Addressing Unforeseen Challenges with Spent Media Disposal

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01 Project Background

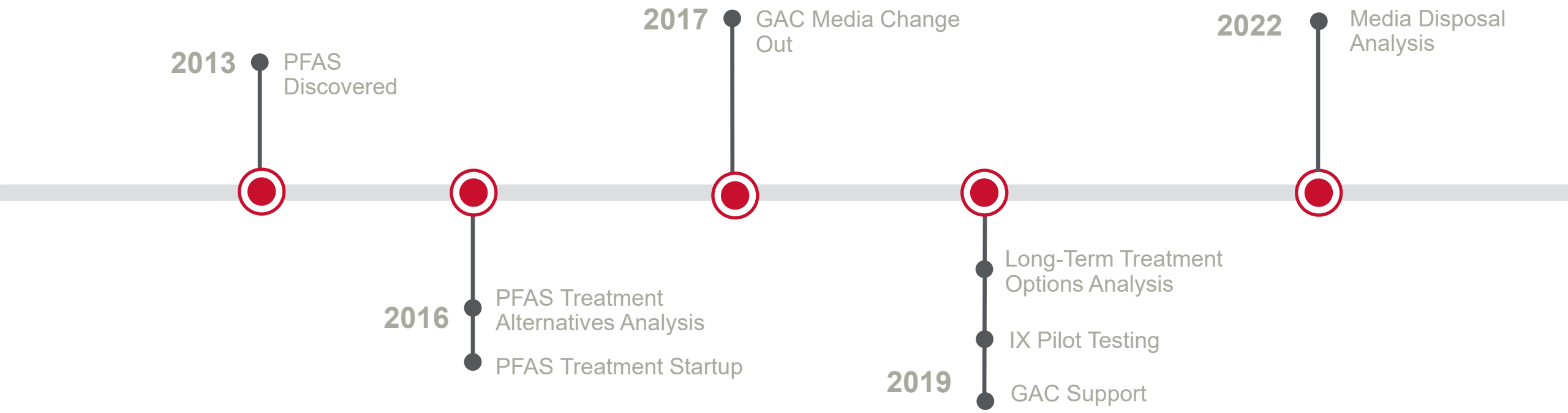
Project Location

- Issaquah, Washington
- Primary supply is four groundwater wells
- Augmented with purchased regional surface water

Well No. 4 Site

- Located adjacent to I-90 (adjacent to Issaquah Creek)
- Constrained site (accessed through Medical/Dental Center Parking Lot)

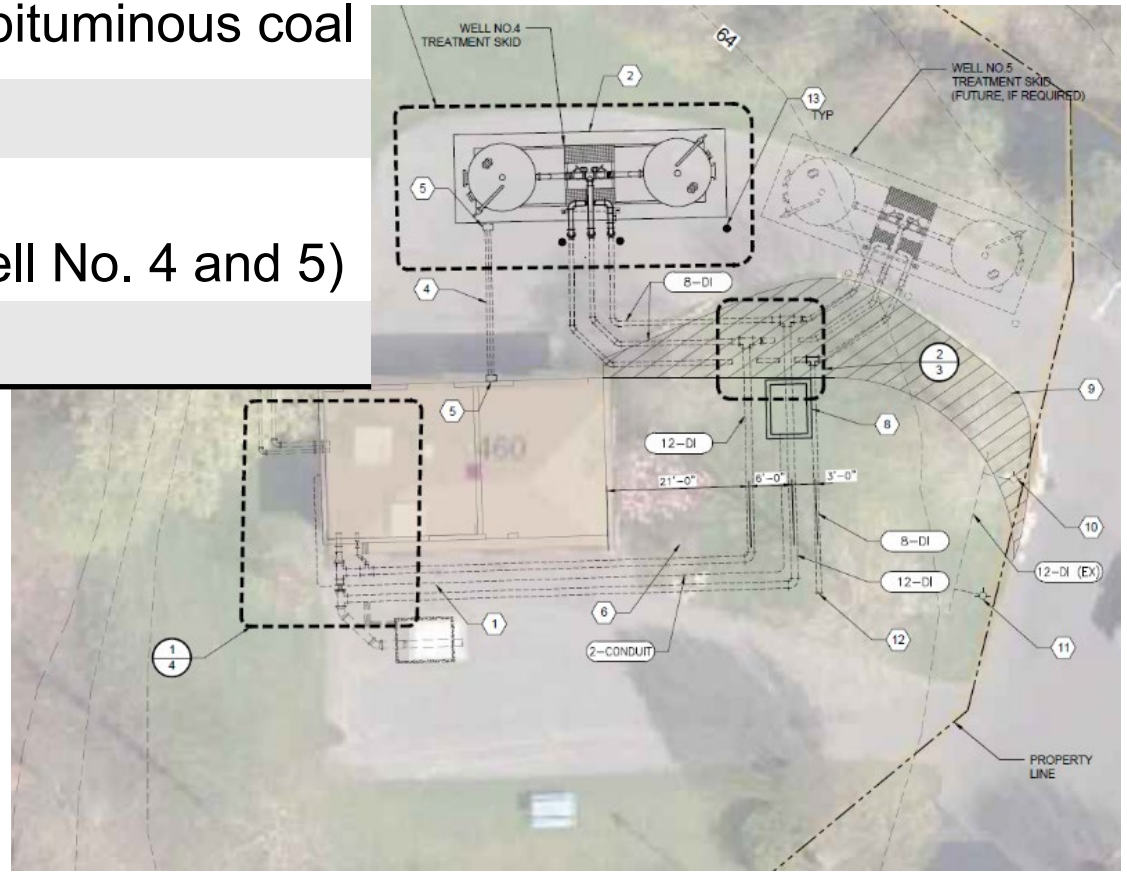
Project Timeline



02 GAC Systems and Operations

GAC Design Basis

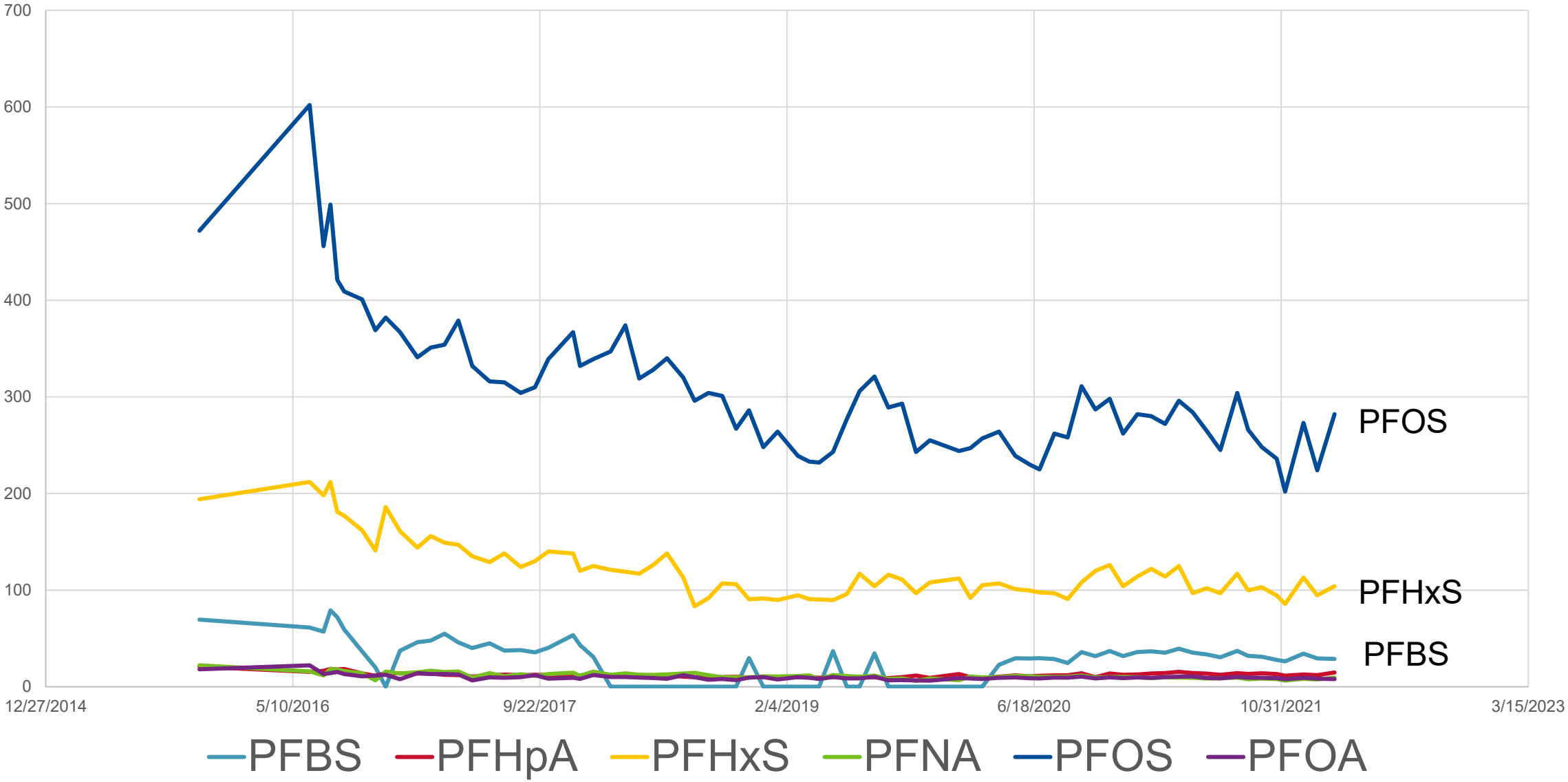
Parameter	Value
Configuration	2 vessels (lead/lag) for Well No. 4 Expandable to add 2 more vessels for Well No. 5
Carbon	Originally coconut shell, now bituminous coal
Carbon per contactor	20,000 lbs
Flow Rate	250 gpm (Well No. 4) Expandable to 1,400 gpm (Well No. 4 and 5)
Contact Time	21.4 minutes



GAC Media Summary

	Coconut	Calgon Carbon F300
	May 2016 – May 2017	May 2017 to Present
Time in Service	11 months	54 months
Water processed	102 million gallons	463 million gallons
Bed Volumes w/o breakthrough (Lead Vessel)	19,092	57,511
Bed Volumes w/o breakthrough (Lag Vessel)	-	29,088

Well No. 4 Raw Water PFAS Concentration (ng/L)



03 GAC Systems Challenges

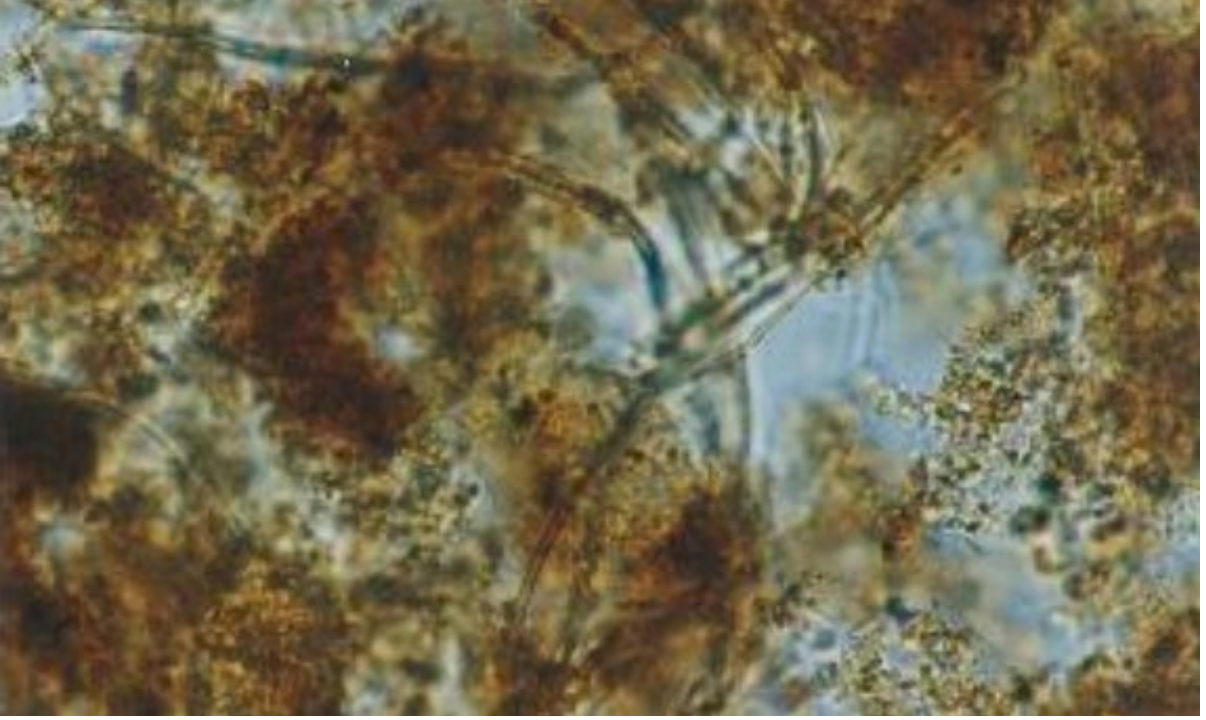
Radioactive Media

- Spent GAC was temporarily stopped during transit for detectable radioactivity
- Non-detectable radionuclides and radiation in the groundwater
- Non-detectable ≠ zero
- Very low concentrations x lots of water = significant mass
- Concern now that current load of GAC has treated 3+ times more water

Analyte	Result (pCi/kg)
Gross alpha	0.00104
Gross beta	0.00765
Gamma	
Pb-212	130
Pb-214	2,300
Bi-214	2,200
Ra-226	2,200
K-40	860
Total	7,690

High Headloss

- Well discharges at 110 psi
- Additional headloss adds 20+ psi
- Original system had 125 psi rupture disks for over-pressure protection



Bacteria Biofouling

- Biogrowth on GAC was discovered after six months
- Causing high headloss development
- Growth identified as iron-related bacteria
- GAC could take 1 mg/L chlorine
- Would have required extensive re-piping
- Backwashing once a month instead
    - No detected impact on PFAS removal after 5.5 years

Current Water Quality (ng/L) – March 2022

PFAS	WA State Action Level (October 2021)	Gilman Well 4 Raw Water	Gilman Well 5 Raw Water (Offline)	Lag Vessel (25%)	Gilman Finished Water (Well No. 4)
PFOS	15	**282**	**41**	ND	ND
PFOA	10	9	ND	ND	ND
PFNA	9	**10**	ND	ND	ND
PFHxS	65	**104**	**21**	ND	ND
PFHpA	none	15	ND	ND	ND
PFBS	345	29	ND	2	ND

04 GAC Disposal

GAC Disposal Options

- Landfill
  - Permitting and characterization typically required
  - USDOT licensing
- Incineration
  - Approval process required
  - USDOT licensing
- Reactivation
  - Acceptance criteria for media acceptance by vendor
  - USDOT licensing

Landfill

- May be simplest solution
- Huge issues with PFAS residuals
- Risk of PFAS and other contaminants back into the environment
- Leachate can contaminate groundwater sources
- Gets returned to environment without treatment

Incineration

- Viable disposal option
- Requires stringent requirements to ensure PFAS is destroyed
- Risks could be PFAS being volatized and sent into the air
- Current guidance is 900 – 1,000 DegC
- Fewer facilities that can reach recommended temperatures

Reactivation

- Carbon reactivation units use high temperatures to thermally desorb contaminants from GAC
- Allows reuse of GAC
- Not all reactivation facilities operate under RCRA permits and air permits
- Uncertainty about facilities capabilities
- Potable vs. non-potable requirements

05 GAC Sampling and Analysis

Estimated Media Life

What is the limiting factor for change out and disposal?

- PFAS breakthrough on lag vessel?
- Specific parameter not meeting acceptance criteria for reactivation?
- Radionuclide accumulation?

GAC Sampling

- Sampling event took place in March 2022
- Media shipped to Calgon Carbon's lab
- Does GAC meet reactivation acceptance criteria?
- Results will determine options on how to dispose of spent media

GAC PFAS Sampling Analysis – Limiting Factor?

PFAS	SAL	Months Until SAL is Reached	Bed Volumes Until SAL is Reached
PFOA (µg/L)	0.010	109.9	166,577
PFOS (µg/L)	**0.015**	**15.5**	**23,442**
PFHxS (µg/L)	0.065	91.2	138,189
PFNA (µg/L)	0.009	134.3	203,564
PFBS (µg/L)	0.345	830.8	12,58,987

GAC Sampling Results and Analysis – Limiting Factor?

Constituent	Criteria & Testing			Analysis			
	Facility Acceptance Guideline	GAC Results	Test Method	Accumulation Trend with 25% FOS (unit/mo)	Months Until Guideline Exceeded	Media Expiration Date	Bed Volumes Until Exceedance
Arsenic (mg/Kg)	50	**89**	EPA 6010C	1.937	-20.1	5/23/2020	(30,407)
Barium (mg/Kg)	350	90	EPA 6010C	1.959	132.7	12/13/2032	200,459
Iron (mg/Kg)	10,000	**14,000**	EPA 6010C	304.701	-13.1	12/20/2020	(19,826)
Manganese (mg/Kg)	5,000	4,800	EPA 6010C	104.469	1.9	3/16/2022	2,891

Radionuclide Analysis – Limiting Factor?

- USDOT has developed exemption activity concentrations for uranium and its decay products
- Exemption limit for uranium-238 and all of its decay products is 270,000 pCi/kg.
- GAC vessels estimated to treat up to 900,000 bed volumes
- Much longer than the expected lifetime of the carbon vessels before the exemption limit is reached

06 Current Project Status

Current Status

- Based on analysis, replacement would occur in Fall 2022
- 5.5 years of media life
- Original estimate was change out every 6 to 9 months

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