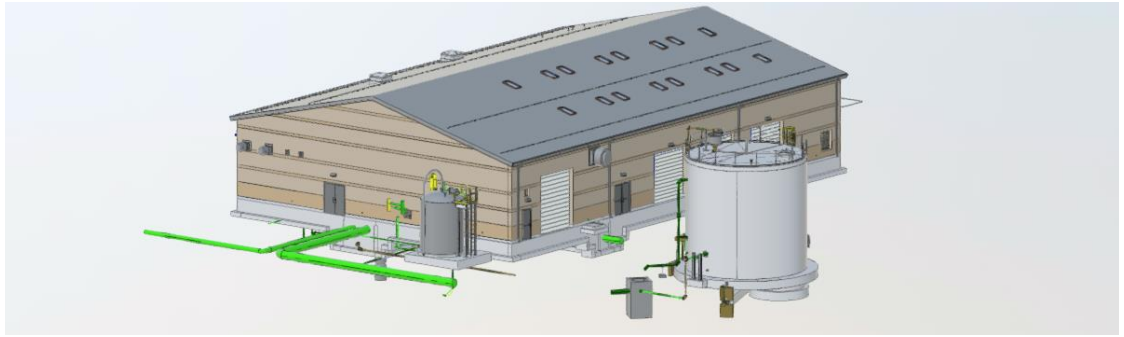
Groundwater Rising: Designing Resilient Water Systems for a Sustainable Future

Cascade Groundwater Alliance Package 5 Water Treatment Plant







Brown AND Caldwell

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Agenda

1. Introduction and Background
2. Project Overview
3. Detailed Design Reviews
4. Lessons Learned

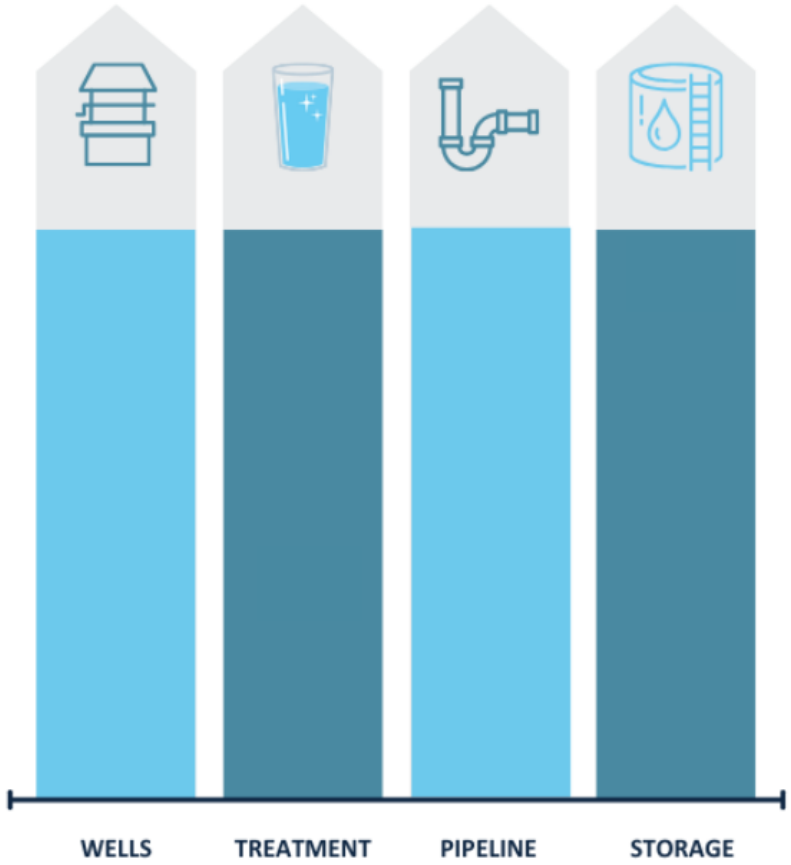
Introduction and Background

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Alliance Overview

Cascade Groundwater Alliance

Construction of the expanded groundwater system is underway and consists of 9 inter-related projects. When complete, the system will provide reliable, high-quality water for the community for generations to come.



GROUNDWATER WELLS
Nine wells will pump groundwater from the deep and protected Sand and Gravel Aquifer

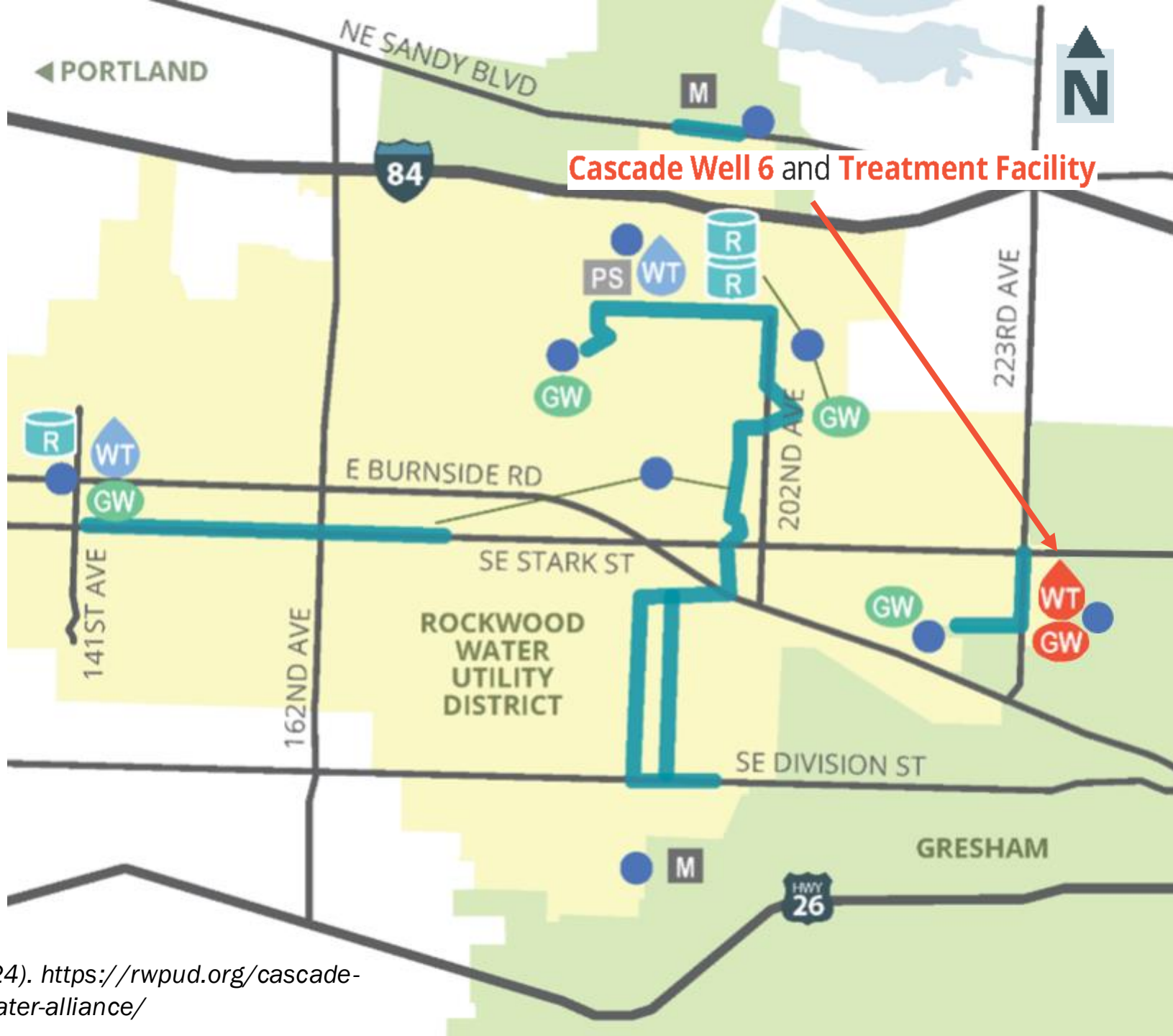
WATER TREATMENT
Three state-of-the art treatment plants will ensure water meets state and federal quality standards

PIPELINE
10 miles of earthquake resilient large diameter water pipe will connect the system

WATER STORAGE
Three modern storage tanks will ensure there is abundant water year round and for emergencies

Alliance Fact Sheet (Modified, 2025). https://rwpud.org/cascade-groundwater-alliance/

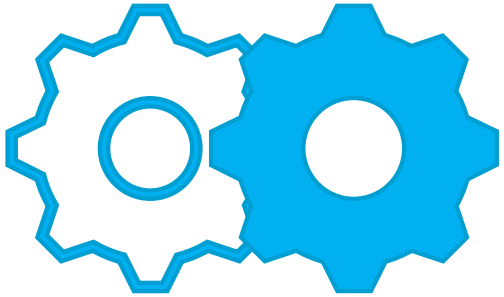
Alliance Map



Alliance Map (Modified, 2024). https://rwpud.org/cascade-groundwater-alliance/



Resilient solutions that last

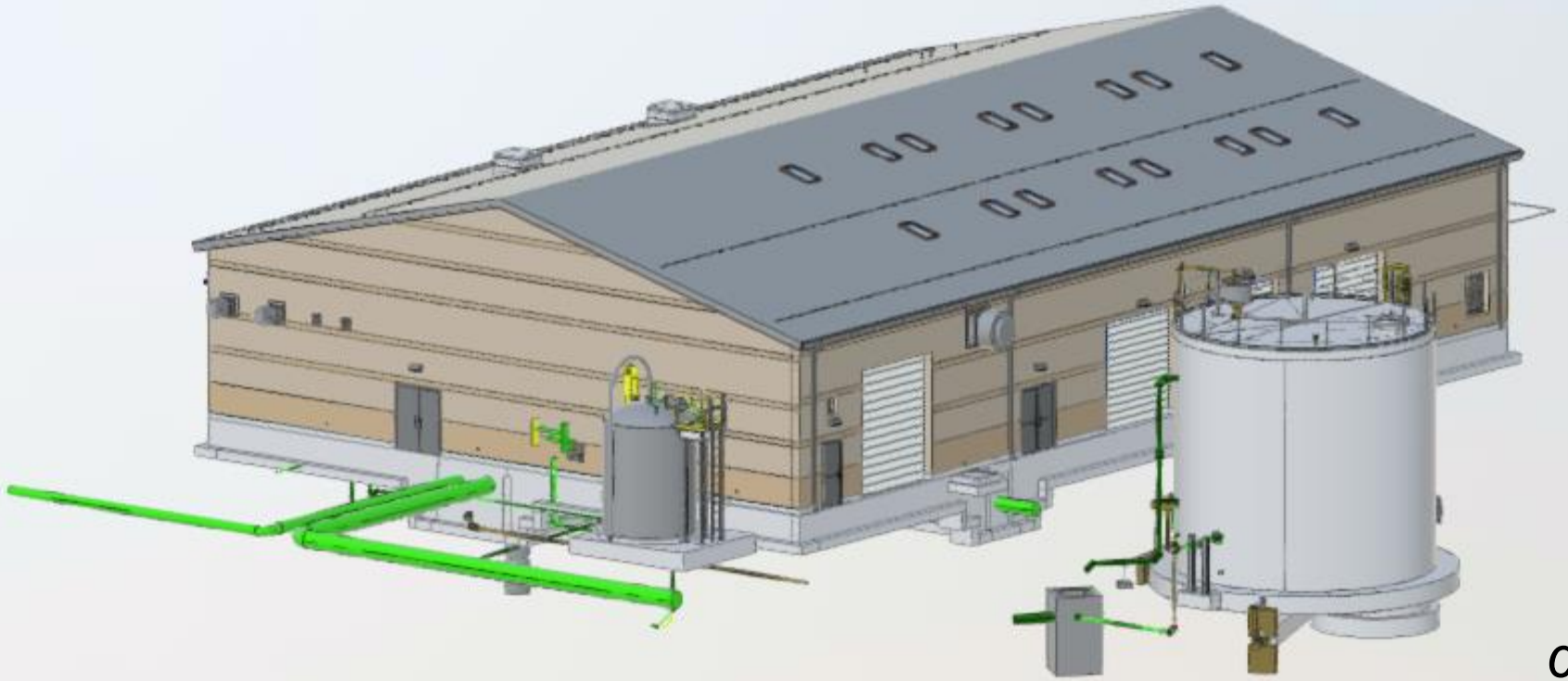


Redundant system components



Adaptable to future conditions

Project Overview



CGA Package 5 WTP

Project Overview





Process Flow



NaOCl

Sodium Hypochlorite
- OSHG Skids
- Brine Tank
- Storage Tanks and Pumps



Groundwater Pumps
- Well 6A (Primary) – 3.5 mgd
- Well 6B (Test Well) – 1 mgd
- Well 10 (Future) ~ 5 mgd

Mn/Fe
Ammonia

Filtration
- 24 Vessels (current)
- 48 Vessels (Future)

Distribution
- City of Gresham
- Rockwood PUD



Residuals Handling
- Backwash Tank
- Discharge Control

Sewer

Detailed Design Reviews

Pumping

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Well 6 and Well 10

- Package 5 includes pumping from Well 6 and 10
- Planning for conveyance from Well 10 to Well 6 WTP
- Planning for future expansion at Well 6 WTP from Well 10





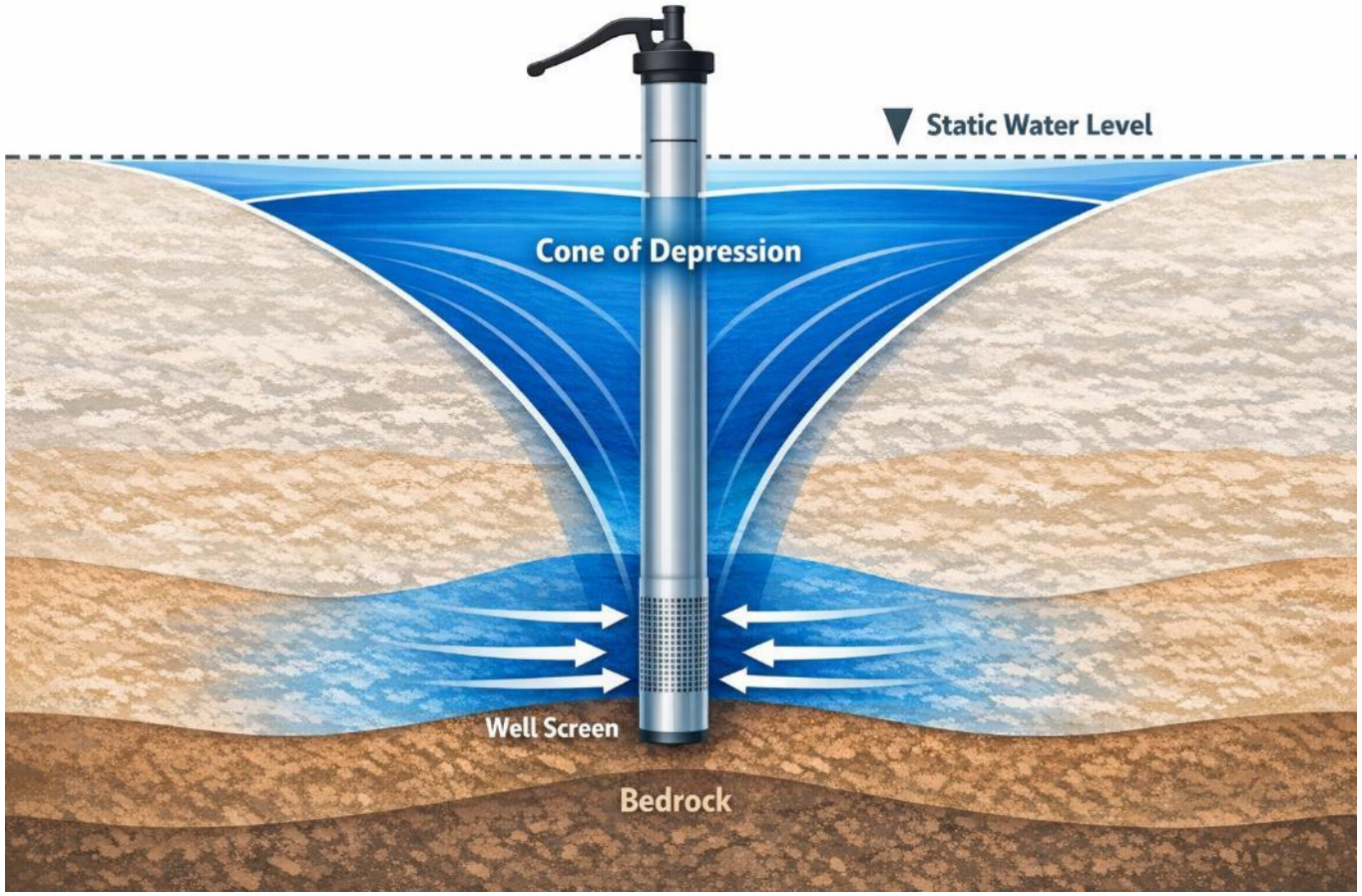
Well 6A and Well 6B

- Well 6A: 3.5 MGD
- Well 6B: 1 MGD
- The design utilizes the test well (Well 6B) for production *(adaptability)*
- Multiple wells provides capacity, flexibility, and system redundancy

GSI Well 6A Construction Report (2025)

Hydrogeology and Well Drawdown

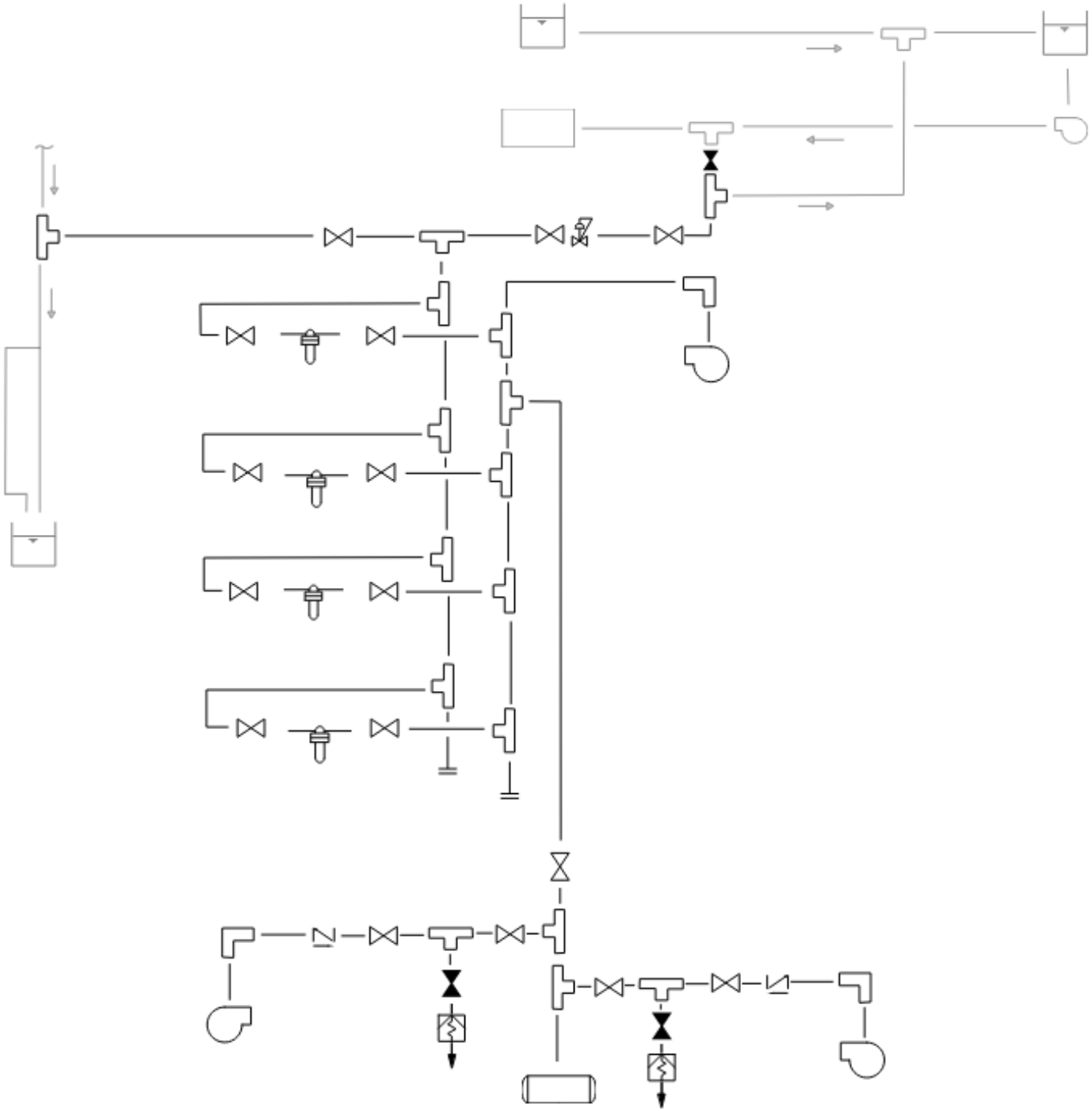
- Hydrogeologic analysis was by our subconsultant, GSI
- Well drawdown varies with season and pumping at other wells
- Well interference at multiple adjacent wells
  - CGA wells
  - Other wells



Microsoft Copilot. (2026). Image generated using generative AI.

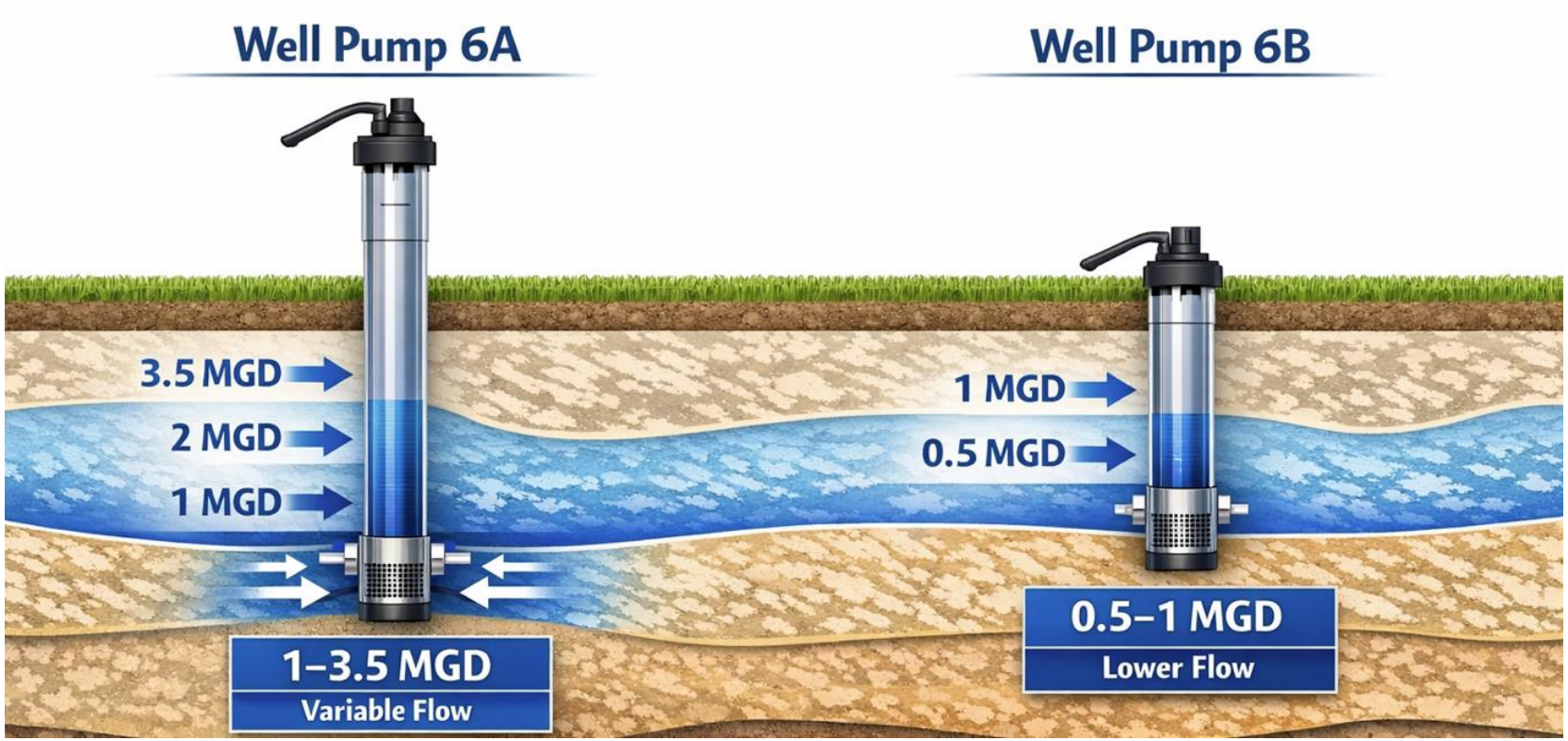
Hydraulic Modeling

- Wells can supply multiple reservoirs and two different systems *(adaptability)*
- Pumping is possible at a wide range of aquifer levels, now and into the future *(resilient and adaptable)*
- Modeling assumptions were refined for multiple demand/operating scenarios



Pump Sizing

- Well 6 pumps sized to cover the target flow range of 0.5 to 4.5 MGD
- Pumps will be equipped with VFDs for increased flexibility *(adaptability)*



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Detailed Design Reviews

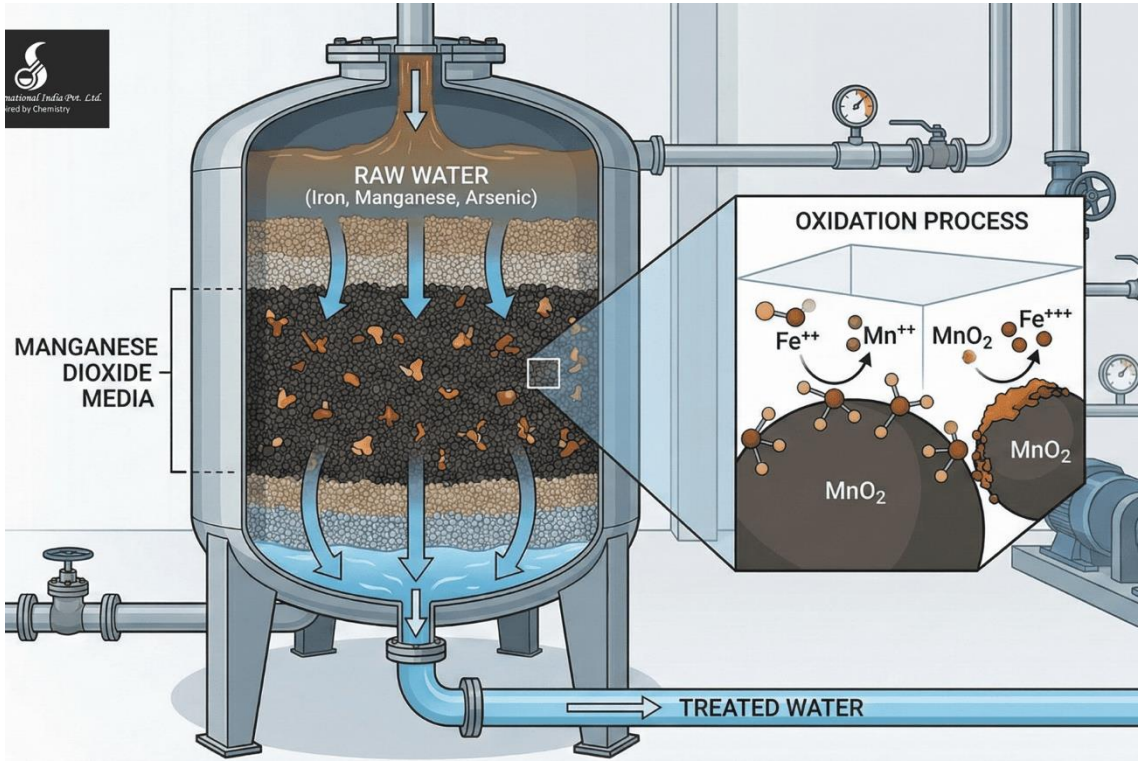
Filtration

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Filtration Overview

- Target constituents:
  - Primary: Mn 2+ → Mn 4+
  - Secondary: Fe 2+ → Fe 3+
- Pyrolusite media (manganese dioxide)
  - No coating to exhaust or regenerate
  - High oxidation potential
- Adsorption and catalytic oxidation allows high loading rates
- Maintains activity as long as the surface remains oxidized (low maintenance)

Speed International Blog (January 2026) https://speediipl.com/blog/how-manganese-dioxide-is-used-in-water-treatment-and-purification

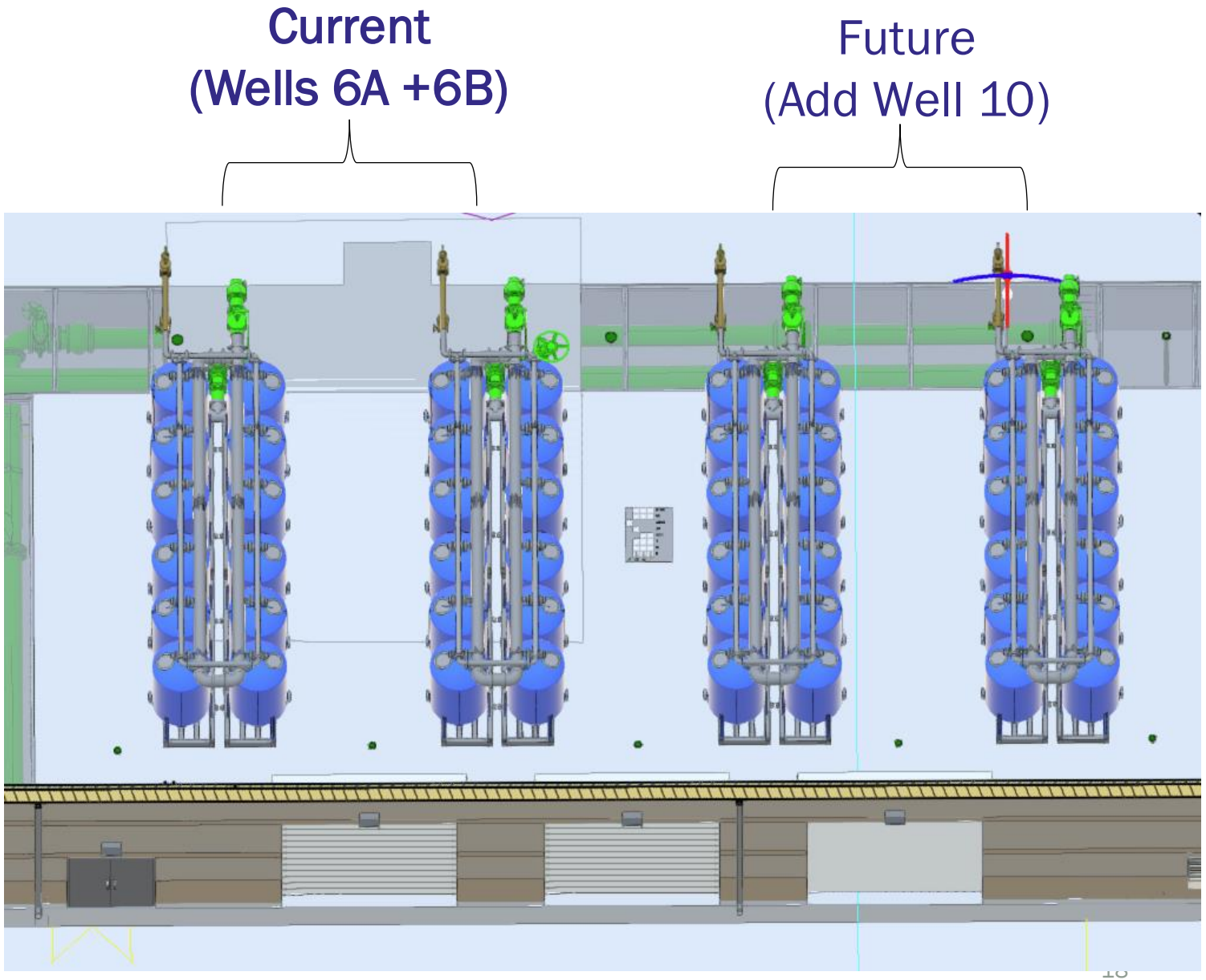


Adsorption + Catalytic Oxidation Mn 2+ Removal Process

Adsorption of Mn2+ → Catalytic oxidation on the media surface → Formation of insoluble MnOx (or Mn4+) on the media → Backwash MnOx to sewer

Filtration Design

- Resilient
  - Low maintenance
  - Low headloss
- Adaptable
  - Space for two additional trains in future
- Redundant
  - Multiple filter trains (N+1)
  - 12 vessels per train
  - Matches other packages



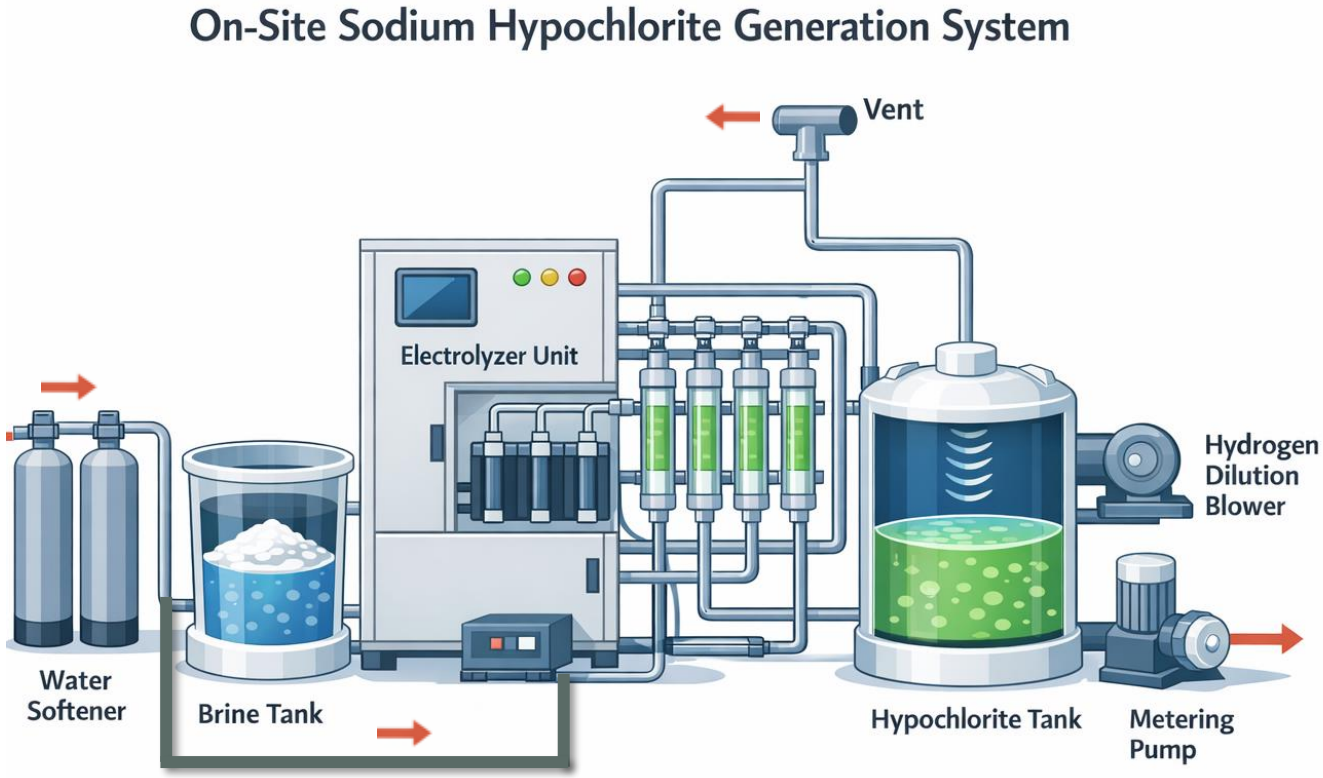
Detailed Design Reviews

Onsite Sodium Hypochlorite Generation (OSHG)

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Onsite Sodium Hypochlorite Generation (OSHG)

Pros	Cons
• **Supply chain resilience** • **Lower life cycle costs for medium to large systems** • Safer, low concentration solution • Minimal degradation	• Higher capital costs • Operational complexity • Water quality dependent • Hydrogen gas management

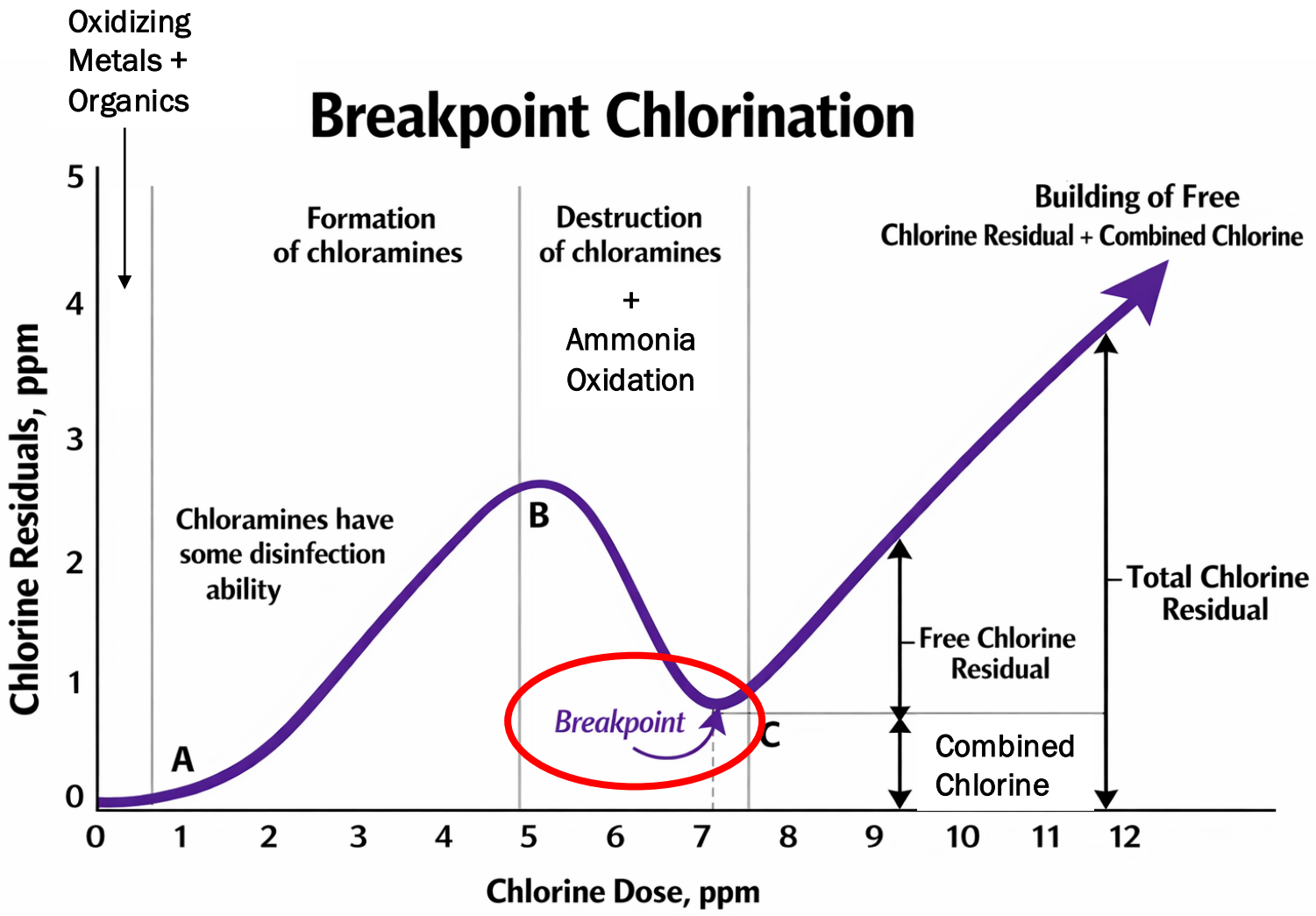


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OSHG Design

- System sizing dependent on water quality
- Sampling and breakpoint testing conducted
- Samples collected intermittently from Well 6A over 8-hour pumping period

Primary	Secondary
• Ammonia • Fe/Mn • TOC/DOC	• PFAS • Sulfides • Radon



Microsoft Copilot. (2026). Image generated using generative AI.

OSHG Design

- Design Impacts
  - Higher chlorine dose due to ammonia
  - Hydraulic retention time required
  - Space for RO in the future

Sampling Results

Parameter	Value (mg/L)
Ammonia	0.64 to 0.80 *
Total Iron	0.07
Total Manganese	0.11
TOC	0.26
DOC	0.55
Radon	245
PFAS	ND
Silica	48
Hardness	54

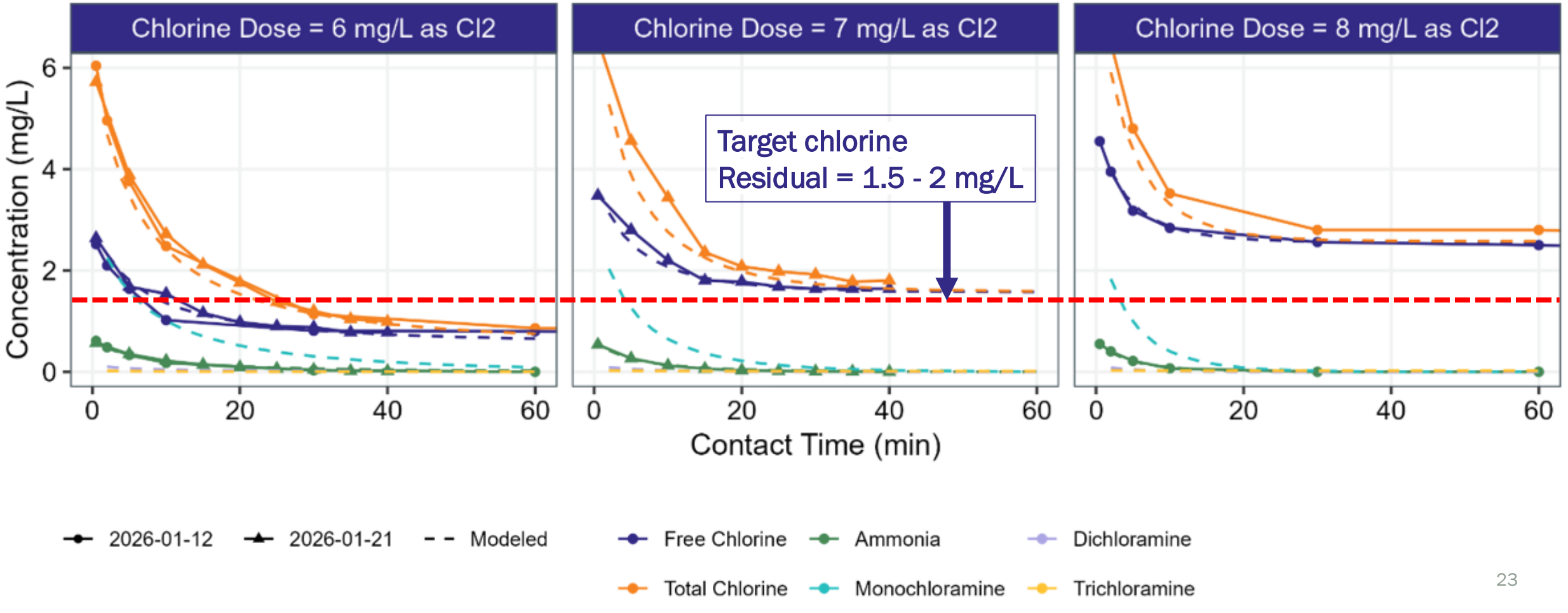
** Ammonia concentration decreased over time*

OSHG Design

Free Cl too low after reaction

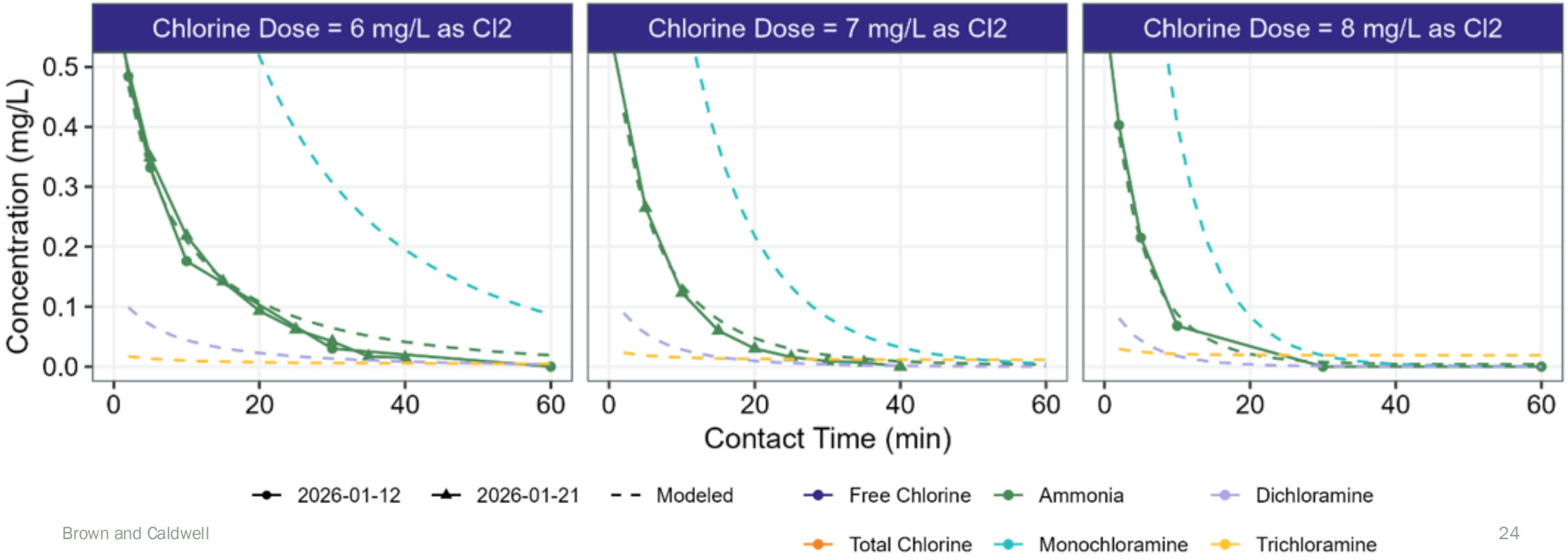
Free Cl within target range

Free Cl slightly high



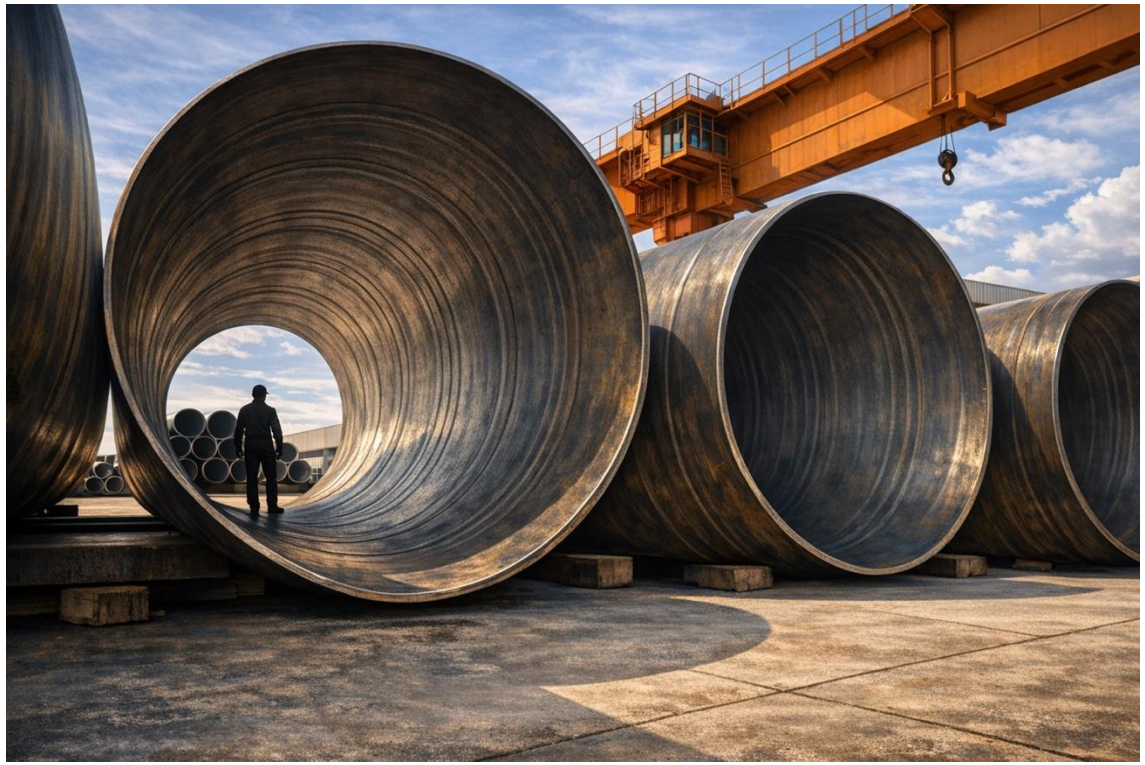
OSHG Design

- Modeling was conducted using BC:OpenWTP
- Model estimates the concentrations of measured parameters including chloromine levels and type
- At the 15–35 minute reaction times, modeling shows the combined chlorine is primarily monochloramine



OSHG Design – Contact Time

Option 1: Slow down velocity with large diameter piping (steel vs FRP)



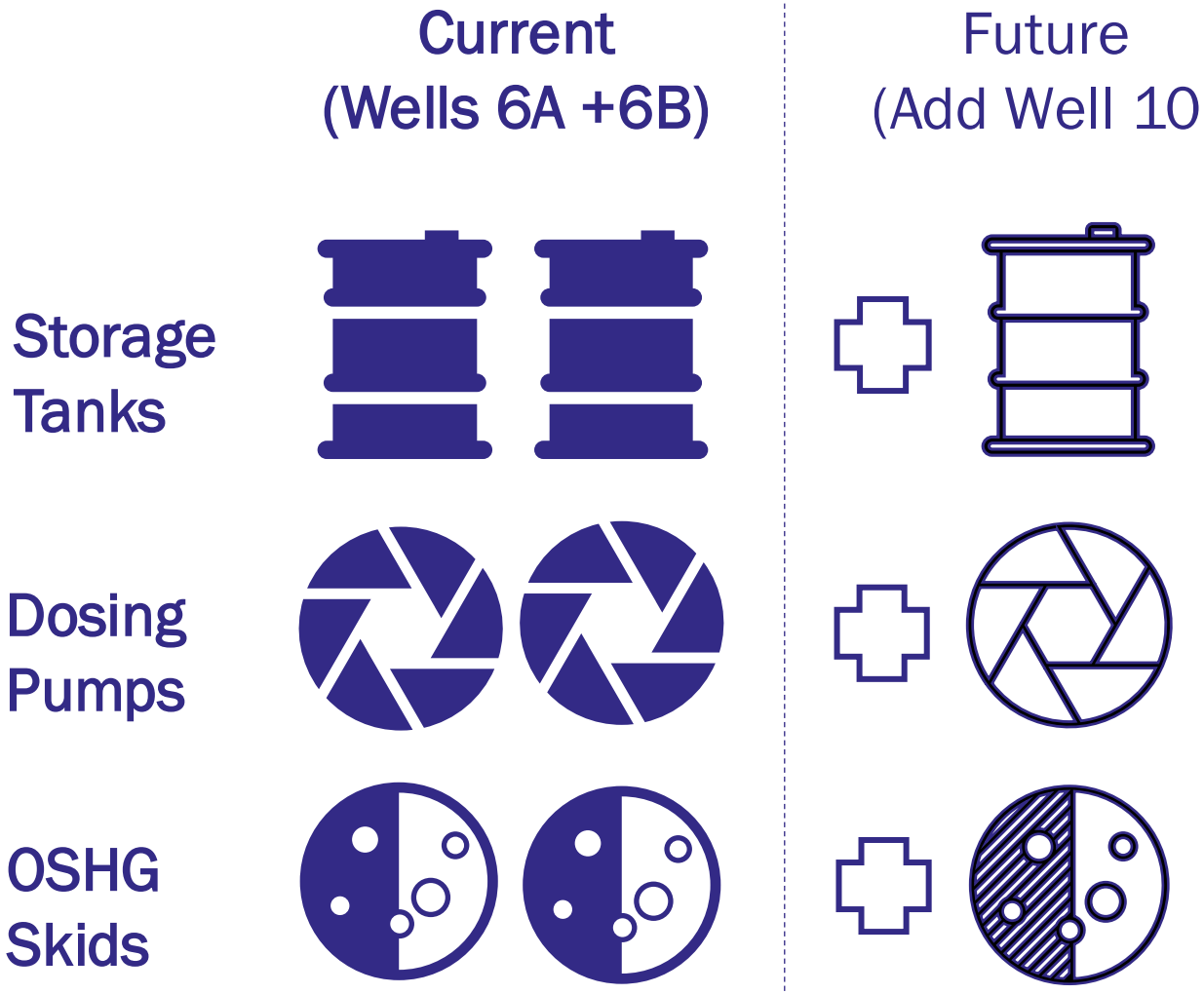
Option 2: Storage tank and pump station (hydraulic break)



Microsoft Copilot. (2026). Image generated using generative AI.

OSHG Design

- Resilient
  - Multiple storage tanks and OSHG units covers wide range of operating conditions
  - Contact pipe requires less maintenance
- Adaptable
  - Additional skids, tanks, and pumps for future Well 10
- Redundant
  - N+1 for all major equipment
  - Emergency bulk delivery capacity
  - Transfer pumping between storage tanks



Detailed Design Reviews

Residuals Handling

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Residuals Handling Design

- Each pressure vessel must be backwashed daily
- Backwash tank designed to provide some settling and controlled discharge



Discharge Options

	Pros	Cons
Sewer	• No chemicals needed	• Capacity limited • Coordination with sewer authority
Storm	• High capacity	• Chemical system required • More permitting requirements • Solids handling
Recycle	• Reduces water consumption • Self contained	• NSF61 materials • Chemical system required • Solids handling

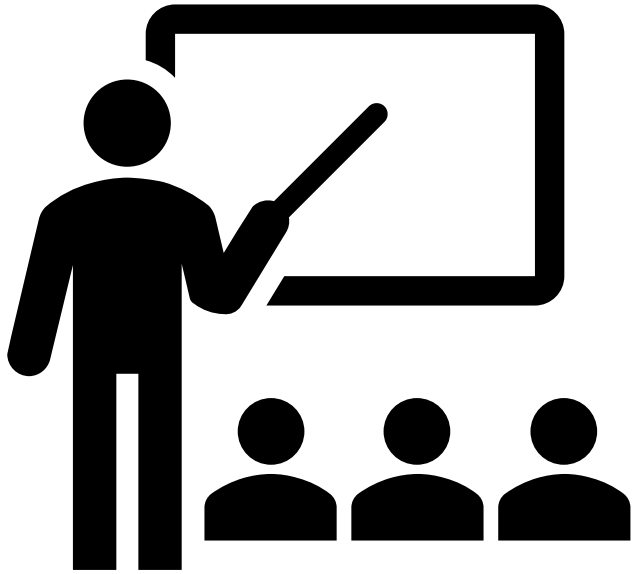
Lesson Learned

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Lessons Learned

BEFORE design starts…

- Know your water quality
- Validate survey information
- Discuss build out scenarios for future
- Confirm well capacity
- Understanding well interference and seasonal fluctuations
- Confirm solids disposal design with client and regulators early



Thank you!

Questions?



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