



# BIOREMEDIATION BREAKTHROUGH



FIXED EARTH





# BAM

**BIOAVAILABLE ABSORBENT MEDIA  
PATENTED and TRADEMARKED**

- Pyrolyzed recycled cellulosic biomass
- Unique honeycomb pore structure
- High cation exchange capacity
  - Surface area – 1,125 sq meters / gram
- Absorbs within structure
  - Contaminant sponge
- Promotes biological colonization

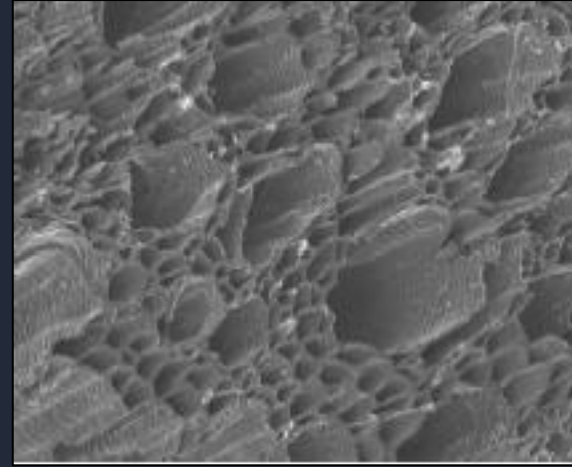




# BAM

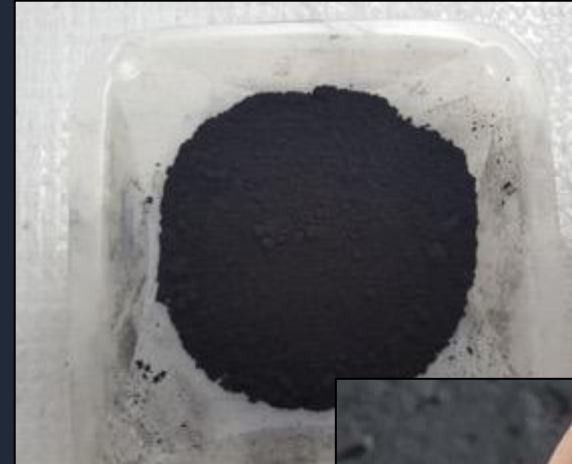
## BIOAVAILABLE ABSORBENT MEDIA

- Particle size ranges based on milling procedure
- Vapor Migration & Odor Control
- Immediate clean up of soil
  - Through absorption
- Effective on wide range of contaminants
  - PFAS
  - Hydrocarbons
  - Chlorinated solvents
  - 1,4 – Dioxane
  - PCBs
  - Some heavy metals



Scanning electron microscope (ESEM) image of BAM micro-pore structures.

Milled BAM Ultra



Coarse BAM X



# PFAS AND BIOLOGY: AN IMPOSSIBLE PAIR?



## Can Microbes Degrade PFAS?

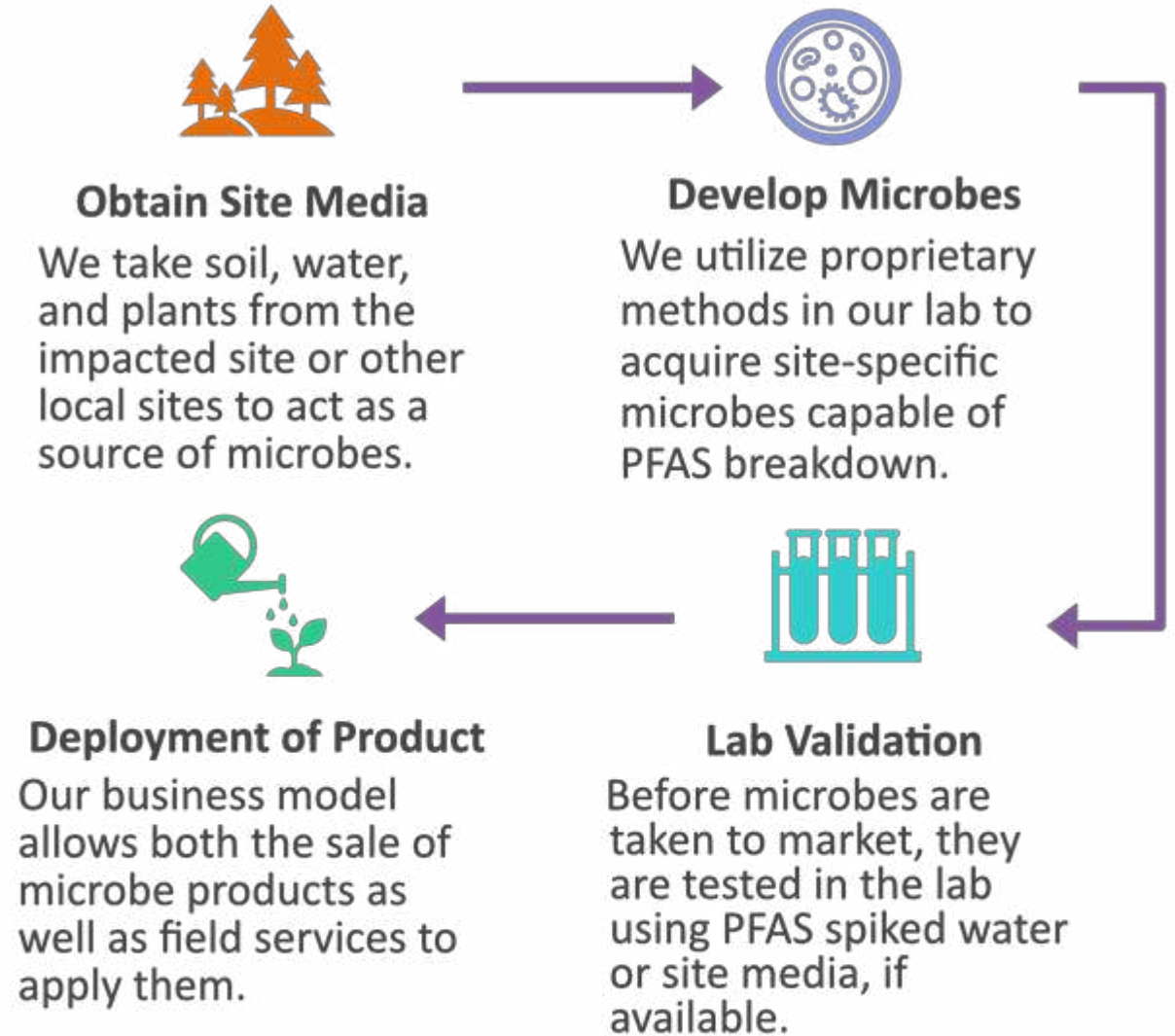


1. Bacteria can survive on PFAS as primary carbon source, fungi can thrive in high concentrations of PFAS if co-metabolite is provided.
2. Fluoride generation has been repeatedly observed in colorimetric petri plate tests.
3. Fluoride increases during in-situ aquifer treatments are observed when conditions support microbial growth.



# SITE-SPECIFIC MICROBE DEVELOPMENT

- Microbes can degrade a variety of PFAS compounds
- Site-specific microbes are adapted to local conditions.
- Non-Genetically Modified
- Unlikely to be invasive or disturb local ecosystems.
- Aerobic metabolism is generally faster than anaerobic.



**1 – 3 Months to Complete**

# Darwin Road Burn Pit



## Soil Blend

- 1,759 yd<sup>3</sup>
- Treatment from 0 to 5 ft-bgs
- Mixing in 2.5% BAM-X and 0.34% organoclay by weight

## In-Situ Injection

- 28,280 ft<sup>2</sup>
- 153 points
- Treatment from 12 to 22 ft-bgs
- ~200 gallons of 20% BAM Ultra, PFAS Degrading Bacteria, and 0.5% calcium peroxide treatment chemistry



# Darwin Road Burn Pit – Soil Treatment



DARWIN BURN PIT SOIL MIXING DATA

Analyte (ng/L)	Control	30 day post mixing (1312/1633)				3 month post mixing (1312/1633)					
		Sample 1	Percent Change	Sample 2	Percent Change	Sample 3	Percent Change	Sample 4	Percent Change	Sample 5	Percent Change
6:2 FTS	2,800.0		100.0%		100.0%		100.0%		100.0%		100.0%
PFBS	680.0	4.7	99.3%	13	98.1%	4.8	99.3%		100.0%		100.0%
PFHpS	51.0		100.0%		100.0%		100.0%		100.0%		100.0%
PFPeS	710.0	2.7	99.6%	6.3	99.1%		100.0%		100.0%		100.0%
PFHxS	25,000.0	64	99.7%	110	99.6%	260	99.0%	26	99.9%	45	99.8%
PFBA	330.0	150	54.5%	120	63.6%	22	93.3%	18	94.5%	28	91.5%
PFHpA	2,100.0	6.6	99.7%	20	99.0%	11	99.5%	28	98.7%	8.1	99.6%
PFHxA	3,500.0	31	99.1%	170	95.1%	51	98.5%		100.0%	41	98.8%
PFOSA				3.4						3.8	
PFOA	16,000.0	67	99.6%	200	98.8%	22	99.9%	35	99.8%	70	99.6%
PFNA						5					
PFPeA	1,900.0	33	98.3%	140	92.6%	28	98.5%	25	98.7%	48	97.5%
PFOS	1,100.0	25	97.7%	18	98.4%	99	91.0%	22	98.0%	62	94.4%
TOTAL	54,171.0	384	99.3%	800.7	98.5%	502.8	99.1%	154	99.7%	305.9	99.4%

## Soil Mixing Results

- ORIN took the approach from the bench study and applied to the site.
- Confirmation samples collected and analyzed for SPLP after soil mixing showed 98.5% or greater reduction compared to the control sample.



# Darwin Road Burn Pit



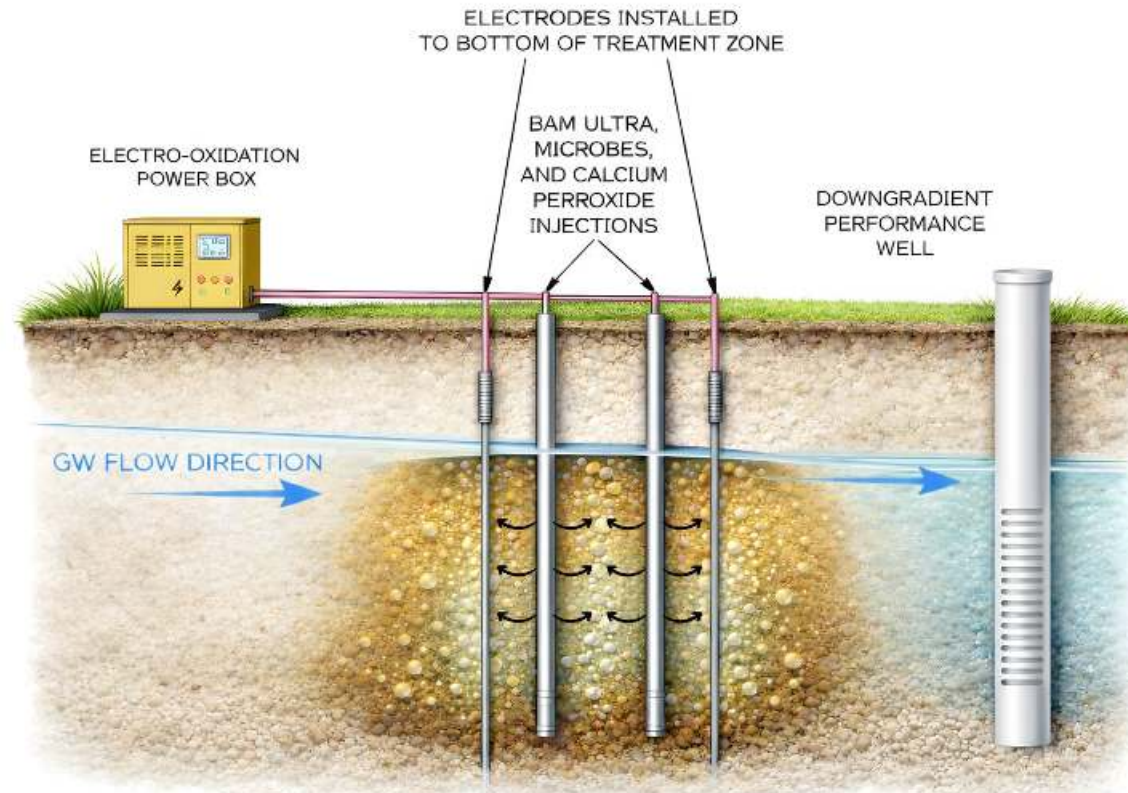
## Electrolysis Grid

- 136 screw pilings installed onsite in a grid pattern
- Screw pilings were advanced to 20 ft-bgs
- Electrooxidation box was turned on June 17<sup>th</sup>
- Electrooxidation system generates oxygen through low voltage currents conducted through the screw pilings



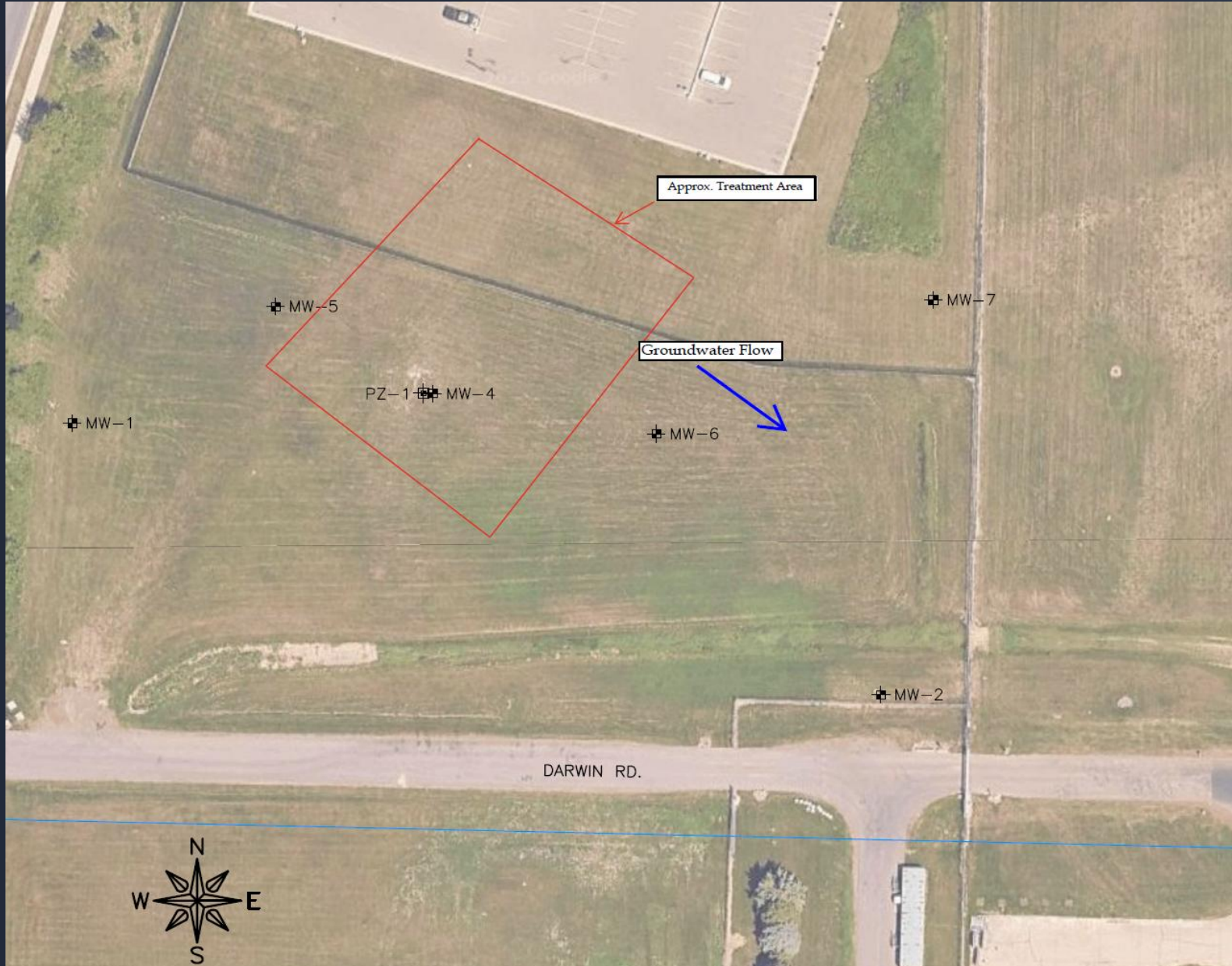
# Darwin Road Burn Pit

## Conceptual Site Model – Cross Section





# Darwin Road Burn Pit Site Layout



DARWIN BURN PIT DATA ANALYSIS



# Darwin Burn Pit Groundwater Data

## Upgradient Non-Treated Well

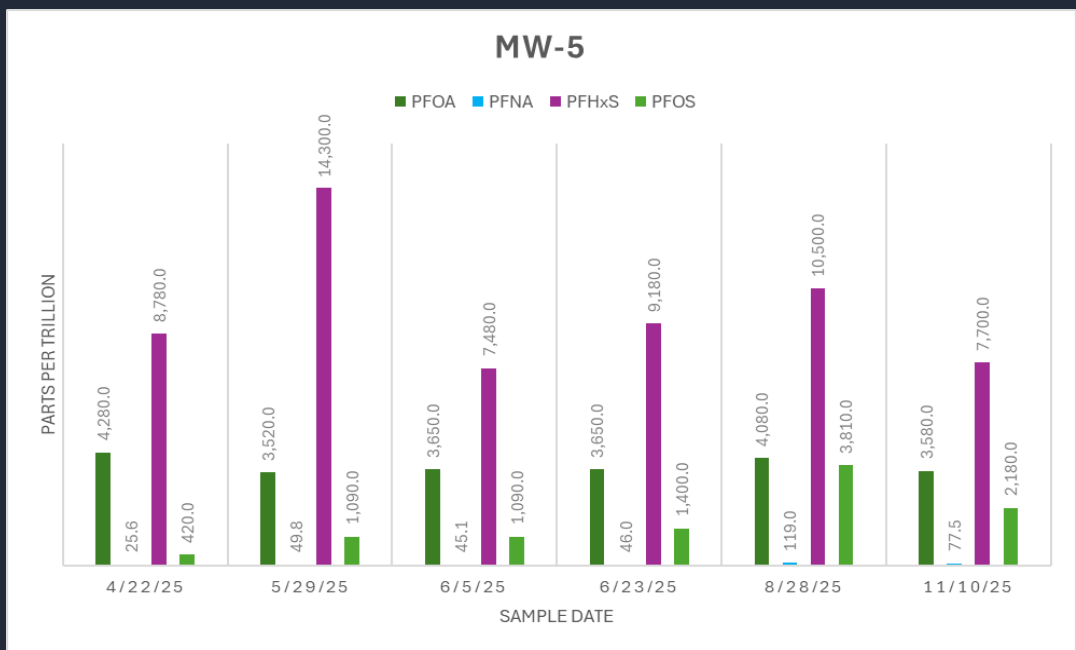
MW-5													
Analyte (ng/L)	Preventative Action Limit (ng/L)	Enforcement Standard (ng/L)	4/22/25	5/29/25	Percent Change	6/5/25	Percent Change	6/23/25	Percent Change	8/28/25	Percent Change	11/10/25	Percent Change
PFOA	2	20	4,280.0	3,520.0	17.76%	3,650.0	14.72%	3,650.0	14.72%	4,080.0	4.67%	3,580.0	16.36%
PFNA	3	30	25.6	49.8	-94.53%	45.1	-76.17%	46.0	-79.69%	119.0	-364.84%	77.5	-202.73%
PFHxS	4	40	8,780.0	14,300.0	-62.87%	7,480.0	14.81%	9,180.0	-4.56%	10,500.0	-19.59%	7,700.0	12.30%
PFOS	2	20	420.0	1,090.0	-159.52%	1,090.0	-159.52%	1,400.0	-233.33%	3,810.0	-807.14%	2,180.0	-419.05%

Note: Zero value indicates analyte below laboratory detection limit

Indicates exceedance of ES and PAL

Indicates meeting ES and PAL

Indicates meeting ES but not PAL



### MW-5

- Upgradient and outside of treatment area
- Data shows little to no effect on contaminant concentrations as untreated groundwater migrates across site

# Darwin Burn Pit Data Groundwater

## Center of Treatment Area



MW-4													
Analyte (ng/L)	Preventative Action Limit (ng/L)	Enforcement Standard (ng/L)	4/22/25	5/29/25	Percent Change	6/5/25	Percent Change	6/23/25	Percent Change	8/28/25	Percent Change	11/10/25	Percent Change
PFOA	2	20	17,000.0	17,400.0	-2.35%	19,600.0	-15.29%	20,100.0	-18.24%	3.8	99.98%	2.7	99.98%
PFNA	3	30	428.0	373.0	12.85%	458.0	-7.01%	509.0	-18.93%	0.0	100.00%	0.0	100.00%
PFHxS	4	40	63,900.0	71,600.0	-12.05%	66,100.0	-3.44%	91,500.0	-43.19%	7.4	99.99%	5.0	99.99%
PFOS	2	20	3,740.0	1,860.0	50.27%	2,570.0	31.28%	2,870.0	23.26%	3.6	99.90%	3.1	99.92%

Note: Zero value indicates analyte below laboratory detection limit

Indicates exceedance of ES and PAL
Indicates meeting ES and PAL
Indicates meeting ES but not PAL



## MW-4

- Center of treatment area
- Influenced by treatment chemistry during injection
- Only well in soil mix area and screened within treatment interval
- Large decrease in contaminants in 3-month sampling event and sustained at 6-month event



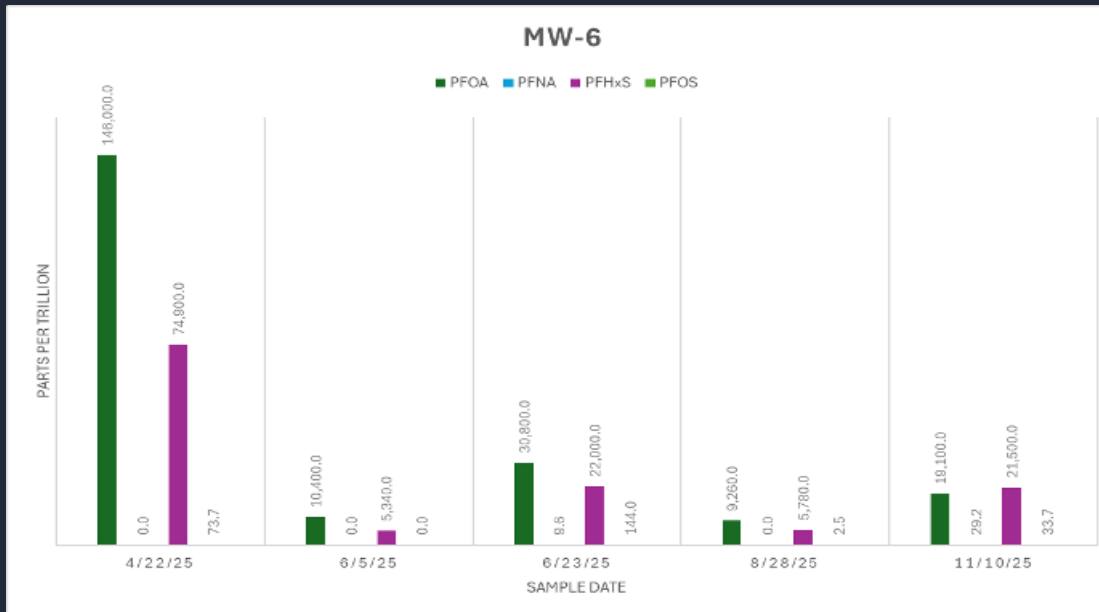
# Darwin Burn Pit Data Groundwater

## Downgradient of Treatment Area

MW-6											
Analyte (ng/L)	Preventative Action Limit (ng/L)	Enforcement Standard (ng/L)	4/22/25	6/5/25	Percent Change	6/23/25	Percent Change	8/28/25	Percent Change	11/10/25	Percent Change
PFOA	2	20	146,000.0	10,400.0	92.88%	30,800.0	78.90%	9,260.0	93.66%	19,100.0	86.92%
PFNA	3	30	0.0	0.0		9.6		0.0		29.2	
PFHxS	4	40	74,900.0	5,340.0	92.87%	22,000.0	70.63%	5,780.0	92.28%	21,500.0	71.30%
PFOS	2	20	73.7	0.0	100.00%	144.0	-95.39%	2.5	96.61%	33.7	54.27%

Note: Zero value indicates analyte below laboratory detection limit

Indicates exceedance of ES and PAL
Indicates meeting ES and PAL
Indicates meeting ES but not PAL



## MW-6

- Downgradient and outside of treatment area
- Influenced by treatment chemistry during injection
- Changes in PFAS compounds are consistent with past studies showing bacteria breaking longer chain PFAS



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