

MERRICK & COMPANY

Remote Location Pilot Testing of Small-Scale Cartridge-Filtration

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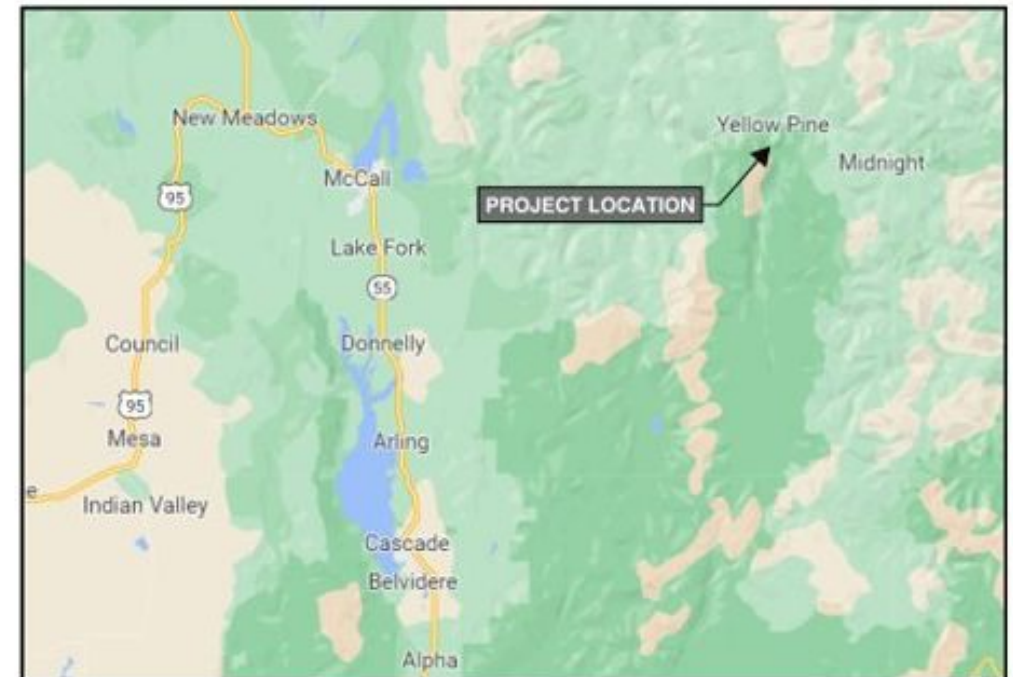
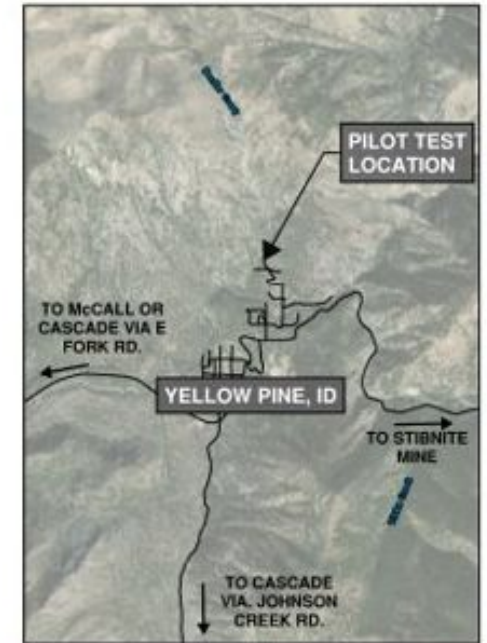
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Project Background

Yellow Pine, ID

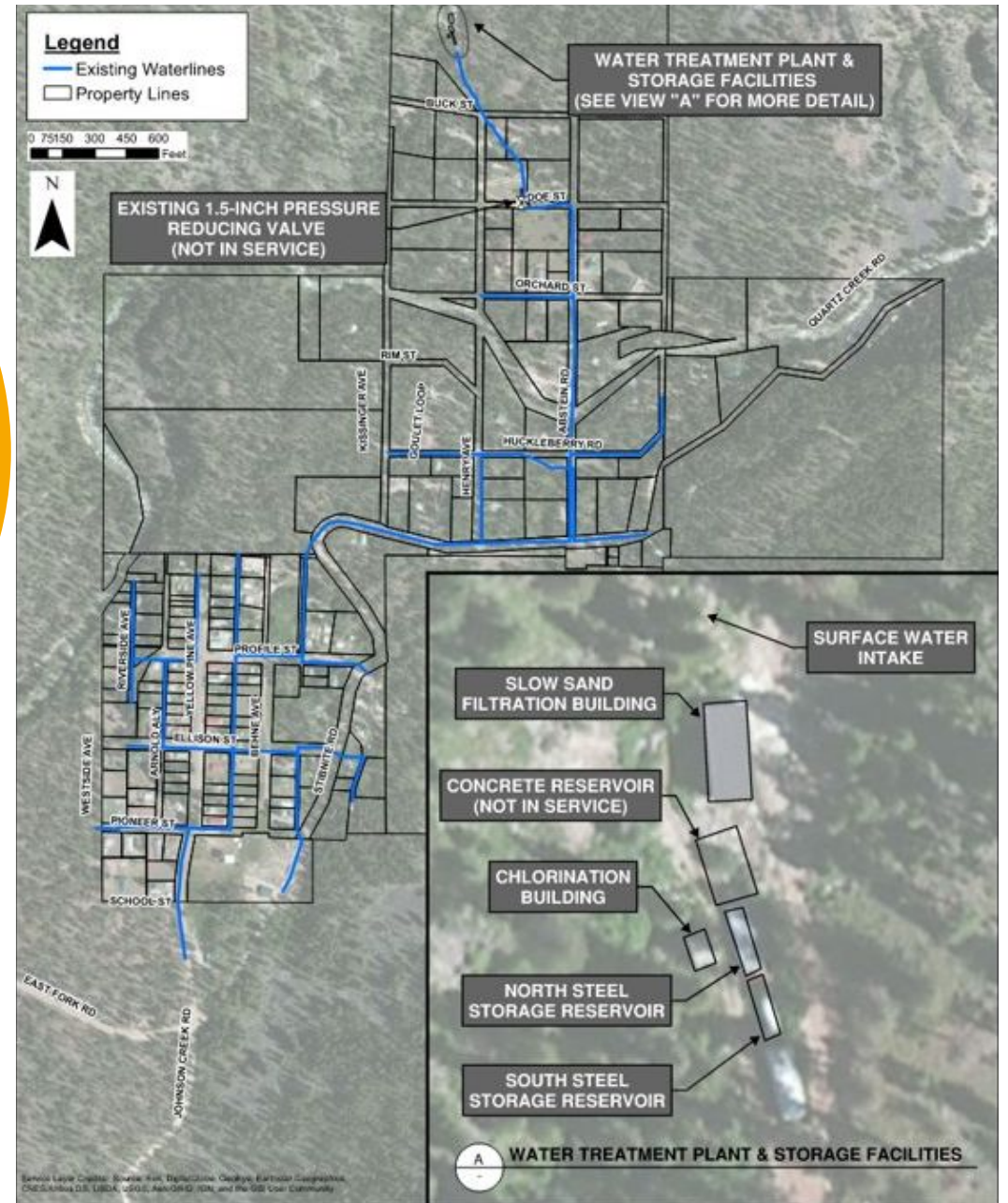
- Originally platted in the 1930s
- Slow sand plant built in 1987
- 30 Full Time Residents
- 80 Residents at Peak
- Annual Harmonica Festival
 - 7/31/2025 – 8/2/2025
- 2 hours from Cascade, 4 hours from Boise



Yellow Pine Distribution System

- Insufficient bury depth
- Excessive leakage
- Mostly installed in 1950's
- Unlined steel pipe from mines in the area
- No isolation valves

Water Main Diameter (in)	Length (ft)
0.75	1,950
1	1,740
1.25	370
1.5	25
2	7,140
6	3,290
Total	14,515 (2.75 miles)



Background

- **Consent Judgement issued in 2009**
 - Deficiencies in slow sand filtration and disinfection
 - Slow sand plant is undersized, insufficient CT
- Project Implementation Schedule accepted by the Attorney General 2010
- Concrete chlorine contact and storage tank, WTP modification project 2014
 - Ran out of funding, tank never connected to system
 - Problems remain
- **Standing boil order issued in 2020**
- **Pilot Study required for state approval of cartridge filtration**

Cartridge Filter Plants

- ❑ Disposable filter cartridges inside pressurized housing
- ❑ Trains of multiple filters with decreasing pore size in each filter
- ❑ May include a roughing filter up front





Comparison

Cartridge Filters vs. Slow Sand

Cartridge Filters

- ❑ Relatively more complex process
- ❑ Smaller footprint
- ❑ Cartridges must be replaced
- ❑ Replacing cartridges relatively simple

Slow Sand

- ❑ Relatively simple process
- ❑ No backwash

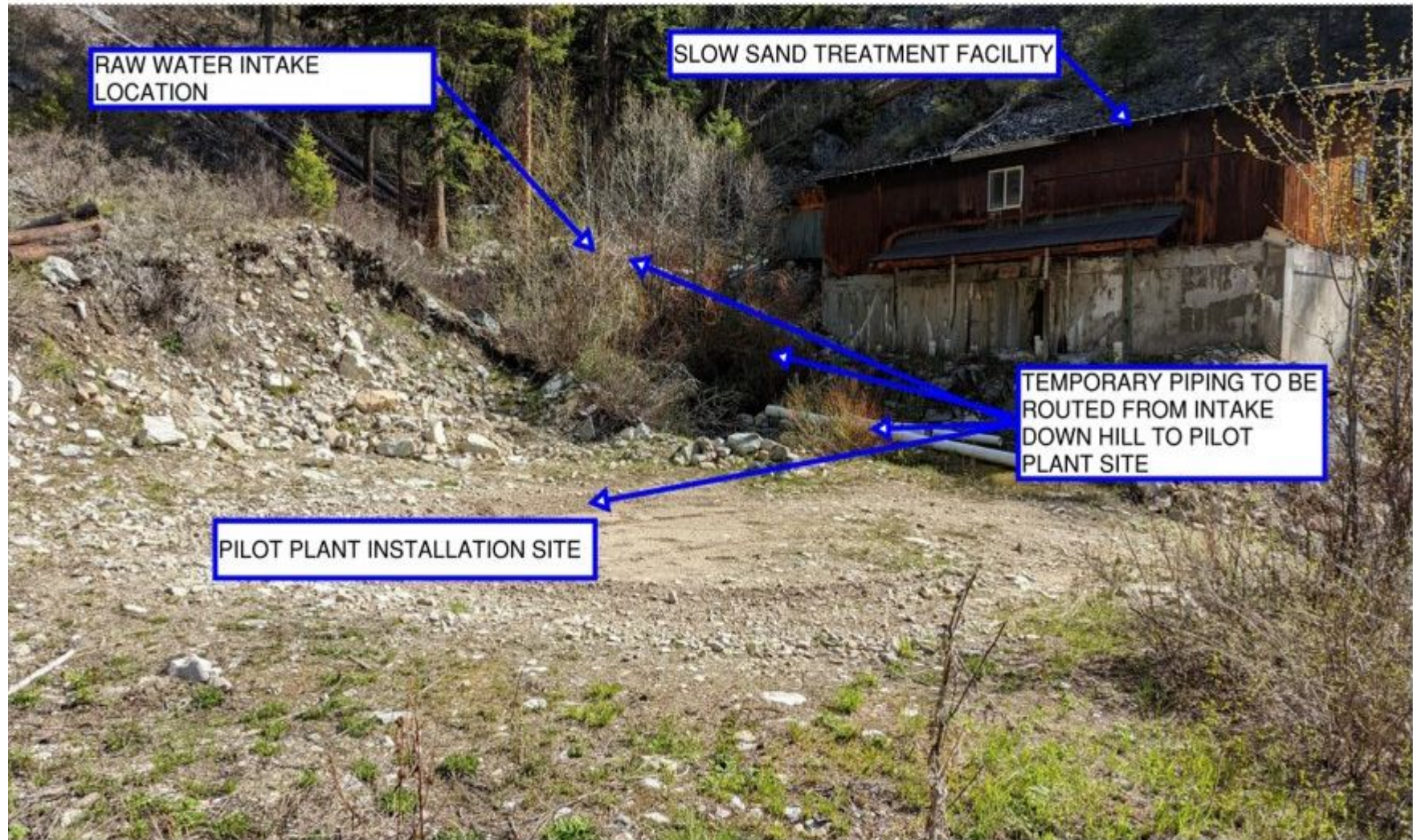
Existing WTP

Existing WTP



Pilot Study Location

Pilot Study Location



Purpose of Pilot Study

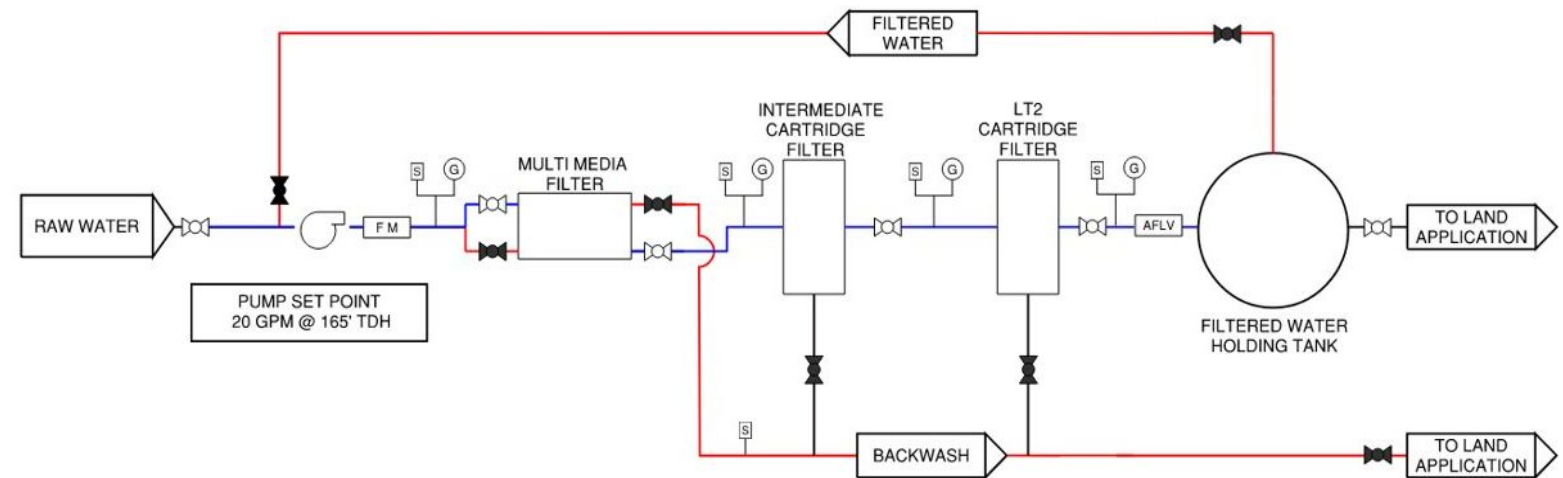
Determine:

- Life span of cartridge filters
- Effectiveness of multimedia filter
- Backwash frequency
- Solids volume from backwash

Purpose

Pilot Test Set-up

Pilot Test Set-up



LEGEND

- BALL VALVE (NORMAL OPEN)
- BALL VALVE (NORMAL CLOSED)
- SAMPLE PORT
- PRESSURE GAUGE
- FLOW METER (INSTANTANEOUS AND TOTALIZED)
- AUTOMATIC FLOW CONTROL VALVE
- NORMAL OPERATION
- FILTER BACKWASH OPERATION

Pilot Study

Pilot Study

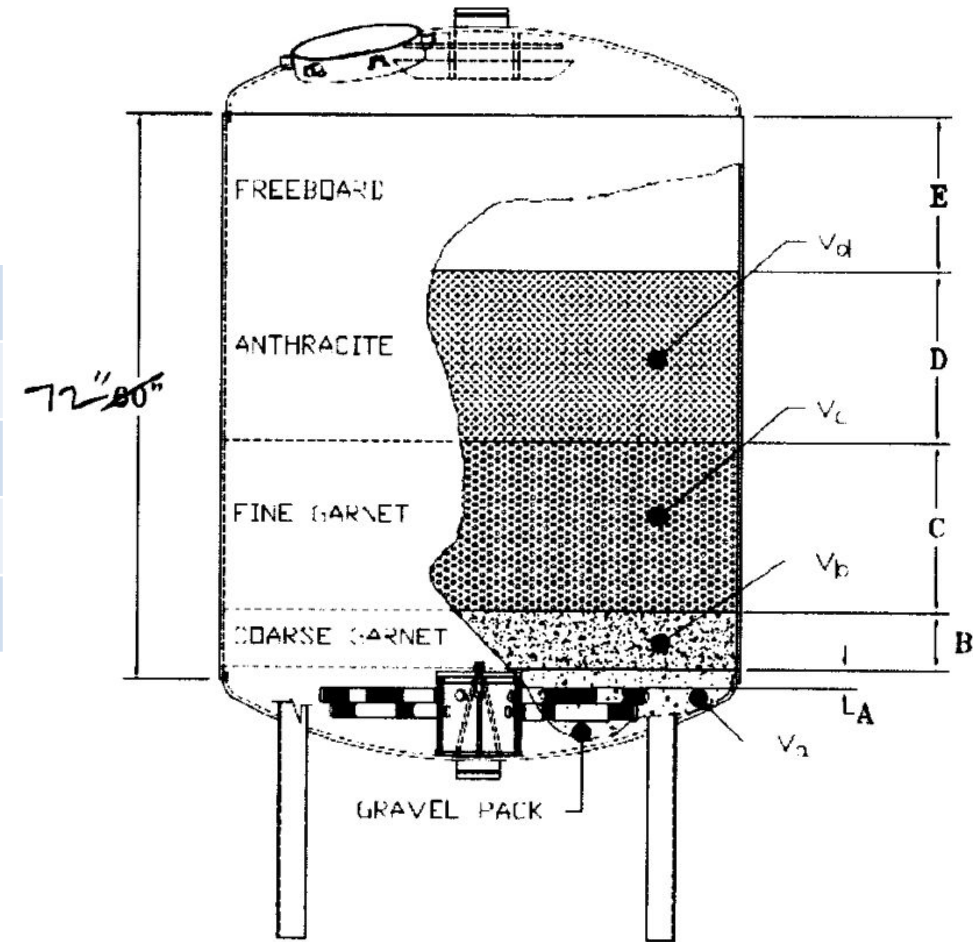


Descriptions of Filters – Multimedia Filter

- Steel Pressure vessel
 - 30" Diameter
 - 72" tall

Filters - Multimedia

A	1/16" – 1/8" Crushed Rock	2"
B	1.5 mm – 0.3 mm Garnet	9"
C	0.15 mm Garnet	20"
D	0.6 mm – 0.8 mm Anthracite	13"
E	Free board	28"



Descriptions of Filters – Intermediate Filter

Phase 1

- HC/40-0.35 Cartridge Filter
- Nominal 0.35-micron filter
- Most effective around 5-micron
- Pleated Polyester

Phase 2

- PP-HC-40-1 Cartridge Filter
- Absolute 1 micron
- Pleated polypropylene



Harmsco® Poly-Pleat™ Series Filter Cartridges

Intermediate Filter



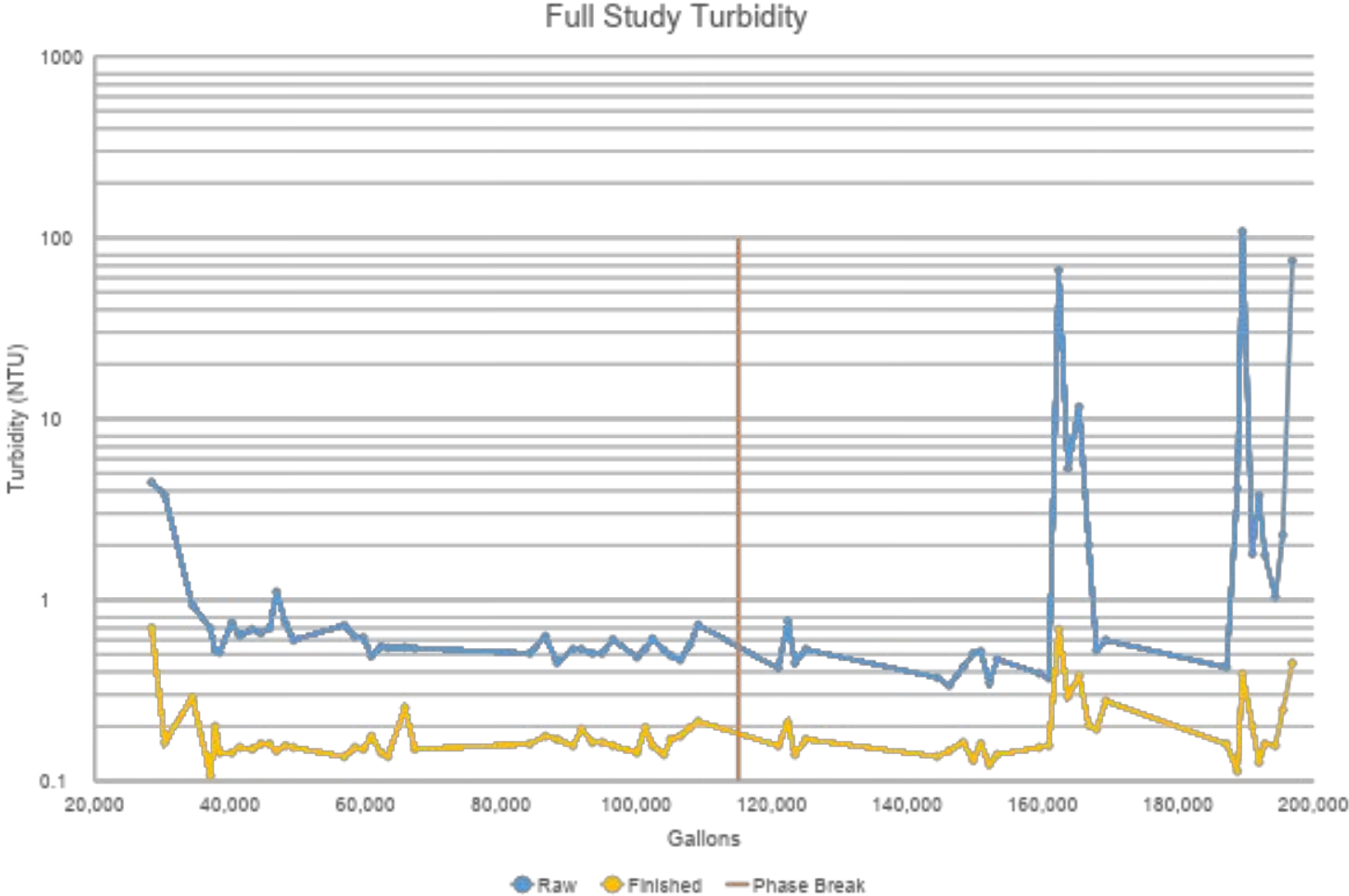
LT2 Filter

Descriptions of Filter – LT2 Filter

- ❑ Long Term 2 Enhanced Surface Water Treatment Compliant Filter
- ❑ 3 log removal of cyst sized particles
- ❑ 3rd party certified 1-micron filter
- ❑ Challenge tested for *Giardia* and *Crypto*
- ❑ Required for regulatory compliance

Turbidity Results

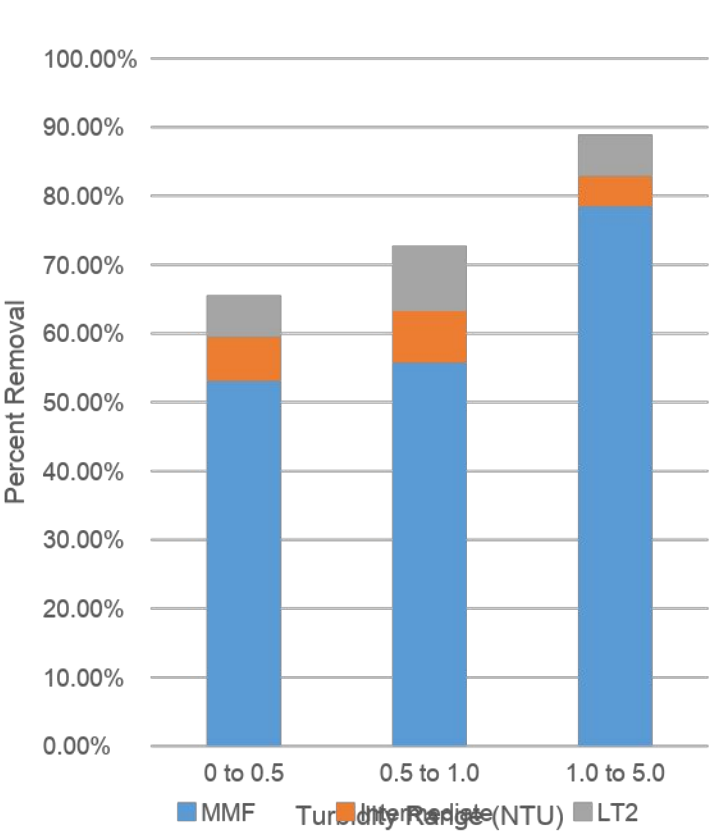
Turbidity Results



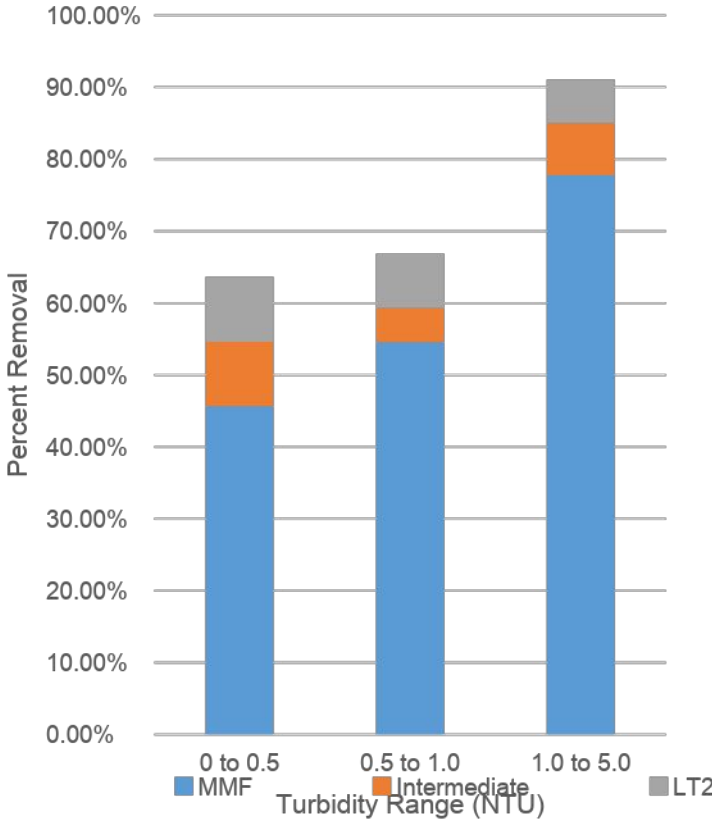
Filter Performance – NTU Percent Removal

Filter Performance

Phase 1 Filter Performance

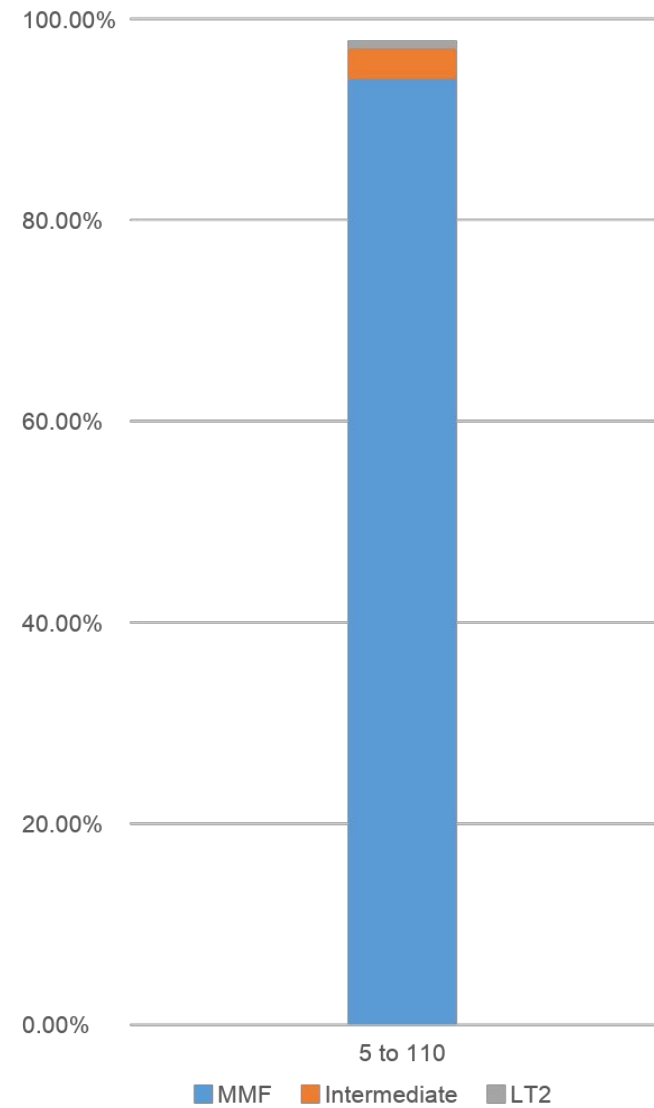


Phase 2 Filter Performance



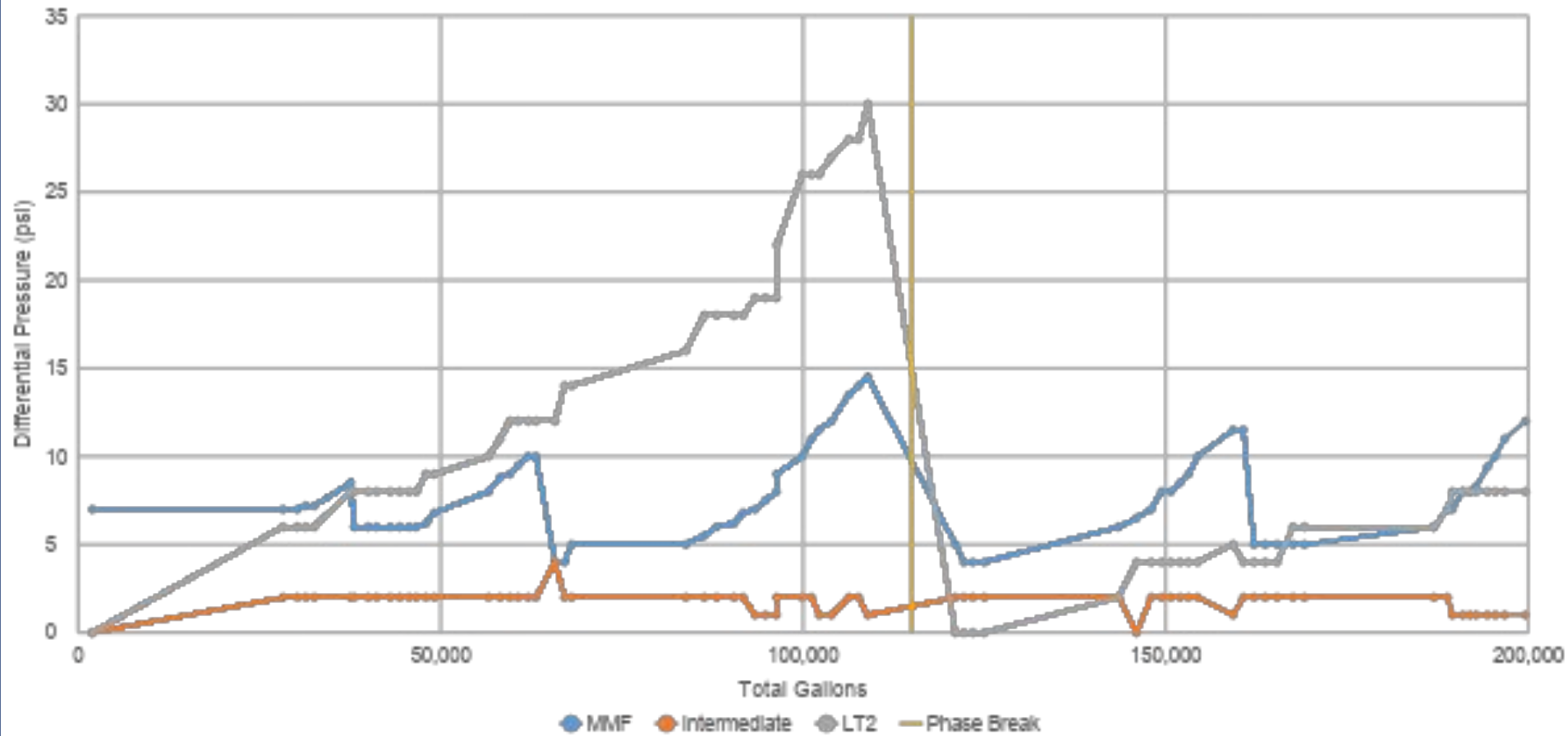
Filter Performance

Filter Performance – NTU Percent Removal



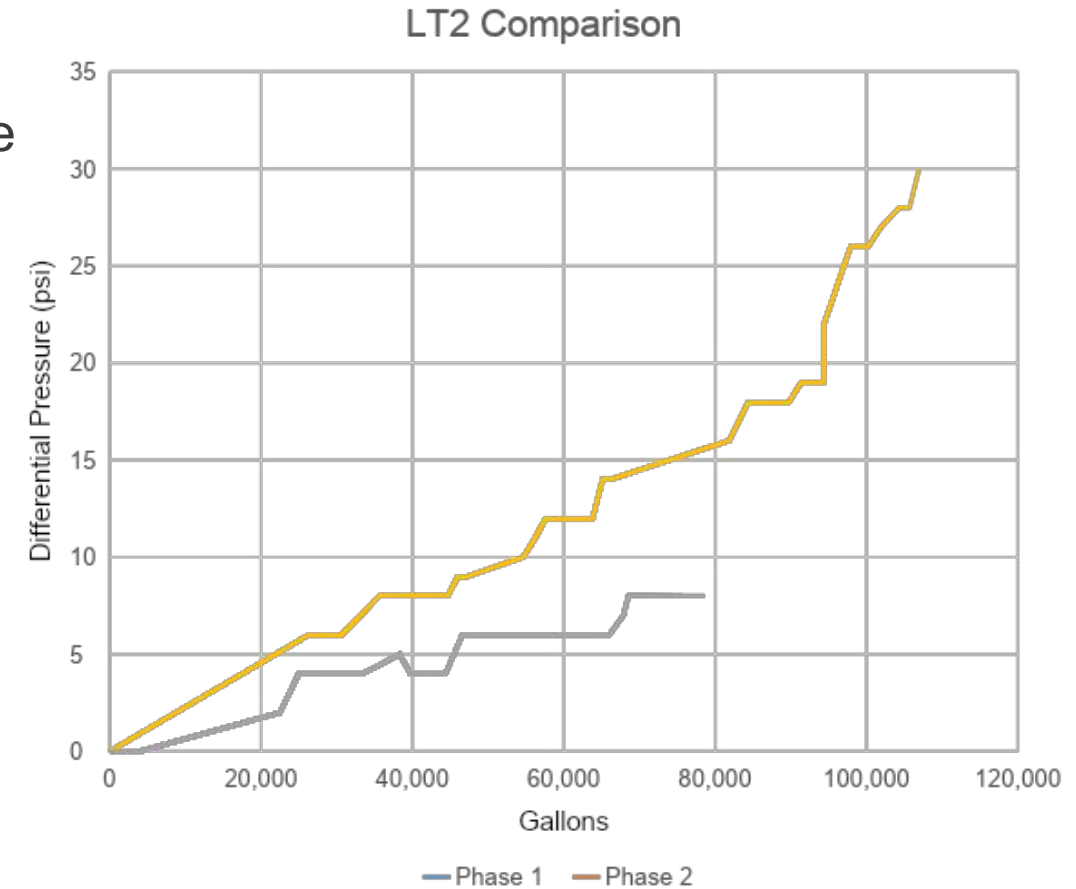
Differential Pressure Results

Pressure Results



Results

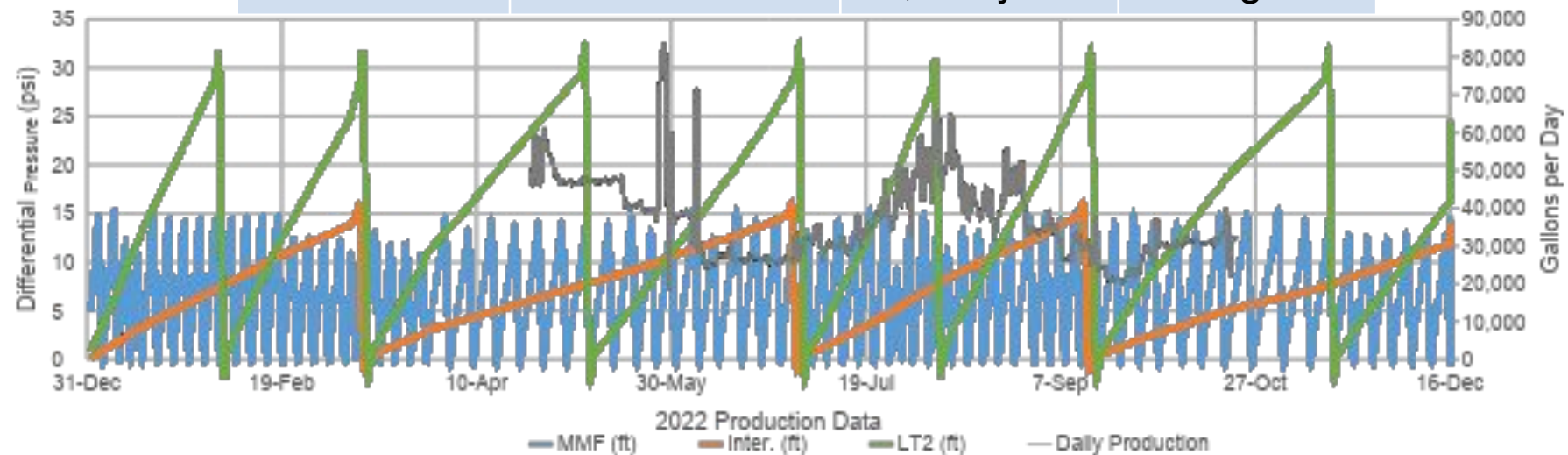
- Multimedia Filter did most of the heavy lifting
- Changing the intermediate filter from a ~5 to a 1 μm improved LT2 filter life by 2x



Expected Filter Life

At full buildout:

Filter	Average Lifespan	Per Filter Train Cost	Cost/gal
MMF	5 Days	0	0
Intermediate	~90 Days	\$400/filter \$1,600/year	\$0.10 / 1000 gal
LT2	~45 Days	\$650/filter \$5,200/year	\$0.40 / 1000 gal



Expected Filter Life

Multimedia Filter Backwash Settling

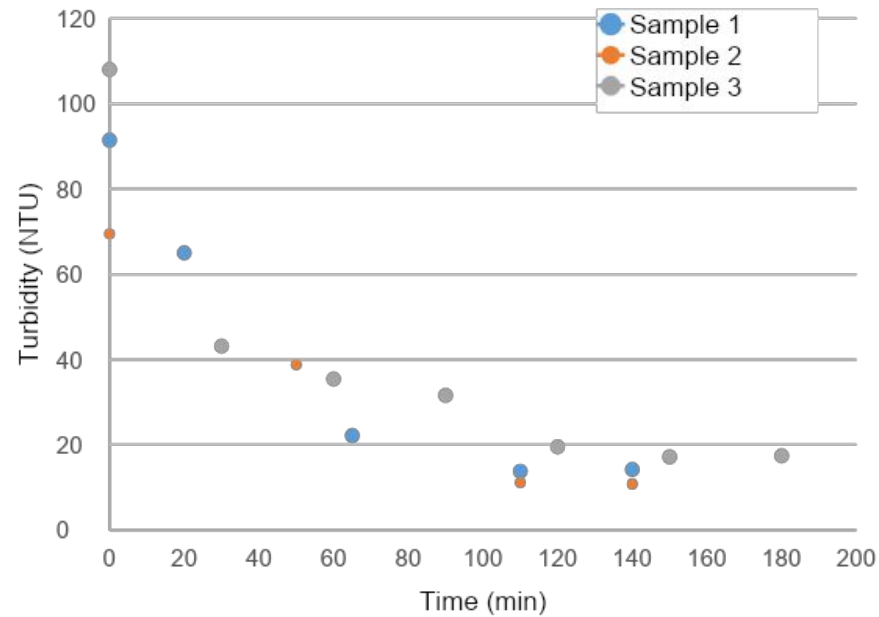
Backwash Settling



Pictures are 4 hours apart

Backwash Settling Testing

- Majority of turbidity settles out within 2 hours



Date	Raw Water TSS (mg/L)	TSS Backwash (mg/L)	Finished Water TOC (mg/L)	Finished Water Free Chlorine Demand (mg/L)	Finished Water Total Chlorine Demand (mg/L)
8-Jun	3	N/A	1.09	0.09	0.3
12-Jun	3	93	1.09	0.15	0.36
15-Jun	ND	166	0.9	0.18	0.36
17-Jun	14	219	0.85	0.1	0.26
Average	6.7	159.3	1.0	0.1	0.3

Backwash Settling Testing

Backwash Treatment and Handling

- ❖ Sewerage available?
- ❖ Discharge permit?
- ❖ Recycle and return?



Pilot Test Results

Pilot Test Results

- ❑ **Cartridge filtration is feasible**
- ❑ Estimated cartridge life exceeds 45 days
- ❑ Filter cost is \$0.50/1000 gal
- ❑ Approximately 1,500 gal. of backwash per cycle
- ❑ Estimated 10 lbs. of solids produced per backwash



Lessons Learned

Lessons Learned

- ❖ Multimedia filter is the backbone of the filter train
- ❖ On/off switch for the pump near the pump
- ❖ Testing window may be dependent on lodging availability!
- ❖ Leave more space near the pilot



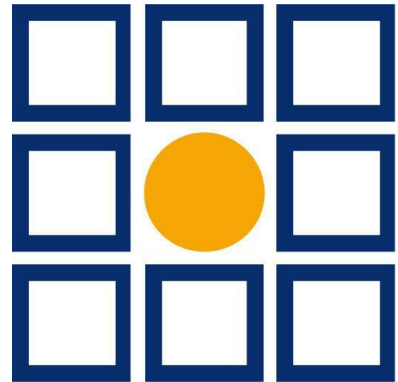
What can we improve next time?

- Continuous data logging
- More testing of the intermediate filters

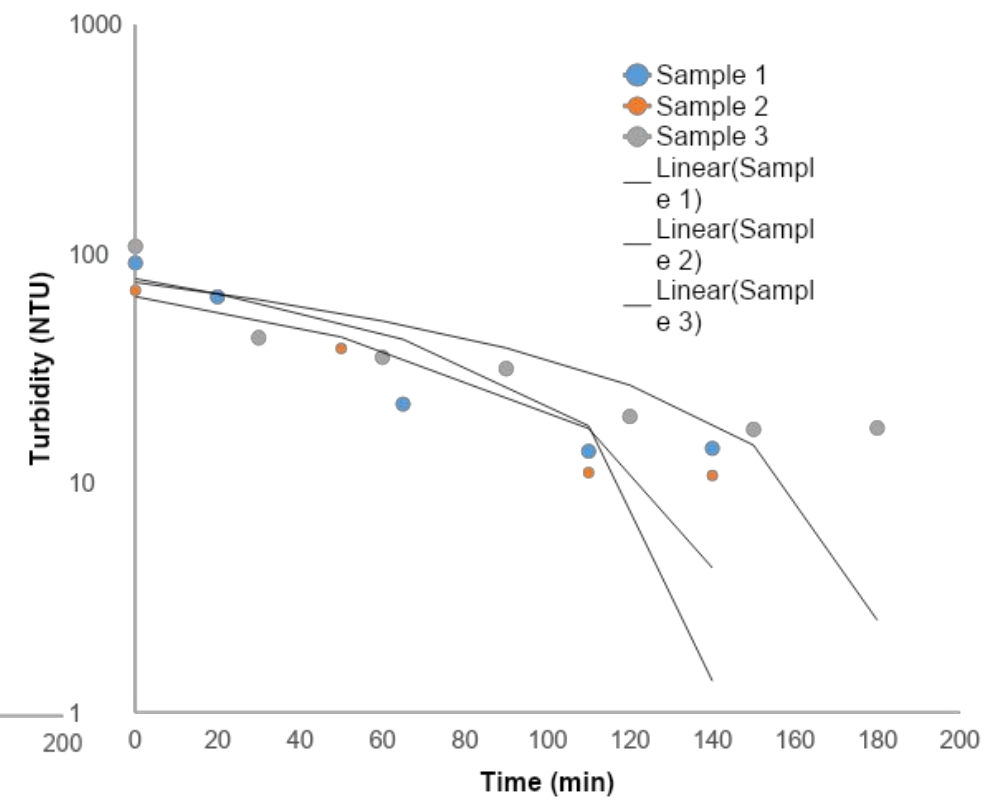
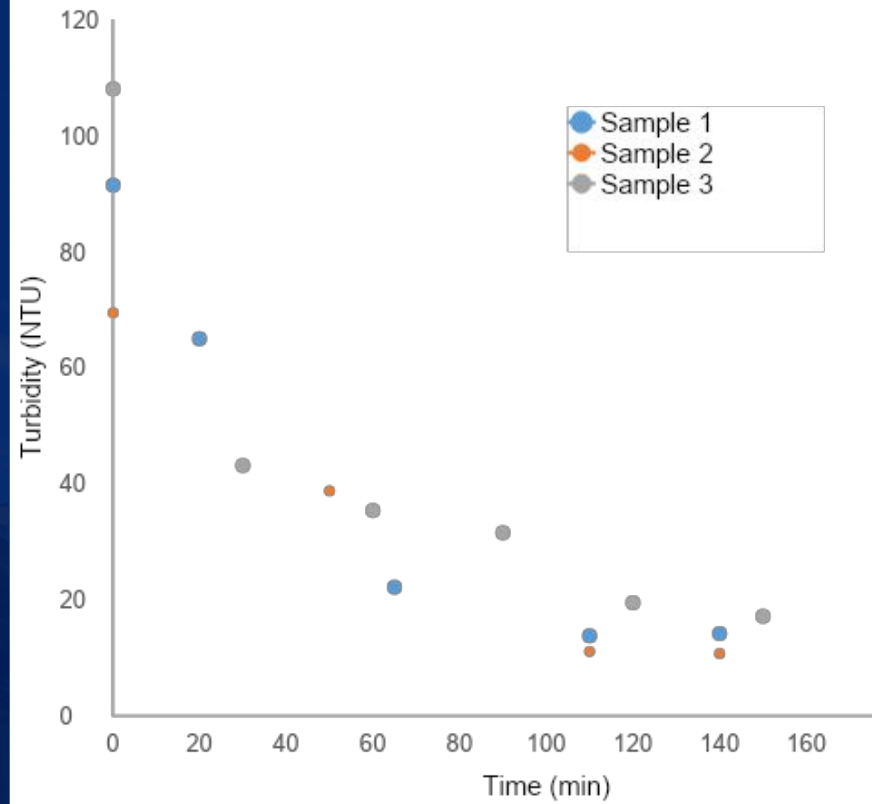
Improvements

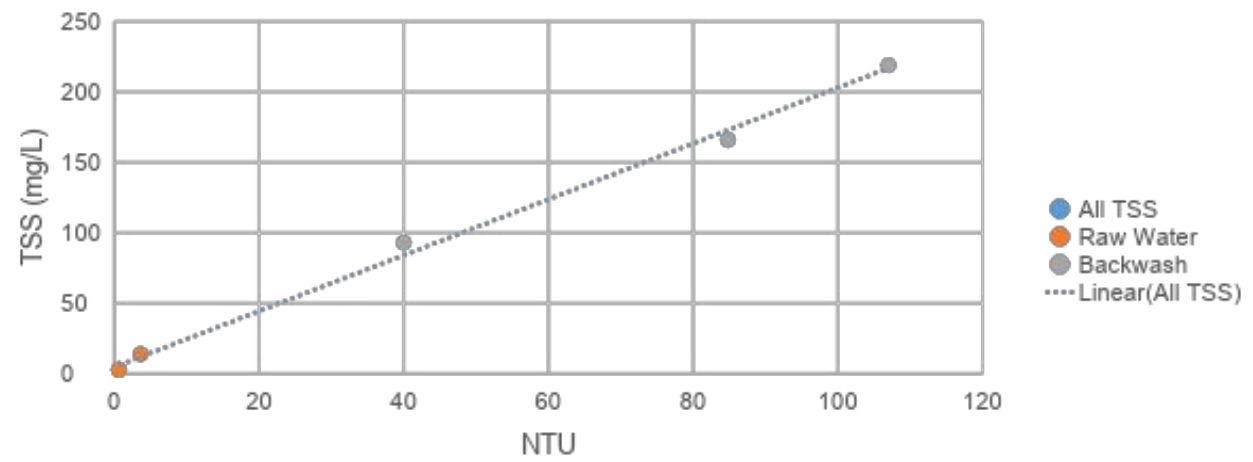
Questions?

Questions



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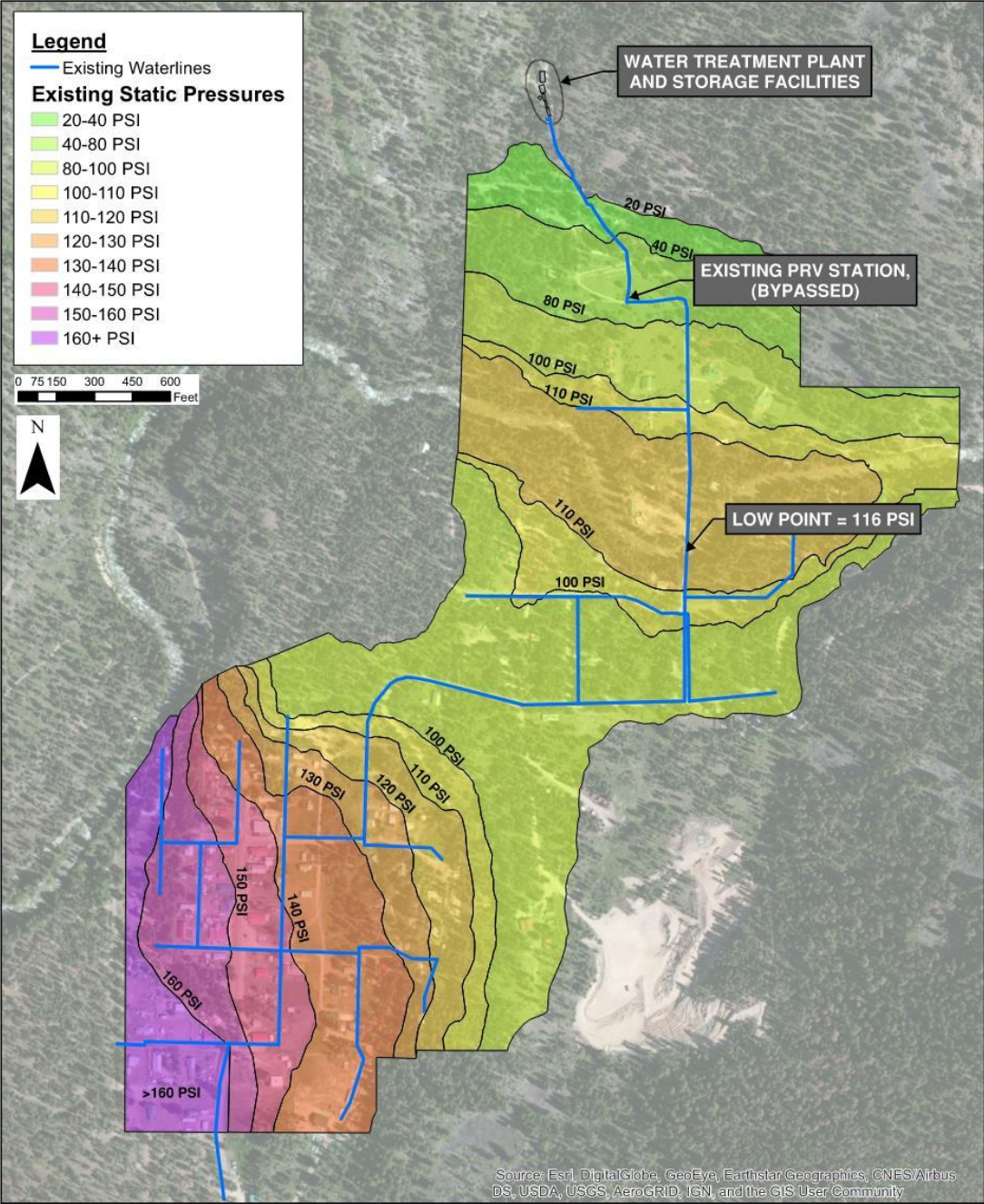
Leakage Estimates

Parameter	Design Demands (gpd, Table 3-4)	Current Production (gpd)	Water Loss	
			Volume (gpd)	% of Production
Base (Winter) Demand	5,000	45,000	40,000	89%
Annual Average Day	22,000	43,000	21,000	49%
Maximum Day	88,000	117,300	29,300	25%

Yellow Pine Distribution System

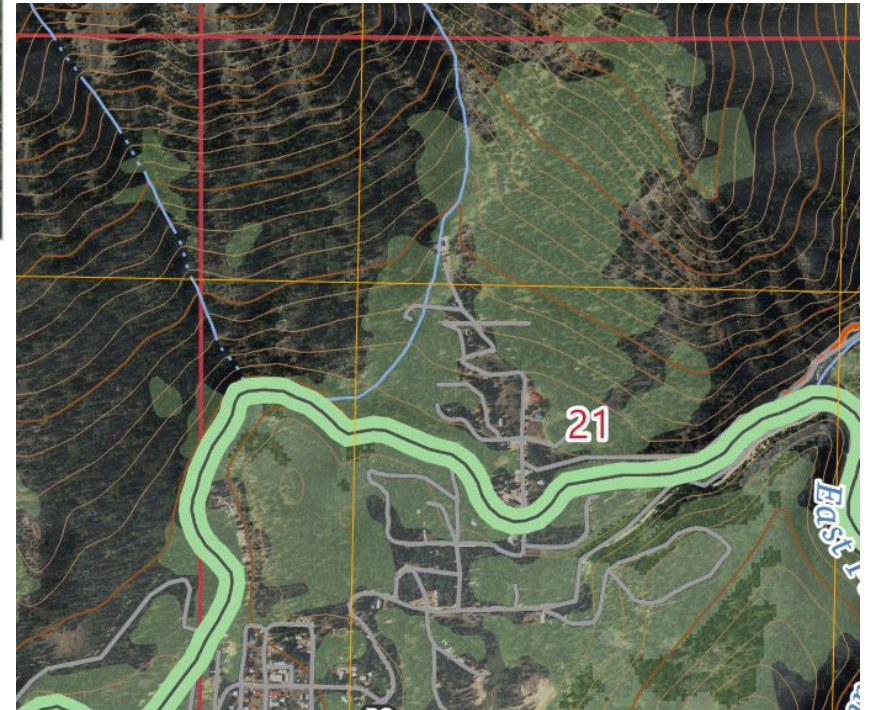
- Due to the small diameter distribution pipe
- PRV installed in 2023

Parameter	Reservoir Water Level Range	Highest Connection	Lowest Connection
Elevation (ft)	5,112 – 5,120	5,088	4,750
Pressure (psi)	0	10 – 14	157 – 160



Surrounding Terrain

Terrain



Existing WTP

Existing WTP – Various Views



Pilot Study

Pilot Study



Existing WTP - Various Views

Existing WTP



Existing WTP – Various Views

Existing WTP

