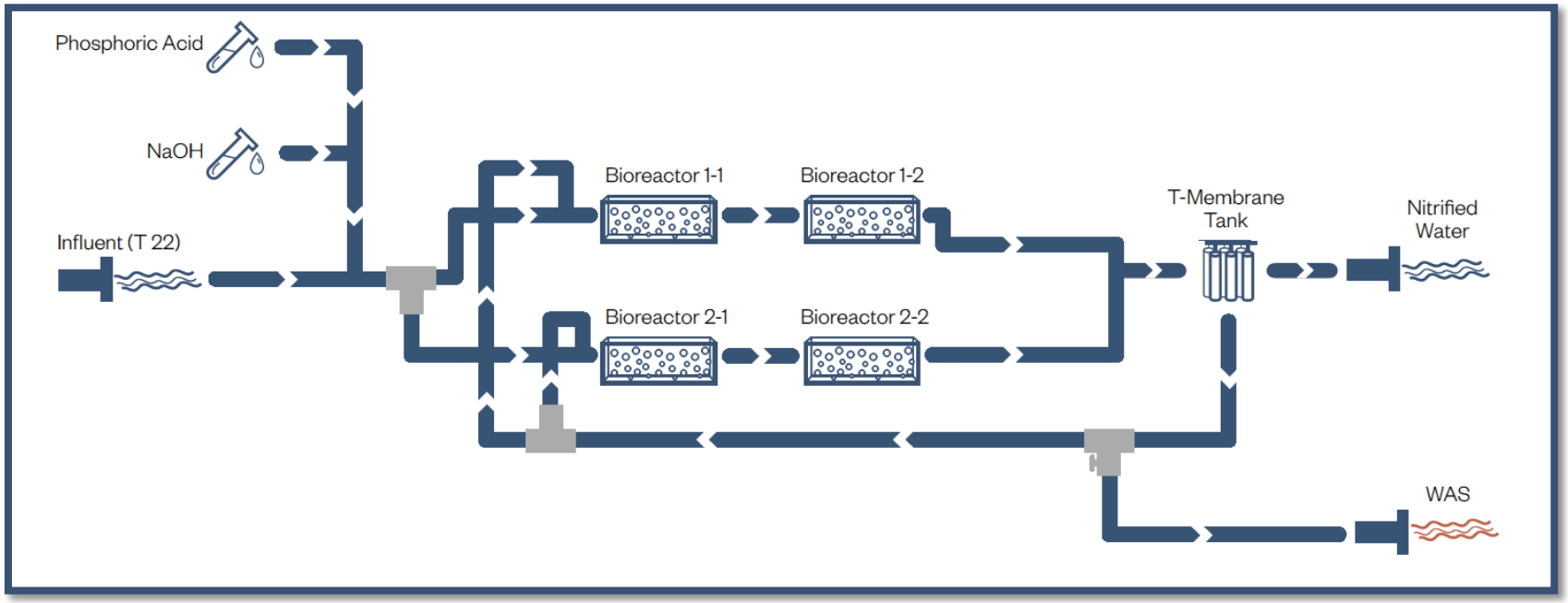
Hazen



Implementation of the Tertiary MBR to Meet Today's Industrial Water Demands and Solve Tomorrow's Reuse Challenges

2016 Arizona Water Reuse Symposium

Bryce Danker, P.E. Hazen and Sawyer

AZ Water Association
Professionals Dedicated To Arizona's Water

WateReuse Arizona

Overview

MBR Experience

MBR Evolution

Definitions

MBR Process

WBMWD Drivers

Project Progression

Designing for the Future with Operations in Mind

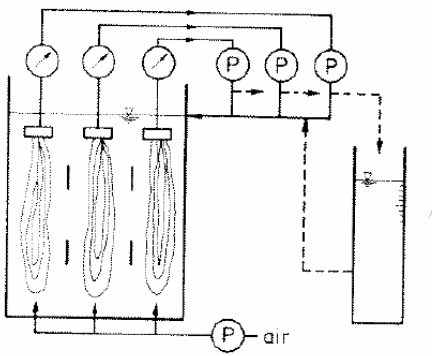
MBR Experience

- Hazen and Sawyer: 10+ Recent MBR Projects

- Personal MBR Experience:
  - Carson Tertiary MBR (TMBR)
    - MBR Operator and Field Engineer
    - Proof of Concept Pilot
    - Process Engineer on 2.0 MGD TMBR Design
  - Process Troubleshooting (Multiple Clients)
    - Biological process modeling/optimization
    - Foam control and mitigation

MBR Evolution

Yamamoto et al. 1989



K. Yamamoto, M. Hiasa, T. Mahmood and T. Matsuo, Direct solid liquid separation using hollow fiber membrane in an activated sludge aeration tank, Wat. Sci. Technol., 21 (1989) 43–54.

- Advances in Membranes
- Advances in Control
- Advances in Membrane Maintenance

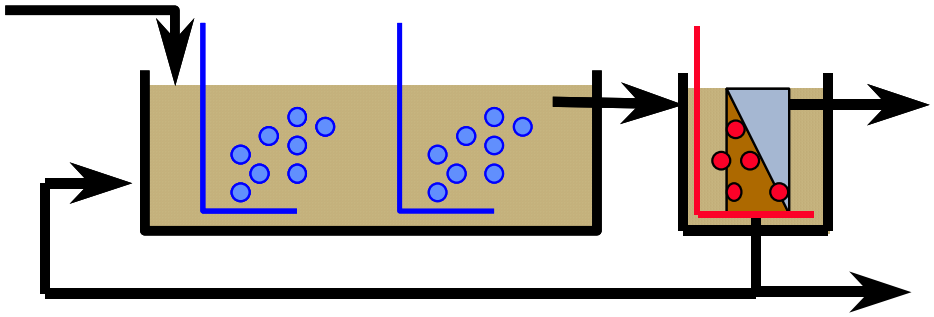
2016

Definitions

- Recovery – Permeate/Feed
- Flux – Throughput per membrane area.
  - Gallons per square foot per day (gfd)
- Air Scour – Aeration used to remove solids from membranes
- CIP – Clean In Place. Chemical cleaning of membranes in tank
- Backwash – Intermittent reverse flow to remove solids from membranes
- Enhanced Backwash – Reverse flow with brief chemical dosing used to increase CIP interval (Chemical Enhanced Backwash, Enhanced Flux Maintenance)

MBR and CAS Process

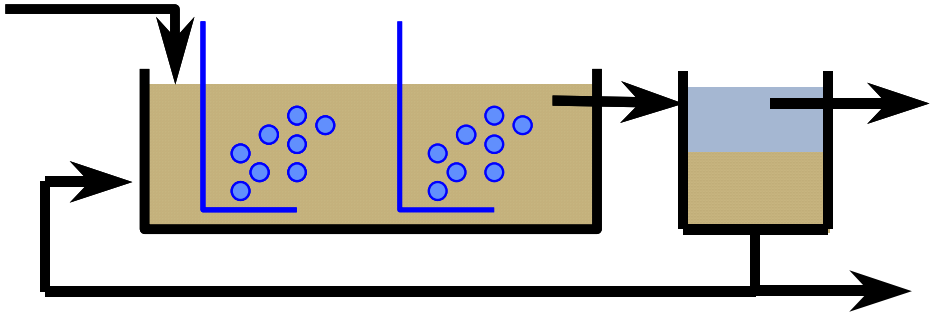
MBR



MLSS Conc.: 6 to 10 g/L

RAS Flow: 2-5 Q

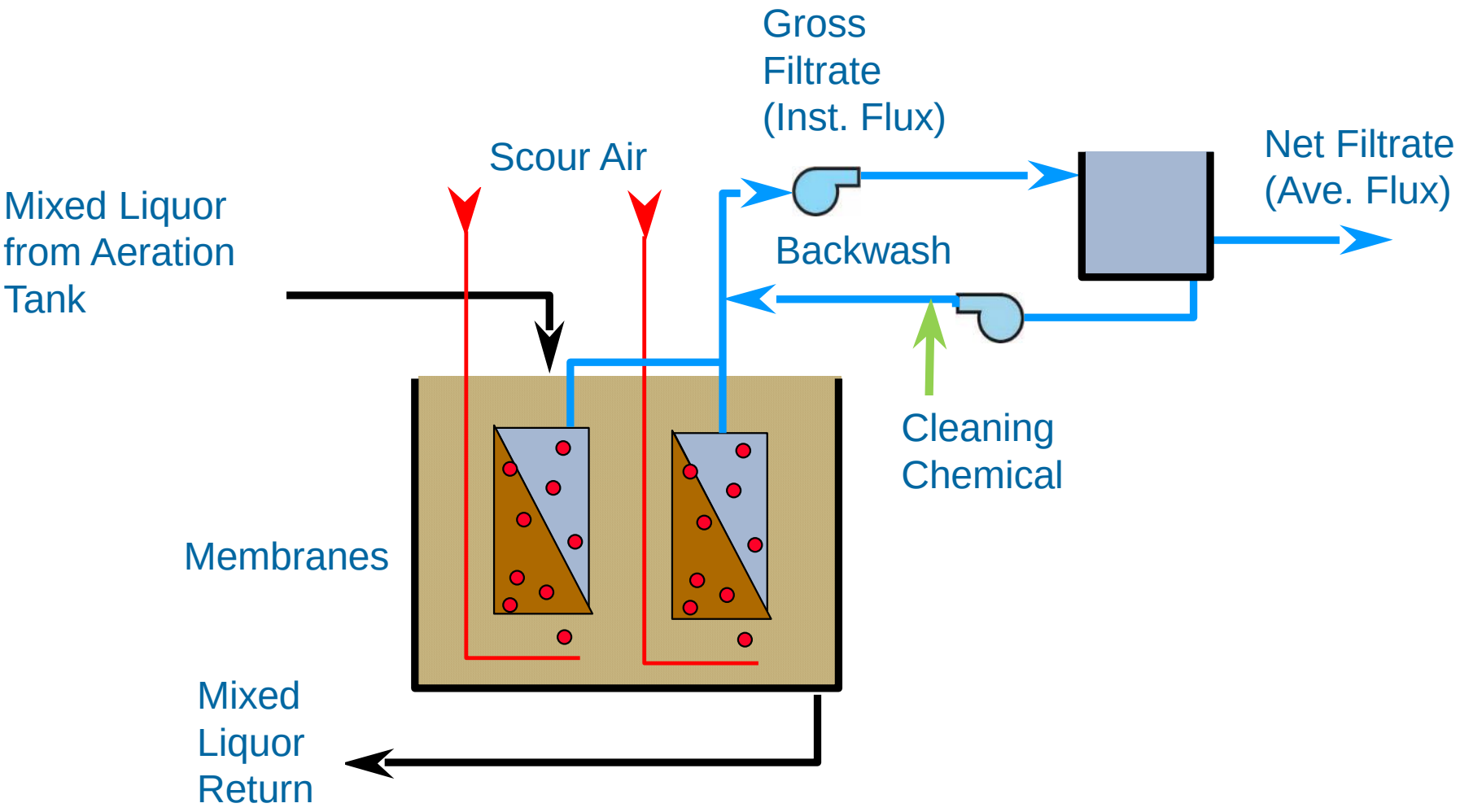
CAS



MLSS Conc.: 2 to 5 g/L

RAS Flow: 0.5 to 1 Q

MBR Process

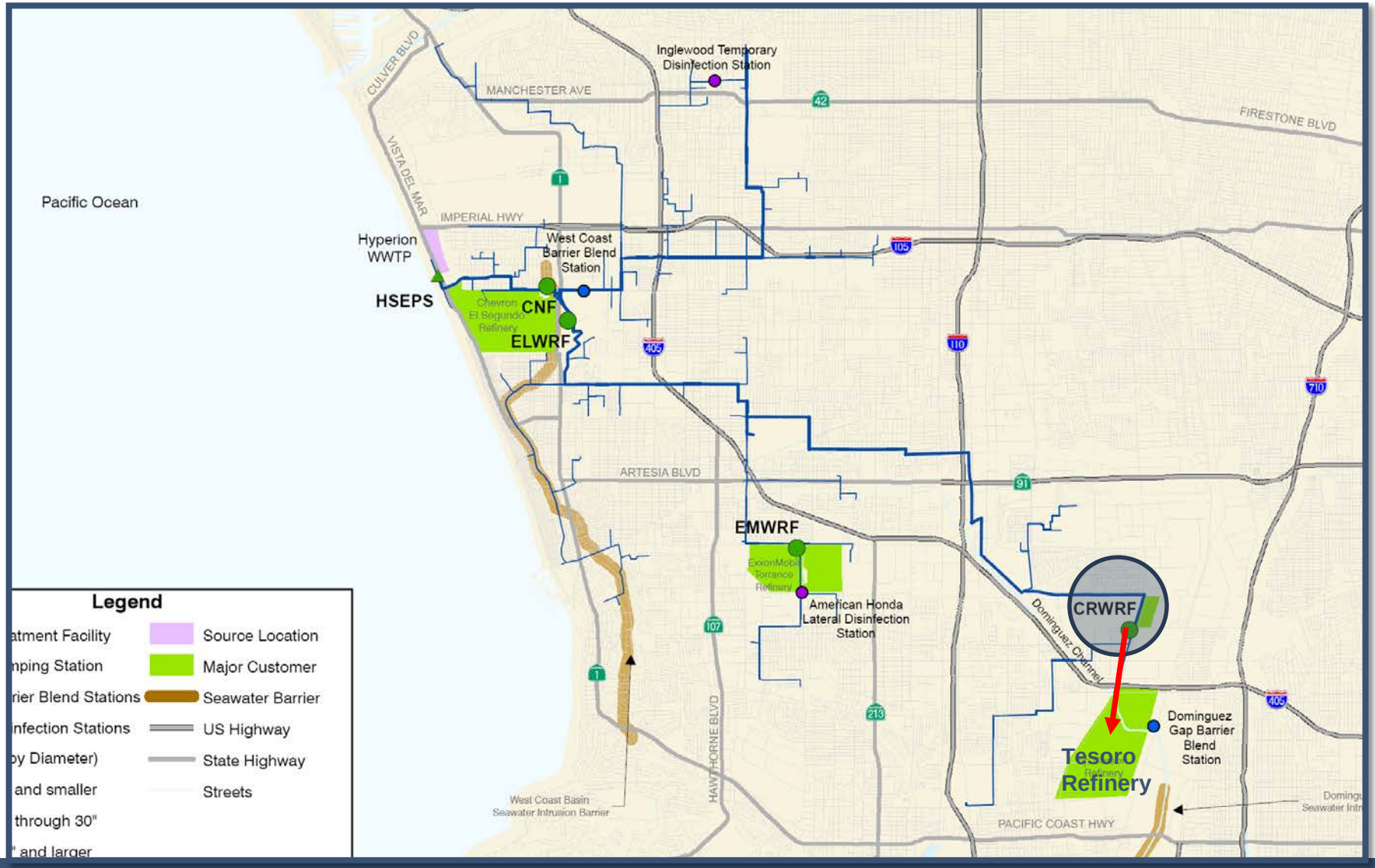

Gross
Filtrate
(Inst. Flux)
Scour Air
Net Filtrate
(Ave. Flux)
Mixed Liquor
from Aeration
Tank
Backwash
Cleaning
Chemical
Membranes
Mixed
Liquor
Return

West Basin Municipal Water District

Innovative District – Water and Recycled Water to 185 sq. mile service area (~1 M people)

Designer Water: Irrigation, Cooling Tower, Seawater Barrier and Groundwater Replenishment, Low and High Pressure Boiler Feed

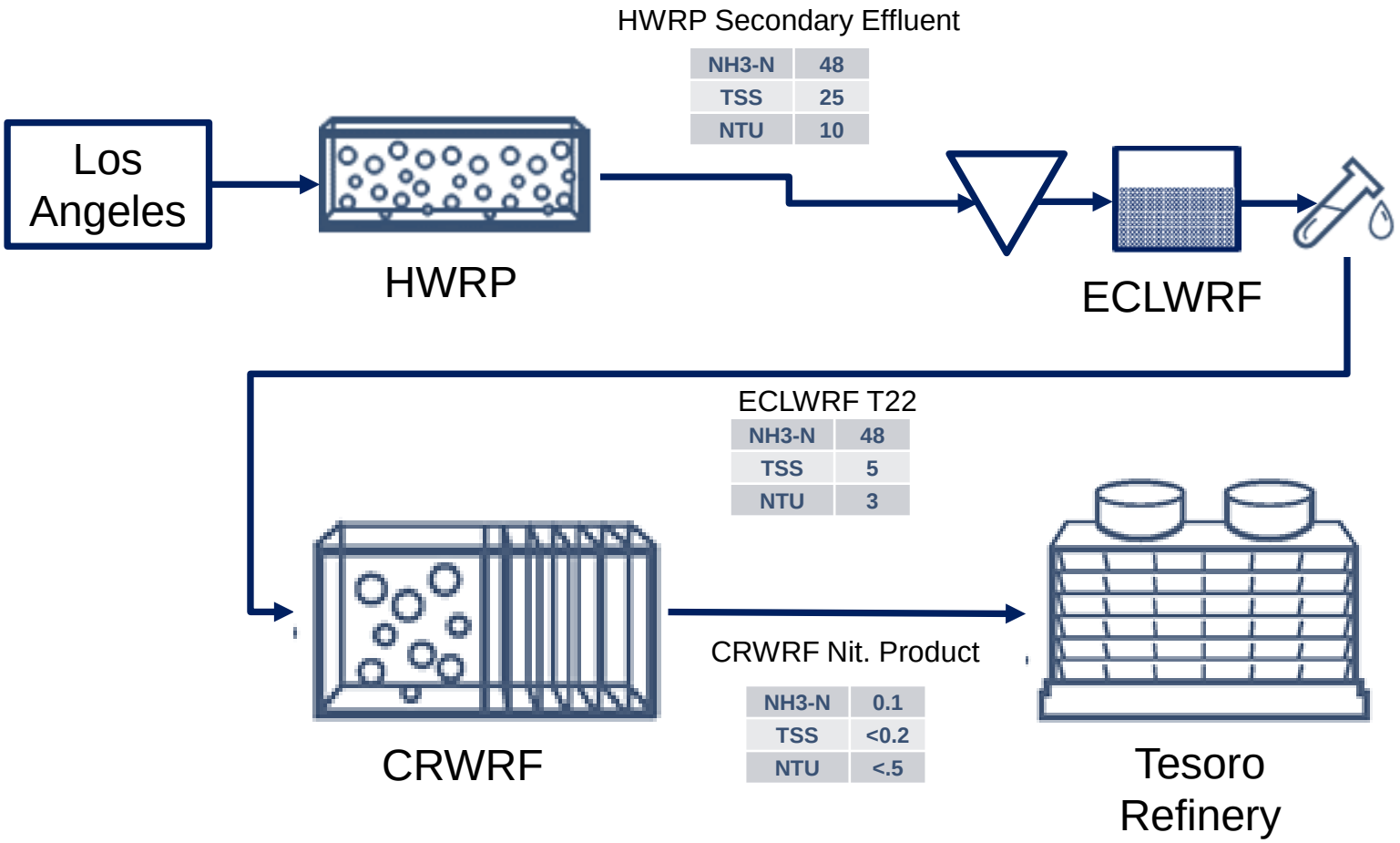
Project Drivers



Project Drivers

- Compact Footprint
- Adaptable and Robust treatment for Variable Influent Quality
- Submerged Membrane Filtration
- Excellent and Consistent Effluent Quality
- Easily Expandable Design
- High On-line Factor

Innovative Process – The Overall Flow Scheme

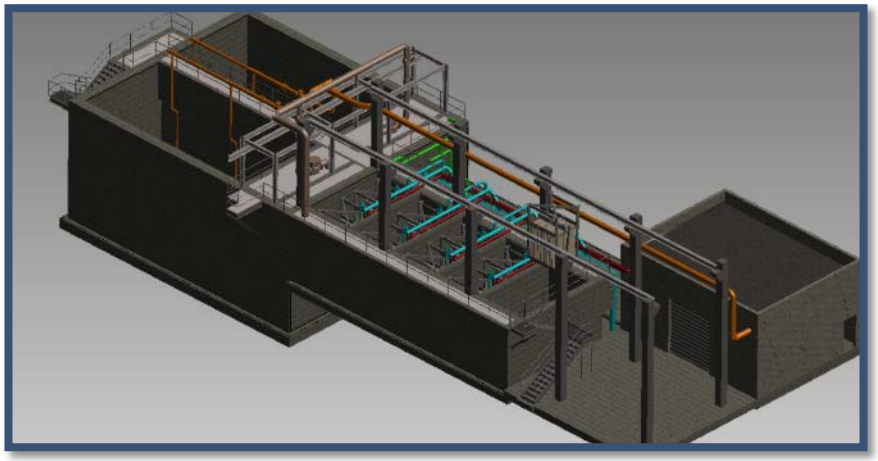


Project Progression

Technology Evaluation

Validation Pilot Testing

30% Design



60%,90%,100% Design

Construction – Startup – Implementation

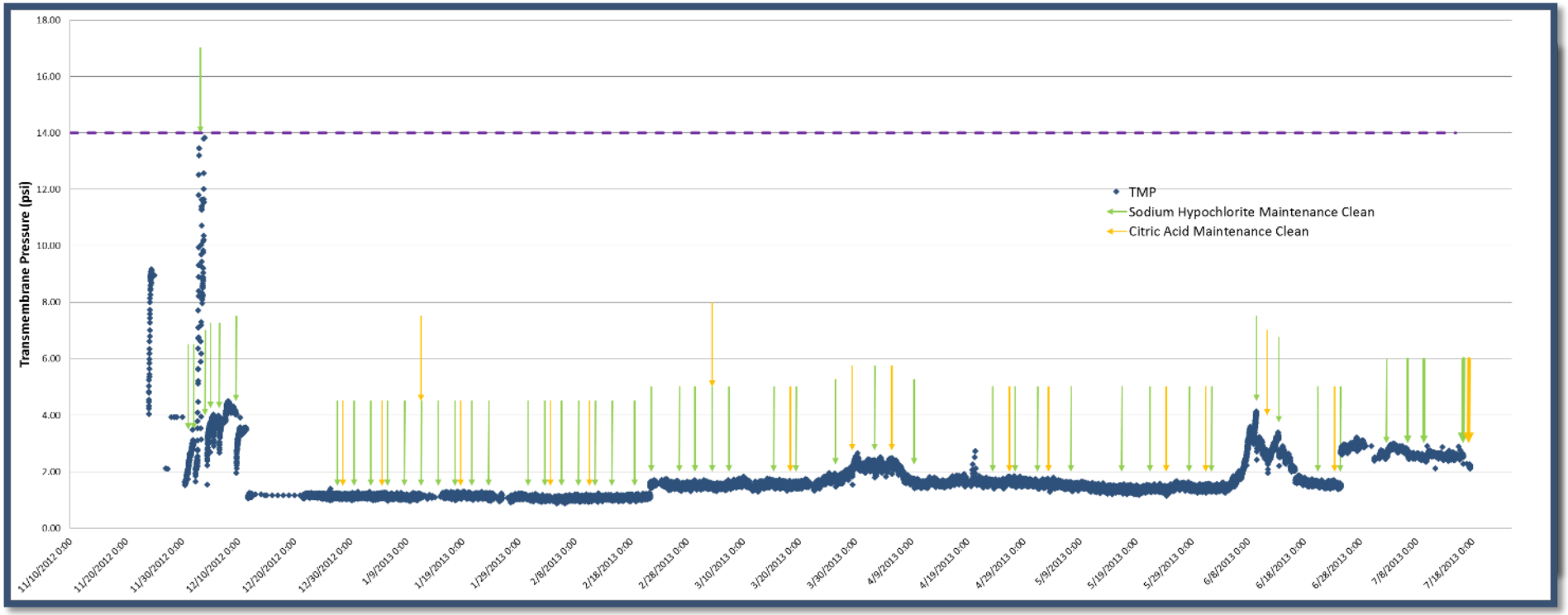
Technology Evaluation

- BAFs
- MBBR
- SBR
- TMBR

Project Progression - Piloting

- Proof of concept pilot
- Excellent robust performance
- Minor Pilot Challenges

Project Progression - Piloting

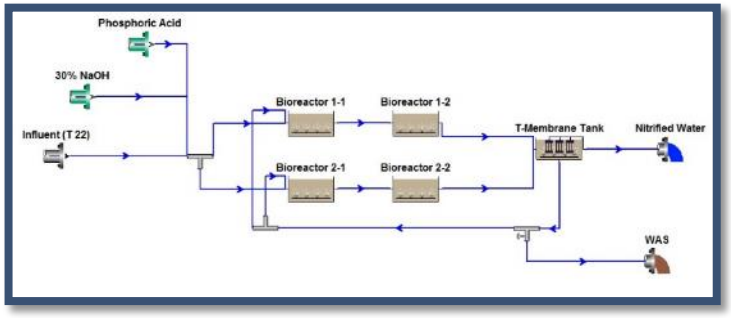


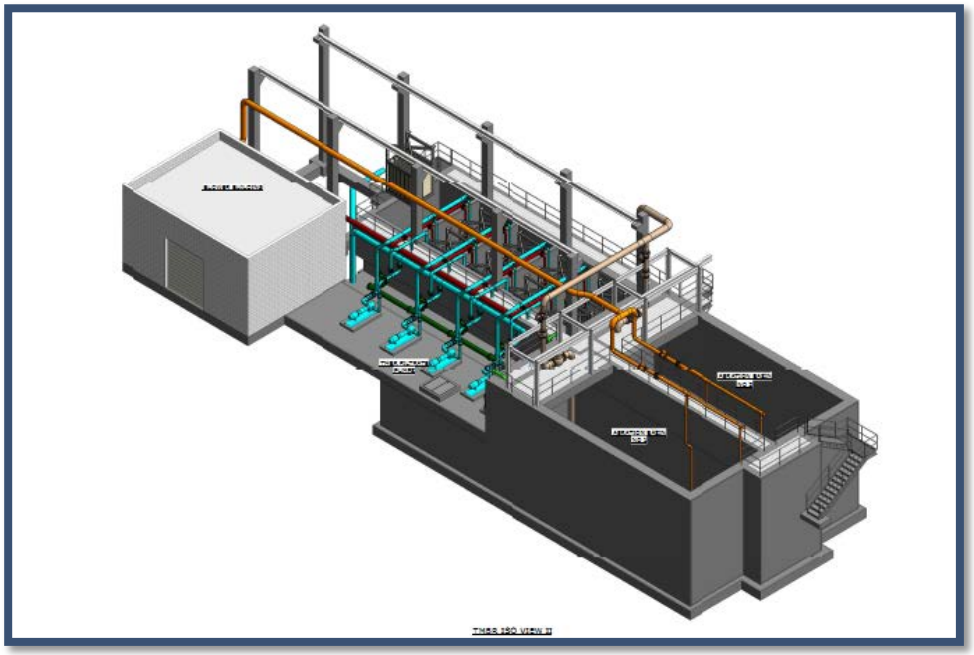
Piloting Progression – 30% Design

- Reviewed Multiple Capacity Options
  - Partial or Complete MF Replacement
  - 2 – 3 mgd TMBR
  - Potential Biofor build out
- Developed 30% PDR and Cost Estimate
- Laid foundation for current project

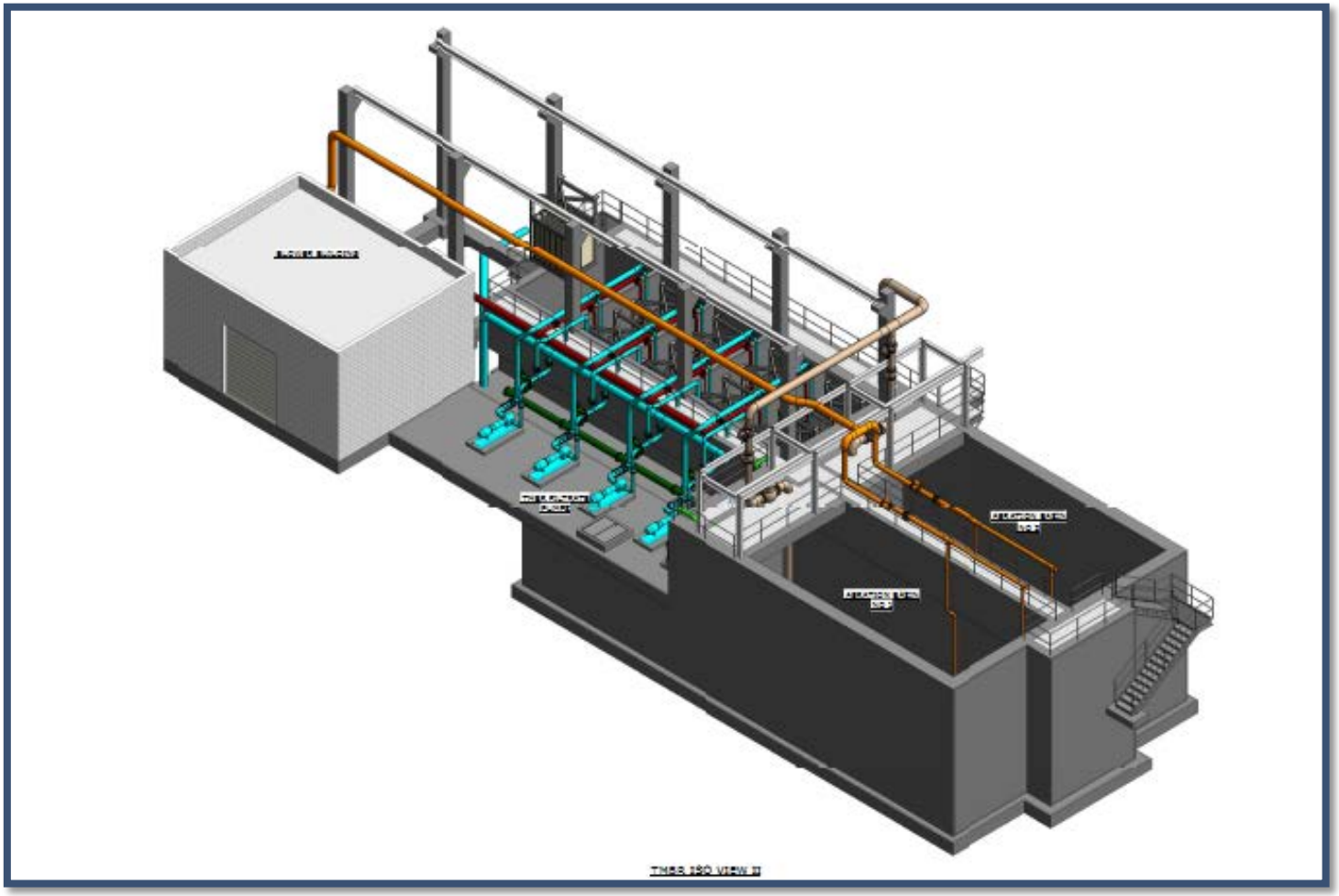
Project Progression – 60% Design

- Builds upon 30% design
- Independent review and improvement of design
- 2nd Piloting Round – Operator Training

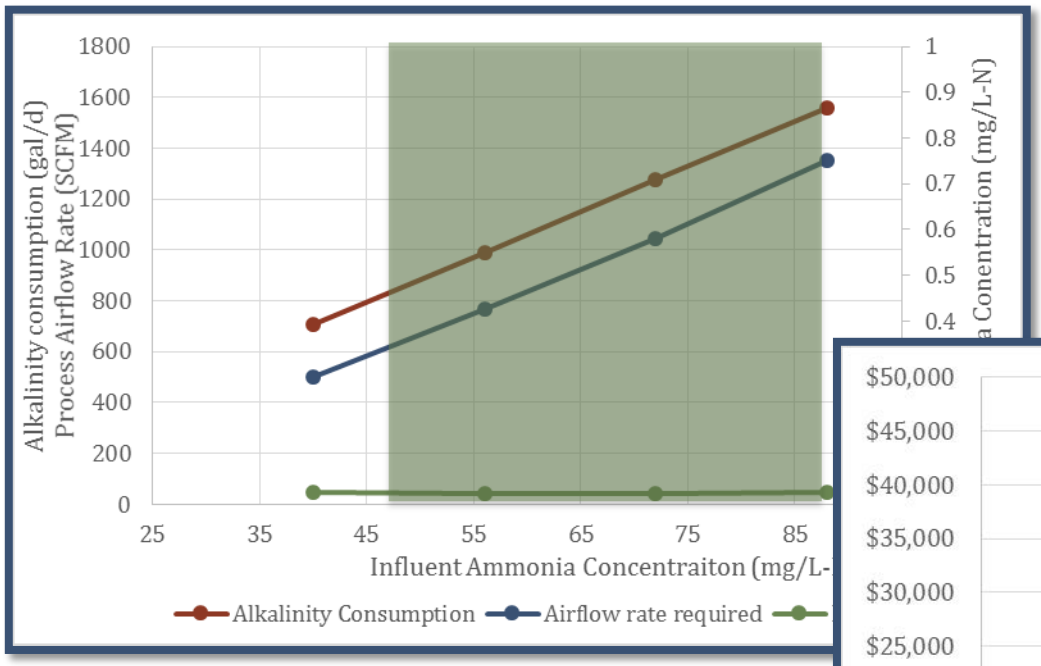


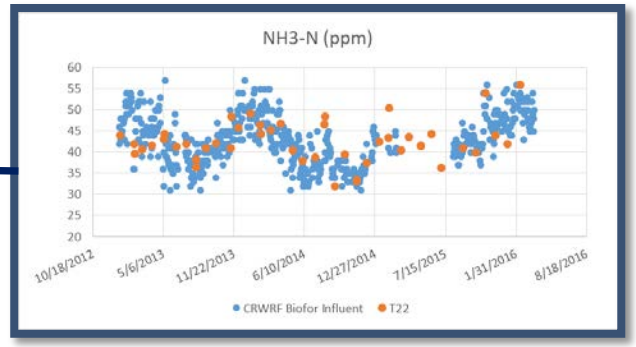


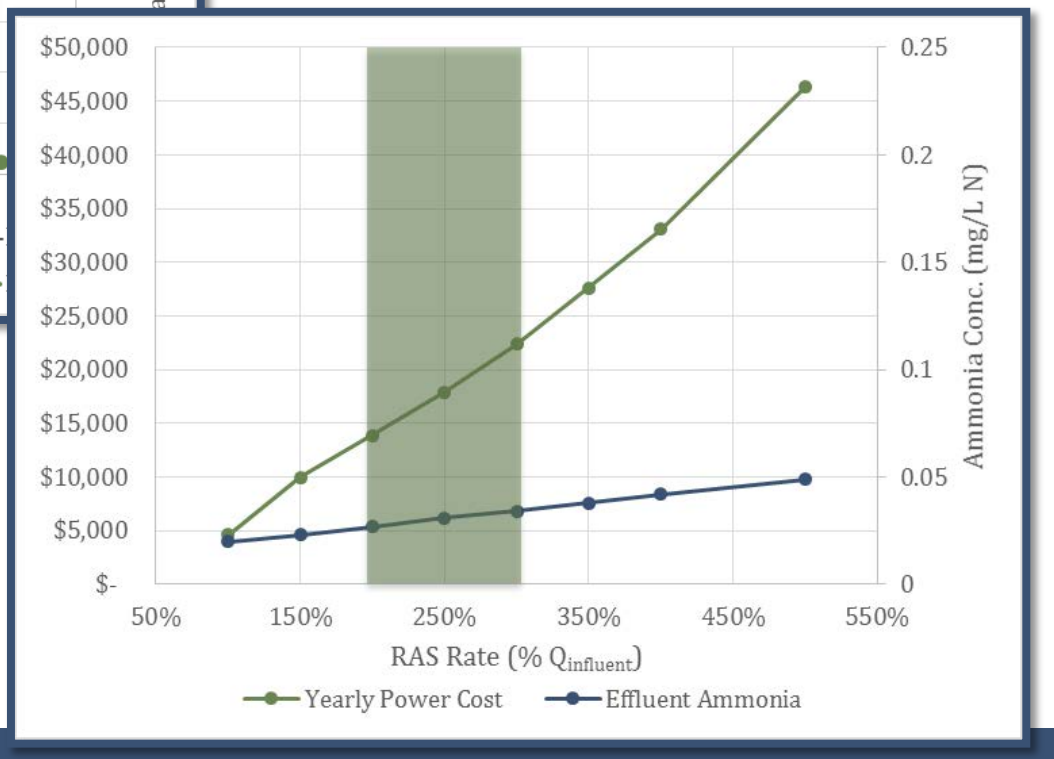
Project Progression – 60% Design



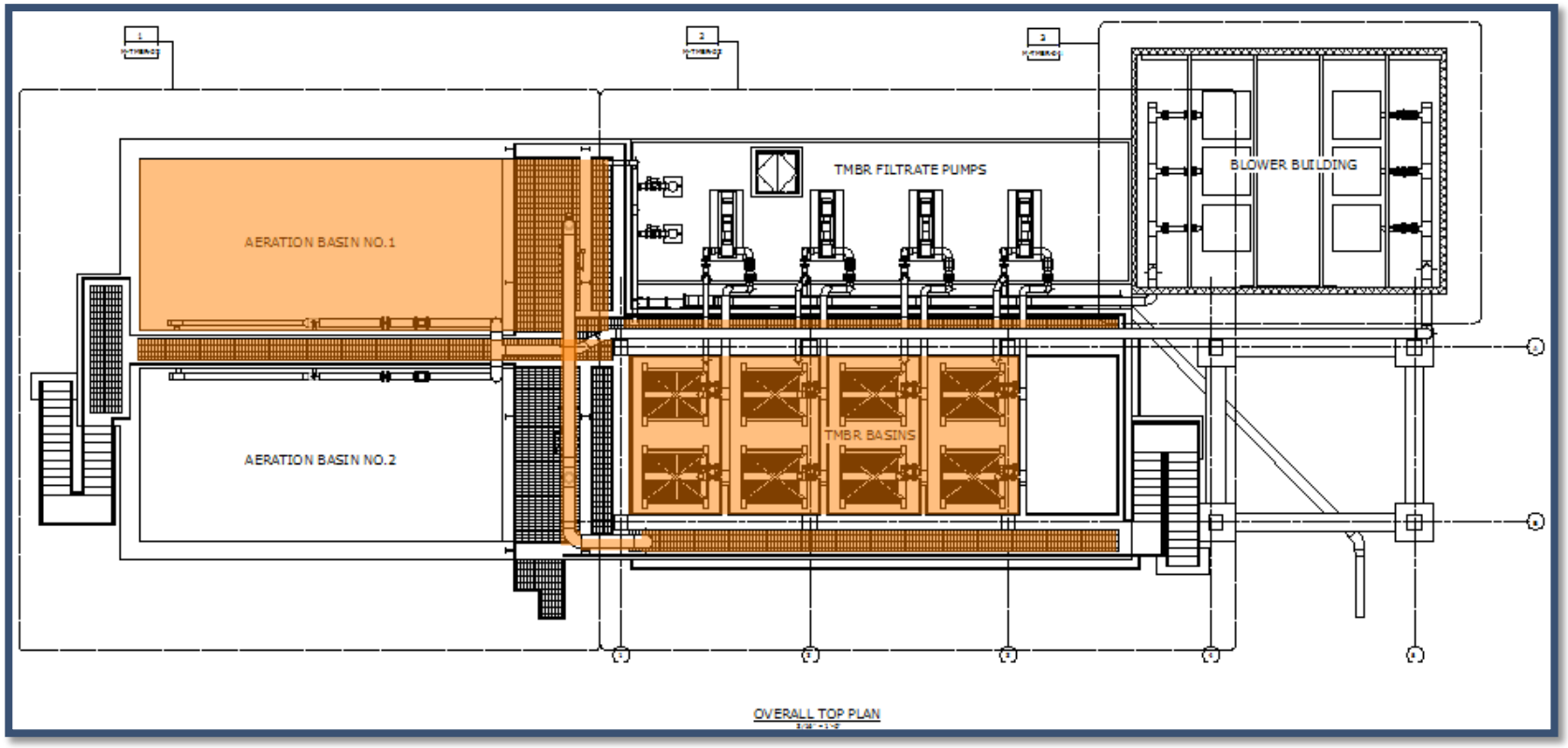
Designing for Today and the Future



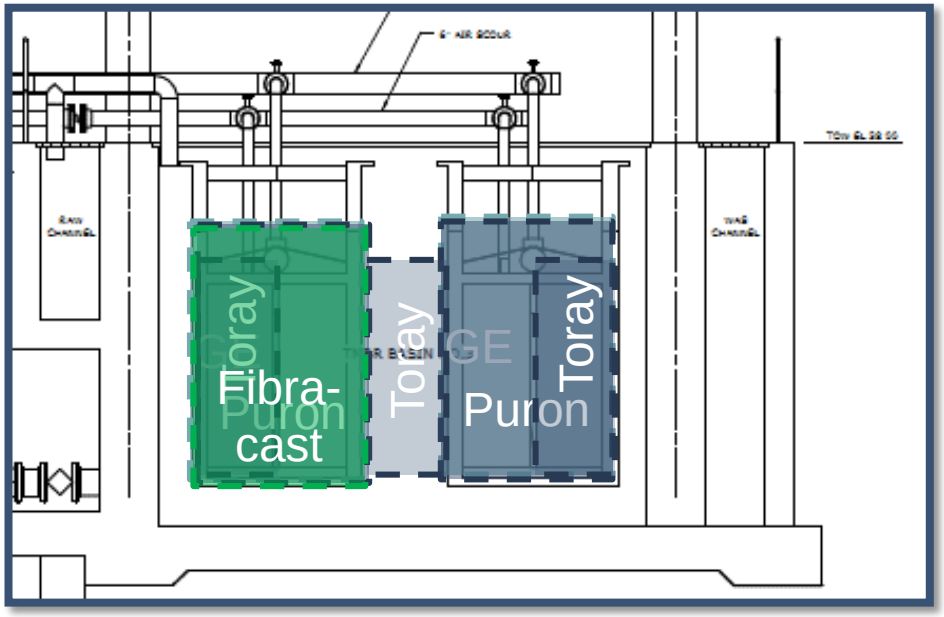




Designing for Today and the Future



Designing for Today and the Future



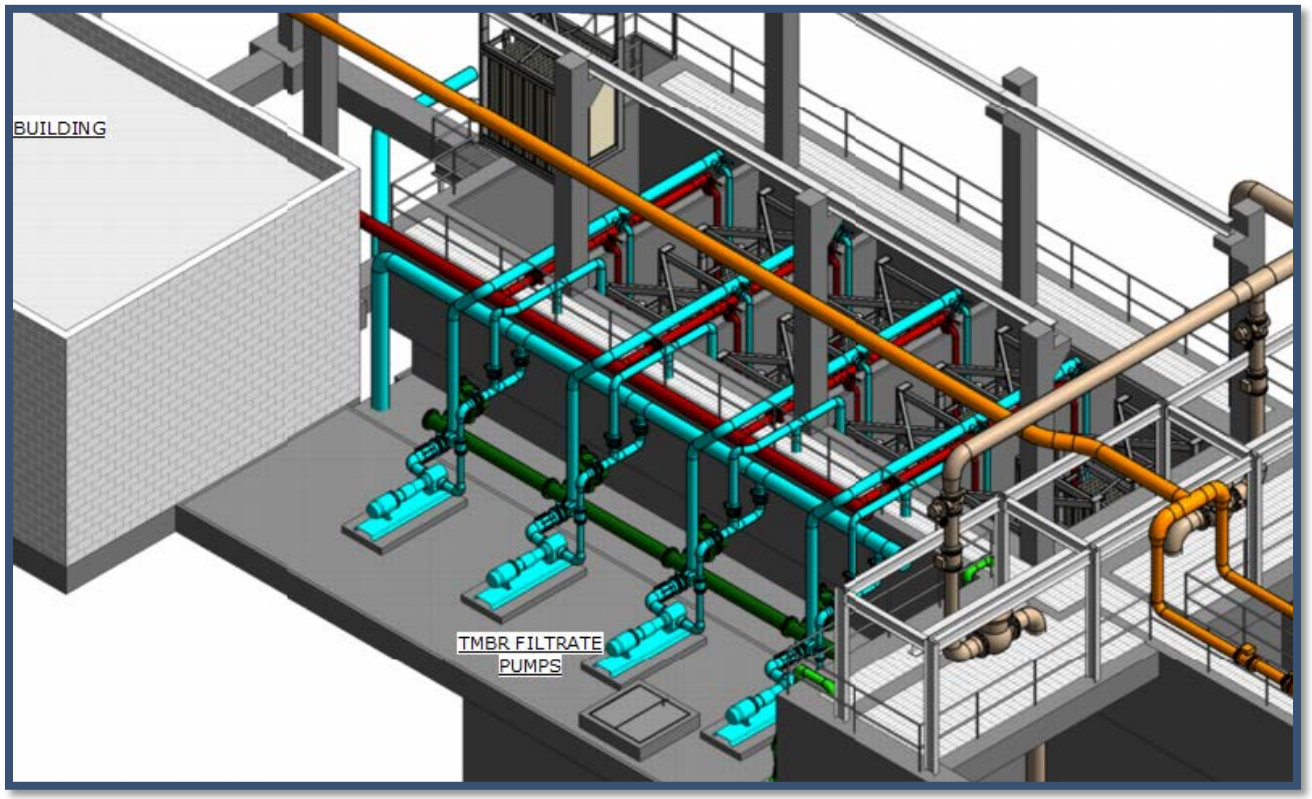
Multiple Membrane Systems on Open MBR Rack

- Open membrane system approach
- Provides district flexibility for future installations
- Tankage and support equipment designed to suit multiple vendors

Designing for Today and the Future

- In place Clean Water Flux

Flexible System (blowers and chem addition



Project Progression – 90% and 100% Design

- Finalize Design
- Membrane Pre-Selection
- Potentially Pilot Selected Membrane

Project Progression – Construction and Startup

- MOPO incorporated into design

- Key to maintain plant production during startup and testing

Key Advantages Recap

- Superior Water Quality
  - Cooling Tower Feed – no ammonia or particulates
  - Boiler Feed – suitable for feed to RO
- Robust Treatment of Variable Influent
- Designed with Operations in Mind

Acknowledgements

- Kevin Alexander – Hazen and Sawyer
- Buddy Boysen – Hazen and Sawyer
- Brad Reisinger – Hazen and Sawyer
- Troy Walker – Hazen and Sawyer
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- Eric Owens– West Basin Municipal Water District

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