

PFAS Removal: GAC & IX



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WHO WE ARE...



Corporate Profile

Who Is Calgon Carbon Corporation

- World's largest producer of Granular Activated Carbon
- Solves customer purification and separation problems with an array of technologies
- Water treatment is core competency with a diverse product portfolio

\$619.8 million

2017 net sales

75 years

experience

1,400+ employees



25 offices

sales and service

20 facilities

Manufacturing, reactivation,
equipment

240 patents

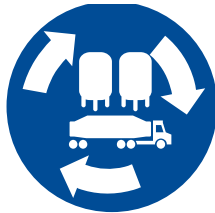
Removing PFAS for 15 Years

Our Experience with PFAS Removal

- Granular Activated Carbon (GAC) and CCC's Equipment Line are proven treatment solutions for PFAS removal
- Over 45 installations for PFAS removal across the United States
- Offer complete solution including activated carbon, ion exchange resin, equipment, on-site installation and exchange services, reactivation and financing.



Proven products and solutions for drinking water, wastewater, remediation and POET



Carbon reactivation to thermally destroy PFAS and enable the reuse of activated carbon



Unrivalled technical service

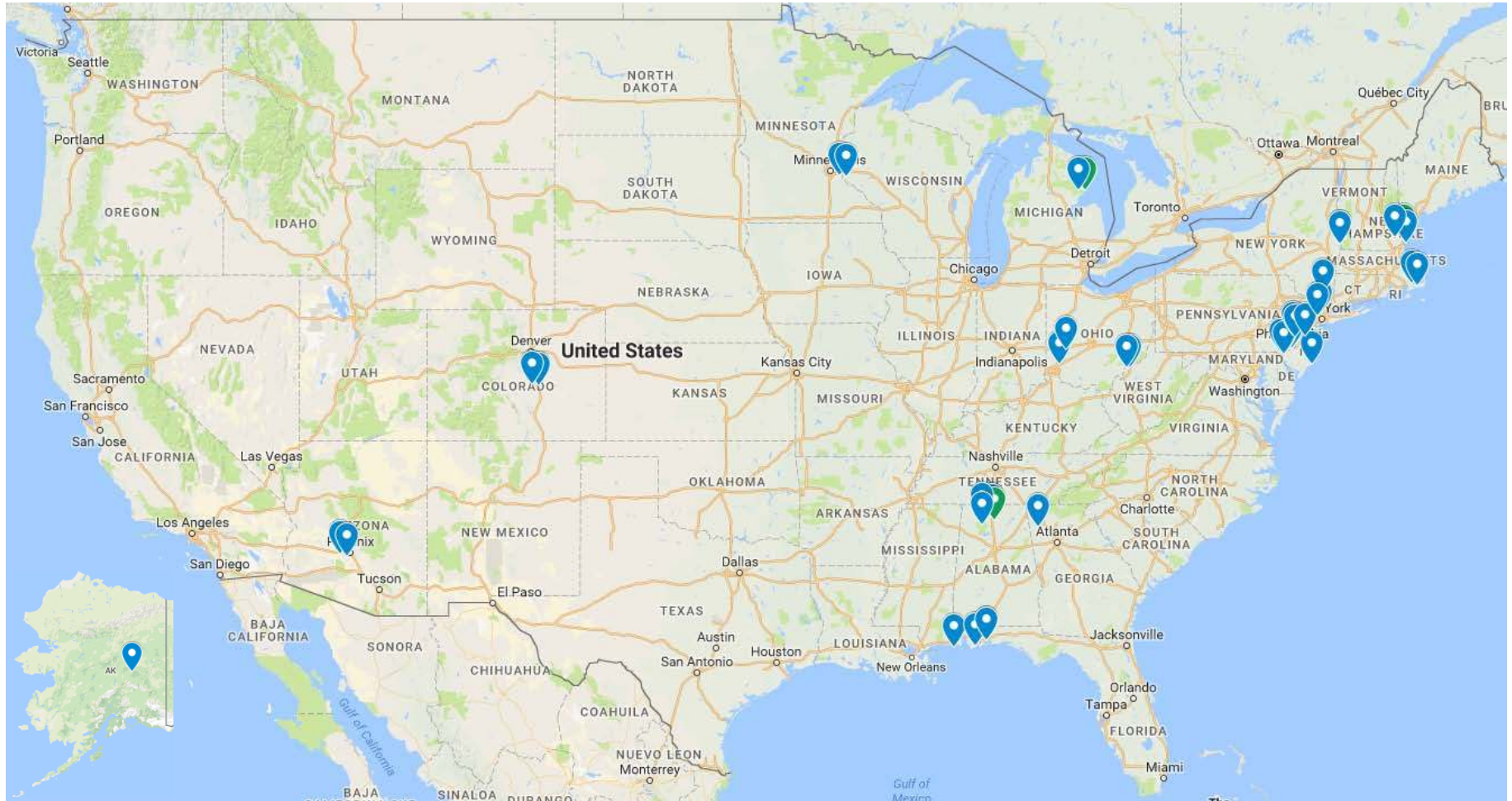


Laboratory & field testing for tailored solutions



Applications Engineers and R&D team dedicated to solving customer problems

Calgon Carbon PFAS Treatment Locations

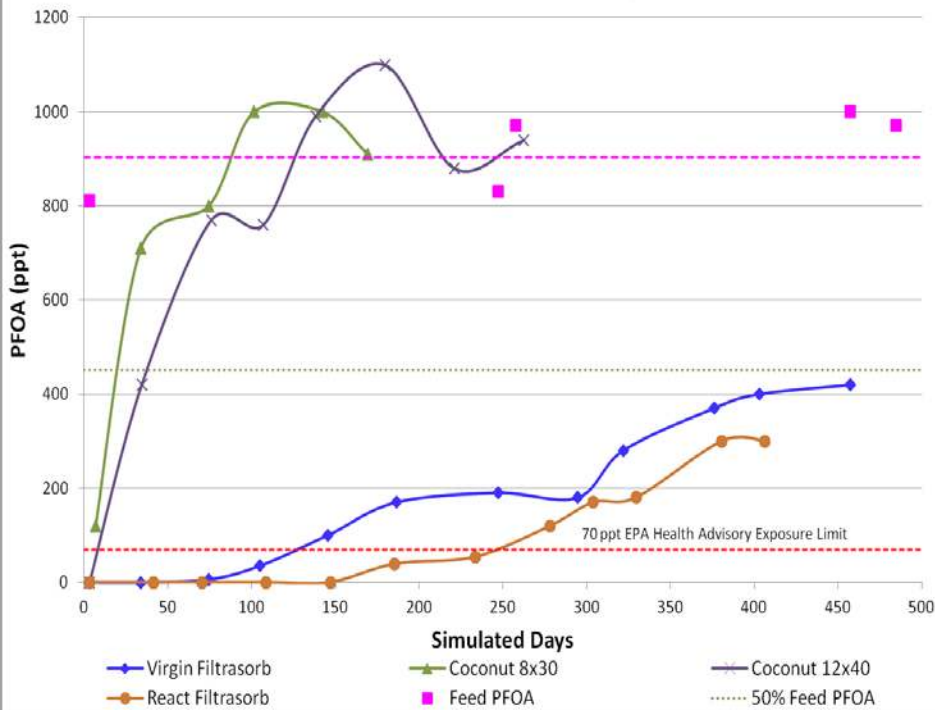


45+ Installations Across the U.S.

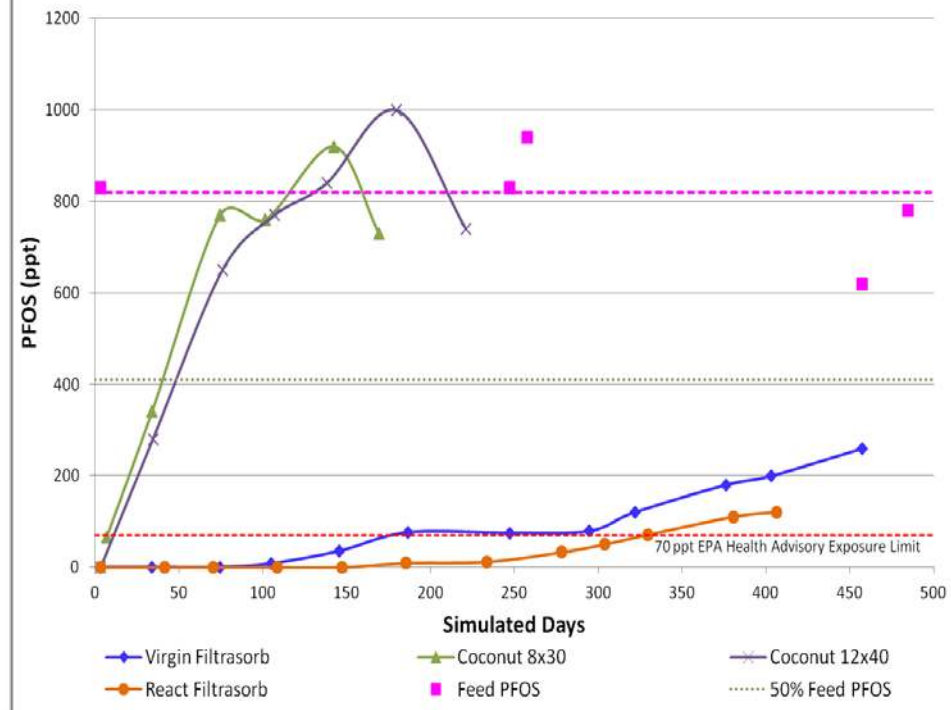
PFAS Removal: GAC



Four Carbon RSSCT PFOA Breakthrough Curves

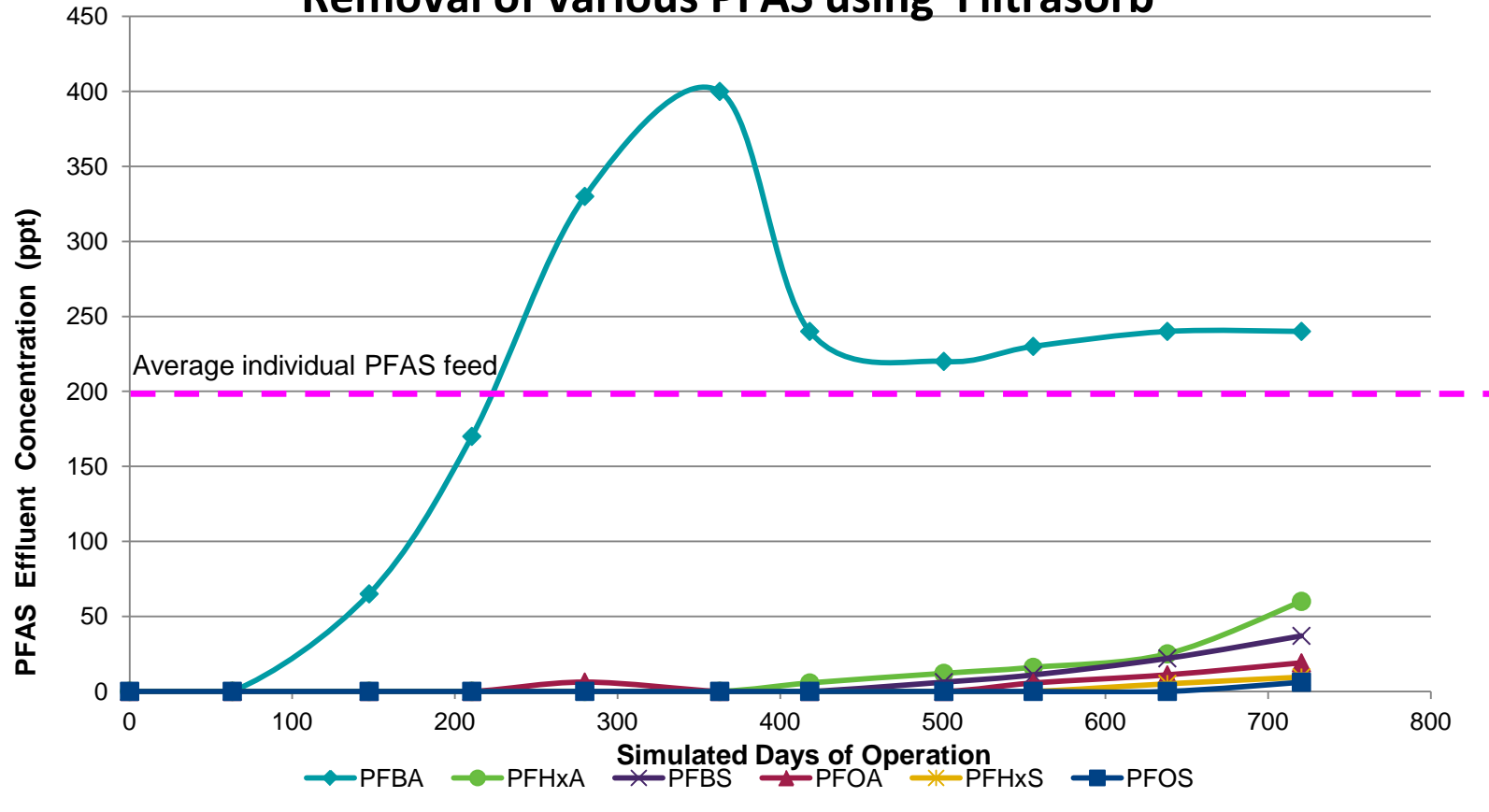


Four Carbon RSSCT PFOS Breakthrough Curves

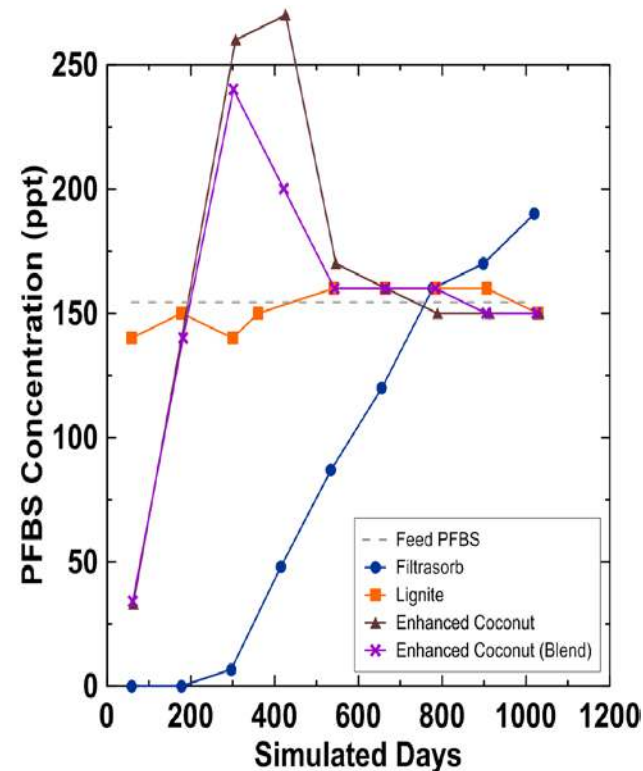
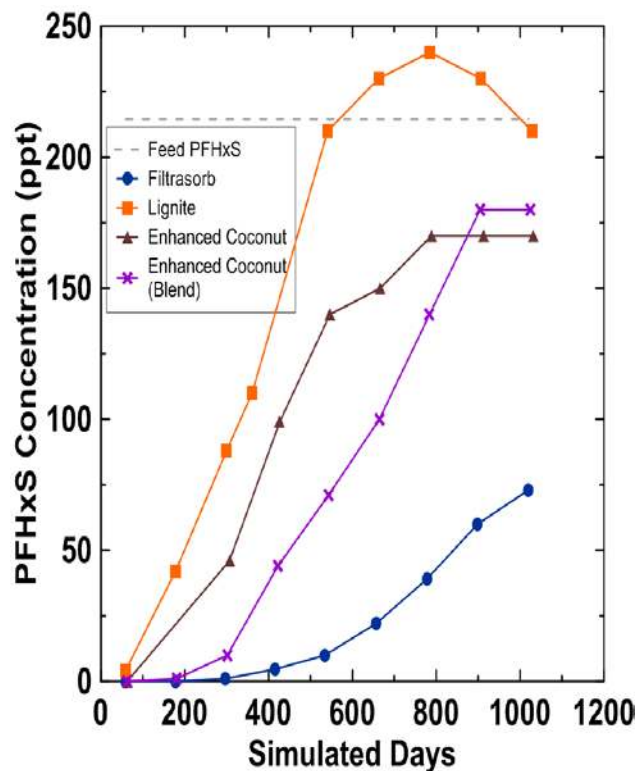
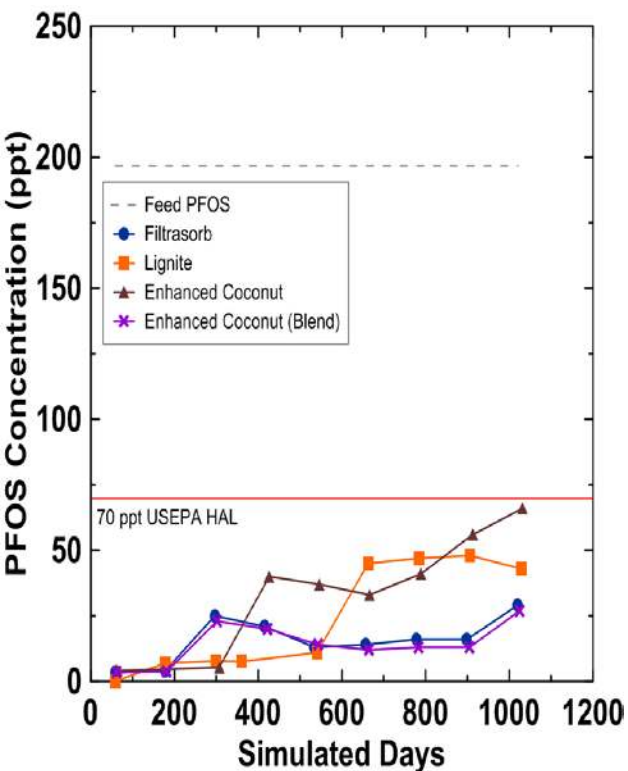


- Influent PFAS: PFOA (920 ng/L), PFOS (800 ng/L)
- Influent TOC: 1.42 mg/L
- EBCT: 10 minutes

Removal of various PFAS using Filtrasorb



- Influent PFAS: PFOA, PFOS, PFHxA, PFHxS, PFBA, PFBS (200 ng/L each)
- Influent TOC: 0.16 mg/L
- EBCT: 10 minutes



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- Influent TOC: 0.16 mg/L
- EBCT: 10 minutes

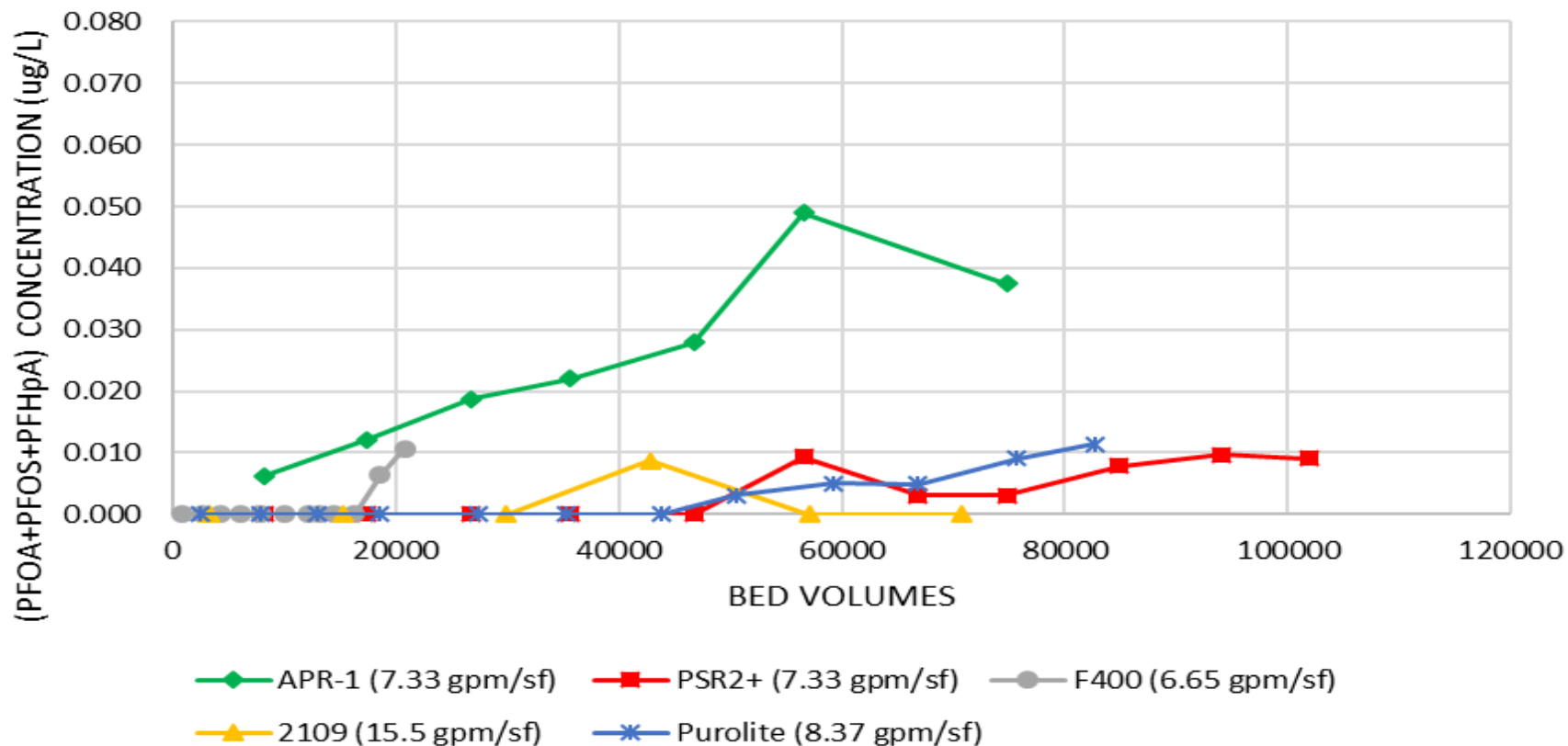
PFAS Removal: IX Resin



Widfield Pilot System Details

Pilot System	Media	Column Diameter (in.)	Bed Length (in.)	Empty Bed Contact Time (min.)	Bed Volumes Per Hour (BV/hr.)	Flow Rate (gpm)	Linear Velocity (gpm/sf)
#1	Filtrisorb® 400 carbon	4	108	10	6.4	0.58	6.65
	Purolite CalRes 120 resin	4	36	2.61	23	0.73	8.37
#2	Dow PSR2-Plus resin	2	24	2	29.4	0.16	7.33
	APR-1 resin	2	24	2	29.4	0.16	7.33
#3	Dow CalRes 2109 resin	2	36	1.44	40	0.34	15.5

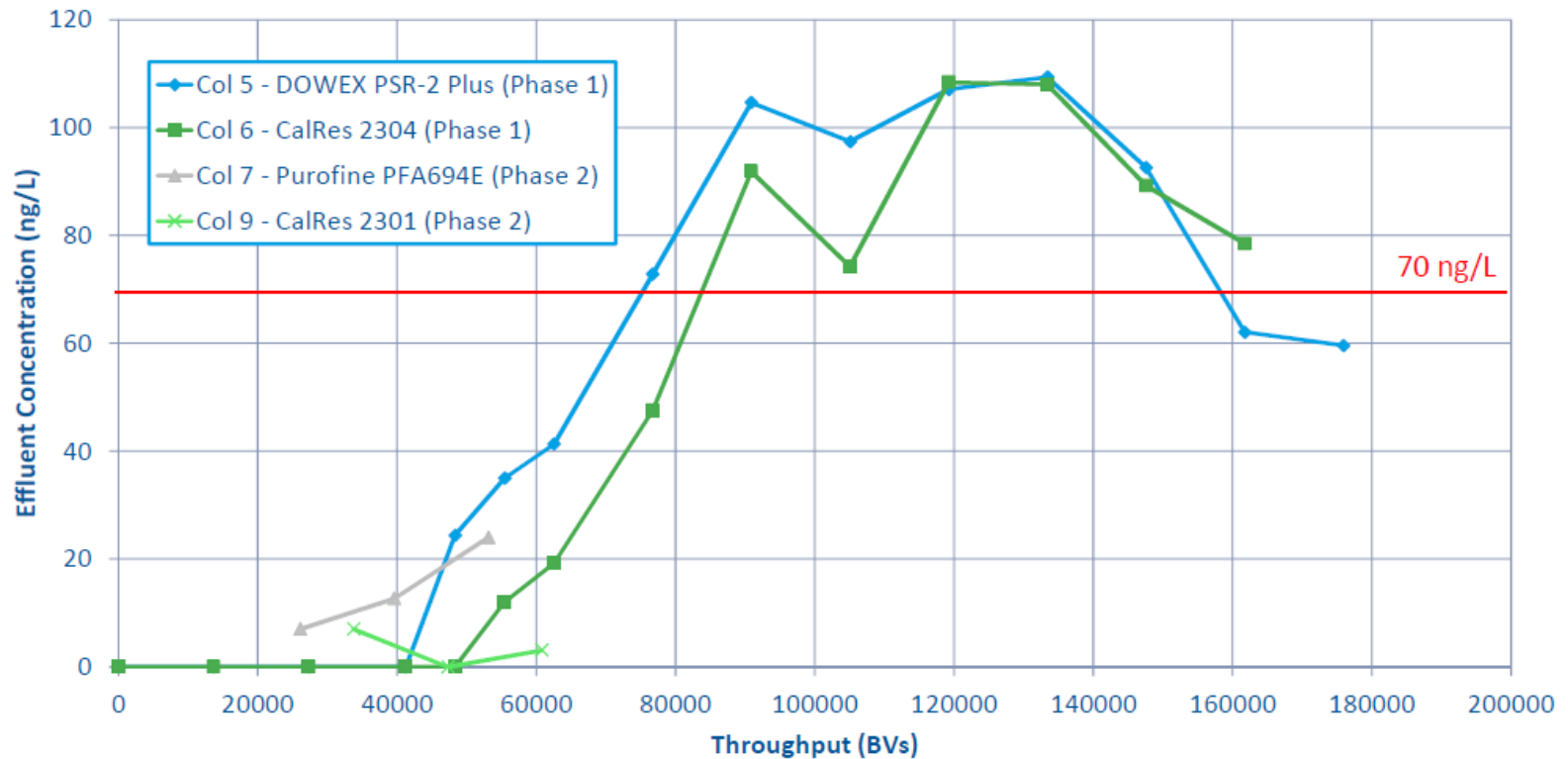
Four Resin PFOA+PFOS+PFHpA Breakthrough Curves



•Influent Concentrations: (ng/L)

PFBS – 50, PFHxS – 100, PFHpA – 14, PFOS – 100, and PFOA-25

IX Pilot Column Comparison PFAS 5 (CT) + GenX

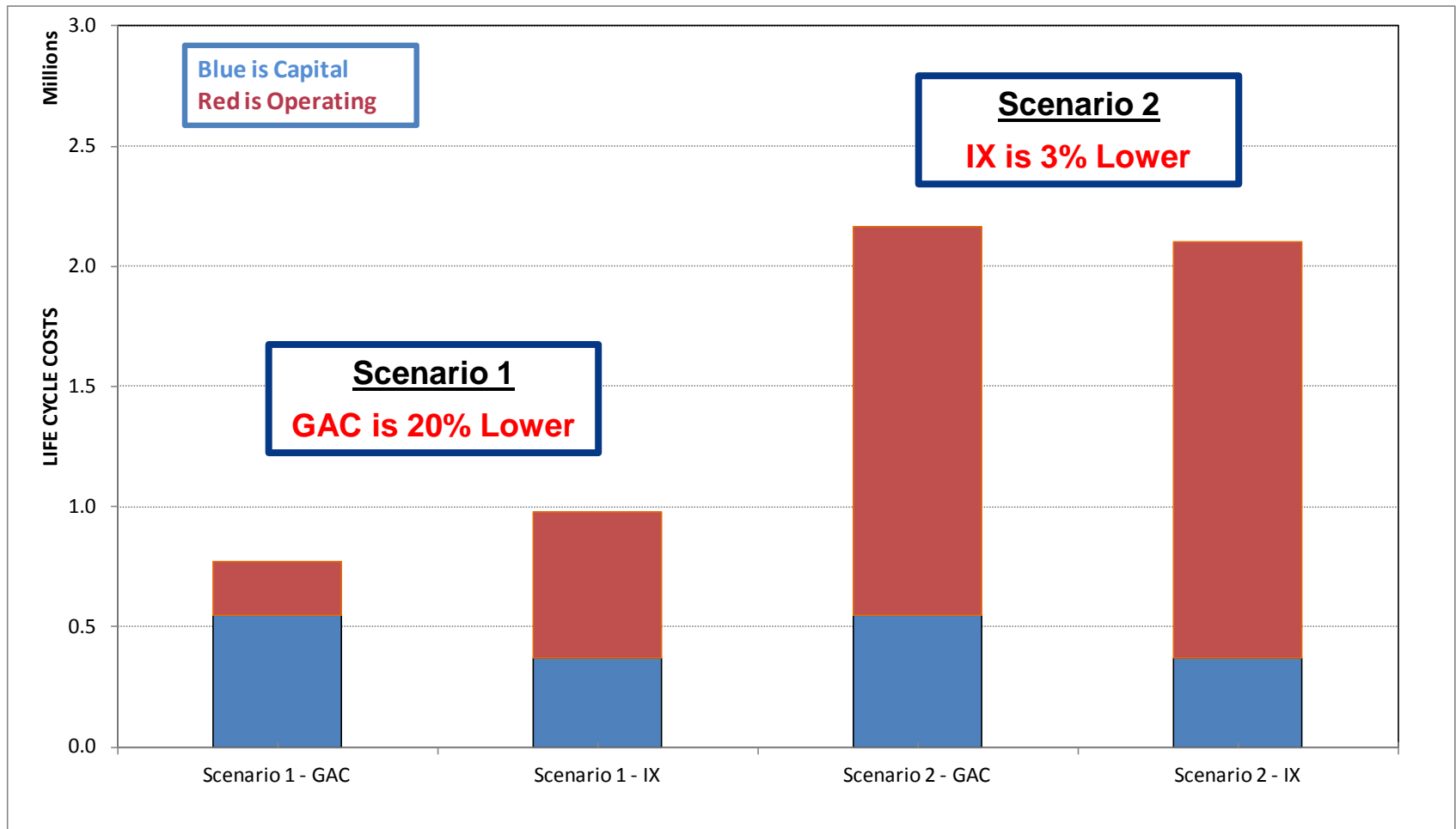
CFPUA - April
Workshop |

Source: CFPUA Workshop: Update on Removal of GenX and Other PFAS – Black & Veatch – Dated 4/5/18

Economic Comparison: GAC vs. IX



10-Year Life Cycle Cost Comparison



Basis: 1.5 MGD with (2) M10S at 10 min EBCT for GAC and (1) M10S at 2.5 min for IX

Final Takeaways



Final Takeaways

Both GAC & IX
are effective
for removal of
PFAS

- Long and short chain
- Service life varies by compound and background water quality

Performance
dictates long
term costs

- Not all media is created equal
- Testing is required to accurately predict service life and determine lowest cost solution