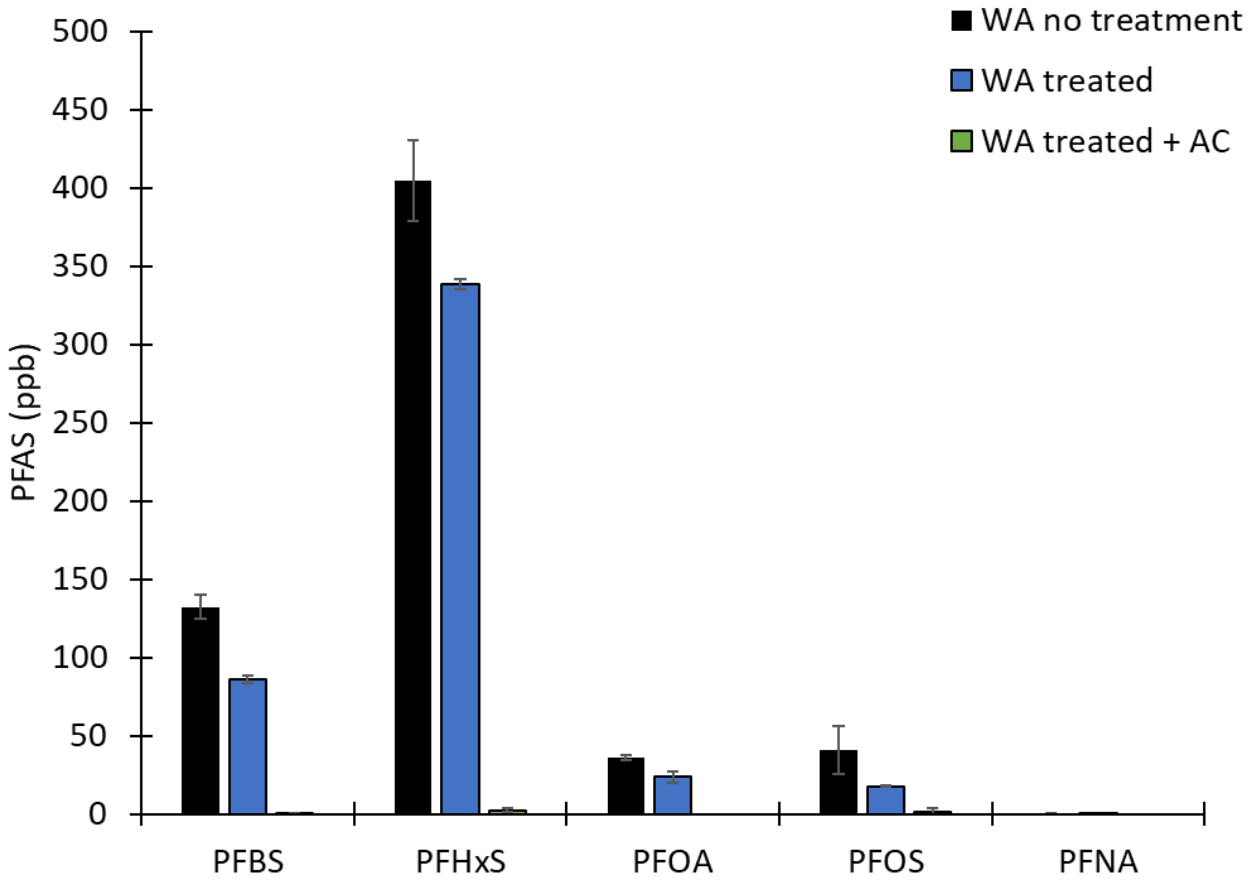
Mining site in Western Australia

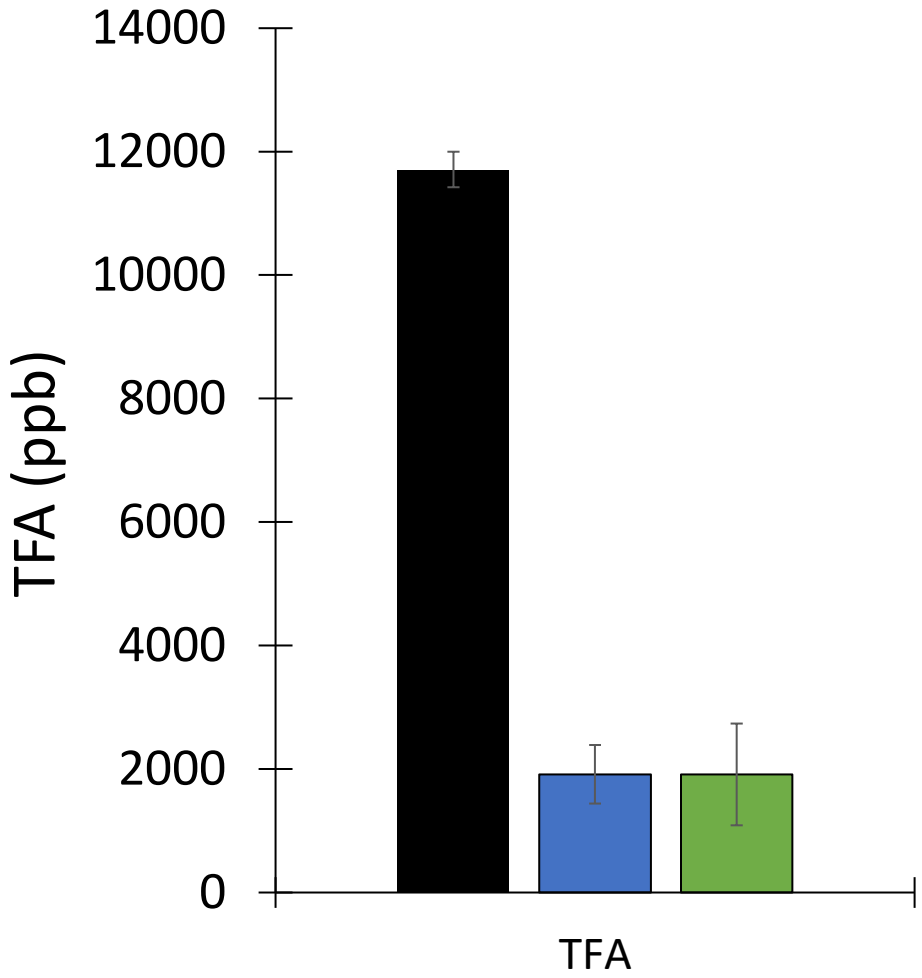
Red mud


PFAS (ppb) (ug/kg soil)
140
120
100
80
60
40
20
0
No treatment
Treated
PFBS
GenX
PFHxS
PFOA
PFNA
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
TFA

Groundwater treatment

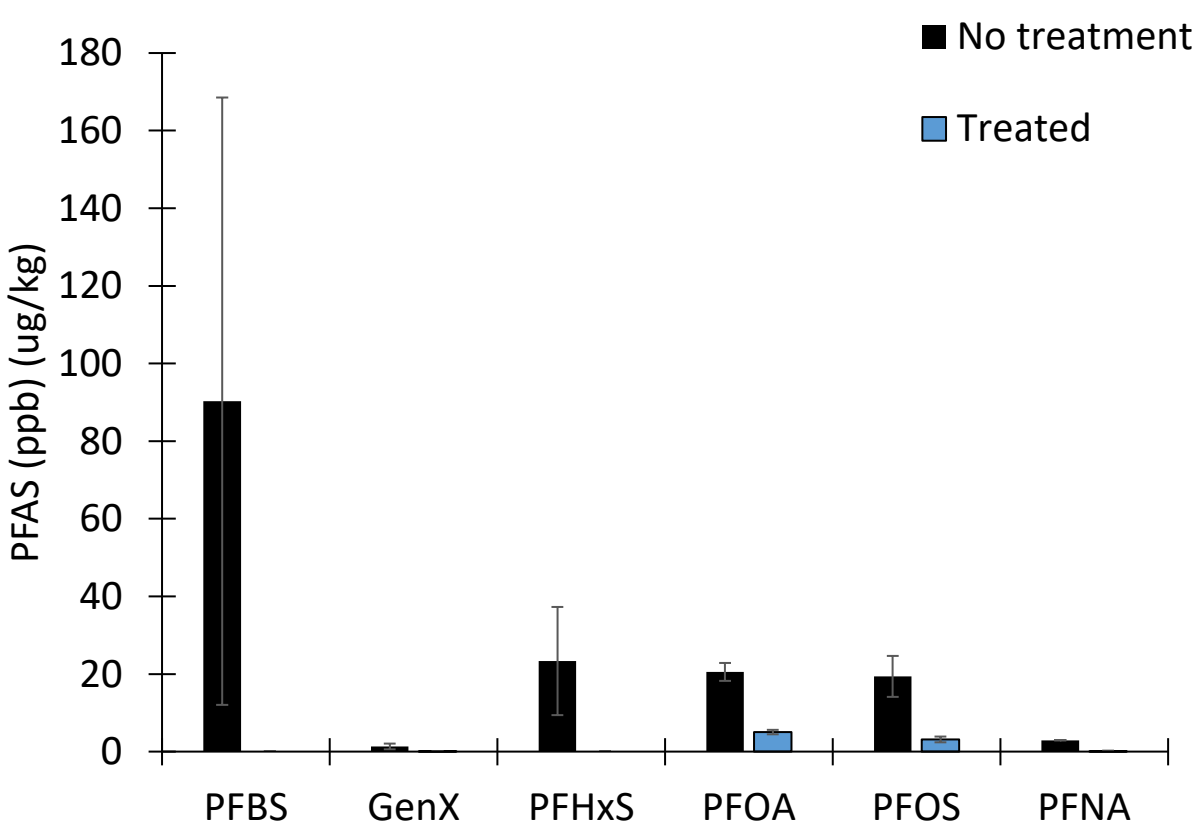
*More suitable with sites highly impacted with GenX, PFHxS, PFBS

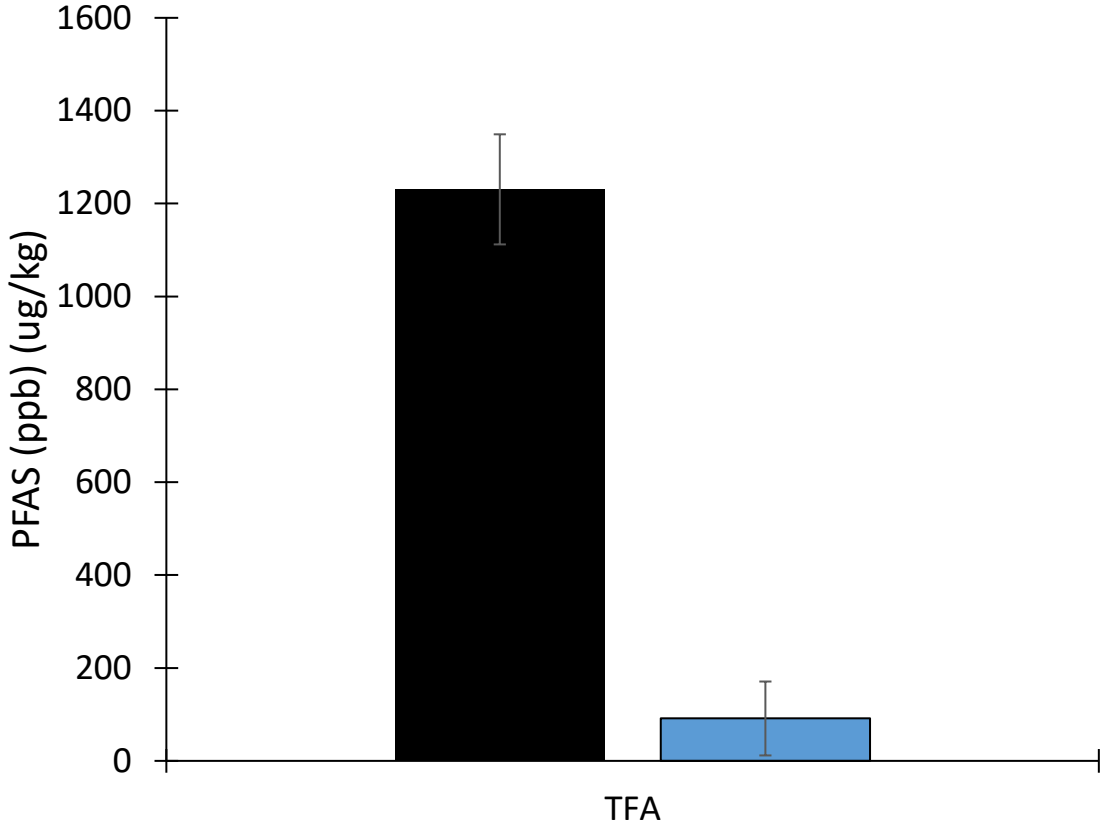




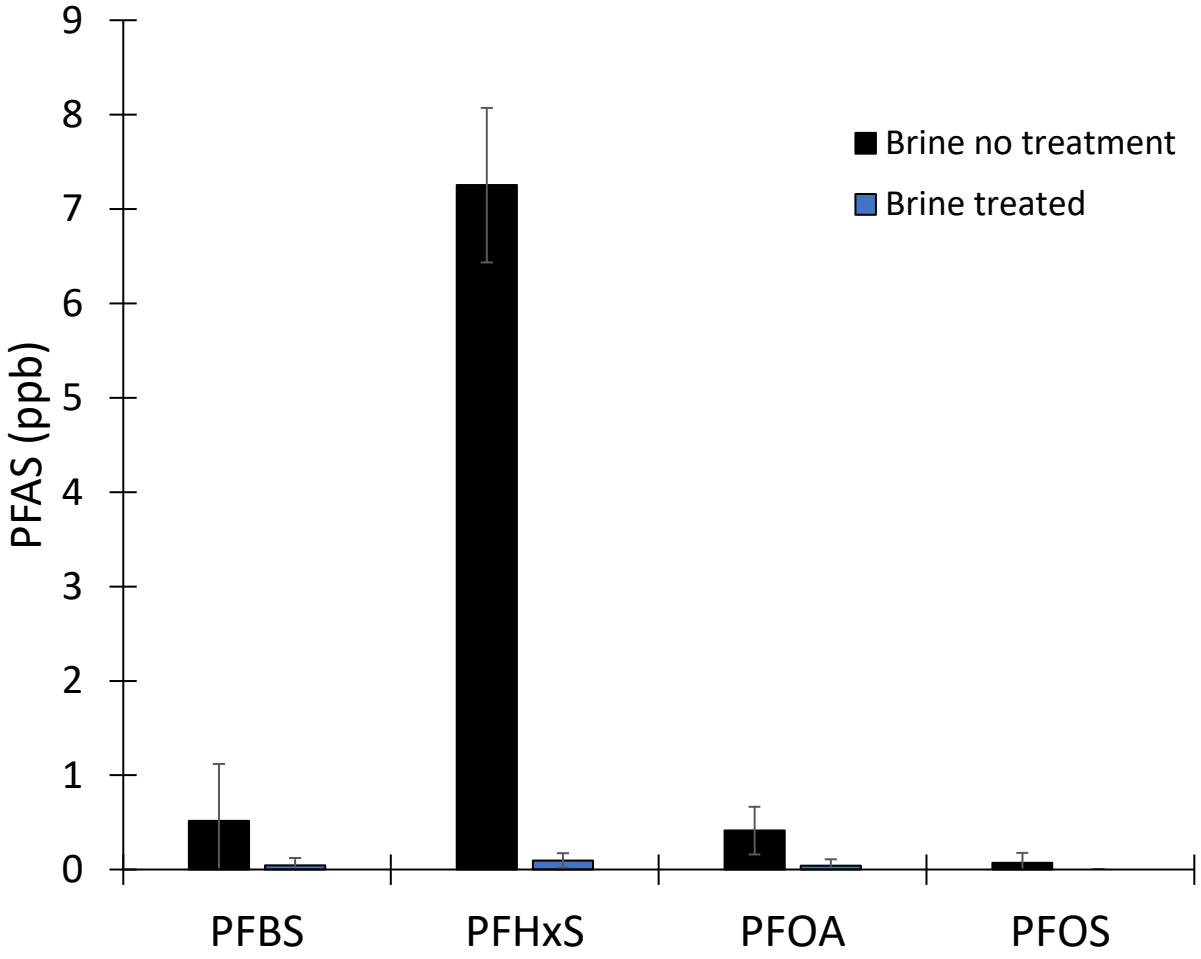
Industrial Landfill (France)

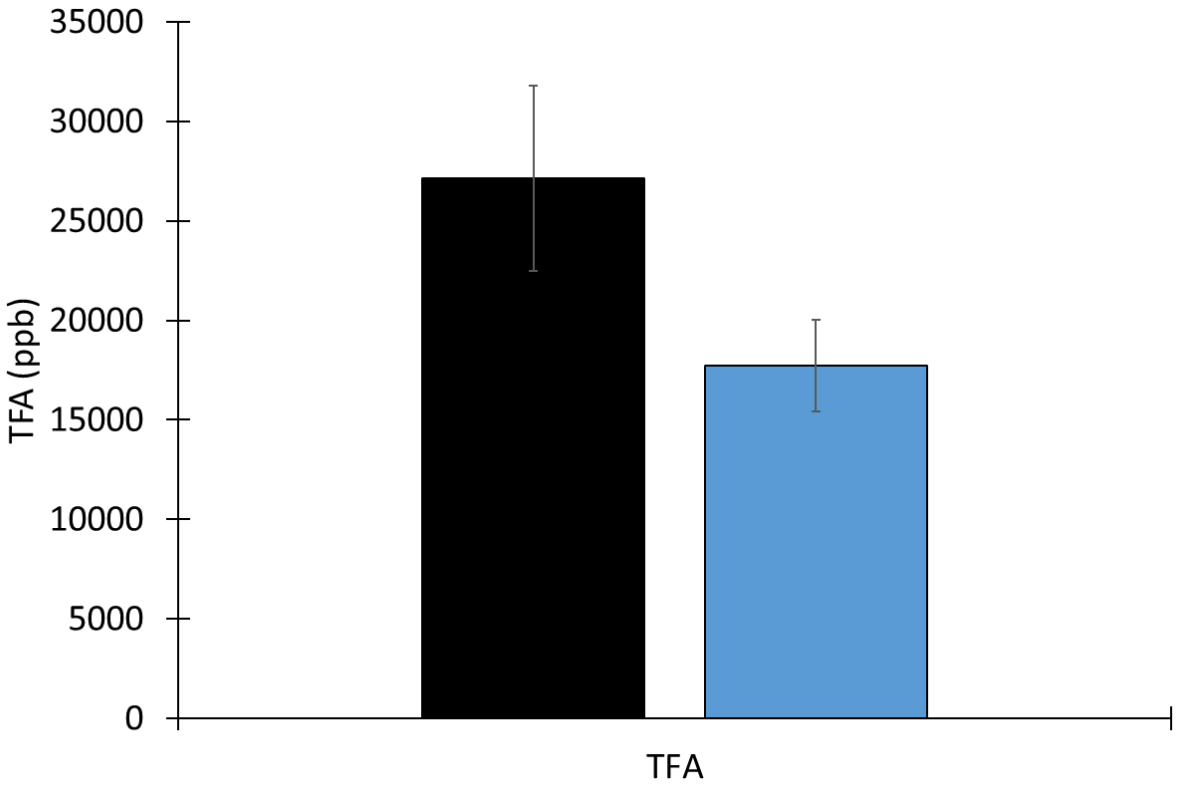
“White mud”


No treatment
Treated
PFAS (ppb) (ug/kg)
180
160
140
120
100
80
60
40
20
0
PFBS
GenX
PFHxS
PFOA
PFOS
PFNA


PFAS (ppb) (ug/kg)
1600
1400
1200
1000
800
600
400
200
0
TFA

Reverse Osmosis (RO) Brine



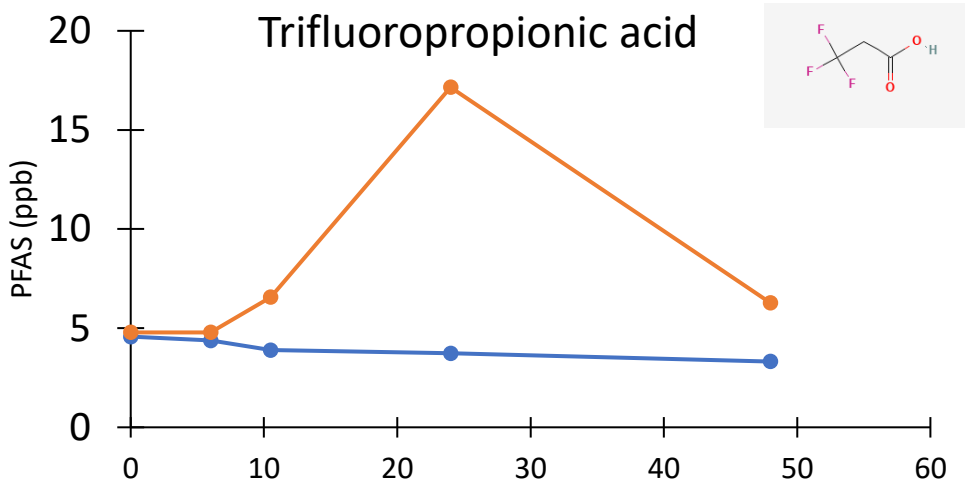


NO HARMFUL BYPRODUCTS PRODUCED

- Transiently seen in water & soil samples

- Fluorinated propanoic acids
- Fluorinated butanoic acid
- Difluoroacetate
- Fluoroacetate

- No toxic byproducts like TFA



OUR PRODUCTS ARE SAFE, EFFECTIVE, AND AFFORDABLE

- Byproducts are transient
- Can be combined with existing soil and water remediation systems
  - Activated carbon
  - Residual petroleum/PFAS after hotspot is removed by dig and haul
- Can reach Natural Source Zone Depletion faster
- Meet environmental regulation
- Beneficial reuse of a closure site

AT BLUUMBIO, WE BELIEVE IN A BETTER TOMORROW.

Katherine French
Founder & CEO

Drew Hendrickson
Microbiologist

Azion White
Biochemist

Jordan Baker
Senior Scientist

Nathan Diplock
Ecologist & Grants

Jake Keller
Product Development

Cooper Borinstein
Fermentation & Scale up

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