Mercer Island Pipeline Shutdown

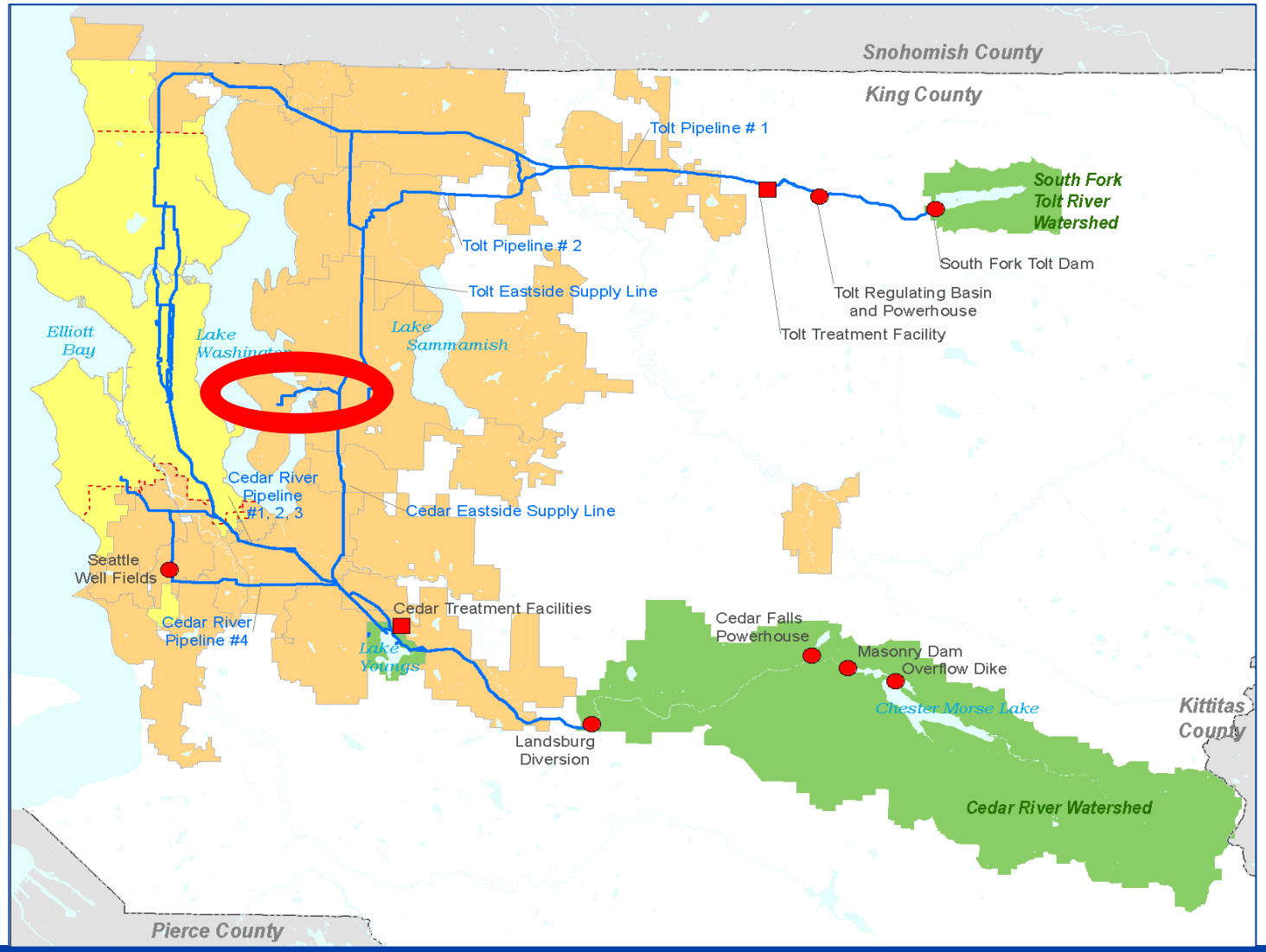
What Happened, Lessons Learned, Next Steps

April 2023

Seattle Public Utilities

City of Seattle

Seattle Regional System



Seattle Retail Service Area

Wholesale Customers

Watersheds

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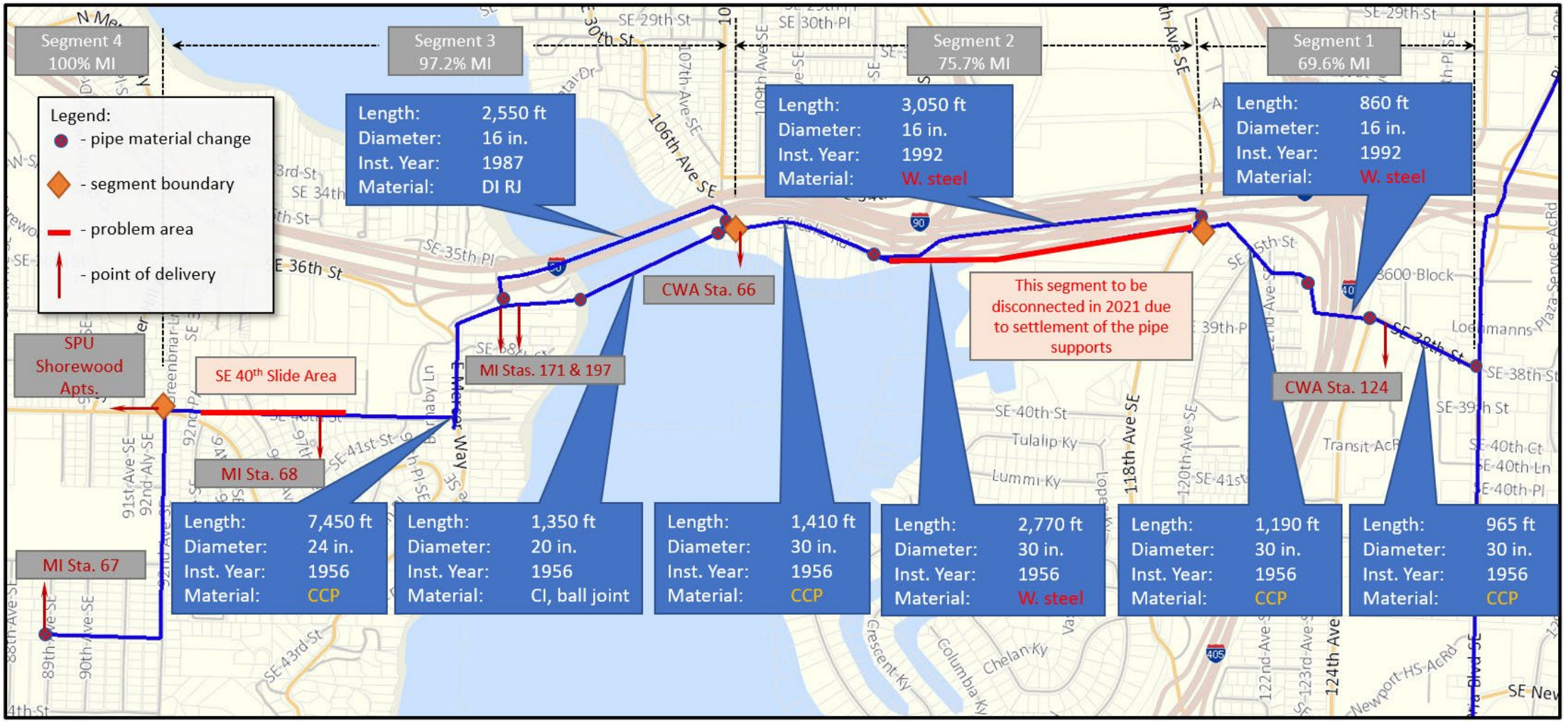
Mercer Island Pipelines Subregional System



DI RJ = ductile iron restrained joint. Typical modern standard pipe for up to about 16 in diameter

W steel = welded steel. Typical modern standard pipe for above about 16-24 in diameter

CCP = concrete cylinder pipe (thin walled steel pipe for watertightness, reinforced with wrapping bars or wire wrap, and surrounded by concrete). Harder to work on or weld to

CI, ball joint = cast iron ball joint pipe (ball joints typically used for flexibility like in river crossings)

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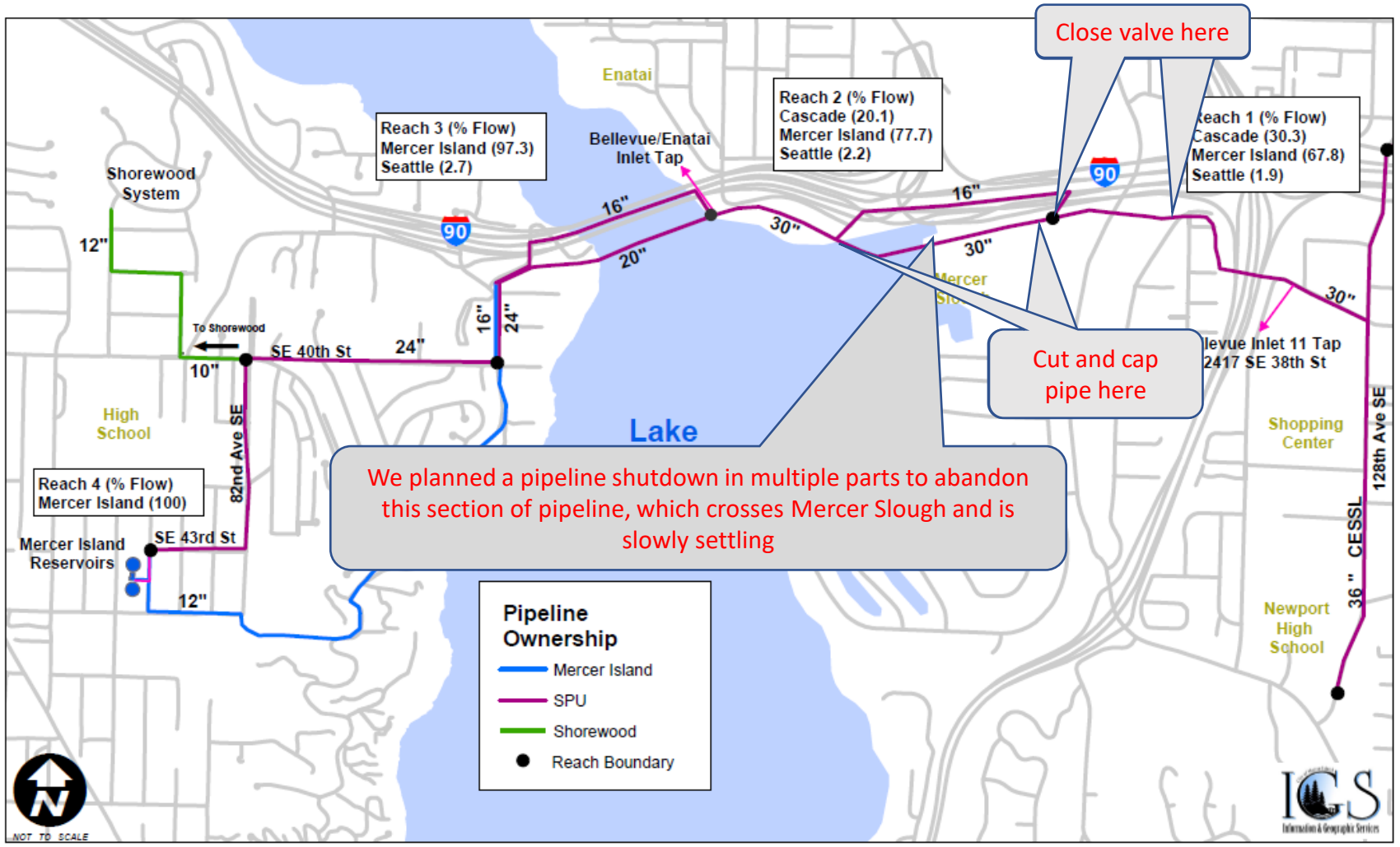
Mercer Island Pipelines Subregional System

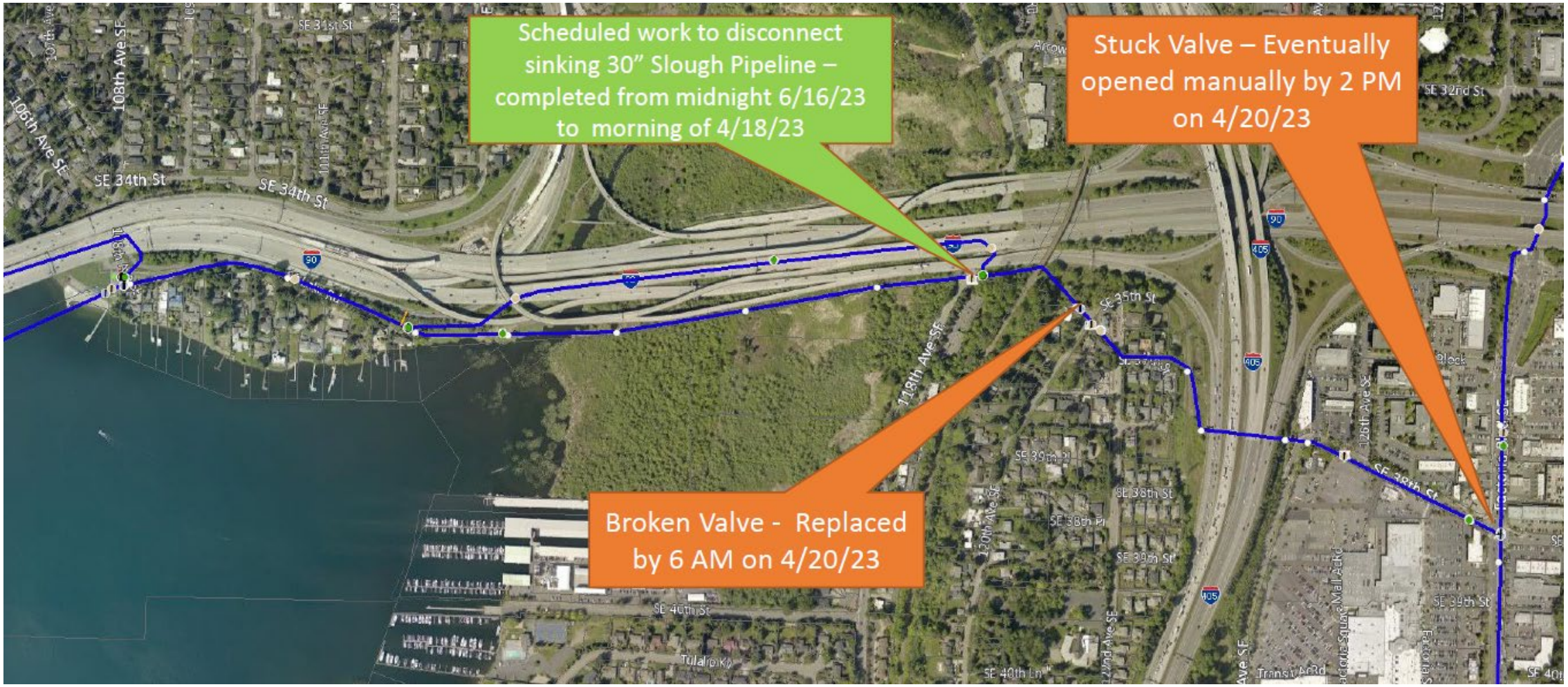


Document Name: SeattleToBellevueSPUSupplyLine

Figure 1-3: Mercer Island Supply Line

Date: 6/1/2015

Mercer Island Pipelines Subregional System – Valve Issues



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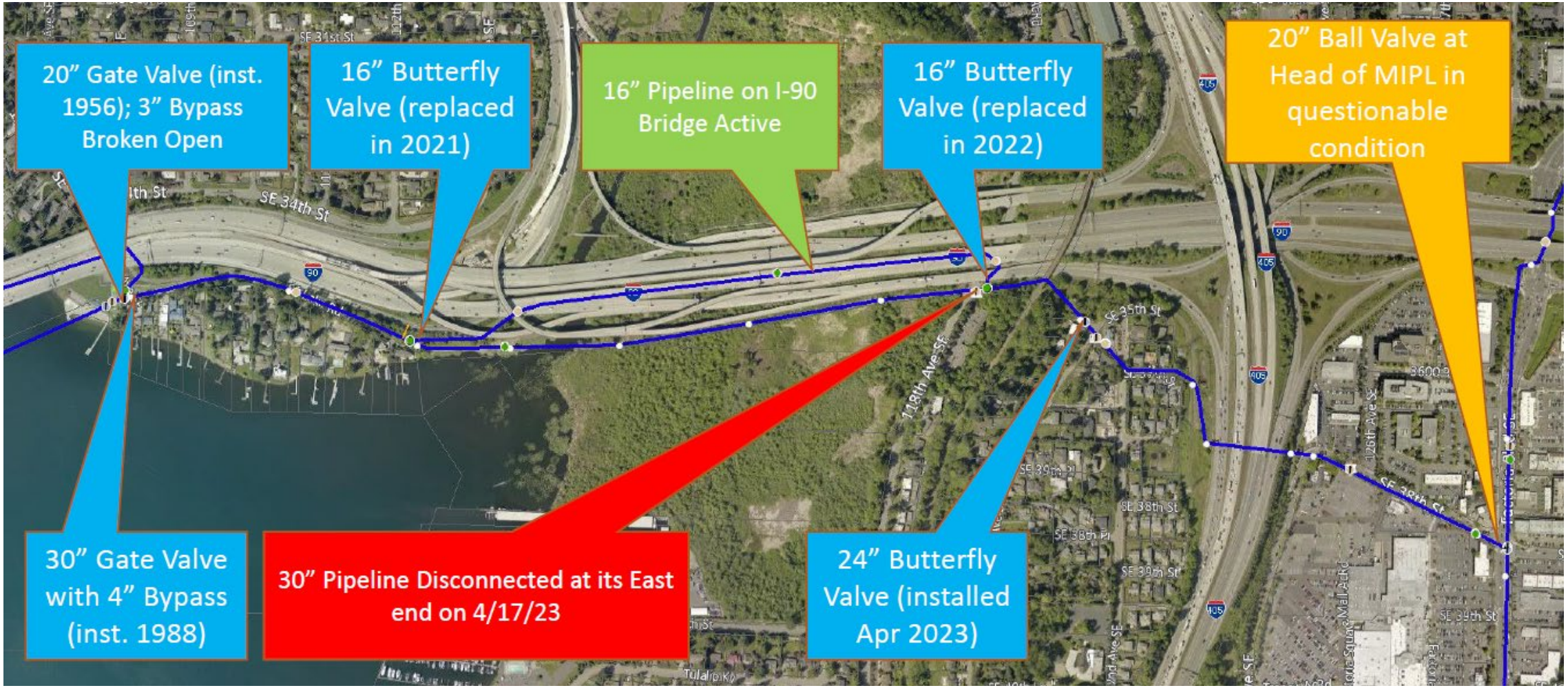
Mercer Island Pipelines Subregional System – Line Valves



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Shutdown sequence

- Close valves Sunday night, April 16
- Perform cut and cap work on east section of Slough pipeline
- Open valves Tuesday morning, April 18

- Mercer Island operates without SPU water using its reservoirs
  - *Can operate using reservoirs for only a few days*

What Went Wrong – Part 1

- Valve at SE 120th Ave did not open on Tuesday morning
- Took crews several hours to diagnose that actuator was OK, gearing was OK – valve body and stem were not moving
- It's a ball valve without a bypass line – no way to provide even a little water around it if it fails
- We had opened and closed that valve twice in 2022, no issues

Response Plans

- Plan A: close upstream valve at Factoria, dig up and remove the vault lids, remove valve, replace with another valve
- Plan B: provide some bypass pumping from Bellevue at Enatai to Mercer Island

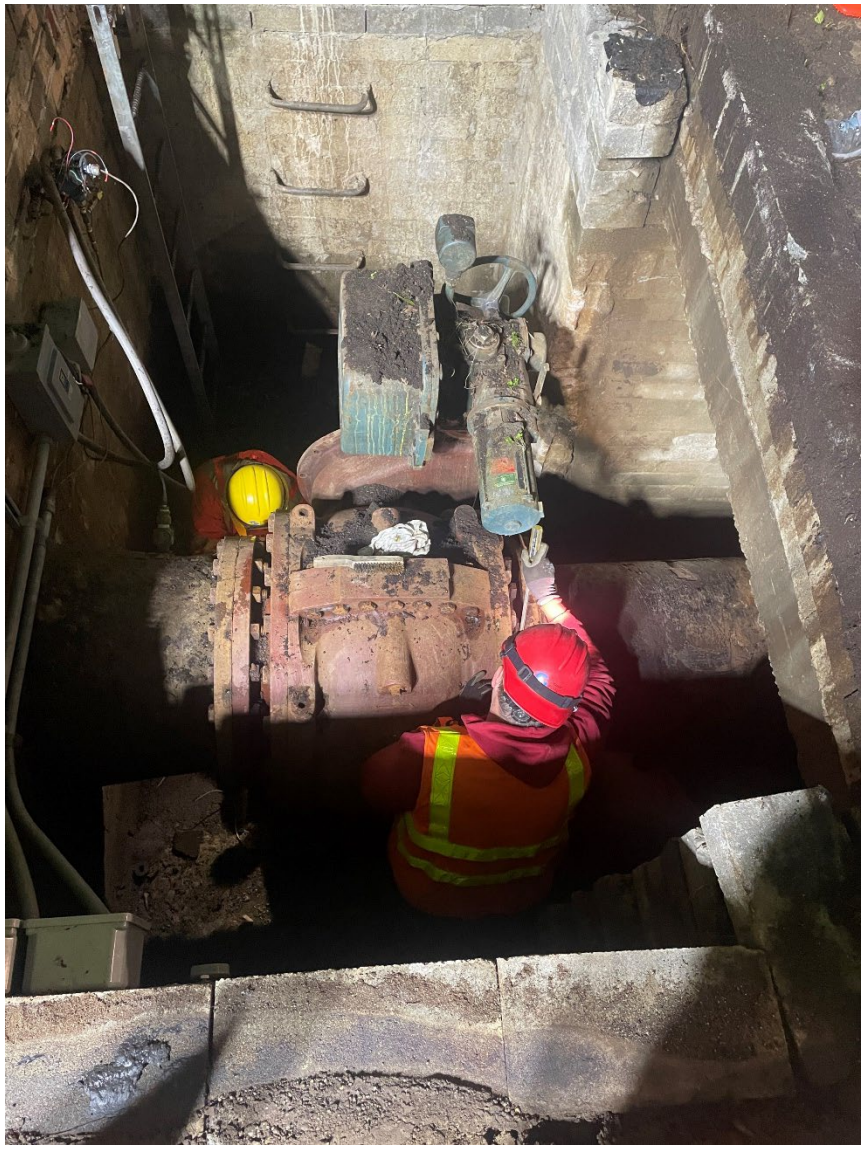
Enacted both plans in parallel

Customer Concerns

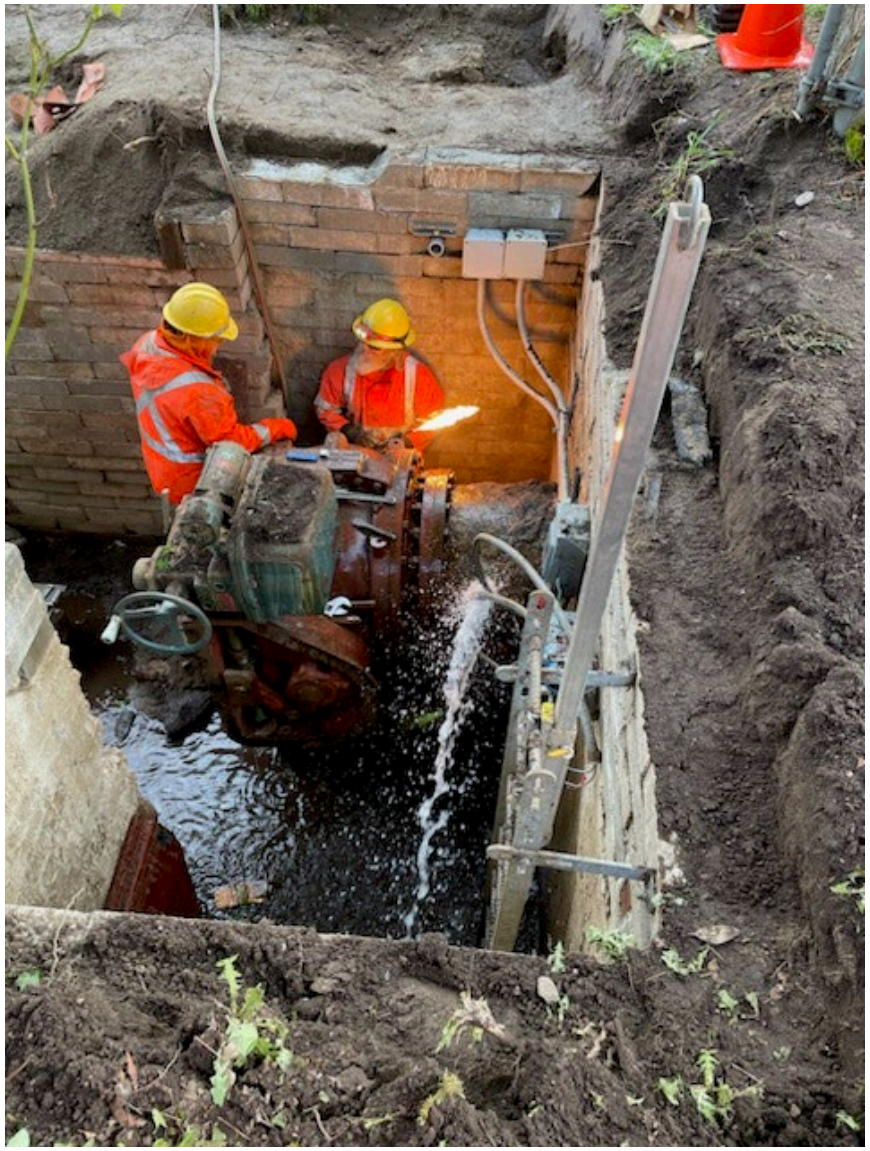
- Mercer Island was depending on their reservoirs to supply water the entire time
  - Working with their residents and businesses to reduce water usage
  - Preparing to declare a precautionary boil water notice if system pressures got too low (below 20 psi)
- Continuous communication with Mercer Island was very important throughout, on multiple staff levels

Valve vault before excavation

Valve vault after concrete lids removed



24-in ball valve that stuck closed



Removing 24-in ball valve

Vault cleared

24-in ball valve that stuck closed

Replacement 24-in butterfly valve

Replacement 24-in butterfly valve in place and piping welded back together

Re-assembly with 24-in butterfly valve

Final welding complete

What Went Wrong, Part 2

- The bypass pumping required too much water from Bellevue Enatai – decreased their system pressure too low
- The pumping required higher discharge pressure than the discharge hose could tolerate
  - Required 175 psi; at about 150 psi the discharge hose tends to fail at couplings
- Need to plan a better bypass plan for next time, as a contingency plan

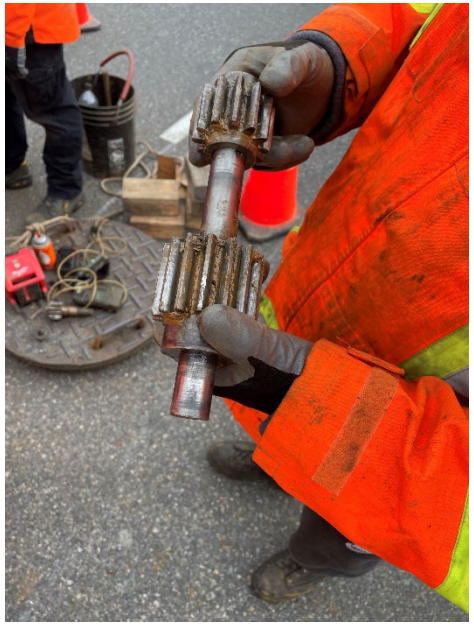
Bypass pumping setup from Bellevue Enatai to Mercer Island

What Went Wrong, Part 3

- Opening the valve at Factoria:
  - Valve closed smoothly for shutdown
  - Opened about 30 turns out of about 300 and stopped moving
- Also a ball valve, no bypass line around it
- Crews scrambled to take the valve apart enough to find the piece that had stripped a gear, turn the valve by hand and lock it open in place
- We had opened and closed that valve previously, but only down to 50% closed; last exercised about 10 years ago
- Valve exercising program needs attention

Valve that opened to 10% then froze is in the middle of the intersection in Factoria

Exposed gear at top of valve



Shear pin broke - top shaft gear came loose (by design to protect gears from damage)

Crews manually turning the valve using a t-wrench attached to the top valve gear

Next Steps – Short Term

- DONE: Clean up sites at Factoria (done), SE 120th, (two lower lids back on, top lid off because we'll want to add a bypass line), Enatai bypass

Next Steps – Long Term

- Develop options for long-term improvements to review with Mercer Island and Cascade
  - Consider adding bypasses around valves without them – and upsize to use for minor water supply as well as equalizing pressure around the valves
  - Consider redundancy throughout this pipeline section – one of the few spots in the water system without redundancy
  - Consider what to do about the valve at Factoria – needs replacing; can it be moved out of the intersection?
  - Consider what to do about the valve at SE 120th – OK as is, needs a bypass installed
    - Ball valve with remote control was in case of slough pipeline failing from settlement; that concern has gone away
- Order and stock spare valves, <u>especially for large valves without redundancy</u>
- Look at our valve exercising and maintenance protocols, <u>especially for large valves with no redundancy</u>

Questions?