Soil Washing of PFAS-Contaminated Soils

ANC 8(a) Brice ENGINEERING

ect2 Montrose Environmental Group

remediation technologies symposium EAST

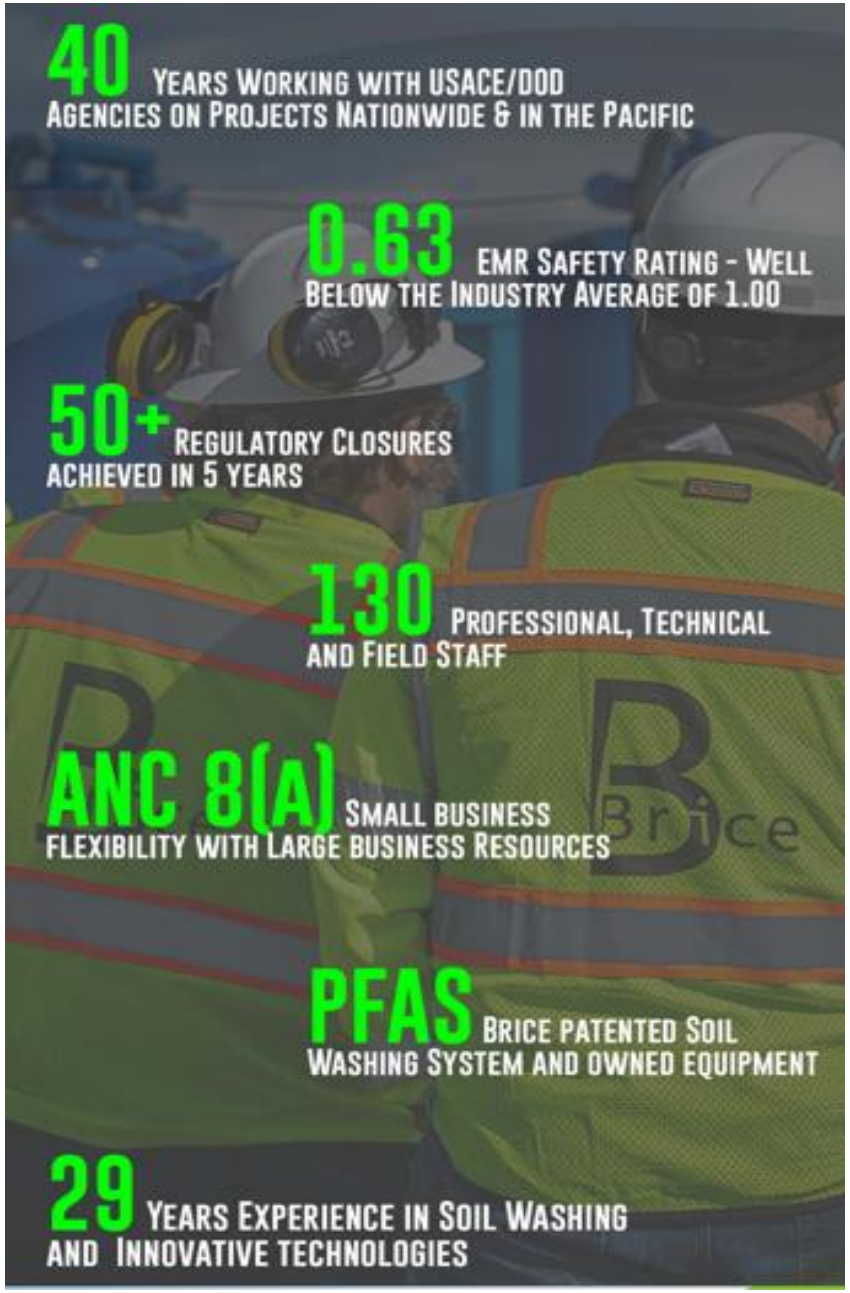
Niagara Falls | 2022

Agenda

- Who are Brice Engineering and ECT2?
- Introduction to soil washing
- Pilot-Scale Soil Washing – Peterson Air Force Base (2020)
  - Initial soil characterization
  - Source area excavation
  - Plant configuration
  - Treatment of coarse and fine fractions
  - Soil – PFAS removal efficiencies
  - Water treatment configuration and results
  - Applications
- Conclusions

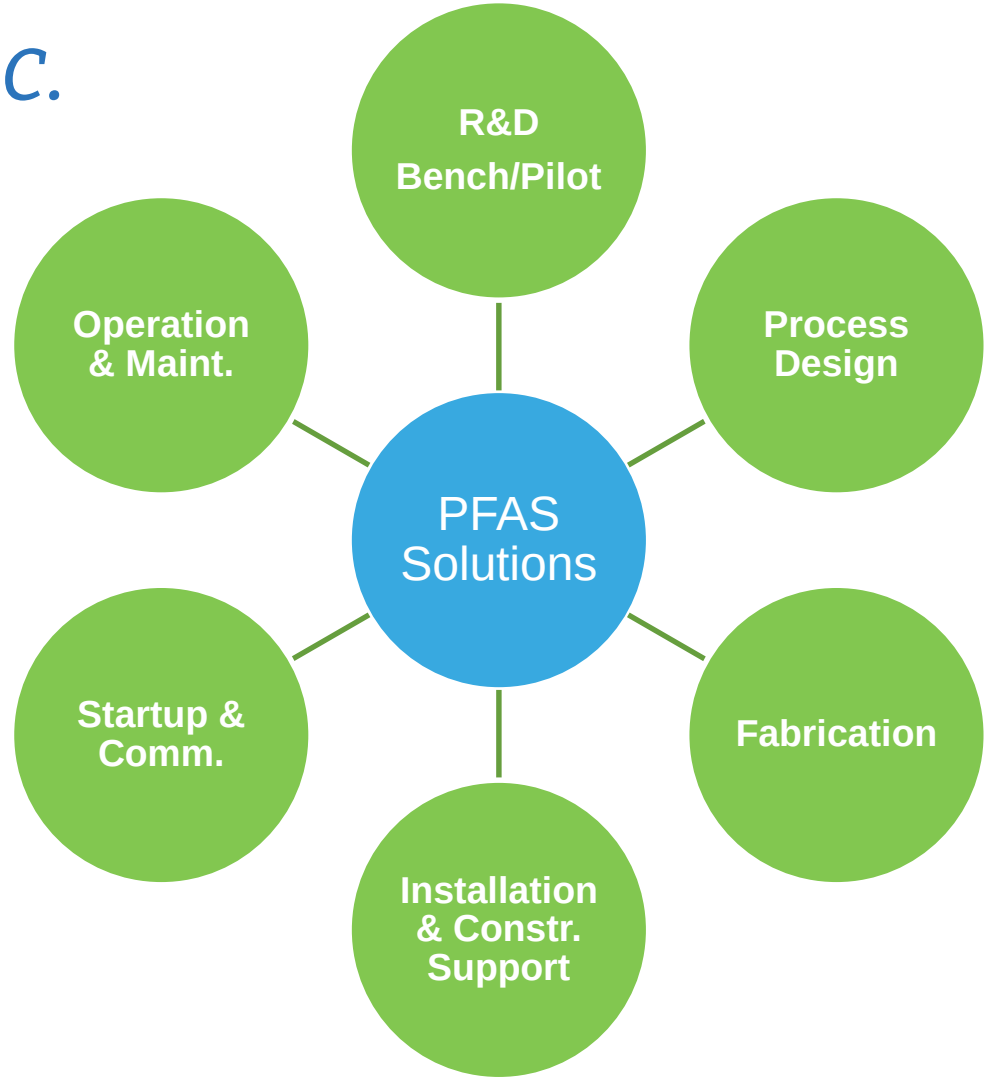
Brice Engineering

- An environmental company that started as a small, family-owned construction company in Alaska
- An Alaska Native Corporation (ANC)
- Patented soil washing process:
  - Water-based
  - Segregation of soil fractions
  - Attrition and extraction
  - Flocculation and dewatering
  - Closed-loop water treatment



ECT2: *Emerging Compounds Treatment Technologies, Inc.*

- ECT2 is a solutions provider of cutting-edge technology solutions to remove emerging and difficult to treat contaminants, PFAS and 1,4-dioxane, from:
  - Investigation-Derived Waste
  - Groundwater
  - Surface Water
  - Construction Dewatering Liquids
  - Soil Washing Effluent
  - Drinking Water
  - Waste Water
  - Foam Spills
  - Landfill Leachate



Soil Washing and PFAS

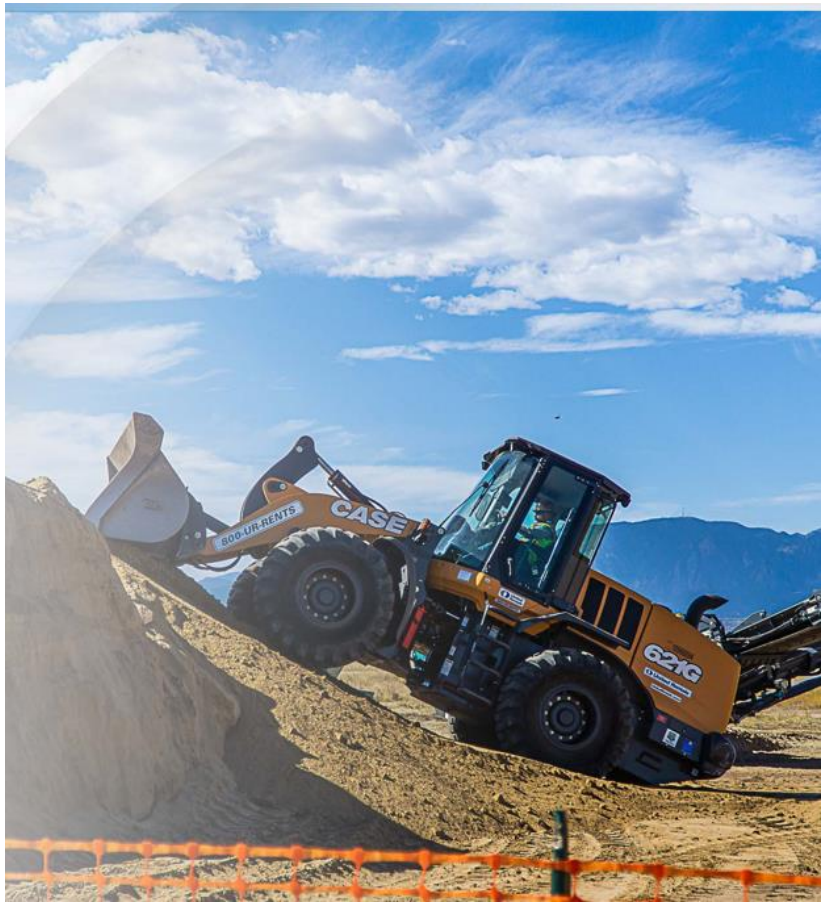
Background

- Mature technology with proven track record
  - Complete treatment of soil mass
  - Beneficial re-use of soil
- Contaminant solubilizes rapidly with:
  - Retention time
  - Soil attrition
  - Water contact
- PFAS removal from process water
  - IX resins can be regenerated
  - Waste concentration
  - Potential to combine with destruction technologies

Pilot Soil Washing Project

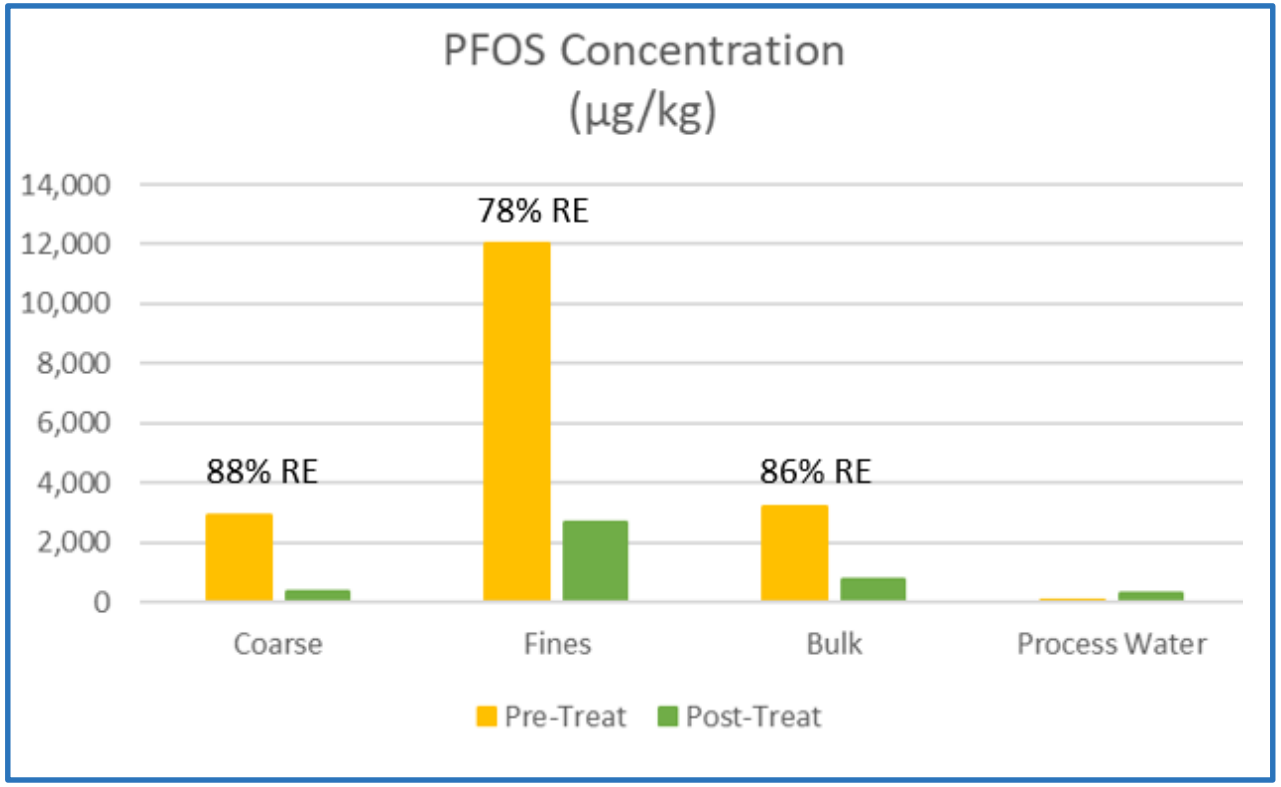
Peterson AFB, CO

PFAS Source:	Former Fire Training Area Active 1996 - 2017
PFAS Concentration:	3,200 – 12,000 ug/kg PFOS in loamy sands
Soil Approach (Brice)	Baseline process testing Source area excavation and characterization Soil processing Stockpiling and sampling Dewatering
Water Approach (ECT2)	Pretreatment - sand filters and GAC Treatment - SORBIX RePure Regenerable IX Resin



Baseline Process Testing

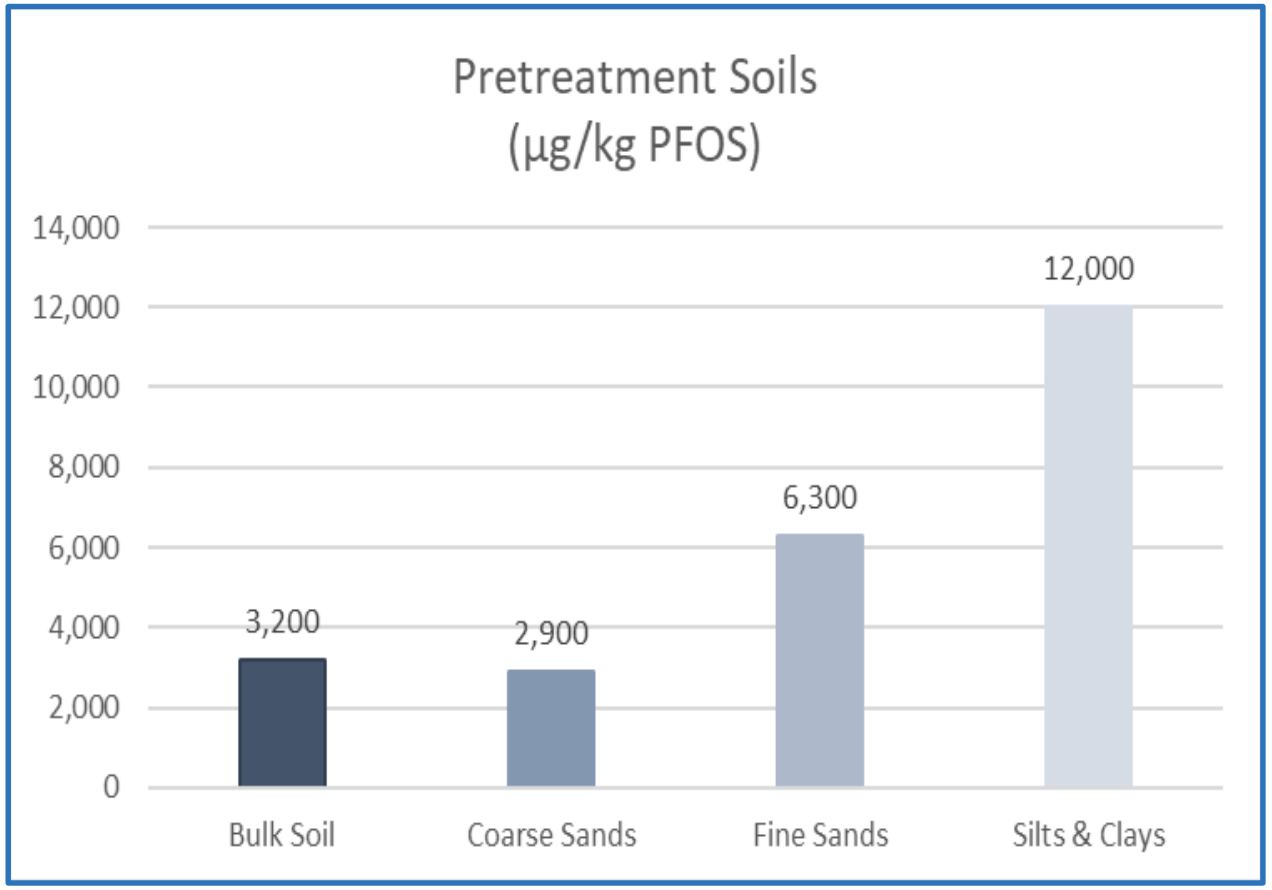
- Collected representative soils from six borings on site
- Homogenize & run through standard protocol
- Pre-treatment:
  - 2,900 – 12,000 µg/kg PFOS
  - Water 0.023 µg/L PFOS
- Post treatment
  - 345 – 2,700 µg/kg PFOS
  - 78% - 88% RE
  - Water 280 µg/L PFOS
- Mass Balance:
  - 96.6% PFOS Recovered

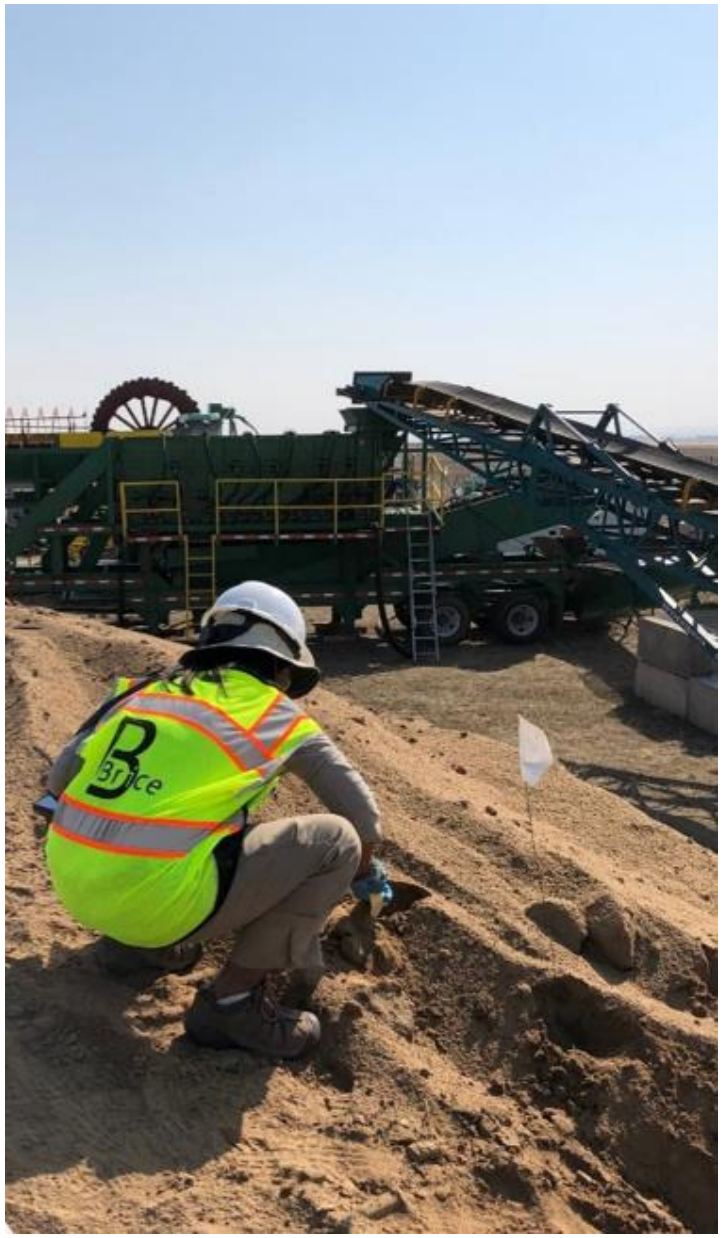


Source Area Excavation

- Area of site with highest detected levels of PFOS
- 75’x 75’ at top of excavation
- Maximum depth 4’ w/ 1.5:1 side slopes
- 488 bank cubic yards (513 cy stockpile)

Stockpile Characterization

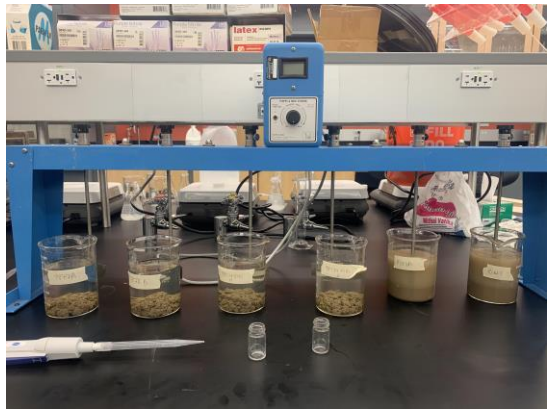




Factors Determining Plant Configuration

Particle Size Distribution

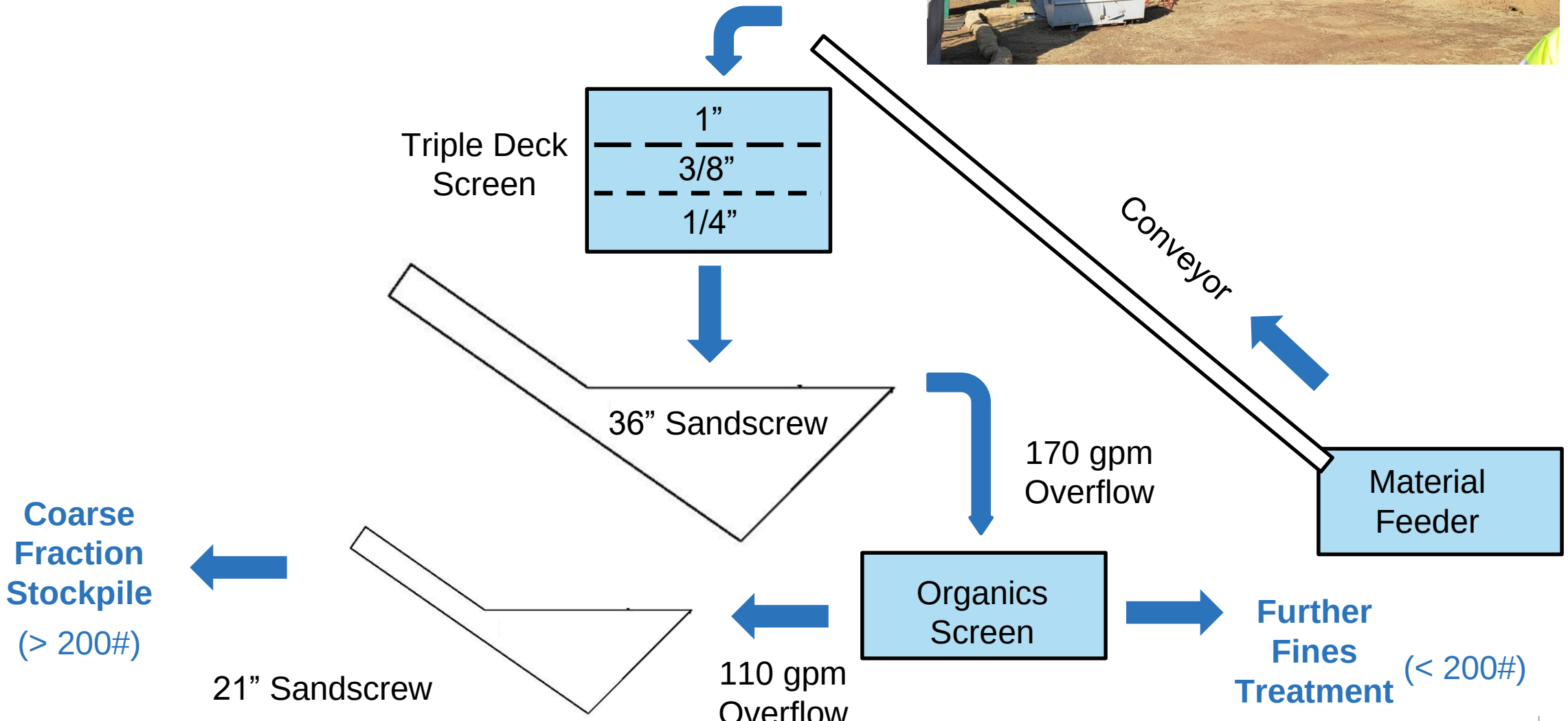
COCs Present and Concentrations



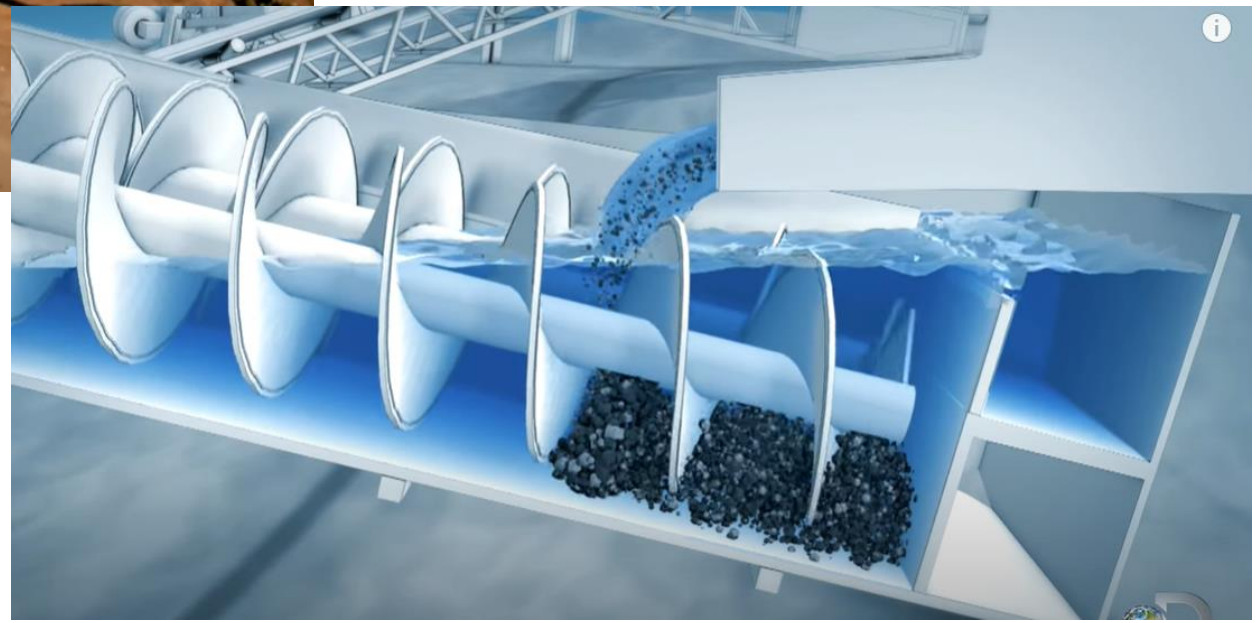
Soil Mineralogy and Organic Matter

Old Guys.....

Size Segregation and Scrubbing/Attrition



What the Heck are Sandscrews?



Clarification and Thickening

Dewatering

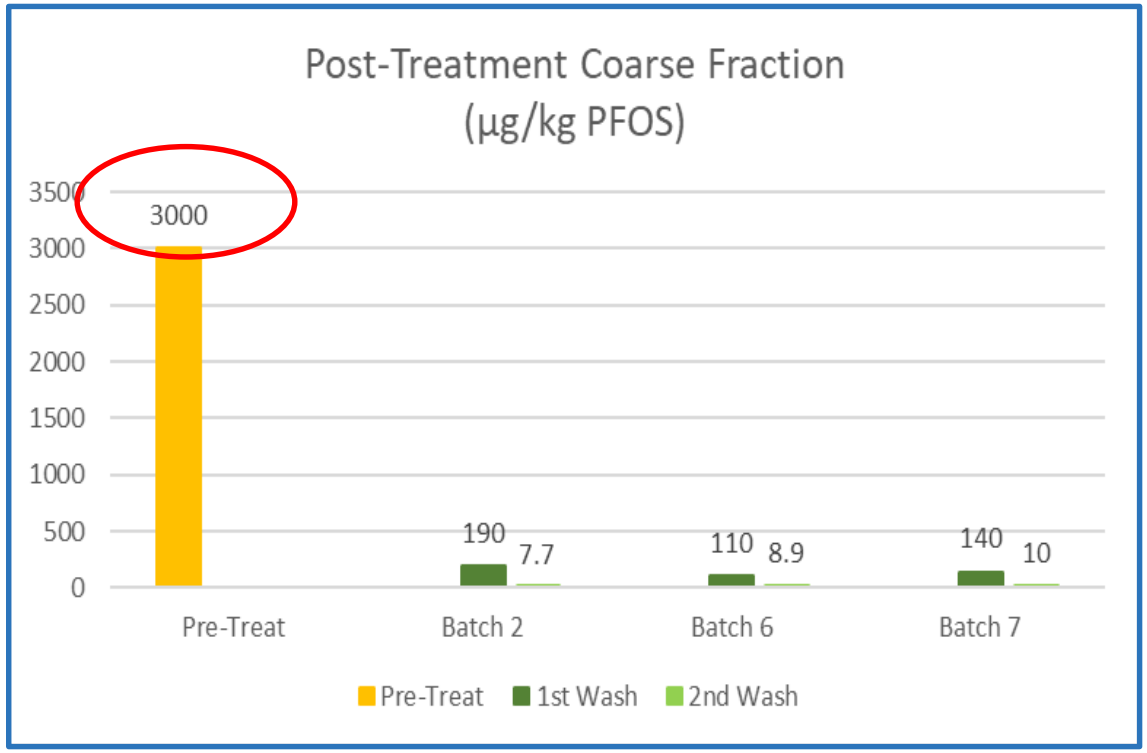
Various technologies available for sediment dewatering depending on % and nature of fines, e.g.:

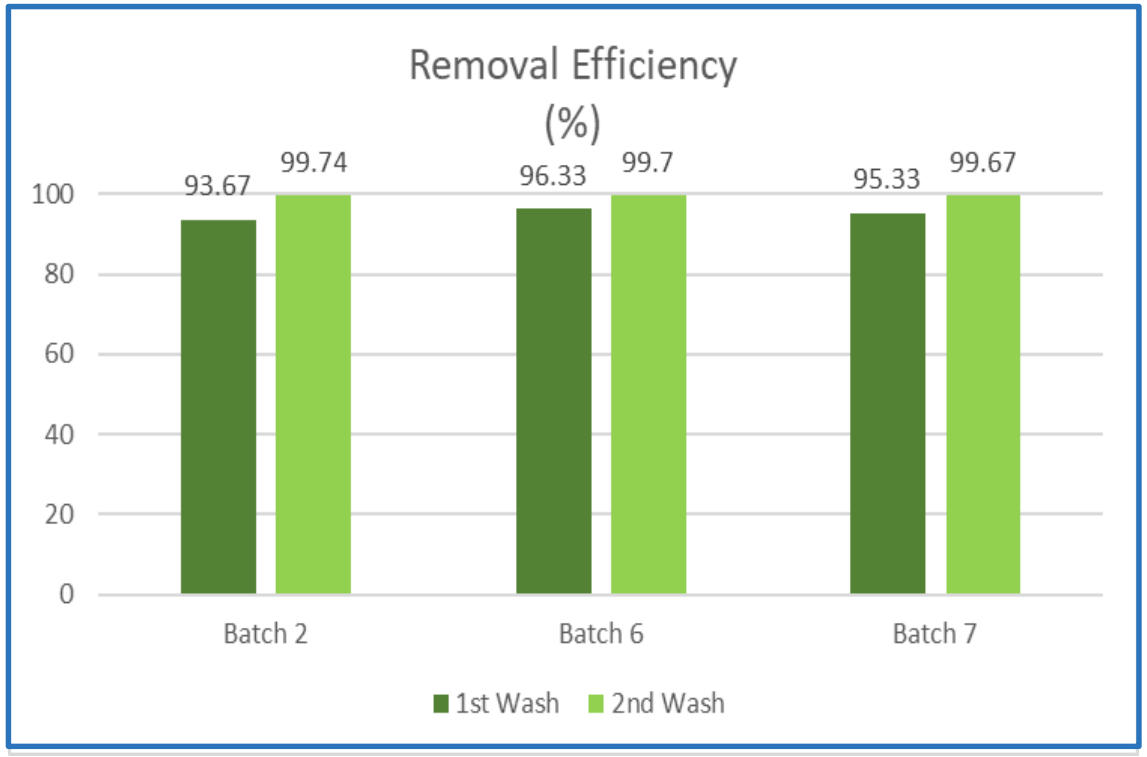
- Filter presses
- Centrifuges/cyclones
- Vacuum filters, etc.

System Setup and Outputs

Washed Gravels | Washed Sands | Fine Cakes

Field Scale Removal Efficiencies (Coarse Fraction)





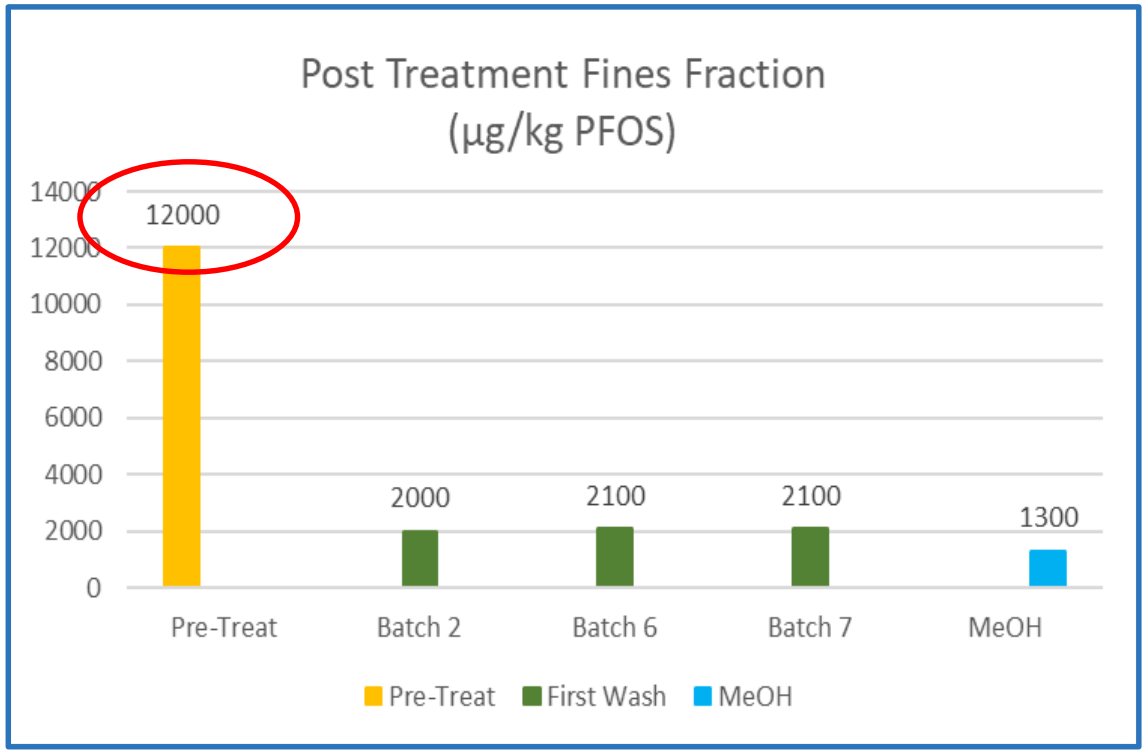
1st wash: 110 – 140 ug/kg

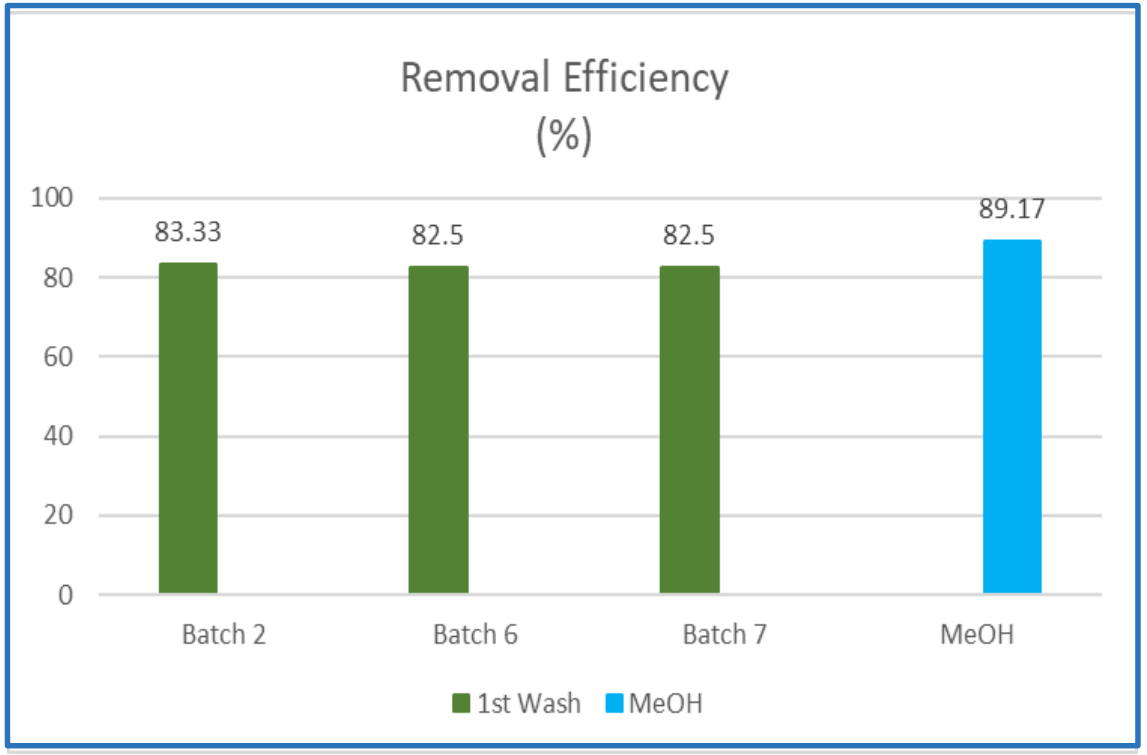
2nd wash: 7 – 10 ug/kg

93 – 96% RE

99% RE

Field Scale Removal Efficiencies (Fines Fraction)





1st wash: 2,000 – 2,100 ug/kg

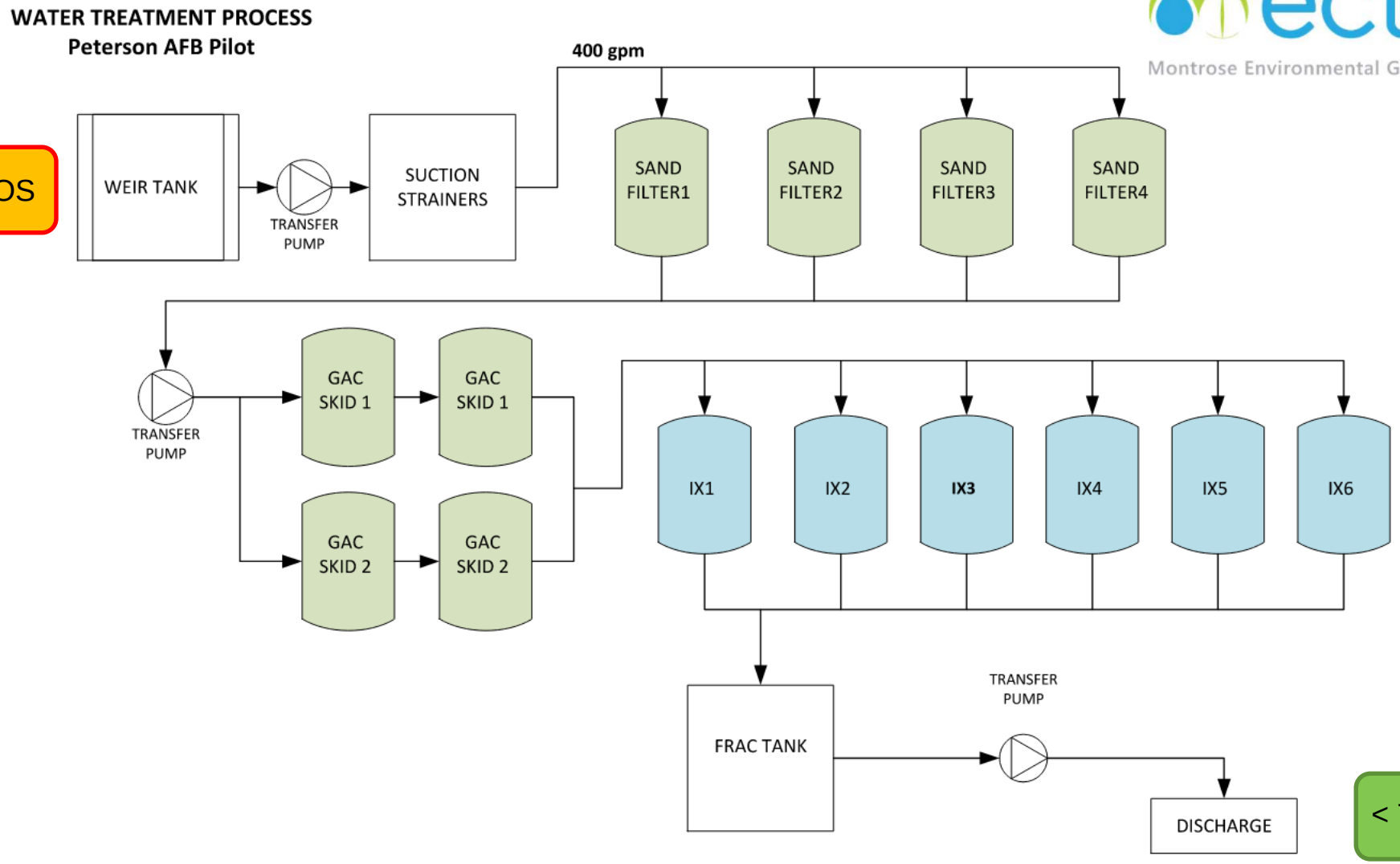
MeOH addition: 1,300 ug/kg

82 – 83% RE

89% RE

Water Treatment Process

490 µg/L PFOS



< 70 ng/L PFOS

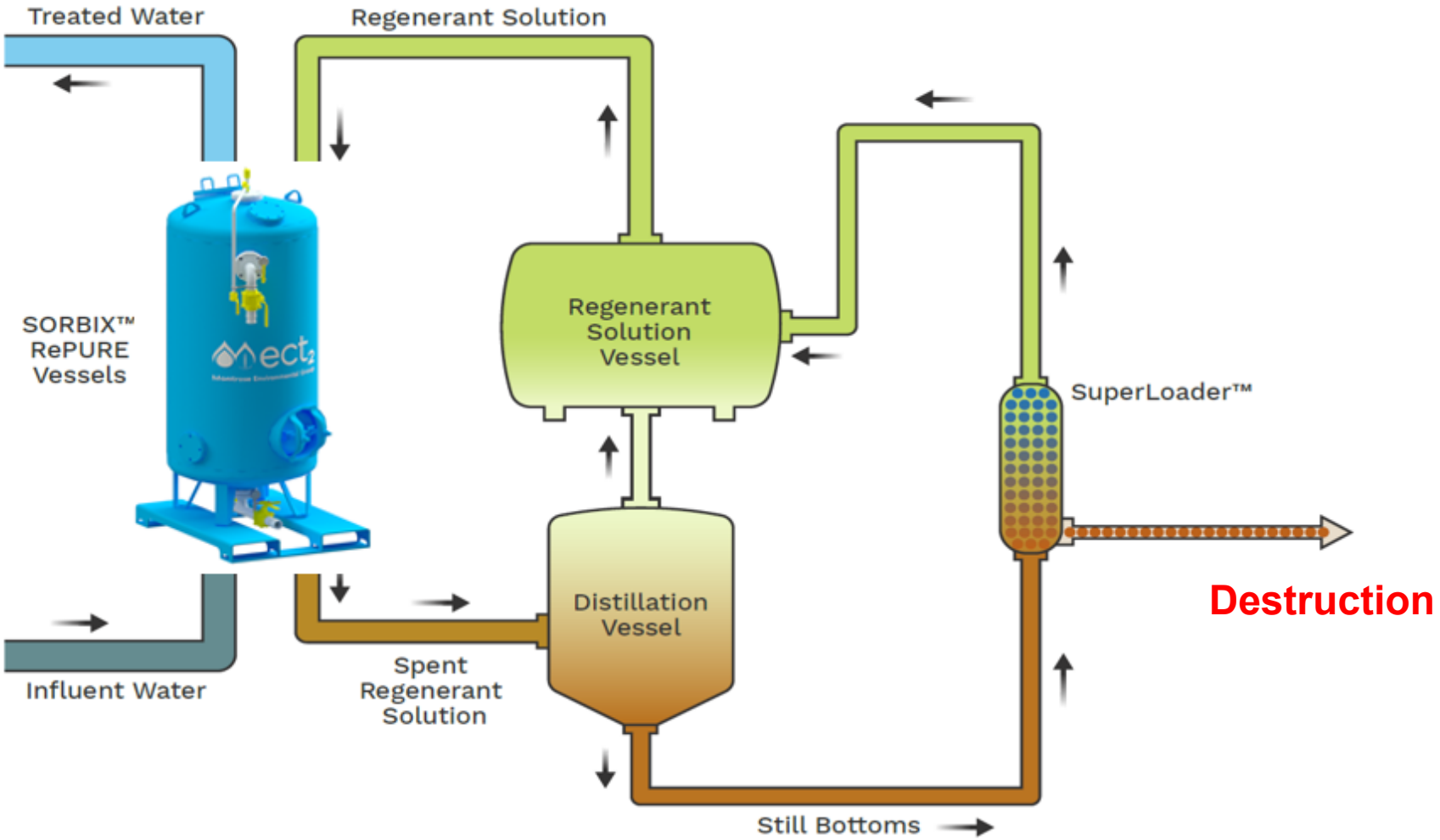
Single-Pass Results

490 µg/L PFOS Influent → 450 gpm Flow Rate → 0.087 µg/L PFOS Post-treatment

Final Water Treatment

- Use of IX resin tank array instead of larger tanks
- Allows for on-site regeneration during operations
- Reconfigured from single pass to lead/lag
- Treated process and decontamination water to 0.008 µg/L PFOS
- Discharge to storm water system

SORBIX RePURE™ Regeneration Technology



13x
More effective treatment with PURE

>99%
Less waste generation with RePURE

67%
reduction in treatment system size

50%
reduction in lifecycle costs

Case Study : Former Pease AFB Groundwater Treatment for PFAS

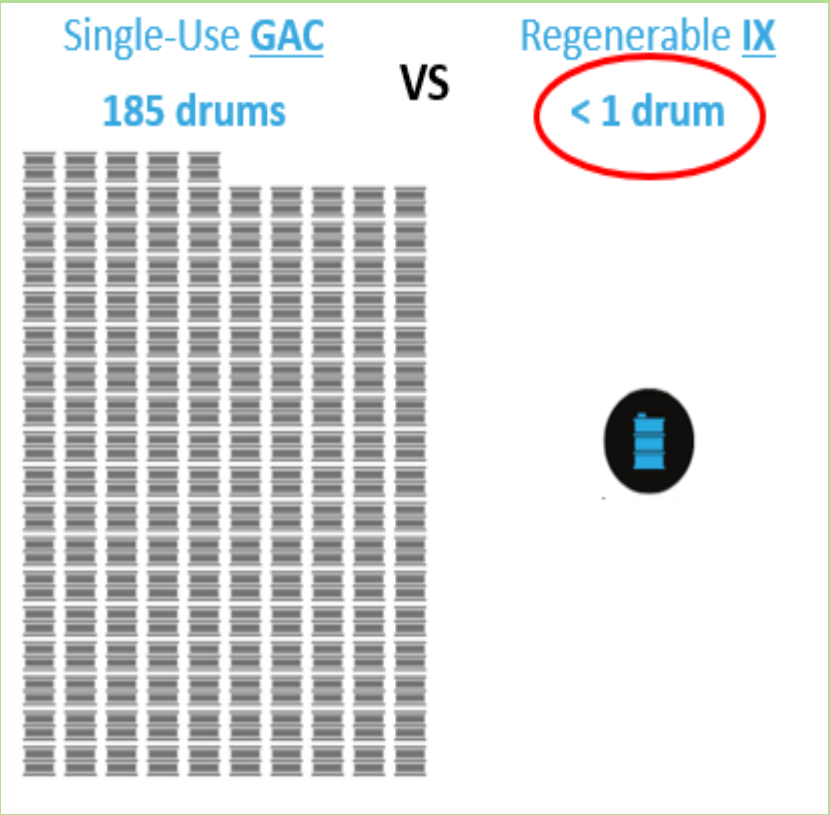
Portsmouth, NH

PFAS Source:	Former Fire Training Area
PFAS Concentration:	50 – 100 ug/L
Project Approach:	Mitigate impact to off-site drinking water (120 - 200 gpm design flow)
Treatment:	SORBIX RePure regenerable IX resin; On-site regeneration
Effluent Concentration:	ND since startup
Groundwater Treated:	50 million gallons since 2018
Waste Generated	None taken off-site; **50 gallons to date**

Full-Scale Regenerable IX System at Pease AFB

200 GPM Regeneration Facility

One Year of Waste



Pilot Soil Washing Project
Peterson AFB

Soil Quantity Treated:	500 bank cubic yards
Price per cubic yard treated:	Highly-dependent upon volume
Cost Savings:	> 50% vs. off-site incineration

Takeaways:

- Treated soil below EPA Risk Management Levels for PFOS/PFOA (1,280 µg/kg) from levels up to 12,000 µg/kg.
- Size segregation key to effective treatment
- Soil fractions reconstituted prior to return – potential for beneficial reuse
- Process water treated via single-pass; optimized to lead-lag configuration

Conclusions and Q&A

- Able to successfully treat PFOS/PFOA contaminated soils
- Applicable to a range of soil conditions/concentrations
- Can support both large scale construction projects as well as source area removal
- Process water can be treated and discharged on-site
- Potential for resin regeneration and PFAS destruction on larger projects

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