Seeing Purple:
Design and Construction of the City of Beaverton's Non-potable Water System for Municipal Irrigation

May 5, 2023

AWWA PNWS 2023 Section Conference

Beaverton OREGON

summit WATER RESOURCES
a Geo-Logic Company

BEAVERTON PURPLE PIPE

Connecting the right water with the right uses.

Topics

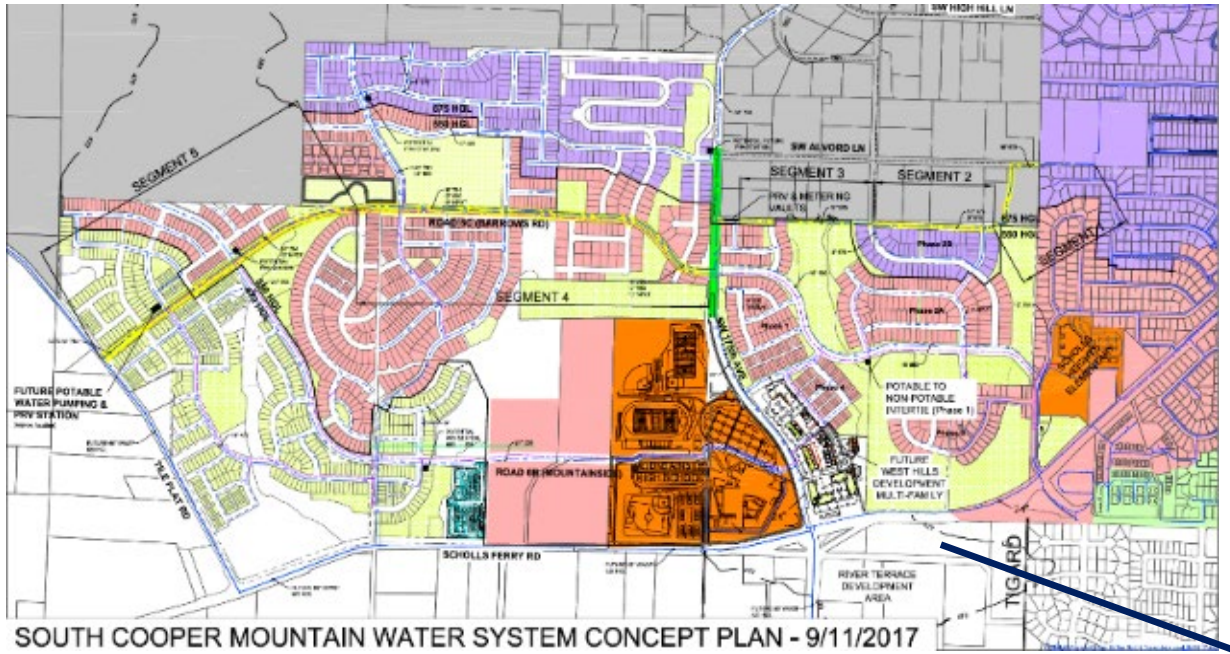
1. Overview of Purple Pipe Program
2. Distribution system and developers
3. Design of stormwater treatment and pump station
4. Bidding and construction progress
5. Closing

Overview: Goals of Purple Pipe Program

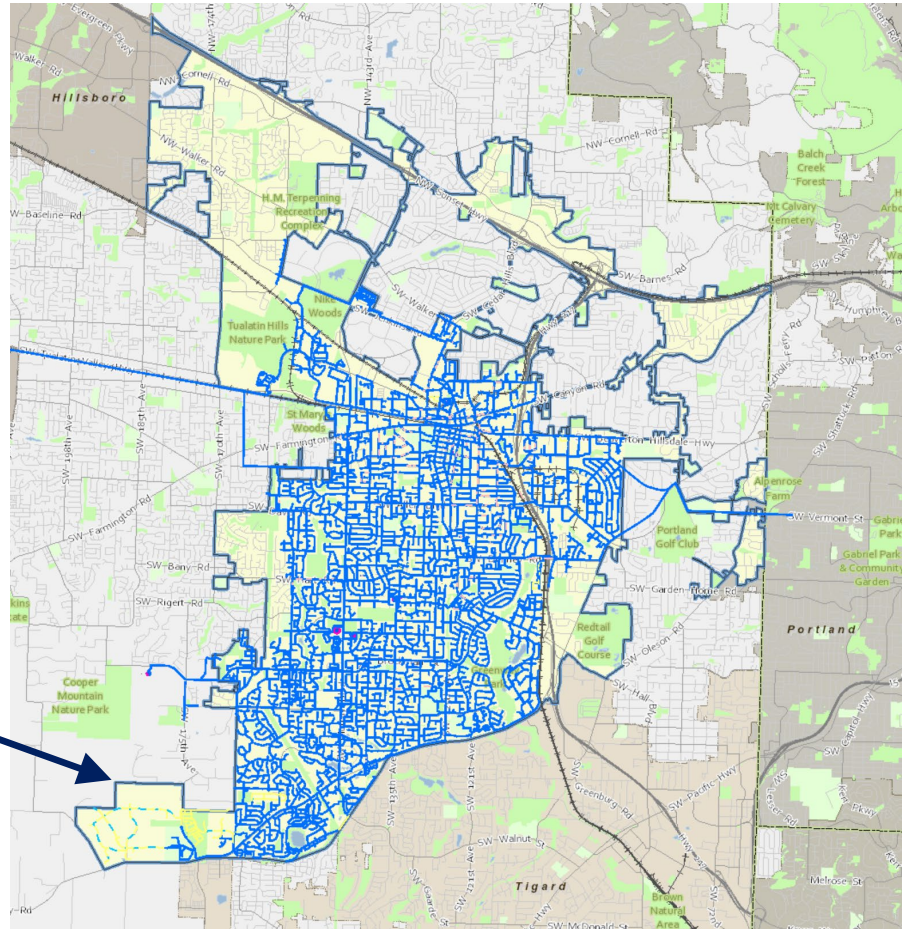
- *Use <u>non-potable</u>* water to irrigate community green spaces in the South Cooper Mountain area of Beaverton and provide stream recharging.
- City's goals:
  - Create a sustainable and reliable source of water
  - Be environmentally responsible and conserve natural resources
  - Be financially responsible

South Cooper Mountain

Annexed in 2013: 544 acres, 3,500 new homes, 2,200-student high school and future elementary school; approximately 9,000 population



SOUTH COOPER MOUNTAIN WATER SYSTEM CONCEPT PLAN - 9/11/2017



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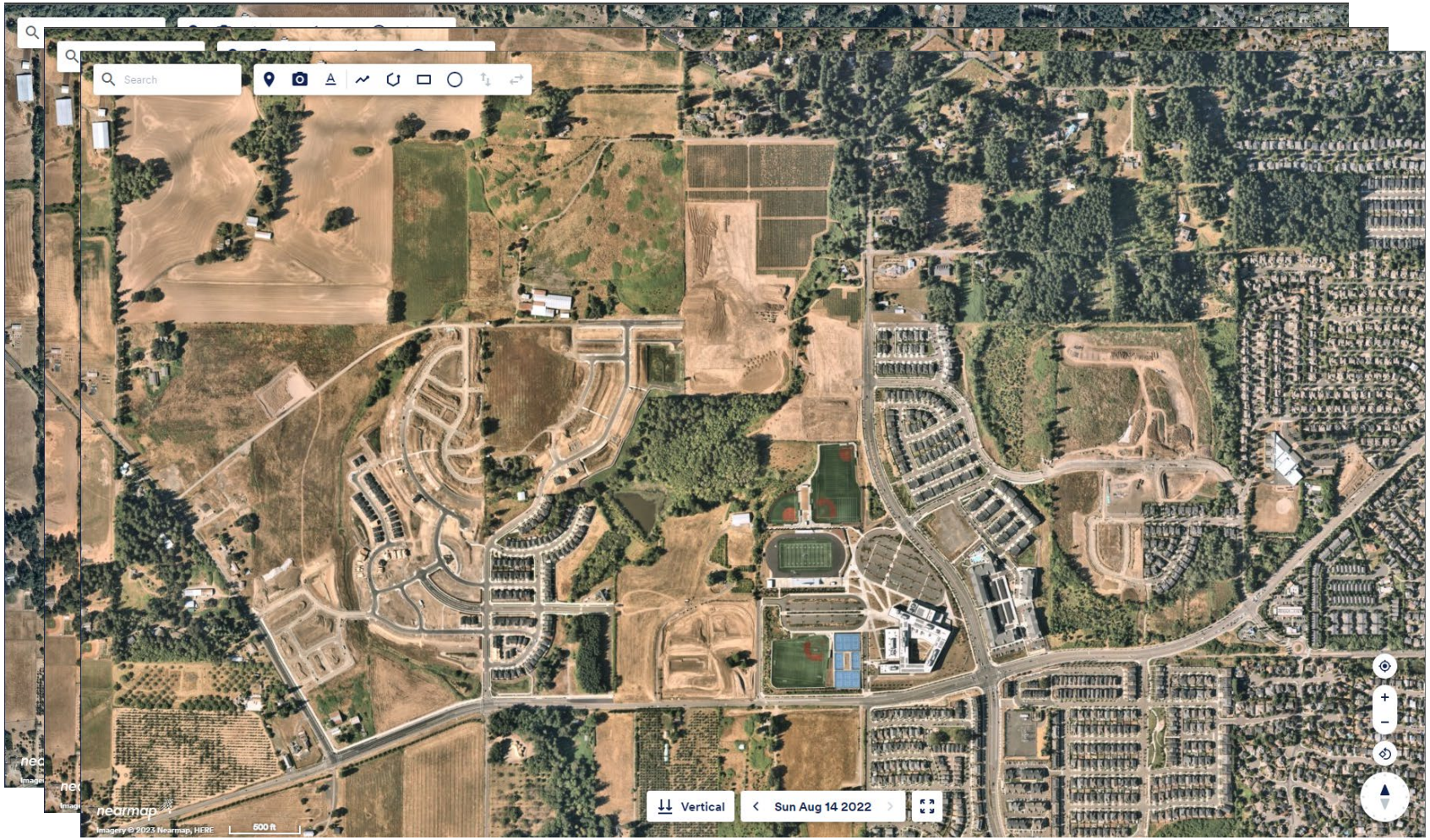
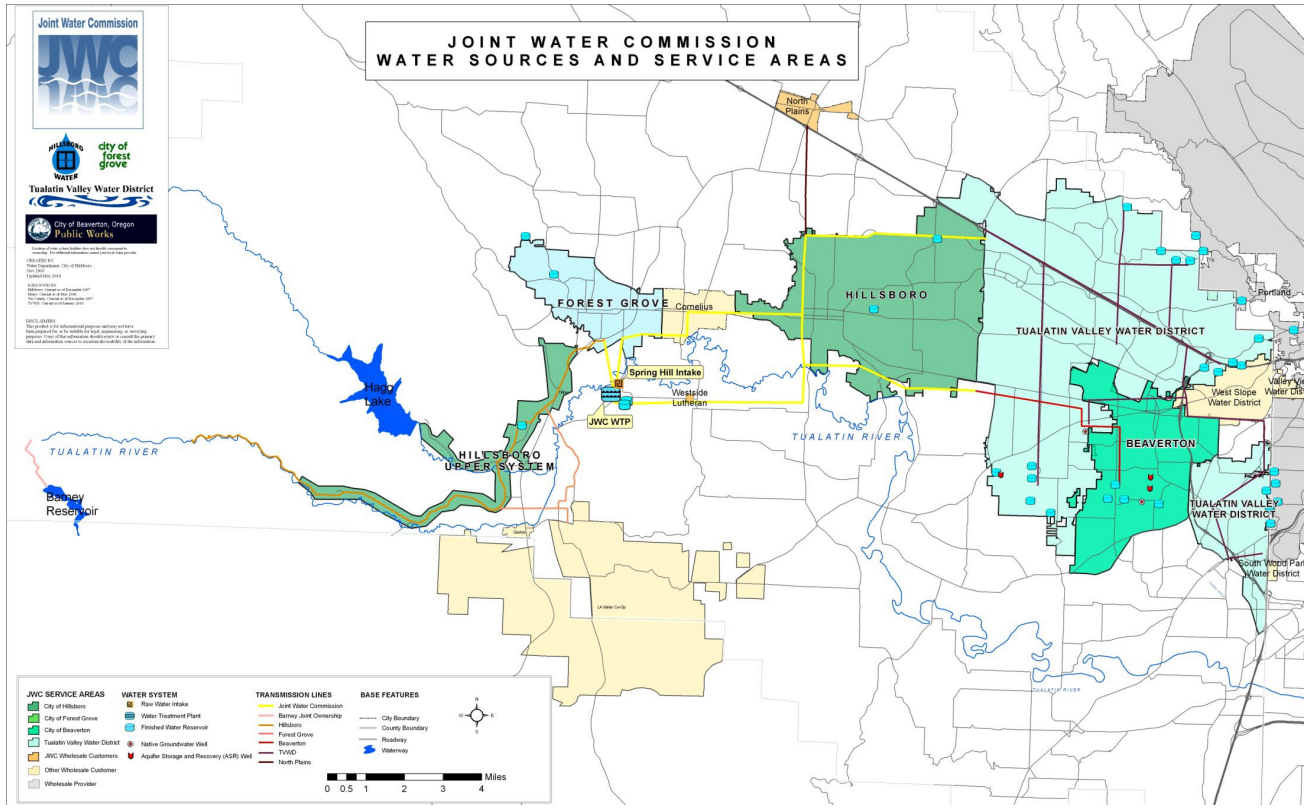
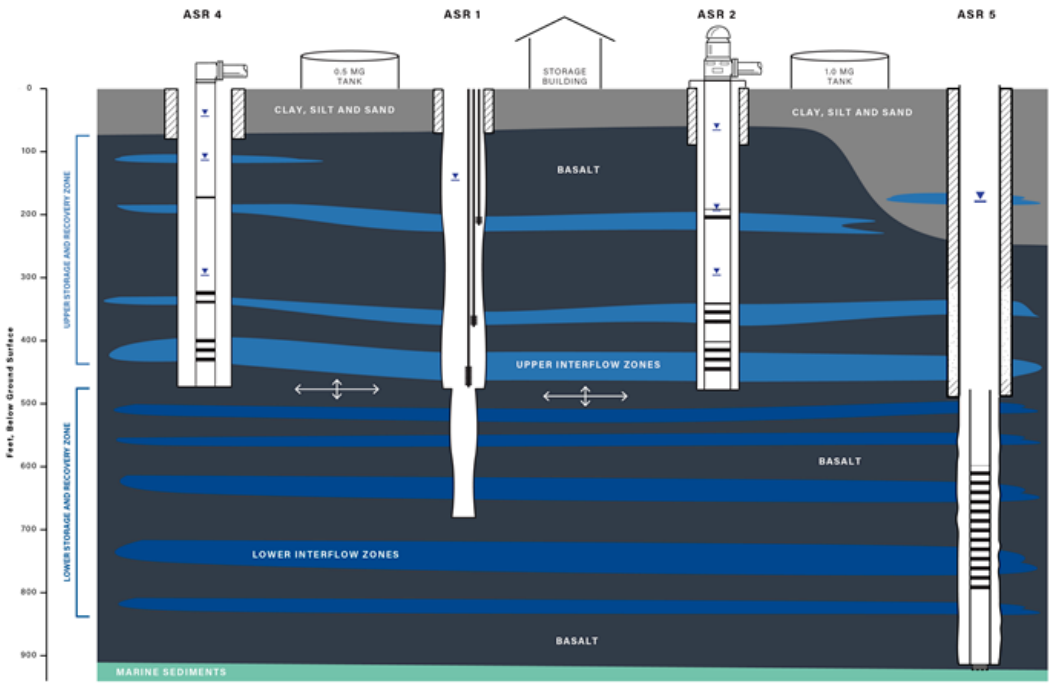
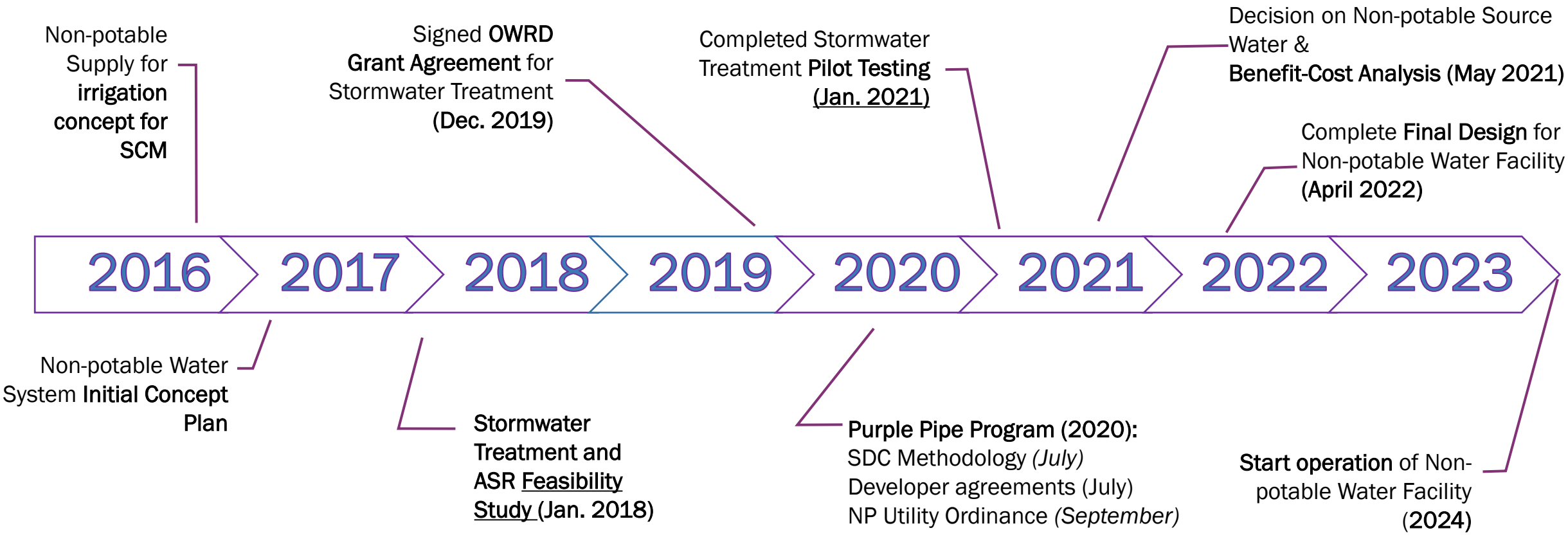


JWC Water Supply System: 75% of summer water
Aquifer Storage and Recovery (ASR): 25% summer water





Beaverton Purple Pipe Implementation Timeline



Benefits Key to City Council and Stakeholder Support

- Component of City's Climate Action Plan
- Puts available water to use that would otherwise be a waste
- Reduces stormwater flow into the storm system
- Provides summer streamflow benefits (for habitat and fish)
- Reduces unnecessary use of chlorinated, fluoridated drinking water for irrigation

Components of the Purple Pipe System

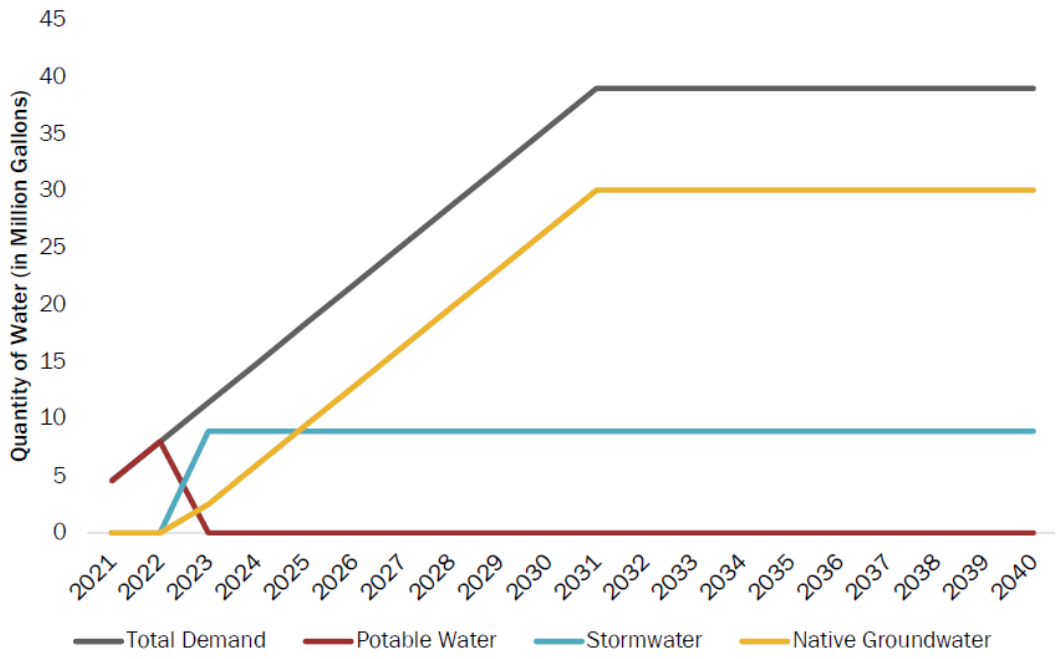
- Source of water:
  - Groundwater – from aquifer
  - Stormwater – collected, treated and stored inside the aquifer
  - Potable water – augment to meet demand
- Pump station, ASR wells, and stormwater treatment
- Non-potable distribution system

Benefit-Cost Analysis

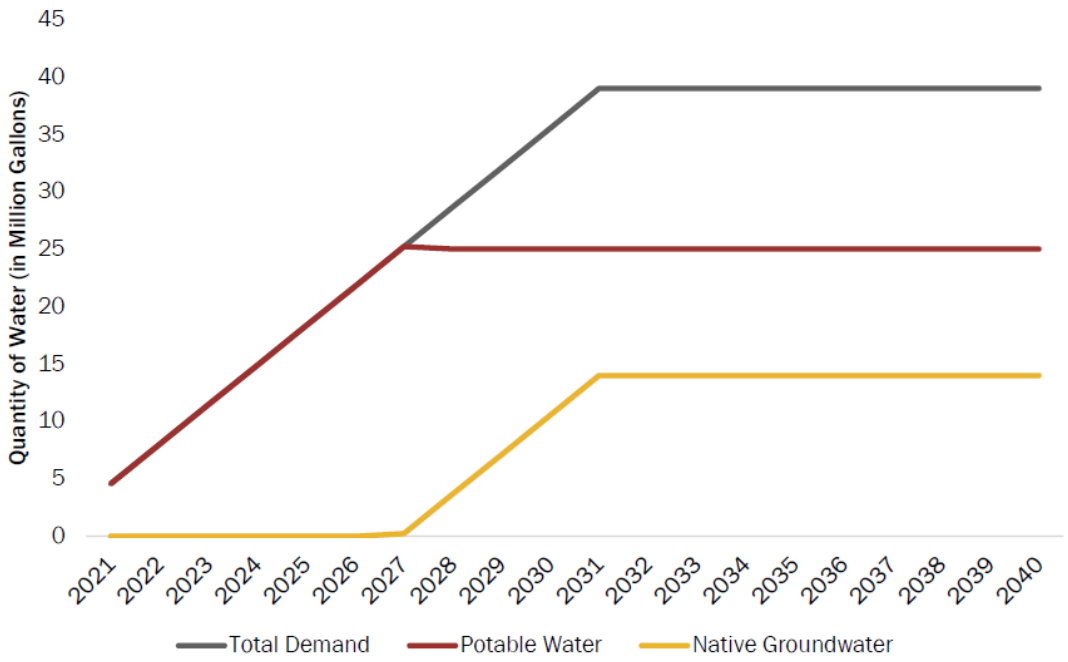
- **Purpose:** Input for Council decision to proceed with stormwater source
- **Alternatives:**
  - No further investment (potable source only, partial distribution)
  - Full implementation (stormwater + GW source, full distribution, streamflow release)
  - Limited implementation (potable + GW source, full distribution)
- **Methodology:**
  - Preliminary engineering cost estimates (capital and operations)
  - Present-value analysis (2020) over 20-year period with discounted annual costs

Benefit-Cost Analysis

Full Implementation



Limited Implementation



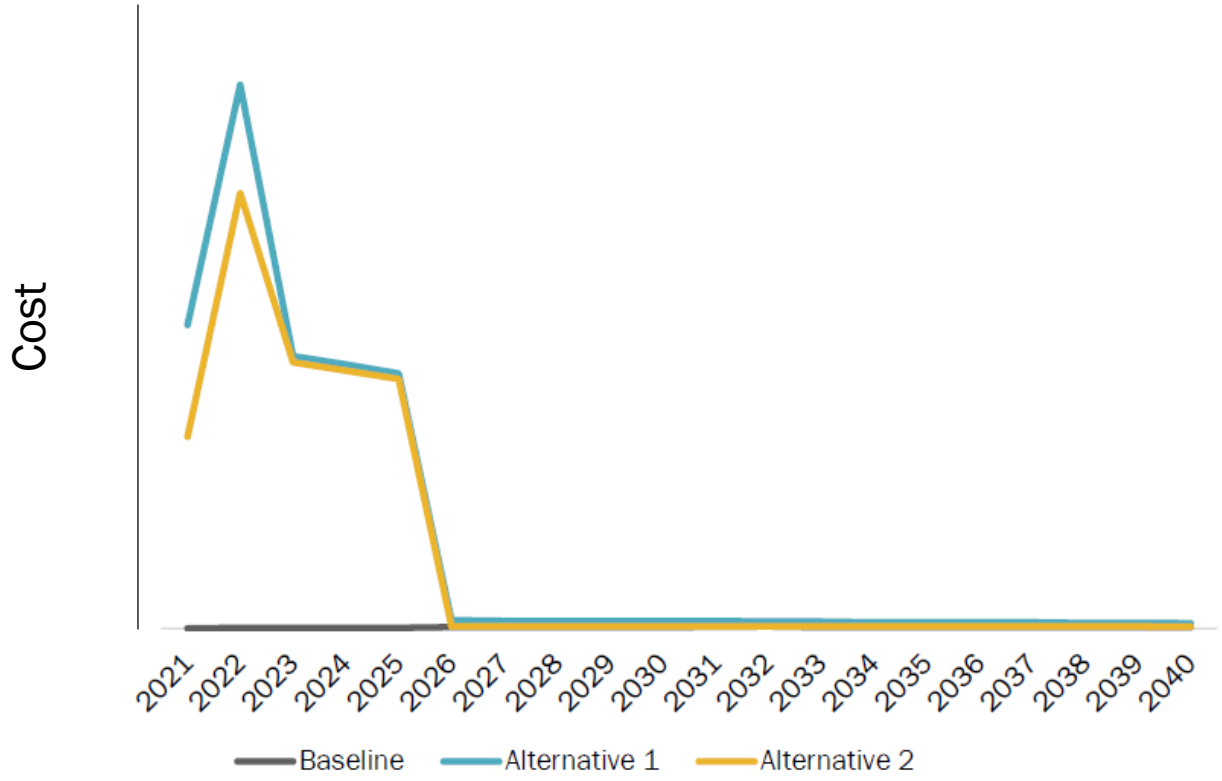
Benefit-Cost Analysis

	Factor	Baseline	Full (Alt. 1)	Limited (Alt. 2)
Benefit	Greater system resiliency		+	+
	Consistency with sustainability goals		+	+
	Reduced cost for potable supply use		+	
	Improved environmental amenities		+	
	Opportunity for cost savings		+	+
Cost	Purple pipe distribution system		$	$
	Stormwater treatment system		$	
	Pump station facility		$	$
	Operation and maintenance		$	$

Benefit-Cost Analysis

BCA Summary

Although Baseline is the least expensive (no further investment), the Full/Limited implementation generates desired benefits to City and residents that outweigh the costs

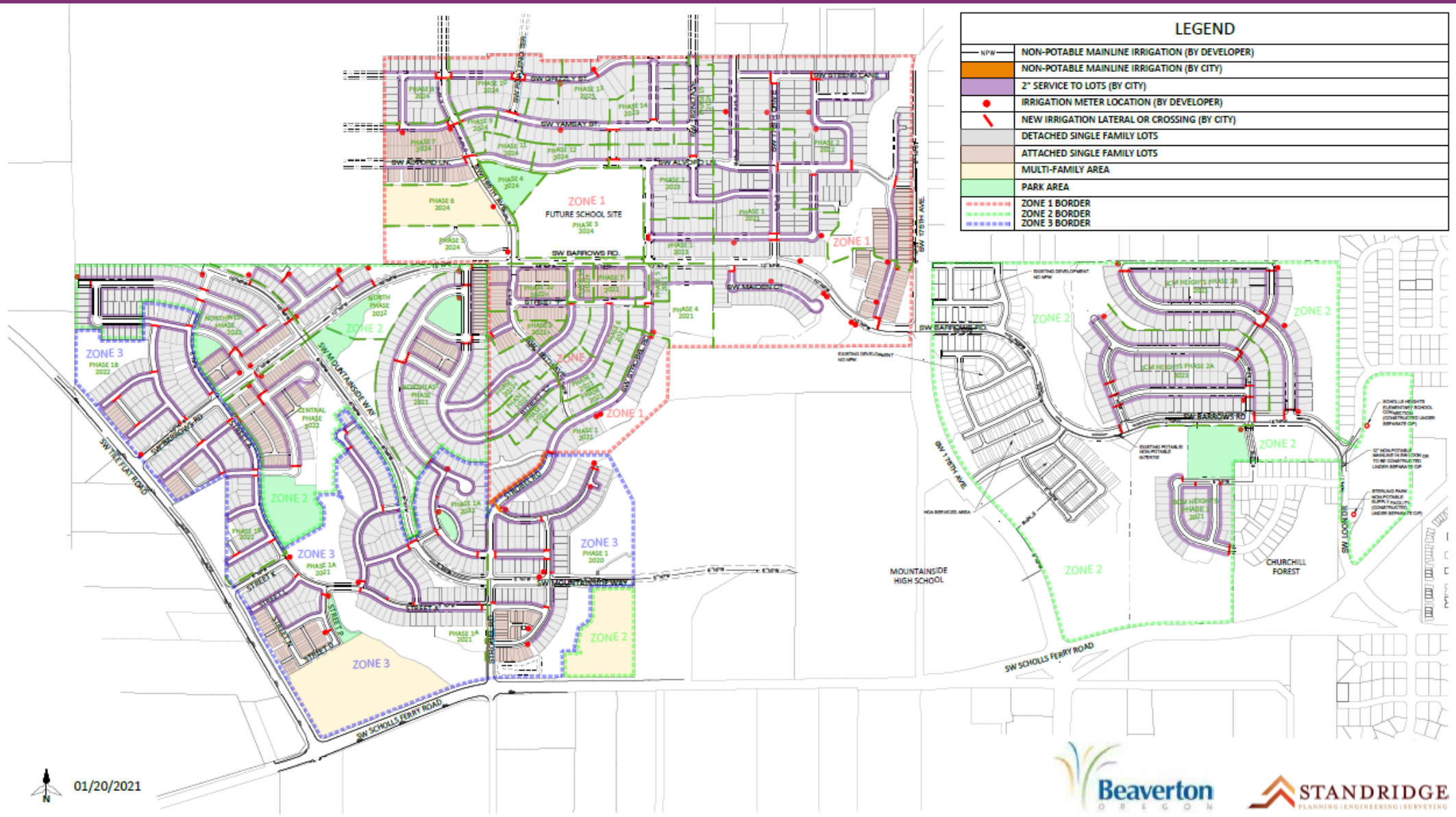


Maintaining City Council Support

- System Development Charge Methodology (Jul. 2020)
- SDC Impact Reductions (Aug. 2020)
- Non-potable Water Utility Ordinance (Sep. 2020)
- Contracts to design purple pipe distribution system (Oct. 2020)
- Approve stormwater treatment source (May 2021)
- Developer construction contract agreements (first phases) (Sep-Nov. 2021)
- Portions funded by EPA (WIFIA) and OWRD grant

- *Council elections and transitions, changes with staff (including PWD)*

Development Community and Distribution System



Purple Pipe Installation is On-going in South Cooper Mountain

Total 2" Installation as of April 2023

~24,000 LF of 2" pipe

~412 SFH Connections

Various greenspace meters

Agreements in place

~14,000 LF

~235 SFH Connections

Coordination with other development construction is critical


20
MPH

Cross-Connection & Design Standards

Table 42

High Hazard Table (Premises Requiring Isolation* by an Approved Air Gap or a Reduced Pressure Principle Type of Assembly Health Hazard)
Agricultural (for example, farms, dairies)
Beverage bottling plants**
Car washes
Chemical plants
Commercial laundries and dry cleaners
Premises where both reclaimed and potable water are used
Film processing plants
Food processing plants
Medical centers (for example, hospitals, medical clinics, nursing homes, veterinary clinics, dental clinics, blood plasma centers)
Premises with irrigation systems that use the water supplier's water with chemical additions (for example, parks, playgrounds, golf courses, cemeteries, housing estates)
Laboratories
Metal plating industries
Mortuaries
Petroleum processing or storage plants
Piers and docks
Radioactive material processing plants and nuclear reactors
Wastewater lift stations and pumping stations
Wastewater treatment plants
Premises with piping under pressure for conveying liquids other than potable water and the piping is installed in proximity to potable water piping
Premises with an auxiliary water supply that is connected to a potable water supply
Premises where the water supplier is denied access or restricted access for survey
Premises where the water is being treated by the addition of chemical or other additives

* Refer to OAR 333-061-0070(8) premises isolation requirements.
** A DC could be used if the water supplier determines there is only a non-health hazard at a beverage bottling plant.

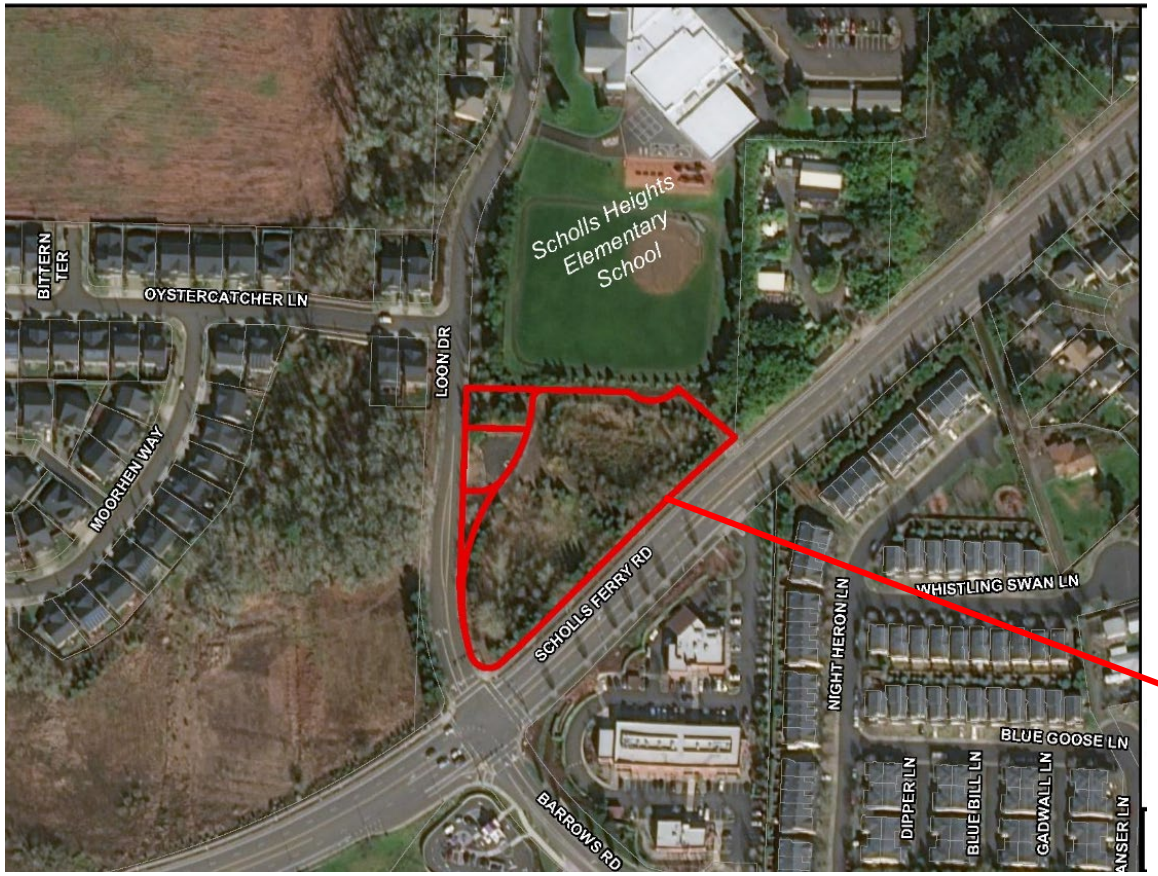
- OAR 333-061-0070
  - Tables 42 and 43
- Water purveyor can require RP
- Building department & plumbing code

Backsiphonage or Backpressure
Air Gap
Reduced Pressure Principle Backflow Prevention Assembly (RP)
Reduced Pressure Principle-Detector Backflow Prevention Assembly (RPDA)

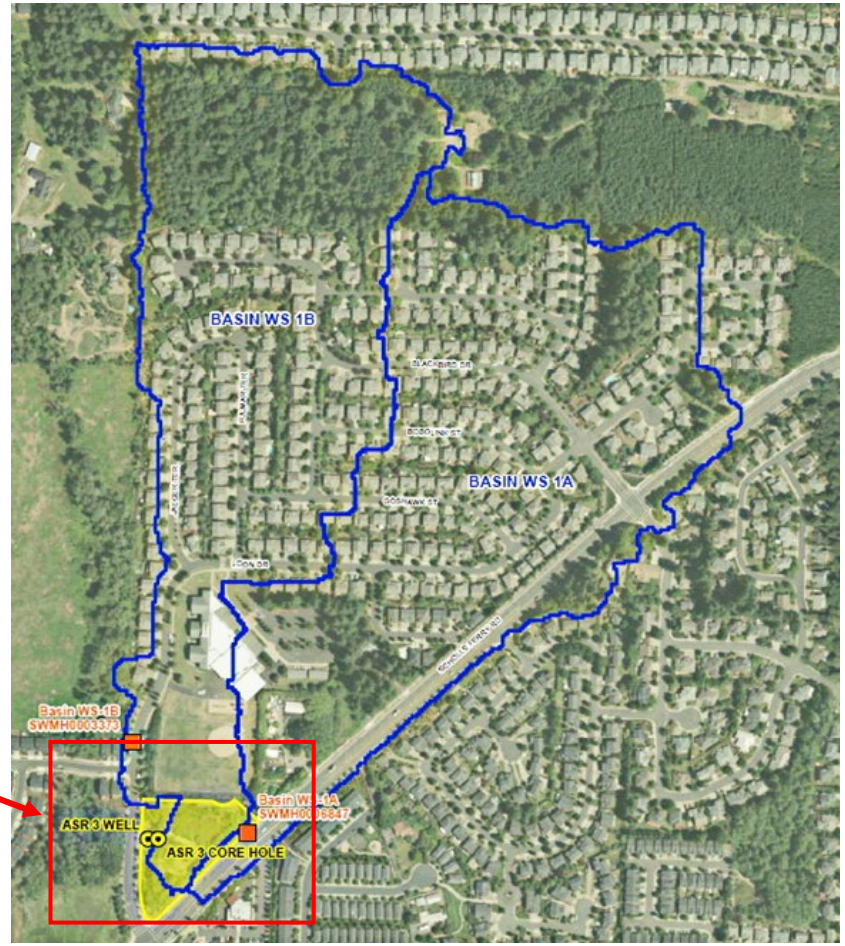
Source of Water for Purple Pipe Program

- The Beaverton Purple Pipe will carry non-potable water:
  - **Groundwater** from an aquifer.
  - **Stormwater** that will be collected, treated and stored inside the aquifer.
  - **Potable water** augment to meet demand.
- The system will NOT carry:
  - “Recycled” water (treated effluent) or graywater.

Sterling Park Non-potable Water Facility Source Water



ASR 3/3A (Native Ground Water)



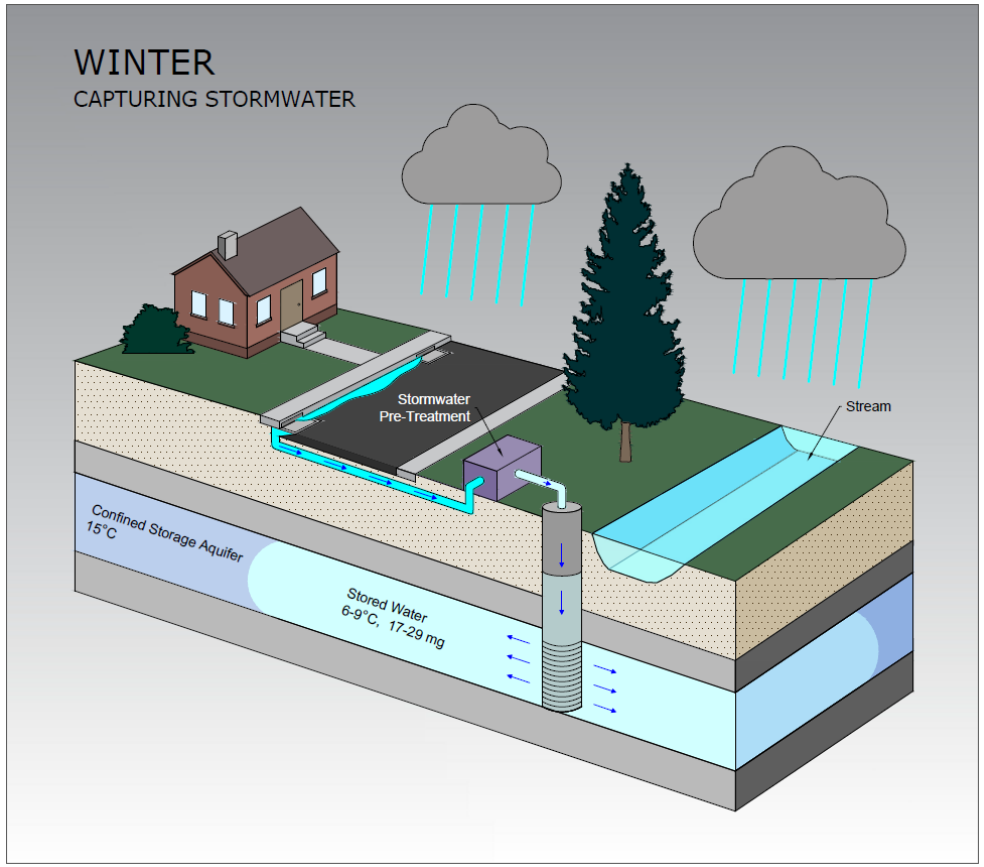
Treated Storm Water

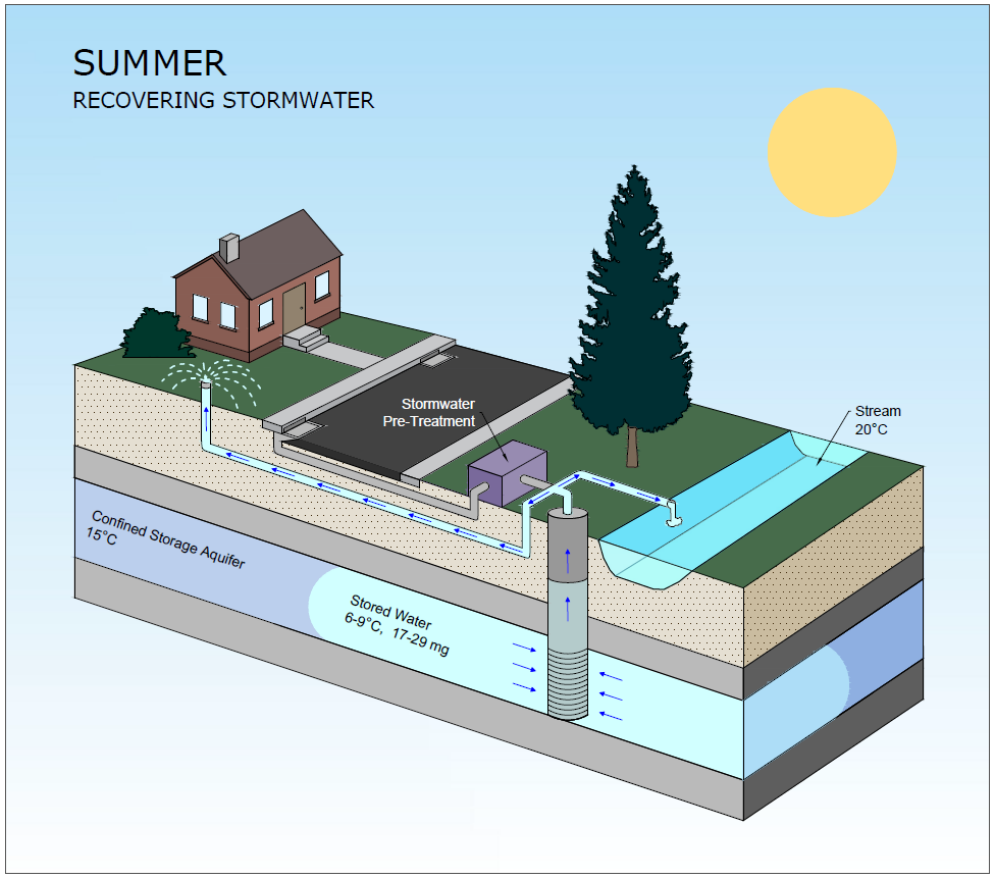
Stormwater to Augment Non-potable Supply

- City partnered with Clean Water Services to conduct a feasibility study with OWRD grant in 2016-2017
- Benefits of the concept:
  - Enhanced groundwater supply
  - Reduced stormwater runoff
  - Increase capacity to stormwater infrastructure

-- Mitigate flow an temperature issues to local streams

-- Reduce surface water demand





Project Permitting, Stormwater Quality & Quantity

State Regulatory Agencies

- Oregon Water Resources Department (OWRD)
- Oregon Health Authority (OHA)
- Oregon Department of Environmental Quality (DEQ)

Limited License for Artificial Recharge (AR)

OWRD

- Leads permit issuance process
- Verifies that water use is allowed under OWRD rules, sets conditions on use (OAR 690-350)

OHA

- Verifies that AR meets requirements for drinking water systems, if applicable (OAR 333-061)

DEQ

- Verifies that AR well is authorized by DEQ (1200-U permit) OAR 340-044
- Verifies that Limited License meets water quality requirements (anti-degradation, MCLs, protect human health) OAR 340-040, 340-044

Stormwater Quality – Bacteriological, General Chemistry, and Metals COI's

Analyte Class	Analyte	Units	Concentrations		
			n-=	Sterling Park Stormwater Average Concentration	Background Groundwater
Bacteriological	Total Coliform	MPN/100 mL	25	>2420	< 1
Gen. Chem.	Turbidity	NTU	25	9.6	ND
	Nitrate + Nitrite	mg/L	20	0.27	ND
	Sulfate	mg/L	7	2.99	1.6
Metals	Manganese	ug/L	8	126	48
	Iron	ug/L	11	810	110
	Aluminum	ug/L	12	215	ND
	Zinc	ug/L	28	322	22

Stormwater Quality – Anthropogenic Compound COI's

Analyte Class	Analyte	Units	Concentrations		
			n=	Sterling Park Stormwater Average Concentration	Background Groundwater
PAHs	Di-n-octylphthalate	ug/L	20	0.85	ND
Pesticides	2,4-D	ug/L	9	1.32	ND
	Paraquat	ug/L	7	2.6	ND
	MCPP-p	ug/L	2	0.26	ND
	Diuron	ug/L	7	0.08	ND
	Triclopyr	ug/L	7	0.11	ND
PFAS/PFOA	PFHxA	ug/L	2	0.0035	ND
	PFOA	ug/L	2	0.0048	ND
	Perfluorononanoic acid	ug/L	2	0.0010	ND
	Perfluorodecanoic acid	ug/L	2	0.0012	ND
	PFOS	ug/L	2	0.0064	ND
Petroleum Hydro	Toluene	ug/L	23	0.88	ND

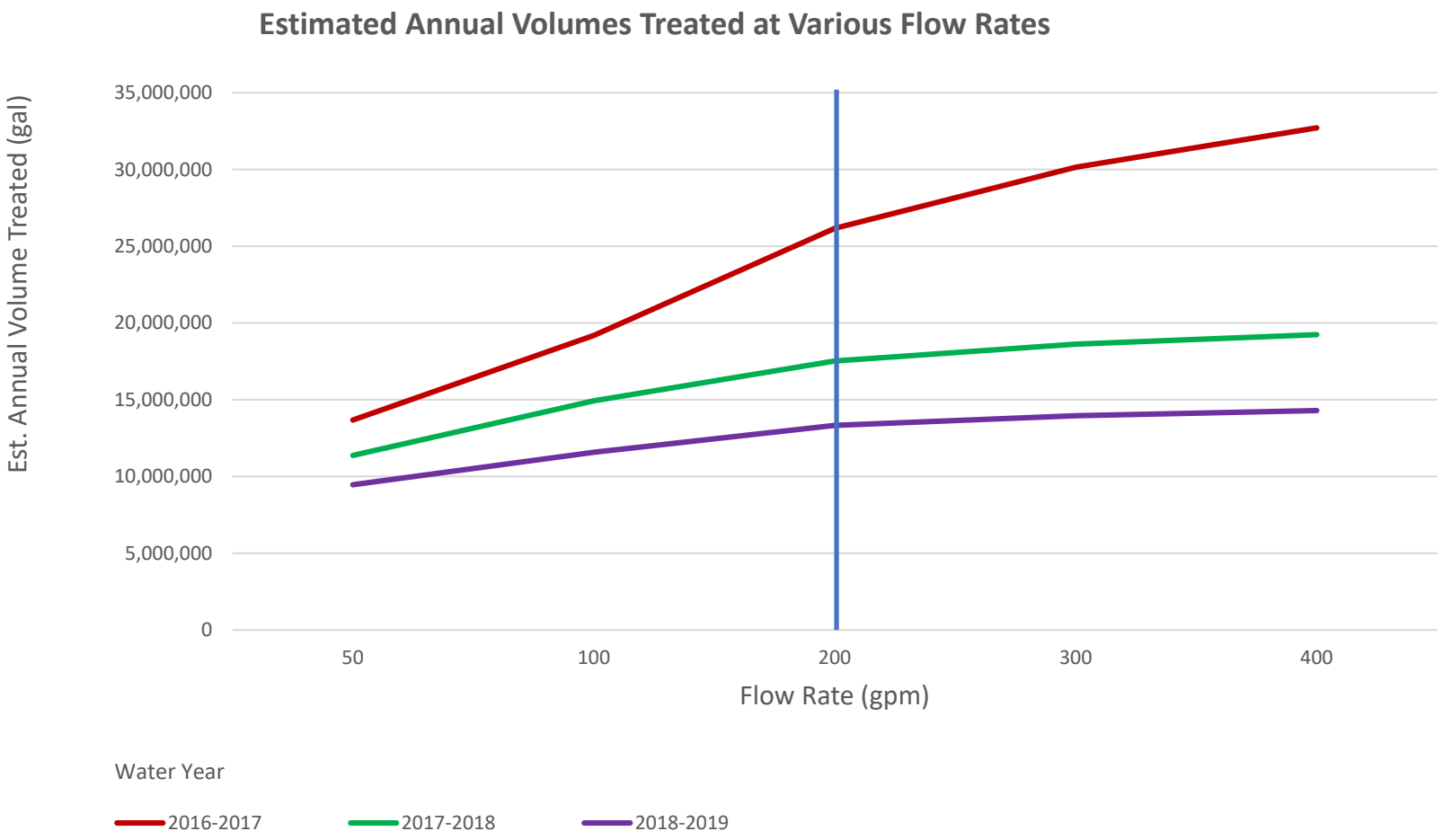
Sterling Park - Stormwater Quantity

Diminishing returns on treatment rates above 200 gpm

Volume range between 13.3 to 26.2 MG

High precipitation year in 2016-2017 and low 2017-2019

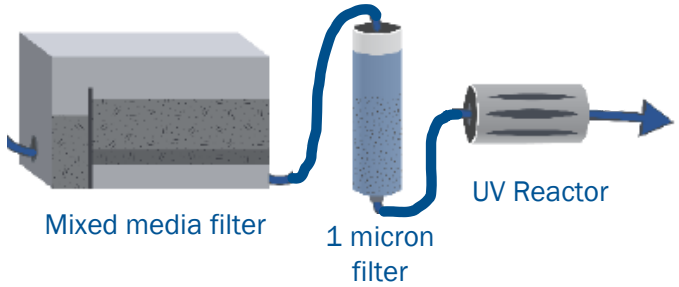
Average precipitation – volume estimated at 22 MG/yr



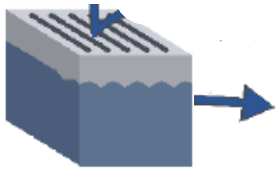
Stormwater Treatment Pilot/Bench Testing

Raw Stormwater
- Turbidity/TSS
- Microbiological
- Metals
- Synthetic Pesticides
- PAH's
- Petroleum Hydrocarbons
- PFAS/PFOA

A

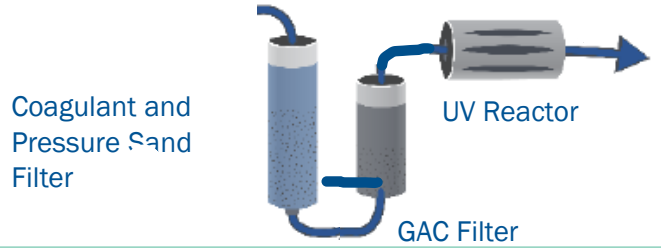


Treated Effluent
- Turbidity/TSS
- Synthetic Pesticides
- PFAS/PFOA



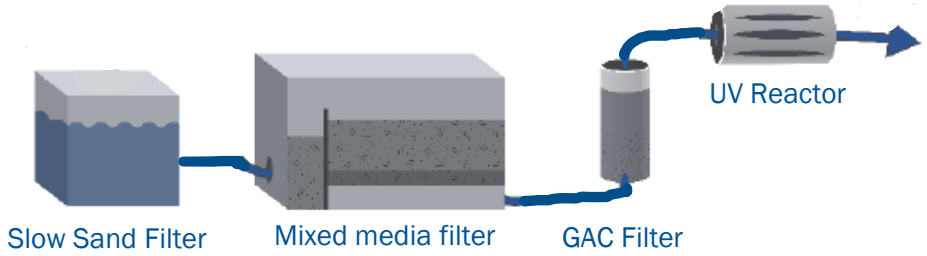
Treated Effluent
- Turbidity/TSS
- PAH's
- Likely* PFAS/PFOA
- Metals

B



Treated Effluent
- PFAS/PFOA

C



Treated Effluent
- Below background

Water Quality – Bacteriological, General Chemistry, and Metals

NOTE: Table only shows analytes with concentrations in raw stormwater above background in native basalt groundwater

Analyte Class	Analyte	Units	Concentrations				
			Raw Stormwater Pilot Testing	Treated Stormwater Package System A	Treated Stormwater Coagulant/Pressure Filter/GAC B	Treated Stormwater SS/Package/GAC C	Background Groundwater
Bacteriological	Fecal Coliform	MPN/100 mL	> 2,420	< 1	< 1	< 1	< 1
Gen. Chem.	Nitrate + Nitrite	mg/L	0.26-0.46	0.32	0.21	0.28	ND
	Sulfate	mg/L	2.3-3.9	48	19	59	1.6
Metals	Manganese	ug/L	29-170	130	41	15	48
	Iron	ug/L	460-530	250	180	120	110
	Aluminum	ug/L	140-430	110	1100	330	ND
	Zinc	ug/L	130-690	29	130	ND	22

BLUE = Treatment reduces analyte concentration to below background
ORANGE = Treatment reduces analyte concentration, but not to below background
BLACK = Treatment raises analyte concentration, or analyte not significantly affected by treatment

Water Quality – Anthropogenic Compounds

NOTE: Table only shows anthropogenic compounds that were detected in stormwater

Analyte Class	Analyte	Units	Concentrations				
			Raw Stormwater Pilot Testing	Treated Stormwater Package System A	Treated Stormwater Coagulant/Pressure Filter/GAC B	Treated Stormwater SS/Package/GAC C	Background Groundwater
PAHs	Di-n-octylphthalate	ug/L	ND-0.85	0.14	ND	ND	ND
Pesticides	2,4-D	ug/L	1.7-2	0.63	0.14	ND	ND
	Paraquat	ug/L	ND-2.6	ND	ND	ND	ND
	MCPP-p	ug/L	0.11-0.6	ND	ND	ND	ND
	Diuron	ug/L	ND-0.08	ND	ND	ND	ND
	Triclopyr	ug/L	0.094-0.13	0.087	ND	ND	ND
PFAS/PFOA	PFHxA	ug/L	0.0027-0.0046	0.0021	0.00355	ND	ND
	PFOA	ug/L	0.0045-0.0051	0.0031	0.0038	ND	ND
	Perfluorononanoic acid	ug/L	ND-0.002	ND	ND	ND	ND
	Perfluorodecanoic acid	ug/L	ND-0.0024	ND	ND	ND	ND
	PFOS	ug/L	0.0044-0.0093	0.0044	0.0044	ND	ND
Petroleum Hydro	Toluene	ug/L	ND-0.88	ND	ND	ND	ND

BLUE = Treatment reduces analyte concentration to below background
ORANGE = Treatment reduces analyte concentration, but not to below background
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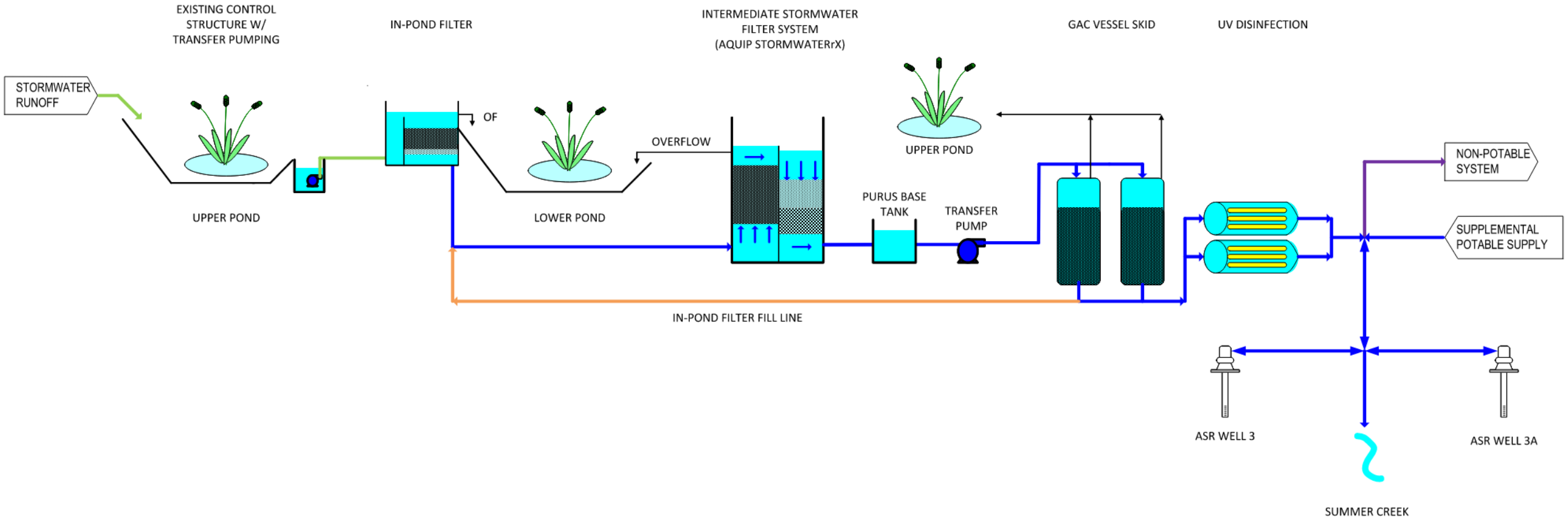
Sterling Park Stormwater Treatment Process Flow



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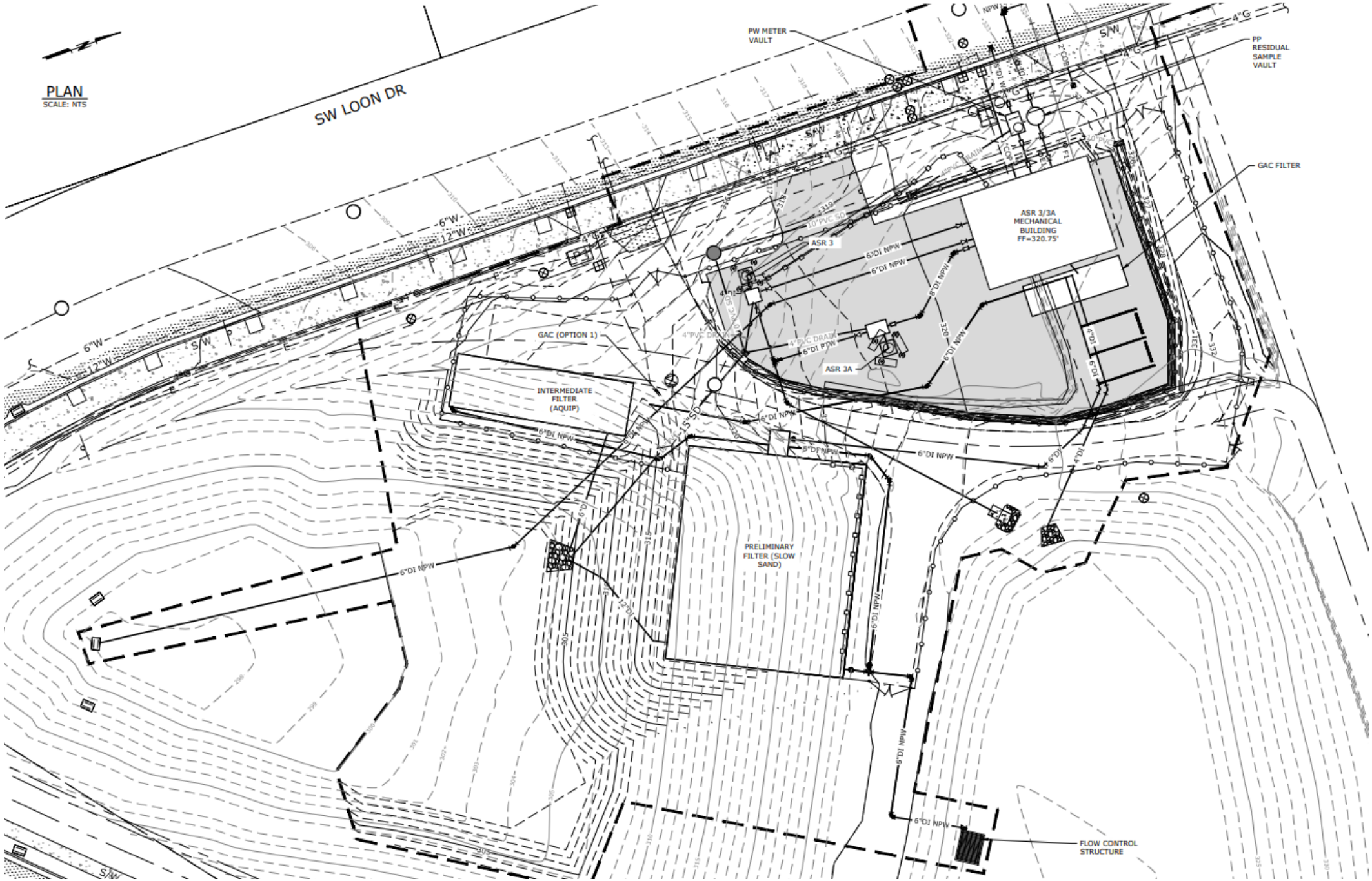
Original Sterling Park Conditions (with Stormwater Ponds and ASR 3 Test Well)

Sterling Park Pump Station and Stormwater Treatment

Site Plan



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Rendering of Sterling Park ASR 3 Pump Station and Stormwater Treatment Facility

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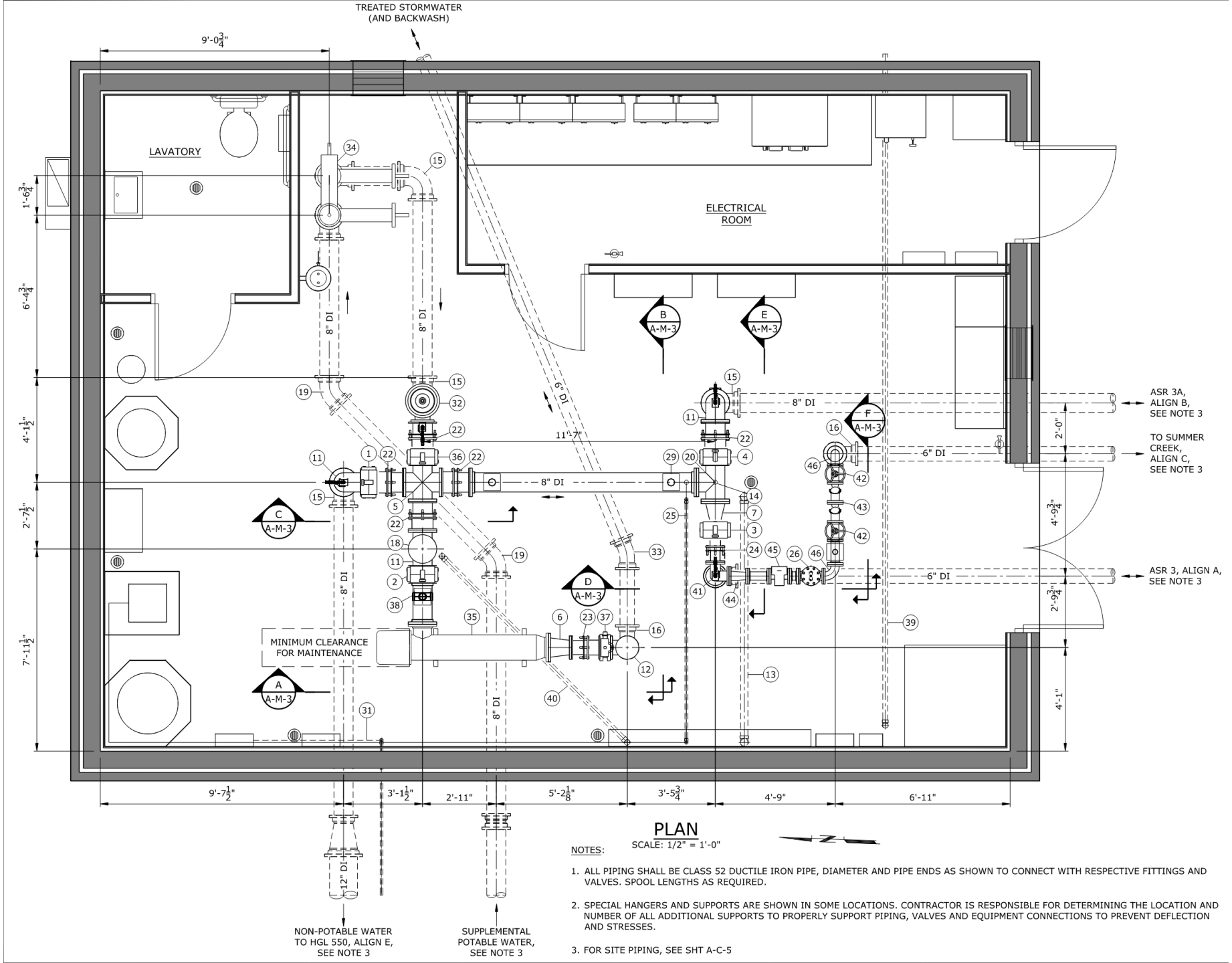
ASR 3 Mechanical Building Layout



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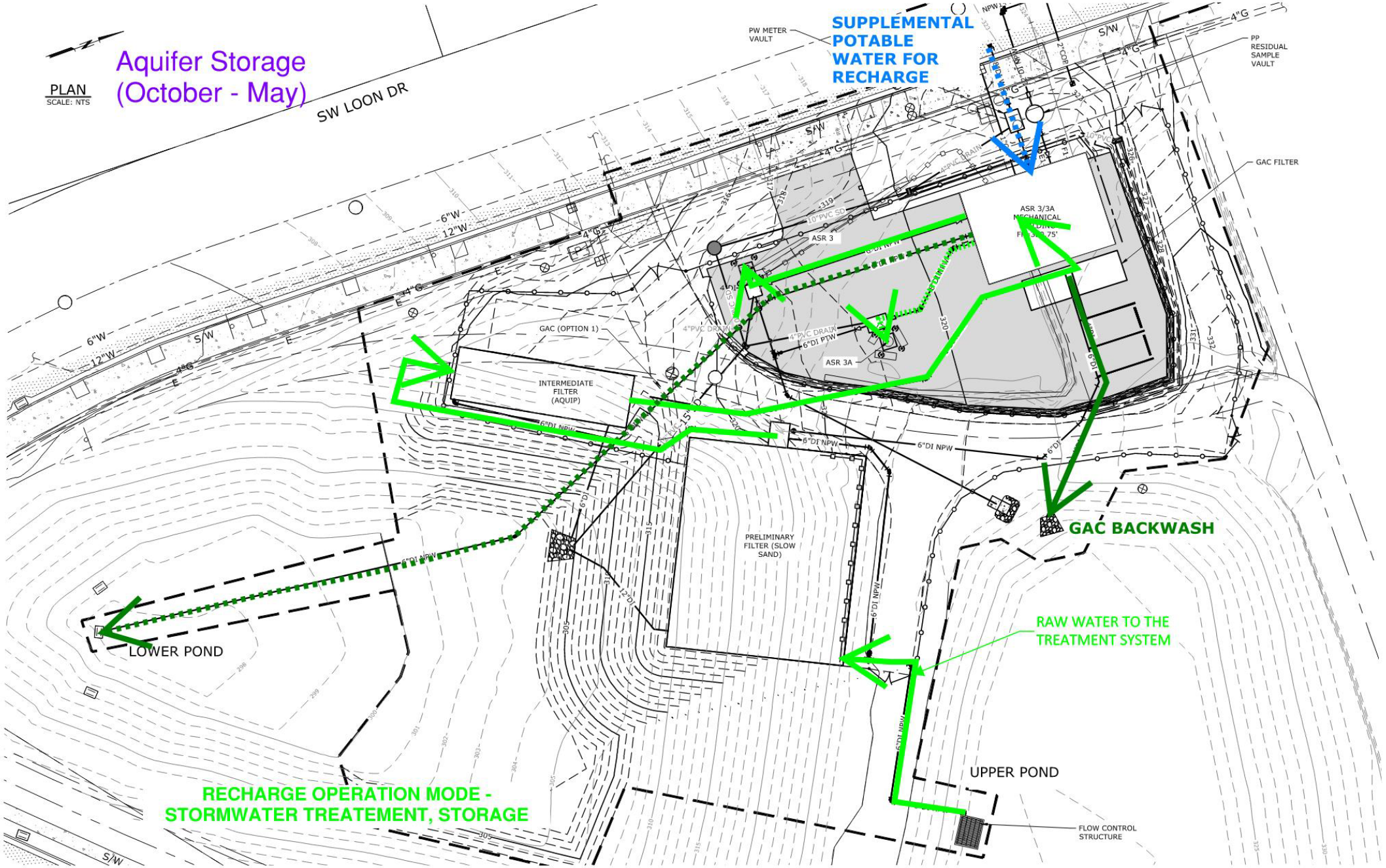
Operations: Stormwater Treatment & Storage



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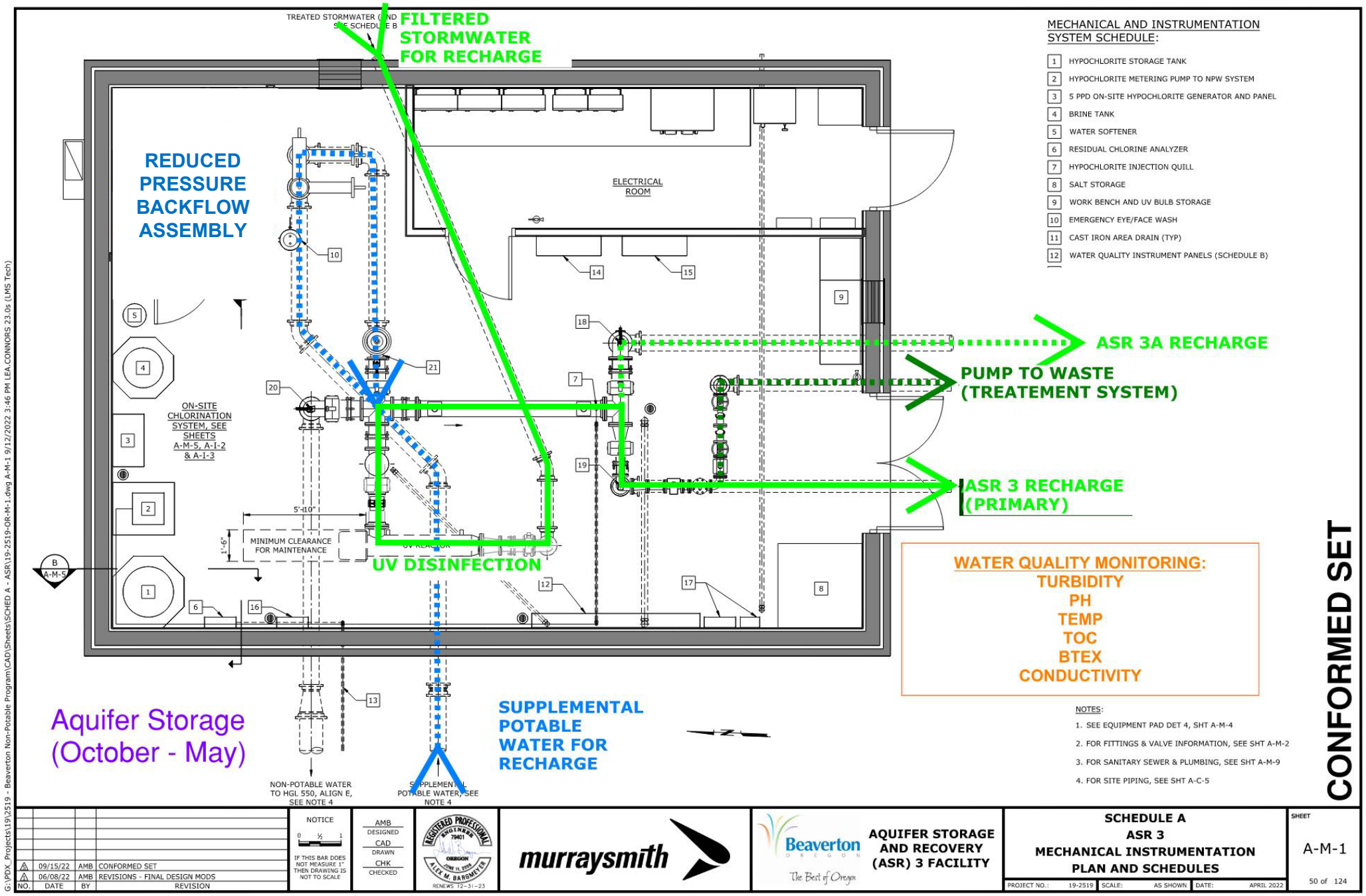
ASR 3 Facility Storage Operations



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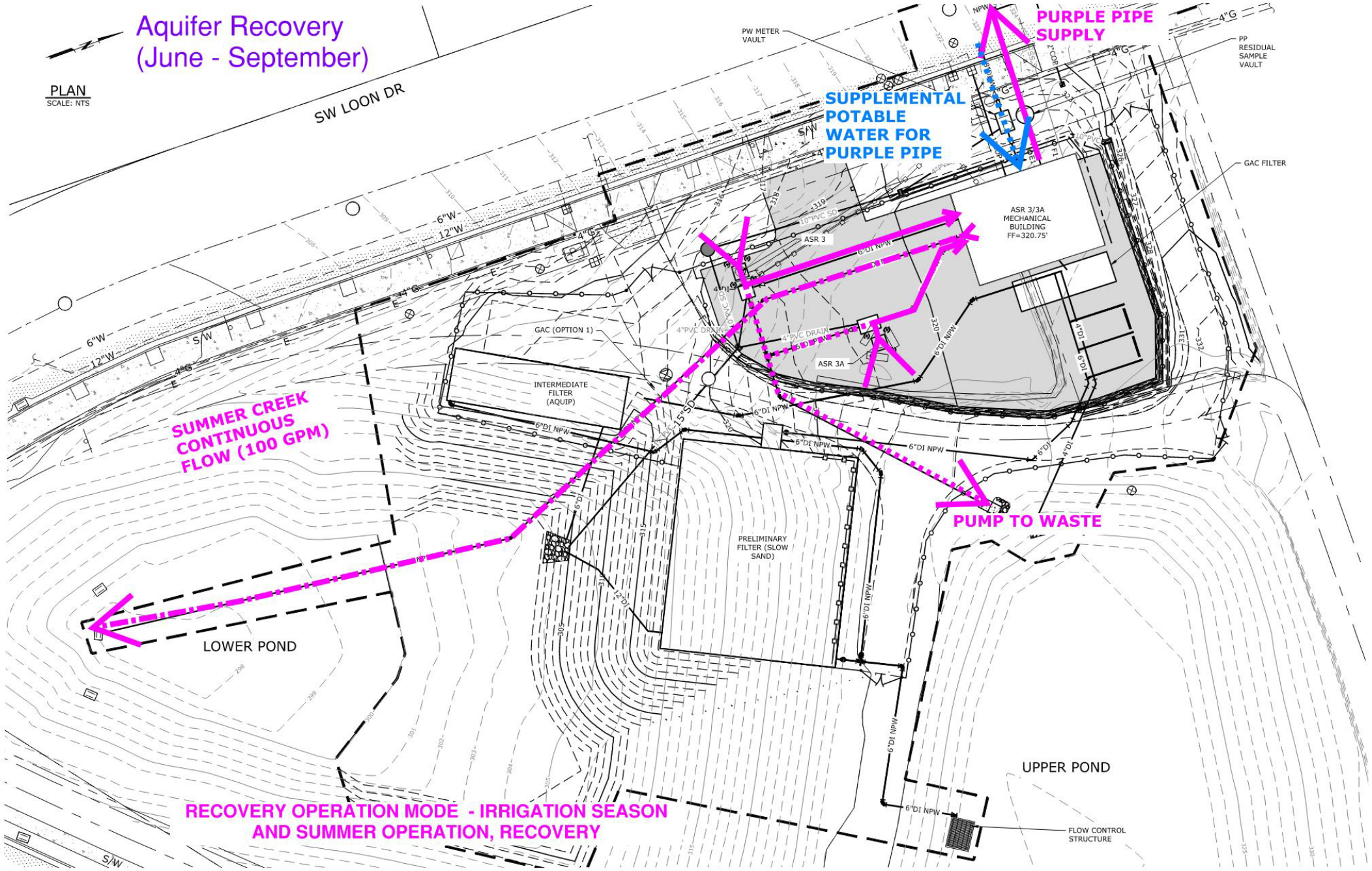
Operations: Recovery for irrigation and stream discharge



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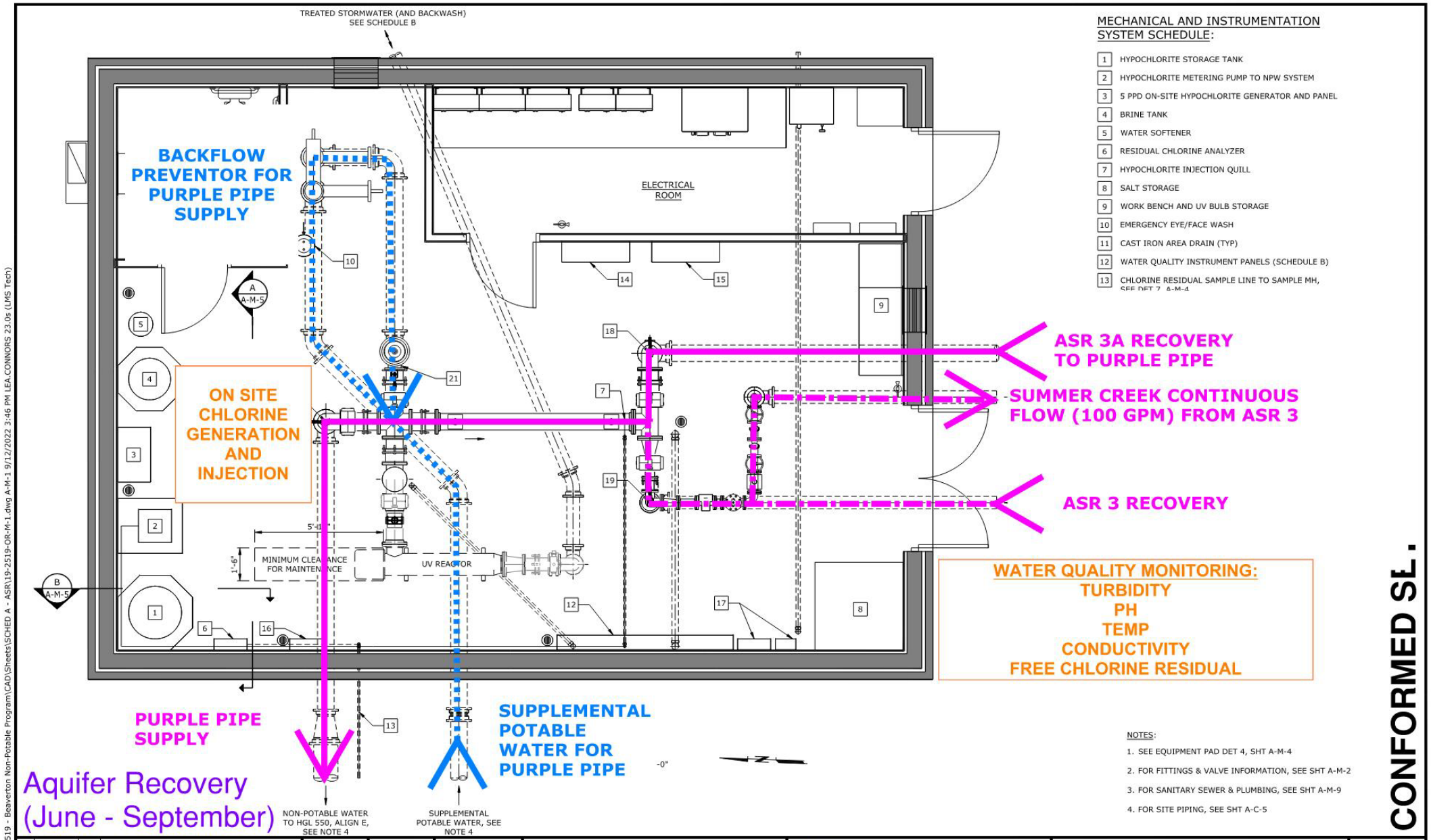
ASR 3 Facility Recovery Operations



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O&M at Sterling Park ASR 3 Pump Station and Stormwater Treatment Facility

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Project Construction – Bidding and Pricing

- Economic climate
- 2 contractor bids received
- Winning bid 26% above Engineers Estimate
  - Generally aligned with BLS Construction Sector cost increases/Producer Price Index
- Material shortages increased costs
- Electrical
- Complex project – 4 Addendums

Project Construction – Procurement Challenges

- Long lead time items
  - Electrical transformers – 50 to 100 weeks
  - Ductile iron, fittings, and valves – 30 weeks
  - Instrumentation and controls equipment – 20 to 50 weeks
  - Treatment equipment – 20 to 30 weeks
  - Purple Pipe supply

Project Construction – Site Challenges

- Very constrained site
  - Overall site ~ 2.5 acres
  - Building site ~ 8,600 ft^2
- Construction season
  - Work in existing stormwater basin delayed

Project Construction – Remaining Work

- In-basin water treatment construction to start May/June
- Pump station building construction
- Stormwater treatment installation
- Pump and downhole valve installation
- Site access paving
- Landscaping
- Instrumentation and controls installation and programing
- System startup

November 2022

December 2022

January/February 2023

April 2023

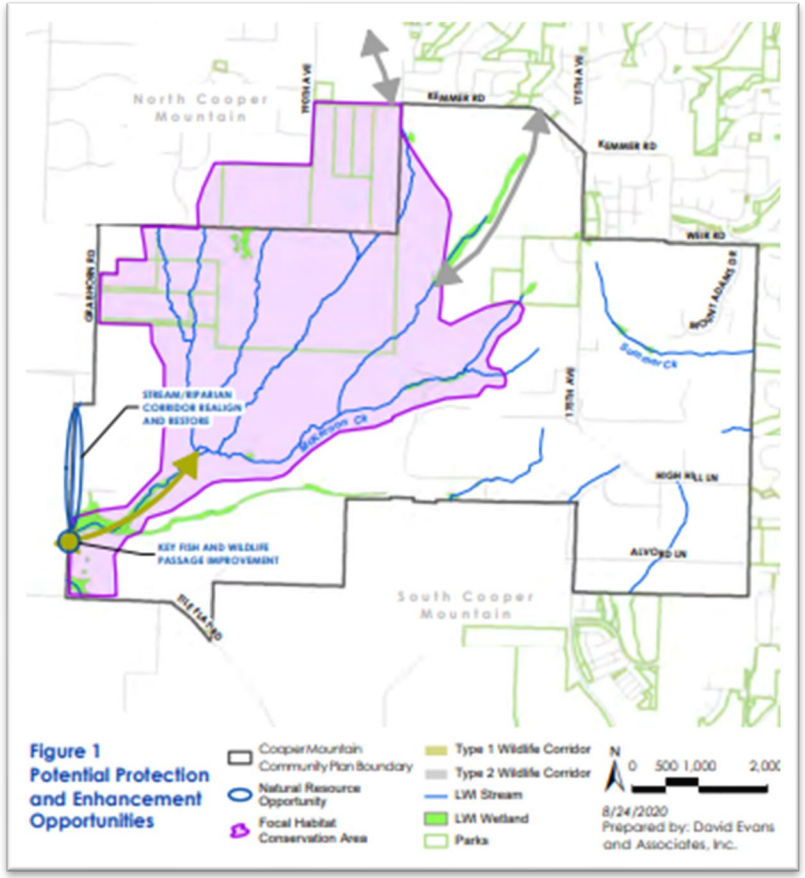
April 2023

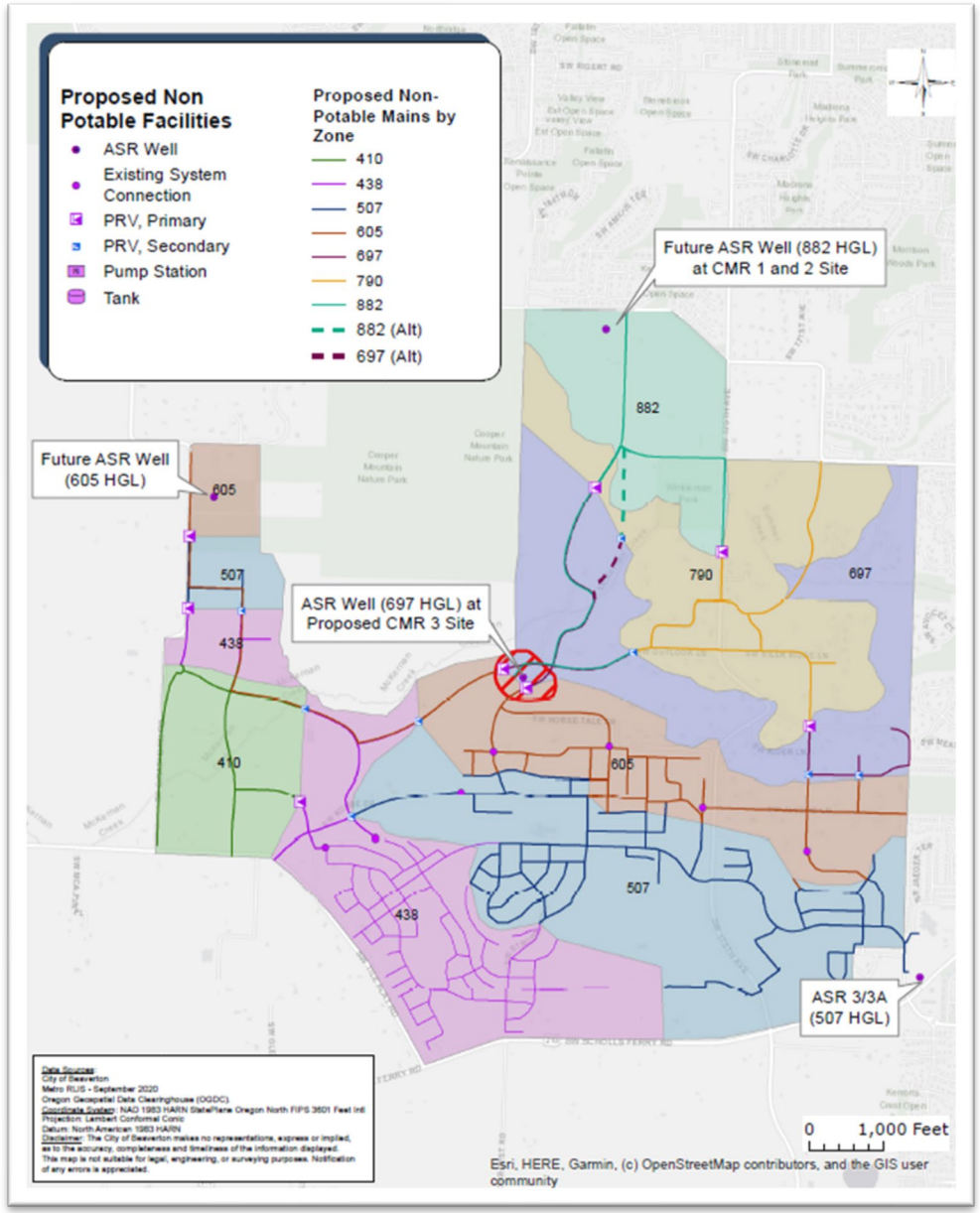

DANGER
DANGER
DO NOT ENTER

Key Lessons

- Find the right opportunity – the benefit-cost can be site-specific
- Master plan – and try to stay ahead
- Engage development community and stakeholders early and often
- Committed champion with the backing of a diverse team
- Develop a sound funding plan
  - Leverage grants and loans
- Be flexible and plan for change
- Bid timing/flexibility in schedule
- Alternative delivery options

Beaverton's Opportunity: Expansion into Cooper Mountain





Opportunities for the Water Industry

Beaverton's "proof of concept" will help utilities and water industry:

- Build on lessons learned
- Establish permitting framework
- Improve on treatment technologies
- Criteria to find the right site/project and its scalability
- Leverage stormwater reuse for funding opportunities
  - Federal, state, and county

Questions?

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