Board of Directors Workshop on Engineering, Operations & Technology Committee

Assessment of Implementation Strategies for Direct Potable Reuse

Item 5a

July 28, 2026

Presented by: Gloria Lai-Blüml, Matt Hacker, Monica Tirtadidjaja, Rajen Budhia, and Elisa Mendez

Item 5a
Assessment of DPR Implementation Strategies

Subject

Assessment of Direct Potable Reuse (DPR) Implementation Strategies for Pure Water Southern California (PWSC)

Purpose

Provide preliminary assessment of DPR alternatives

Next Steps

Seek board approval of CM/GC contract for DPR Demonstration Facility; conduct additional testing and studies to refine DPR implementation strategy for PWSC

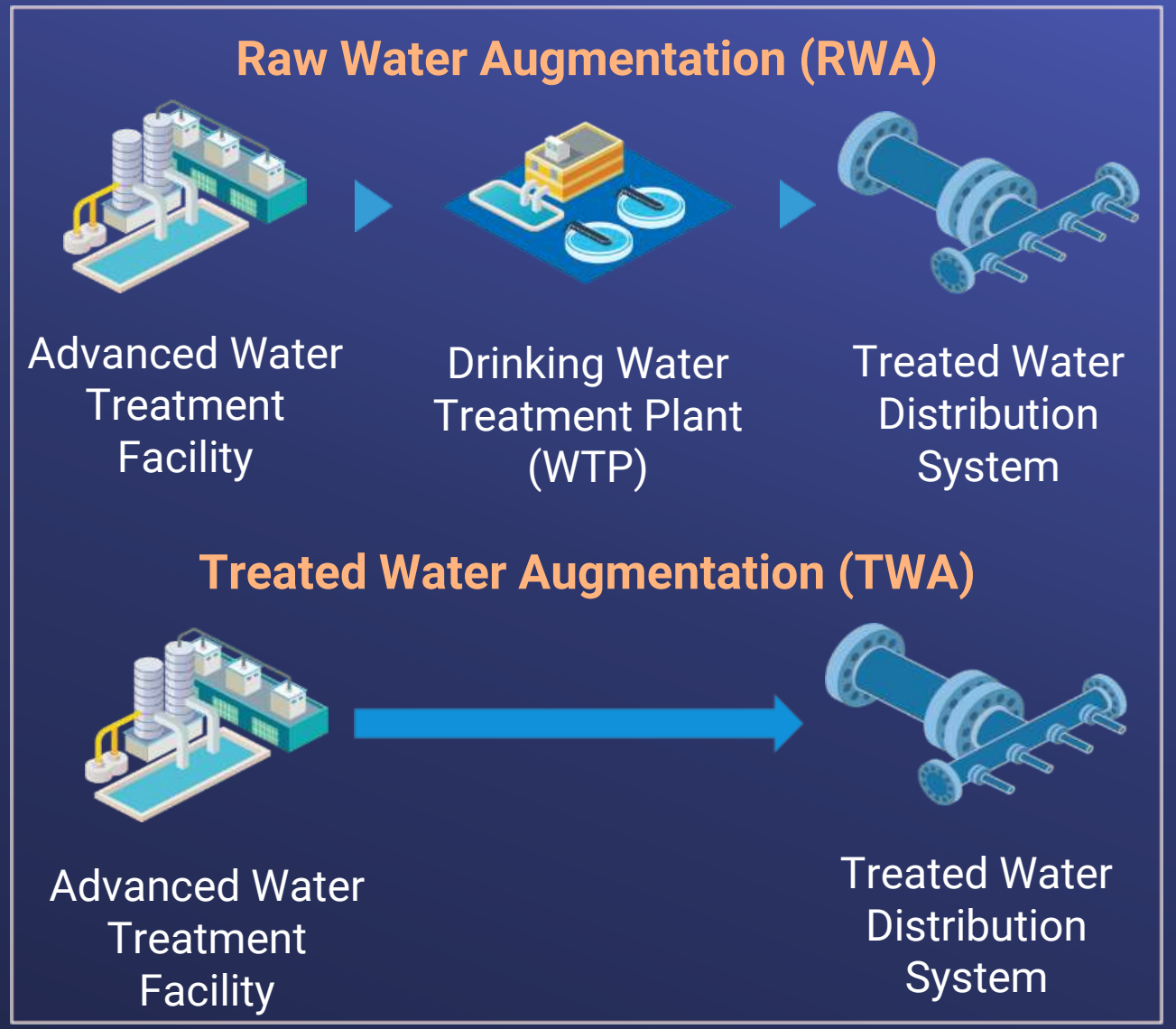
Assessment of DPR Implementation Strategies

Workshop Agenda

- Introduction
- Water Quality Considerations
- Demonstration Facility
- Direct Potable Reuse (DPR) Demand Projections
- Potential Implementation Scenarios
- Public Outreach/Acceptance
- Summary of Key Findings

Workshop Goals

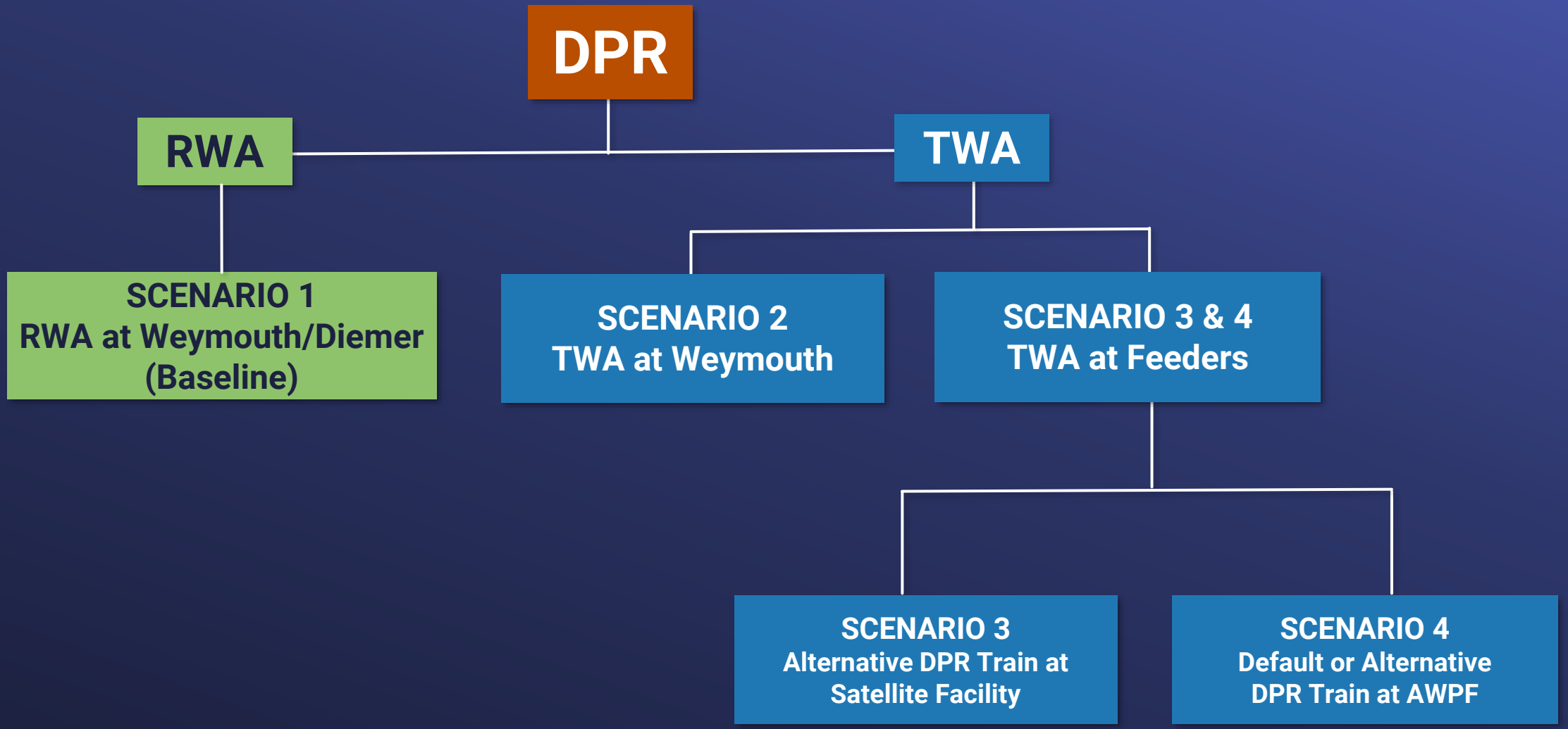
- Provide update on DPR Planning for Pure Water Southern California (PWSC)
  - RWA & TWA opportunities
  - Key findings
  - Future study needs
- Address Board's Questions on TWA



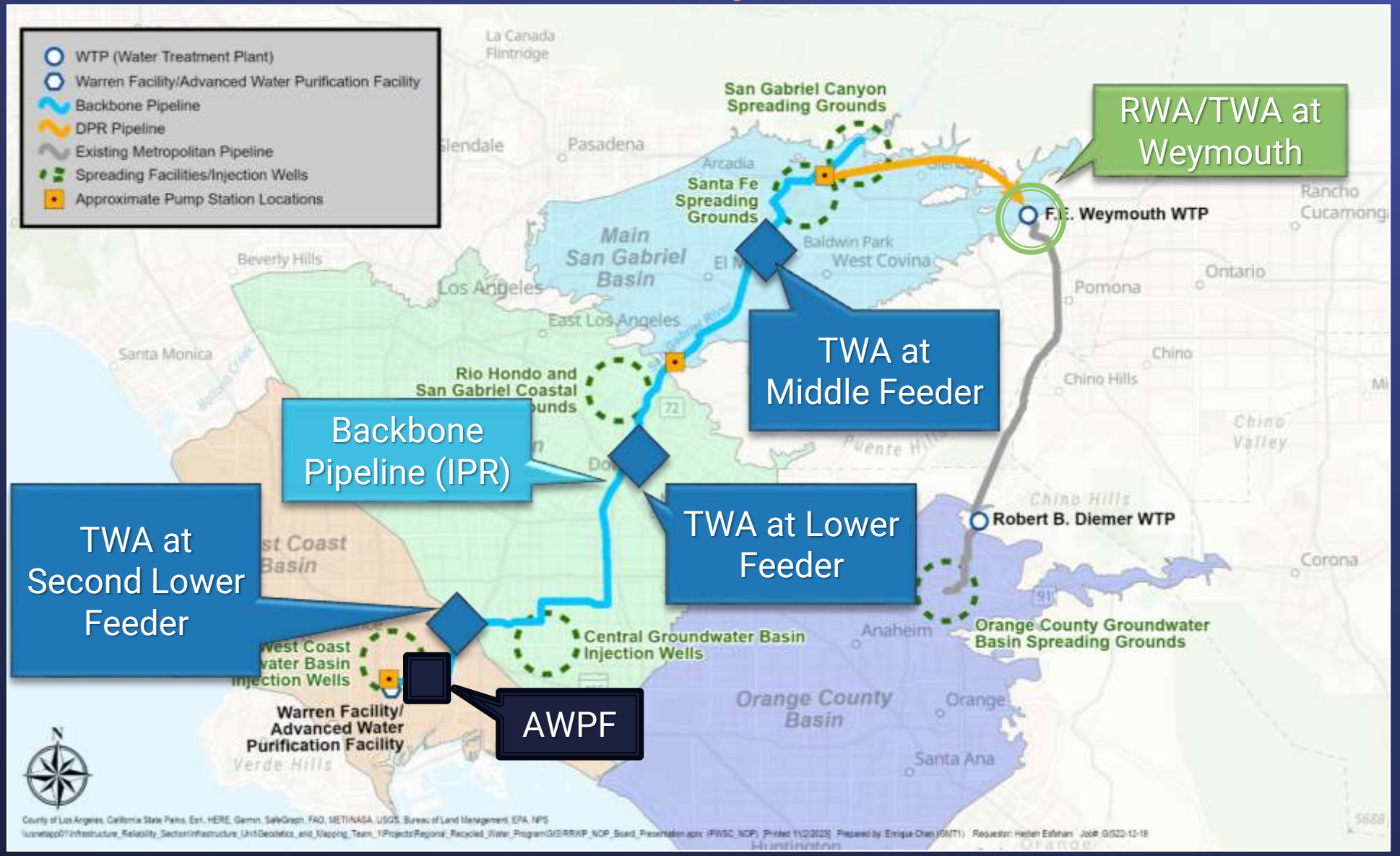
Prior Board Questions on Treated Water Augmentation (TWA)

- Can PWSC costs be reduced via TWA with downsized backbone conveyance, or elimination of pipeline to Weymouth?
- How much TWA production is feasible for PWSC?
- Can PWSC provide all needed treatment at the Advanced Water Purification Facility (AWPF) for reuse in the Central Pool?
- What are the water quality considerations to be addressed?

Potential DPR Implementation Scenarios for PWSC

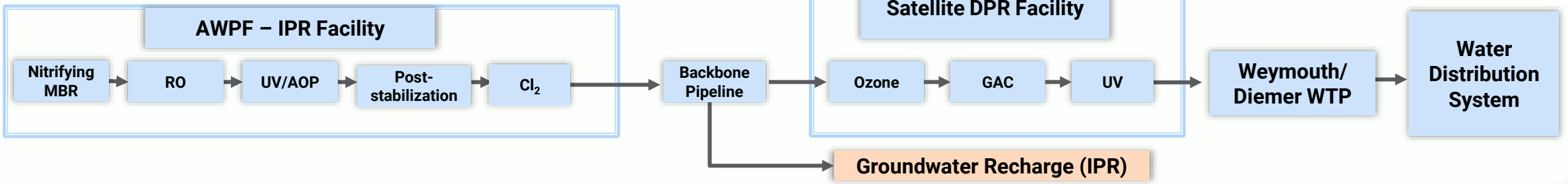


Overview of Potential DPR Pathways for PWSC

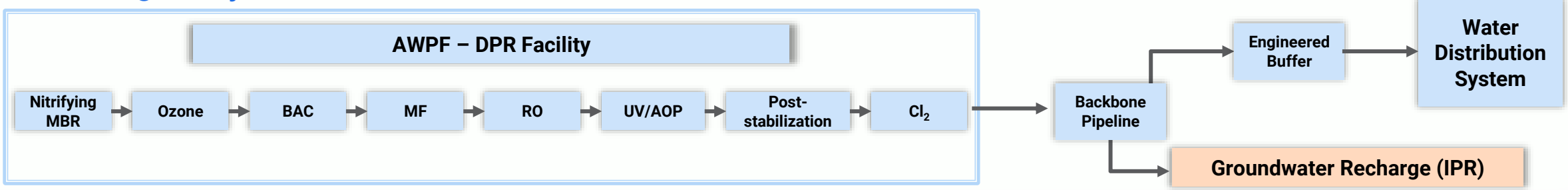


Potential DPR Treatment Approaches for PWSC

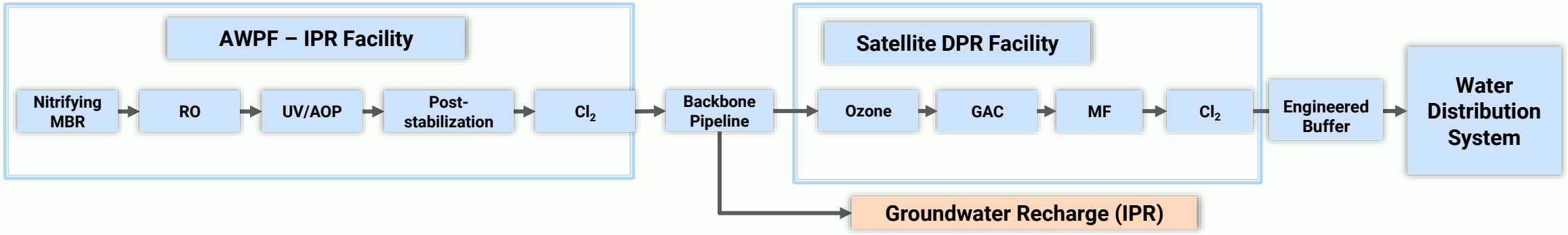
RWA – Alternative Treatment Train



TWA – Regulatory Default Treatment Train



TWA - Alternative Treatment Train



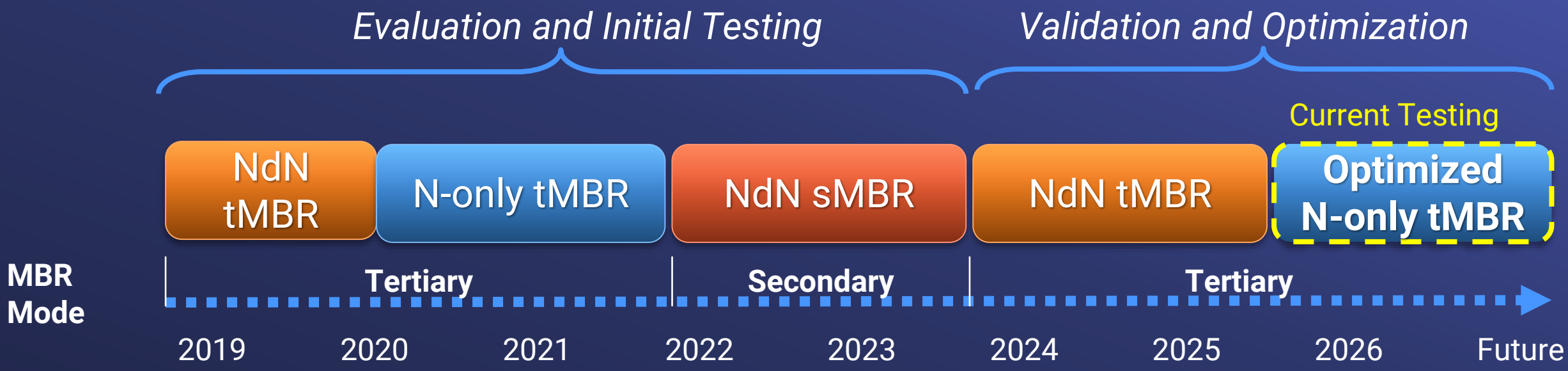
Assessment of DPR Implementation Strategies

Analysis Assumptions

- Ultimate PWSC buildout of 150 MGD
- IPR deliveries are a program priority
- Pure water deliveries to Weymouth (via RWA & TWA) limited to 60 MGD
- Consider both RWA & TWA opportunities
- Use ‘RWA at Weymouth/Diemer’ as baseline
- Target 92 percent online factor for water production
- Use rough-order-of-magnitude (ROM) costs relative to baseline for cost comparison
- Establish water quality targets for nitrate
- Provide initial assessment

Water Quality Considerations

Indirect Potable Reuse Demonstration Testing



NdN: Nitrifying-denitrifying
N-Only: Nitrifying-only

Direct Potable Reuse Regulations (2024)

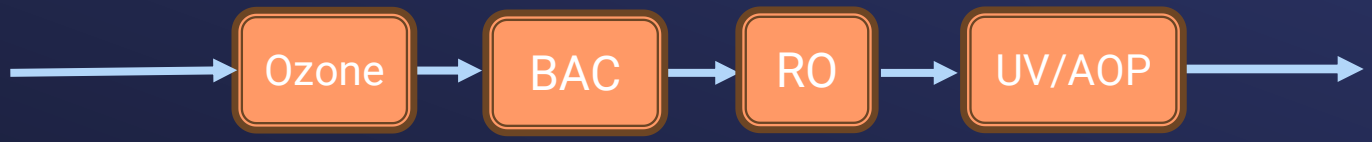
Multiple Barrier Approach

Pathogen Removal

Source Water	LRV Requirements		
	Virus	Giardia	Cryptosporidium
Surface Water	4	3	2
IPR Water	12	10	10
DPR Water	20	14	15

Chemical Control

- Default DPR treatment train:

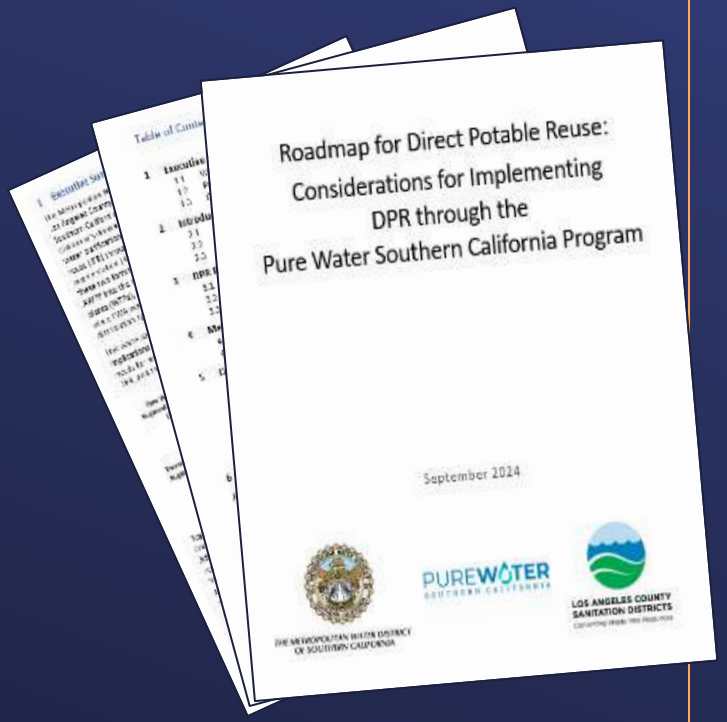


- Alternative treatment trains may be permitted if they provide equivalent public health protection

Operational and Monitoring Requirements

- Comprehensive source control program
- Robust monitoring and response systems
- Corrosion control and stabilization
- Establishment of Independent Science Advisory Panel

Roadmap for Direct Potable Reuse



Key considerations on implementation approach for DPR through raw water and treated water augmentation

- Presented to Metropolitan's Board in September 2024
- Topics covered
  - Evolution of DPR within the PWSC program
  - Regulatory requirements and implications
  - Metropolitan's overall research approach
  - Benefits and challenges of DPR
  - Next steps and research recommendations

Benefits of RWA and TWA

Raw Water Augmentation

- ✓ Serves a broader service area, resulting in more consistent water quality and regional reduction to constituents (e.g., TDS)
- ✓ Capitalizes on additional conveyance detention time and treatment barriers, and optimal hydraulic distribution and blending
- ✓ Minimal operational impact on existing treated water distribution system

Advanced Water Treatment Facility → Drinking Water Treatment Plant → Treated Water Distribution System

Treated Water Augmentation

- ✓ Potential for reduced conveyance infrastructure and pumping energy
- ✓ Eliminates the need to assess blending impacts on existing WTPs
- ✓ Reduces DPR-related changes to WTP monitoring, reporting, and operational plans

Advanced Water Treatment Facility → Treated Water Distribution System

DPR Planning and Testing Approach

Ozone pilot-scale testing

Oxidation Demonstration Project

Ozone retrofit of treatment plants

Workshops
Formulate process trains

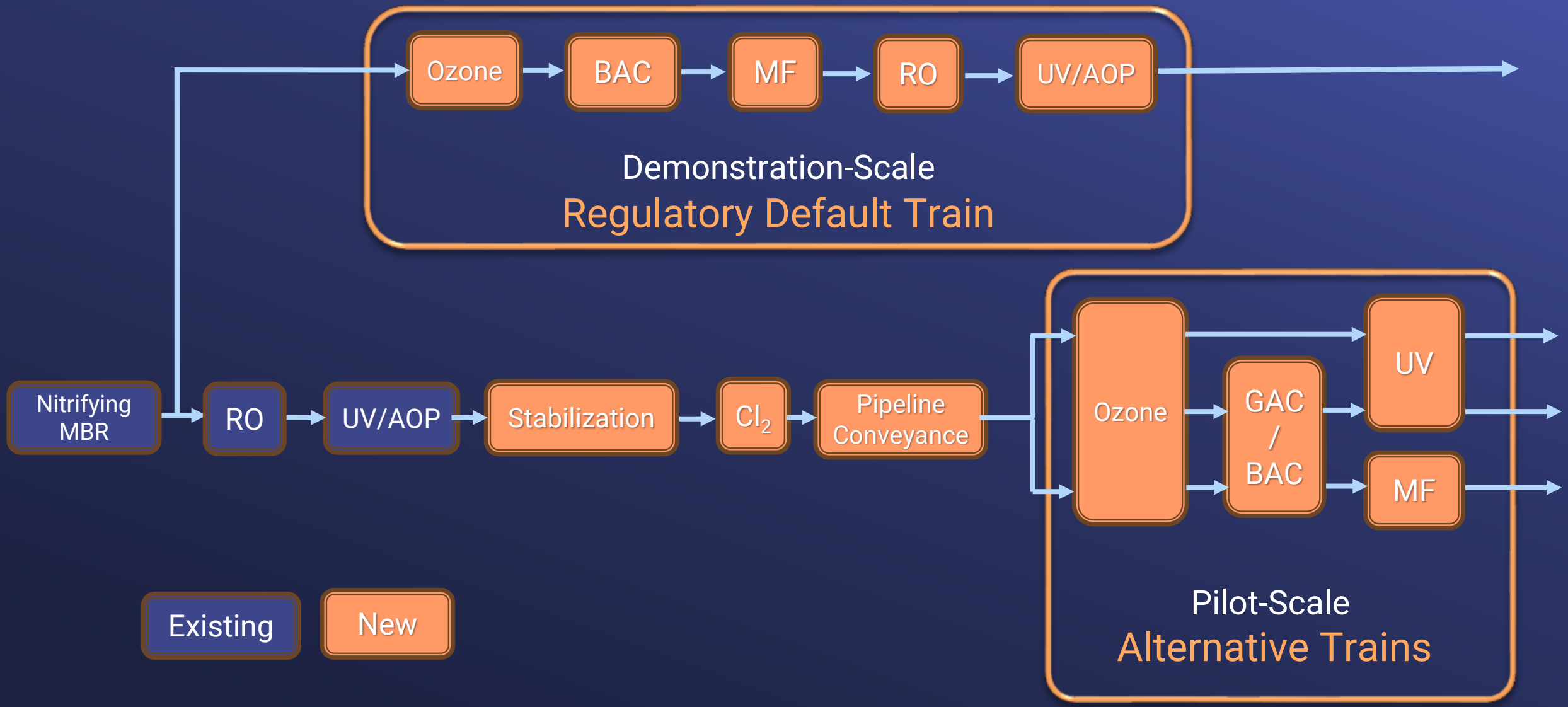
Literature Reviews
Identify key knowledge gaps

Bench-Scale Testing
Perform screening studies

Pilot & Demonstration Testing
Validate and assess long-term performance

- DPR research will be similar to prior Metropolitan programs to investigate alternative treatment processes
  - Extensive bench-, pilot-, and demonstration-scale research on ozone prior to phased implementation
- Build upon IPR research which began in 2010 and demonstration testing which started in 2019

DPR Testing Process Flow Diagram



Supporting DPR Implementation Decisions Through Testing

Key Objective

DPR alternative treatment equivalency validation – Demonstrate equivalent public health protection and operational reliability

Additional Supporting Studies

- Corrosion and Metal Mobilization
- Chemical Peak Dilution Modeling
- Emerging Contaminants
- Impact on Water Quality Aesthetics

Ongoing Stakeholder and Regulatory Engagement

- Ongoing coordination and collaboration with Sanitation Districts
- Continued engagement with Independent Science Advisory Panel
- Coordination with Division of Drinking Water early in program planning
- Knowledge sharing through industry organizations (WateReuse, AWWA, WRF)
- Active collaboration with other CA reuse programs – sharing lessons learned and regulatory pathways

siliconvalley ADVANCED WATER PURIFICATION CENTER

PURE WATER PROJECT LAS VIRGENES-TRIUNFO
Bringing Our Water Full Circle

WRD WATER REPLENISHMENT DISTRICT | ALBERT ROBLES CENTER

SD Pure Water San Diego

PURE WATER LOS ANGELES

Monterey One Water

ORANGE COUNTY WATER DISTRICT

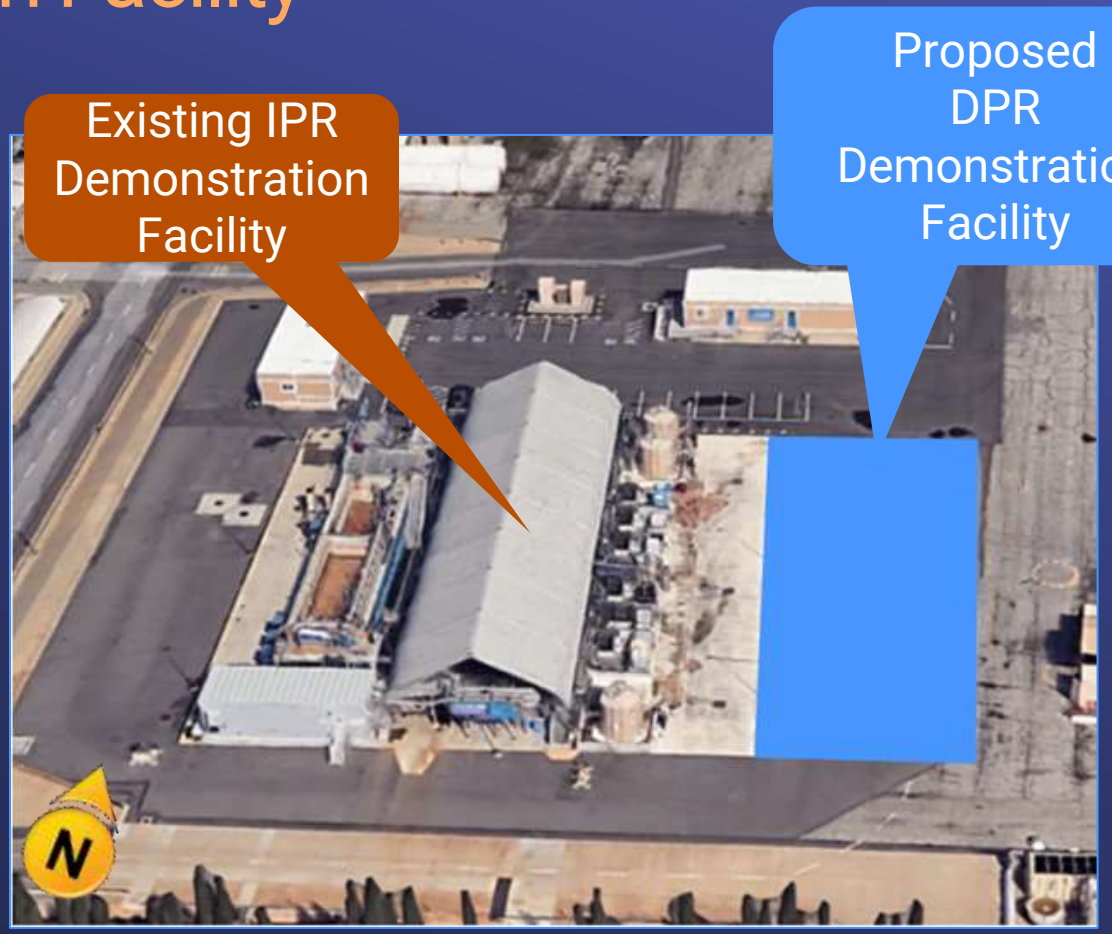
Water Quality Considerations: Key Takeaways

- Both RWA and TWA are viable pathways for PWSC, each offering distinct advantages
  - RWA provides purified water across a broader service area while leveraging existing infrastructure, monitoring, and response systems
  - TWA may reduce conveyance and pumping needs and simplify integration with existing treatment plants
- DPR requires more extensive treatment and more rigorous monitoring and reliability measures than IPR
- Testing additional processes at the demonstration facility is needed to confirm optimal DPR implementation strategies and regulatory pathway
- Ongoing engagement and collaboration with key partners will help effectively leverage expertise and resources

DPR Demonstration Facility

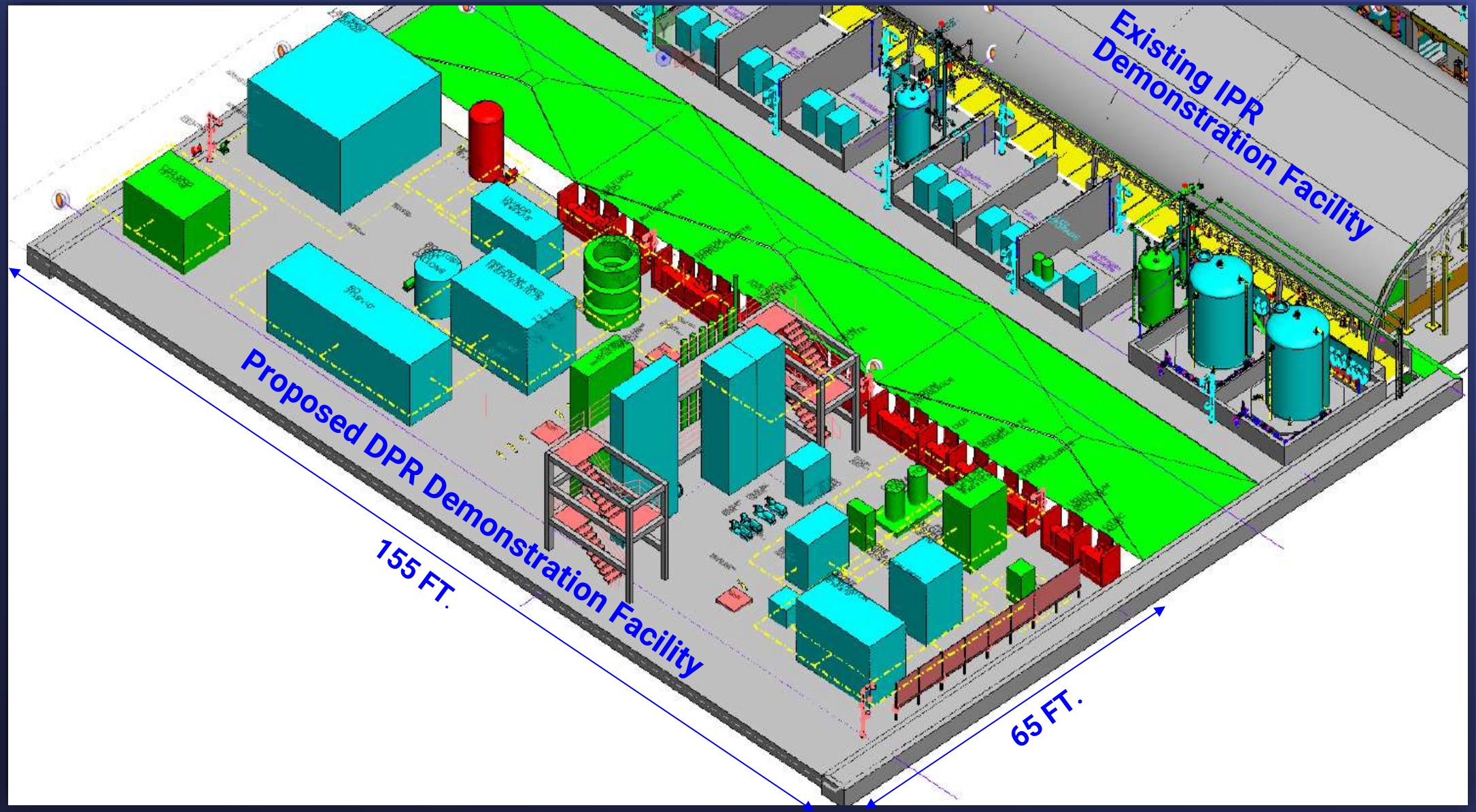
Proposed New DPR Demonstration Facility

- Accommodate DPR treatment trains and other testing equipment
- Site Improvements
  - New electrical building
  - New utility connections
  - Electrical, SCADA, & IT upgrades
  - IPR train tie-ins
  - Field offices & laboratory
- Implement via CM/GC project delivery
- Included in $875 M CIP budget for FYs 2026-2028
  - $72 M - Estimated Project Cost
  - $25 M – FY 2026-2028 budget
- Pursuing grant funding

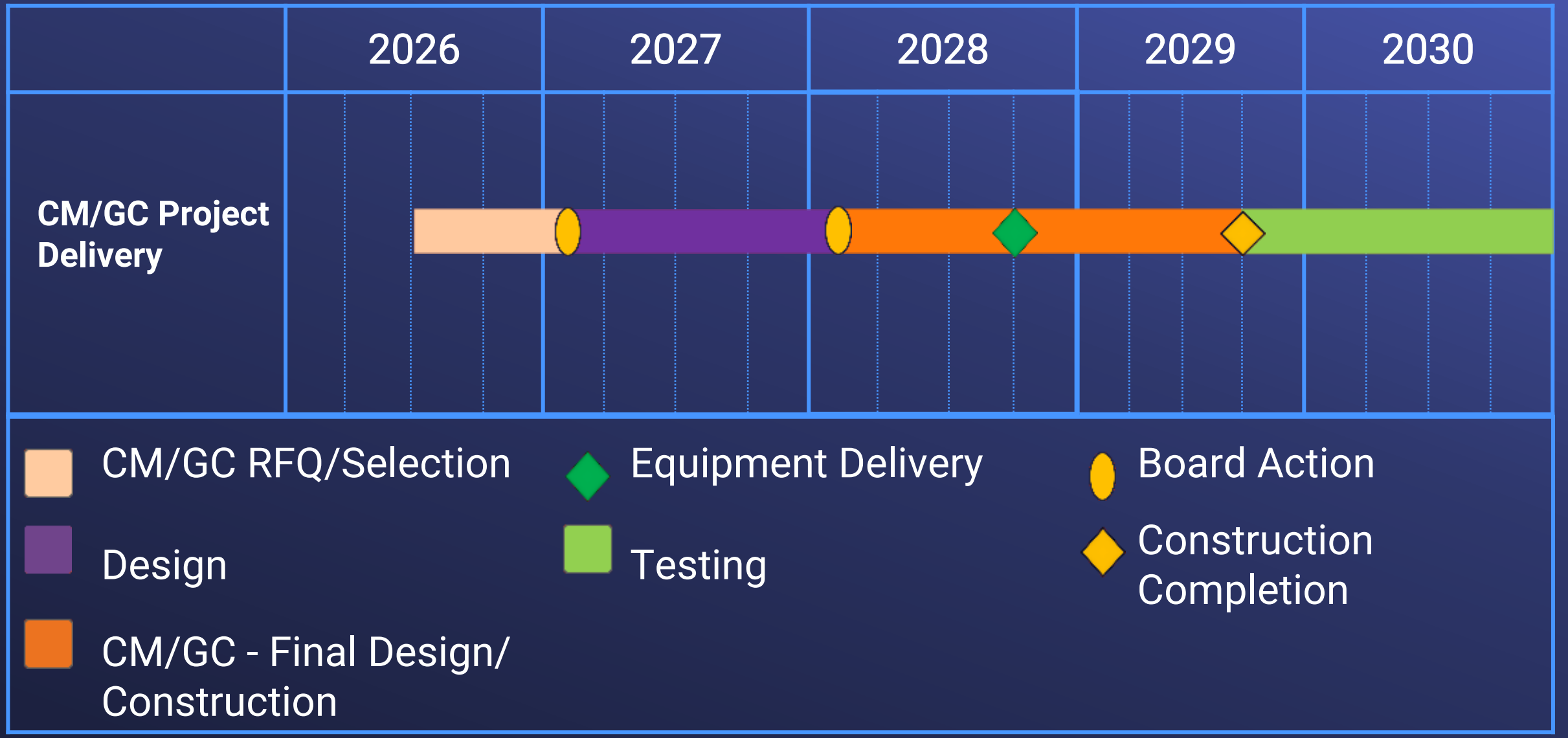


Grace F. Napolitano Pure Water
Southern California Innovation Center

Conceptual DPR Demonstration Facility Layout



Preliminary Schedules for DPR Demonstration Facility



Planned Studies to Advance DPR Development

- Water Quality
  - DPR Treatment Alternatives & Optimization
  - Temperature Impacts
  - Compliance with Nitrogen Targets
  - Chemical Peak Dilution
  - Post-Treatment Stabilization
  - Corrosion & Metal Mobilization
  - Water Age & Nitrification
- Hydraulic & Operational Modeling
  - Blending
  - Engineered Storage
  - Off-Spec Flow & Treatment Residuals Management
- Public Outreach & Taste Testing
- Satellite Facility Siting

DPR Demonstration Facility: Key Takeaways

- New DPR Demonstration Facility to be constructed at Napolitano Innovation Center via CM/GC project delivery method
- Anticipated construction completion & start DPR testing - Late 2029
- Full-scale DPR treatment recommendations - 2031
- DPR Demonstration Facility project included in Board-approved CIP budget for current biennium (FYs 2026-2028)

Demand Development and Assumptions

Demand Projections with Monte Carlo Simulation Model

What Is a Monte Carlo Simulation Model?

- A **Monte Carlo simulation** is a computational technique that uses repeated sampling to estimate the probability of different outcomes

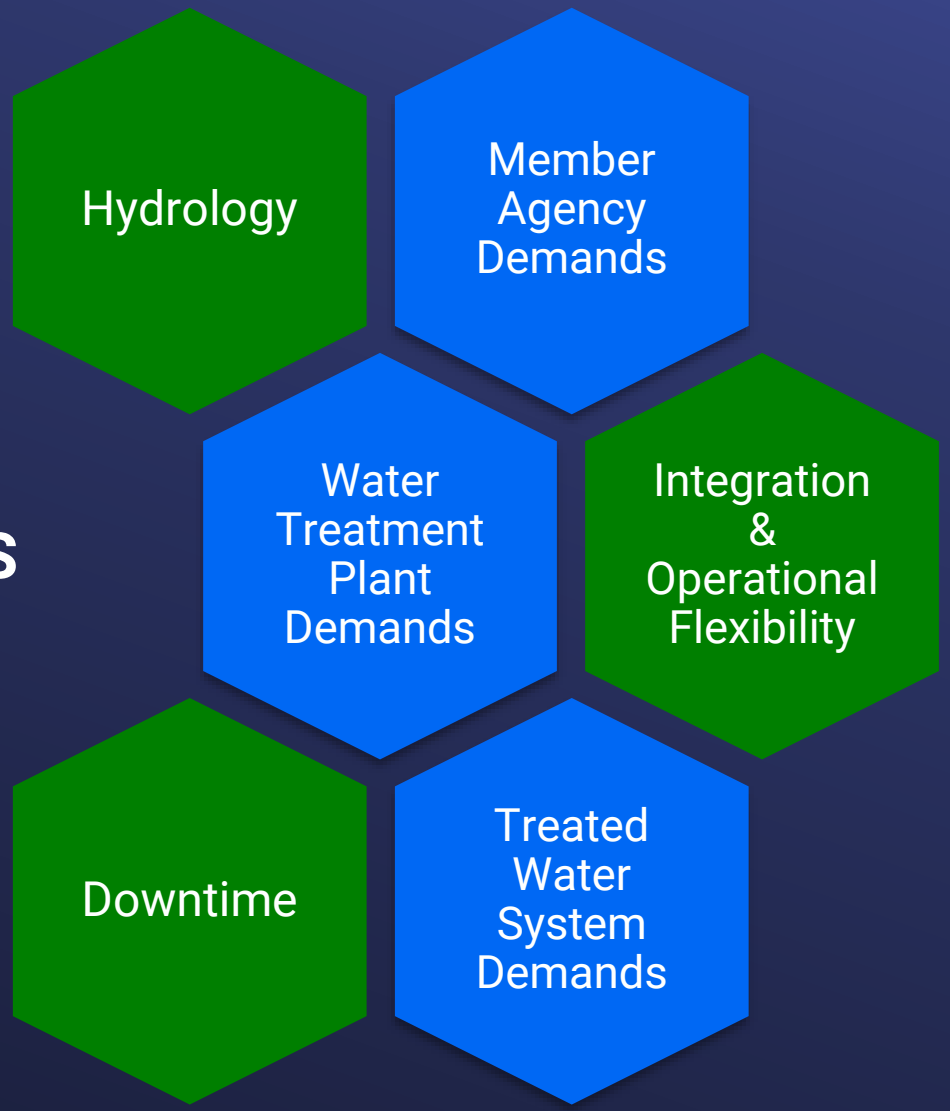
Why It Matters

- Helps assess **risk and uncertainty** in analyses with multiple factors
- Provides a **range of possible outcomes**, not just a single estimate
- Common practice in water supply project assessments

Demand Modeling for IPR and DPR

Demand Modeling Factors for IPR and DPR

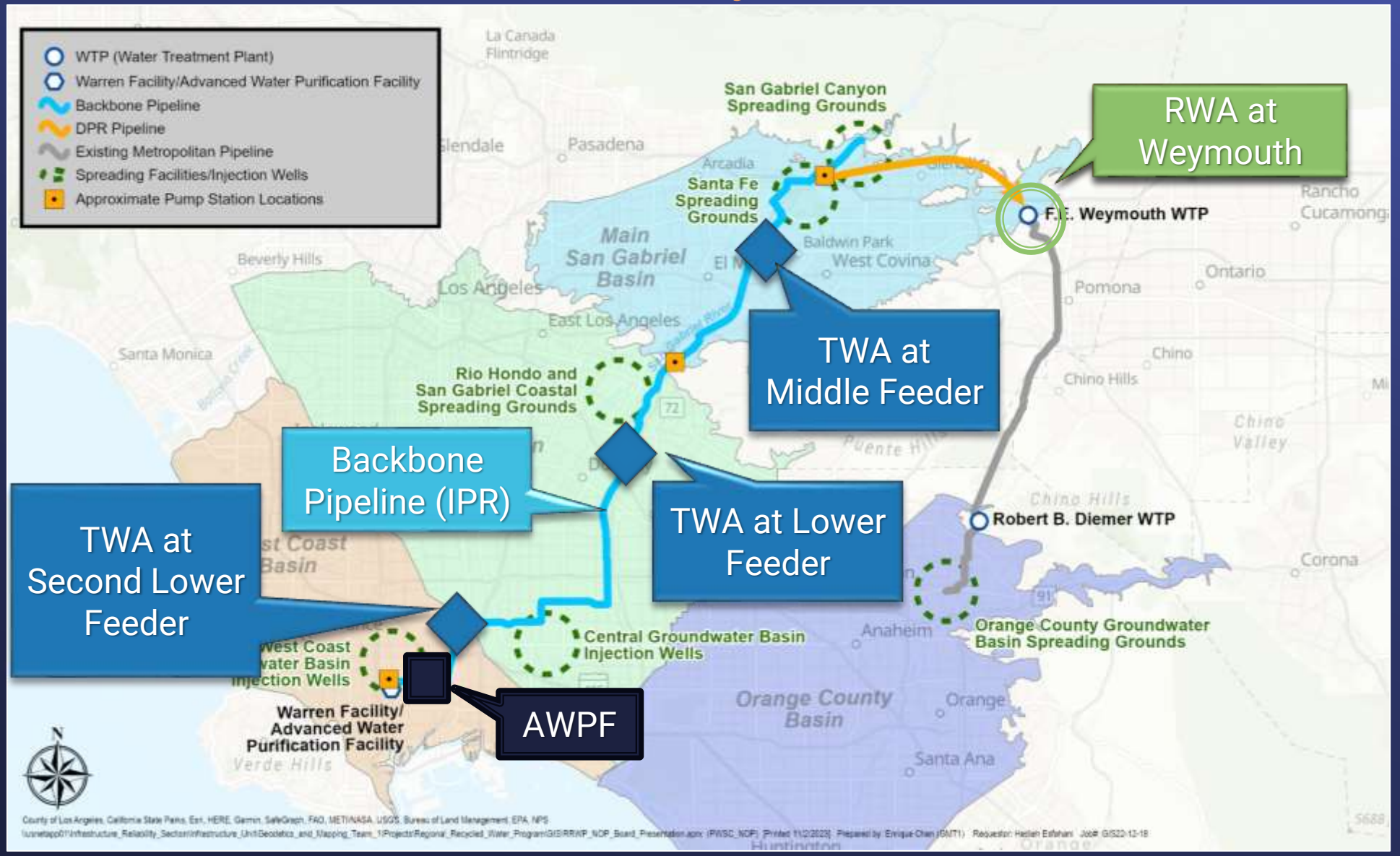
FACTORS



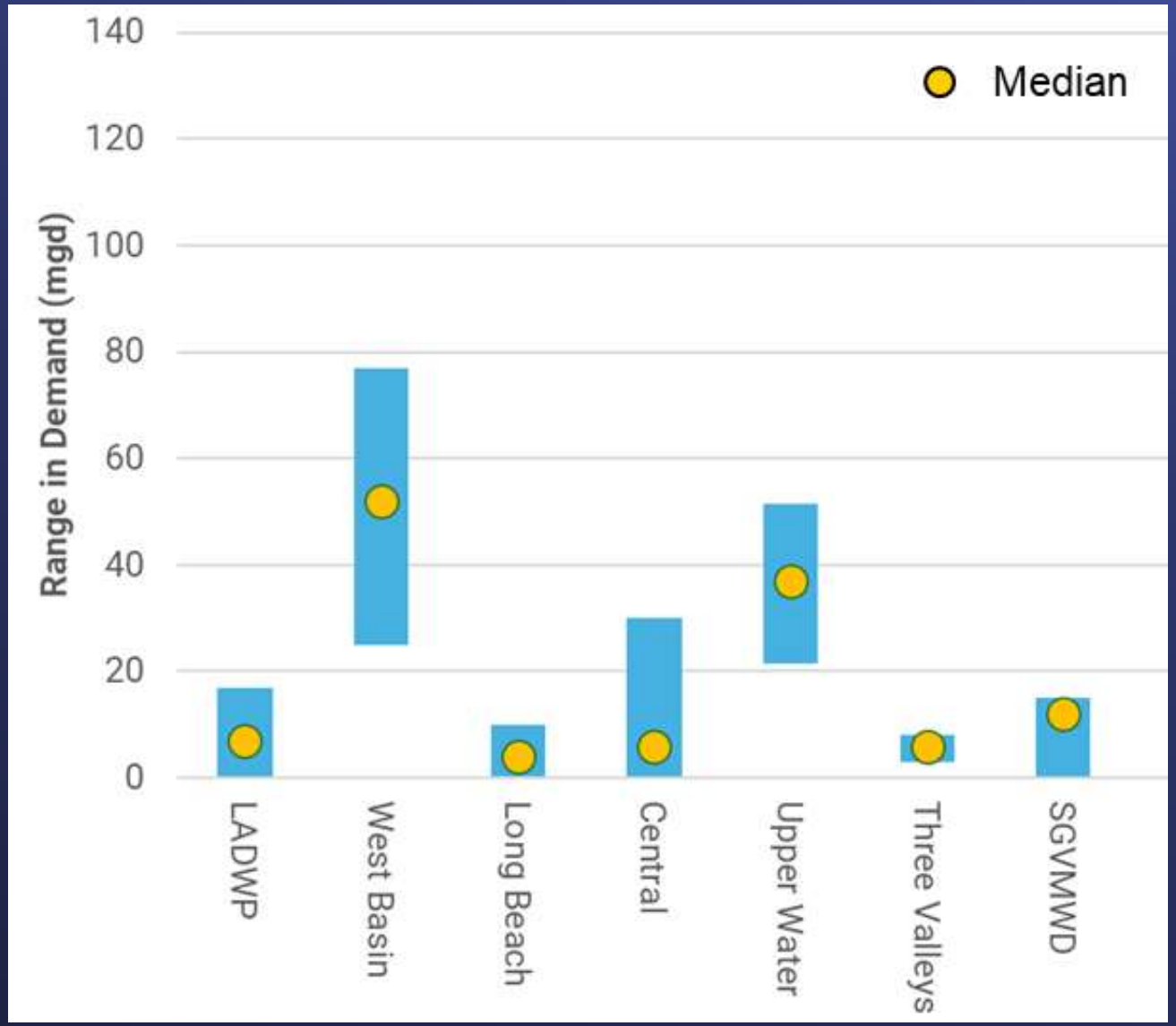
Factors not assessed in this study

- Water Age
- Nitrification
- Treatability at the Treatment Plants
- Hydraulic concerns in Central Pool

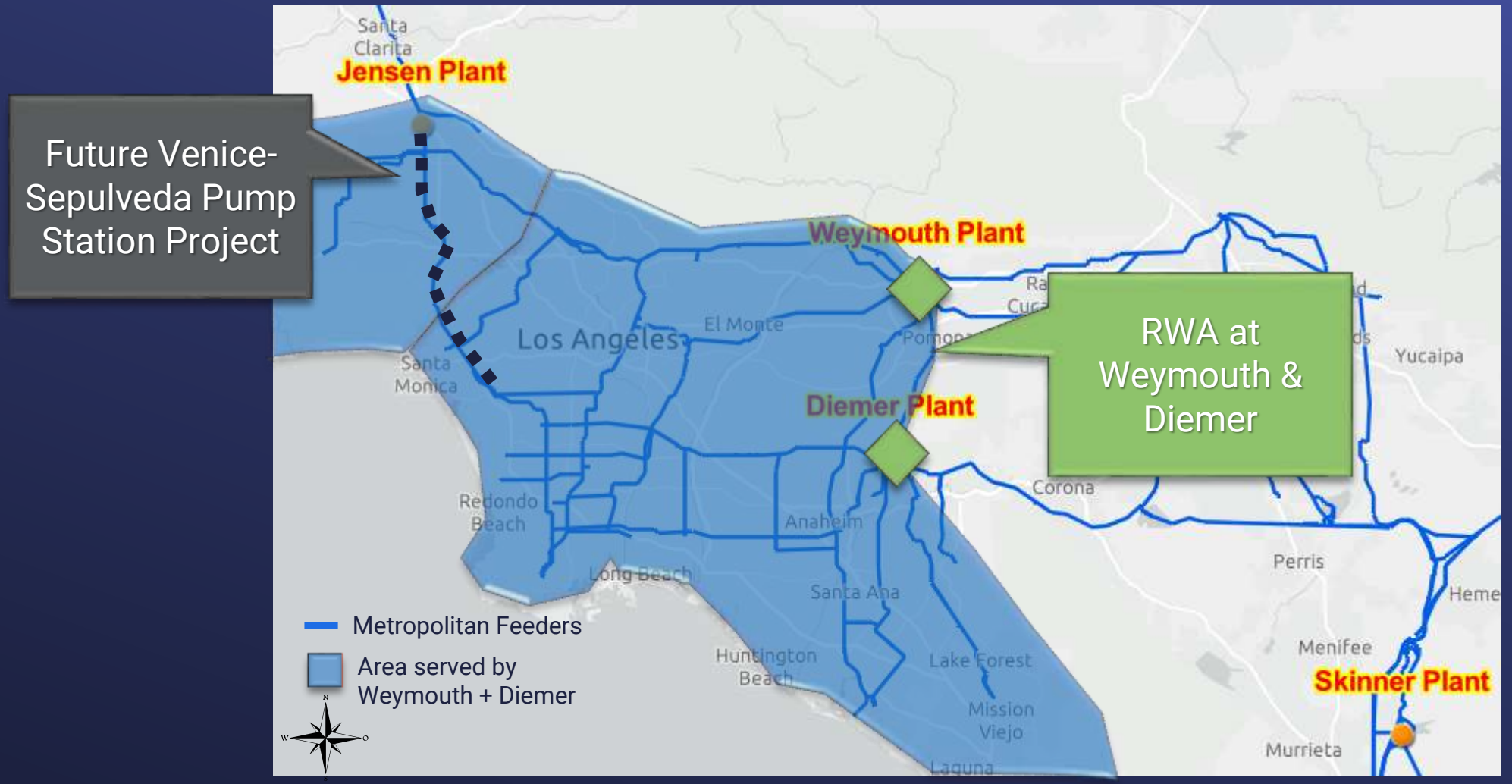
Overview of Potential DPR Pathways for PWSC



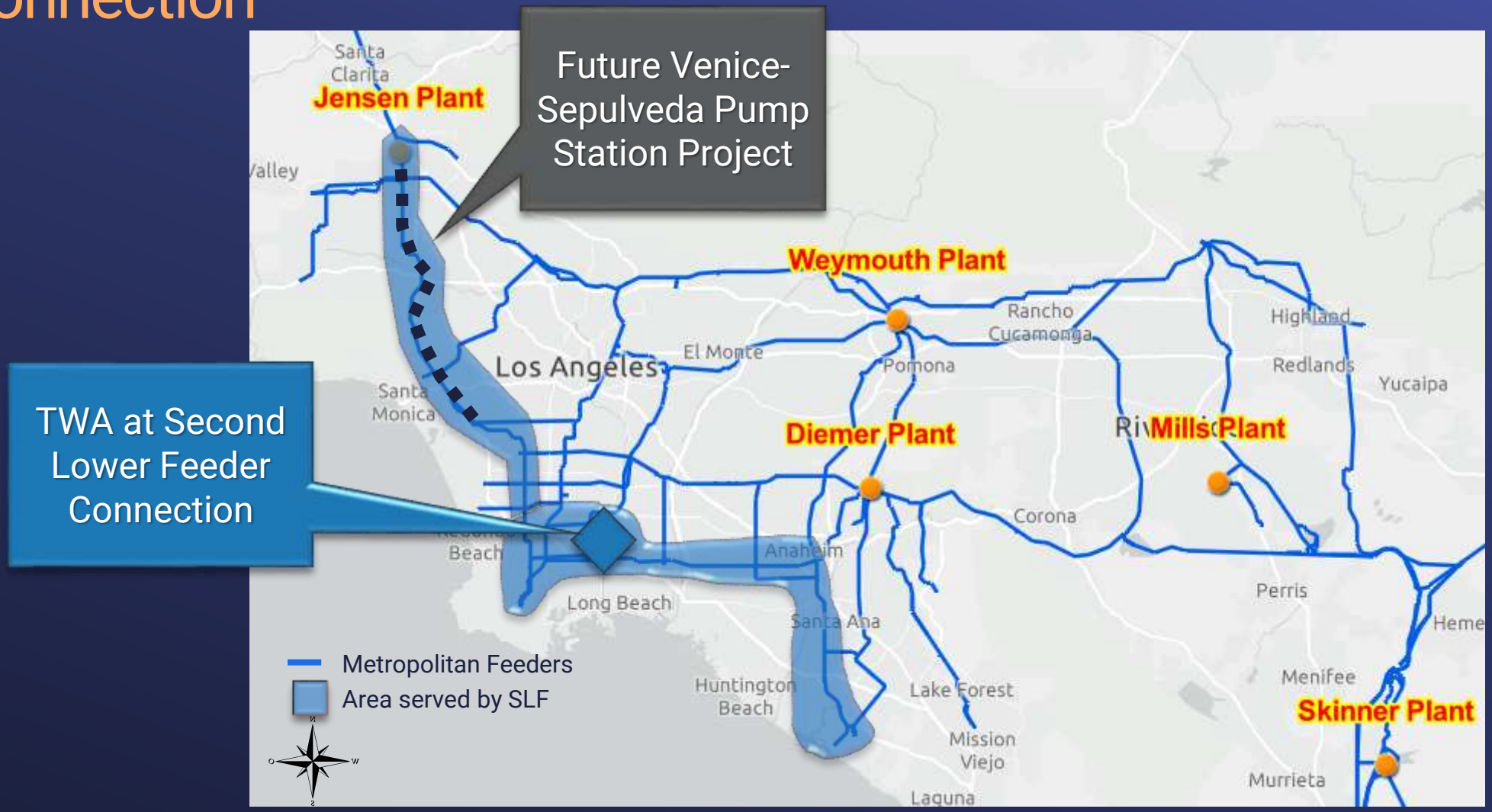
IPR Demand Ranges for Purified Water Recipients



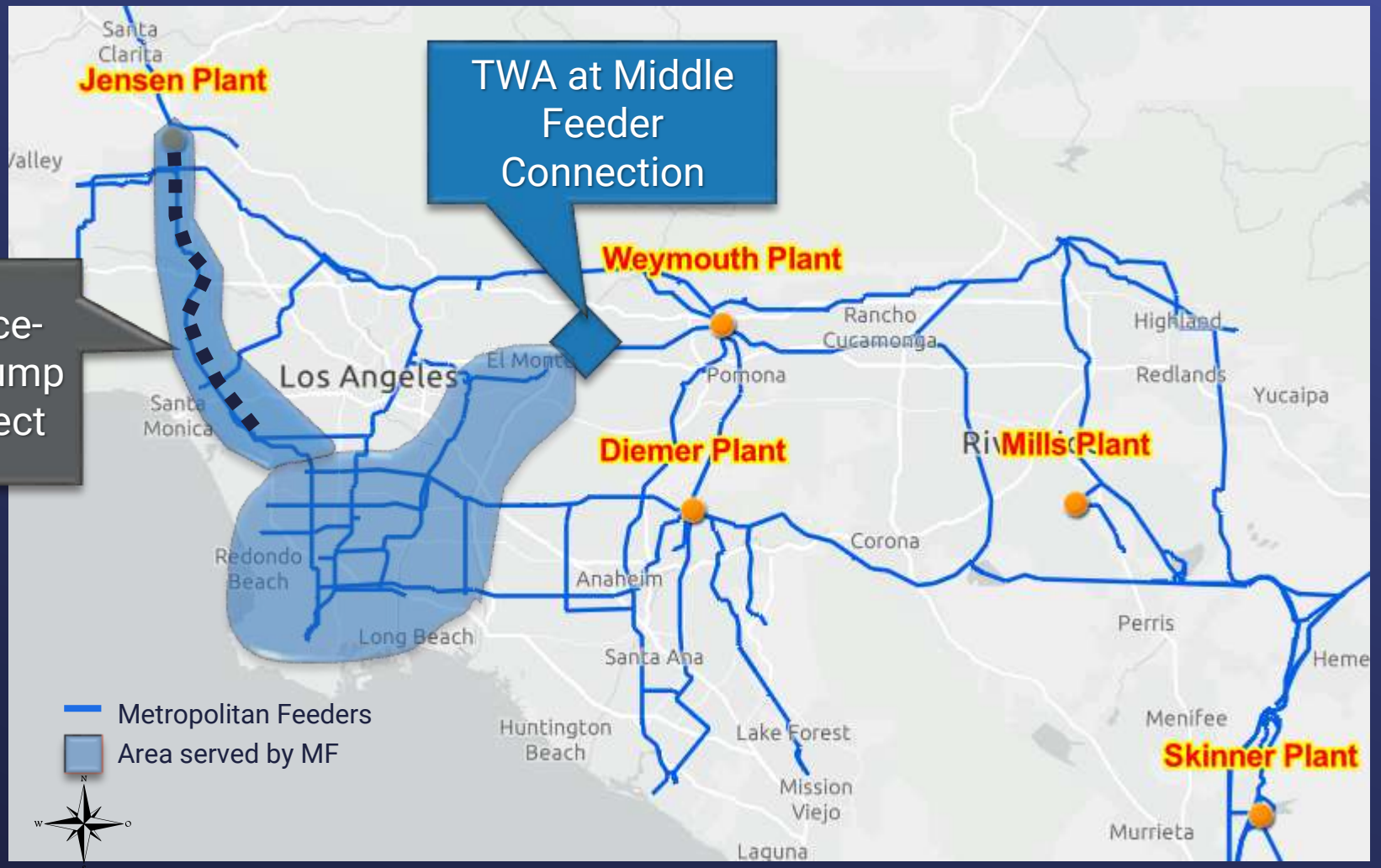
Demands Potentially Served from RWA at Weymouth & Diemer



Demands Potentially Served by TWA at Second Lower Feeder Connection



Demands Potentially Served by TWA at Middle Feeder Connection



PWSC Demand Management Assumptions
Flexible to respond to changing hydrology

Extreme Dry

- Mandatory demand reduction of 10 percent
- Limit IPR deliveries
- Maximize DPR

Normal & Dry Years

- Maximize IPR deliveries
- IPR deliveries to Central Basin in dry years only

Wet Years

- Limit IPR deliveries
- Consider turn-down of AWPF production

Major Earthquake

- Mandatory demand reduction of 25 percent
- Limit IPR deliveries
- Maximize DPR

Downtime & Emergency Online Goal (>92 percent)

General Downtime or Emergency 1 percent of the time

Spreading Basin/Injection Well Maintenance

2 weeks per year or ~4 percent of the time

Major Earthquake 1x in 25 years, or ~ 1 percent of the time

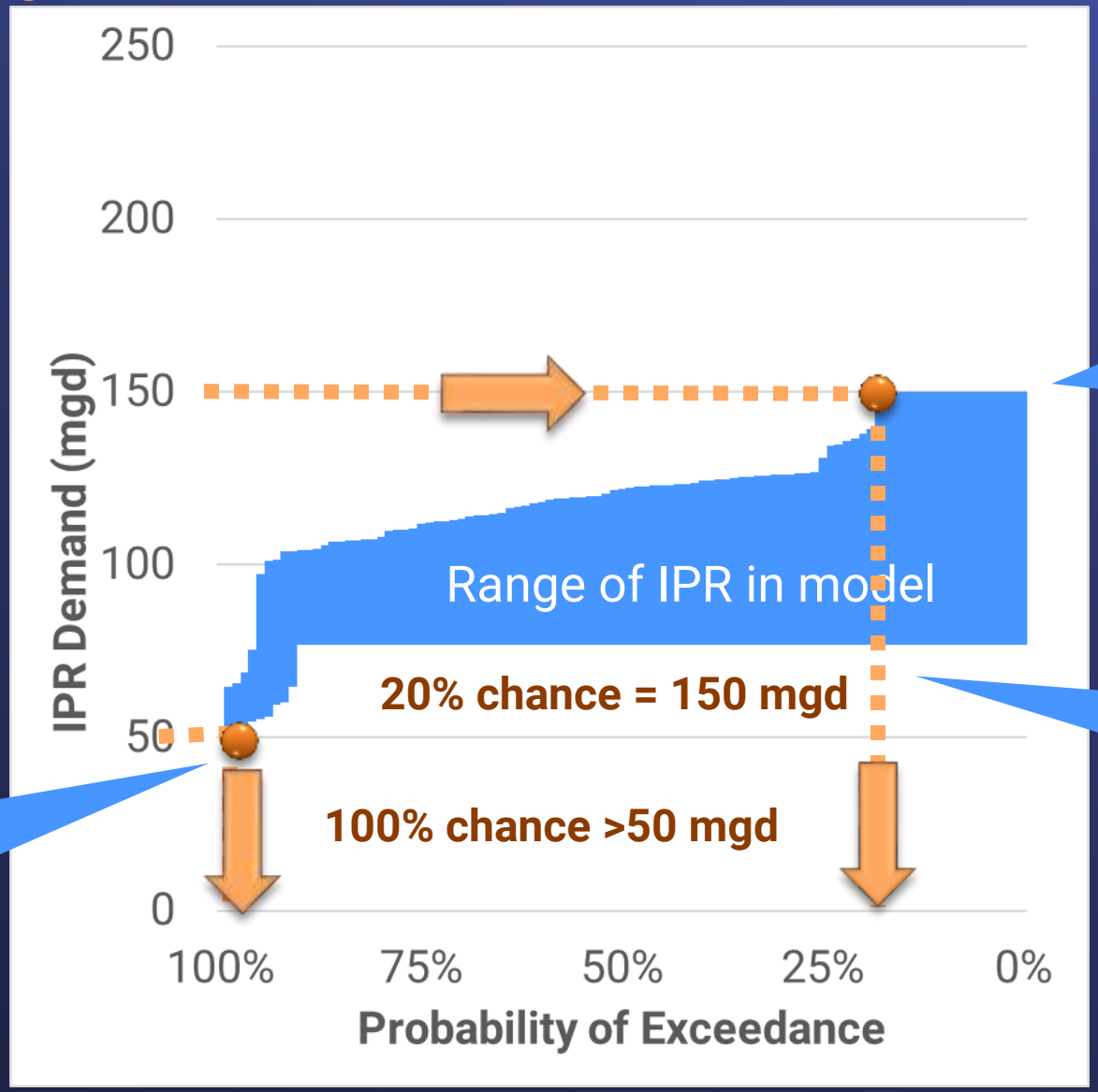
Hydraulic Integration Assumptions

- 150 mgd project size in all scenarios
- Pipeline to Main San Gabriel Basin in all scenarios
- IPR Priority

- DPR Pipeline to Weymouth: 60 MGD
- Second Lower Feeder (SLF) at Connection: 213 MGD
- Middle Feeder (MF) at Connection: 162 MGD

- Weymouth: 60 MGD
- Diemer: 70 MGD
- Jensen: 60 MGD

IPR Demand Range



Up to 150 MGD IPR during high demand periods

IPR between 75 mgd & 120 mgd >70% of the time

Reduced IPR demand during earthquake or extreme dry periods

DPR Demand Range and Blend Ratio

RWA

- **Demand @ Weymouth & Diemer**
  - 60-860 mgd
  - Median: 415 mgd
- **RWA Potential**
  - 0-60 mgd
  - 90th Percentile: 55 mgd
  - Median: 30 mgd
  - Median blend: 7%

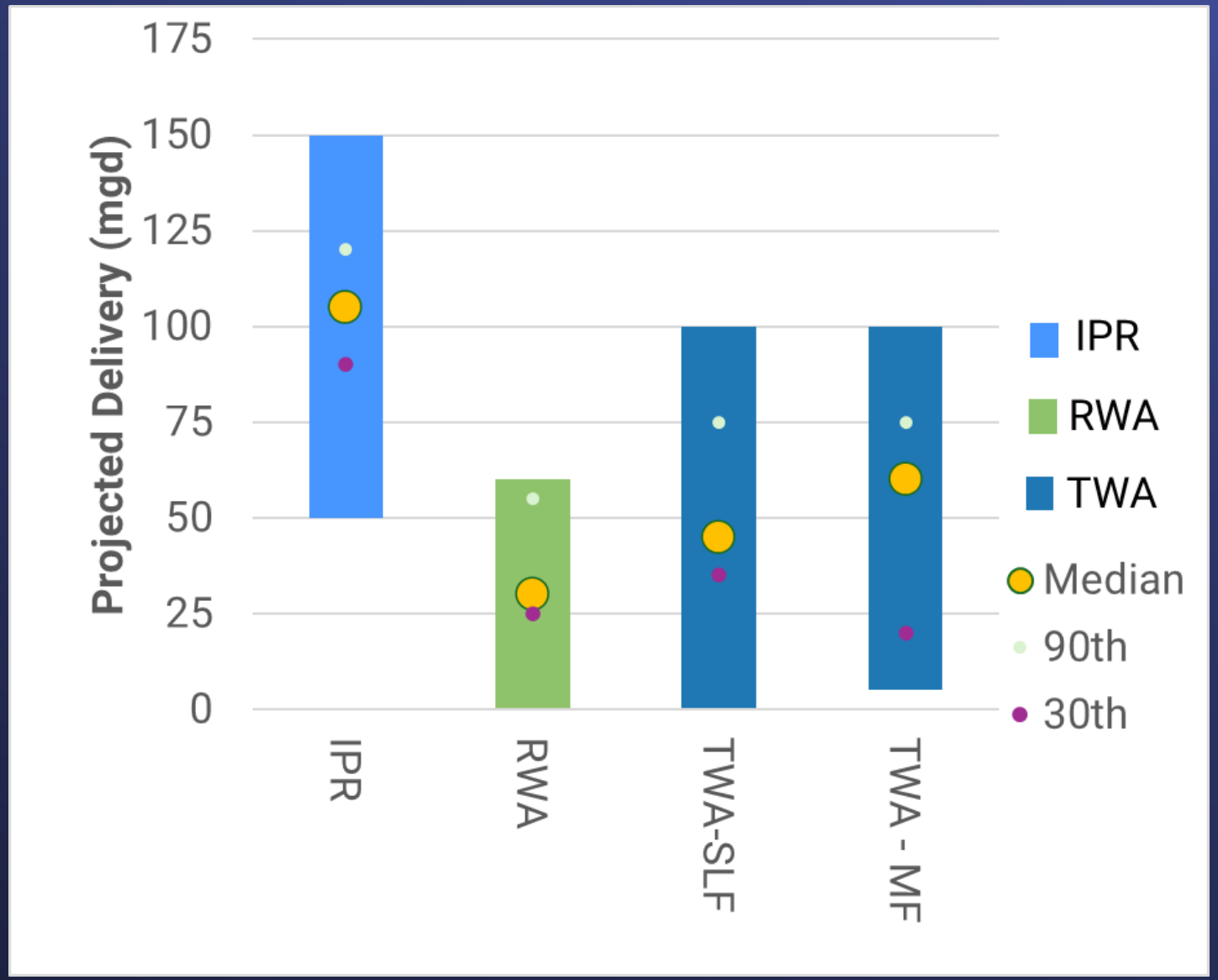
TWA @ Second Lower Feeder

- **Demand Served by SLF**
  - 0-600 mgd
  - Median: 320 mgd
  - Max 213 mgd @ connection point
- **TWA Potential**
  - 0-100 mgd
  - 90th Percentile: 75 mgd
  - Median: 45 mgd
  - Median blend: 16%

TWA @ Middle Feeder

- **Demand Served by MF**
  - 10-170 mgd
  - Median: 120 mgd
  - Max 162 mgd @ connection point
- **TWA Potential**
  - 5-100 mgd
  - 90th Percentile: 75 mgd
  - Median: 60 mgd
  - Median blend: 29%

Projected Delivery Ranges for Scenario Development



Demand Development: Key Takeaways

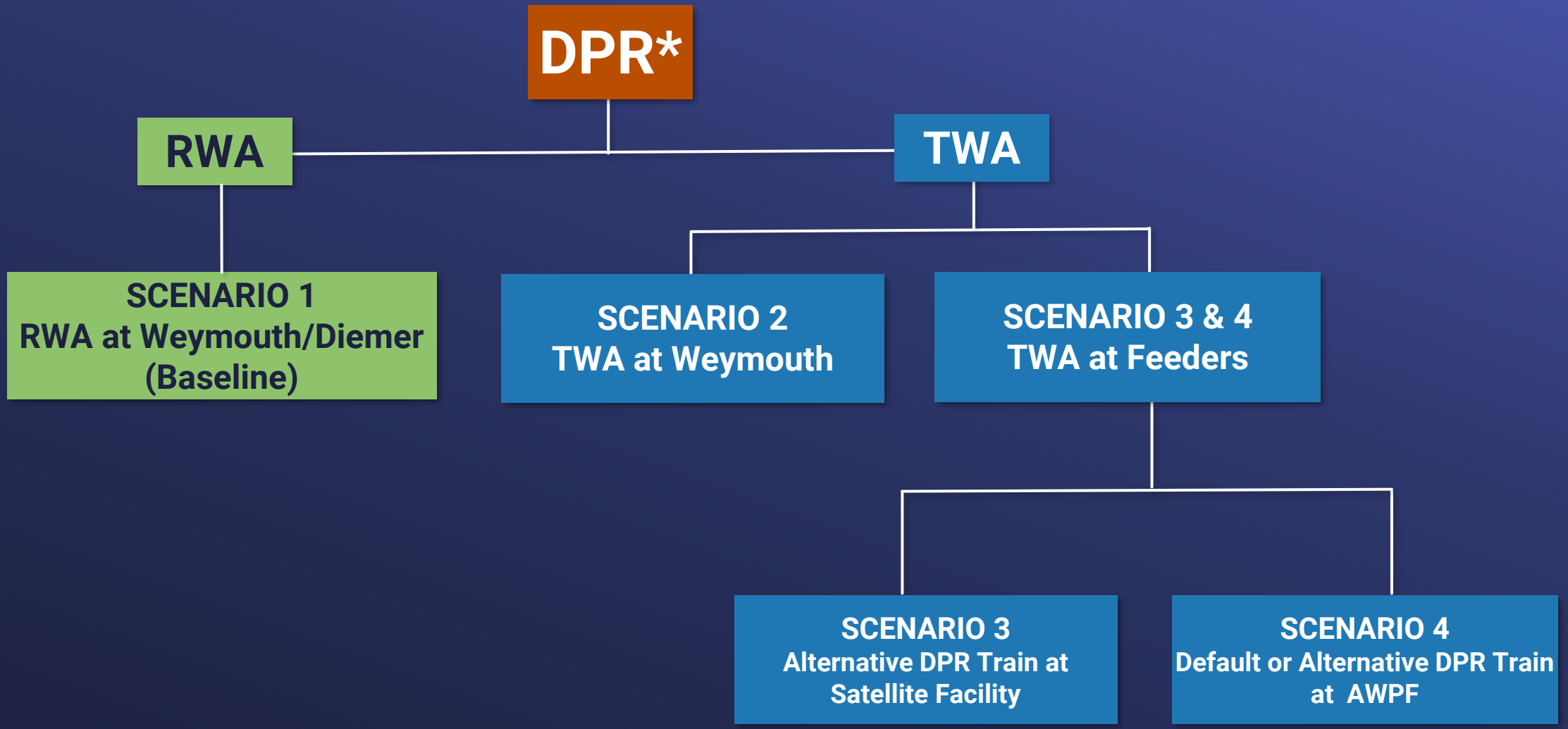
- Range in potential DPR deliveries from Monte Carlo demand simulation model

Connection	**Seasonal Max** mgd	**High** (90^{th} Percentile) mgd	**Medium** (Median) mgd	**Low** (30^{th} Percentile) mgd
IPR	150	120	105	90
RWA – Weymouth + Diemer	60	55	30	25
TWA – Second Lower Fdr.	100	75	45	35
TWA – Middle Fdr.	100	75	60	20

- All scenarios provide emergency supply following a seismic event
- Additional studies to evaluate nitrification, treatability at the treatment plants, and hydraulic limitations in the Central Pool, are needed to further refine the demands

DPR Implementation Scenarios

Potential DPR Implementation Scenarios for PWSC



*A total of 13 sub-scenarios developed/analyzed

SCENARIO 1A

Weymouth + Diemer RWA Baseline

- Advanced Water Purification Facility
- Water Treatment Plants
- Satellite Facility
- IPR Service Connections Served
- RWA DPR Connection
- Pump Station

Pipe Size

- 30 in
- 48 in
- 54 in
- 84 in

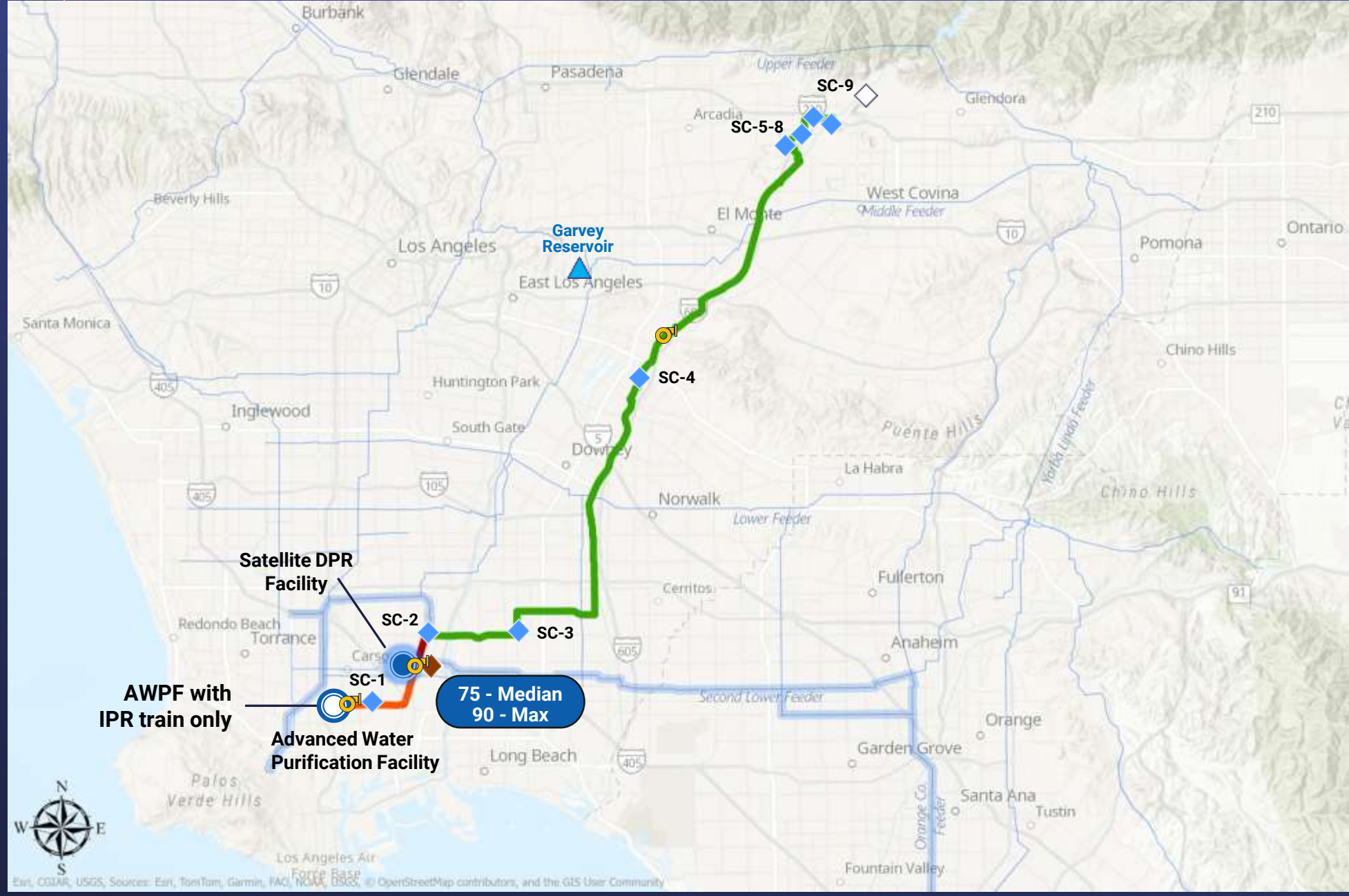
SCENARIO 3

3A-Second Lower Fdr.

- Advanced Water Purification Facility
- Satellite Facility
- IPR Service Connections Served
- IRP Not in Service
- TWA DPR Connection
- Pump Station

Pipe Size

- 54 in
- 66 in
- 90 in



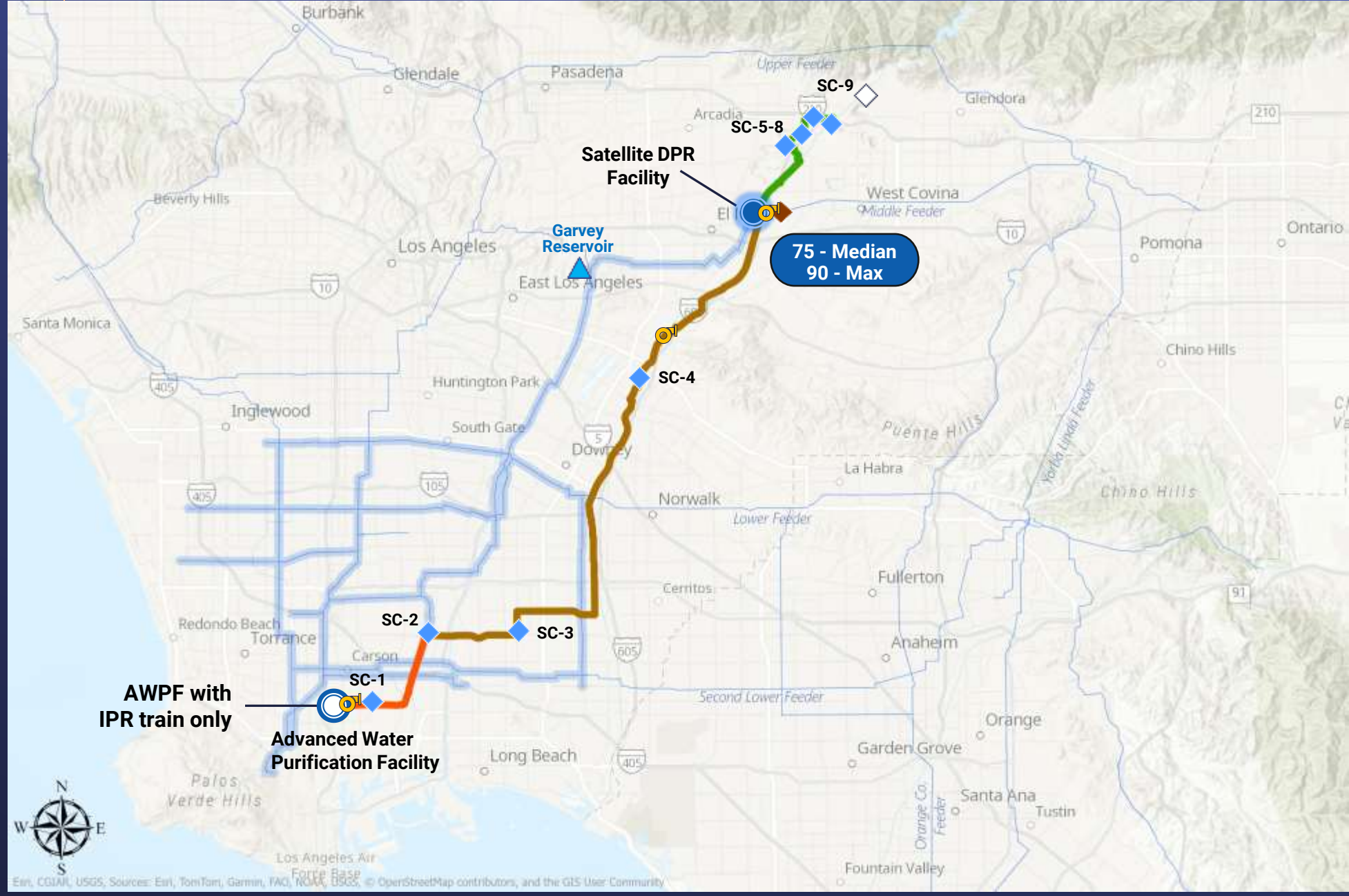
SCENARIO 3

3A-Middle Feeder

- Advanced Water Purification Facility
- Satellite Facility
- IPR Service Connections Served
- IRP Not in Service
- TWA DPR Connection
- Pump Station

Pipe Size

- 54 in
- 78 in
- 90 in



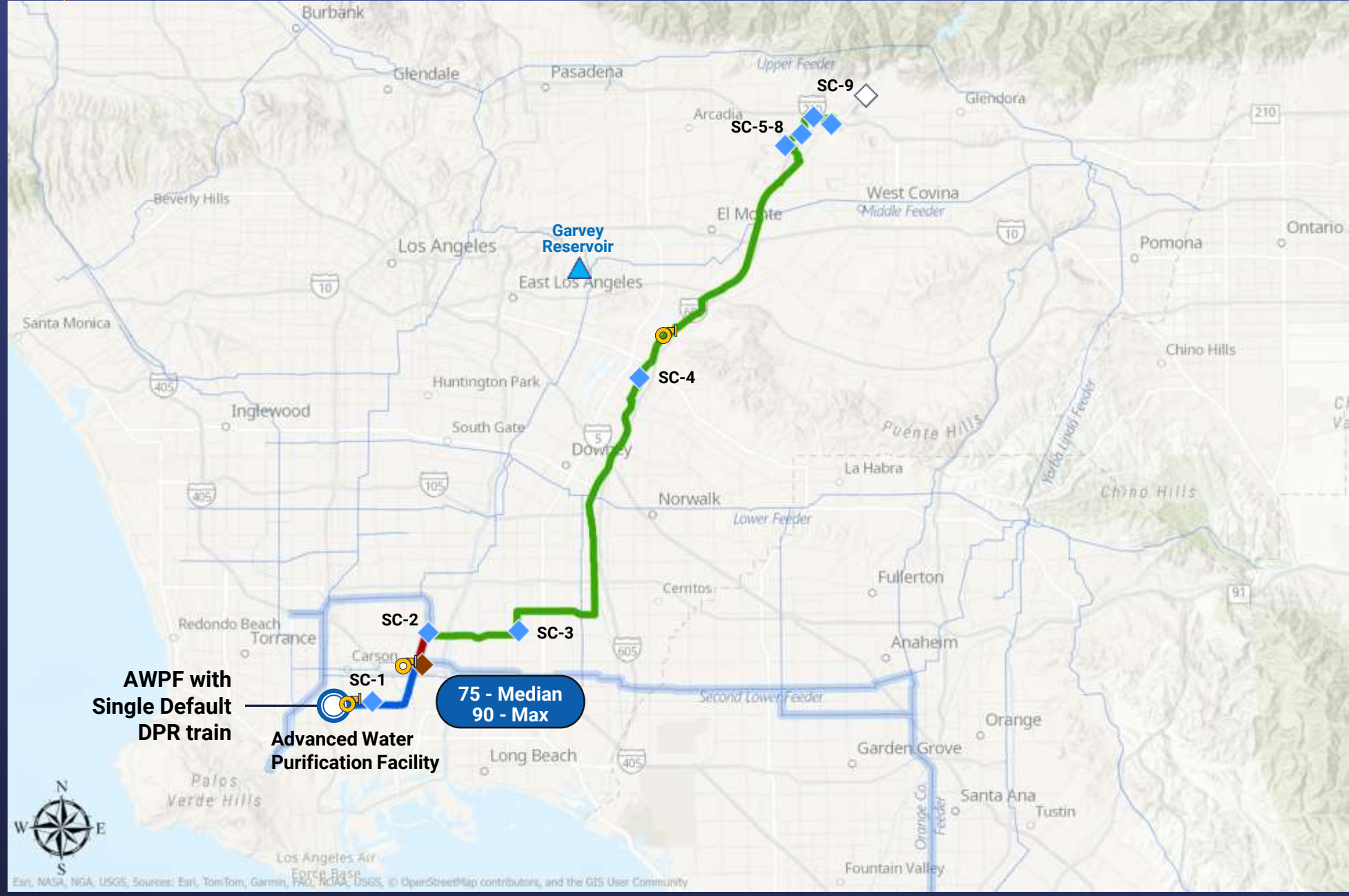
SCENARIO 4

4A- SLF (Default DPR Train)

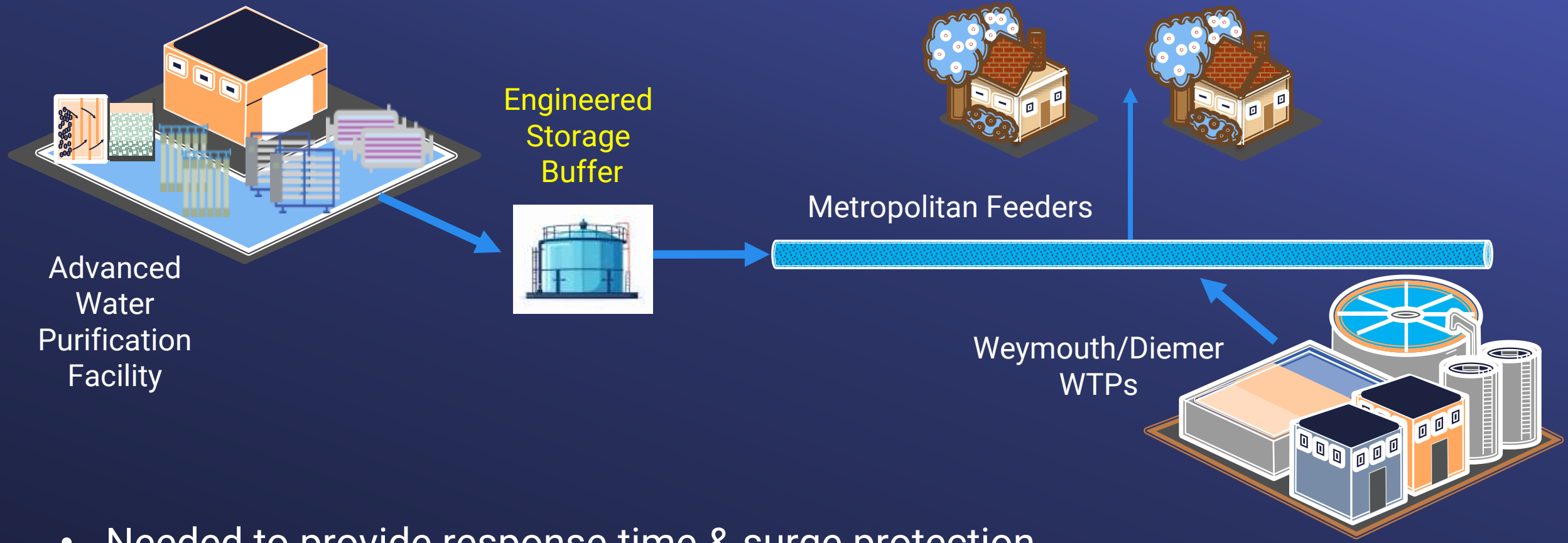
- Advanced Water Purification Facility
- IPR Service Connections Served
- IRP Not in Service
- TWA DPR Connection
- Pump Station

Pipe Size

- 54 in
- 66 in
- 84 in



Engineered Buffer for TWA Operational Support



- Needed to provide response time & surge protection
- Preferably at feeder connection location
- Some buffering capacity provided at AWPF clearwell

Potential Metropolitan Reservoirs for TWA Use

	Palos Verdes Reservoir (via Second Lower Feeder)	Garvey Reservoir (via Middle Feeder)	Weymouth Finished Water Reservoir
Max/Median Flow (MGD)	100/75	100/75	60/40
Max. Capacity (AF)	695	1,610	151
Distance to Backbone (mi)	4.3	6.4	12
Benefits	• Lower lifecycle costs	• Largest storage buffer for DPR demand management	• Easiest to operate • Additional demands in Central Pool
Challenges/Limitations	• Limited buffering at end of existing distribution system • Require response time strategies, such as storage tanks	• Potential nitrification issue • Potential feeder capacity limit	• Require new pipeline • Limited ability to handle flow variations

Potential for Conveyance System Reduction with TWA

	Scenario 1 RWA at Weymouth & Diemer (Baseline)		Scenario 3 TWA at Feeders with DPR Treatment at Satellite Plant		Scenario 4A TWA at Feeders with DPR Treatment at AWPF	
IPR Flow (MGD)	105		75			
DPR Flow – Median/Max. (MGD)	45/60		75/100			
Backbone (size & length)	84"	37.4 mi	90"	4.3 mi	84"	4.3 mi
	48"	1.7 mi	66"	1.6 mi	66"	1.6 mi
			54"	31.5 mi	54"	31.5 mi
DPR Pipeline (size & length)	54"	12 mi	DPR Pipeline Eliminated			
Relative Costs* - Capital	Baseline		-12%		-13%	
- O&M			+6%		-10%	
- Unit Cost			-3%		-10%	

** Rough-order-of-magnitude costs only; some contingency built in to address infrastructure needs. Additional studies needed for cost confirmation of TWA scenarios.*

- No satellite facility
- No RO concentrate management

Balancing DPR and IPR Demands for Operational Flexibility

DPR Treatment at Satellite Facility

	RWA at Weymouth/Diemer (Baseline)	High TWA (Scenario 3A)	Medium TWA (Scenario 3C)	Low TWA (Scenario 3B)
IPR Demand (MGD)	90	75	105	**115**
Median/Max DPR Flow (MGD)	30 /60	75 / 100	45 /60	35 /50
Online Factor	95 percent	93 percent	92 percent	**94 percent**
Relative Costs* - Capital	Baseline	-12%	-14%	-14%
- O&M		+6%	-3%	-3%
- Unit Cost		-3%	-7%	-9%

** Rough-order-of-magnitude costs only; some contingency built in to address infrastructure needs. Additional studies needed for cost confirmation for TWA scenarios.*

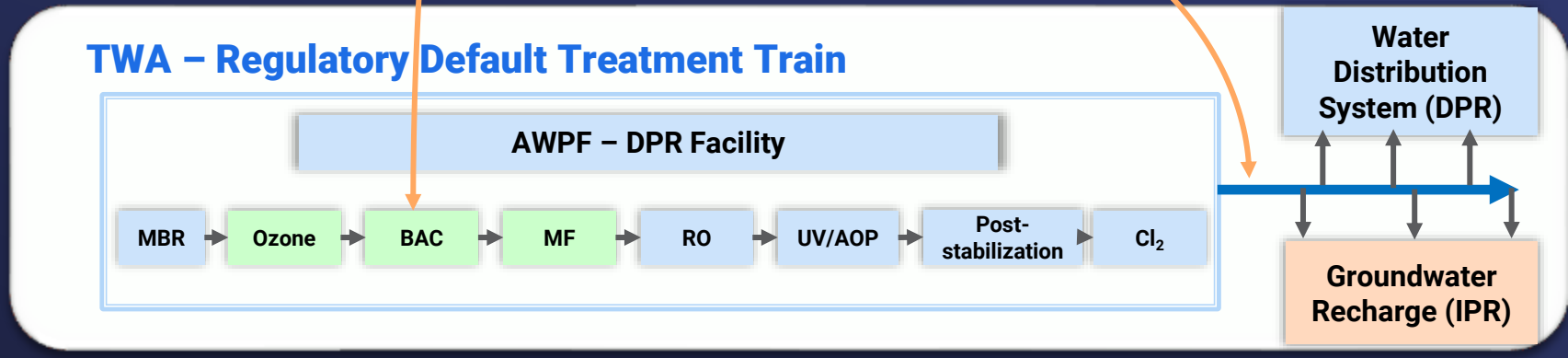
- Higher IPR demand
- Smaller DPR satellite treatment facility
- Higher online factor

Combined vs. Separate IPR/DPR Treatment Trains & Deliveries

All Treatment at AWPF

	RWA at Weymouth/Diemer (Baseline)	Combined IPR/DPR Treatment Train (Scenario 4A)	Separated IPR/DPR Treatment Trains (Scenarios 4B/4C)
DPR Treatment Approach	Alternative Train	**Regulatory Default Train**	**Alternative Train**
Conveyance	Single Pipeline	**Single Pipeline**	**Dual Pipeline**
Relative Costs* - Capital	Baseline	-13%	-7% to -11%
- O&M		-10%	-3%
- Unit Cost		-10%	-5%

**Rough-order-of-magnitude costs only; some contingency built in to address infrastructure needs. Additional studies needed for cost confirmation for TWA scenarios.*



DPR Strategies: Key Takeaways

- Both RWA and TWA are feasible for PWSC and warrant further study
- Opportunities for conveyance system cost savings with TWA
- Combined IPR and DPR treatment at the AWPF with a single delivery pipeline appears to be most economical approach
- Location(s) of engineered buffer(s) need to be identified for TWA
- Additional studies needed for evaluating TWA scenarios and projected costs

Public Outreach/Acceptance

Public Outreach

A strong base is already in place for broad community engagement

Tours

Presentations

Events

Community Partnerships

Web

Social Media

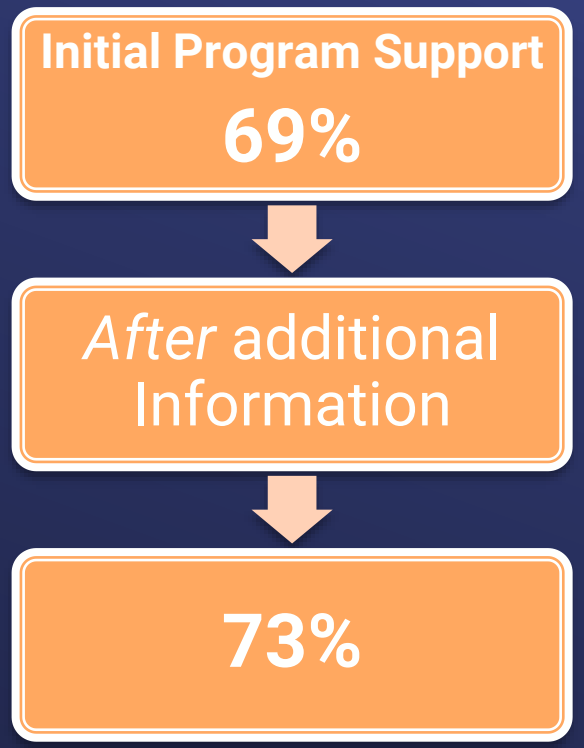
News

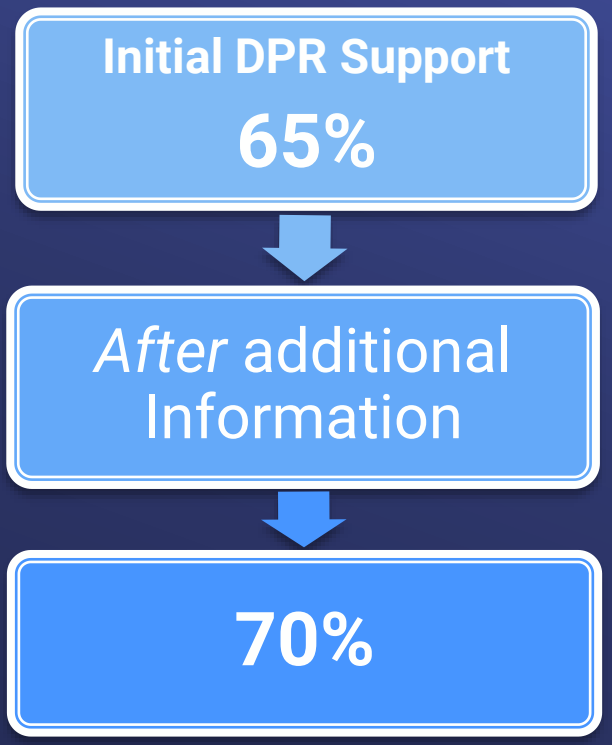
Multilingual Materials

The next step is to expand DPR messaging opportunities

2024 Public Opinion Research: information builds support

*After hearing **the benefits of the program**, support increased*





*When given **clearer** information about the **purification process** and how **DPR works**, support increases*

Messaging is most effective when shifted to specific, plain-language explanations that help people understand what is being considered and why.

Expanding Regional Messaging on Recycled Water

New Educational Video:
Renewed: The journey to safe drinking water

Recycled Water Working Group:
Monthly collaboration and partnership on educational events

COUNCIL FOR WATERSHED HEALTH

New DPR Tour Stop Opportunity

Benefits

- Show how DPR fits into the overall program and purification process
- Visuals to demonstrate
  - raw water augmentation
  - treated water augmentation
  - monitoring, treatment barriers and regulatory oversight
- Connect science to what matters to people: safe water, reliability and transparency

Tasting Station: the missing engagement tool

Why add tasting?

- Makes the experience more personal and tangible
- Reflects expert guidance that tasting can support public acceptance of potable reuse
- Demystifies purified water in a simple, memorable way
- Offers real-time insight into whether the tour experience builds confidence

Ground Water Replenishment System

Albert Robles Center

Pure Water Las Virgenes

Sydney Water Corporation

Public Outreach/Acceptance: Key Takeaways

- Pure Water Southern California has a strong outreach foundation to build from
- Clear, plain-language information increases public understanding and support
- DPR messaging should become more specific, visual and accessible as implementation strategies are evaluated
- New engagement tools, including a DPR tour stop and tasting station, can help build confidence by making the science tangible

Summary of Key Findings

Summary of Key Findings

DPR Implementation Strategy for PWSC

- Backbone pipeline supports IPR and all DPR implementation scenarios
- Significant IPR demand along backbone pipeline
- Opportunities for conveyance system cost savings with TWA
- Additional studies needed to assess DPR alternatives to refine implementation strategy & costs

Next Steps

DPR Implementation for PWSC

- Seek Board approval to award CM/GC agreement for DPR demonstration facility
- Refine DPR scenarios based on Board, member agency, and Independent Science Advisory Panel feedback
- Perform technical studies to further assess water quality and operational impacts
- Advance planned public outreach efforts


THE METROPOLITAN WATER DISTRICT OF
SOUTHERN CALIFORNIA
1928