MARIN WATER

Update on Recycled Water and Potable Reuse

OPERATIONS COMMITTEE MEETING

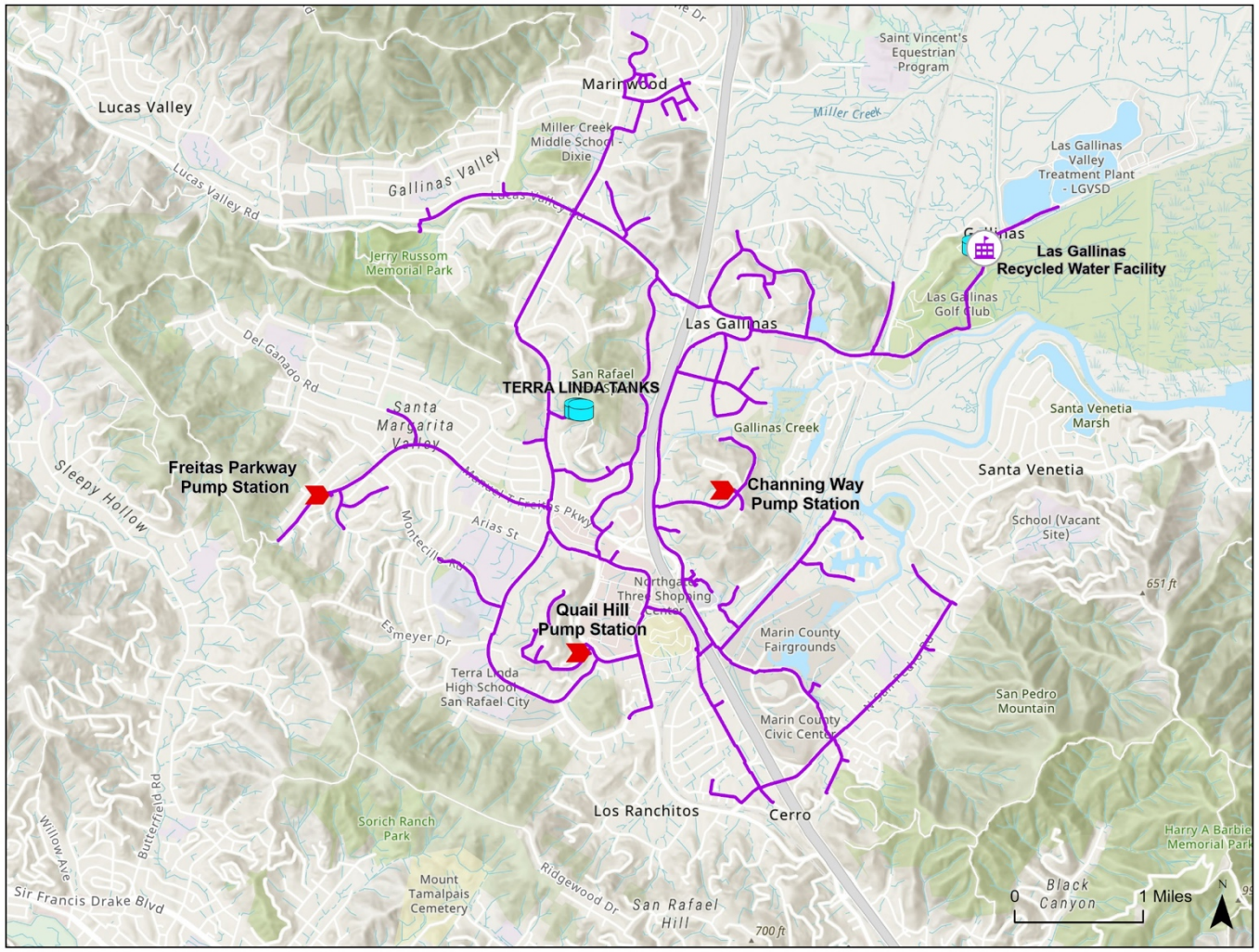
November 17, 2023

Overview

- Recycled Water
- Potable Reuse: Indirect Potable Reuse (IPR) & Direct Potable Reuse (DPR)
- Next Steps

Current Recycled Water System

- 706 AF in WY 2023
- 358 customers
- 25 miles of distribution pipelines, 3 pump stations and 2 storage tanks
- MMWD pioneered non-traditional uses of recycled water such as toilet flushing in condominium, car wash, HVAC cooling towers and commercial laundries



Current Recycled Water System: Commercial Truck Hauling

- Designated locations throughout recycled distribution system for permitted commercial users to fill up and haul to construction/work sites
- Trained and permitted estimated 85 municipalities/contractors on the proper use of RW
- Up to 7 million gallons annually is hauled for:
  - Dust control and soil compaction
  - Sewer flushing
  - Street cleaning
  - Irrigation

Sanitary agency filling up with recycled water for sewer cleaning near Civic Center Drive

Current Recycled Water System: Residential Fill Station

- Drought response tool
- Constructed and operated residential recycled water fill station to support customers throughout the drought
- In partnership with County of Marin

	2021	2022
Amount of Recycled Water Picked up	1.3 AF	1.2 AF
Customer Visits	3,795	4,402

How to Increase Recycled Water Use?

- Add new customers within existing recycled water system
- Expand existing recycled water system
  - District has conducted number of master planning studies to assess feasibility
- Add a new recycled water system
  - Central Marin Sanitation Agency (CMSA), San Rafael
  - Sewage Agency of Southern Marin (SASM), Mill Valley

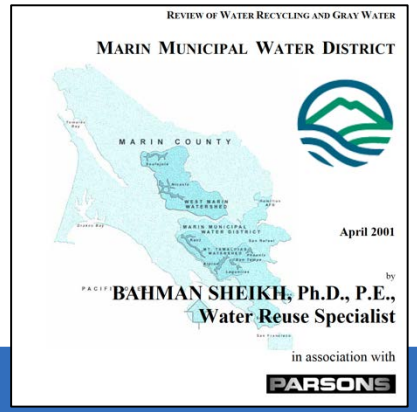
Increase Recycled Water Use: Add customers within existing service area

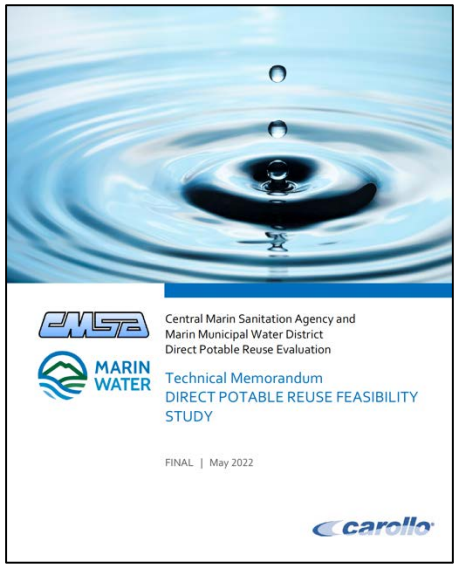
- Dual Plumb Projects
  - Terra Linda High School Gym –12 fixtures (2023)
  - The Oaks Senior Care Facility – 96 fixtures (2022)
  - Kaiser Medical Office Building – 82 fixtures (2022)
- Landscape Irrigation Projects
  - Venetia Valley School, expansion of existing irrigation (2022)
  - 400 Smith Ranch Road Sports Facility (2022)
  - 949 Del Presidio – Gas Station (2022)

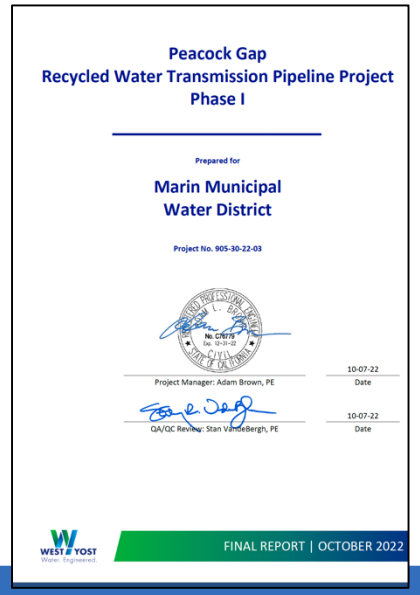
Increase Recycled Water: Expansion Studies

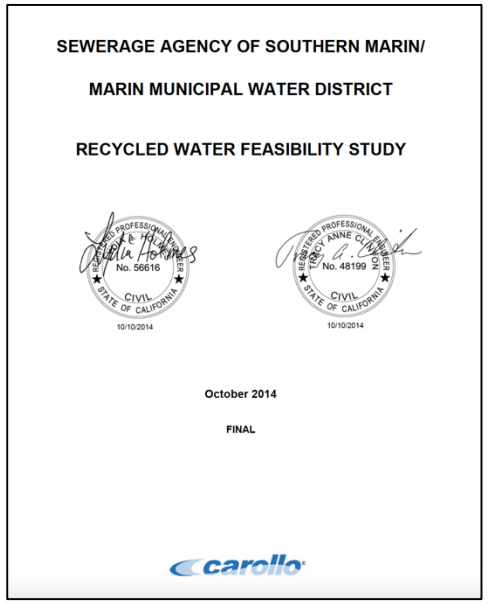
Planning efforts to identify opportunities for investment and expansion of recycled water system:

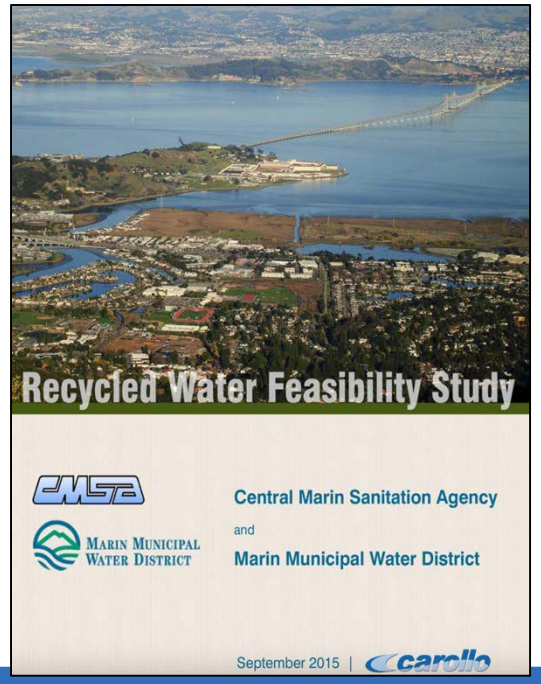
- 2000 Recycled Water Expansion Feasibility Study
- 2001 Bahman Sheikh Recycled Water Study
- 2007 Feasibility Study Update
- 2014 MMWD-SASM Recycled Water Feasibility Study
- 2016 MMWD-CMSA Recycled Water Feasibility Study
- 2017 Water Resources Plan 2040
- 2022 Peacock Gap Recycled Water Preliminary Design
- 2022 MMWD-CMSA Direct Potable Reuse Feasibility Study
- 2023 Strategic Water Supply Assessment







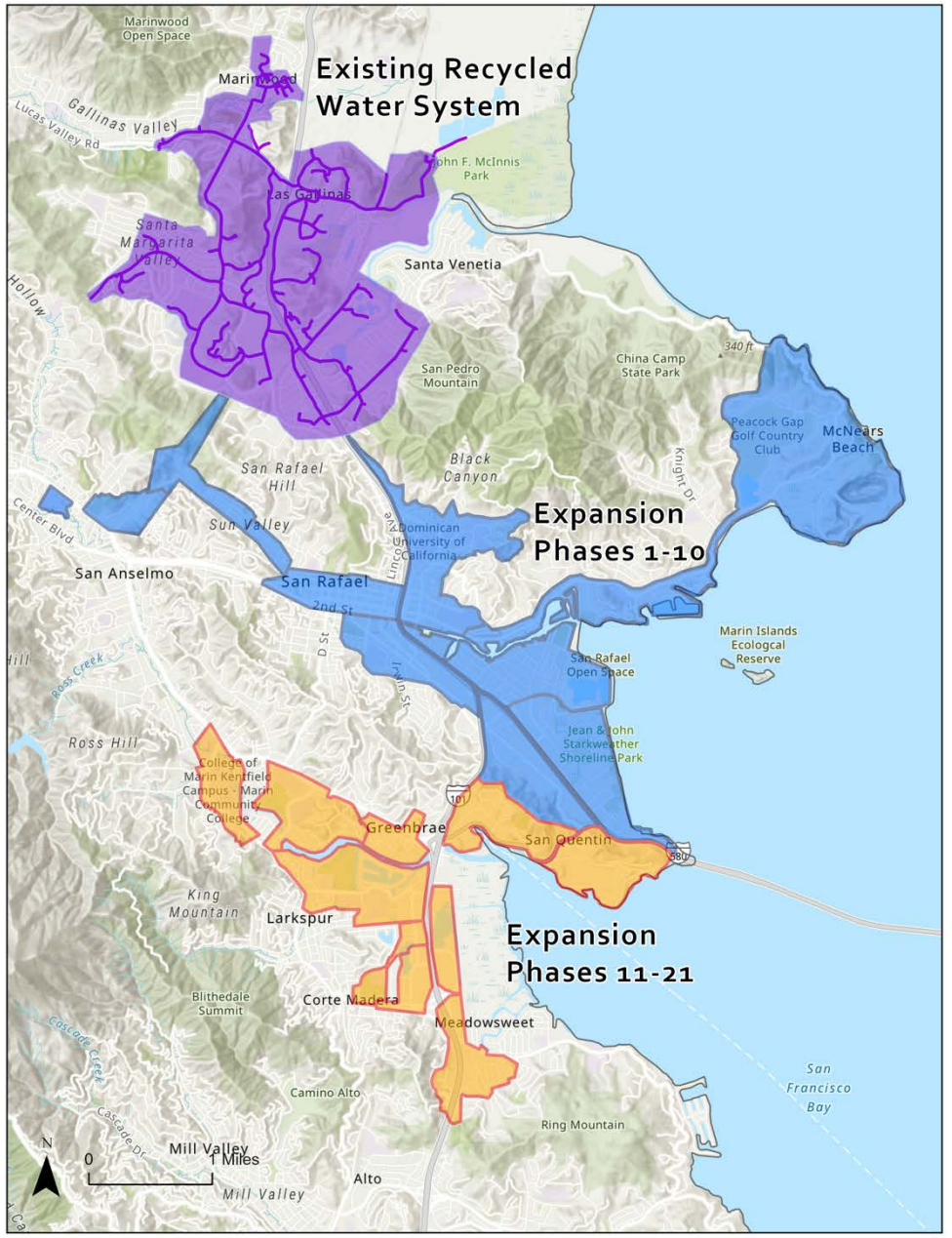




Increase Recycled Water Use: Phased Expansion of System

Evaluated phased approach to expanding recycled water system (2000 Recycled Water Feasibility Study) and updated demand offsets and costs since *(SF Bay Area CCI 2023)*

	Demand (acre-feet)	Pipe Length (miles)	Est. Capital Cost	Annual Cost/AF
Existing System	706	25		
Expansion Phases 1-10 *(San Rafael, Peacock Gap, Canal Area)*	345	24.0	$60.6M	$10,945
Expansion Phases 11-21 *(San Quentin, Corte Madera, Larkspur/Greenbrae)*	602	17.0	$64.7M	$7,126



Increase Recycled Water Use:
Project-based Expansion of System

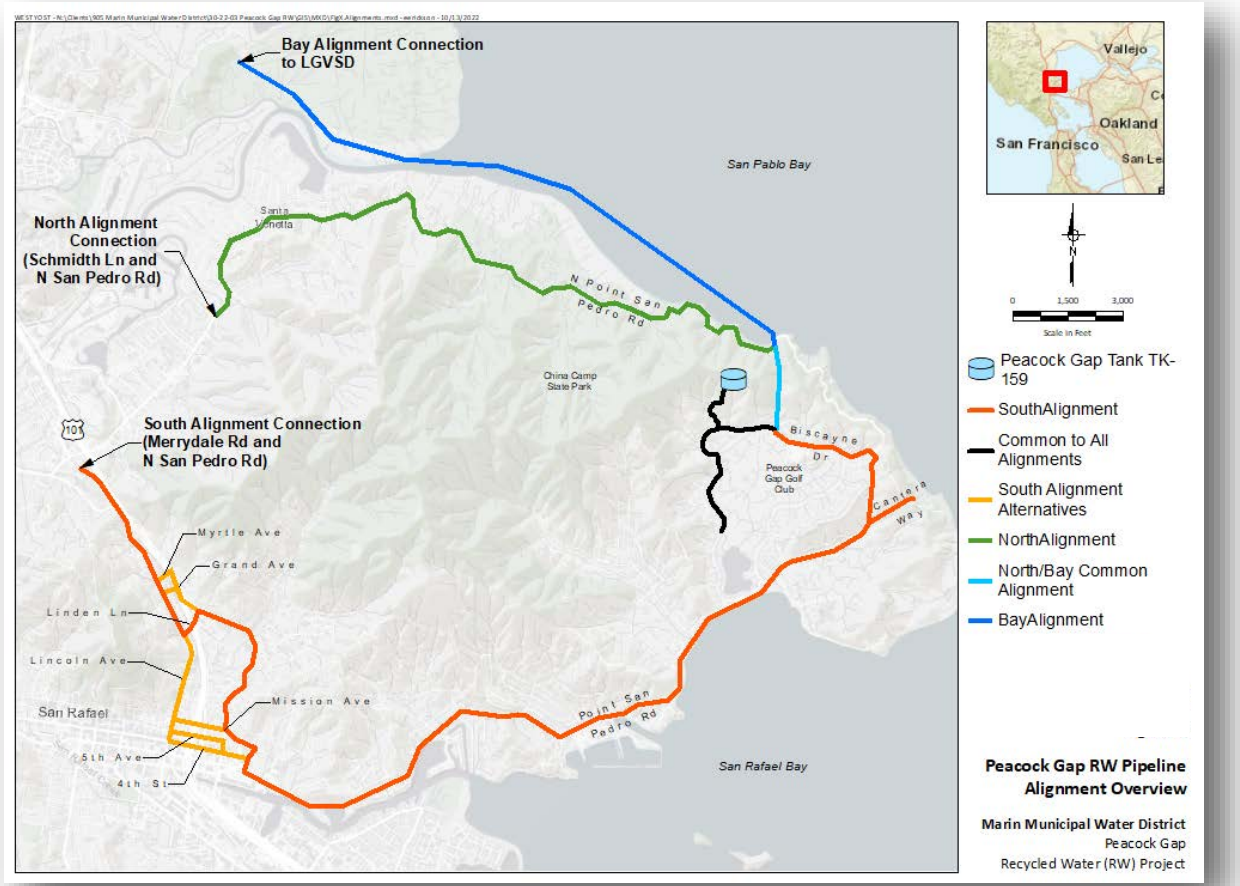
- Project-based expansions of recycled water system also evaluated for feasibility
- Expansion projects are typically adjacent to existing recycled water system
- Potable offset demands and costs are monitored and updated *(SF Bay Area CCI 2023)*

Project	Demand (acre-feet)	Est. Capital Cost	Annual Cost/AF
Lucas Valley Extension	21	$3.3M	$10,015
Mt. Tam Cemetery	18	$3.0M	$10,382
Circle Road	8.3	$2.3M	$16,449
Peacock Gap	285	$26.7M	$6,355

Increase Recycled Water Use: Project-based Expansion
Peacock Gap Preliminary Design (2022)

- Evaluated 3 pipeline routes to serve Peacock Gap area with recycled water
- Assessed water demand offset, environmental considerations, constructability, etc.
- Identified preferred alternative and provided 30% design drawings

Alignment	Demand (ac-ft)	Pipe Length (miles)	Est. Capital Cost	Annual Cost/AF
South Route (Central San Rafael)	285	8.7	$26.7M	$6,355
North San Pedro Route	176	5.7	$16.6M	$6,390
Bay Route	173	4.9	$19.9M	$7,552



Increase Recycled Water Use: Add New Recycled Water System

Evaluated as part of 2015-16 Feasibility Studies with CMSA and SASM, and updated costs since *(SF Bay Area CCI 2023)*

Project	Demand (acre-feet)	Est. Capital Cost	Annual Cost/AF
San Quentin (CMSA)	150	$11.4M	$5,359
MMWD/SASM	81	$4.3M	$4,078

Summary: Recycled Water Expansion Opportunities

Project	Demand (acre-feet)	Est. Capital Cost	Annual Cost/AF
Expansion Phases 1-10* *(San Rafael, Peacock Gap, Canal Area)*	345	$60.6M	$10,945
Expansion Phases 11-21 *(San Quentin, Corte Madera, Larkspur/Greenbrae)*	602	$64.7M	$7,126
Peacock Gap* *(South Alignment)*	285	$26.7M	$6,355
San Quentin (CMSA)	150	$11.4M	$5,359
MMWD/SASM	81	$4.3M	$4,078
Lucas Valley Extension	21	$3.3M	$10,015
Mt. Tam Cemetery	18	$3.0M	$10,382
Circle Road	8.3	$2.3M	$16,449

**Peacock Gap is a sub-project of Phases 1-10 with majority of demand due to golf course*

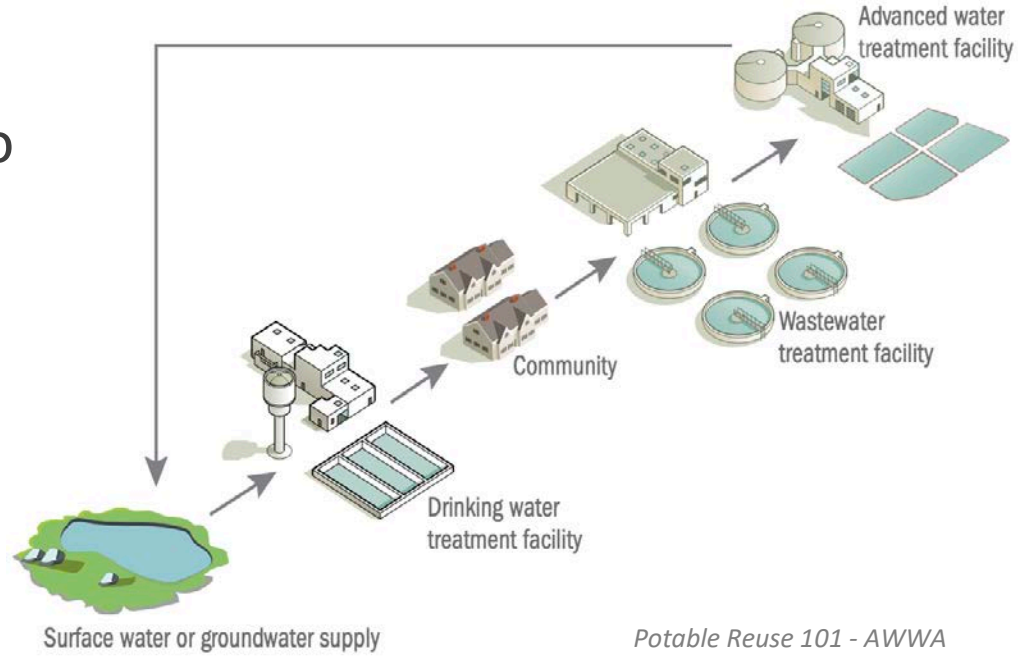
Challenges and Opportunities: Recycled Water

- Drought proof supply
- Expansion of recycled water in District service area is possible but high $/AF
- Expanding recycled distribution system creates future long-term maintenance
- Continue to pursue grant funding opportunities to improve cost-benefit of recycled “purple pipe” opportunities
- **Explore potable reuse options**

Potable Reuse Options

Overview: Indirect Potable Reuse (IPR)

- Planned use of recycled (purified) water to replenish drinking water supplies with a suitable environmental barrier
- Two types of IPR:
  - **Groundwater recharge**: use recycled water to replenish groundwater basin as source of municipal water supply
  - **Surface water augmentation**: placement of recycled water into a surface water reservoir that is used as a source of domestic drinking water supply



Potable Reuse 101 - AWWA 2016

Groundwater augmentation IPR not feasible in Marin

Treatment Requirements: Indirect Potable Reuse (IPR)

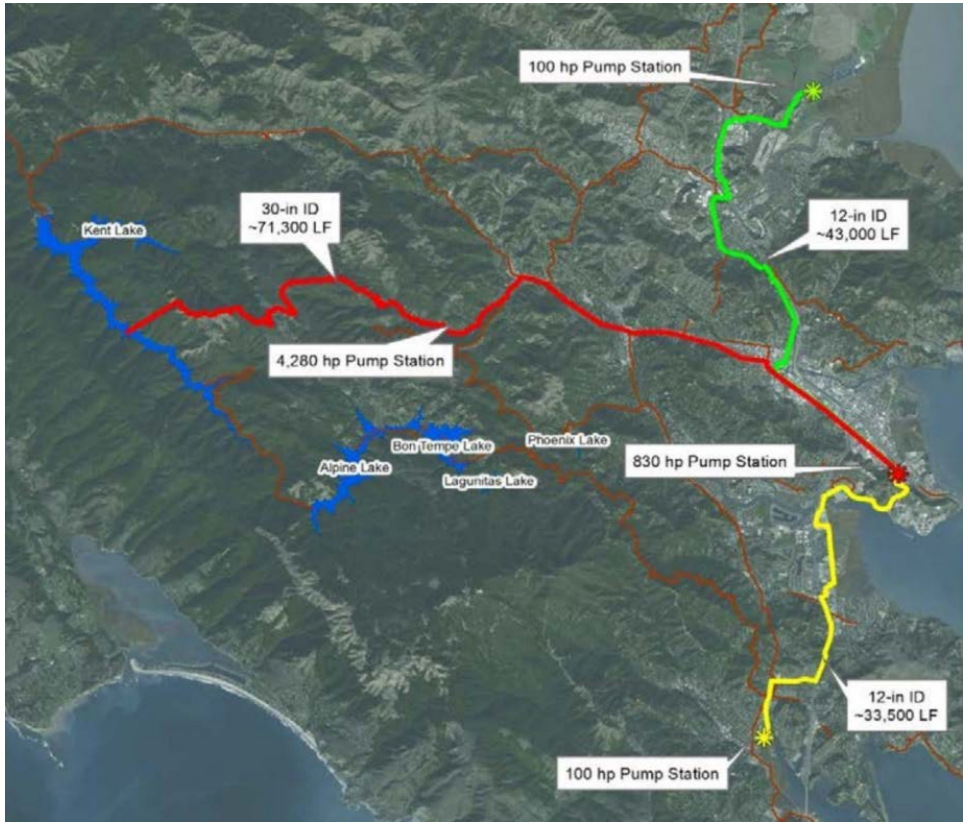
- Pathogen Control reduction required through the treatment train:
  - 12-log reduction enteric virus
  - 10-log reduction Giardia
  - 10-log reduction Cryptosporidium
  - No individual process may receive more than 6-log reduction credit for any one pathogen class
- Additional requirements depending on selected treatment process include combinations of:
  - Retention time: 2 – 6+ months (underground or in surface water)
  - Dilution: 10:1 – 100:1
  - Reverse Osmosis (RO)
  - Advanced oxidation process
  - May include higher log reduction credits as well
- Develop source control program as well as online monitoring and pretreatment program

1 log = 90% reduction of pathogens
2 log = 99% reduction
3 log = 99.9% reduction
4 log = 99.99% reduction
5 log = 99.999% reduction
… and so on

Conceptual Project in Marin: Indirect Potable Reuse (IPR)

Marin Regional IPR Project (Surface Water Augmentation)

- Collect secondary effluent from LGVSD & SASM, convey to CMSA
- Construct Advanced Water Purification Facility to meet Surface Water Augmentation IPR: Ultrafiltration, Reverse Osmosis, UV-AOP, conditioning
- Convey purified water to Kent Lake through 28 miles of dedicated pipelines and 4 new pump stations
- Expected annual yield 7,840 AFY (7 mgd)



Project	Demand (acre-feet)	Est. Capital Cost	Operations	Annual Cost/AF
Marin Regional IPR (Surf. Water Augmentation)	7,840	$452.0 M	Continuous	$4,504
			Intermittent	$13,512*

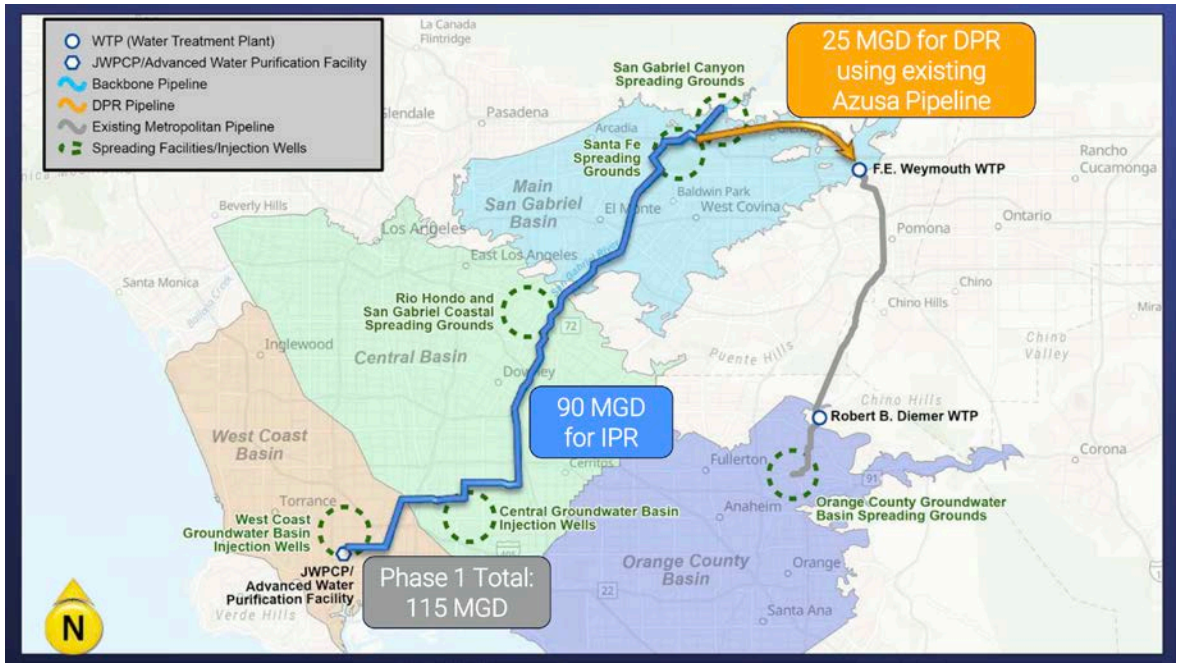
** Cost($)/AF assumes continuous operations. Cost/AF likely to increase 3x if operated intermittently.*

Planned or Operational Projects (California): Indirect Potable Reuse (IPR)

Project	Reuse Type	Capacity	Retention Time	Status	Cost
Orange County Groundwater Replenishment System	IPR – groundwater augmentation	Expansion from 100 to 130 MGD completed in 2023	> 2 months in groundwater basin	Operating since 1976	$284 M (Expansion of +30 MGD completed in 2023)
San Diego Pure Water Project	Phase 1: IPR-surface water augmentation Phase 2: DPR raw water augmentation	Phase 1: 30 MGD Phase 2: Add'l 53 MGD	>2 months in reservoir with >10:1 dilution	Construction Phase 1: 2025 startup **Phase 2: ~2035**	Phase 1: ~$1.5 billion Phase 2: Under development
Santa Clara Valley Water Advanced Water Purification Facility	Current: Non-potable use Future: IPR-groundwater augmentation	Current Facility: 8 MGD Future: +4-24 MGD	N/a	Current Facility operating; **Future phases - planning**	Future Phases: Est. $1 Billion
Pure Water Southern California (Metropolitan Water)	Phase 1: IPR-groundwater augmentation Future: DPR (planning)	Phase 1: 100 MGD Future: 150 MGD (up to 168,000 AFY)	2-6 months in groundwater basin	Phase 1 Design & Construction 2024-2031 **Startup Operations: 2032**	$3.4 Billion (cost est. from 2018 and undergoing revision)
Pure Water Monterey	IPR-groundwater augmentation	3,500 AFY Future: +2,250 AFY	6-9 months in groundwater basin	Operational since 2020	$46M Future: +$141M

Planned or Operational Projects (California): Pure Water Southern California

- Partnership between Metropolitan Water District of Southern California and LA County Sanitation Districts to build one of largest reuse programs in world
- Will increase drought resiliency in Southern California
- At full-scale will operate a 150-MGD advanced water treatment plant, 60+ miles of dedicated conveyance to groundwater basins
- Incorporate flexible design for future expansion through DPR (raw water augmentation)
- Current Project Schedule:
  - Operating a demonstration plant since 2019 & conducting preliminary design studies
  - Final Design: 2025-2027
  - Construction: 2027 – 2031
  - Start-up and testing: 2032



Pure Water Southern California -- Phase 1

Considerations: Indirect Potable Reuse

- Large capital investments and significant operating costs
- Permitting for blending purified recycled water into Kent Lake water
- For Marin, conveyance of to local reservoir significantly increases cost
- Constituents of concern
  - Trace contaminants – pharmaceuticals, PFAS, personal care products, other trace organics
  - Concentrate management – RO concentrate discharged to Bay
- Continuous operations – treatment facilities are not designed to be operated intermittently
- **Is DPR a better fit?**

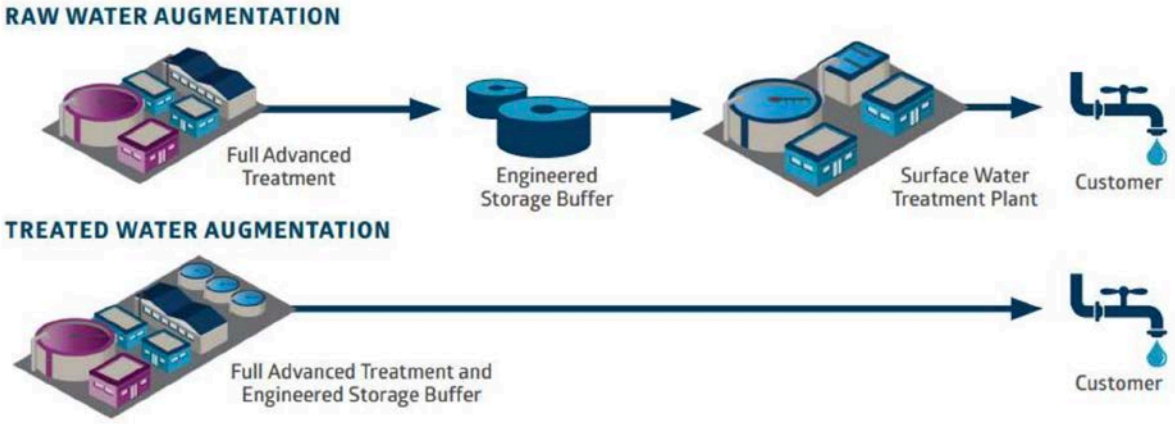
Overview: Direct Potable Reuse (DPR)

Planned introduction of purified recycled water either

- **<u>Raw water augmentation</u>**: into a raw water supply immediately upstream of a water treatment plant

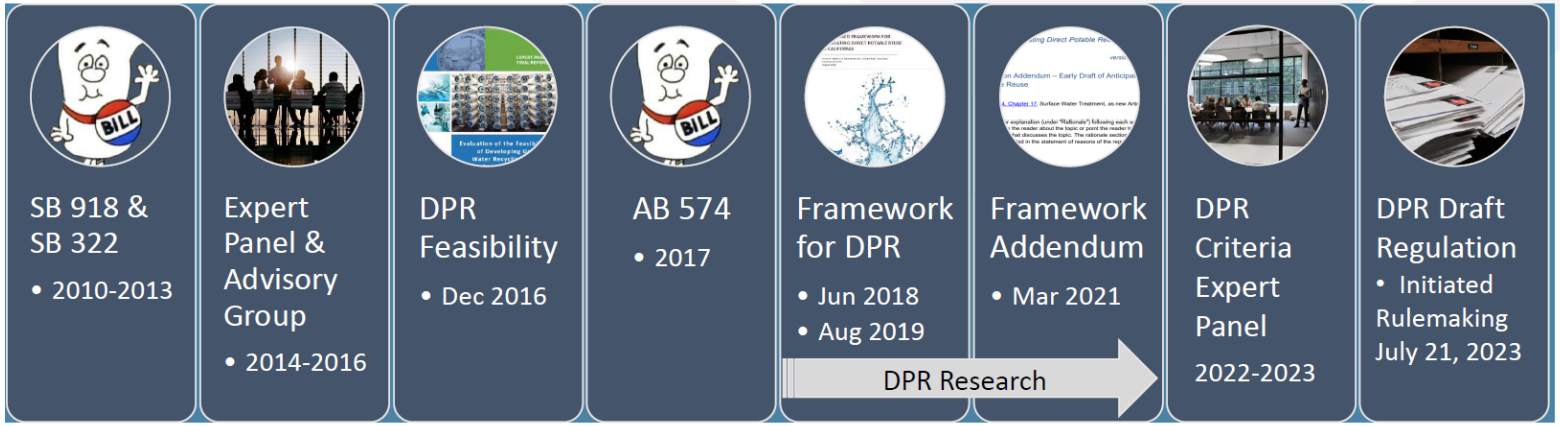
OR

- **<u>Treated water Augmentation:</u>** directly into a public water system



California Regulatory Context: Direct Potable Reuse (DPR)

DPR Regulatory Development Timeline



AB 574: Adopt uniform water recycling criteria for direct potable reuse through raw water augmentation by December 31, 2023

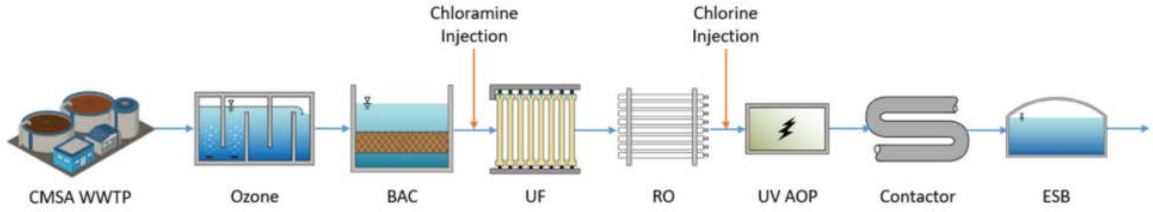
California Water Boards

- CA SWRCB Released Draft Regulation for 45-day Public Comment on July 21, 2023
- Public Hearing: Sept 7, 2023
- Target Adoption: Dec 31, 2023
- Estimated effective date: 2nd Quarter 2024

Draft Treatment Requirements: Direct Potable Reuse (DPR)

- Pathogen Control and reduction required through the treatment train:
  - 20-log removal enteric virus
  - 14-log Giardia
  - 15-log Cryptosporidium
  - No individual process may receive more than 6-log reduction credit for any one pathogen class
- Required to include:
  - Ozone/biologically activated carbon (BAC) filtration
  - Reverse Osmosis (RO)
  - UV/AOP
- Develop source control program as well as online monitoring and pretreatment program
- 24 months of monthly feed water monitoring prior to operations for regulated contaminants

1 log = 90% reduction of pathogens
2 log = 99% reduction
3 log = 99.9% reduction
4 log = 99.99% reduction
5 log = 99.999% reduction
… and so on



From DPR TM (2022)

Conceptual Project in Marin: Raw Water Augmentation (DPR)

Marin Regional DPR Project (Raw Water Augmentation)

- Collect secondary effluent from LGVSD & SASM, convey to CMSA
- Construct Advanced Water Purification Facility to meet Raw Water Augmentation DPR: Ozone/BAC, Ultrafiltration, Reverse Osmosis, UV-AOP, chlorine contact, conditioning
- Convey purified water to Bon Tempe Lake through 22.6 miles of dedicated pipelines and 3 new pump stations
- Discharge RO reject to CMSA effluent outfall
- Expected annual yield 7,840 AFY (7 mgd)

Project	Demand (acre-feet)	Est. Capital Cost	Operations	Annual Cost/AF
Marin Regional DPR (Raw Water Augmentation)	7,840	$433.8 M	Continuous	$5,146
			Intermittent	$15,438*

** Cost($)/AF assumes continuous operations. Cost/AF likely to increase 3x if operated intermittently.*

Conceptual Project in Marin: Treated Water Augmentation (DPR)

MMWD-CMSA TWA (DPR) Project

- Advanced Water Purification Facility at CMSA, only treat CMSA effluent, connection to exiting distribution (treated water augmentation) up to 4 mgd
- Targeted to meet DRAFT DPR treatment requirements
- Treatment Trains include:
  - Ozone (O3)
  - Biological active carbon (BAC)
  - Ultrafiltration (UF)
  - Reverse Osmosis (RO)
  - Ultraviolet light advanced oxidation process (UV AOP) using free chlorine
  - Free chlorination
  - Additional UV disinfection
  - Stabilization and chloramination for distribution

Figure 5.1 Map of Proposed Infrastructure

Project	Demand (acre-feet)	Est. Capital Cost	Operations	Annual Cost/AF
MMWD-CMSA DPR (Treated Water Augmentation)	4,480	$124.4 M	Continuous	$3,562
			Intermittent	$10,686*

** Cost($)/AF assumes continuous operations. Cost/AF likely to increase 3x if operated intermittently.*

Planned or Operational Projects: Direct Potable Reuse (DPR)

Project	Reuse Type	Capacity	Status
Big Spring, Texas	DPR-raw water augmentation	1.7 MGD	In operation since 2013
El Paso, Texas	DPR-treated water augmentation	10 MGD	Construction anticipated 2024
Windhoek, Namibia	DPR-treated water augmentation	5.5 MGD	Operational since 1968
PureWaterSF (SFPUC)	DPR-treated water augmentation	4 MGD	Alternative water supply planning; **construction horizon ~2040**
San Diego Pure Water Project	Phase 1: IPR-surface water augmentation **Phase 2: DPR raw water augmentation**	Phase 1: 30 MGD Phase 2: Add'l 53 MGD	Construction Phase 1: 2025 startup **Phase 2: ~2035**
Pure Water Southern California (Metropolitan Water)	Phase 1: IPR-groundwater augmentation **Future: DPR raw water augmentation**	Phase 1: 100 MGD Future: 150 MGD (up to 168,000 AFY)	Phase 1 Design & Construction 2024-2031 **Startup Operations: 2032**

Considerations: Direct Potable Reuse

- Public acceptance – No implementation of treated water augmentation in the US
- Regulations are still under review – earliest effective date is mid-2024, subject to refinement over time
- Constituents of concern
  - Trace contaminants – pharmaceuticals, PFAS, personal care products, other trace organics;
  - Concentrate management – RO concentrate discharged to Bay
- Introduces different water sources for different parts of service area
- Not designed to be intermittently operated

Water Reuse Options Cost Estimate Summary

Project	Reuse Project Type	Demand (acre-feet)	Est. Capital Cost	Cost/AF
MMWD/SASM	Recycled (Non-potable)	81	$4.3M	$4,078
San Quentin (CMSA)	Recycled (Non-potable)	150	$11.4M	$5,359
Peacock Gap *(South Alignment)*	Recycled (Non-potable)	285	$26.7M	$6,355
Marin Regional IPR	IPR – Surface Water Augmentation (potable)	7,840	$452.0 M	$4,504*
Marin Regional DPR	DPR – Raw Water Augmentation (potable)	7,840	$433.8 M	$5,146*
MMWD-CMSA DPR	DPR – Treated Water Augmentation (potable)	4,480	$124.4 M	$3,562*

** Cost($)/AF assumes continuous operations. Cost/AF likely to increase 3x if operated intermittently.*

Next Steps

- Expansion of (purple pipe) recycled water in District service area is possible but capital intensive
  - Pursue grant opportunities to help fund recycled water projects
- Monitor industry regulations, trends and technological advances such as DPR
- Consider multi-benefit opportunities with sewage agencies as SF Bay nutrient regulations move forward
  - Irrigation with recycled water ideal for nutrient removal (vs IPR and DPR which concentrate nutrients)
- Continue to evaluate and prioritize reuse opportunities as a component of overall Water Supply Roadmap implementation