

May 3, 2024



Starting from Scratch: When the Treatment Process is the Most Straightforward Part of Designing a New Water Treatment Plant

Case Study: Whatcom PUD Water Treatment Plant 1

PNWS-AWWA 2024

Chadwick Johnson, PE

Agenda

- 01** Project Background
- 02** Proposed Improvements
- 03** Design Constraints
- 04** Design Solutions
- 05** Key Takeaways





01

Background



Case Study

Whatcom PUD Water Treatment Plant 1 (WTP1)

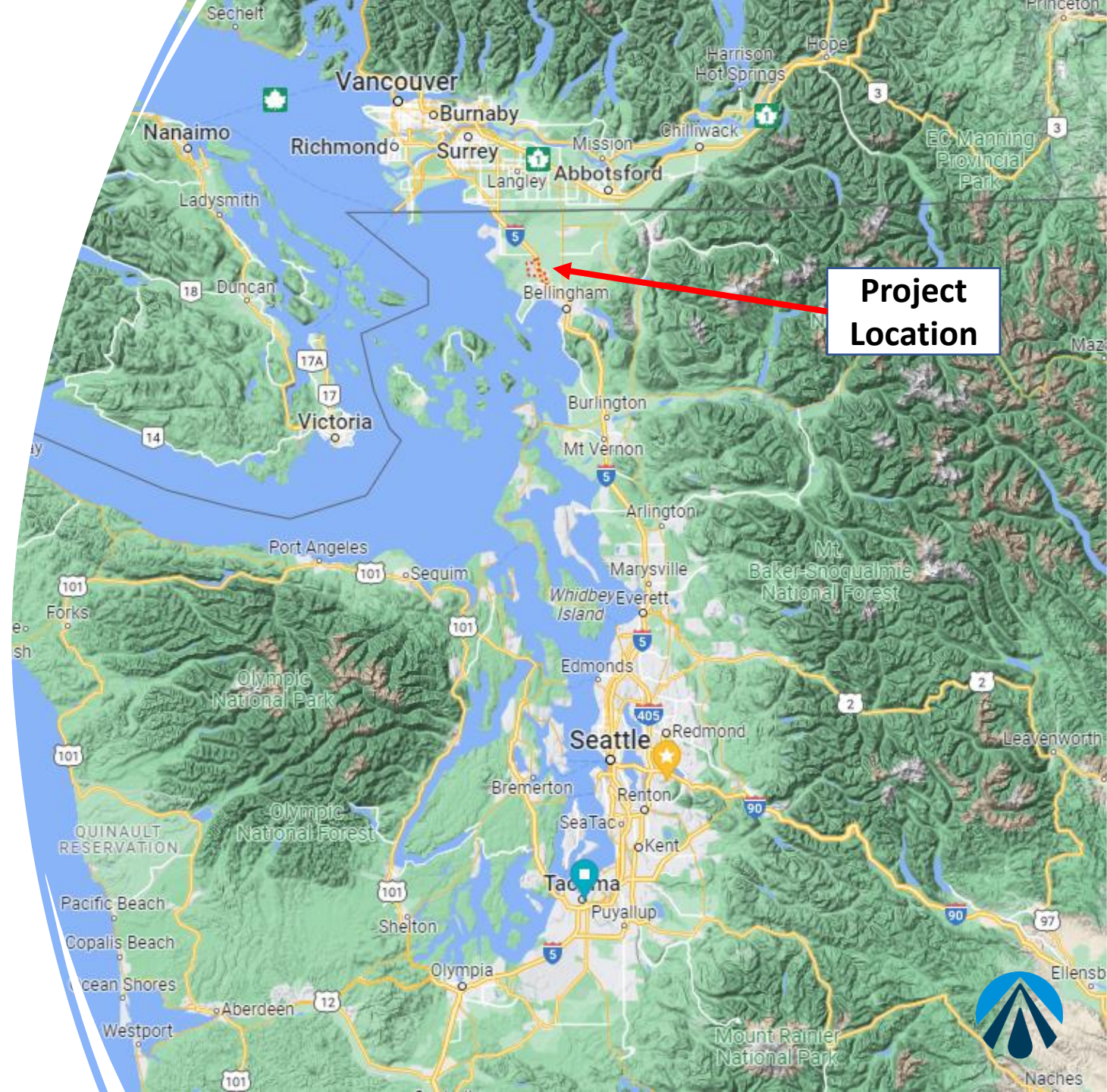
30% preliminary design of a new
21 MGD WTP operating in a
closed water system



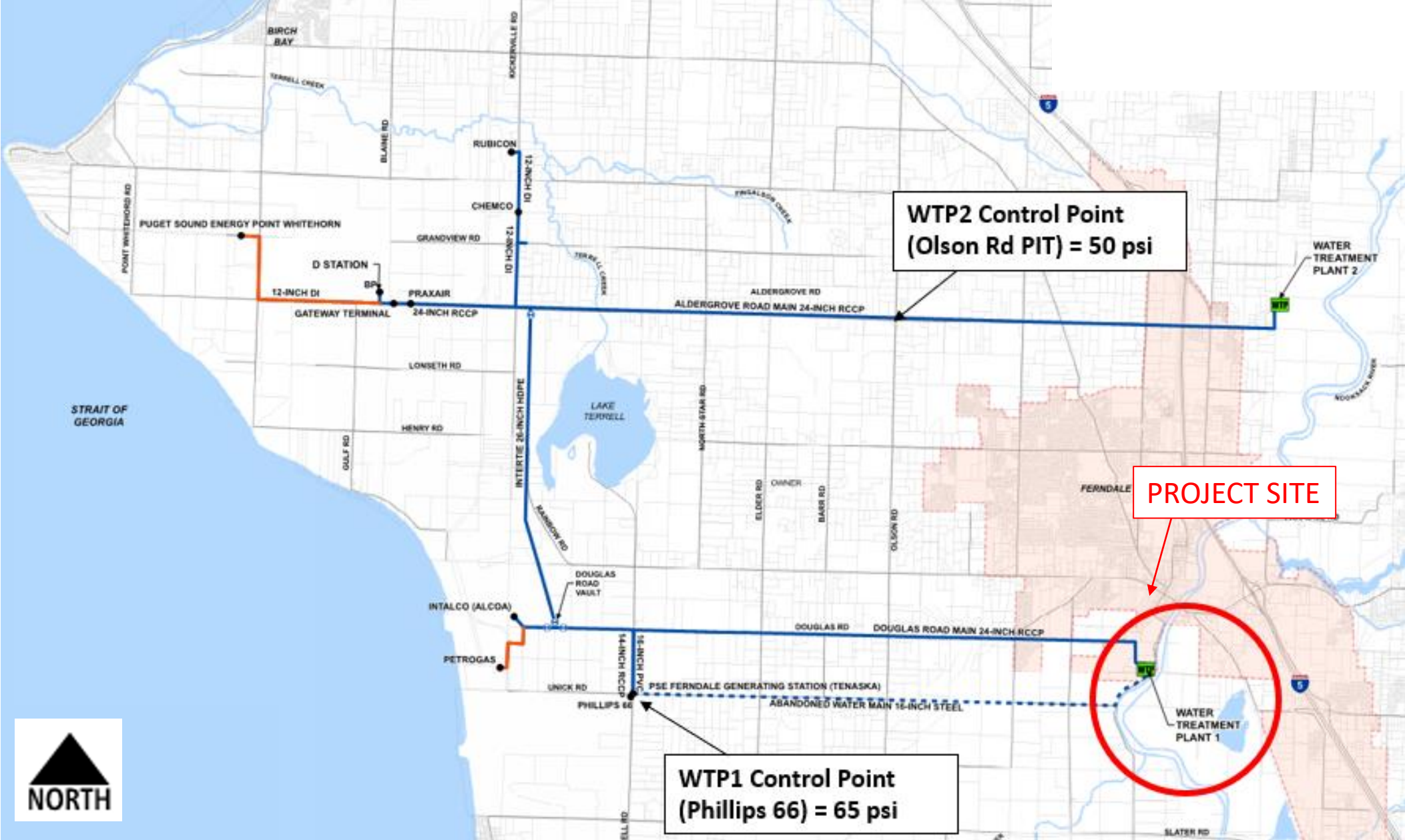
Whatcom PUD WTP1

Background

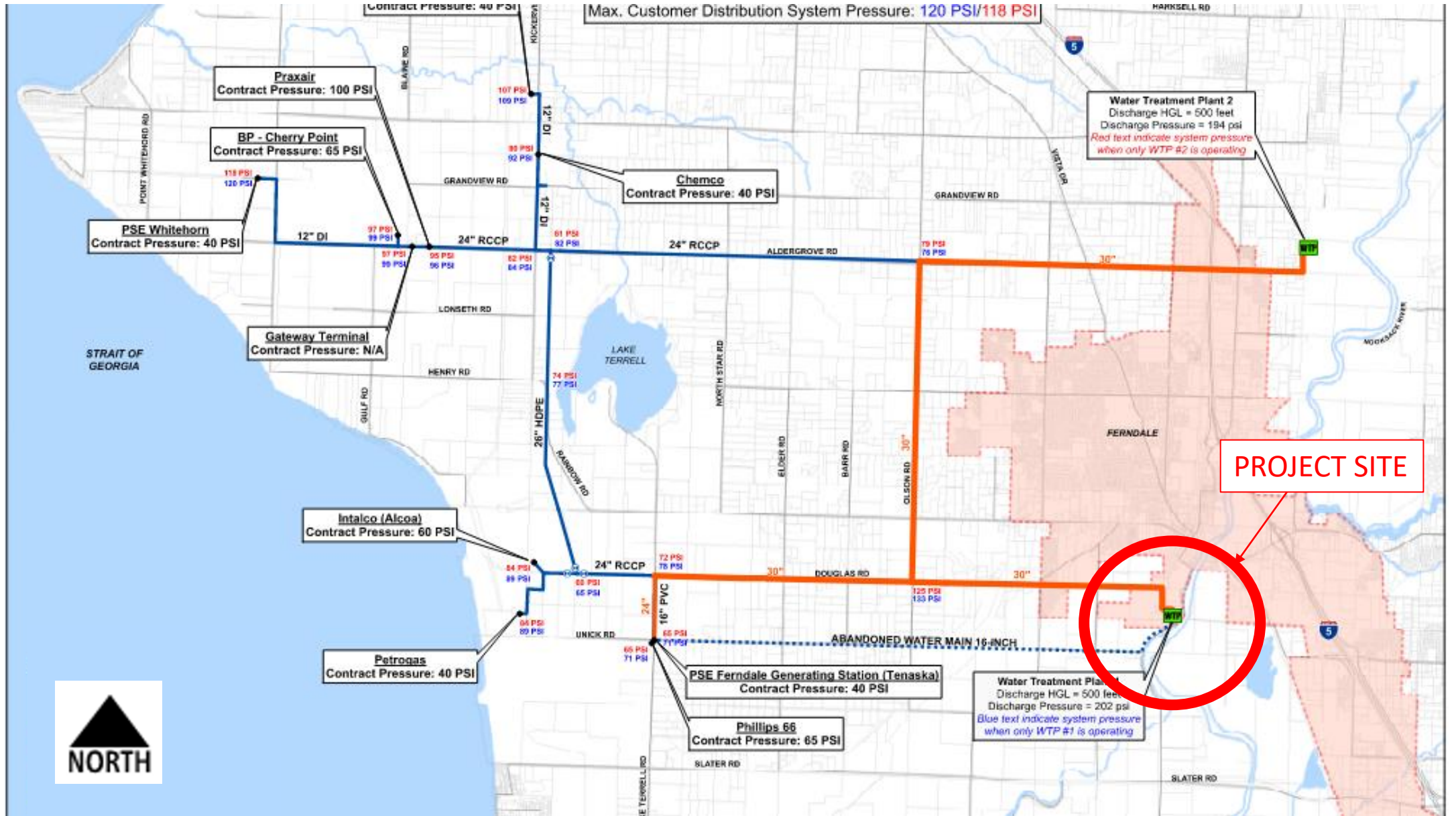
- Location: Ferndale, WA
- Non-potable water (industrial and irrigation customers)



Existing Water System



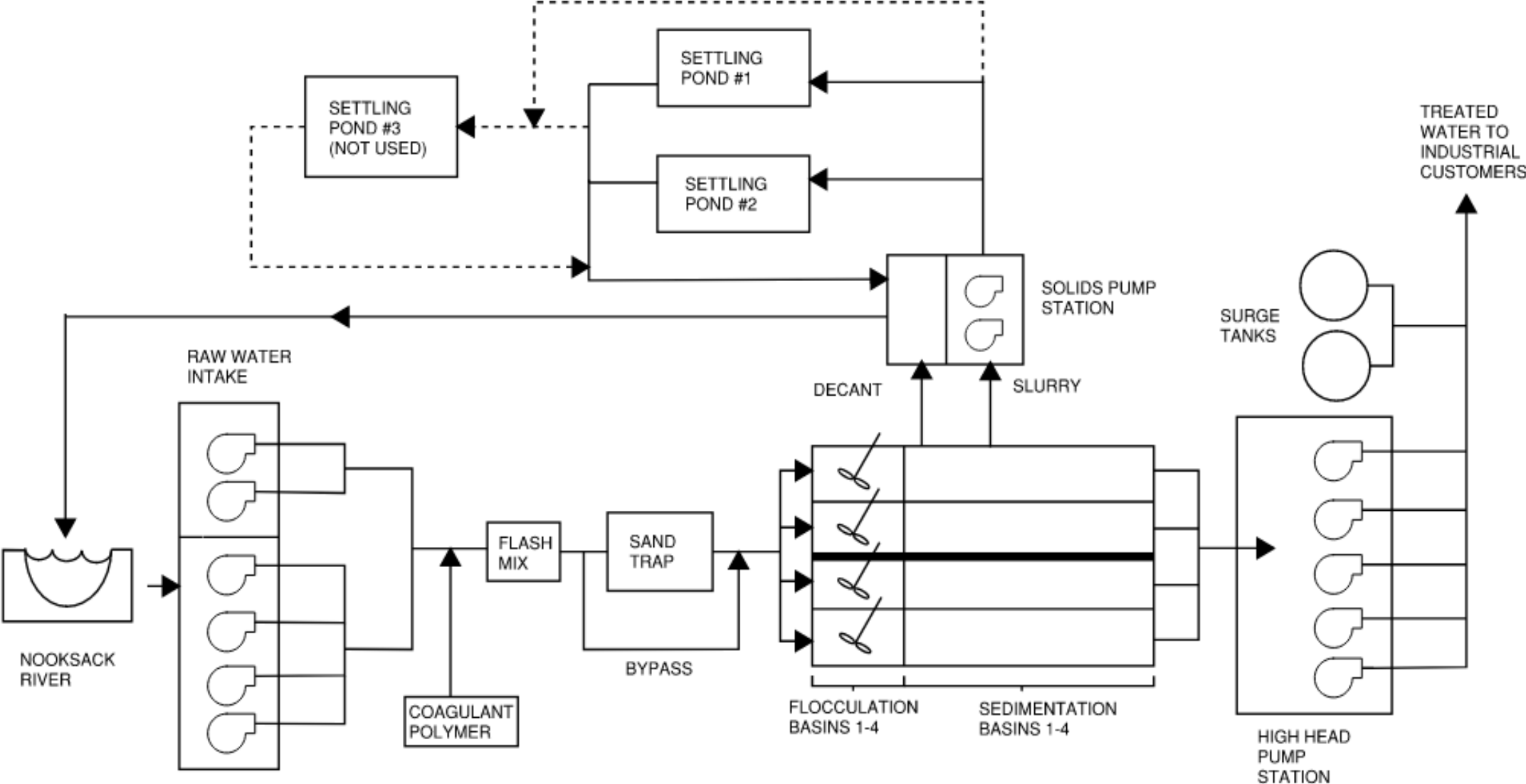
Proposed Water System



Existing Site Plan



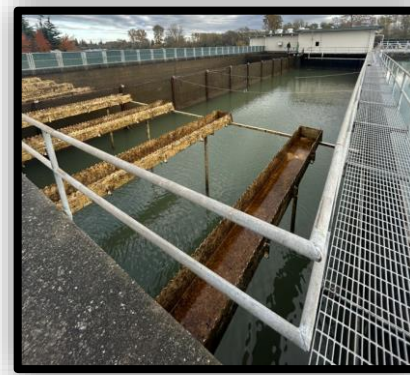
Existing Process Flow



Turbidity is primary water quality parameter (<10 NTU)

Existing Facilities


- WTP1 constructed in 1960s
- Equipment and structures aging and high risk of failure
- Multiple single points of failure (little redundancy)
- Both WTPs must operate to meet average demands
- 24/7 Operations, no storage
- Pumping into closed water system
- No room inside WTP for expansion/replacement upgrades



Treatment Concerns

- Raw water supply conditions can vary significantly
- Highly variable raw water turbidity; 10 NTU to >2000 NTU
- Frazil ice in river
- Freezing at surface of treatment building











02

Proposed Improvements



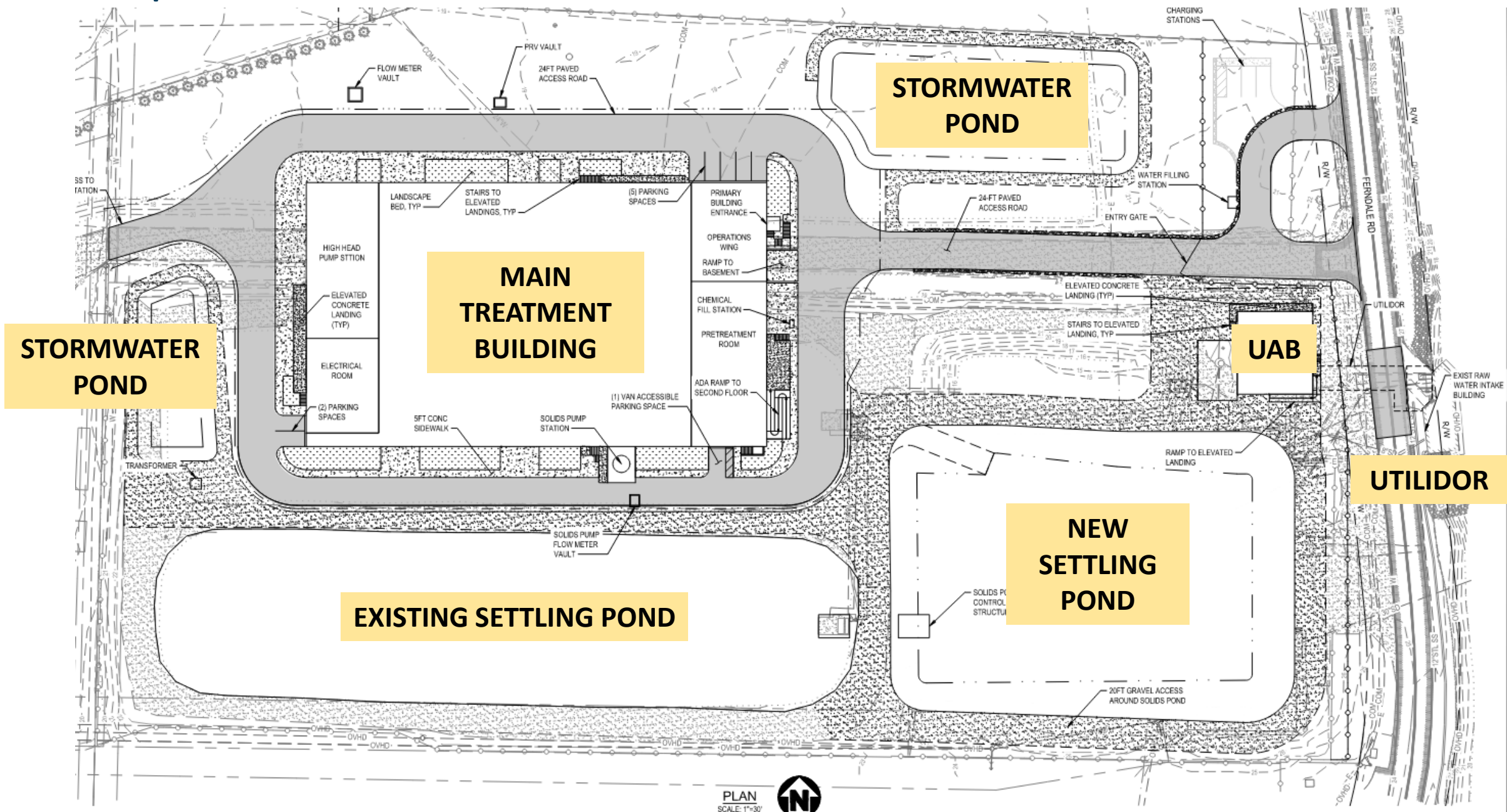
Proposed Improvements

-  Complete replacement of WTP1
-  Cover treatment basins
-  Increase capacity to 21 mgd, redundancy along train
-  Singular treatment building
-  Install utilidor under County owned road
-  Relocate transmission main

*Integration with Ferndale Road/Levee Improvements



Proposed Site Plan



STORMWATER POND

STORMWATER POND

MAIN TREATMENT BUILDING

UAB

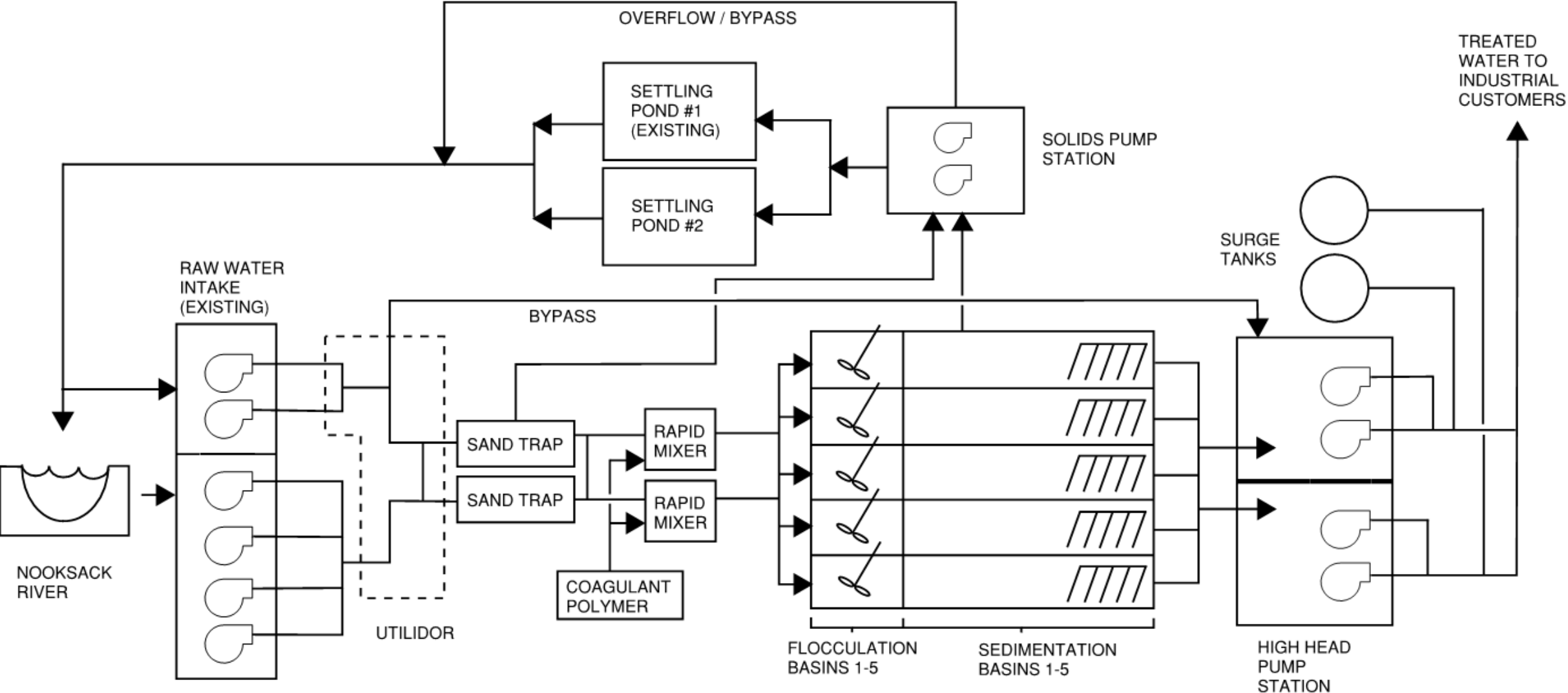
UTILIDOR

EXISTING SETTLING POND

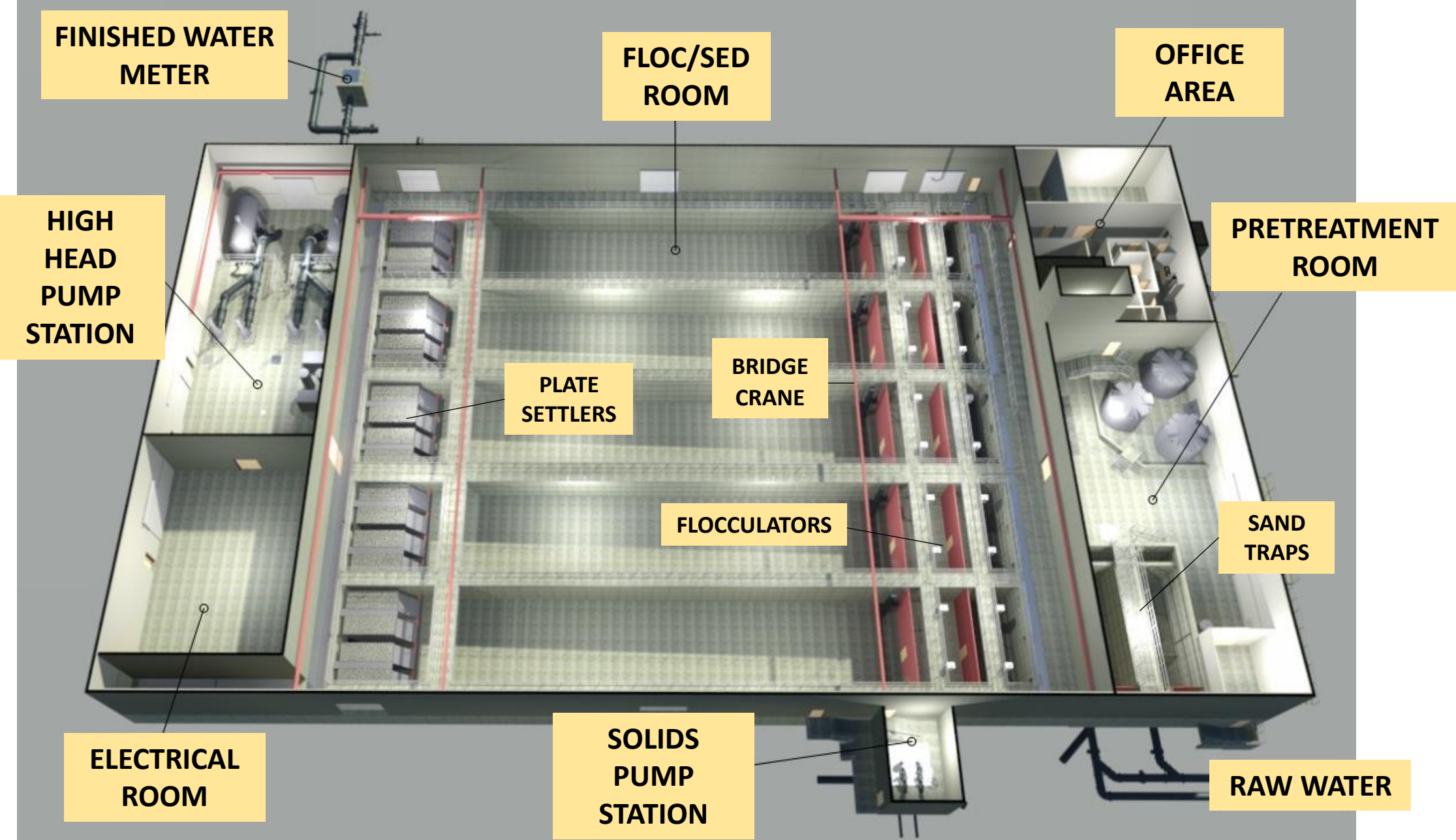
NEW SETTLING POND



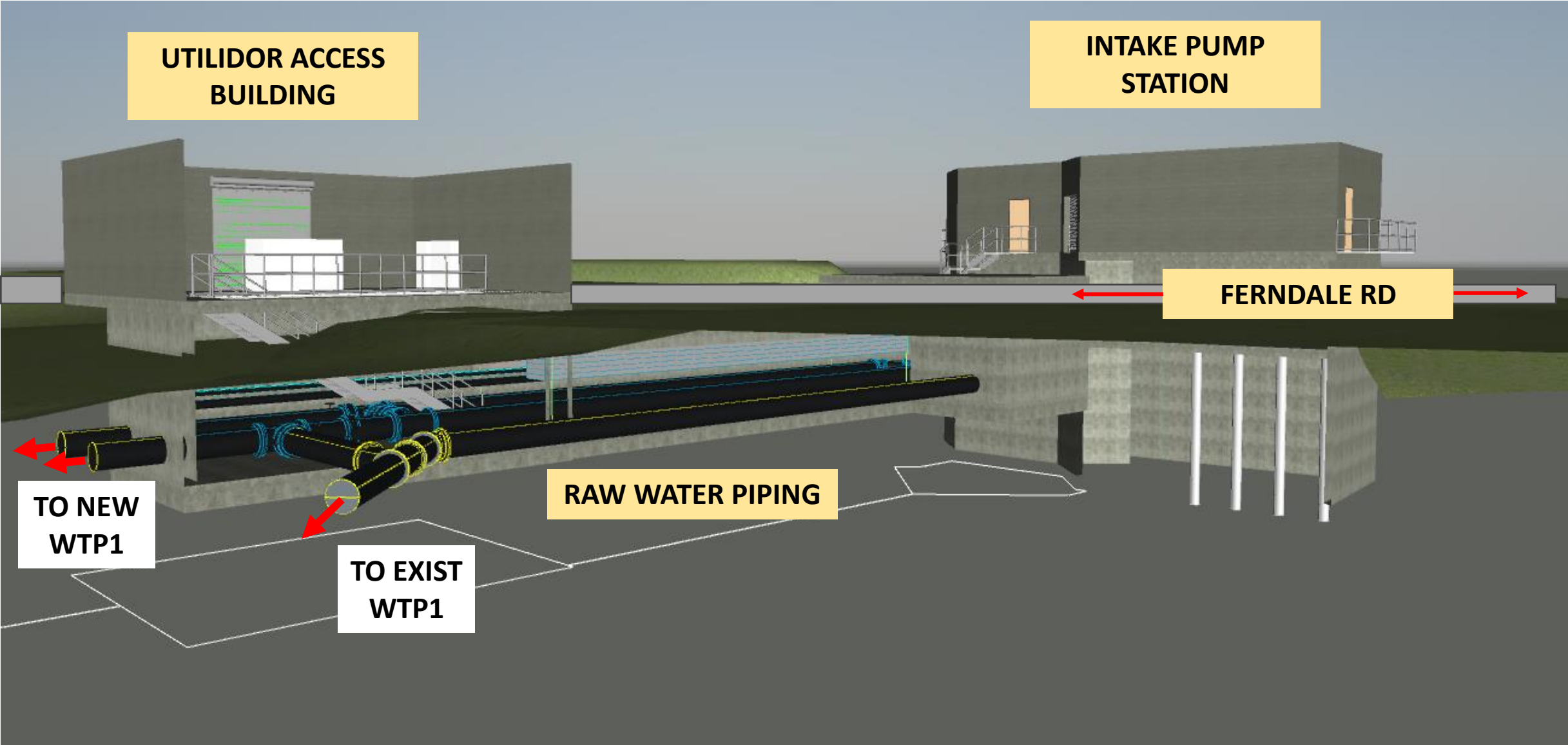
Proposed Process Flow



Proposed Treatment Building



Proposed Utilidor and UAB





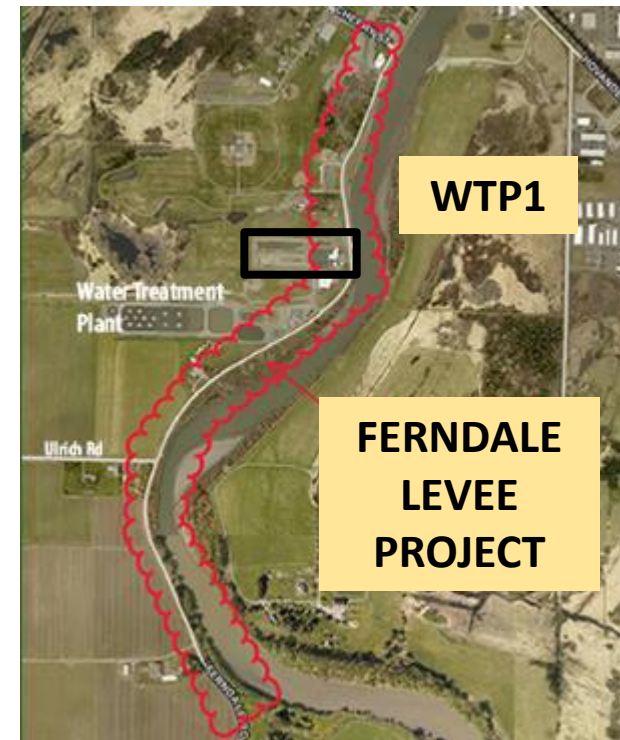
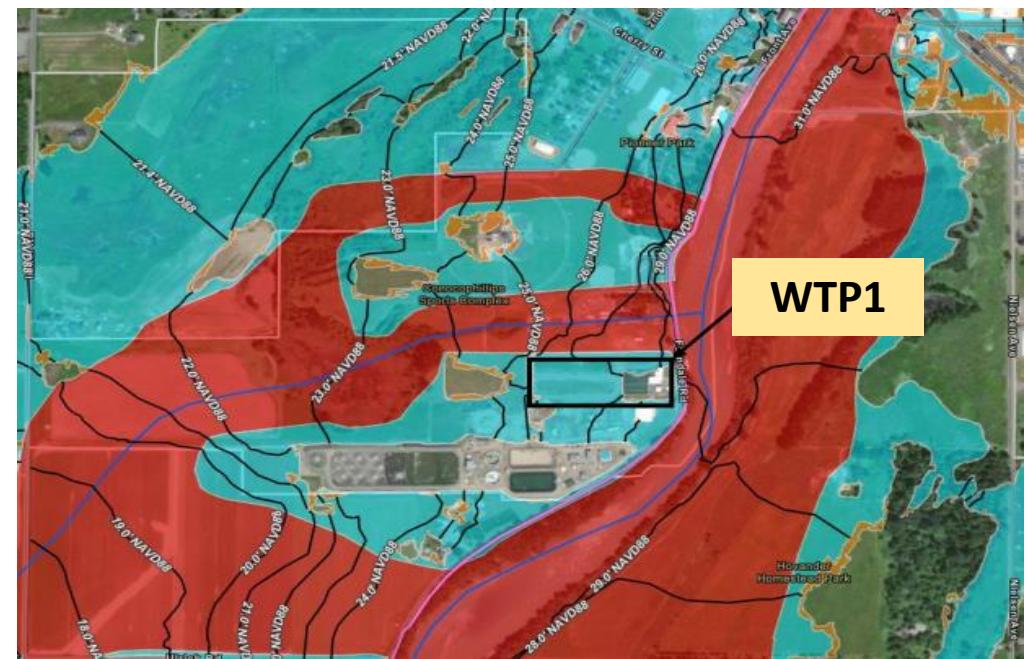
03

Design Constraints



Site Constraints

- Poor soils / risk of liquefaction
- High groundwater table, deep excavation requirements
- Stormwater management on constrained site with significant hard surfaces
- “Zero Rise” requirements
- Designing to effective vs. proposed floodplain maps
- Ferndale Road and Levee Improvements Project



Building Constraints

- Minimize fill while elevating all equipment above floodplain
- Preference for singular building for all treatment processes
- Access to equipment for O&M
- Intake Pump Station not seismically resilient
- Risk Category IV seismic resilience required (fire flows)

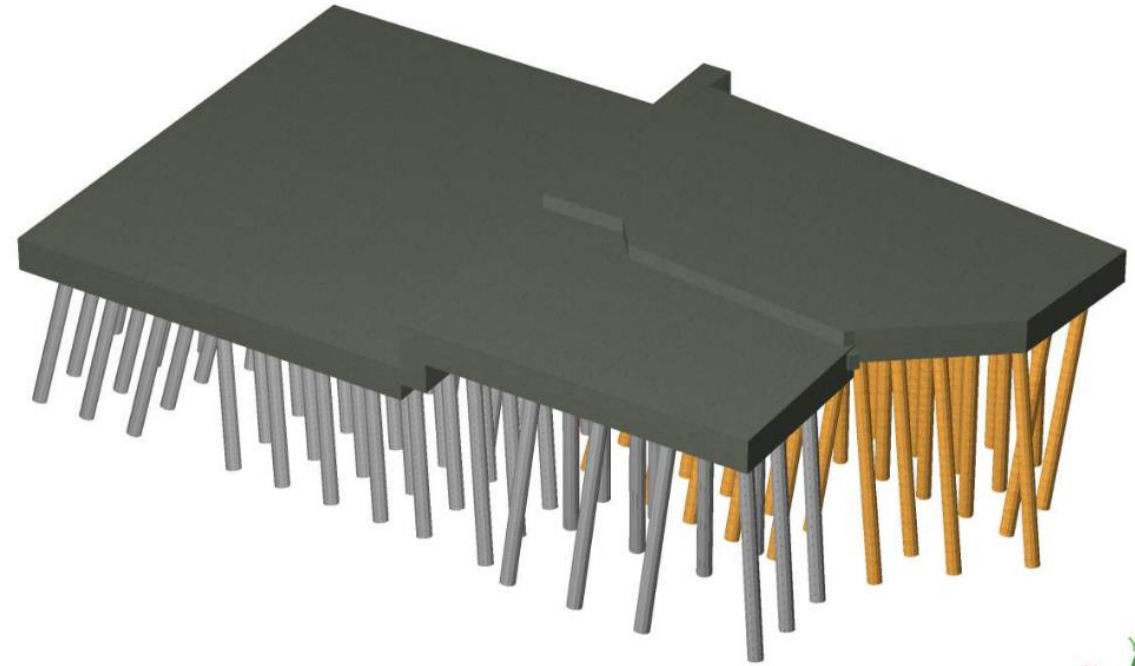


2009 storm event at WTP1 site



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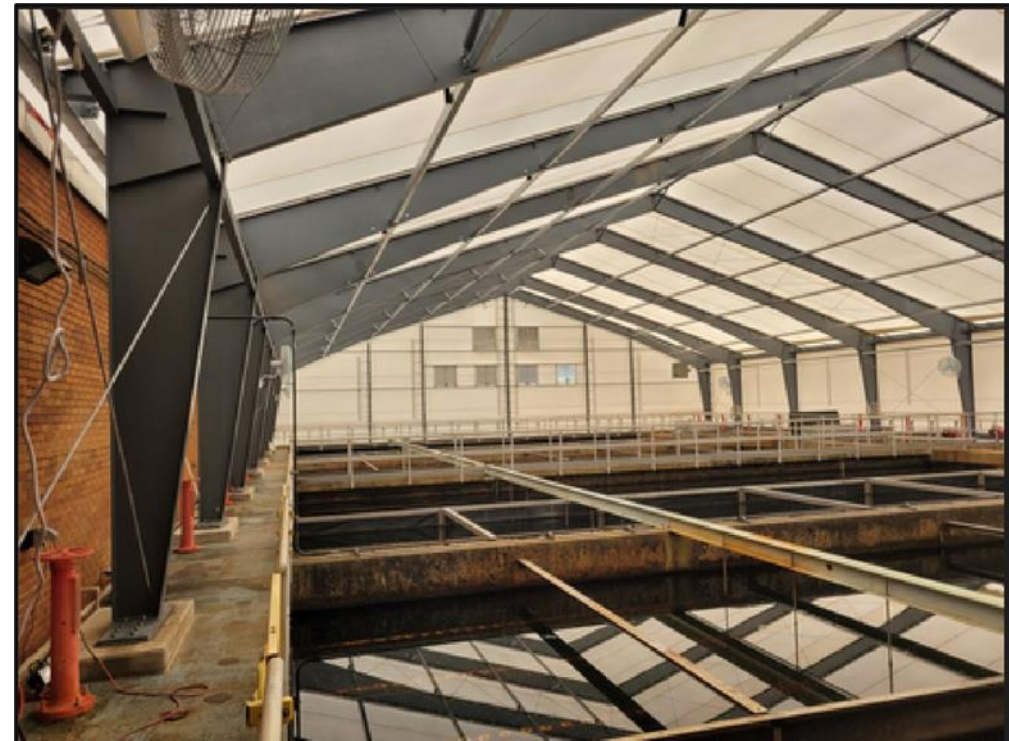


Seismic modeling of IPS foundation piles



Treatment & Operational Constraints

- Conventional treatment required with covered basins
- Basin size cannot be reduced with plate or tube settlers
- Manual basin cleanings
- Interest in alternative energy and energy efficiencies
- Existing and future conditions
- Full redundancy of all processes
- Closed water system creates surge risks





04

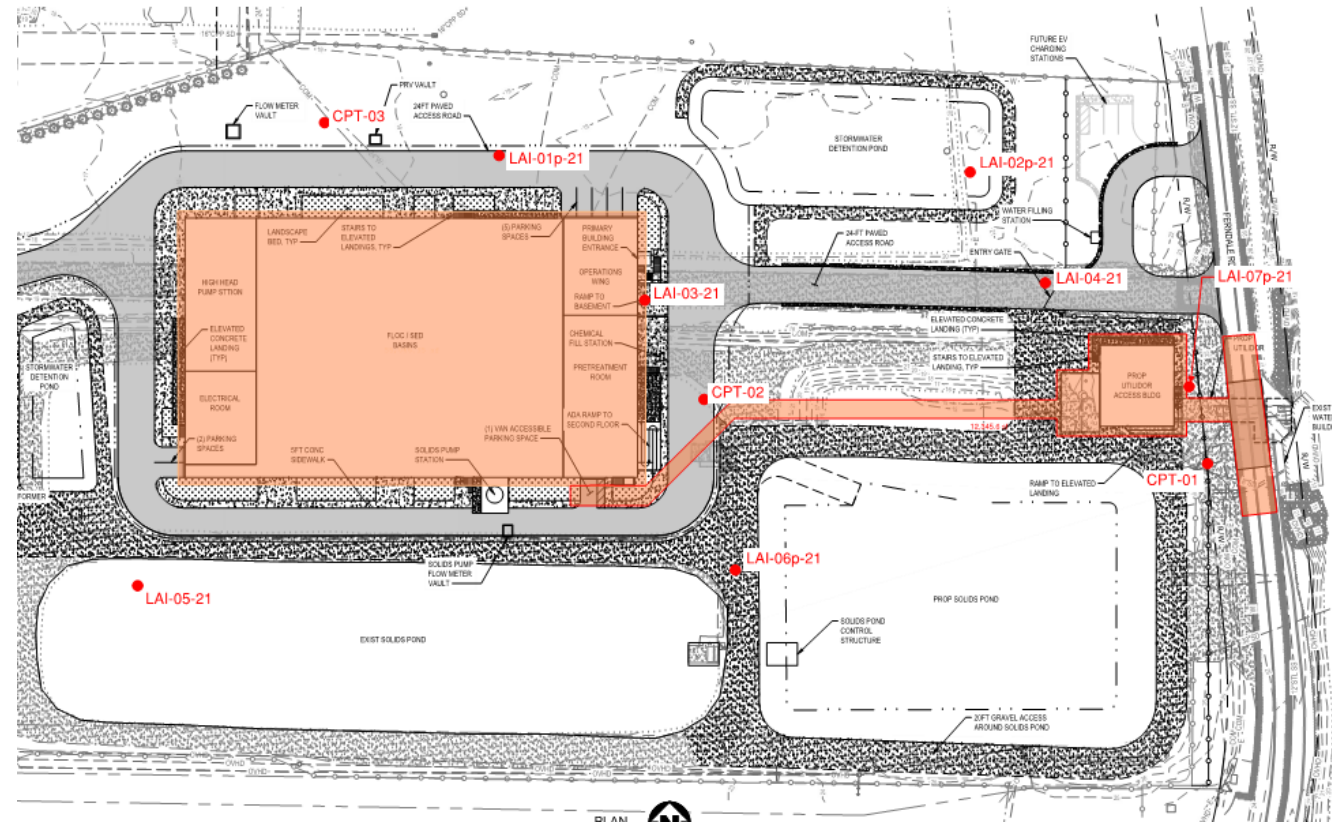
Design Solutions



Site Constraints

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Solutions

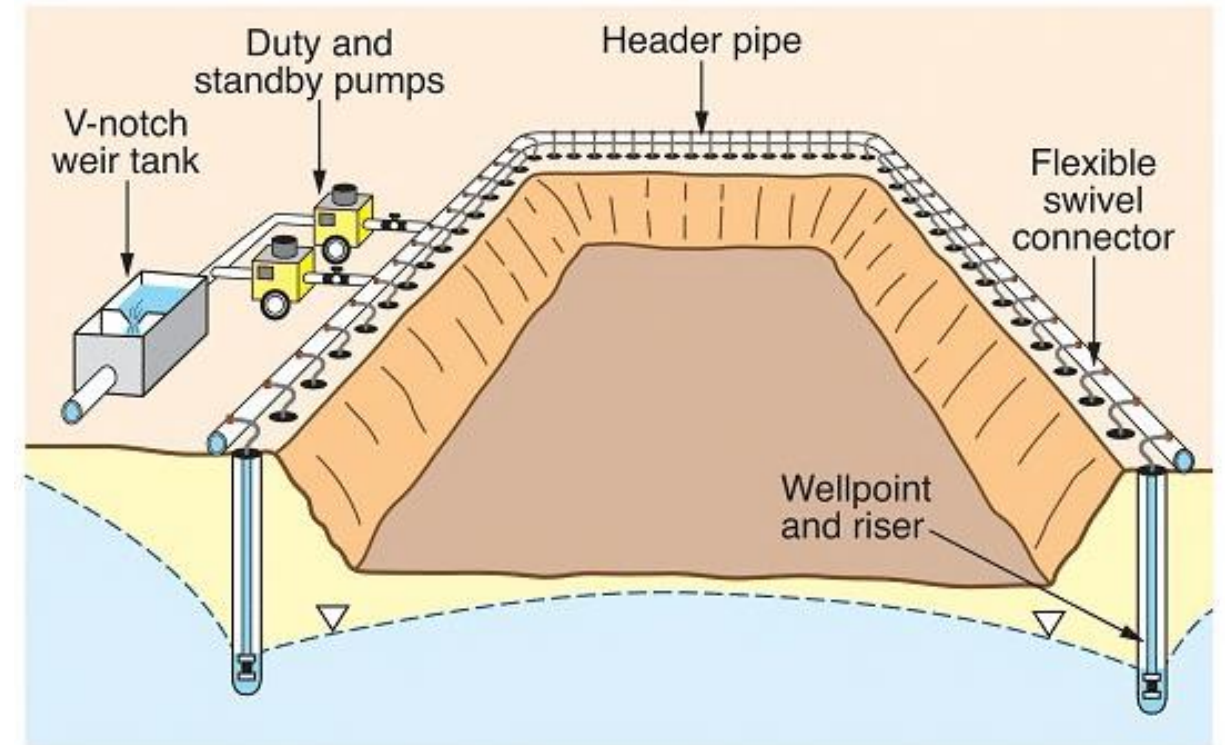


Deep soil cement mixing columns to improve seismic resilience

Site Constraints

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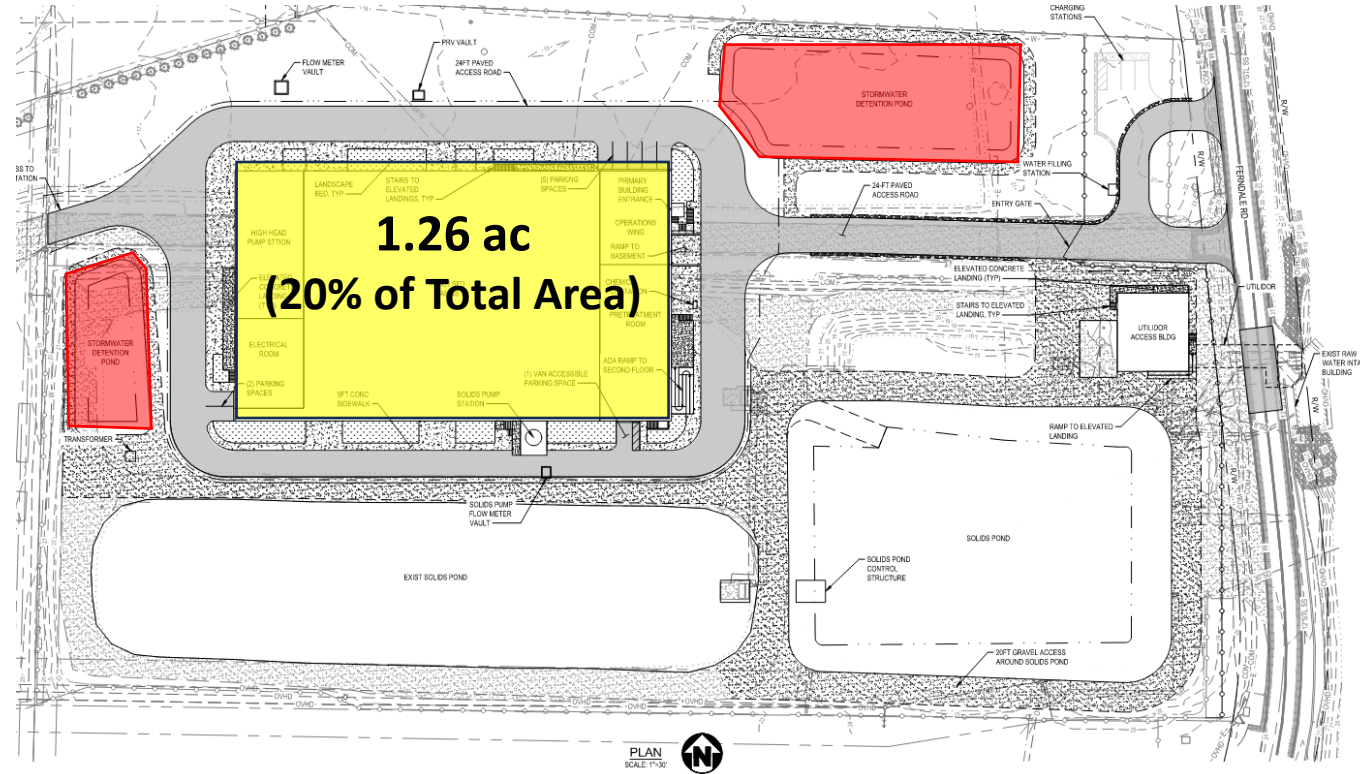


Shoring and well point dewatering system for excavations

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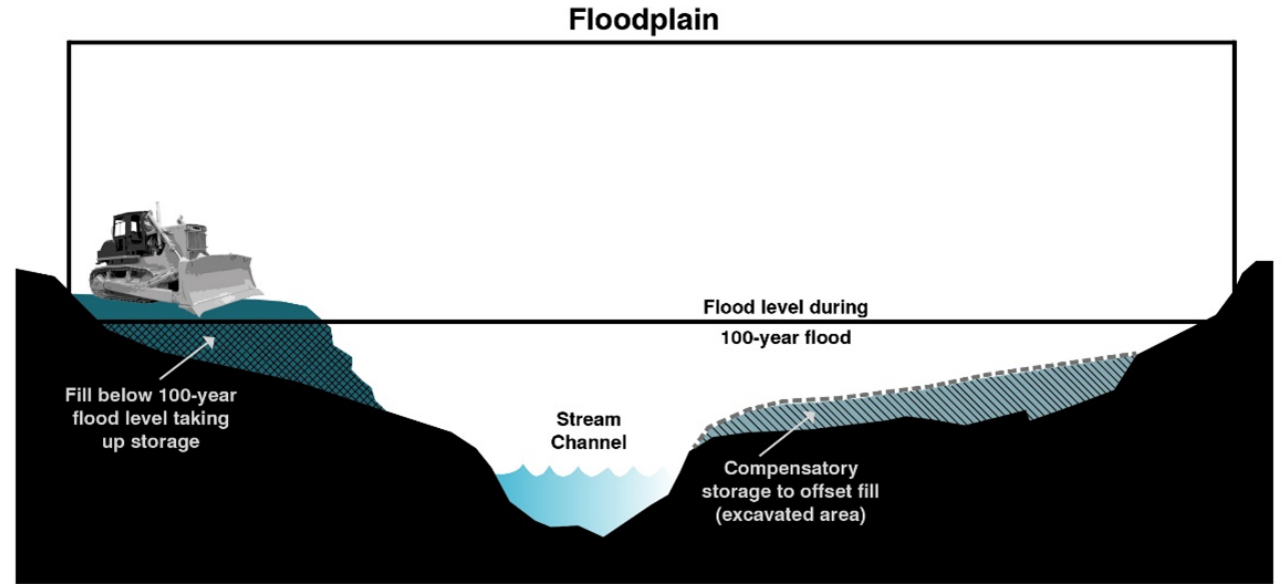
Solutions



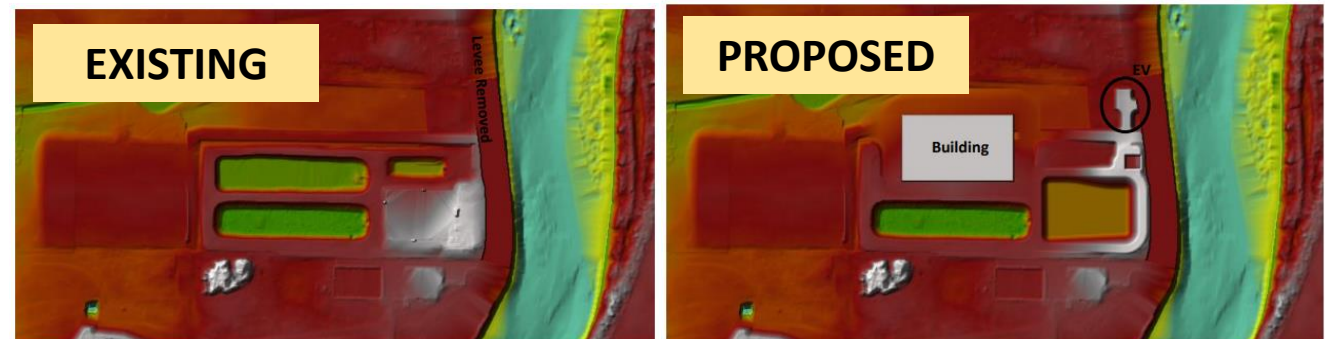
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Example cut, fill, and compensatory storage in a floodplain

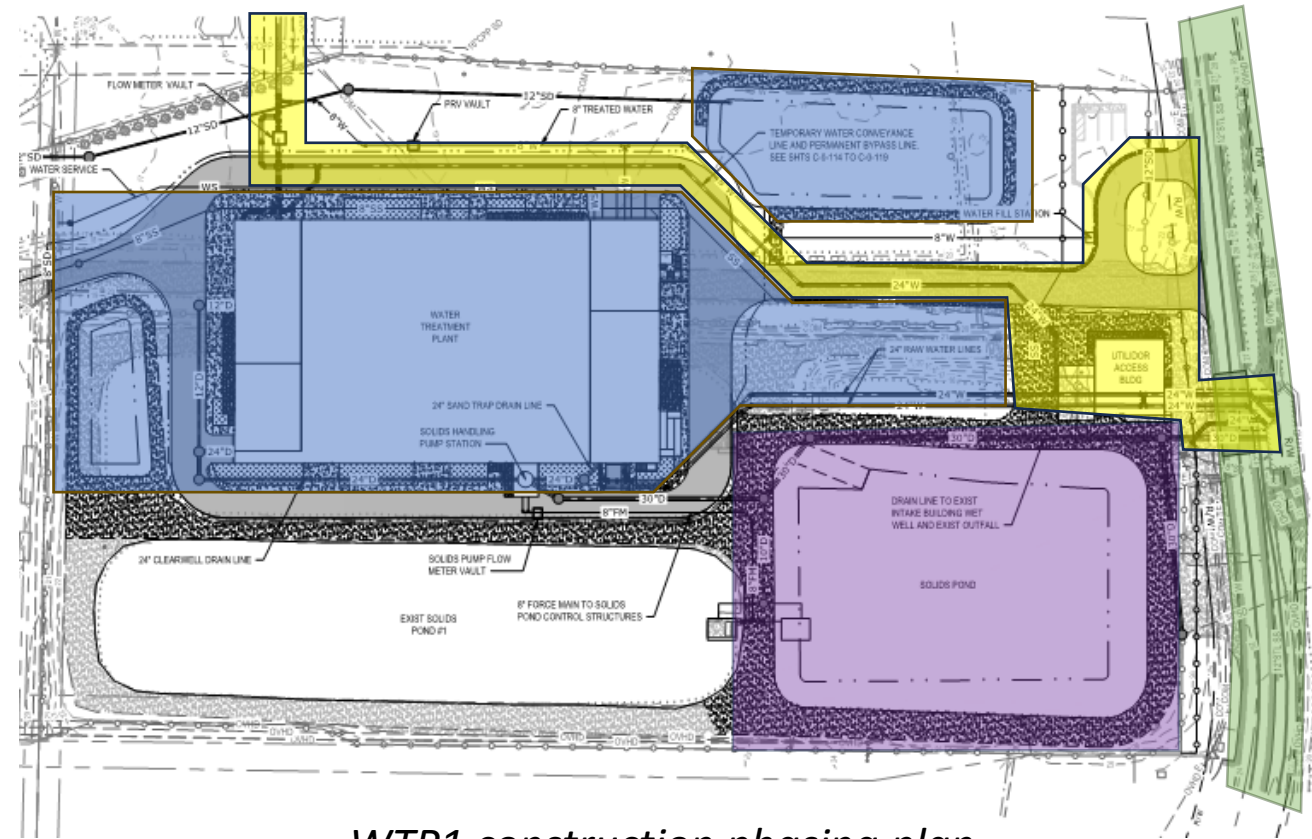


Flood modeling of new WTP1 site

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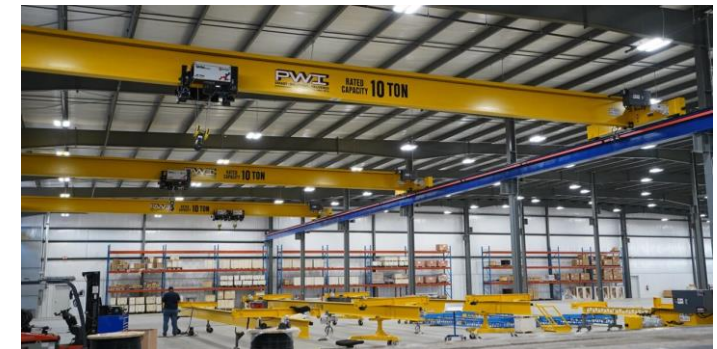
WTP1 construction phasing plan

Phase 1 >> Phase 2 >> Phase 3 >> Phase 4

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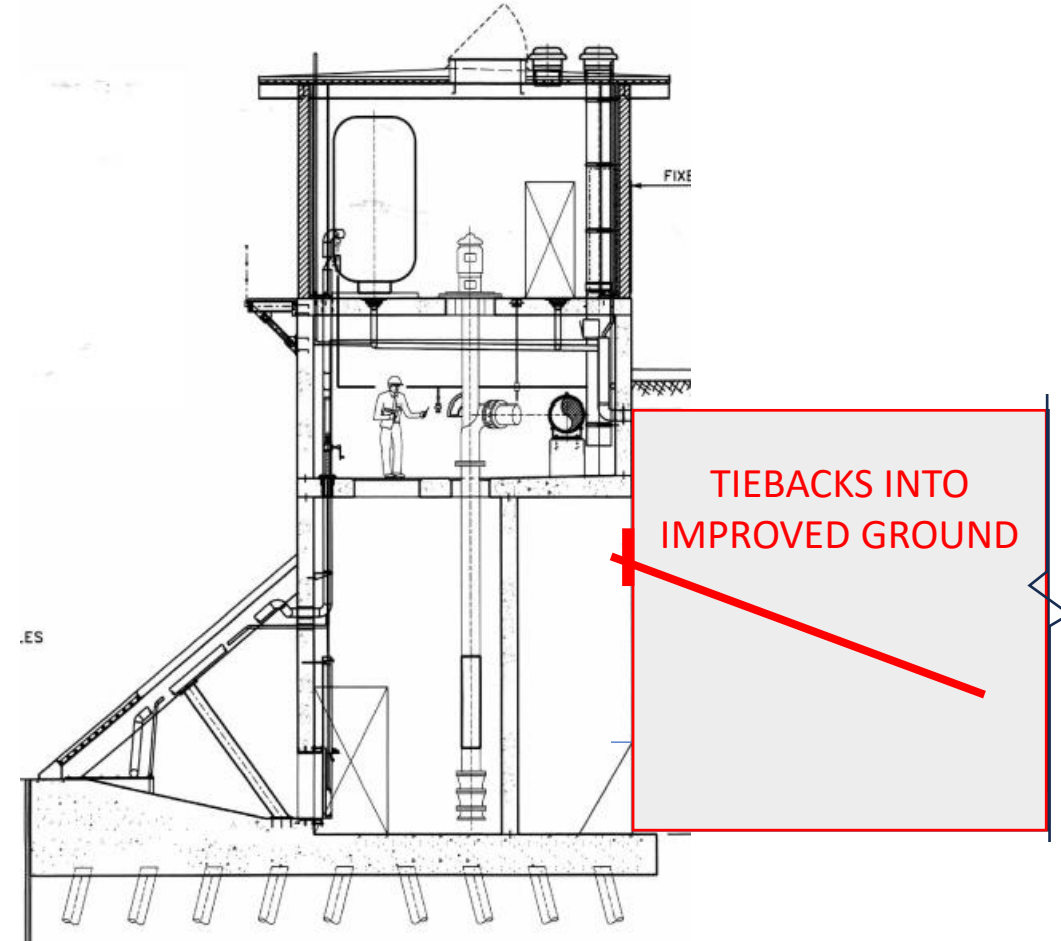
Elevated entrances, bridge cranes and access hatches



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Solutions



Connection of utilidor to IPS provides resistance to overturning moment and sliding



Treatment & Operational Constraints

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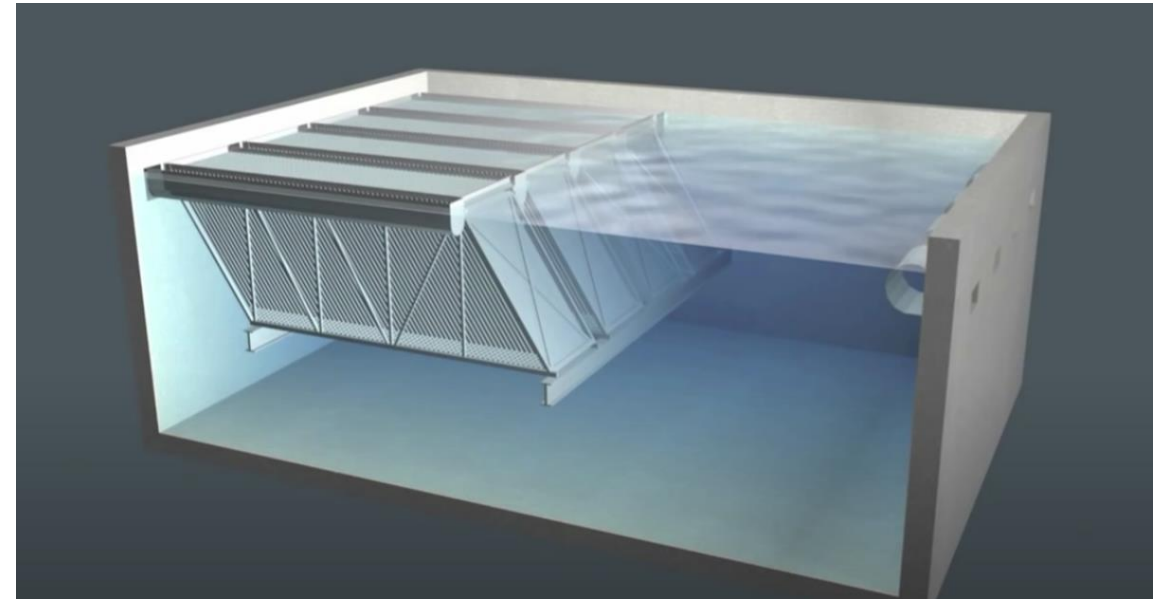


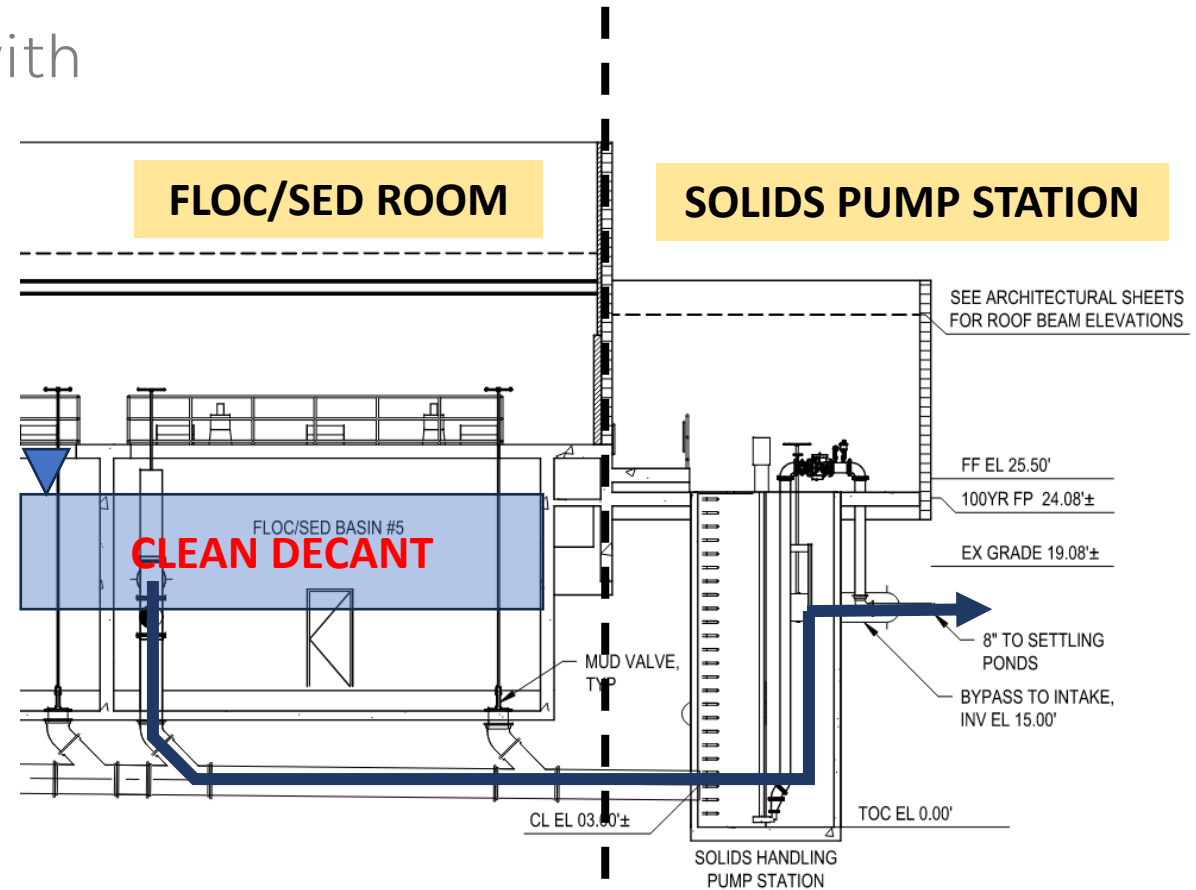
Plate settlers added as polishing step



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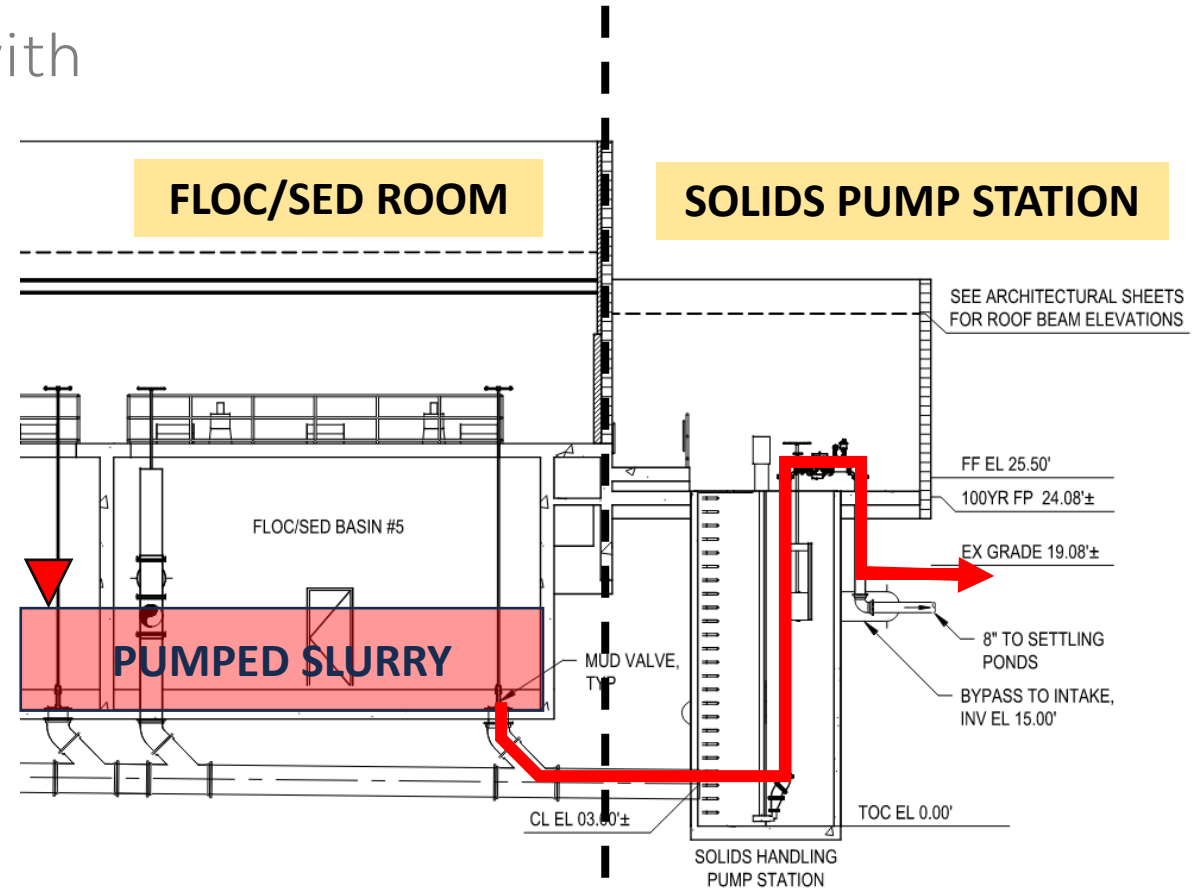
Decanting/pumping during basin clean out



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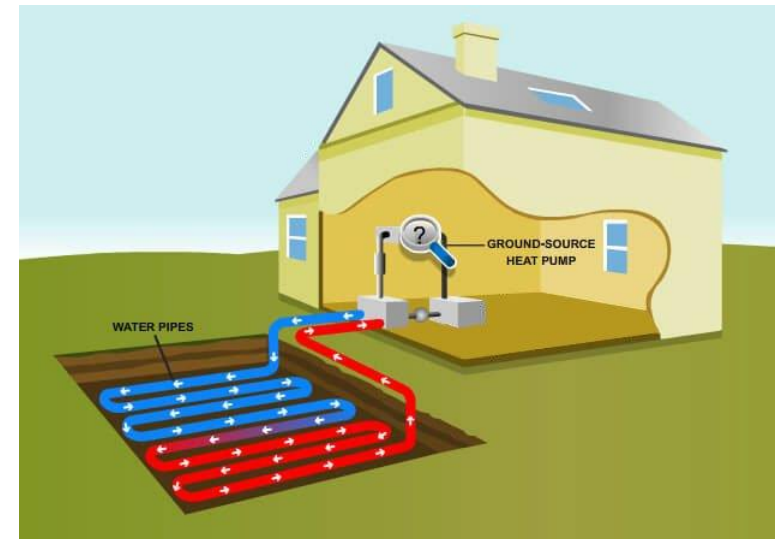
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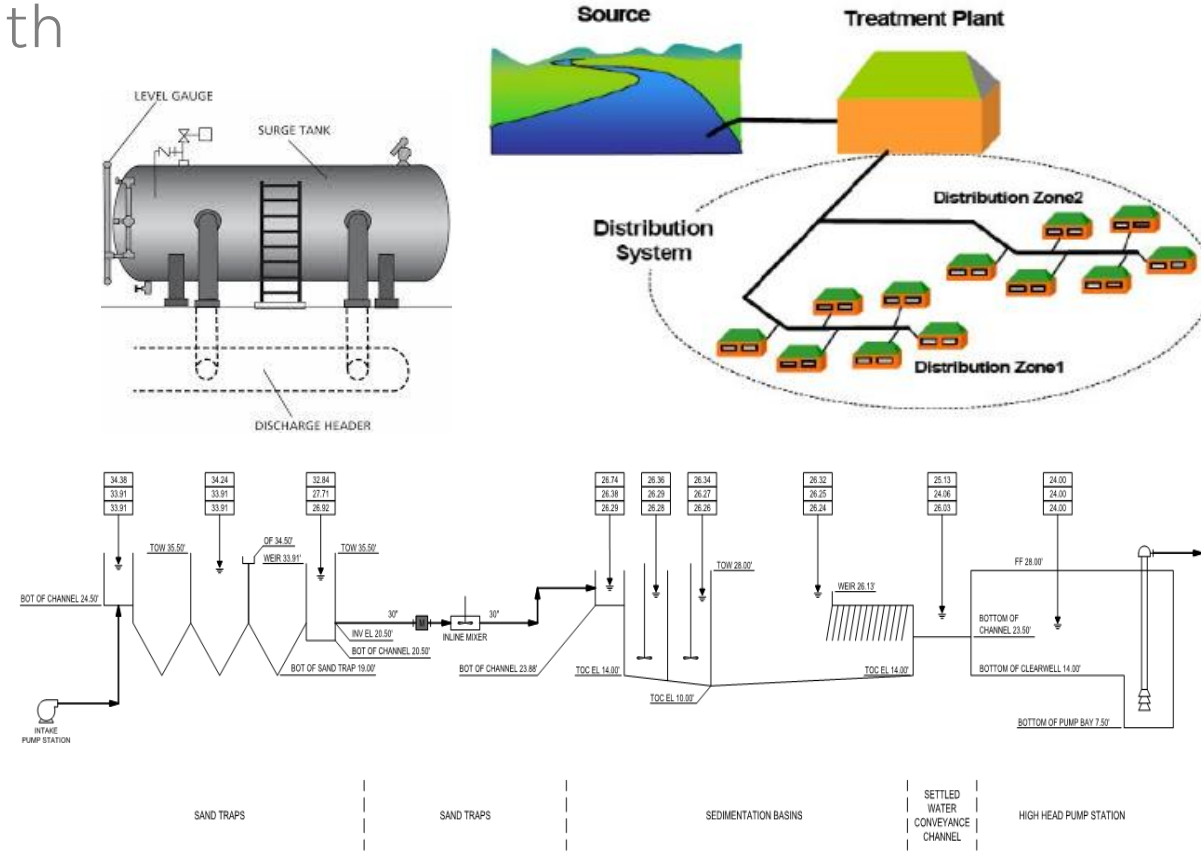
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Solutions



Proposed hydraulic profile











05

Key Takeaways



Key Takeaways

-  * Understand client needs and design constraints early
-  Leverage experience and knowledge of operators in design
-  Coordinate with jurisdiction to understand nearby projects
-  Never too early to think about constructability/phasing
-  * Don't ignore your civil design, even on treatment projects
-  * Design your facilities with equipment replacement in mind





Thank You

Q&A

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