



# FREMONT SIPHON

replacement project



**King County**

Department of  
Natural Resources and Parks  
**Wastewater Treatment Division**

## **Crossing the Lake Washington Ship Canal The Complexities of the Fremont Siphon Project**

**Mike Bruen, MWH**

# The Team



**Owner : King County WTD**

## Design Team

- ▶ MWH
  - ▶ McMillan Jacobs Assoc.
  - ▶ SubTerra, Inc.
  - ▶ Bright Engineering
  - ▶ ESA
  - ▶ Envirolssues
  - ▶ SWCA Environmental

## Construction Management

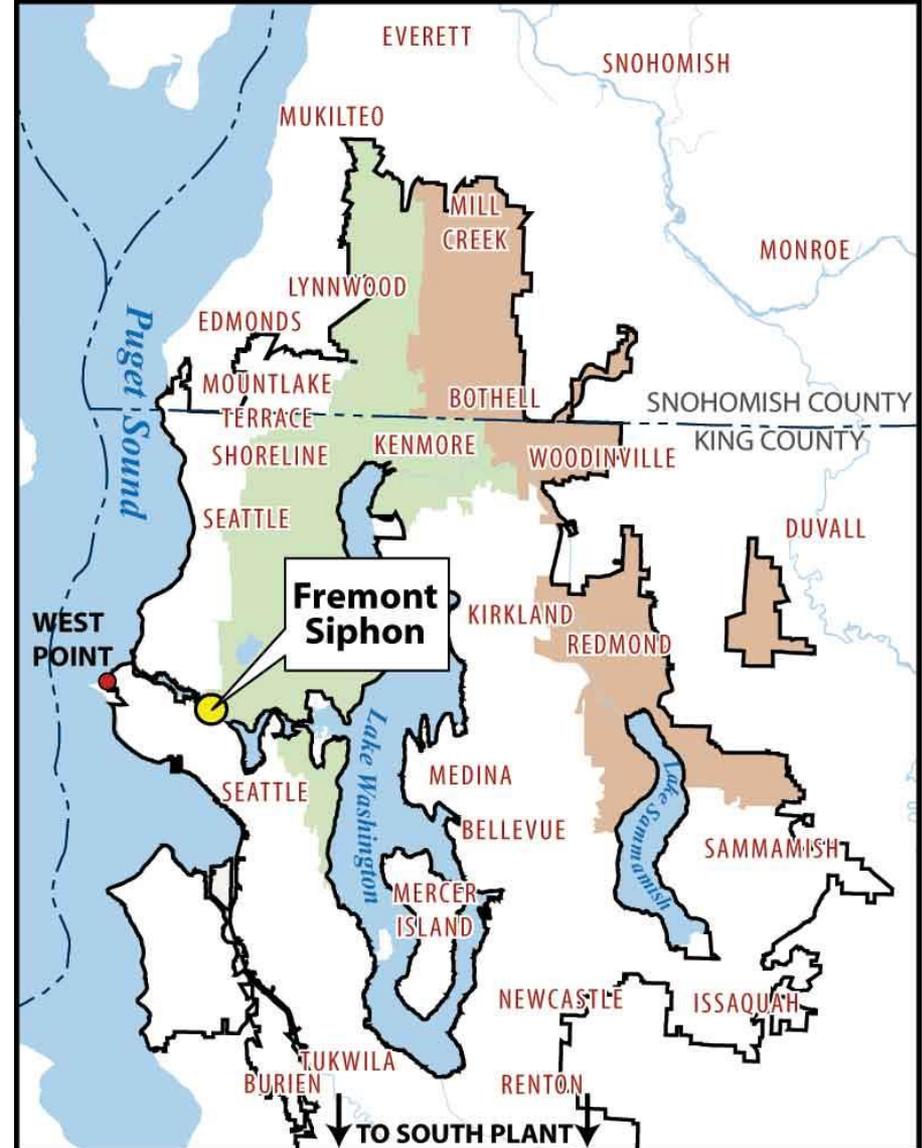
- ▶ Jacobs Engineering
  - ▶ Shannon & Wilson
  - ▶ Staheli Trenchless

## Contractor: Stellar J Corp

- ▶ NW Boring

# The Fremont Siphon is a critical system component

- ▶ Serves 60 square miles in winter, 114 in summer
- ▶ Carries 50% of the wastewater going to the West Point Treatment Plant
- ▶ Needs replacement after 100 years of service



-  Fremont Siphon Service Area - year round
-  Additional Seasonal Service Area - summer
-  King County Service Area for West Point and South Treatment Plants

# Seattle is a Combined Service Area

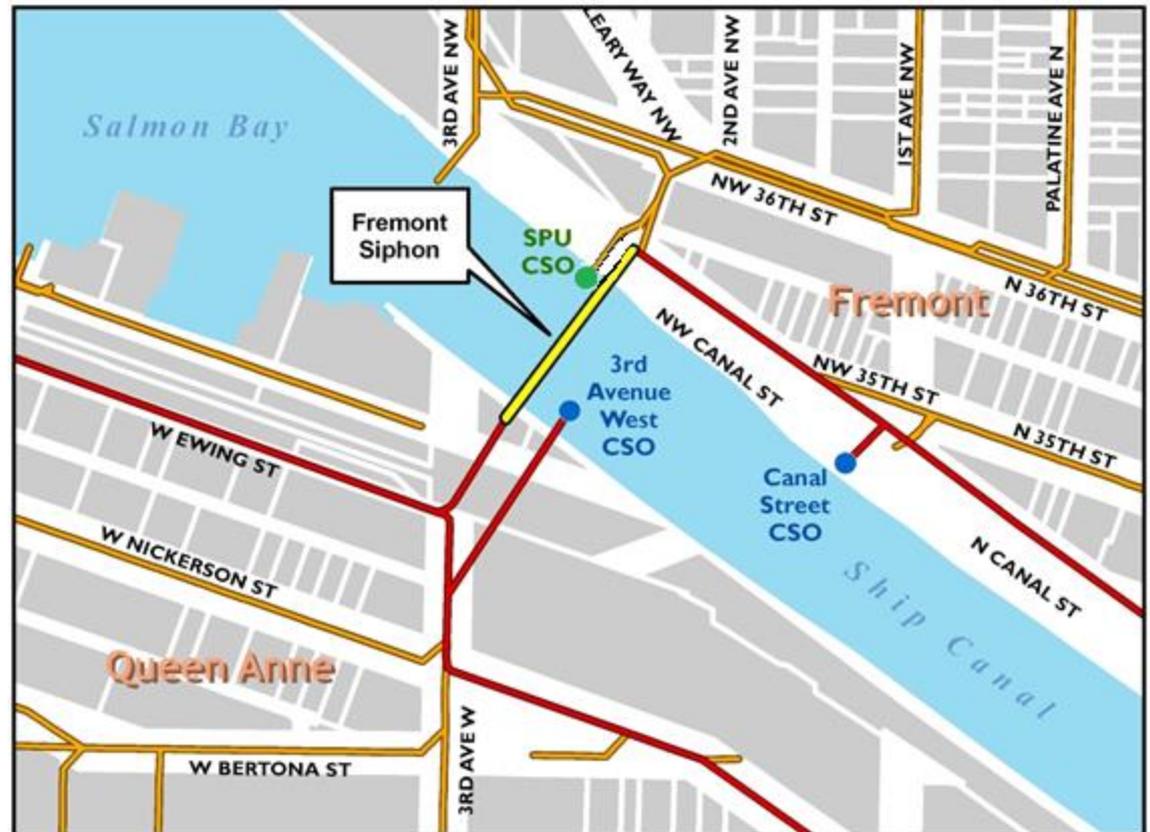


- ▶ Stormwater and wastewater are conveyed in the same pipes
- ▶ Relief points in the system– combined sewer overflows (CSOs) prevent flooding and backups

# Overview: Wastewater Conveyance in the Project Area



- ▶ Seattle Public Utilities collects most residential and commercial flow
- ▶ King County receives flow from SPU's system
- ▶ Both SPU and King County have CSO facilities that discharge into the Ship Canal



- King County sewer lines
- Seattle Public Utilities sewer lines

# Existing Siphon Overview

- Located under the Lake Washington Ship Canal, west of the Fremont Bridge
- Pipes were constructed as the North Trunk Sewer from 1907–1913
- Siphon pipelines after almost 100 years of service need replacement

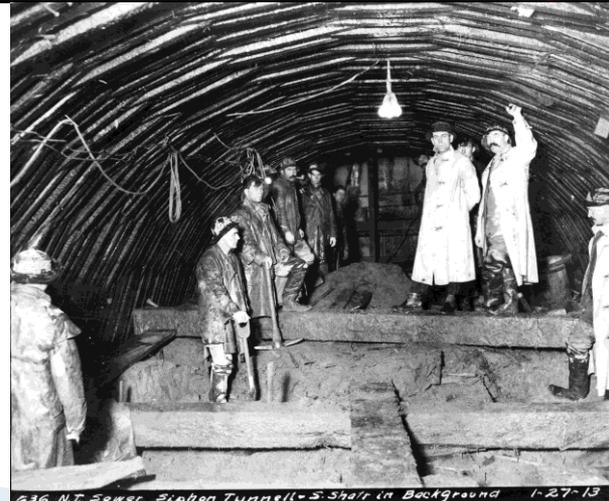
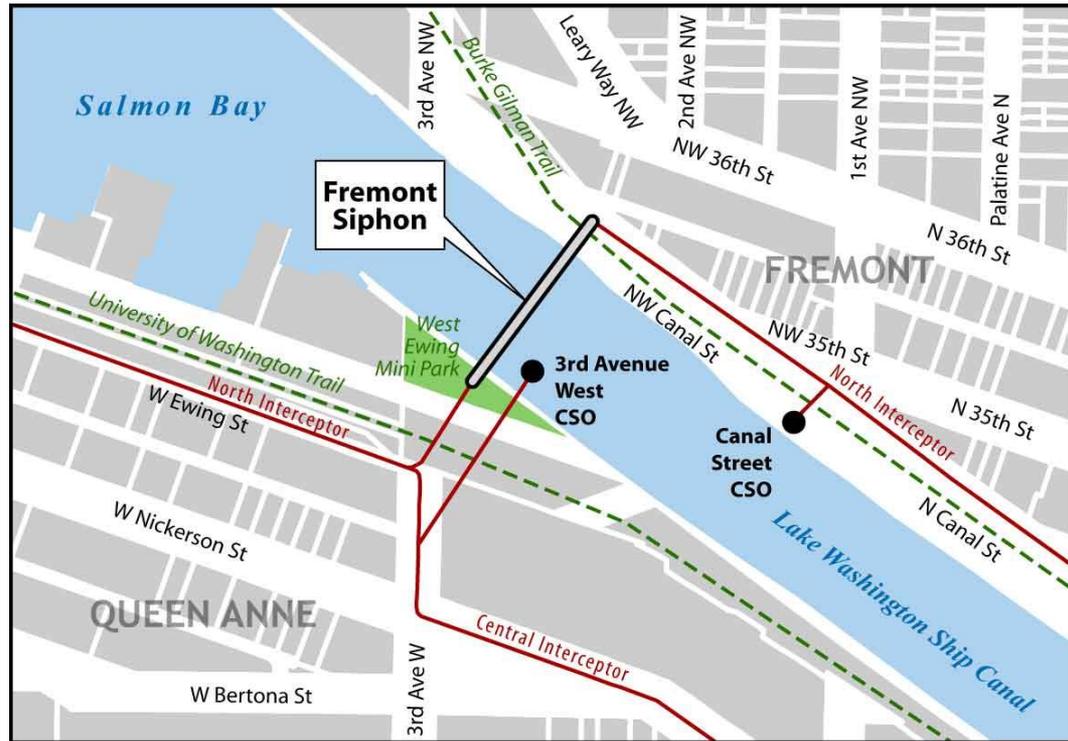


Photo courtesy of Seattle Municipal Archives



# Project Alternatives

- ▶ Small diameter tunnels (twin), new alignment, microtunnels beneath the Ship Canal
- ▶ Large diameter tunnel, new alignment, new pipes installed in tunnel beneath the Ship Canal
- ▶ Utilize existing tunnel, replace carrier pipes; requires temporary bypass (microtunnel)
- ▶ Maintain current location using existing pipes; slip line one at a time; condition assessment suggested very thin pipe
  - ▶ estimated thickness in 2016 = 0.05 to 0.02 inches)
  - ▶ Measured thickness in 1999 = 0.25 inches



# Design Criteria (con't)

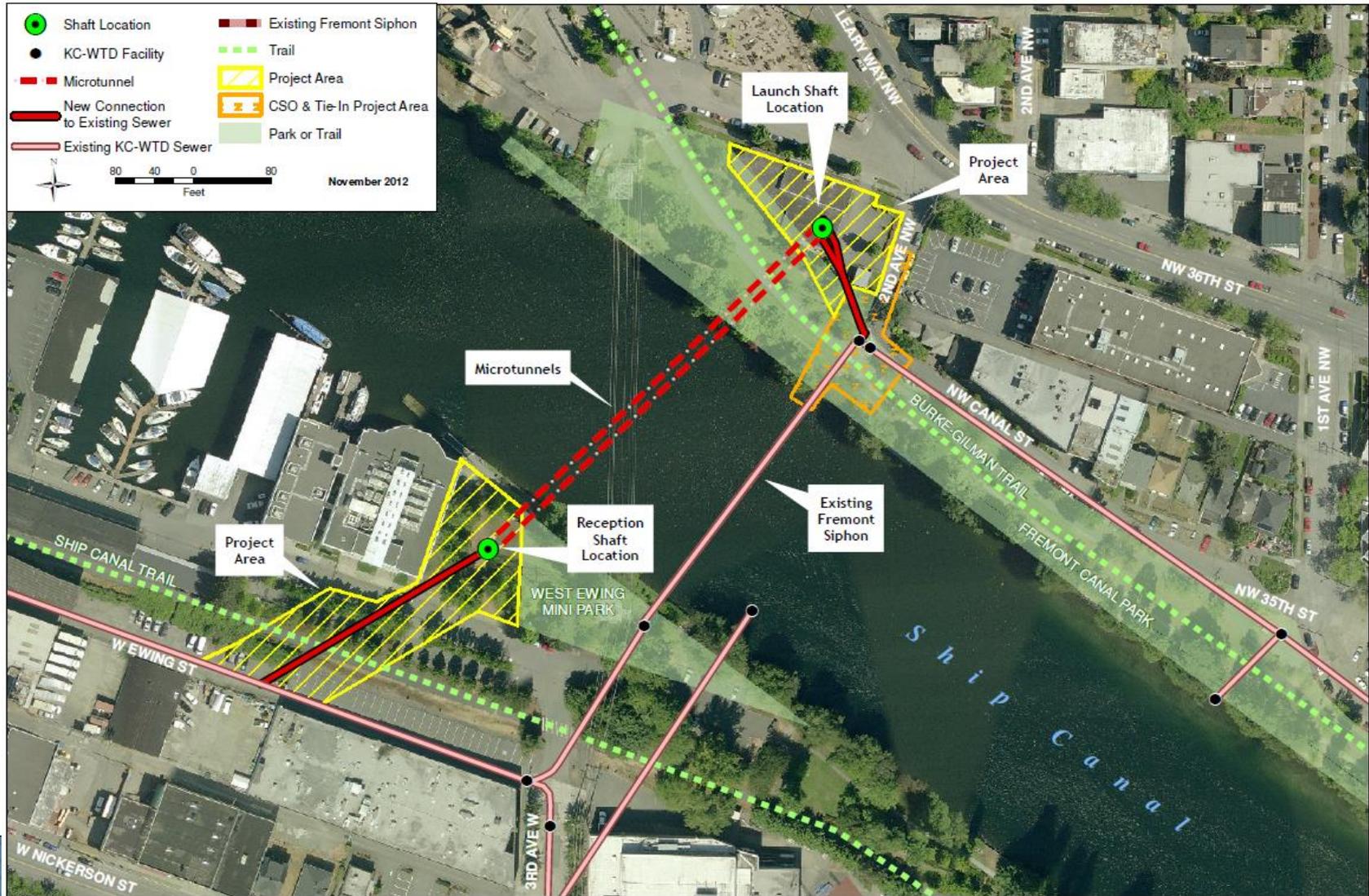
- ▶ Acceptable Pipe Materials (two pass)
  - ▶ RCP (Casing only)
  - ▶ Steel (Casing only)
  - ▶ FRPP (Carrier)
- ▶ Construction Approach – single and double pass
- ▶ Design life of 50–years

# Challenges and Risks

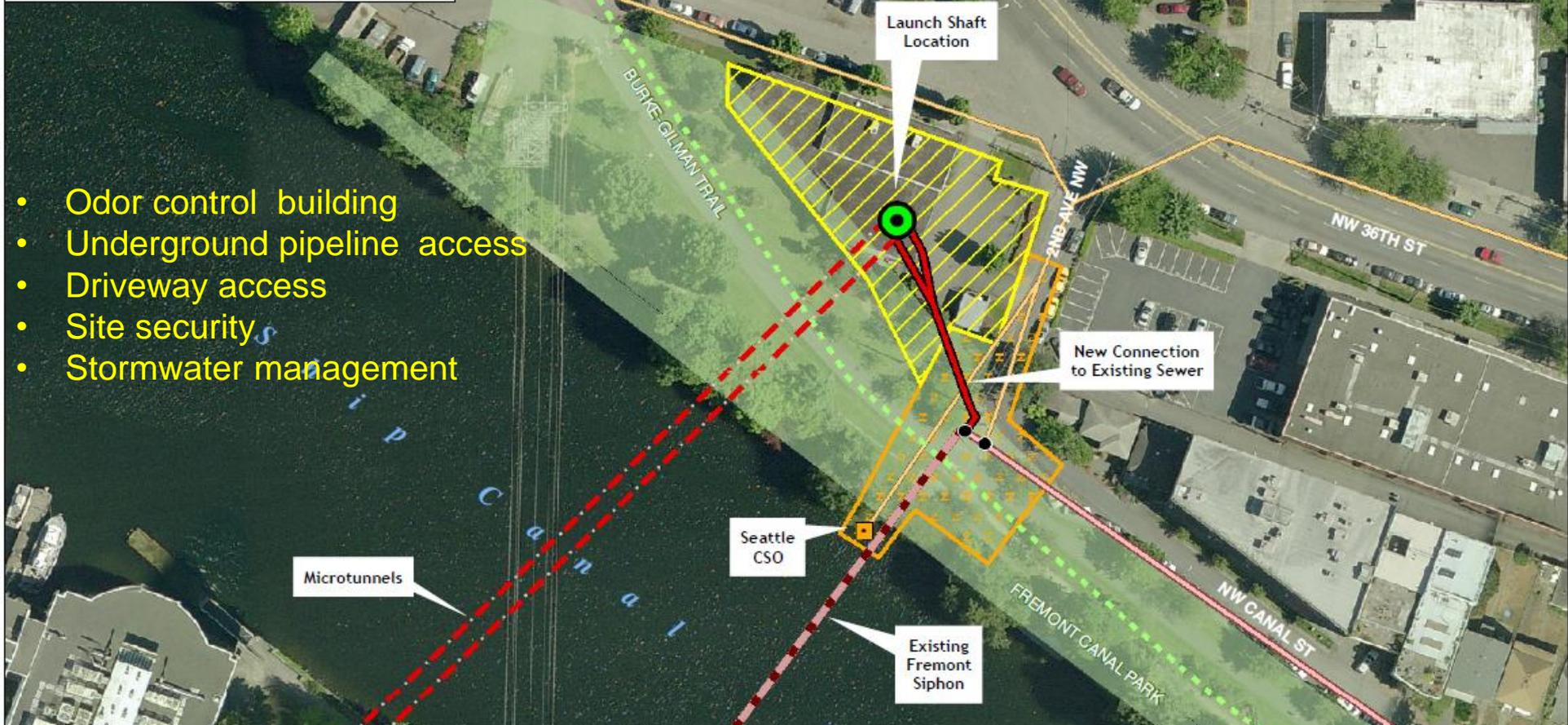
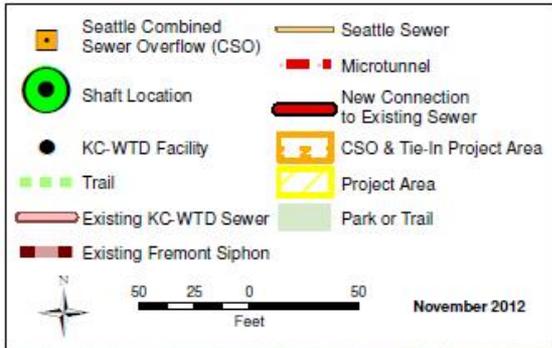


- Hydraulic
  - Making brand-new pipe sections and a new siphon behave like a 100-year old pipe ...
- Geologic / Geotechnical
  - Water pressure to 4.5 bar
  - Obstructions – boulders
- Construction sequencing, limited space, buildings
- Existing pipes remain in service, live connections
- Community – Burke Gilman Trail impacts (Seattle's longest and busiest bicycle trail)

# Fremont Siphon Project



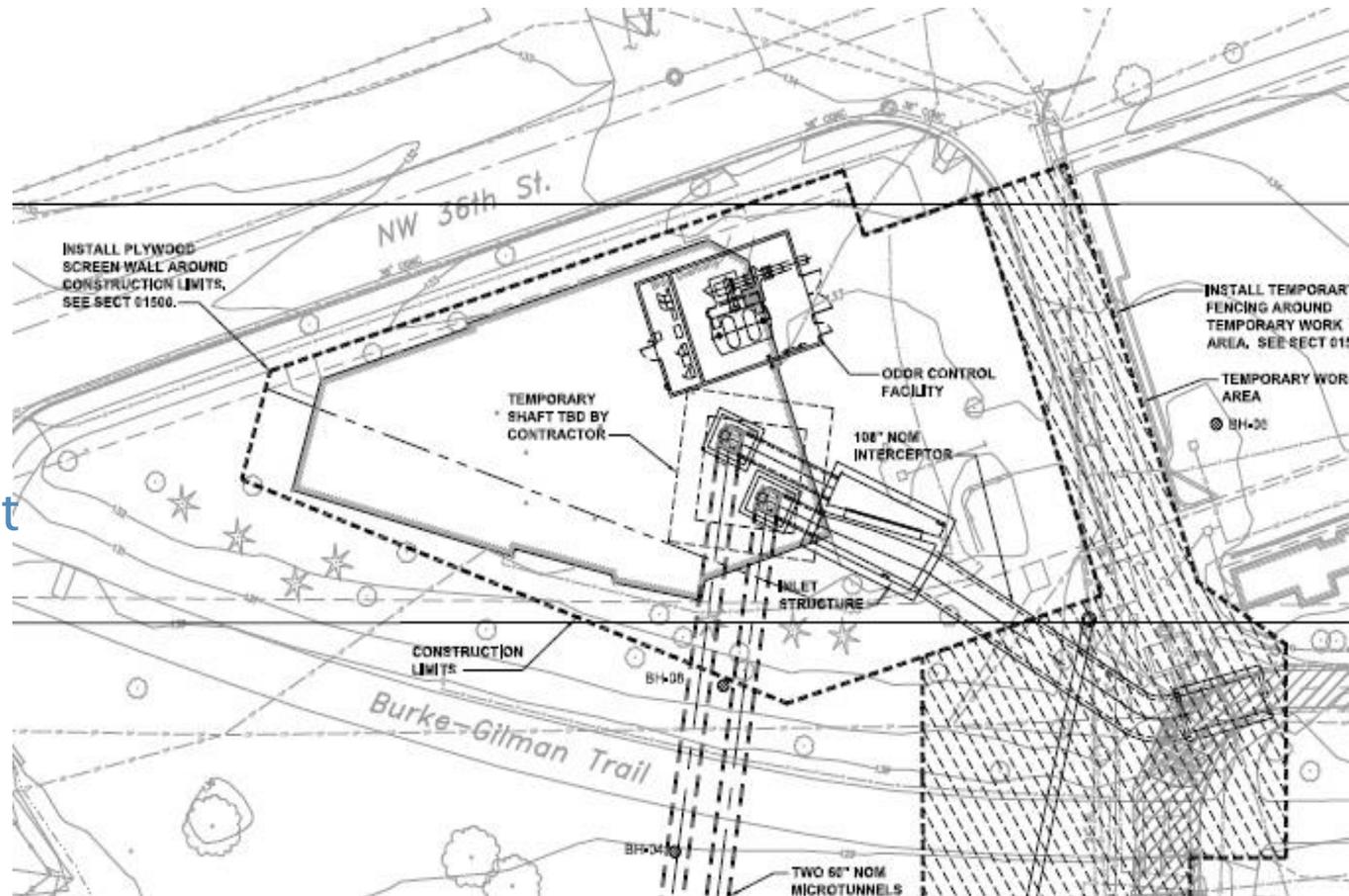
# Fremont – North Site



- Odor control building
- Underground pipeline access
- Driveway access
- Site security
- Stormwater management

# North Shaft

- ▶ 0.4 Acres
- ▶ Access
- ▶ Minimize Bend
- ▶ ~90' Deep,
- ▶ 32' Round Shaft
- ▶ Minimize impact  
B-G Trail

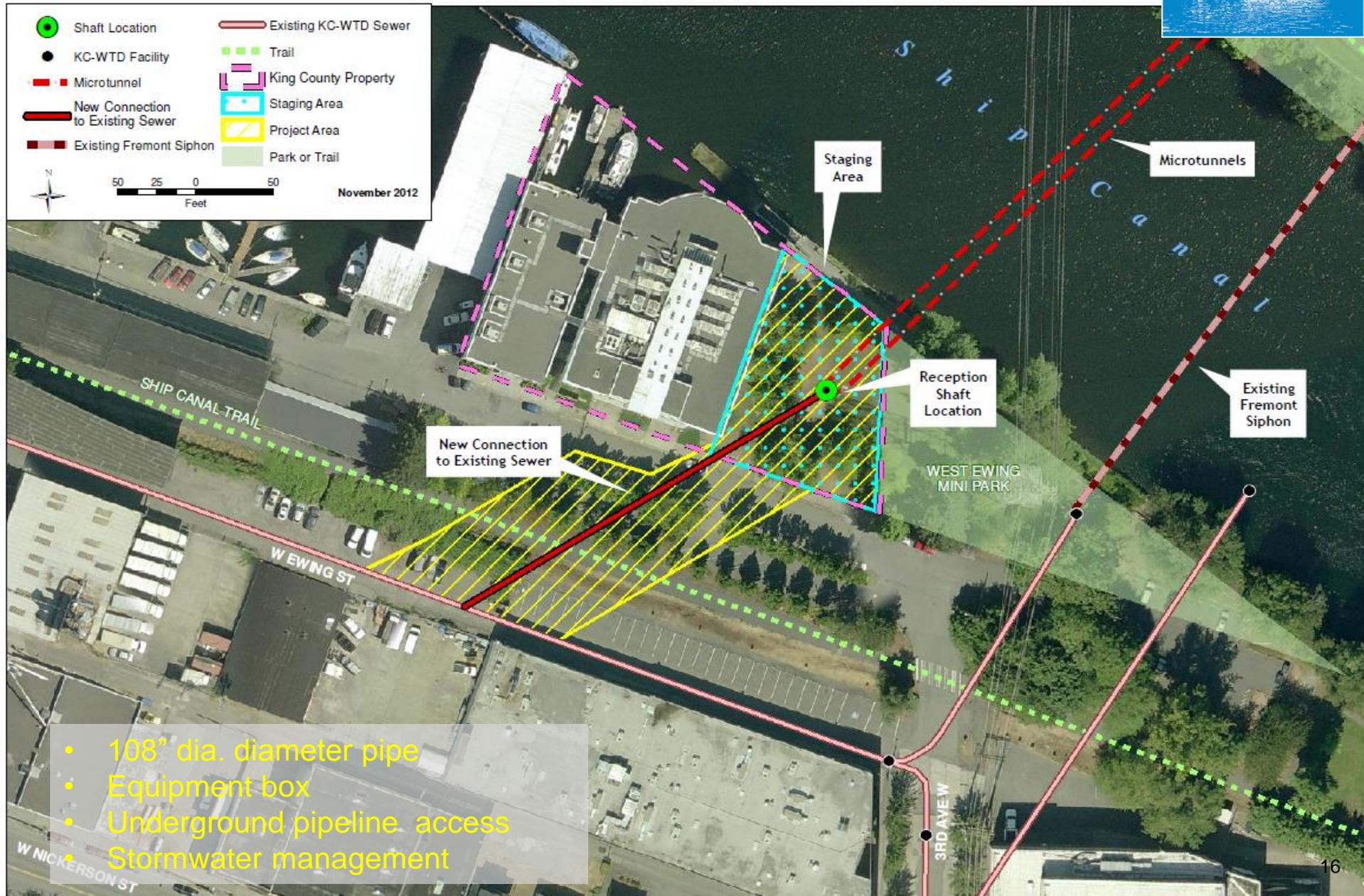
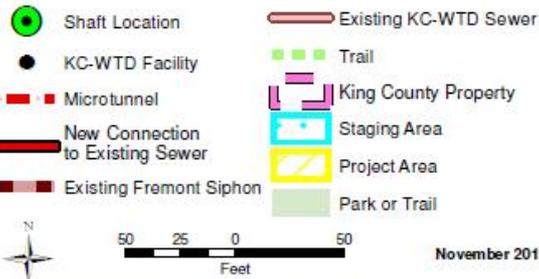


# North Site Shaft

Concrete Placement Thrust Wall



# Queen Anne – South Site



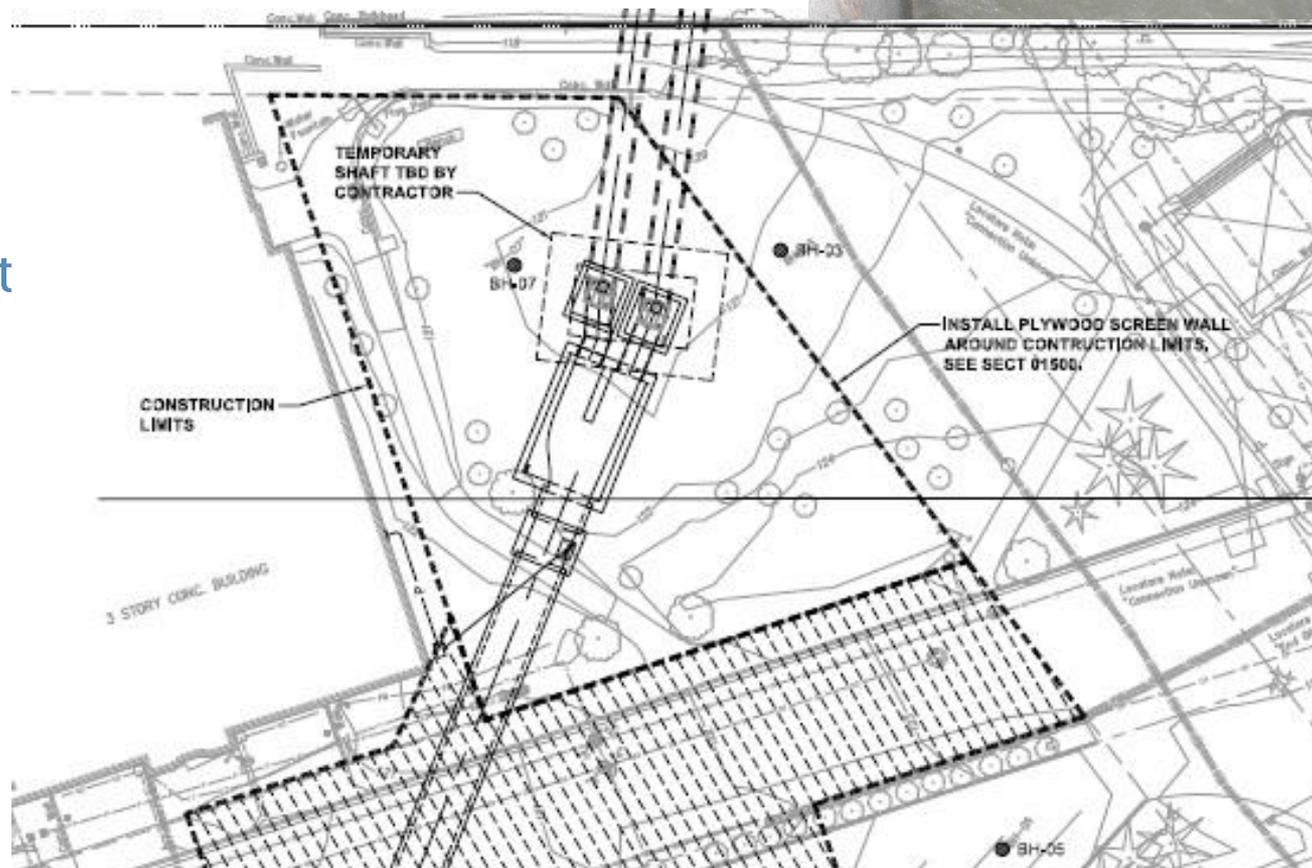
- 108" dia. diameter pipe
- Equipment box
- Underground pipeline access
- Stormwater management

# South Shaft

- ▶ 0.25 Acres
- ▶ Access
- ▶ Straight Shot
- ▶ ~80' Deep,
- ▶ 26' Round Shaft
- ▶ Buildings adj.



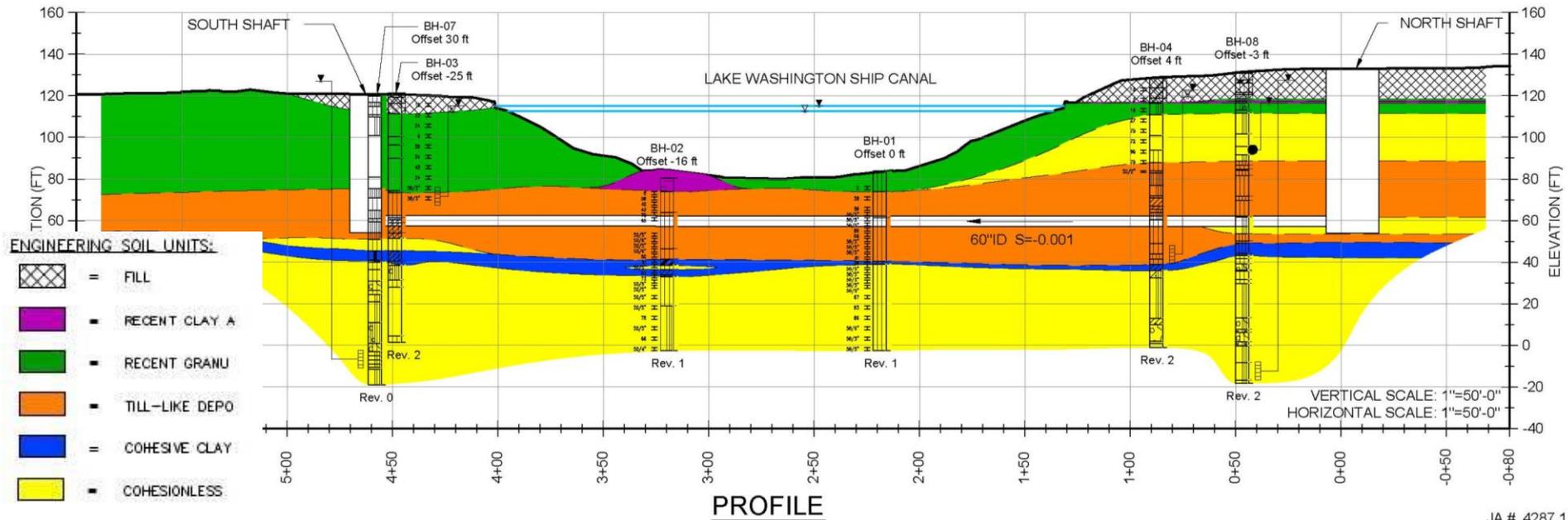
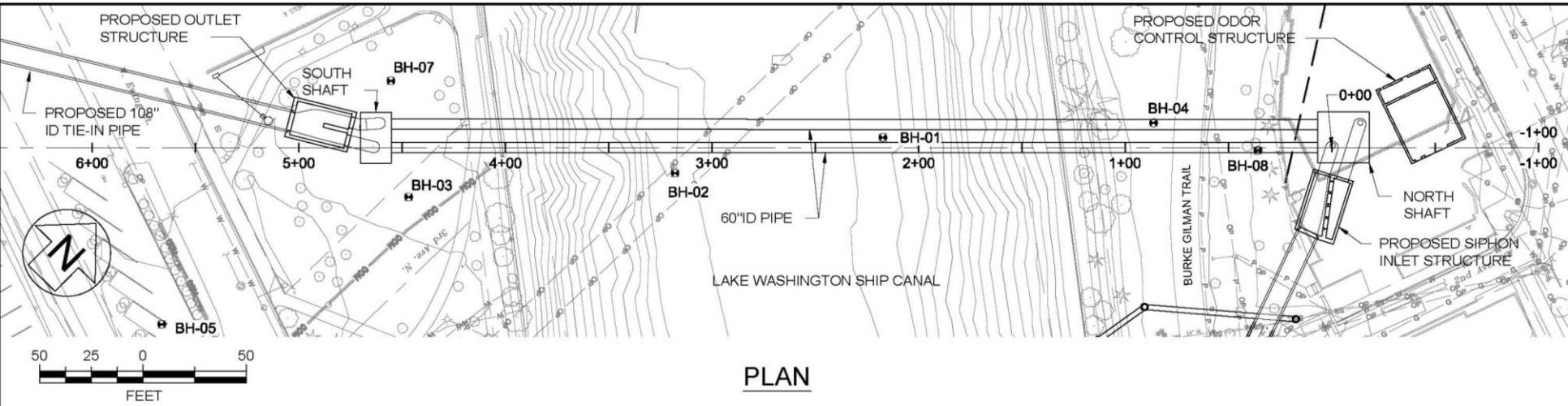
Existing pipe at Afterbay



# South Site Shaft



# Tunnel Alignment



# Tunnel Design



- ▶ Twin pressurized face microtunnels
- ▶ Two pass option
- ▶ 60” nominal carrier pipe diameter
- ▶ Threading the vertical alignment between Canal & lower aquifer (2D cover, min 1D cover dense material)

# Microtunneling Boring Machine



# Live Sewer Tie-In

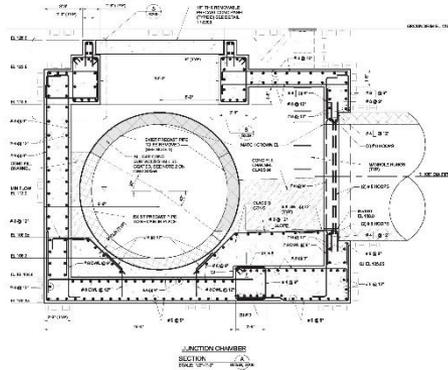
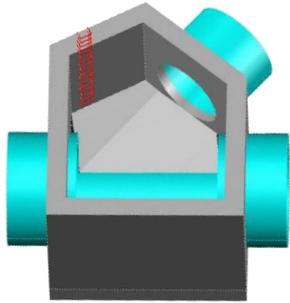


- ▶ Live sewer connections at both ends
  - South: 108” to 138” dia. connection
  - North: Forebay to 108” dia. connection
- ▶ Dry season work: 120-day constraint
- ▶ SPU’s 30” CSO Relocation
- ▶ Community constraints (road and trail closures, noise levels, tight spacing)
- ▶ Forebay is the challenge because of existing utilities

# Live Sewer Tie-Ins



South: 108" to 138" dia. connection



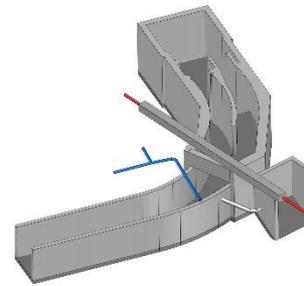
## Challenges:

- New 108" RCP connection.
- Existing 138" pipe to be kept in service.

## Solution:

- Build structure around 138" pipe while in service, tie in during DWF period.
- Installed removable hatches for future slip line operation and large maintenance access.

North: Forebay to 108" dia. Connection

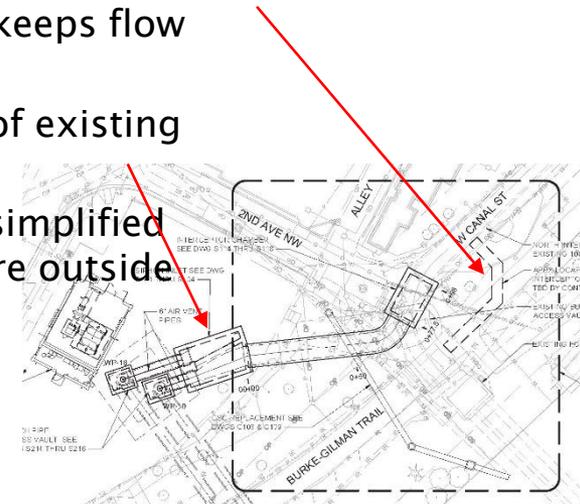


## Challenges:

- Transitions from 108" round to rectangular.
- Center dividing wall, split inverts.
- 8" High Pressure Gas, 8" Water.

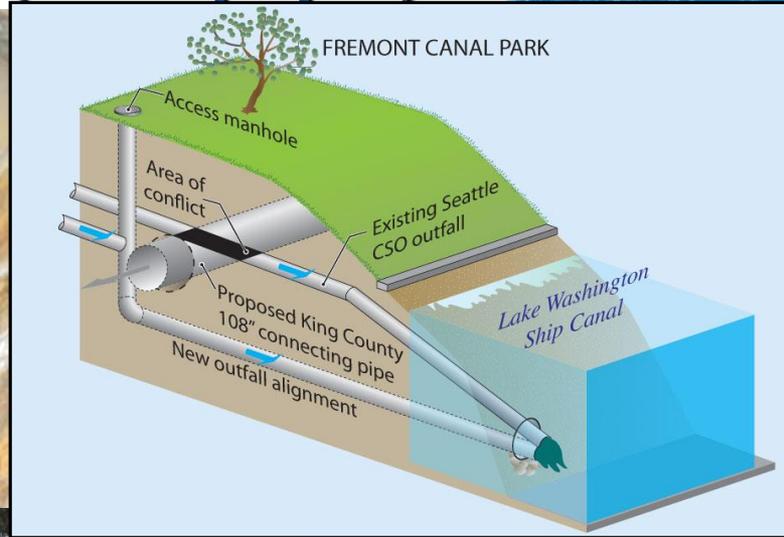
## Solutions:

- Temporary diversion trench around forebay keeps flow active.
- Demolish most of existing forebay.
- Construct new, simplified splitting structure outside roadway.



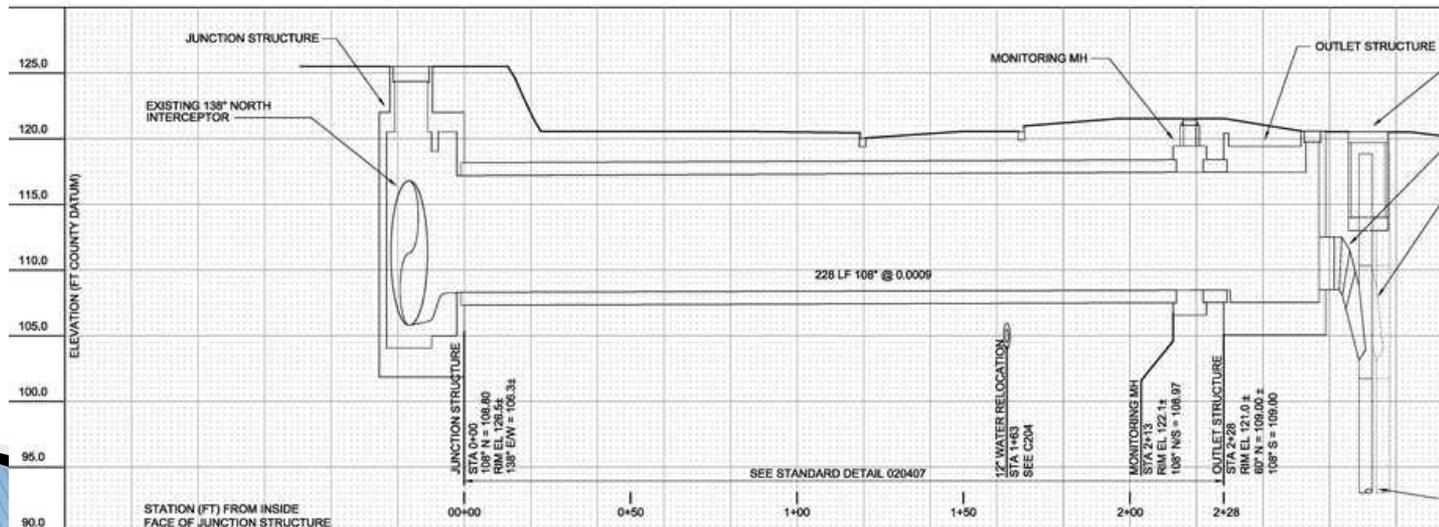
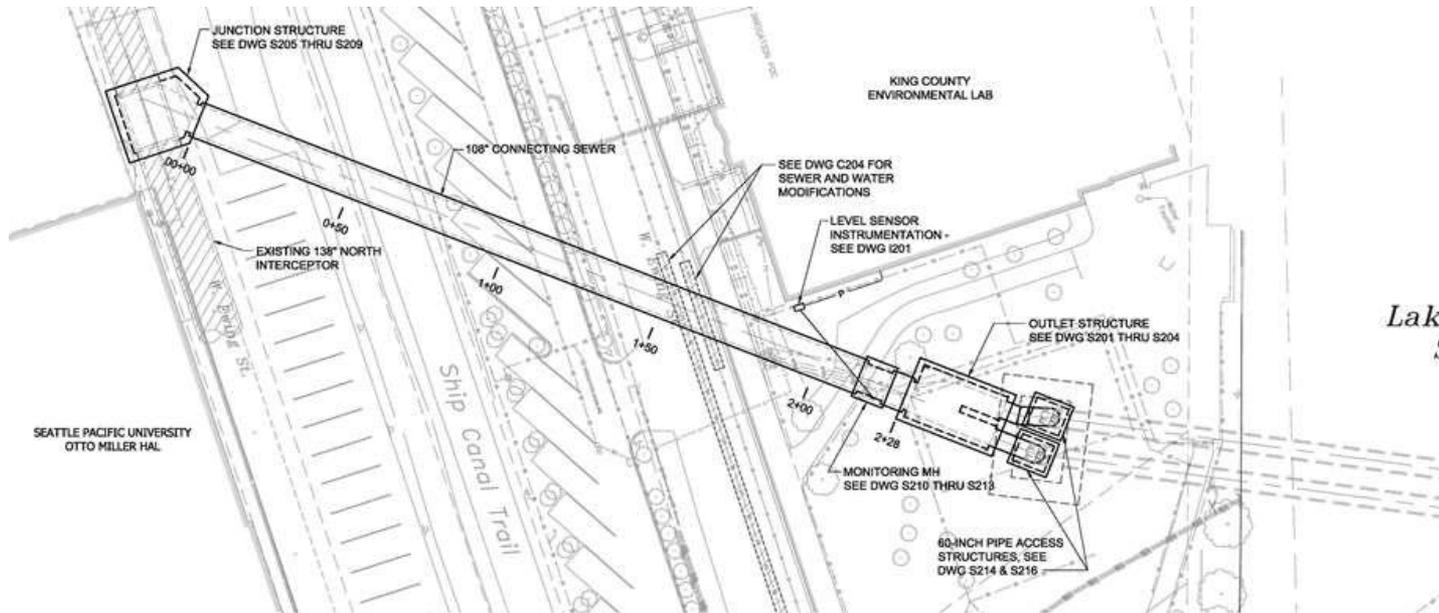


# Replacement & reconfiguration of Seattle's CSO outfall (30" pipe)



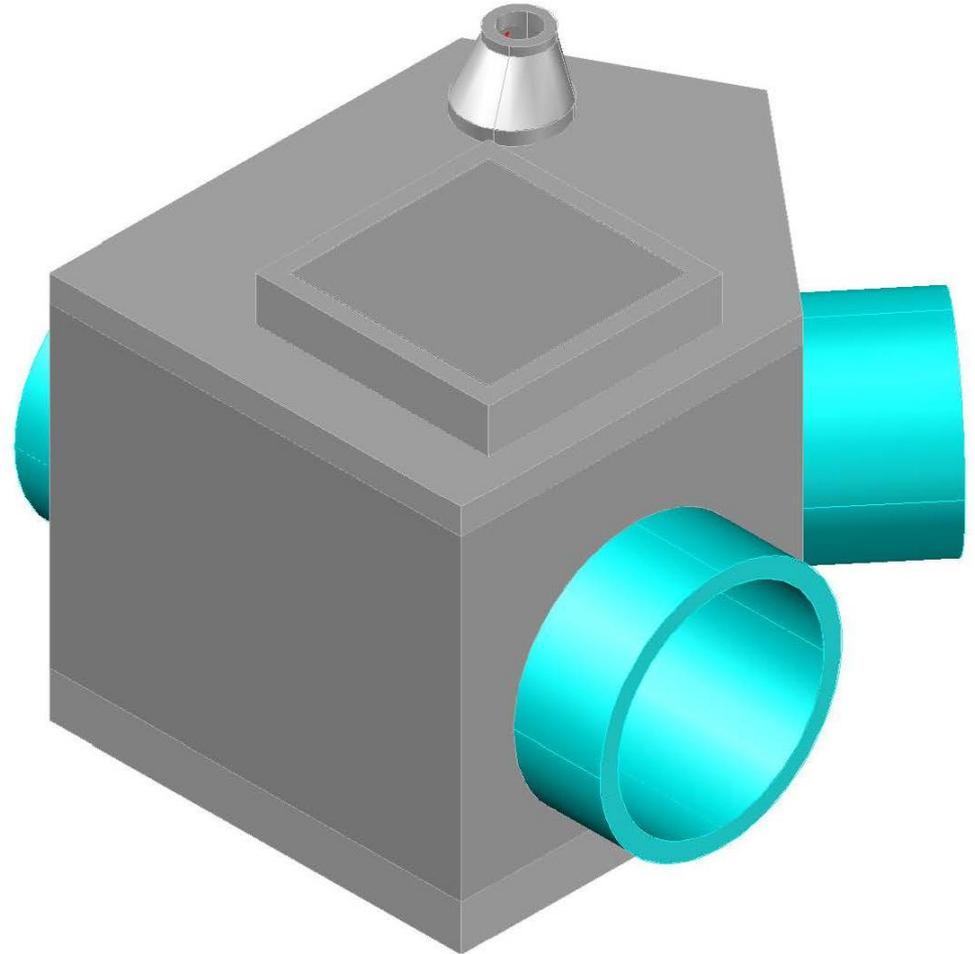
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# South: Junction Chamber



# South Side: Junction Chamber

- ▶ New 108" RCP
- ▶ Existing 138" RCP
- ▶ No hatch access
- ▶ Provision for future slip lining
- ▶ Construction sequencing



# South Site Pipe Installation



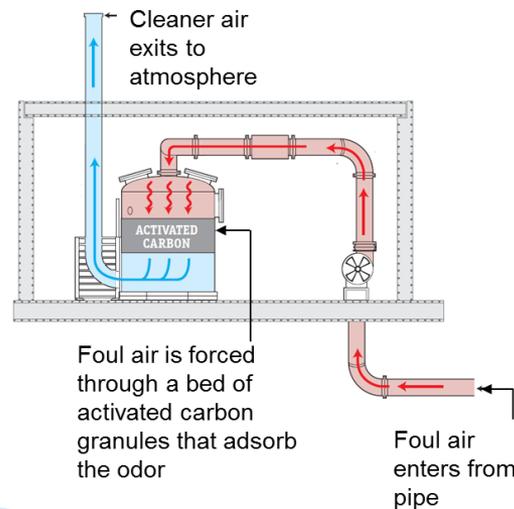
# Odor Control Facility



Odor control included to address concerns from residents near project site

- Air flow calculated from sewer flow rates.
- Odor constituents based on previous King County odor control site monitoring and design.
- Air dispersion modeling completed to set height of vent stack.

**Activated Carbon Scrubber**



# Burke–Gilman and Ship Canal Trails

- ▶ Are able to maintain both trails open and accessible at all times, with little impact to community





# Questions?



# South Side – Junction Chamber Construction Sequence

- ▶ Shore & Excavate around 138”
- ▶ Construct slab & walls
- ▶ Install 108”
- ▶ Break out 138”
- ▶ Flume if necessary
- ▶ Finish top

