Treatment Train for Removing PFAS from High Concentration Stormwater

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Agenda

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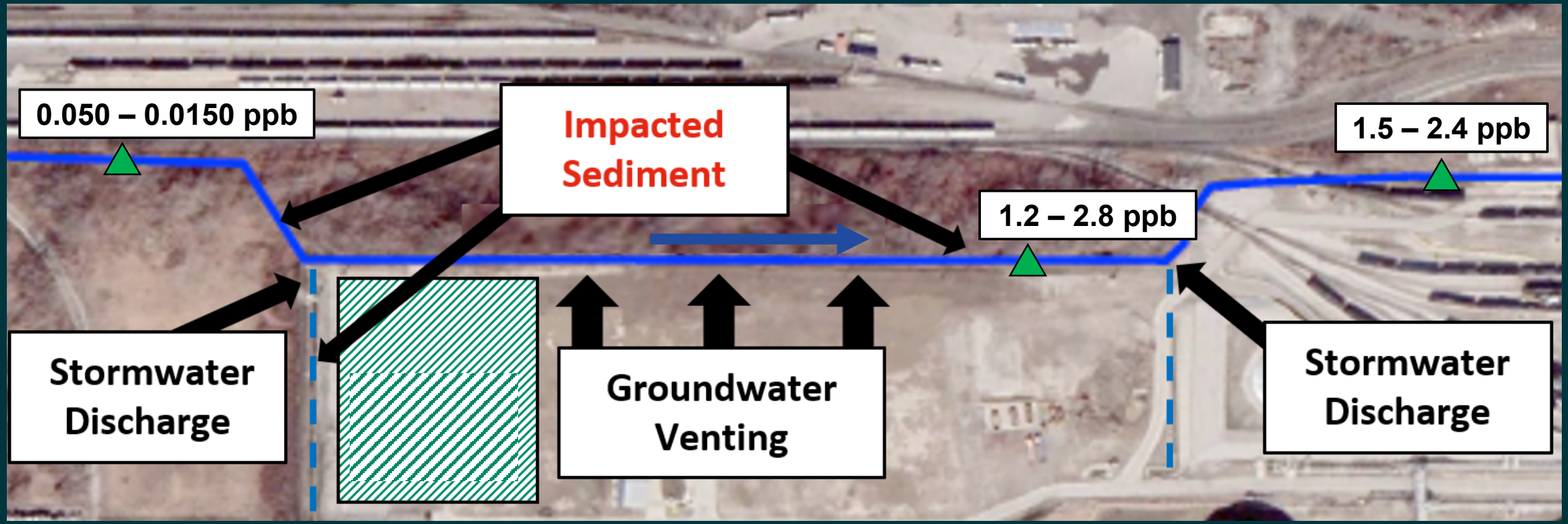
Site Background



- Surface Water Sample Location
- Former Fire Training Area
- Stormwater Drain
- Stormwater Drain Flow Direction
- 1.2 – 2.8 ppb - PFOS Concentration Range in Surface Water

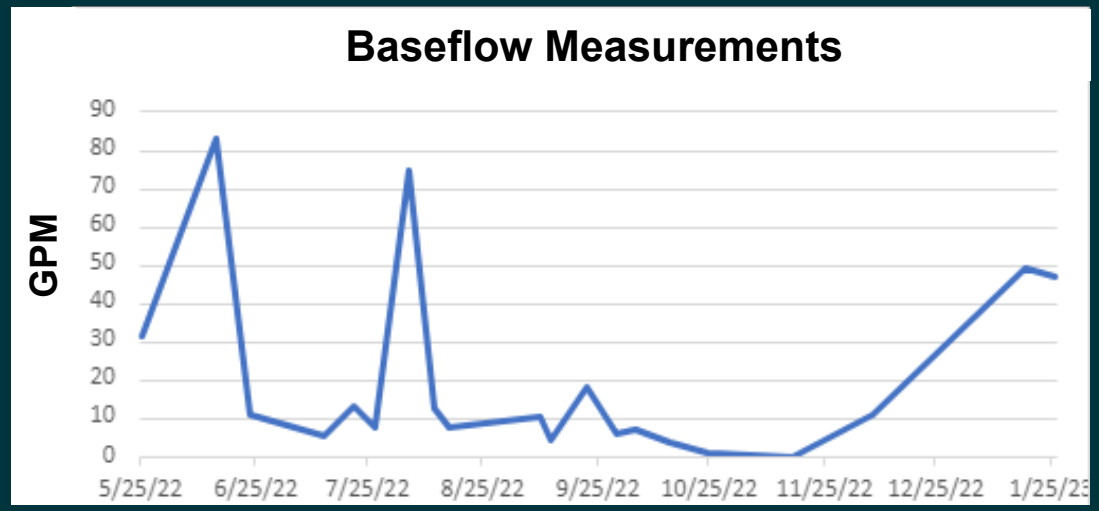
Water Quality Analysis of Stormwater Drain

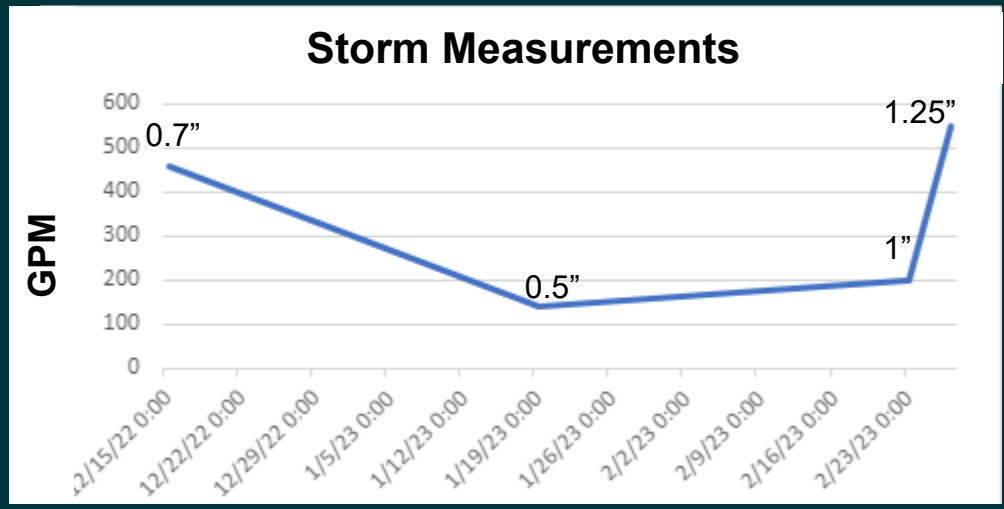
		Desired Criteria For IX Resin	Drain SW Sample Baseflow (No Storm)	Drain SW Sample 2" Storm
Compound	Unit			
Diesel Range Organics (Compete for resin space)				
DRO (C10-C28)	ug/L		**564**	**103**
Anions (Can reduce resin capacity)				
Bromide	mg/L		< 1.25	< 1.25
Nitrogen, Nitrate	mg/L	<5 mg/L	< 0.250	**0.705**
Nitrogen, Nitrite	mg/L		< 0.250	**0.939**
Sulfate	mg/L	<200 mg/L	**72.6**	**45.6**
Chloride	mg/L		**63.6**	**213**
Metals				
Arsenic	ug/L		**1.13**	**2.62**
Calcium	ug/L		**57700**	**45000**
Chromium	ug/L		**0.989**	**7.32**
Copper	ug/L		**1.96**	**9.74**
Iron	ug/L	<500 ug/L	**698**	**2670**
Lead	ug/L		**0.601**	**12.9**
Magnesium	ug/L		**13100**	**6740**
Manganese	ug/L	<20 ppb	**635**	**81**
General Chemistry				
Total Alkalinity	mg/L		**143**	**46.1**
Total Hardness	mg/L		**219**	**127**
Total Dissolved Solids	mg/L		**358**	**482**
Total Suspended Solids	mg/L	<1 mg/L	**3**	**35.3**
Ferrous Iron	mg/L		**0.668**	**0.272**
Ammonia-N	mg/L		< 0.0800	< 0.0800
Total Organic Carbon	mg/L	< 2 ppm	**10.2**	**1.32**

- Water quality data was collected during baseflow and a storm event.
- During storm event DRO, Mn and TOC decreased while iron and TSS increased (was expected).
- Iron increase is likely due to iron in stormwater from nearby railroad and recycling facility.

Flowrate Measurements

- Collected velocity measurements inside culvert, then converted to flow
- Collected readings during baseflow and storm conditions
- Discrete measurements (snap shots) can be affected by WHEN collected during storm event
- Baseflow readings ranged from 5 - 83 gpm (anomalous year)
- Storm event readings ranged from 144 - 551 gpm
- Pilot system designed to operate 100 gpm to ensure baseflow capture and treatment (regulatory driver).

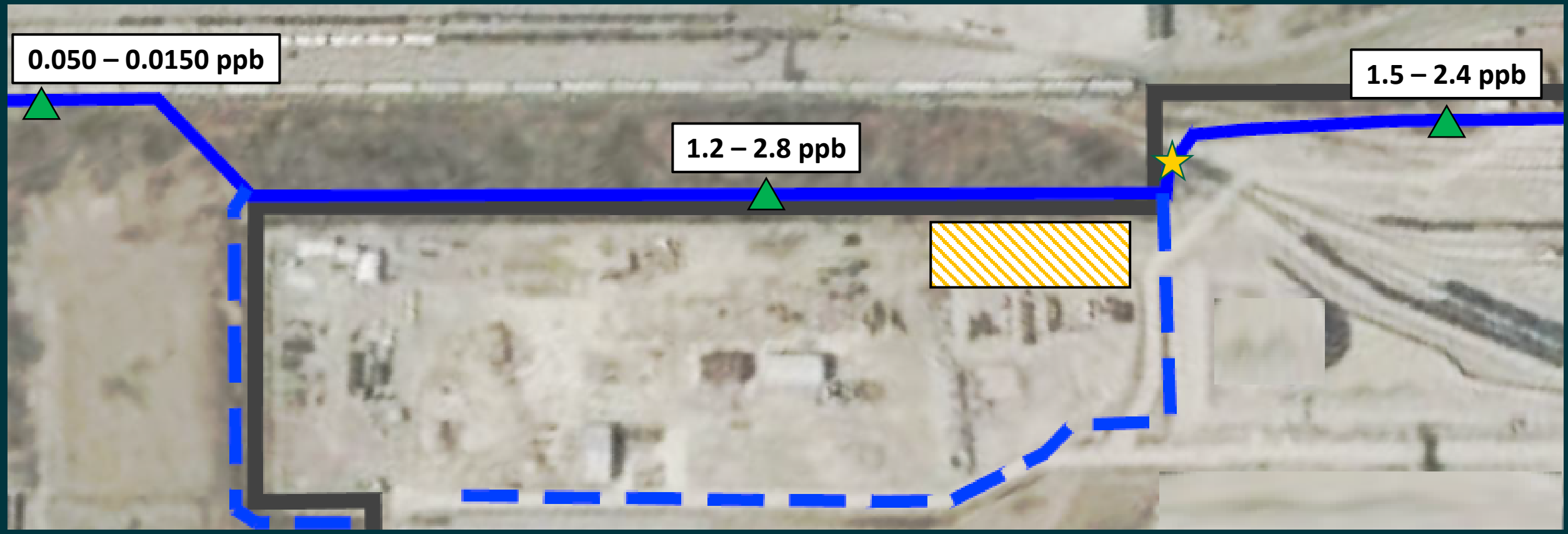




Pilot Design Basis Summary

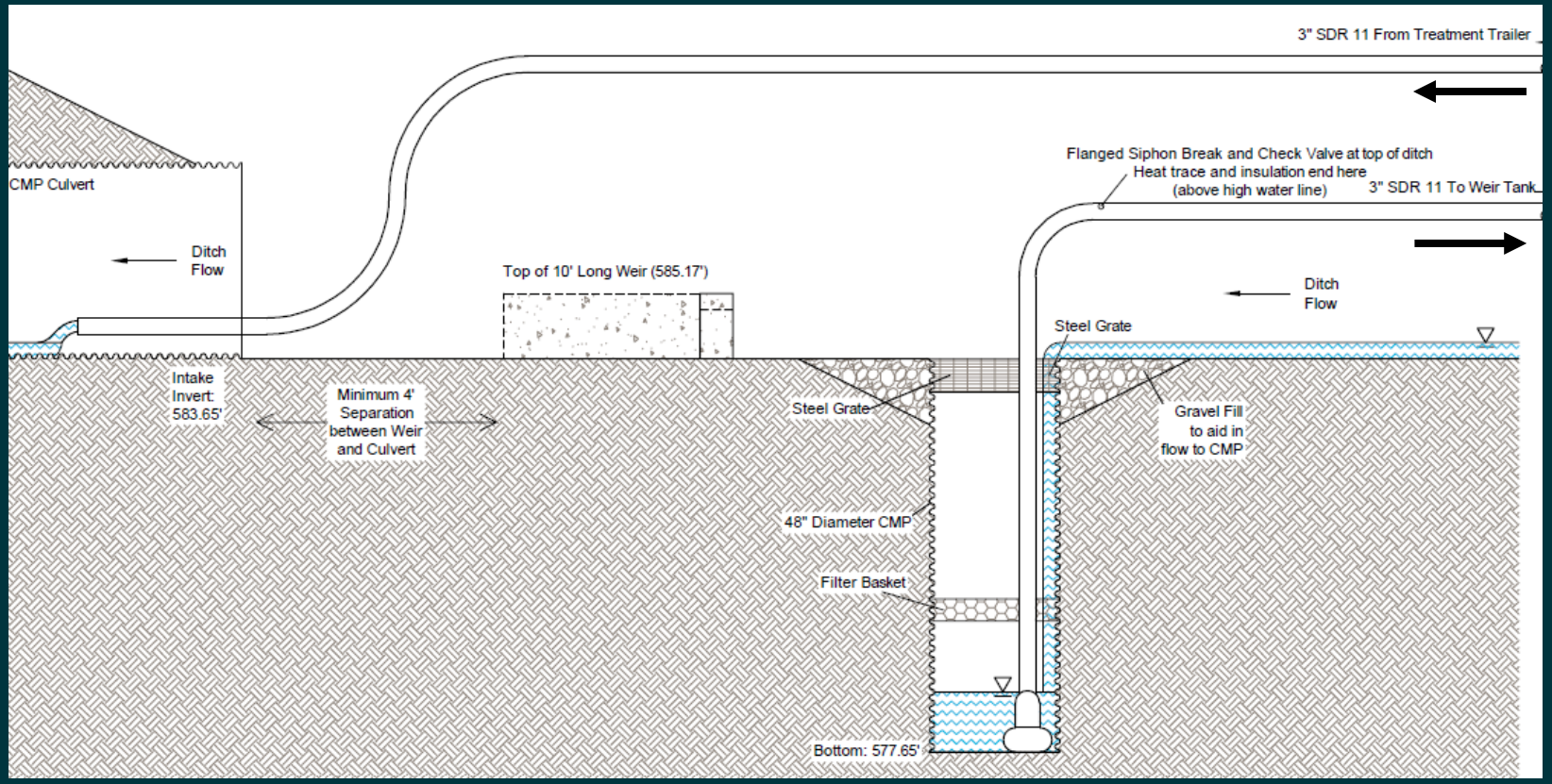
- Pilot extraction location based on proximity to open area where pilot system could be built.
- Robust solids removal in pre-treatment system (TSS can have significant impact on IX resin).
- Current pre-treatment includes:
  - 18,000-gallon Weir tank
  - Sand filters
  - Bag filters
- DRO, Metals and TOC data varied based on rainfall conditions.
- Operate pilot and evaluate whether these parameters have an impact on the IX resin performance.
- IX Resin (Purolite PFA694) selected to reduce contact time and be able to treat higher flow rates during significant storm events (looking towards full scale).
- Utilize three IX vessels in series to remove PFAS due to variability of stormwater.
- Regulatory discharge limit of 64 ppt for PFOS.

Pilot System Location

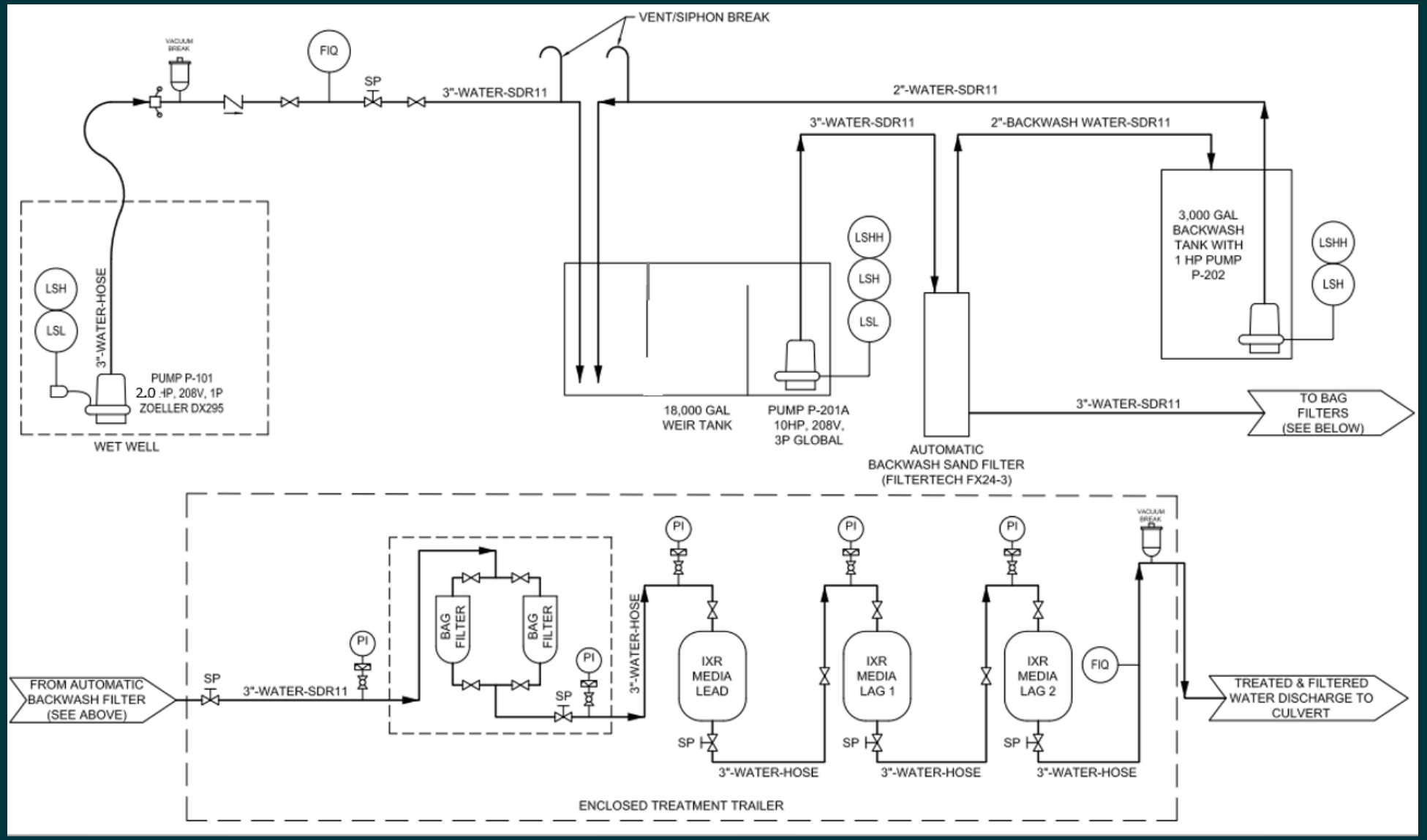


- Pilot System Location
- Extraction/Discharge Location
- Drain Flow Direction

Surface Water Extraction to Pilot Treatment System



Pilot Treatment Design



Pilot System Equipment

Pilot System Operation – Phased Approach per Regulatory Permit

- **Phase 1 – Pre-Treatment Operation & Evaluation**
  - Evaluate effectiveness of the sediment removal while in IX Resin bypass mode.
  - Collect data regarding the critical pre-treatment needs of IX Resin.
    - Daily TSS samples and weekly water quality samples.
  - After 2 weeks, went to Phase 2.

- **Phase 2 - PFAS Treatment with IX Resin**
  - Evaluate performance under various stormwater flow conditions.
  - Evaluate the resin usage rate.
  - Pilot will be operational until full-scale system is operational (2024).
  - Full-scale design is underway.

Phase 1 Pre-Treatment Evaluation Results

- Identified DRO, Fe, Mn, and TOC outside the ideal range for Purolite IX resin.
- TSS treatment is effective.
- Following discussions with Purolite, decided to start processing pre-treated water through resin for pilot-scale evaluation.
- Results will be incorporated into full-scale pre-treatment design.

Sample ID	Units	Purolite Desired	SP-INF-Lead-WQ-20230403	SP-INF-Lead-WQ-20230410
Date Collected		Criteria	4/3/2023	4/10/2023
Time Collected			1215	1100
Analyte				
Diesel Range Organics				
DRO	ug/L	ND	**345**	**498**
Metals				
Arsenic	ug/L		<0.0680	**1.09 J**
Calcium	ug/L		**46000**	**128,000**
Chromium	ug/L		<0.334	<0.334
Copper	ug/L		**2.65**	**1.46**
Iron	ug/L	<500 ppb	**162**	**146**
Lead	ug/L		**1.34**	**0.836**
Magnesium	ug/L		**13400**	**41800**
Manganese	ug/L	<20 ppb	**5.73**	**209**
General Chemistry				
Total Suspended Solids (TSS)	mg/L	ND	**1.4**	<1.0
Total Alkalinity as CaCO3 to pH 4.	mg/L		**99.6**	**317**
Total Hardness	mg/L		**143**	**541**
Total Organic Carbon	mg/L	<2	**2.94 F1**	**8.21**
pH	S.U.		**7.71**	**7.95**
Temperature	°C		**23.2**	**22.7**

Phase 2 Initial PFAS Effluent Results (2nd Day)

- During the start of Phase 2 (IX Resin treatment), initial influent and effluent samples were collected and analyzed for PFAS (Method 537.1 – 28 compounds).

- Influent results (post pre-treatment):
  - 1080 ppt PFOS
  - 114 ppt PFOA
  - 3,492 ppt Total PFAS

- Effluent results (post IX Resin treatment):
  - 3 ppt PFOS
  - ND for all other PFAS constituents

- Surprised to see a detection of PFOS, need further analytical results to see if this continues.

Special thanks to Eurofins for expedited turnaround!

Key Takeaways and Path Forward

- Stormwater is a different animal than groundwater or industrial effluent treatment.
- Long term piloting is necessary for successful full-scale treatment.
- Upfront groundwater quality evaluation is crucial for identifying pretreatment needs (multiple events to account for different storm events and seasonal changes).
- Understanding flowrates for baseflow and different storm events is critical.
- Pretreatment was able to effectively and systematically removed TSS and turbidity.
- Effects of DRO, Mn and iron on the IX resin will be evaluated during the pilot to better understand prior to full-scale design.
- Treatment for PFAS in stormwater is challenging, but not impossible!

Special thanks to our engineering team (Rebecca Mora, Matthew McCloskey and Peter Tacy)!

Thank You!

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