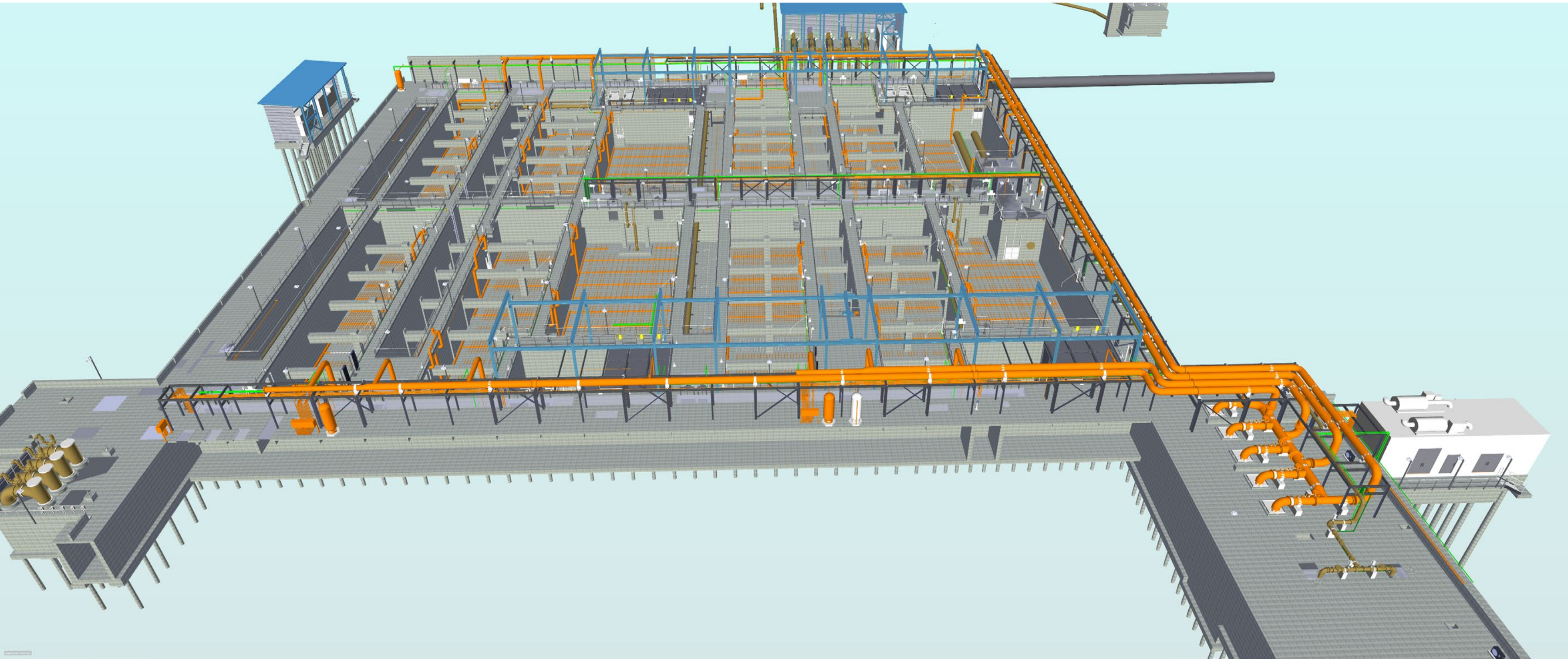
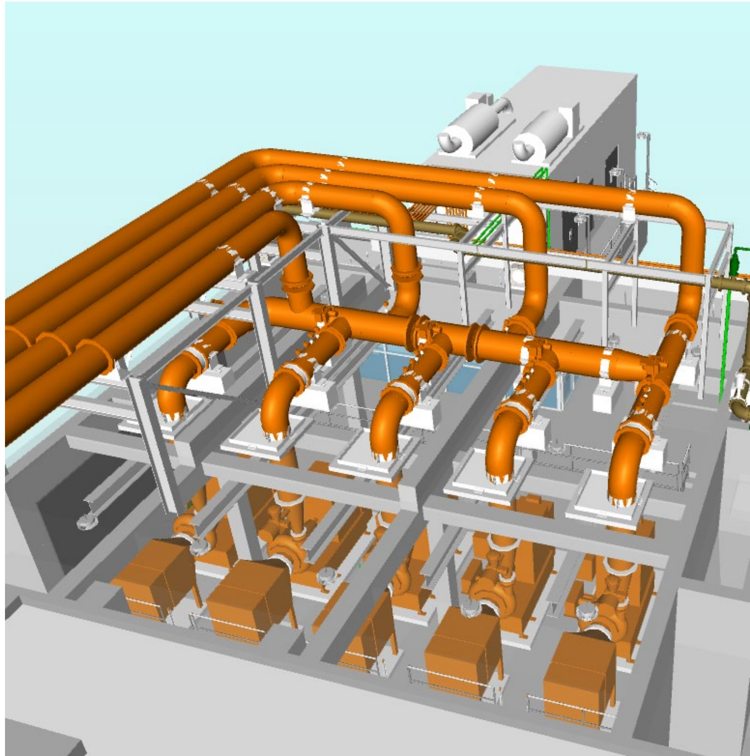
Brown AND Caldwell

Palo Alto Regional Water Quality Control Plant
Secondary Treatment Upgrades

August 29, 2024

CITY OF PALO ALTO





Agenda

1. Palo Alto RWQCP Factoids
2. Project Drivers
3. Process Selection
4. Construction Update
5. Project Team, Costs, and Timeline

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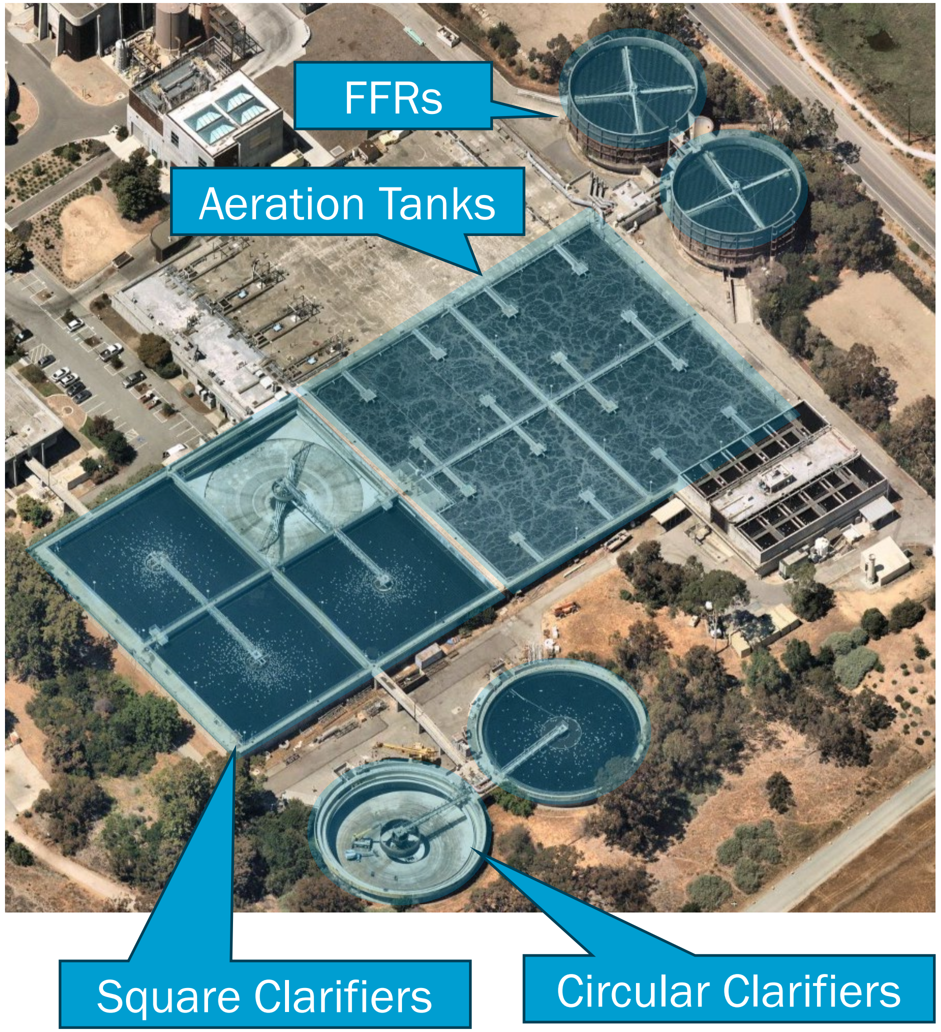
Existing secondary treatment: FFR + NAS

Existing secondary process design criteria

Parameter	Value
Fixed Film Reactors	
Number	2
Diameter, each	95 ft
Media Depth	21.5 ft
Aeration Tanks	
Number/Type	4 Complete Mix (Fine Bubble) Aerators
Side Water Depth	16.25 ft
Volume, each	1.98 Mgal
Secondary Clarifiers	
Number	4 square, 2 circular
Plan Dimensions	120 ft x 120 ft (square) 120 ft diameter (circular)



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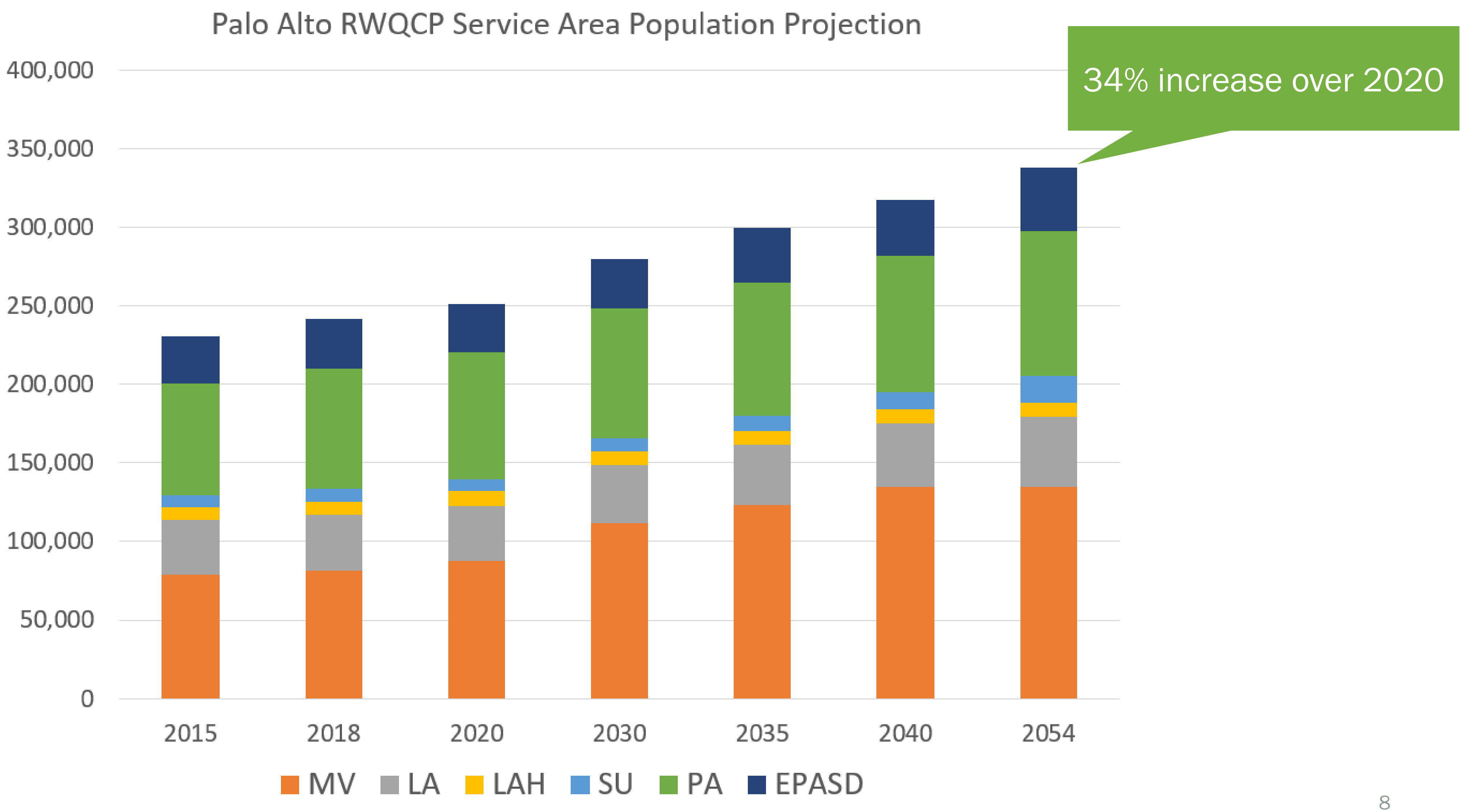
Project driver: Aging infrastructure

Aeration Blower (1980)

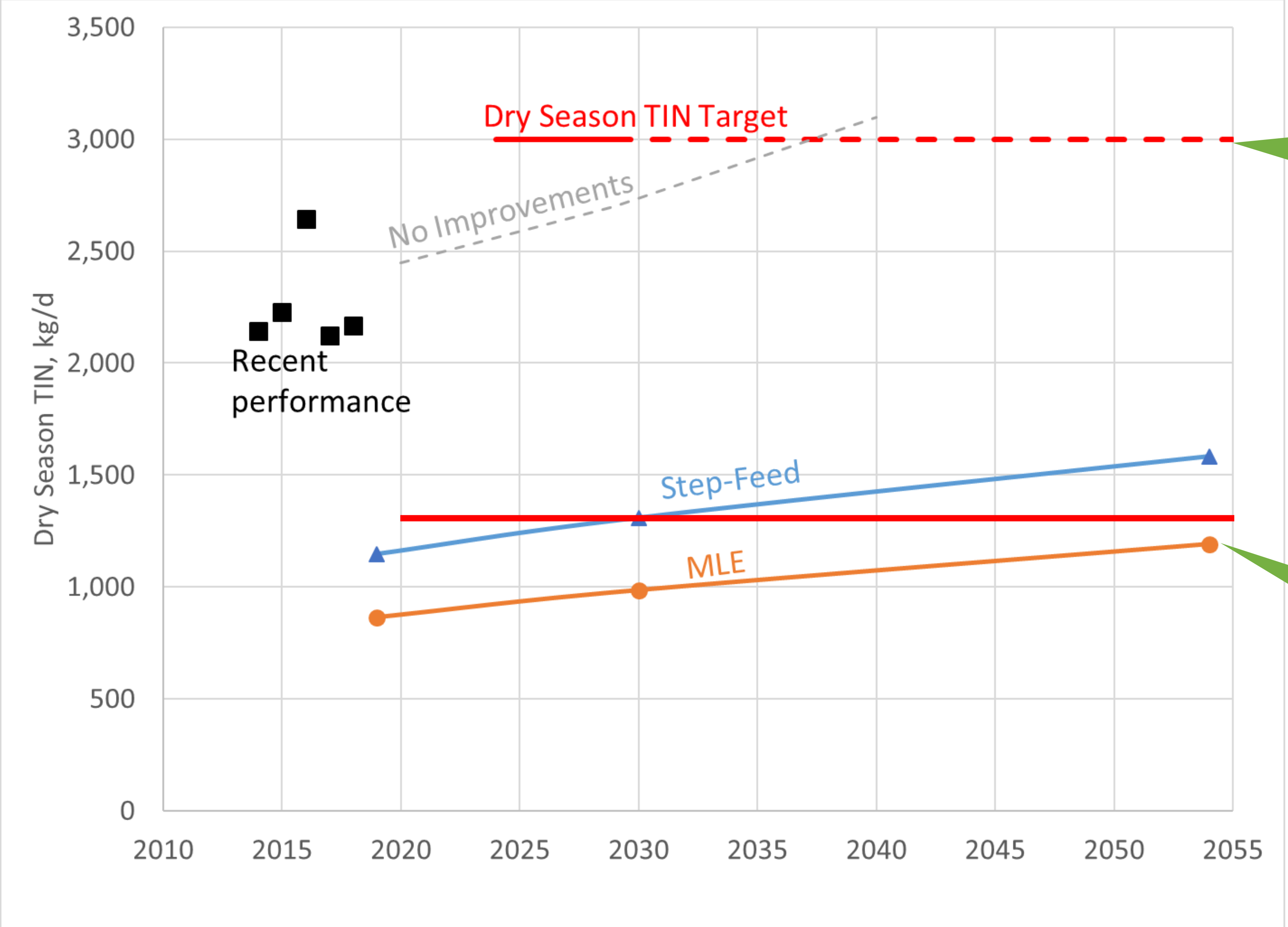
Fixed Film Reactors (1980)

Intermediate Lift Pumps (1988)

Project driver: Planned growth in service area



Project driver: Limits on nitrogen to San Francisco Bay



Second Nutrient Watershed Permit Target = 3,000 kg/d (Existing Performance + 15%)

New 2034 Load Target

Capacity limitations prevents construction of MLE in existing tanks

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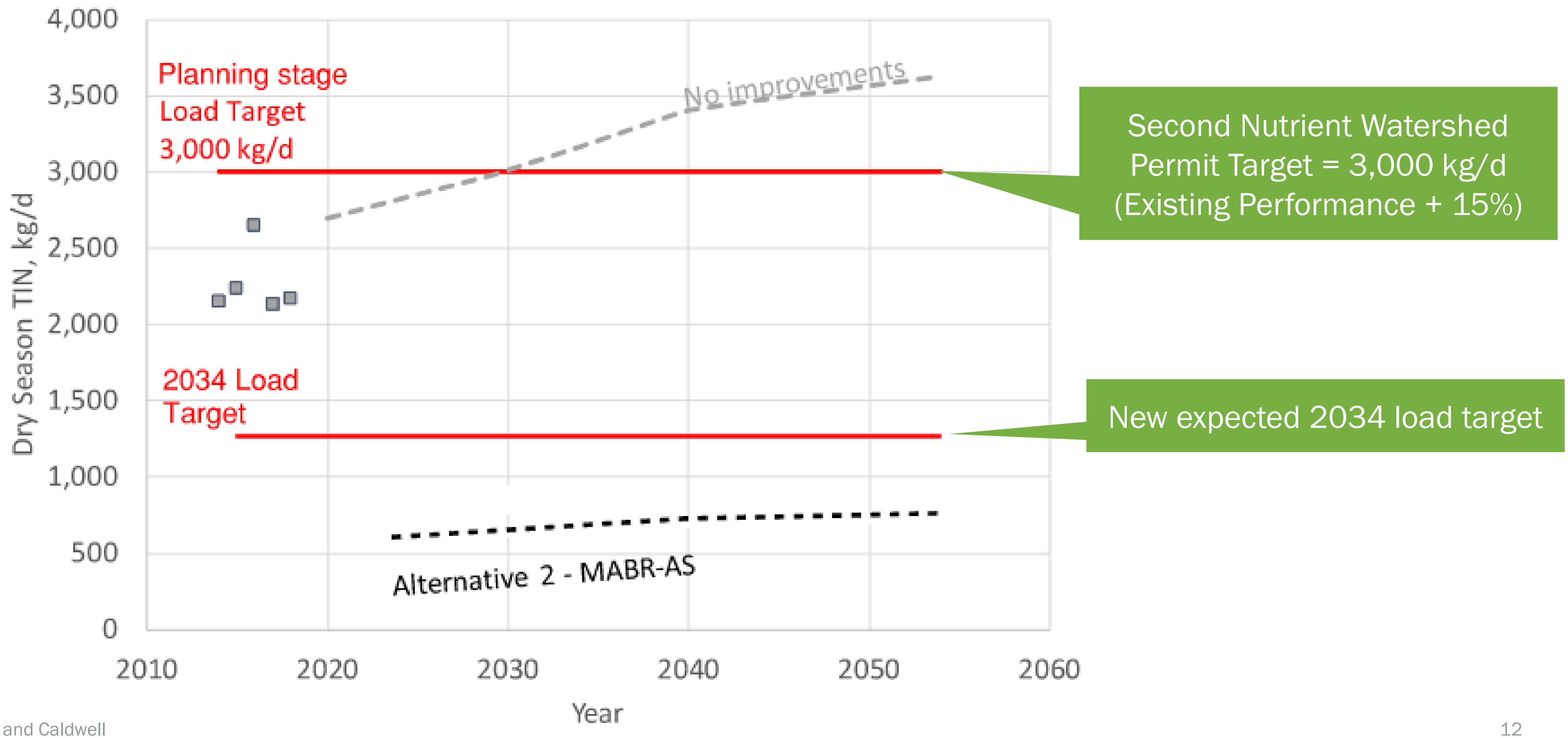
Re-evaluation of secondary treatment alternatives

Parameter	Alternative 1A Convention MLE Activated Sludge	Alternative 1B Convention Step-feed Activated Sludge	Alternative 2 Step-feed Activated Sludge + MABR Intensification
Additional tankage requirement	✘	✘	✓
Ability to conduct maintenance	✘	✓	✓
Ability to achieve ammonia limits	✘	✓	✓
Ability to achieve TIN target	✘	✓	✓
Ability to phase implementation	✘	✘	✓

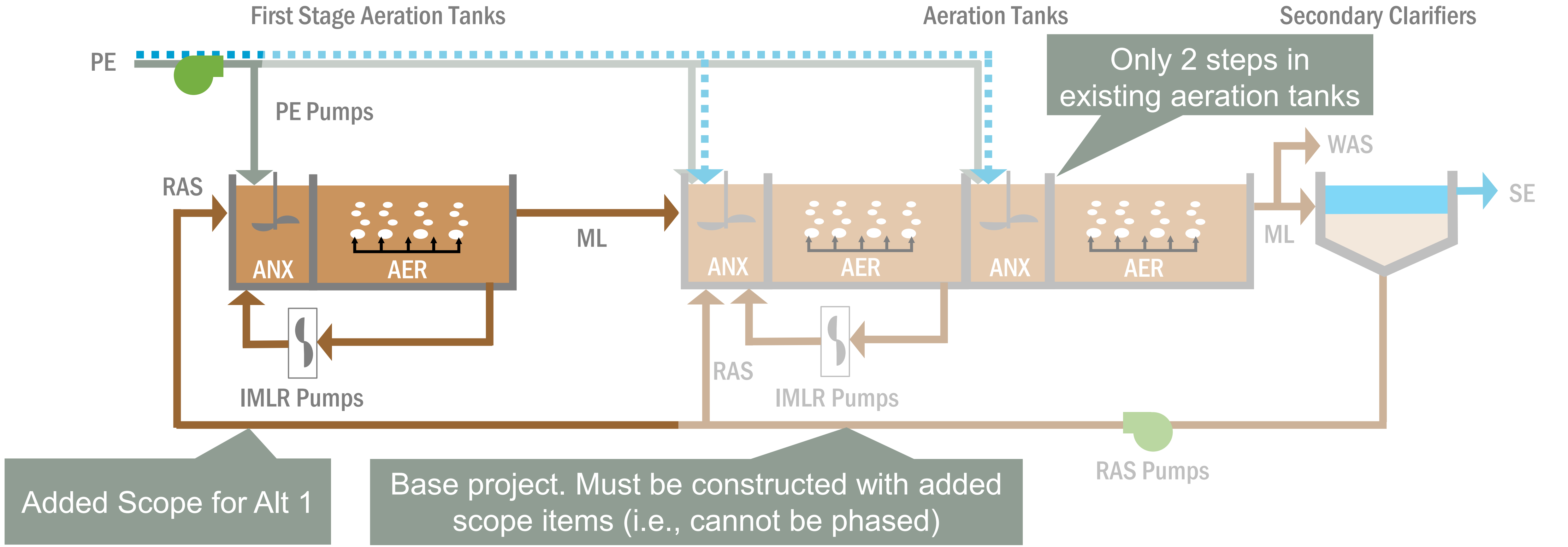
✓: Superior performance
✘: Inferior performance

Retained for further evaluation

Project driver: Limits on nitrogen to San Francisco Bay



Alternative 1 – Conventional step-feed AS process flow diagram



<u>Legend:</u>

Normal Operation (3-Step Feed Mode)

High-Flow Operation (Contact Stabilization Mode)

AER	Aerobic
ANX	Anoxic
ML	Mixed Liquor

PE	Primary Effluent
RAS	Return Activated Sludge
SE	Secondary Effluent
WAS	Waste Activated Sludge

Alternative 1 – Conventional step-feed AS site layout

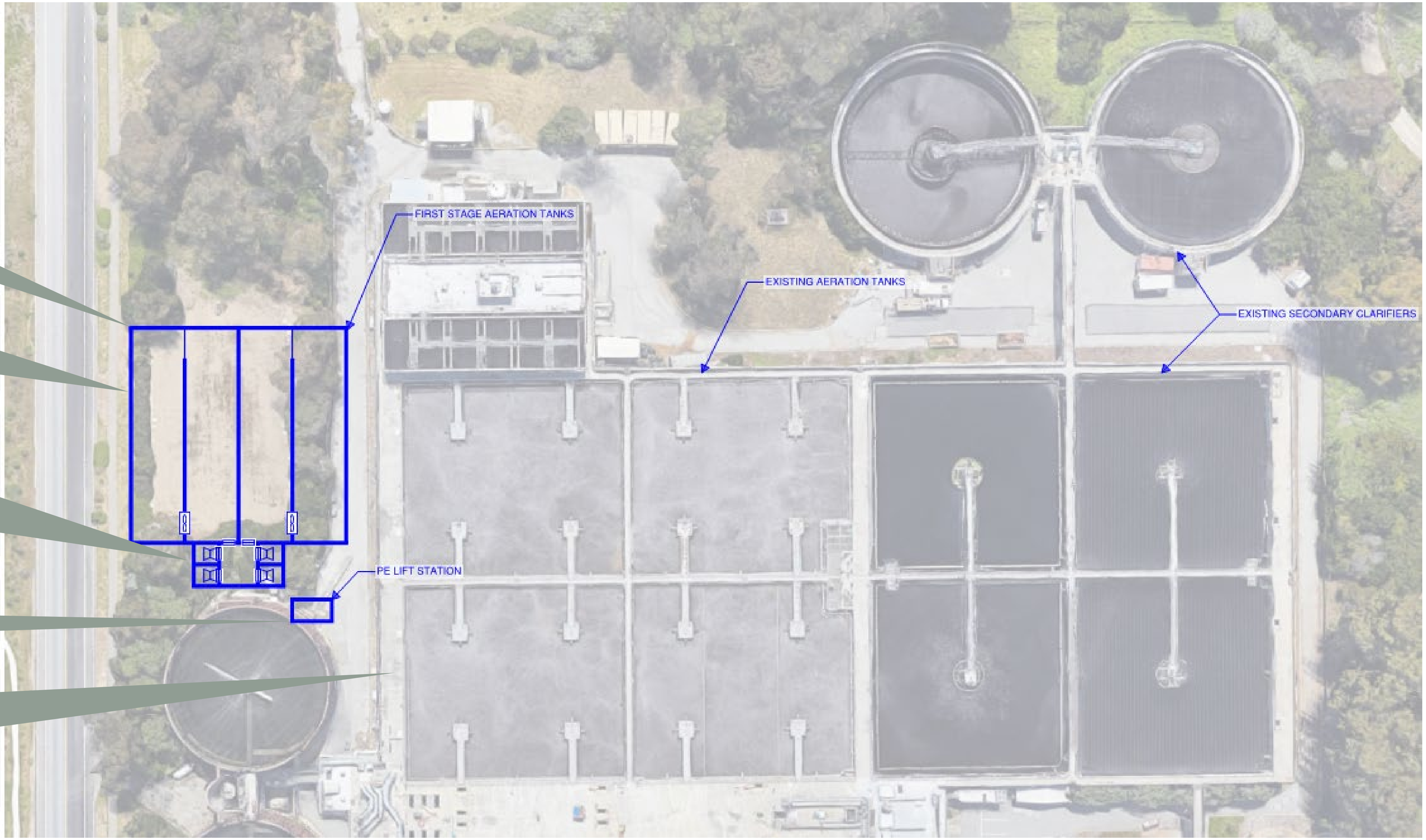
Conflict with 2 x 96” pipes

New first stage aeration tanks

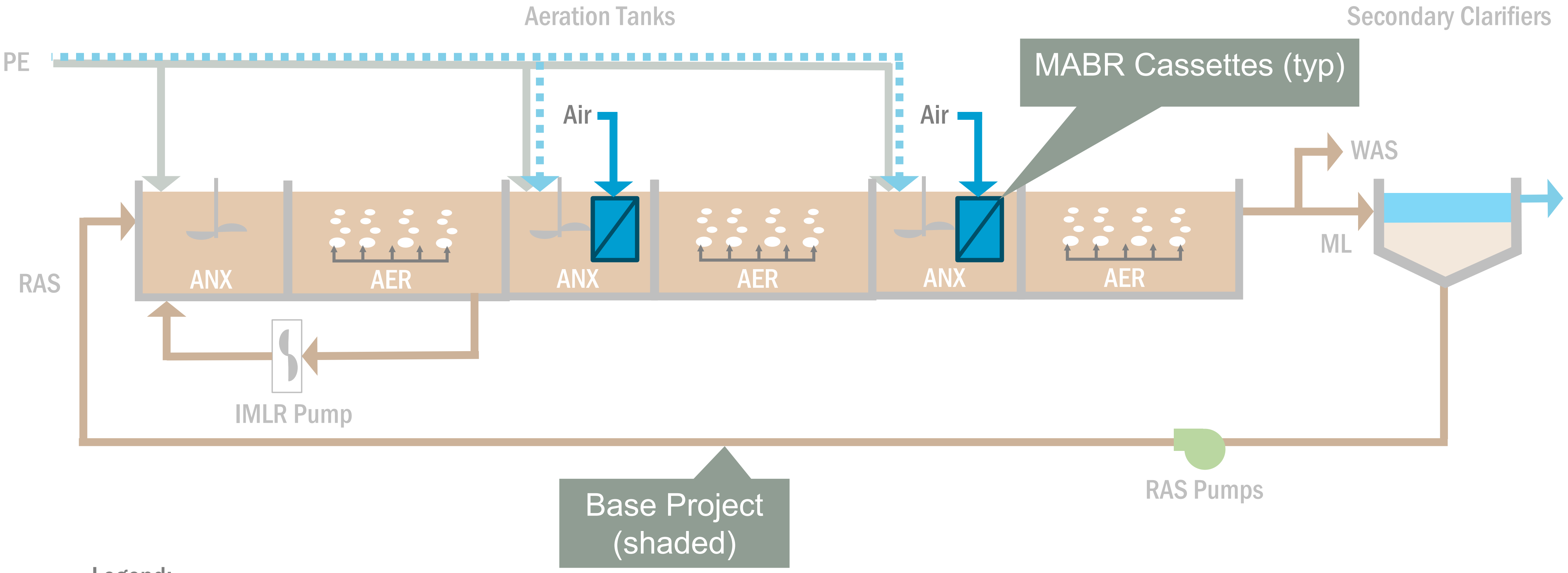
New ML distribution structure

PE lift station

Mods to existing aeration tanks not shown



Alternative 2- Step-feed AS + MABR Intensification



Legend:

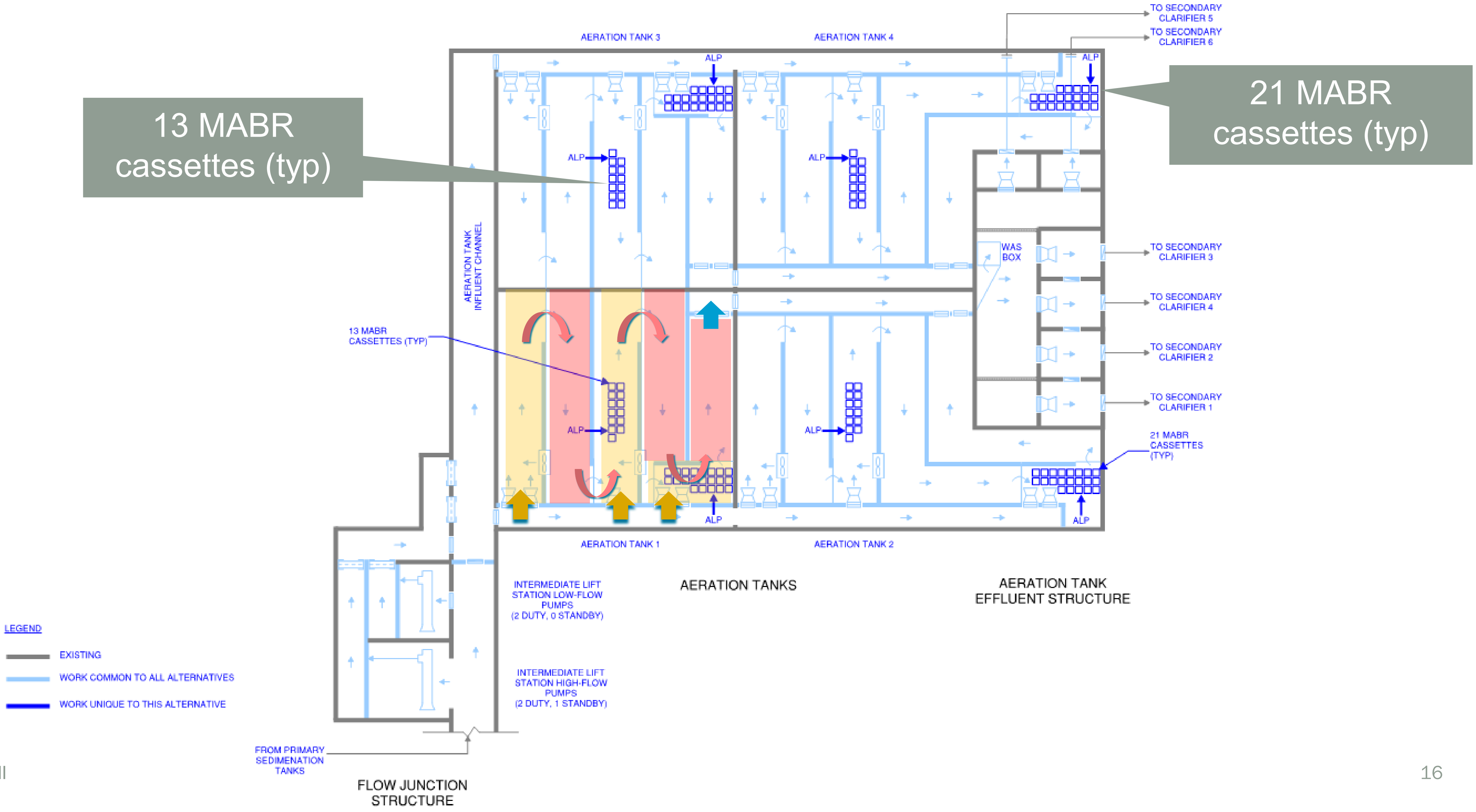
Normal Operation (3-Step Feed Mode)

High-Flow Operation (Contact Stabilization Mode)

AER	Aerobic	PE	Primary Effluent
ANX	Anoxic	RAS	Return Activated Sludge
ML	Mixed Liquor	SE	Secondary Effluent
			Waste Activated Sludge

Alternative 2

Step-feed AS + MABR intensification



MABR example installation at Yorkville-Bristol San District

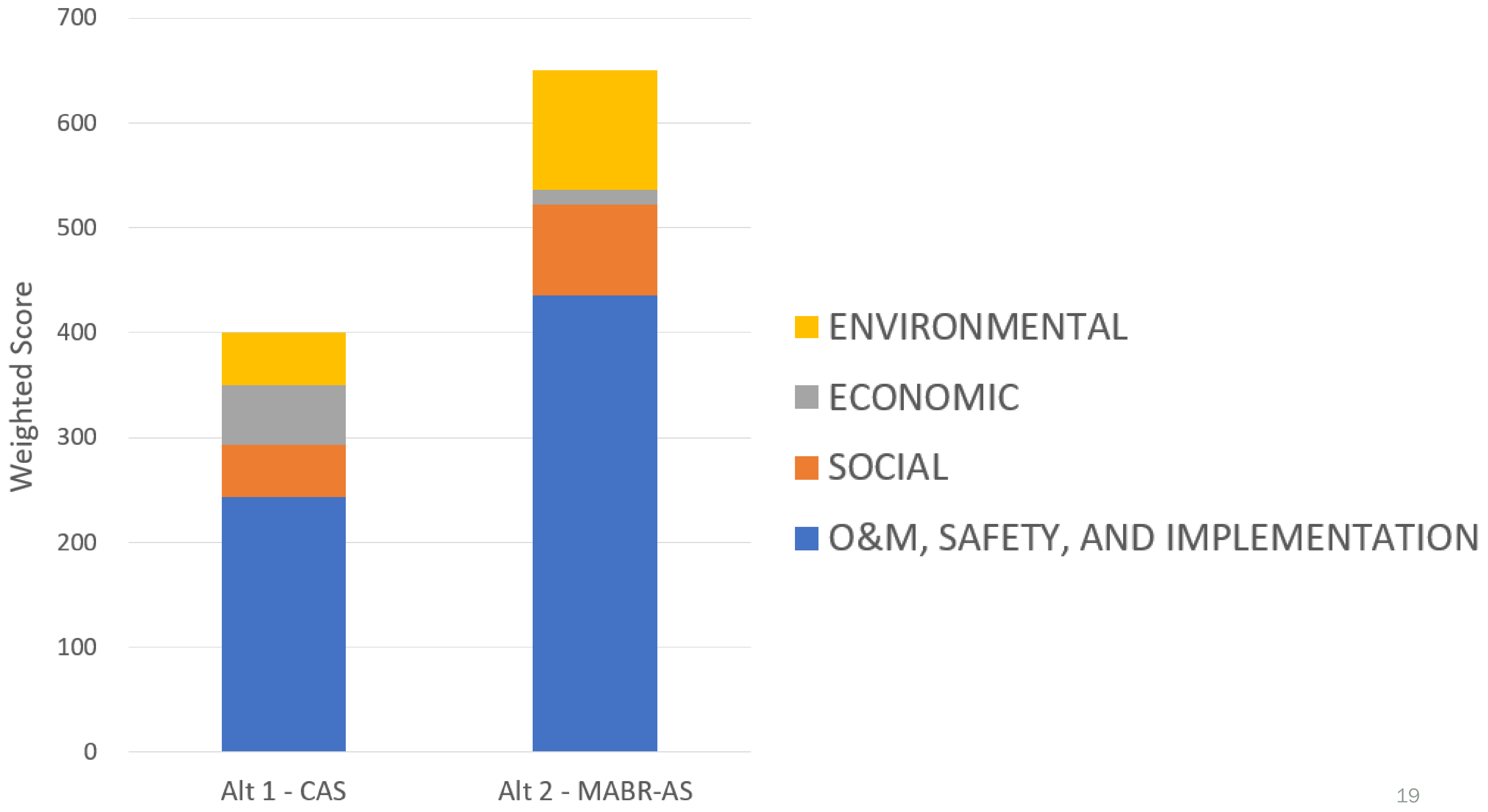
before

after

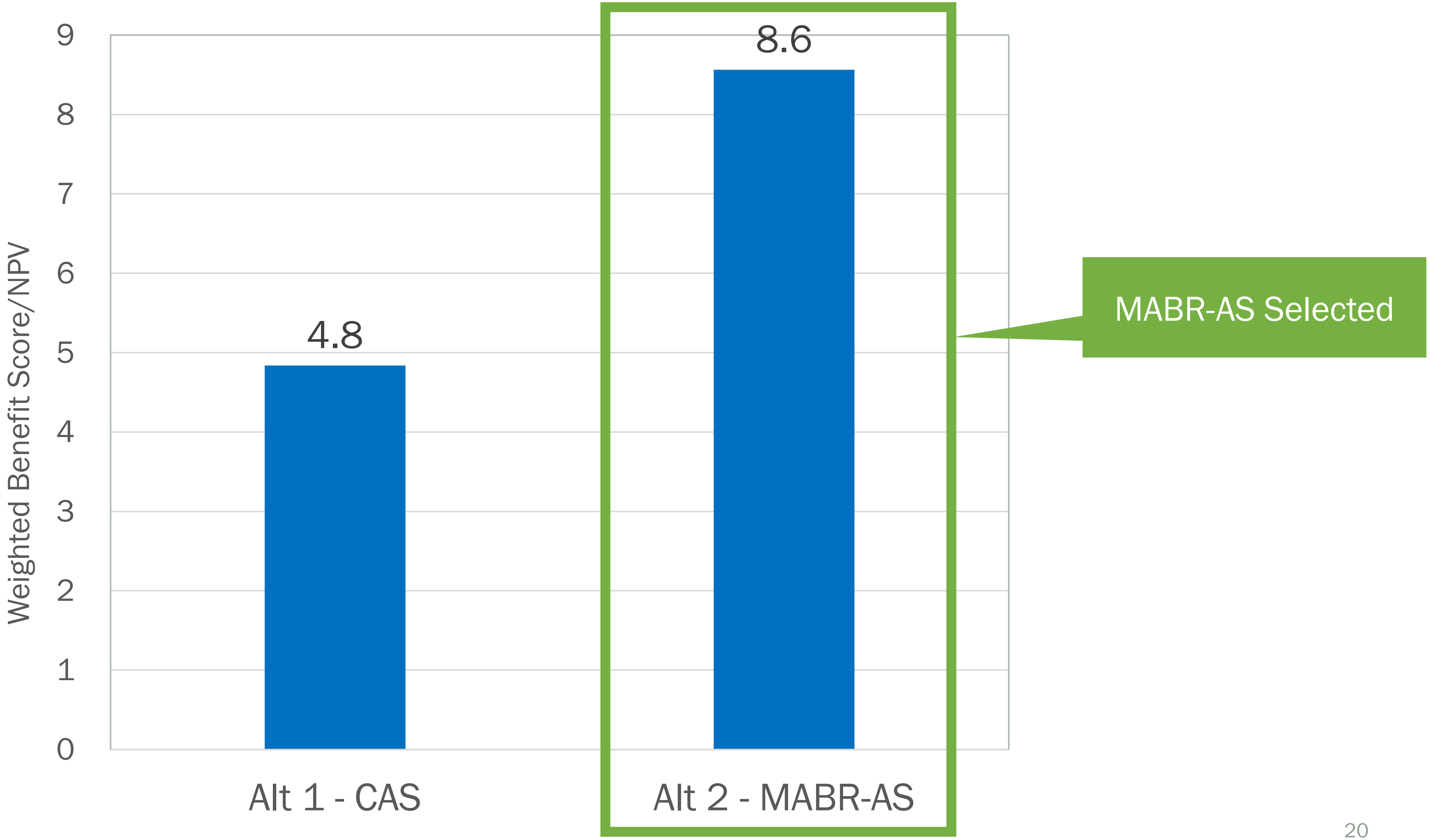
MABR Cassette Version 2.0 versus 2.0+

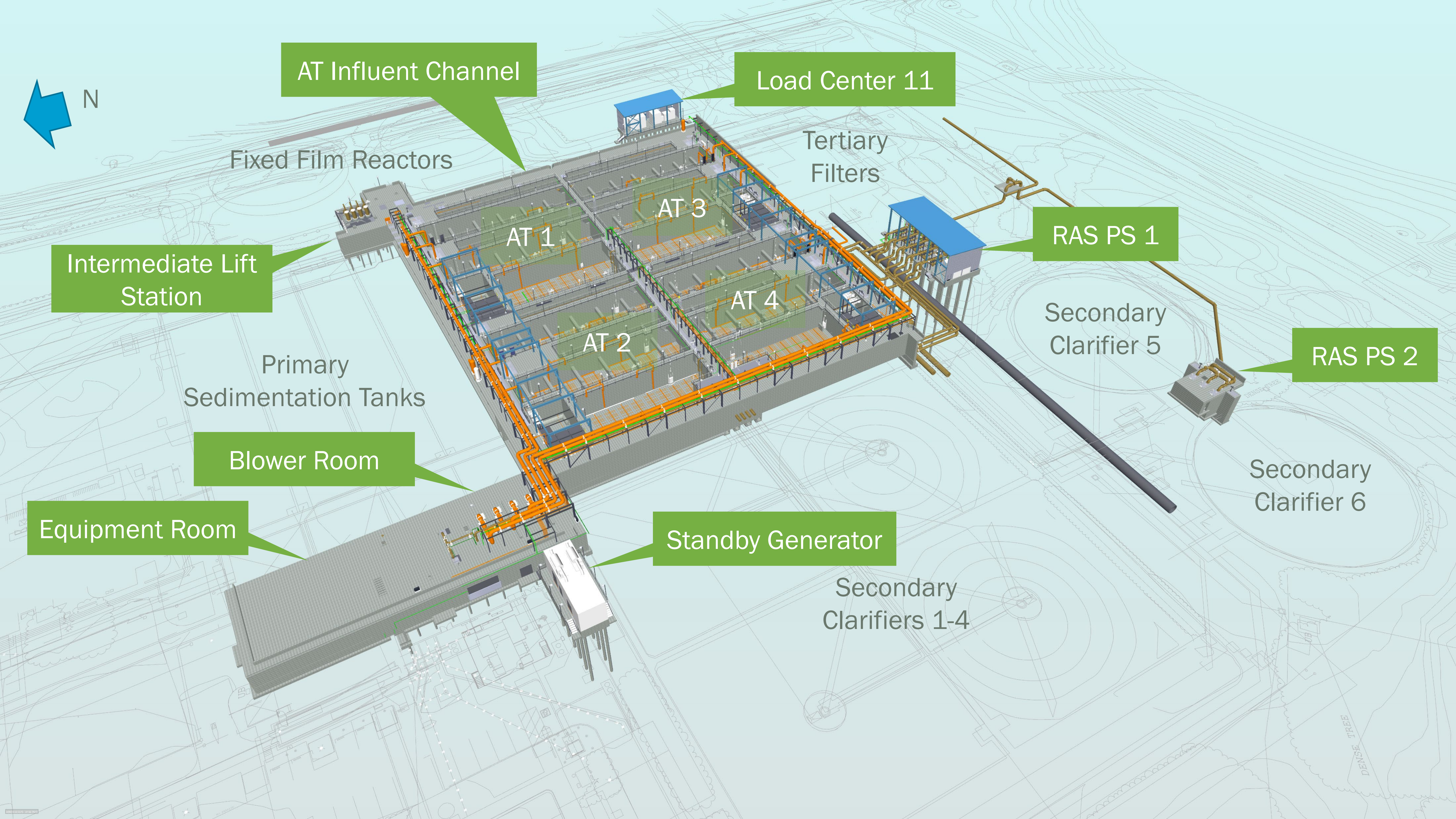
Parameter	V2.0	V2.0+	Difference, %
# modules per cassette	48	52	+8%
Module surface area per cassette, m^2	40	45	+12.5%
Surface area per cassette m^2	1,920	2,340	+21%
Avg airflow per cassette, scfm	5	6	+20%
Max airflow per cassette, scfm	10	12	+20%

Weighted non-monetary benefits favor MABR-AS



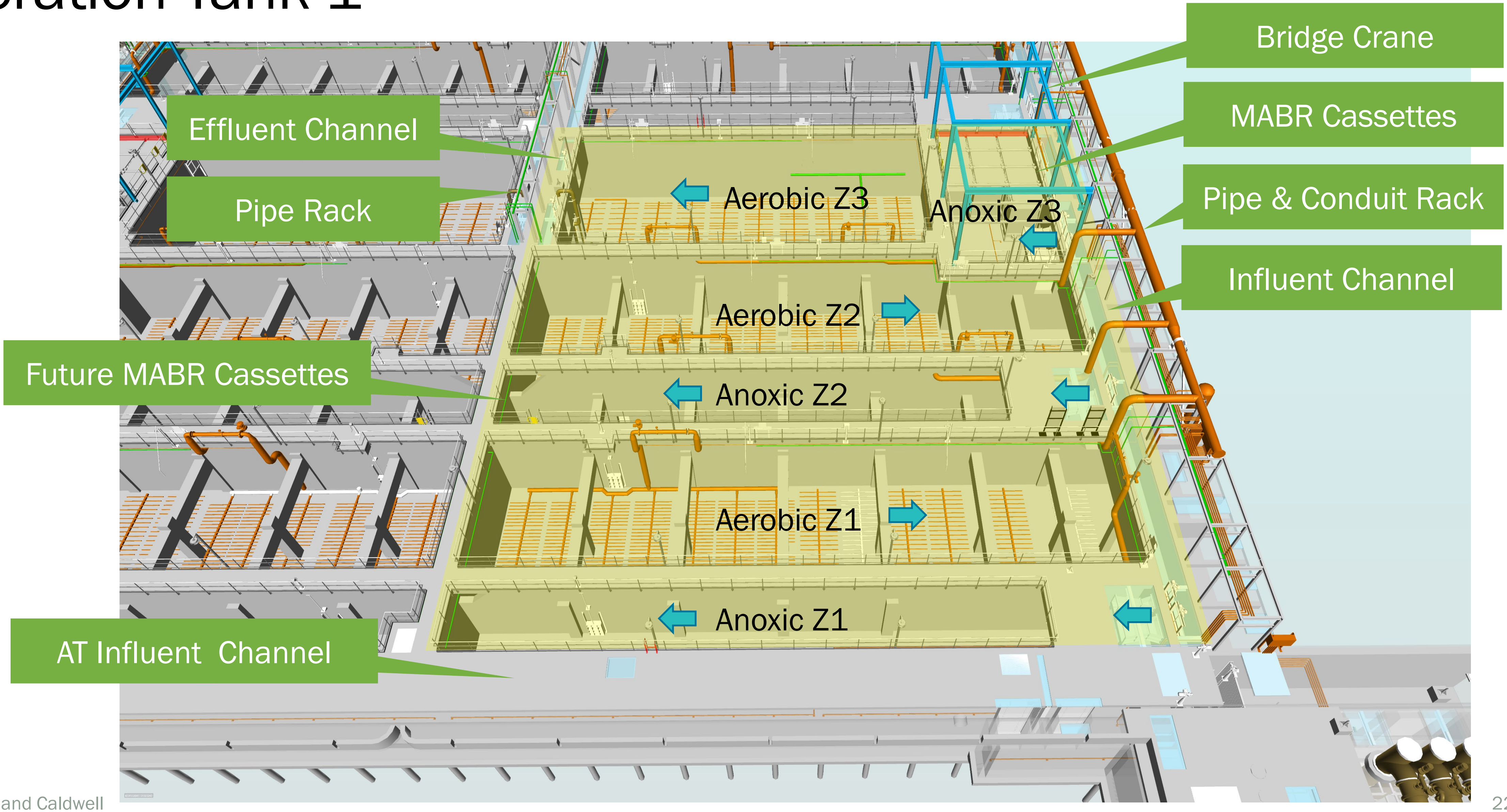
Benefit-to-cost ratio ("bang for the buck") favors MABR-AS



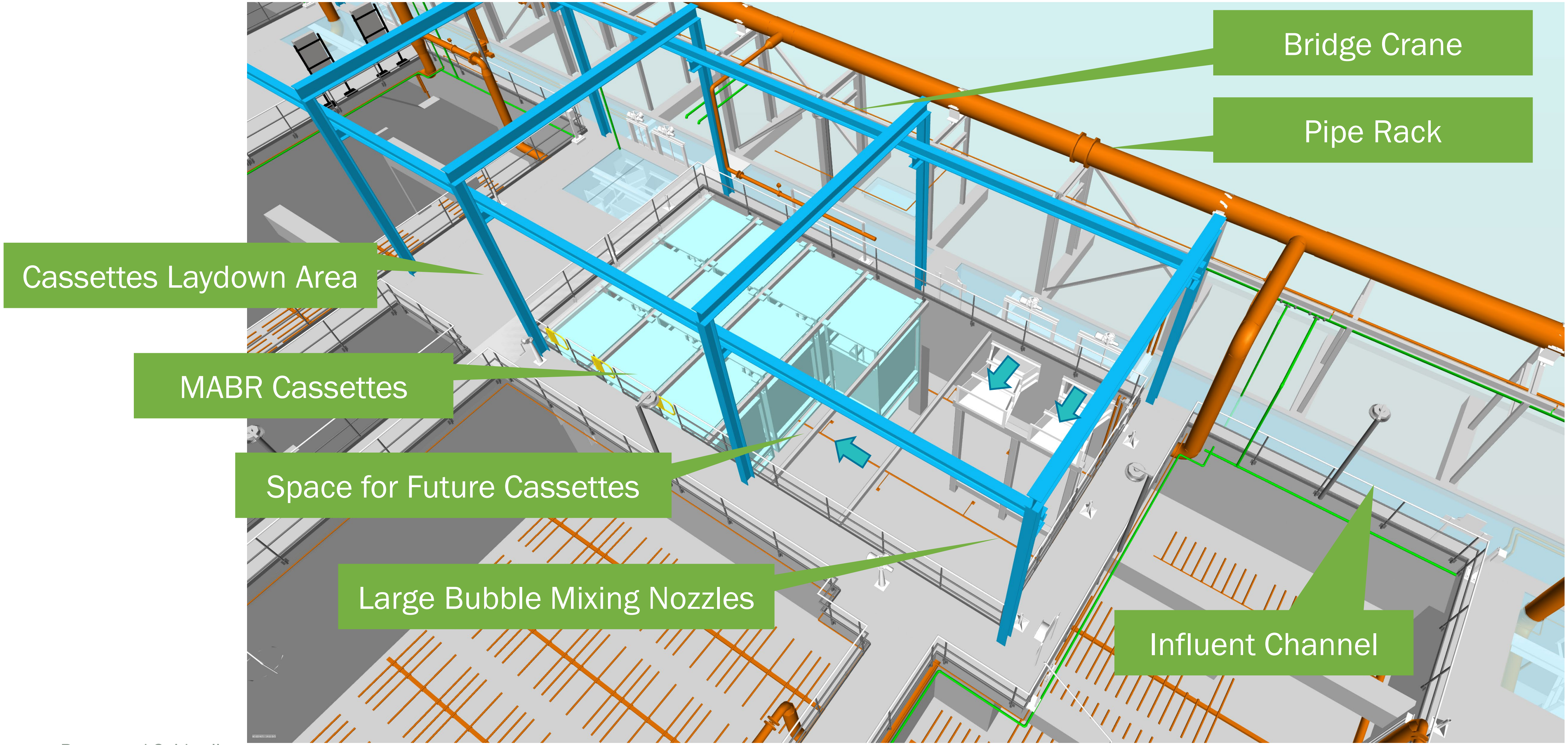


N
AT Influent Channel
Load Center 11
Fixed Film Reactors
Tertiary Filters
AT 3
AT 1
RAS PS 1
Intermediate Lift Station
AT 4
Secondary Clarifier 5
AT 2
RAS PS 2
Primary Sedimentation Tanks
Blower Room
Secondary Clarifier 6
Equipment Room
Standby Generator
Secondary Clarifiers 1-4

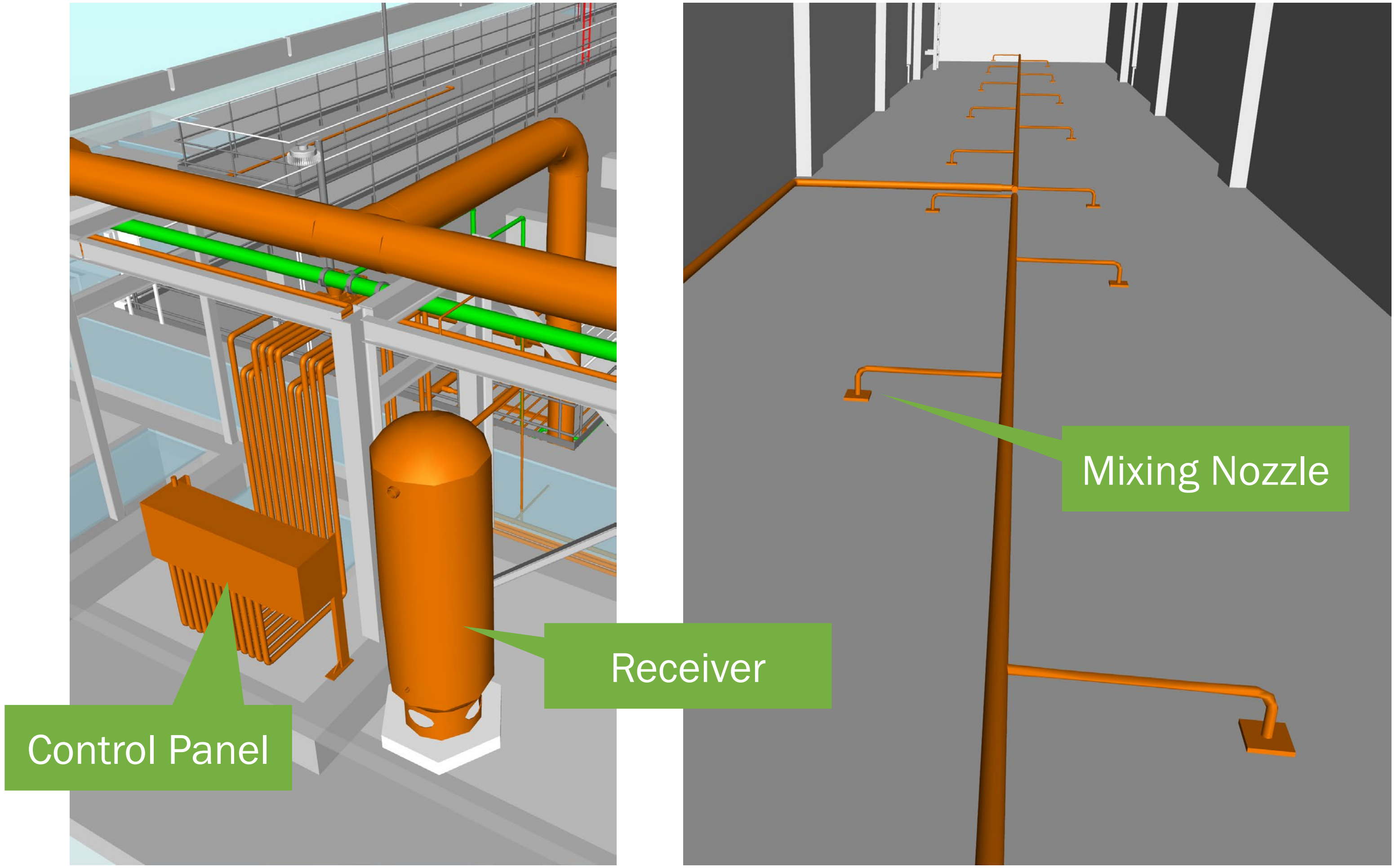
Aeration Tank 1

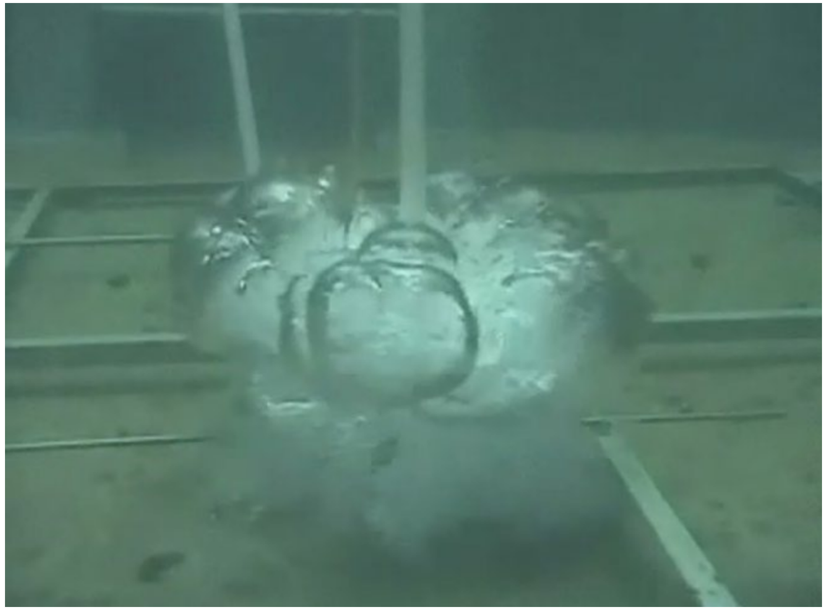


Anoxic Zone 3 with MABR cassettes



Large-bubble mixing in unaerated zones and structures





A Lot of Temporary Systems Needed for Construction

6 temporary bypass pumping systems

+ temporary blower system

+temporary standby generator

PARAMETER	SYSTEM 1	SYSTEM 2A	SYSTEM 2B	SYSTEM 2C	SYSTEM 2D	SYSTEM 3
FLUID	PE	ML	ML	ML	ML	PE
CONSTRUCTION PHASE	05	01	02	03	04	06
SOURCE OF FLOW	Primary Effluent Channel	Aeration Tank 3	Aeration Tank Influent Channel	Aeration Tank 1	Aeration Tank Influent Channel	Fixed Film Reactors Effluent Channel
DESTINATION OF FLOW	Two new elevated aeration tank influent channels, flow split evenly between the two channels	Aeration Tank Effluent Structure	Aeration Tank 4	Aeration Tank Effluent Structure	Aeration Tank 2	Influent Channel of Primary Sedimentation Tanks
MINIMUM NUMBER OF PUMPS	7 duty and 1 standby	3 duty and 1 standby	3 duty and 1 standby	3 duty and 1 standby	3 duty and 1 standby	1 duty and 0 standby
MINIMUM FLOW CAPACITY OF ALL DUTY PUMPS COMBINED	55,600 gpm	26,700 gpm	26,700 gpm	26,700 gpm	26,700 gpm	1,000 gpm
MINIMUM HEAD CAPACITY	To be determined by temporary system design engineer	To be determined by temporary system design engineer	To be determined by temporary system design engineer	To be determined by temporary system design engineer	To be determined by temporary system design engineer	To be determined by temporary system design engineer
PREREQUISITES FOR REMOVAL OF TEMPORARY PUMPING SYSTEM	See Section 01 12 16	See Section 01 12 16	See Section 01 12 16	See Section 01 12 16	See Section 01 12 16	See Section 01 12 16

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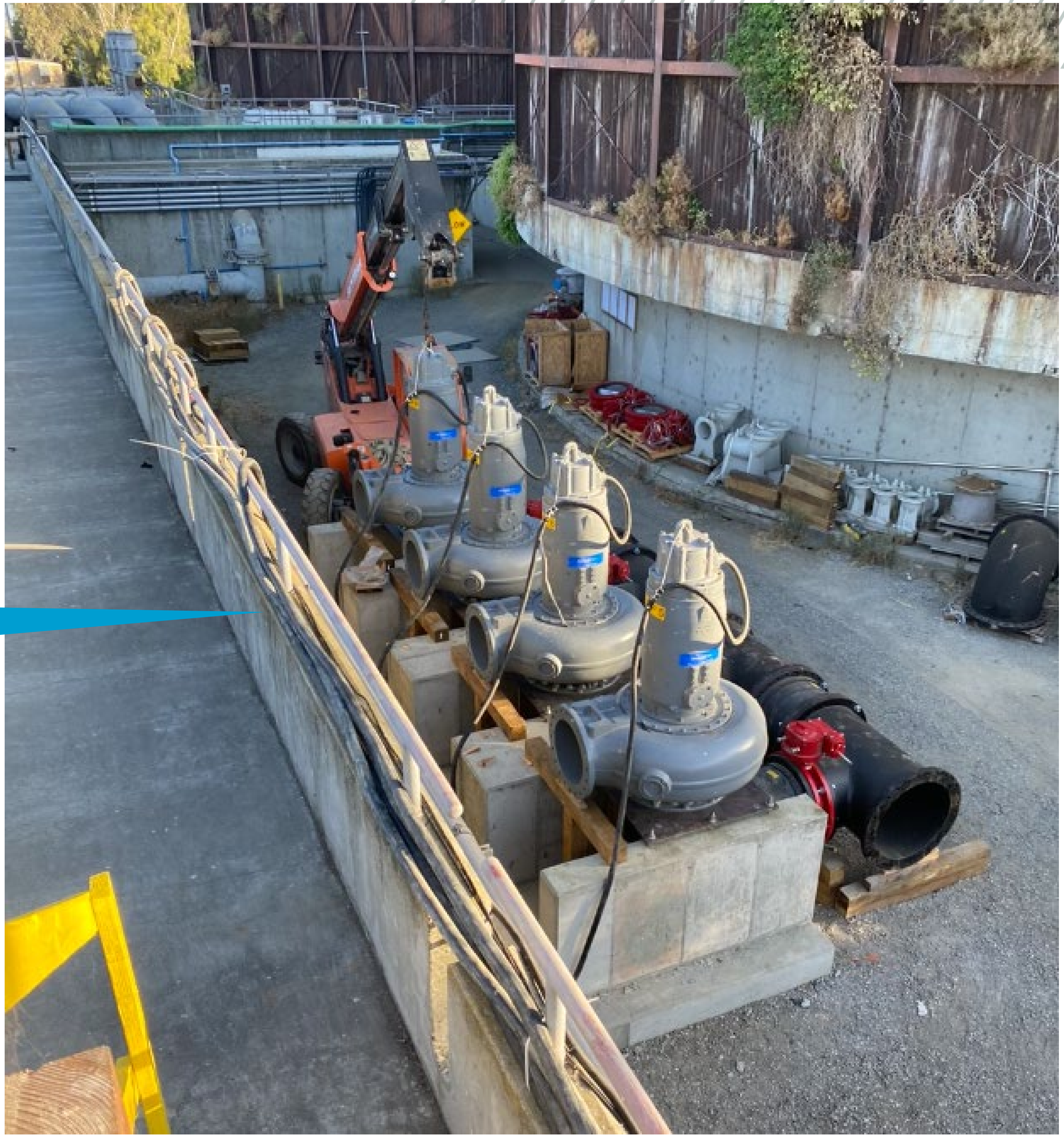
Temporary Bypass System

3+1 Temporary Bypass Pumping System

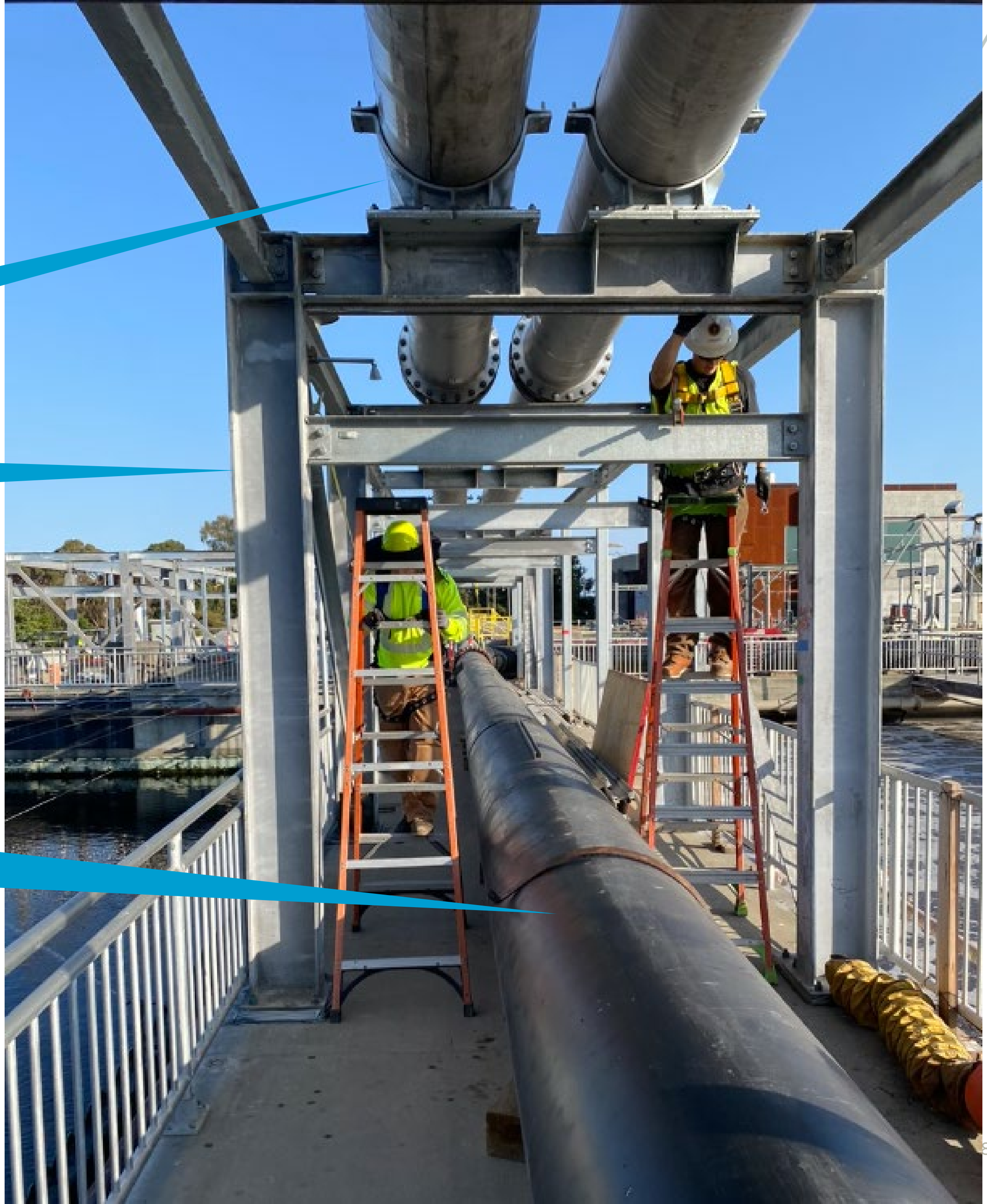


New Overhead Pipe Rack

New aeration piping

New Pipe Rack

Temporary Bypass Pipe




New aeration piping
New Serpentine Wall, Typ
New columns/beams

Temporary Blowers

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Project Team, Costs, & Financing

Design	**Brown and Caldwell**
Contractor	Anderson Pacific
Construction Manager	Carollo Engineers
Total Project Cost	**$193M**
Financing	SRF Loan with 0.8% interest rate

Project Timeline

Step	Timing
Design completion	Q3 2022
Bidding / Award	Q4 2022
Start Construction	Q1 2023
Complete Construction	Q2 2028

Key Takeaways

- MABR is a great technology for intensification retrofits
- Relatively easy phasing of MABR cassettes gives flexibility
- Dry weather capacity may drive the design, not always PWWF
- Plan next expansion before building

Thank you.

Questions?