



PORTLAND WATER BUREAU

PREPARING PORTLAND'S DISTRIBUTION SYSTEM FOR FILTRATION

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Presentation Agenda

- PWB Distribution System and UDF Background
- Why UDF to Prepare the Distribution System?
- What have we learned so far?
- Wrap-up and Questions



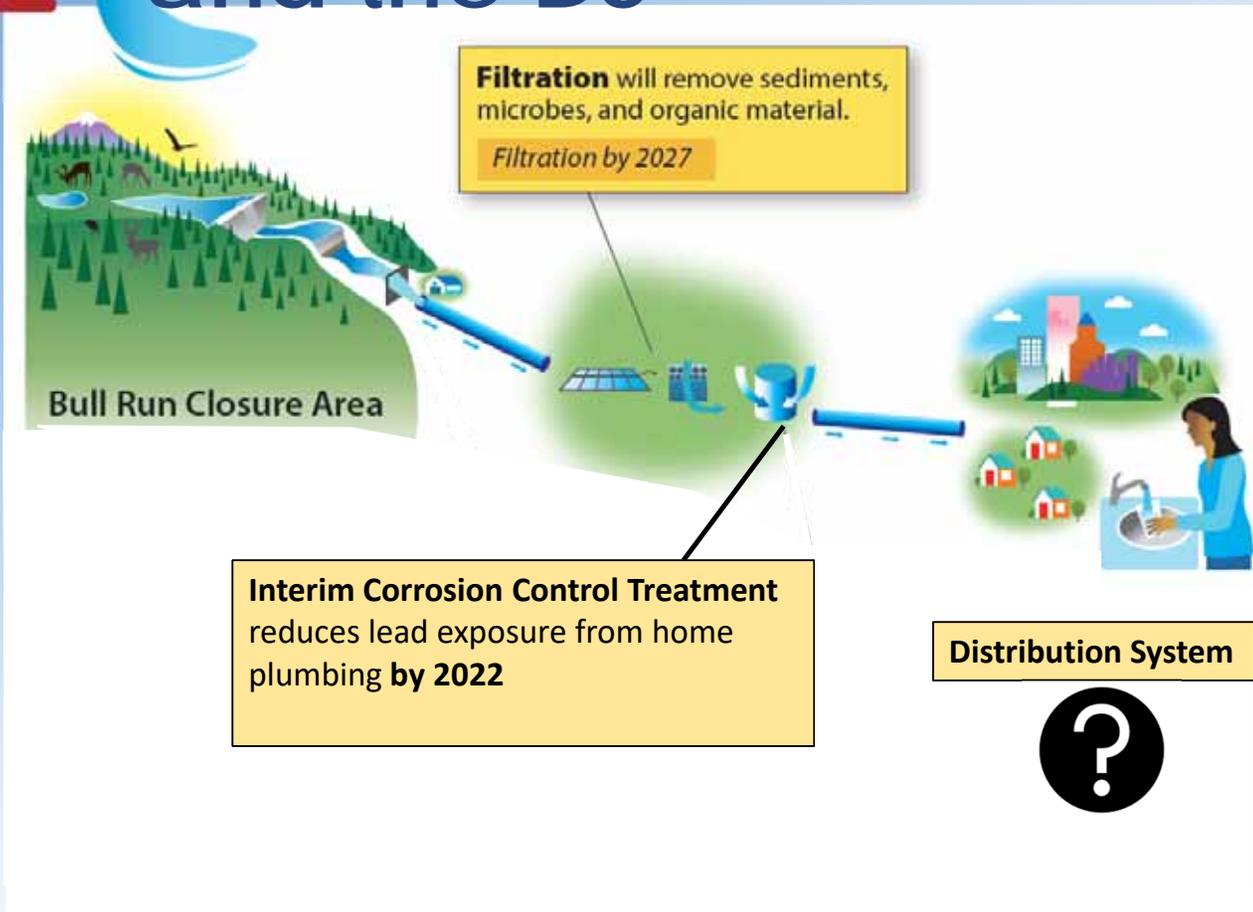
PWB Distribution System

- DS is more than 100-years old
- More than 2,200 miles of distribution mains
 - Ranging from 2-in, up to 56-in
 - 20-miles of conduits between the Bull Run Watershed and COP
 - DS primarily consists of unlined cast iron (UCI) and ductile iron (DI)
 - ~65% UCI
 - ~32% DI
 - More than 55,000 system valves
 - Almost 15,000 hydrants





Bull Run Treatment Projects and the DS



- Changes in treatment will impact the stability of the DS
- How do we stabilize the DS?



Conditions that Impact Water Quality Stabilization

- Water age / Water Use
- Direction of flow
- Pipe material (UCI vs DI vs plastic) and pipe age
- Source water quality
- Sediment and Solids

Impact of Sediment and Corrosion By-Products

- Colored water events
 - Aesthetically displeasing water
- Increased disinfectant demand – decreases disinfectant residual
- Facilitate biofilm growth
 - Nitrification
 - Reduced DS pH



How Do We Flush the DS to Remove Sediment



Spot Flushing

Moves stagnant water and helps to maintain better chlorine residuals.



Autoflusher



Unidirectional Flushing

Cleans out sediment and biofilms that build up due to aging pipes and an unfiltered source water.



Polling Question #1

What % of the PWB distribution system is unlined cast iron?

- 32%
- 55%
- 65%
- 82%



Timeline of UDF Expansion

Compliance Agreement May 2017 – Corrosion Control

Participated in a Water Research Foundation (WRF) study focused on flushing

Bi-lateral Compliance Agreement Dec 2017 - Filtration



Water Research Foundation Study Outcomes

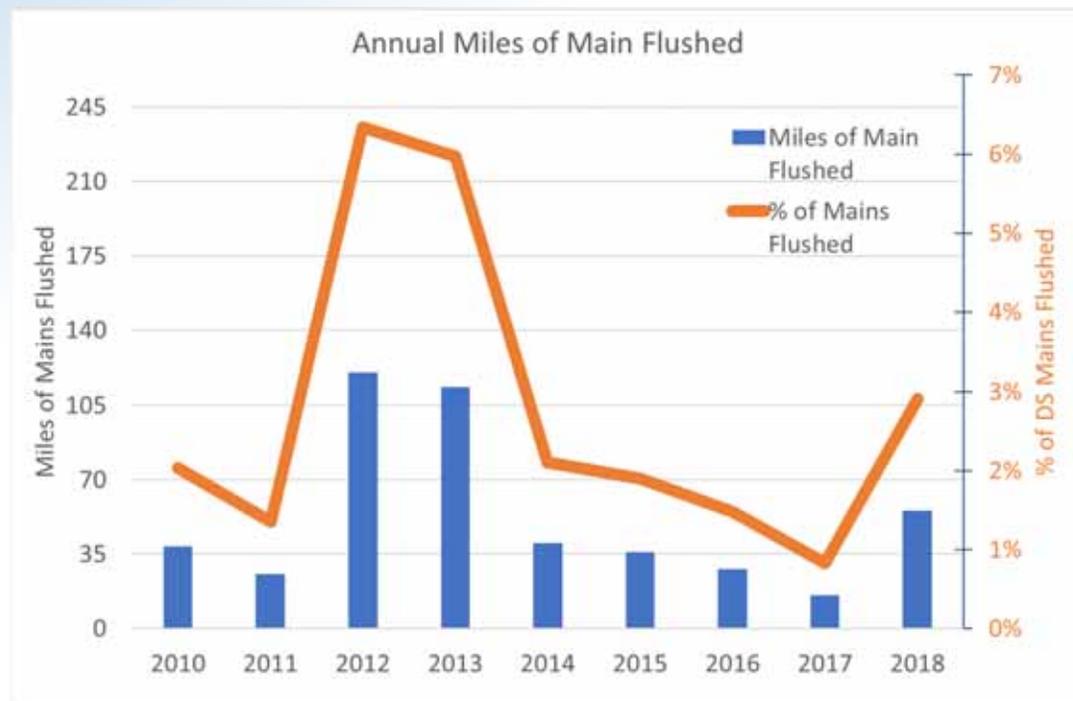
- Developed the backbone of our flushing protocol including:
 - Scouring velocity
 - Flushing duration and water efficiency
 - Water quality parameters
 - Flushing from a Clean Water Interface (CWI)
- Provided insight into the effectiveness of UDF and other flushing methods for removal of:
 - Sediment
 - Corrosion By-products
 - Biofilm



System Turnover

Clean the distribution system before operation of the new water treatment plant in September 2027.

- Pre-2019
 - Limited effectiveness
 - Average **50-year** turnover
- New Program Goal
 - Average ~ **240** miles/year





History of UDF Expansion at PWB

- Pre-2019
 - UDF consisted of one field staff and a coordinator
 - Primary focus was water quality driven mitigation (turbidity events, nitrification, etc.)
- 2019
 - Field-staff expanded to eight
 - One coordinator
 - Consultant contract - Program development and hydraulic modeling support
- 2020
 - Engineer added for in-house hydraulic modeling



Miles of Main Flushed





Estimating Mass Removed



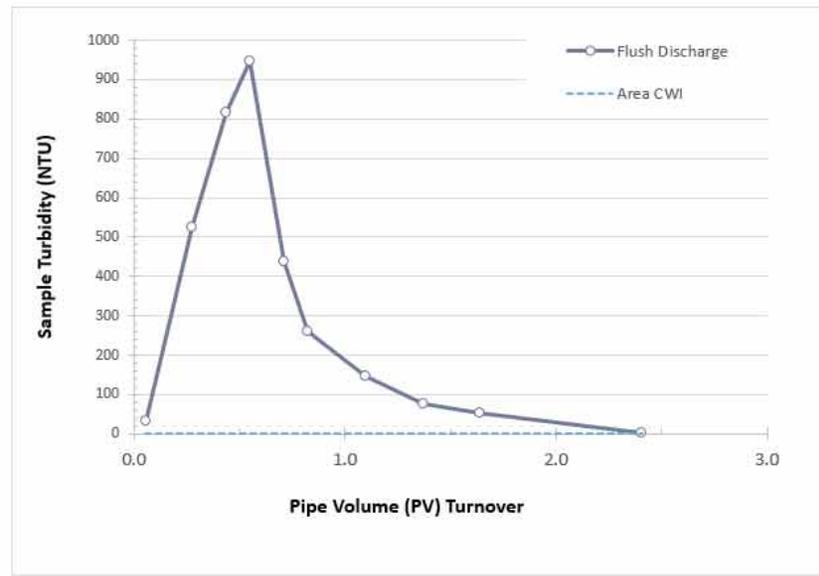
Unidirectional Flushing Dashboard Tool to Estimate Deposit Mass Removed

Year	2020
Pressure Zone ID	138
Flush Area ID	209
Sequence	6
Pipe/Lining Type	CI
Sequence Length	1,291 feet
Pipe Diameter	12.00 inch
Flow Rate Achieved	830 gpm
Velocity Achieved	2.35 ft/s
Area CWI Turbidity	1.93 NTU

Nominal Mass Removed	47.22 pounds
Length-Normalized	193.11 lbs/mile
Volume-Normalized	746.06 mg/L

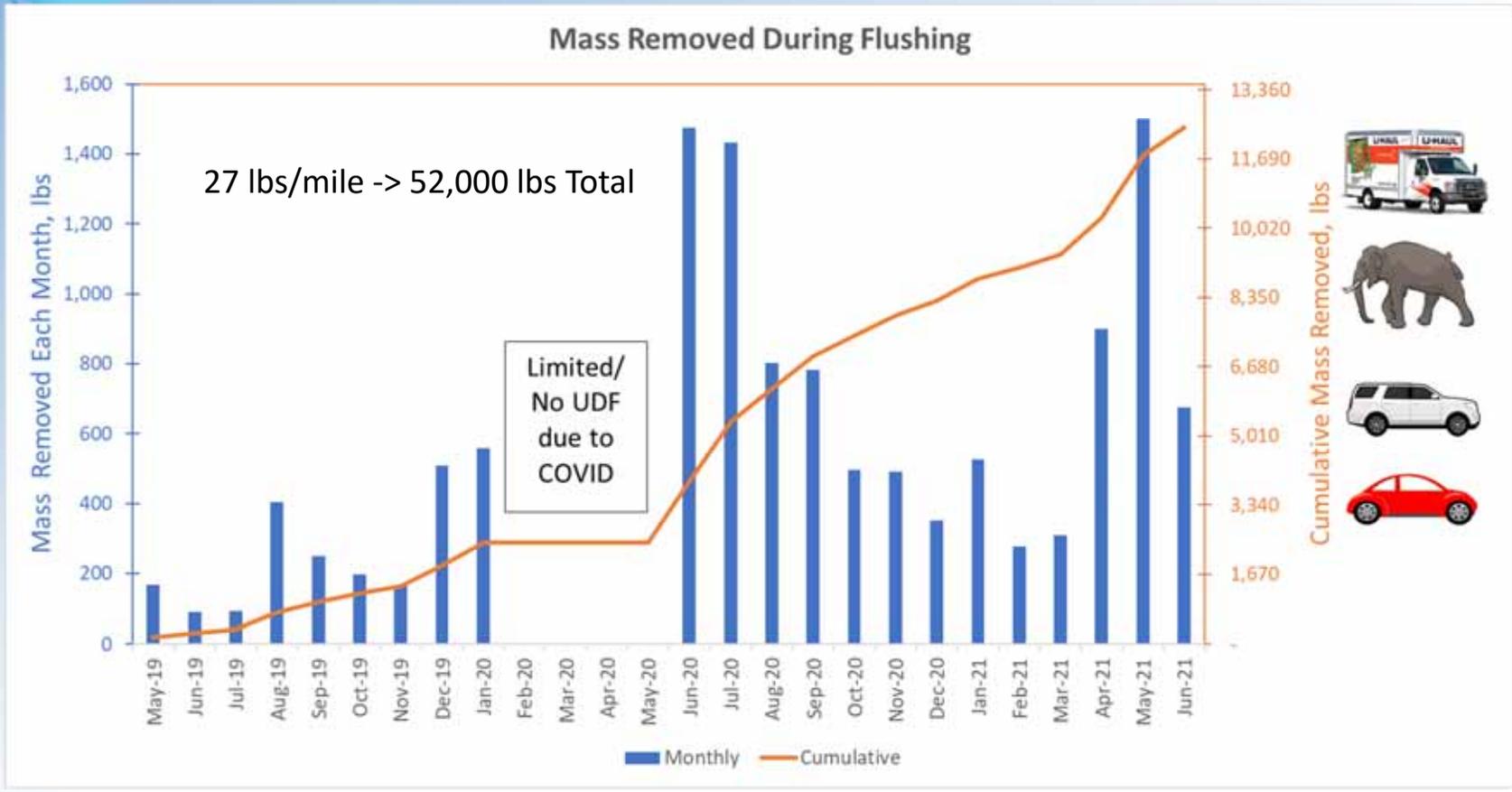
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Grab Sample (#)	Elapsed Flush Time (min:sec)	Sample Turbidity (NTU)	Pipe Volume Turnover (PV)
#1	00:30	31.9	0.05
#2	02:30	526.0	0.27
#3	04:00	817.0	0.44
#4	05:00	948.0	0.55
#5	06:30	437.0	0.71
#6	07:30	261.0	0.82
#7	10:00	146.0	1.09
#8	12:30	74.7	1.37
#9	15:00	54.2	1.64
#10	22:00	3.1	2.41

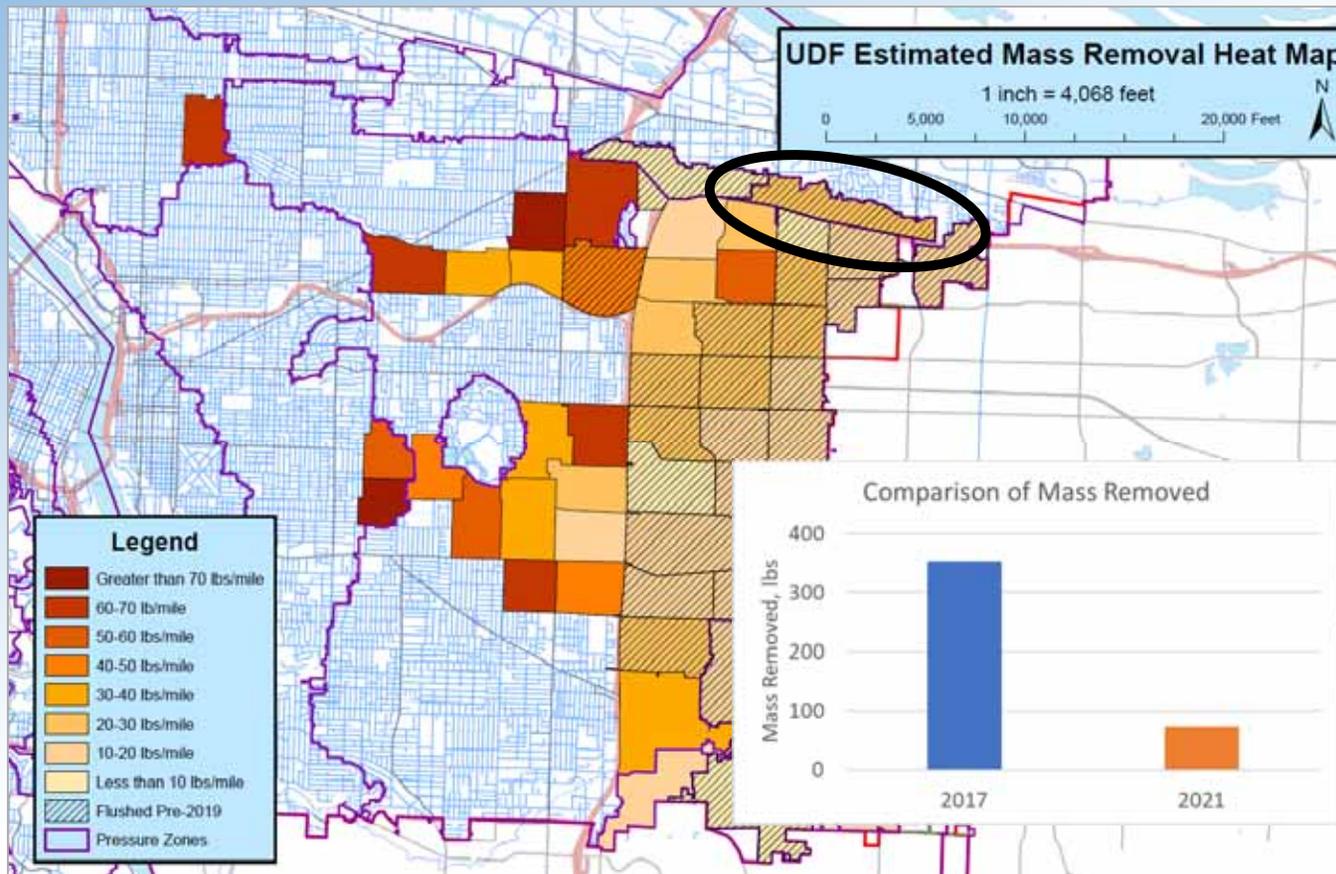




Mass Removed from the DS



Geographical Representation of Sediment Load in the DS





Polling Question #2

What mass of solids have been removed from the PWB distribution system to date?

- 5,000 lb or an SUV
- 8,000 lbs or an Asian elephant
- 3,000 lbs or a sedan
- 12,000 or a U-haul truck



Moving Forward

- Continue to collect data to assess the effectiveness of flushing
- Use a data driven approach to guide flushing protocols moving forward
- Flush the remaining 75% of the DS by Sept. 2027



Thank You