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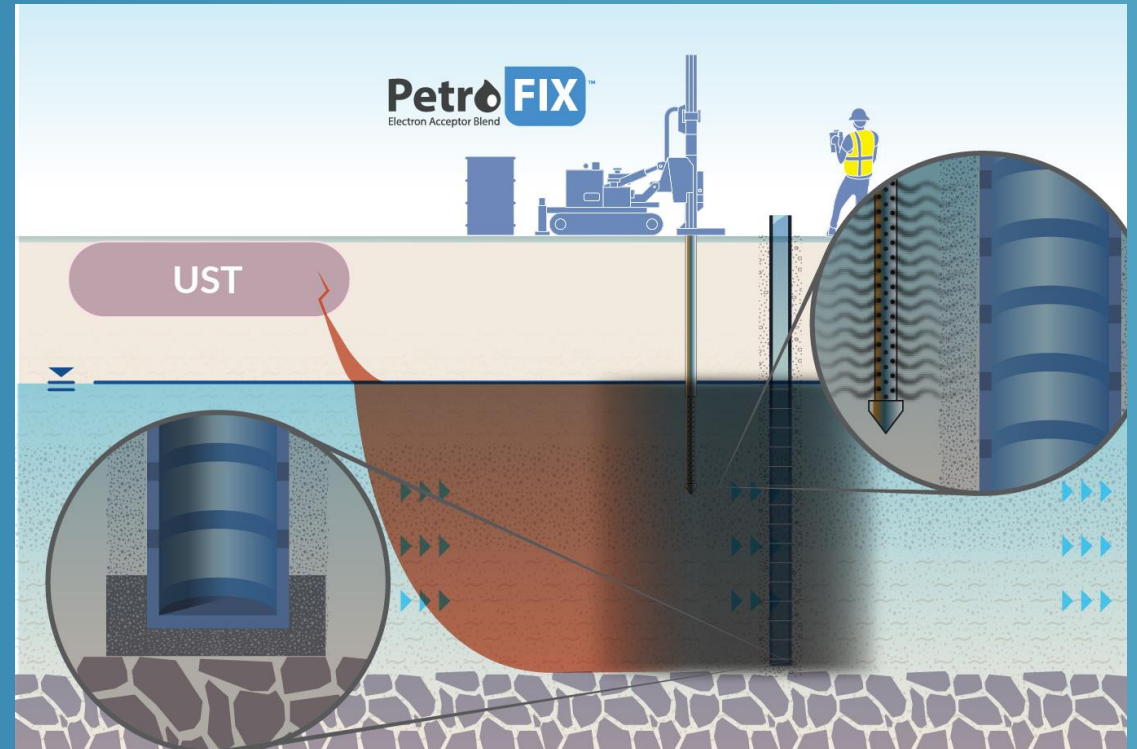
## The Importance of Application Methods for In-Situ Micron Scale Carbon Injections to Treat Hydrocarbon Spills

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# Nuance

- Talking specifically about colloidal carbon
  - Some but not aspects carry over to some but not all other in situ application products
- Every site is special
- Know your site and the technology you're using



# A Tale of Two Pressures

## Low pressure in fractured bedrock

0845	Resin Injection		
	-10 gpm		
	-18 psi		
0905	End batch Total gallons 205.9		
	-mix		
	- batches are being made thicker today due to low water content		
0925	Resin Injection		
	-10 gpm		
	-16 psi		
0945	End batch 2 Total gallons 423.9		
	-mix		
1005	Resin Injection		
	-10 gpm		
	-18 psi		
1025	End batch 3 Total gallons 627.7		
	-mix		
1040	Resin Injection		

- Ideal pressure range for colloidal carbon 30-70 PSI
- High pressure site fractured till lithology
- While low pressures are encouraged for colloidal carbons some site may require higher pressures
  - No or too low PSI may result in limited distribution

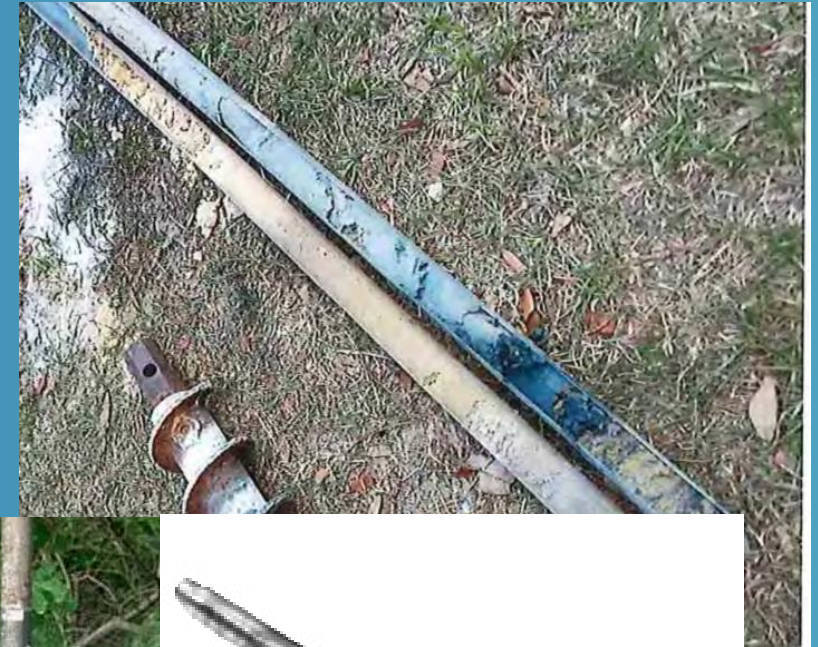
Pressure (psi)	Time
400	10:17
400/350	10:22
600/550	10:31
800/600	10:43
800/600	10:46
900/725	10:50

While 30-70 PSI may be ideal for most site except the possibility to be above or below this.

# Tooling Done Wrong

- Sandy site using pressure activated tips and 4ft lifts
- Saw banded limited influence in borings
- Didn't make changes in field saw no changes in COCs

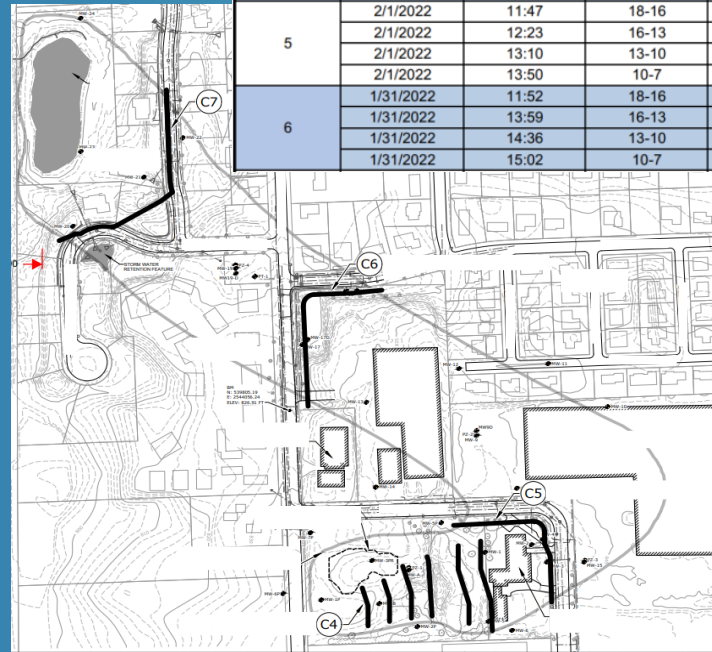
Sample		Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE	Naphthalene	1-Methyl-naphthalene	2-Methyl-naphthalene
Location	Date								
GCTL		1	40	30	20	20	14	28	28
NADCs		100	400	300	200	200	140	280	280
MW-4	10/24/1994	1190	3400	198	768	119	NS	NS	NS
	8/29/2007	80.0 I	10400	1220	6490	12 U	NS	NS	NS
	3/8/2016	11.3	532	2,280	1,180	0.50 U	807	149	279
	11/02/2018	10.4	46.3	1,760	1,480	0.50 U	696	114	209
	2/3/2020	6.1	24.7	738	61.7	0.51 U	719	116	189



# Making Changes

- Glacial till
- 3 ft retractable screens with 3 ft lifts
  - Retractable screens unique to colloidal carbons
- Have a Plan B
  - Glacial till at the source was breaking screens

Injection Point	Date	Time	Injection Depth (feet)	Injection Pressure (psi)	Flow Rate (gpm)	Volume of PetroFix Injected			Total Gallons Per Location
						Beginning Flow Meter (gal)	Ending Flow Meter (gal)	Gallons Injected Per Interval	
1	2/2/2022	11:32	18-16	26	3.90	0.00	184.00	184.00	738
	2/2/2022	12:13	16-13	24	4.50	184.00	368.00	184.00	
	2/2/2022	12:49	13-10	23	5.90	368.00	551.00	183.00	
	2/2/2022	13:30	10-7	17	6.20	551.00	738.00	187.00	
2	2/2/2022	8:39	18-16	15	4.30	0.00	93.00	93.00	530
	2/2/2022	9:15	16-13	10	3.90	93.00	230.00	137.00	
	2/2/2022	9:47	13-10	9	3.60	230.00	418.00	188.00	
	2/2/2022	10:38	10-7	7	3.60	418.00	530.00	112.00	
3	2/2/2022	8:44	18-16	7	4.30	0.00	93.00	93.00	530
	2/2/2022	9:15	16-13	10	4.00	93.00	230.00	137.00	
	2/2/2022	9:47	13-10	7	3.70	230.00	418.00	188.00	
	2/2/2022	10:39	10-7	6	3.10	418.00	530.00	112.00	
4	2/2/2022	8:42	18-16	11	4.50	0.00	93.00	93.00	439
	2/2/2022	9:11	16-13	21	5.00	93.00	230.00	137.00	
	2/2/2022	9:48	13-10	5	3.90	230.00	268.00	38.00	
	2/2/2022	10:25	10-7	9	4.20	0.00	171.00	171.00	
5	2/1/2022	11:47	18-16	24	3.20	0.00	93.00	93.00	552
	2/1/2022	12:23	16-13	24	3.50	93.00	230.00	137.00	
	2/1/2022	13:10	13-10	10	3.60	230.00	368.00	138.00	
	2/1/2022	13:50	10-7	10	4.50	368.00	552.00	184.00	
6	1/31/2022	11:52	18-16	25	2.60	0.00	92.00	92.00	312
	1/31/2022	13:59	16-13	3	3.60	92.00	230.00	138.00	
	1/31/2022	14:36	13-10	5	5.10	230.00	296.00	66.00	
	1/31/2022	15:02	10-7	2	1.60	296.00	312.00	16.00	

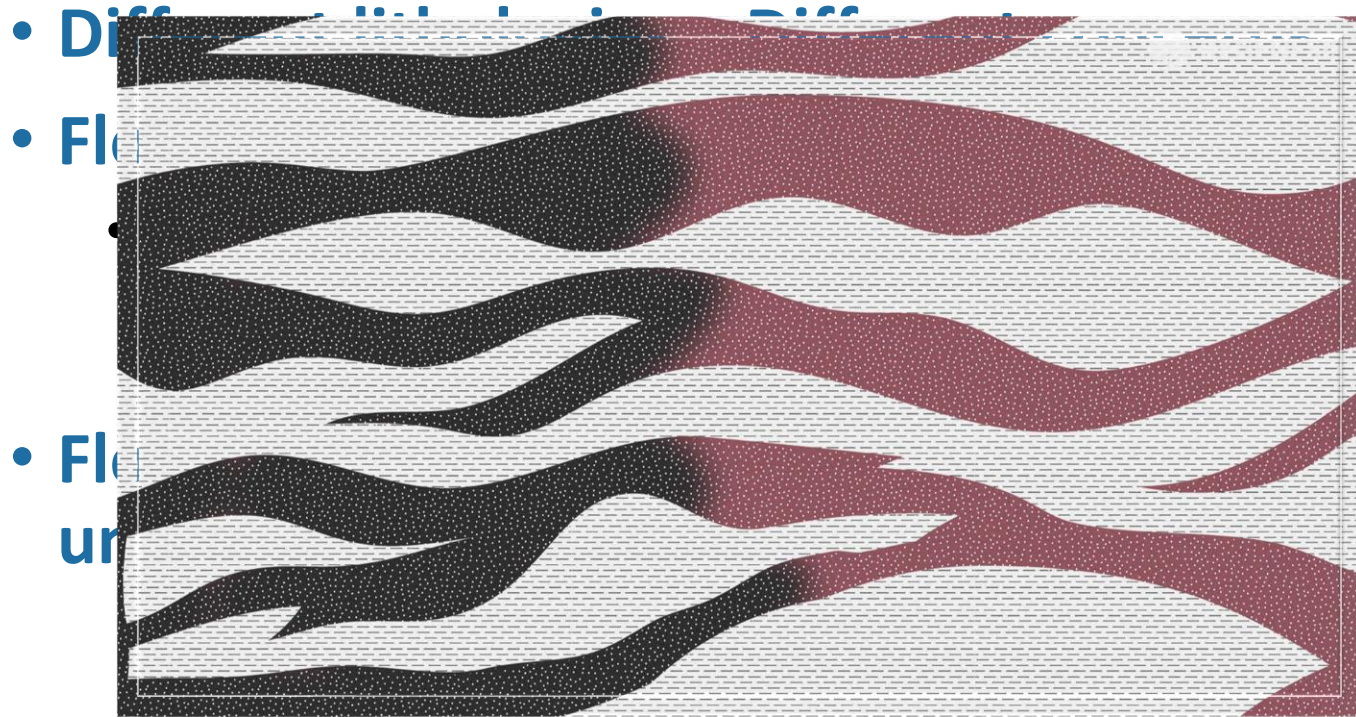


# Confirmation Comparison

- **Different lithologies = Different concerns**
- **Flooding targets where GW naturally is**
  - **GW does not move through clays evenly**
    - Heterogenous clay compared to homogenous sandy clay
- **Flooding leaves natural flux zones unaltered while treating them**

Pressures on site ranged from 20-70 PSI (average ~40) @ 2-4.5 gpm (average ~3.75) using 3 ft retractable screen

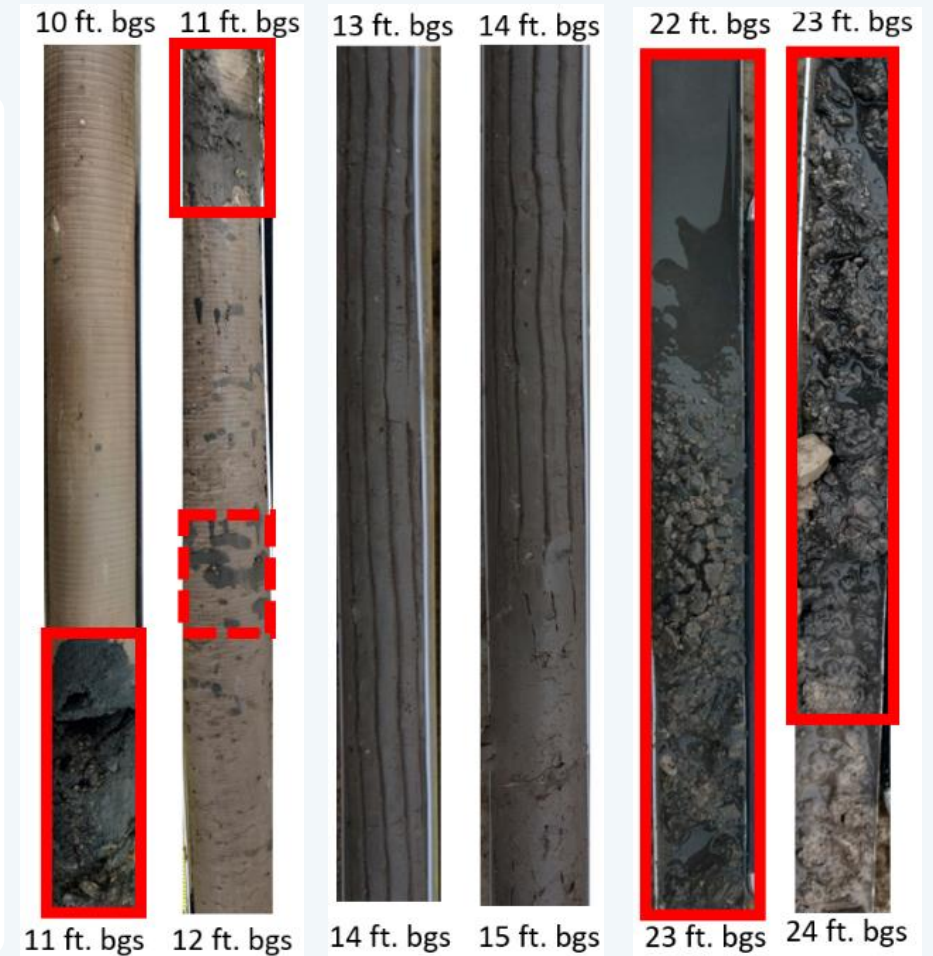
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