Impacts of Siting Water Infrastructure in Flood-Prone Areas

A Case Study of the Willamette Valley

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Agenda

- A primer on floodplains
- Willamette Valley Case Study
  - Overview
  - Green Peter / South Santiam
  - Detroit / North Santiam

01

A Primer on Floodplains

Floodplain Primer

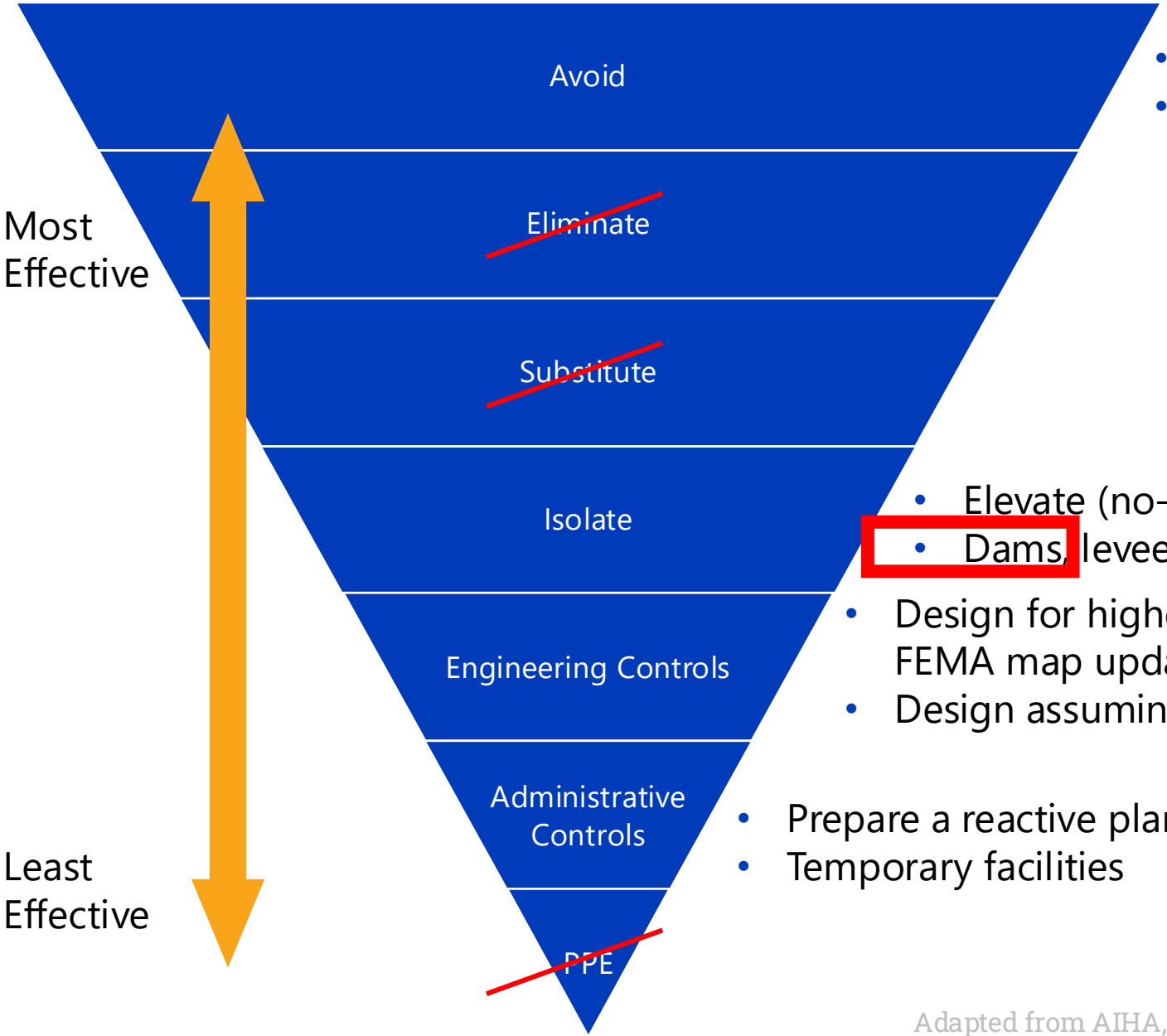
Why consider being in/near floodplains?

- Proximity to:
  - Water!
  - Communities
  - Transportation corridors

Risks

- Erosion
- Facility damage
- Floodwater undesirable quality
- Local infrastructure damage
- Dammed reservoirs

What Do We Do About Floodplains?



- Groundwater
- Move uphill

- Elevate (no-rise considerations)
- Dams, levees, flood walls, etc.
- Design for higher flood year (last FEMA map update?)
- Design assuming floods will happen

- Prepare a reactive plan
- Temporary facilities

Adapted from AIHA, *Hierarchy of Controls*, 2024

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02

Willamette Valley Case Study

A deeper dive into isolation



Setting the Scene



Corey Kipp, PE
Carollo Engineers

Design Manager/Project Manager



DeEtta Fosbury, RG
Summit Water Resources

Senior Hydrogeologist

City of Salem



Finned Friends

United States Army Corps of Engineers (USACE)

Willamette Valley System Dam Operators



Willamette Valley water suppliers

Willamette Valley System (WVS)

- 13 dams
- Operated by USACE
- **Primary purpose: flood control**
- Secondary purposes:
  - Hydroelectric
  - Recreation
  - Seasonal water storage



Source: USACE

Willamette Valley Deep Drawdowns

- Biological opinion by National Marine Fisheries Services (NMFS) indicated endangered salmon species are at risk due to dams in WVS
- Interim injunctive relief measures until permanent solution is in place (e.g. fish ladder) – drawdown dams (lower water operating levels) to allow for juvenile fish passage



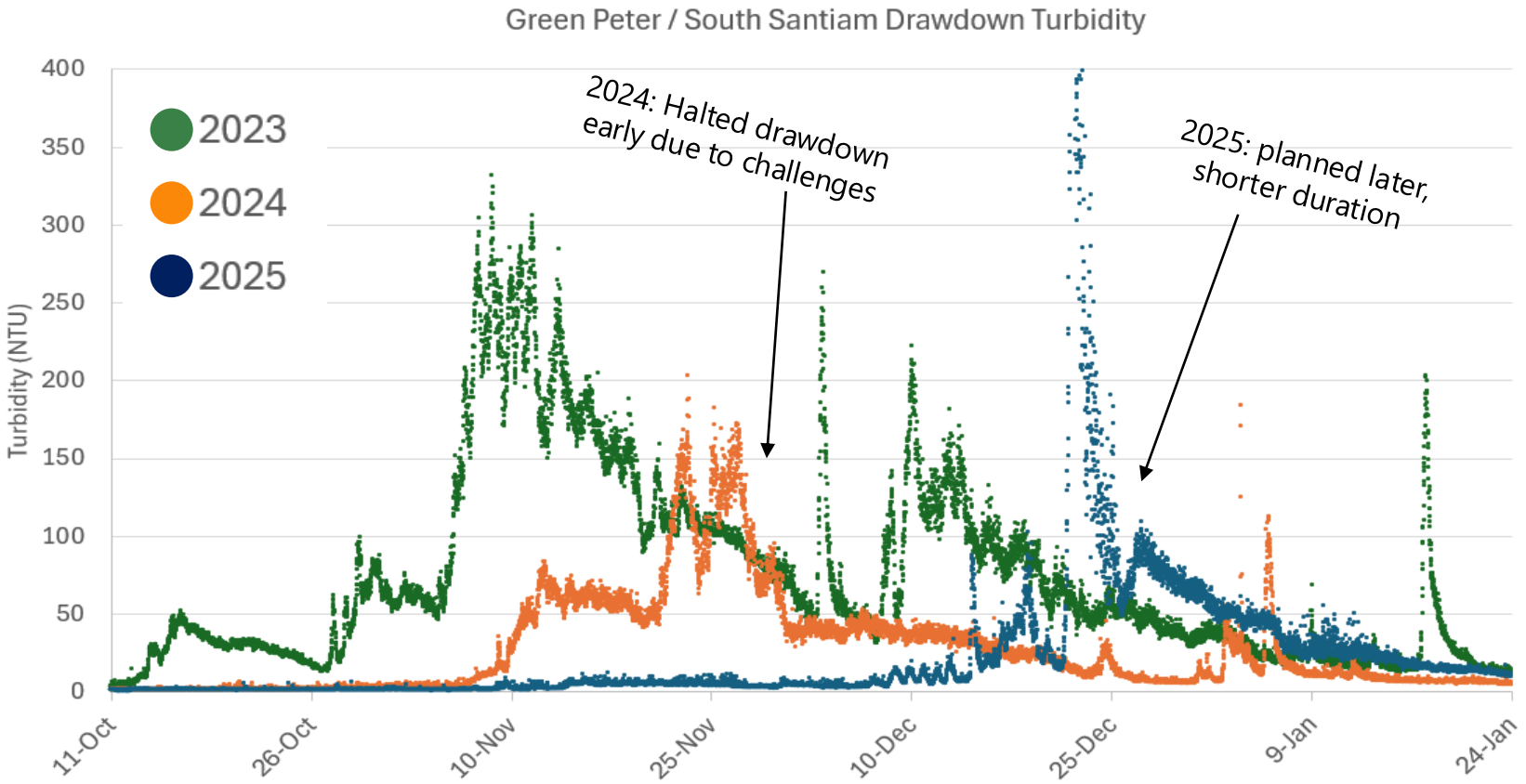
Historical Impacts and Locations of Deep Drawdowns

Reservoir Drawn / River	Supplied Water Treatment Plants	Measured Stream Sustained Turbidity (NTU)	Measured Stream Peak Turbidity (NTU)
Green Peter / S. Santiam	Lebanon Sweet Home Albany(1) Jefferson(2)	100+	200+
Cougar / McKenzie(3)	EWEB Springfield (planned)	150-200+	250-400
Detroit / N. Santiam	Salem Stayton Lyons Mehama Gates Jefferson	TBD Fall 2026 USACE modeling: 40-100% increase in sediment transport	
Lookout Point and Fall Creek / Middle Fork Willamette	Springfield Lowell EWEB (planned)	100+	400-800

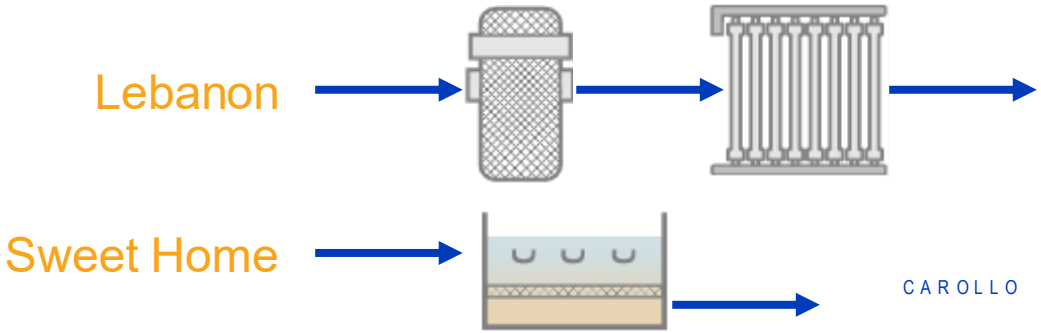
1) Supplied by both the South Santiam River and the combined Santiam River
2) Supplied by combined Santiam River
3) Includes Cougar Reservoir 2002-2004 deep drawdown
4) Turbidity Data Source: USGS, OHA
5) Assuming 1 FNU = ~1 NTU

Normal river turbidity: ~0.5-5 NTU

Green Peter / South Santiam Deep Drawdowns



- Rapid plugging of filters
- Challenges meeting water demand
- Combined $37M in claims against USACE



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Detroit Deep Drawdowns

- USACE modeling for Detroit: 40-100% increase in sediment transport

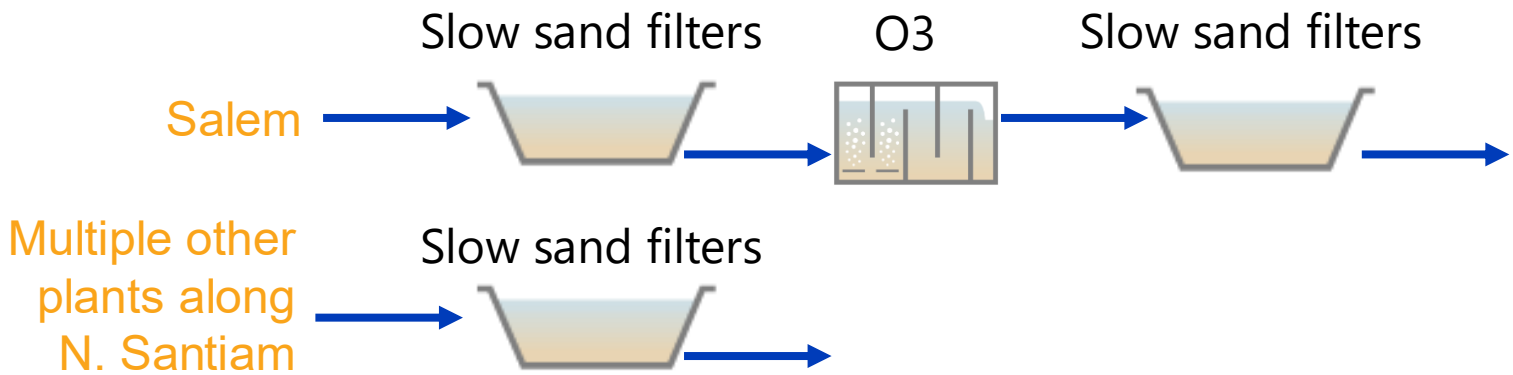


Table 1.1 Recommended Upper Limits of Feedwater Turbidity to Slow Sand Filtration Systems

Recommended Upper Limit of Feedwater Turbidity into SSF (NTU)	Reference
<10	Environmental Protection Agency (EPA), 2024
5-10(1)	Collins, Youngstrom, and Broder, 2012
<10	AWWARF, 1991

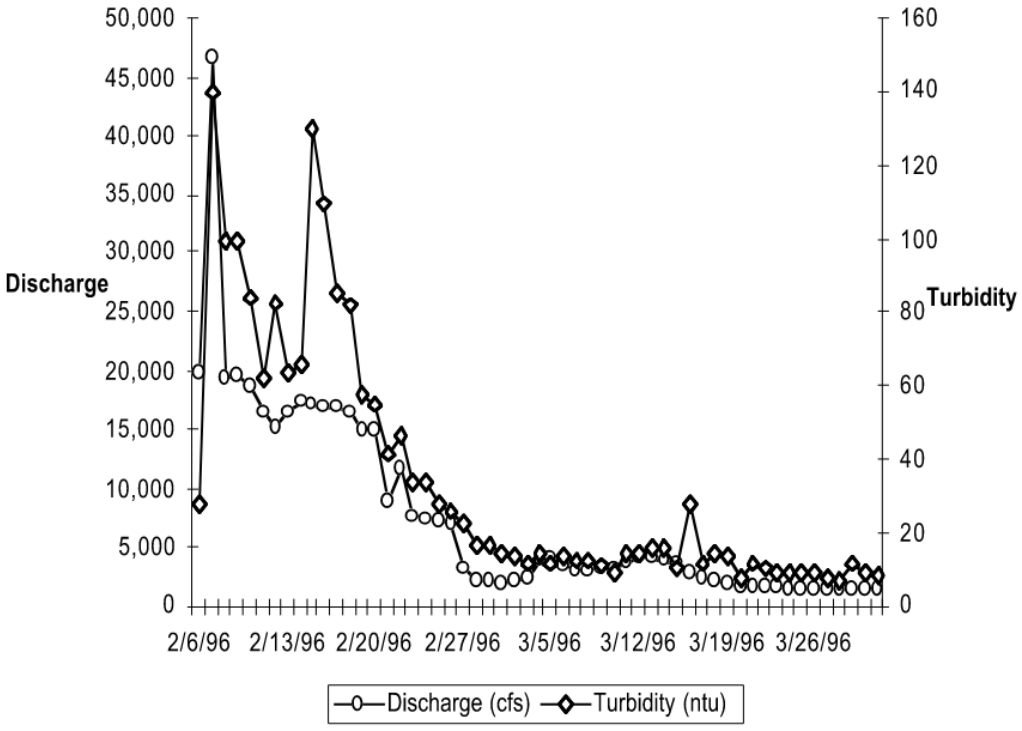
Notes:
(1) Presence of clay particles must be evaluated.

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Geren Island Water Treatment Plant – Salem, OR

- Slow sand treatment process – elegant solution during normal pristine mountain runoff
- 2018 algal toxin event > addition of ozone, ranney well, and rebuild of Filter 2

- Limited case studies for slow sand filters under turbidity loading
  - **Best case study: 1996 Oregon floods**
  - **~5.5 months from event to meeting regulatory turbidity (<1 NTU) in filtered water**



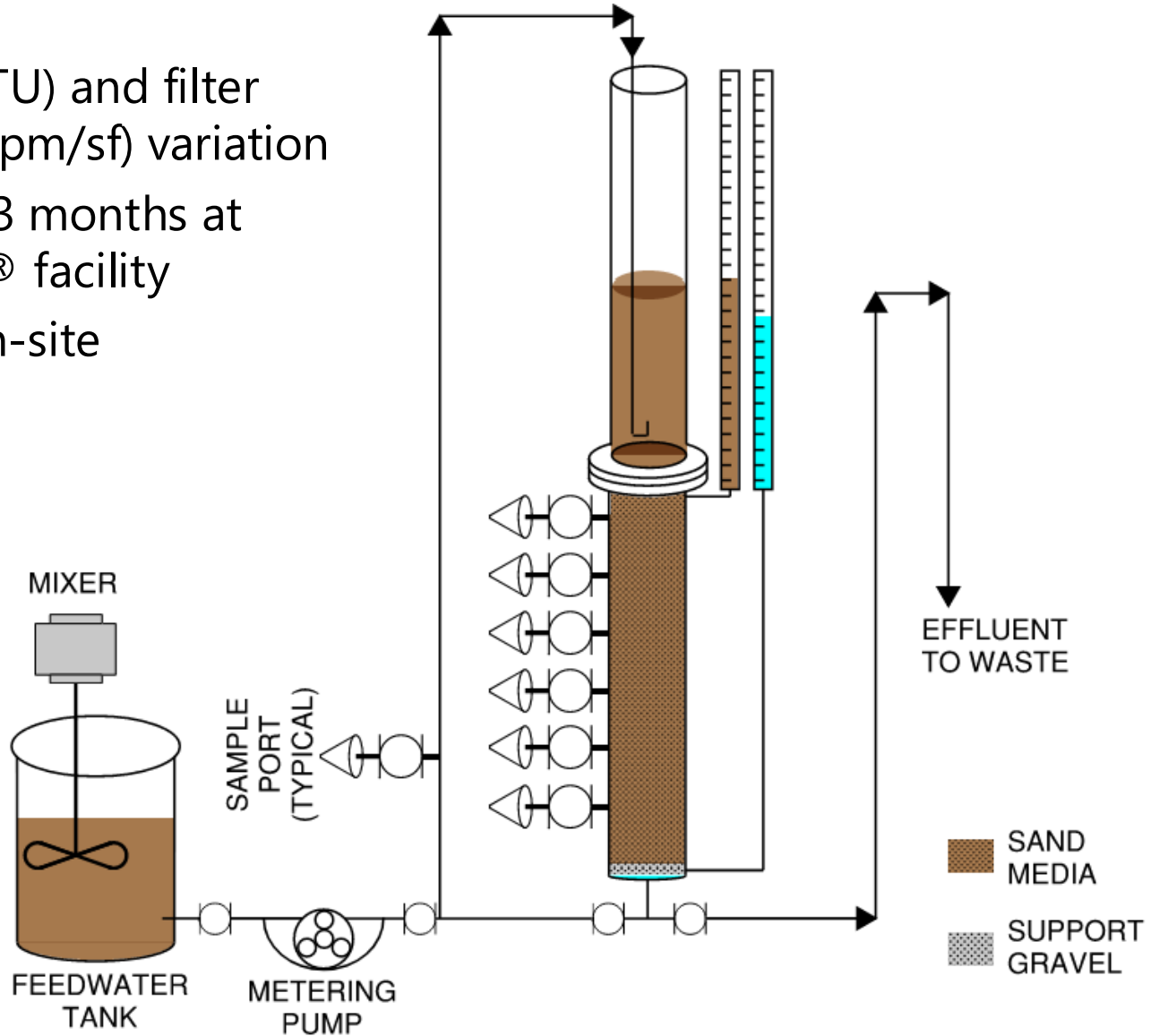


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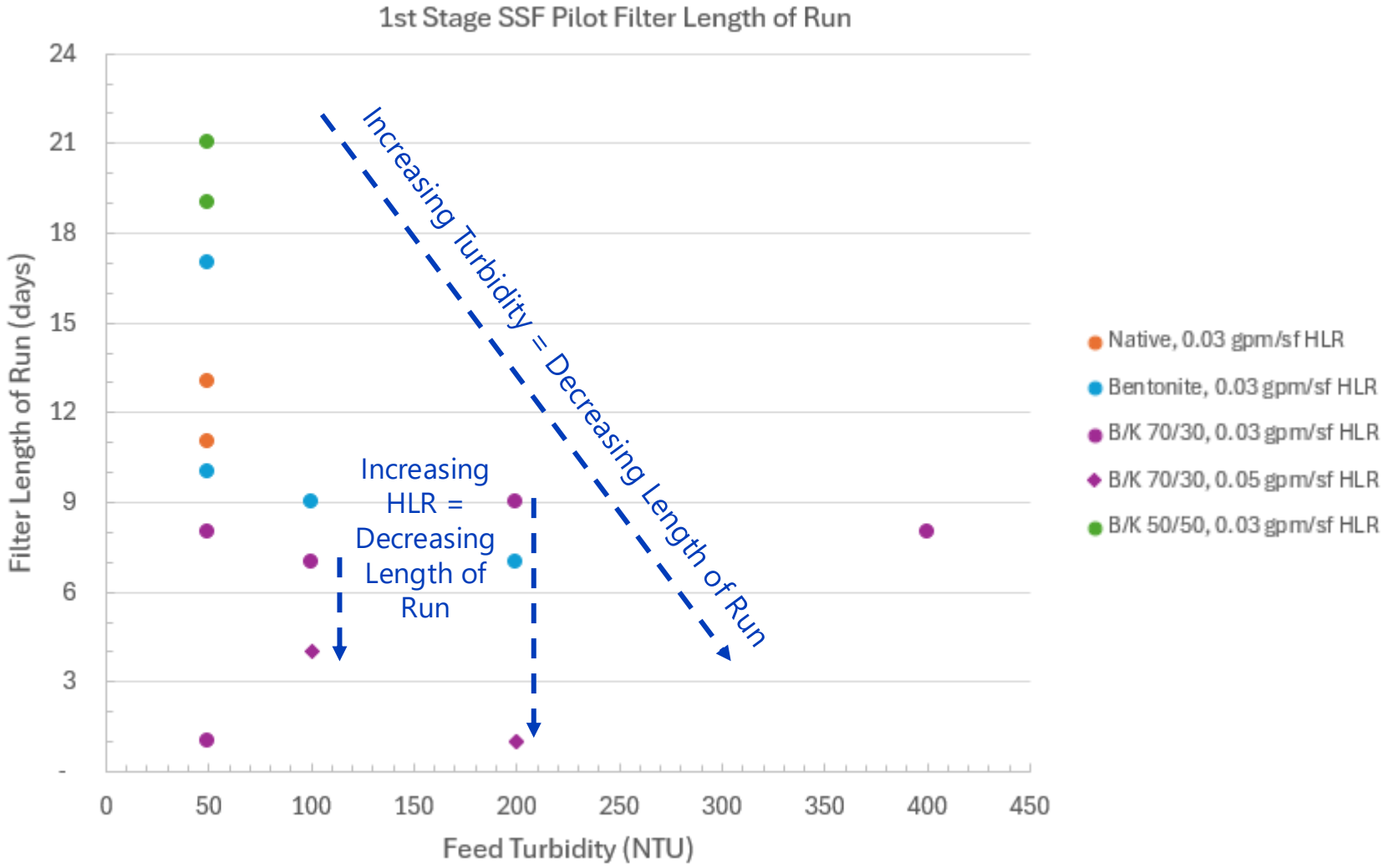
Salem Preparations – Slow Sand Pilot for Impacts of Turbid Raw Water

- Turbidity (50-400 NTU) and filter loading (0.03-0.05 gpm/sf) variation
- 18 case runs over ~3 months at Carollo's WaterARC® facility
- On-going testing on-site





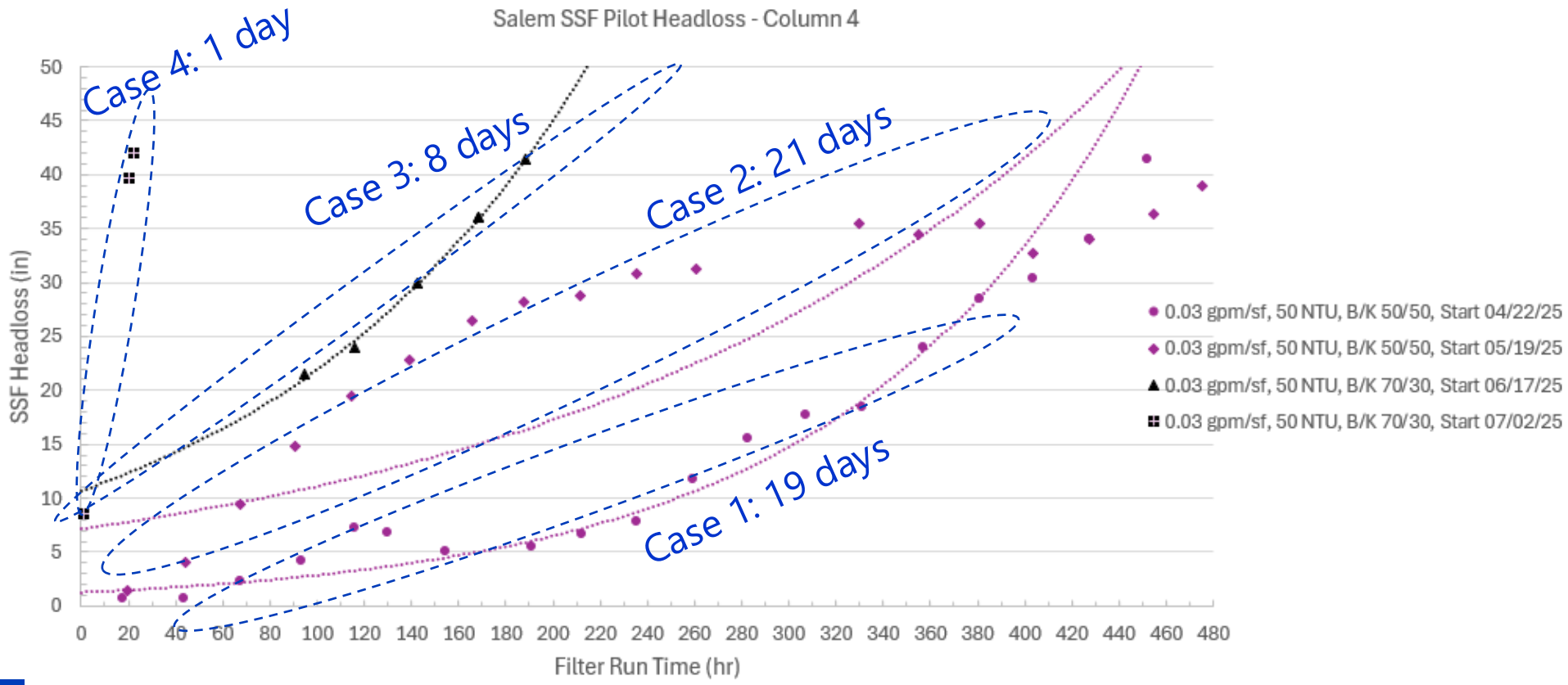
Salem Preparations – Slow Sand Pilot for Impacts of Turbid Raw Water



- **Run times are significantly less (2 to 3 weeks) than normal conditions at Salem (2 to 3 months)**

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Salem Preparations – Slow Sand Pilot for Impacts of Turbid Raw Water



- **Length of run reduction over time due to increasing clean bed headloss:**
  - **Decreased operating capacity per filter run**
  - **Increased re-sanding**
  - **More scraping over time**

Salem Preparations – Groundwater Extraction



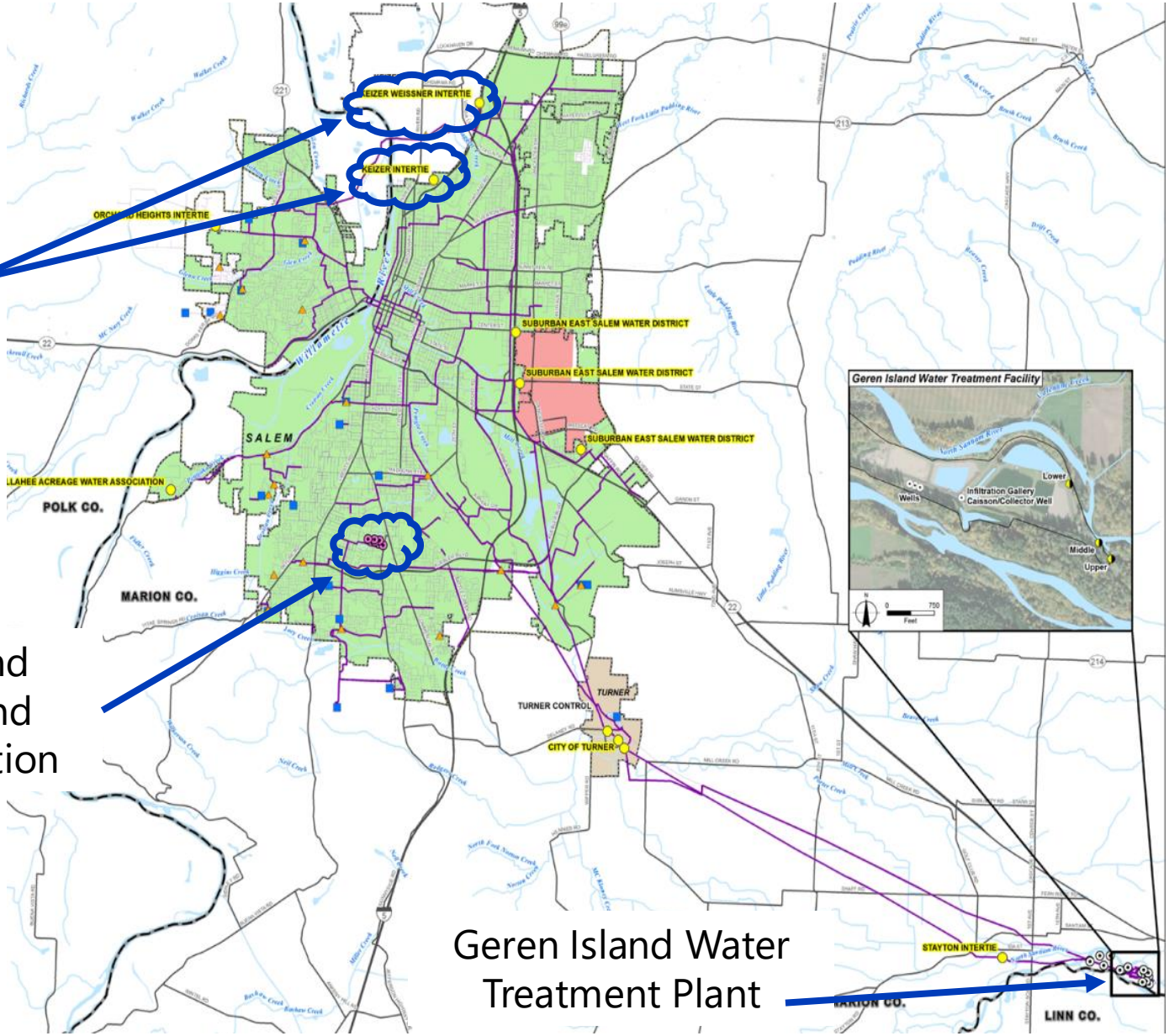
- Existing Ranney Well (SECW)
- Two existing production wells (E/W Well)
- Four new wells drilled 2025
- Exploring using other existing test wells

- Is groundwater affected by River turbidity?

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Salem Preparations – Pushing the Limits (ASR and Interconnects)

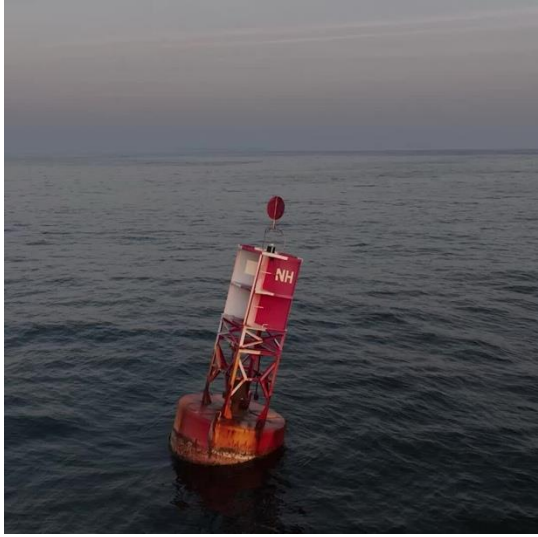
- Testing of Keizer interconnections, upgrades to booster pump stations, and upgrades to chlorine dosing at interconnect
- ASR injection and discharge beyond historical operation



Geren Island Water Treatment Plant

04

How to Buoy Your Water Supply





It may be time to re-consider floodplain impacts

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What Should You Do to Prepare?

- Assess your current infrastructure, weigh the risks
- Consider future planning
  - » Increasing storm frequency
  - » Is your reservoir / dam a candidate for future operating changes or removal?

- Are dammed water sources still the place to be?
  - » We would select the South Santiam again! With some caveats… *- South Santiam water provider*

Thank you!

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