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Managing Water in the West

San Diego Basin Study Public Meeting

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October 24, 2018

U.S. Department of the Interior
Bureau of Reclamation

Meeting Purpose and Agenda

Meeting Purpose: ***Share and discuss the results and conclusions of Task 2.4***

- **Welcome & Introductions**
- **San Diego Basin Study Overview and Update**
- **Task 2.4 Background and Methods**
- **Task 2.4 Impacts Assessment Results**
- **Task 2.4 Results Discussion by Concept**
- **Task 2.4 Conclusions**
- **Next Steps**
- **Adjourn**

San Diego Basin Study Participants

- **Technical Team**

- **Study Technical Advisory Committee (STAC)**
- **Public Stakeholders**

Agenda

- Welcome & Introductions
- Study Overview and Update
- Results by Impact Area

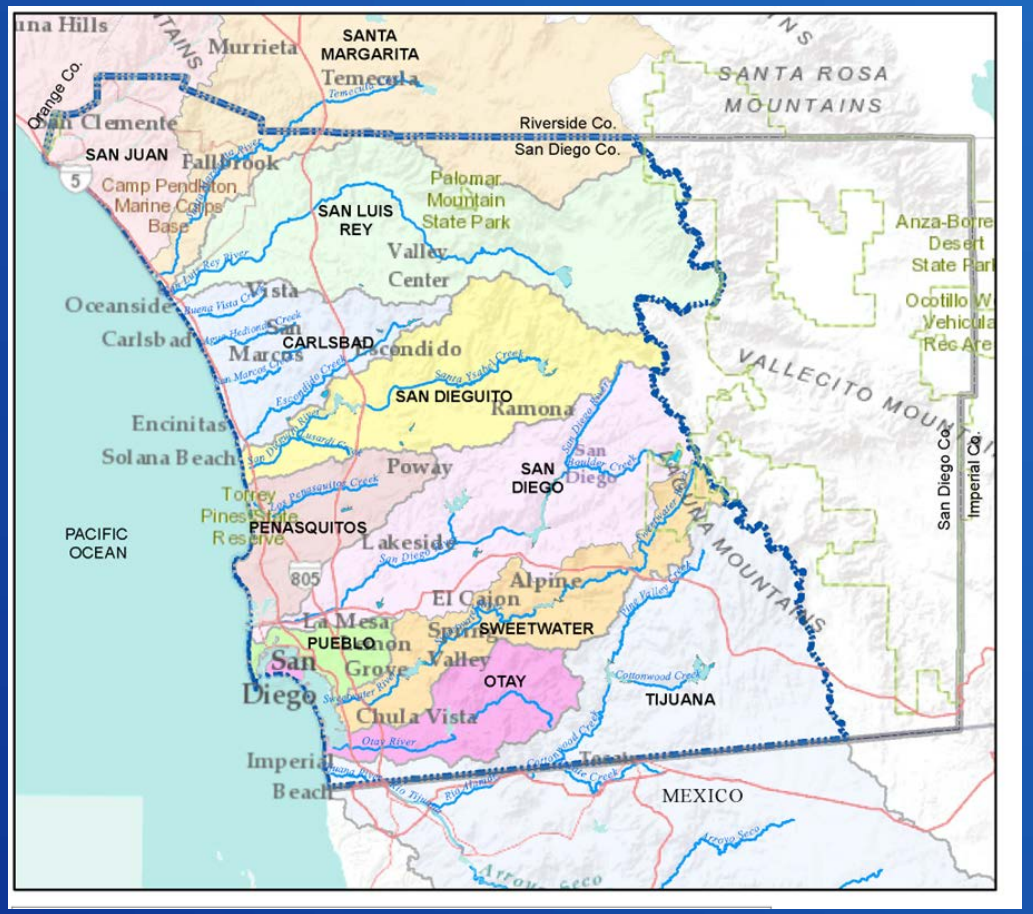
Break

- Results by Concept
- Background and Methods
- Next Steps
- Adjourn

San Diego Basin Study Objectives

1. Determine how climate change will impact the water supply system

2. Develop structural and non-structural adaptation strategies to manage climate change impacts



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San Diego Basin Study Overview

- Project time frame April 2015 – February 2019
- Total project cost $2.1 million
  - $1 M Bureau of Reclamation
  - $759,460 SD IRWM Program Prop 50
  - $300,000 City of San Diego
- Project managed by the Bureau of Reclamation and City of San Diego

The City of SAN DIEGO

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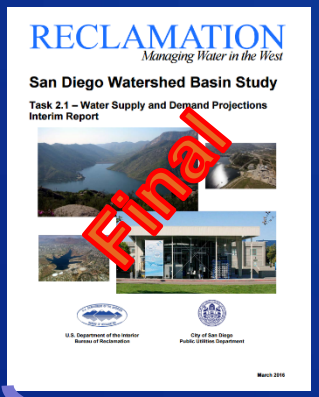
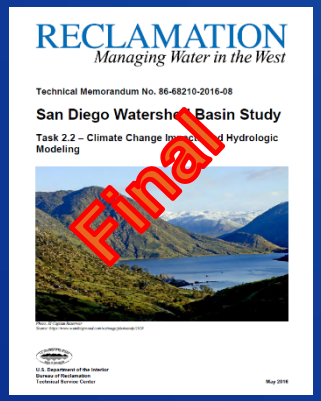
San Diego Basin Study Tasks & Status

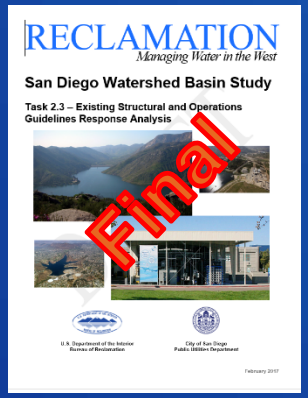
Water Supply and Water Demand Projections (Task 2.1)



Downscaled Climate Change and Hydrologic Modeling (Task 2.2)



Existing Structural Response and Operations Guidelines Analysis (Task 2.3)



Structural and Operations Concepts (Task 2.4)

Task 2.4

Final

Trade-Off Analysis and Opportunities (Task 2.5)

Task 2.5

Draft

Summary Report

(Task 2.6)

Feb 2019

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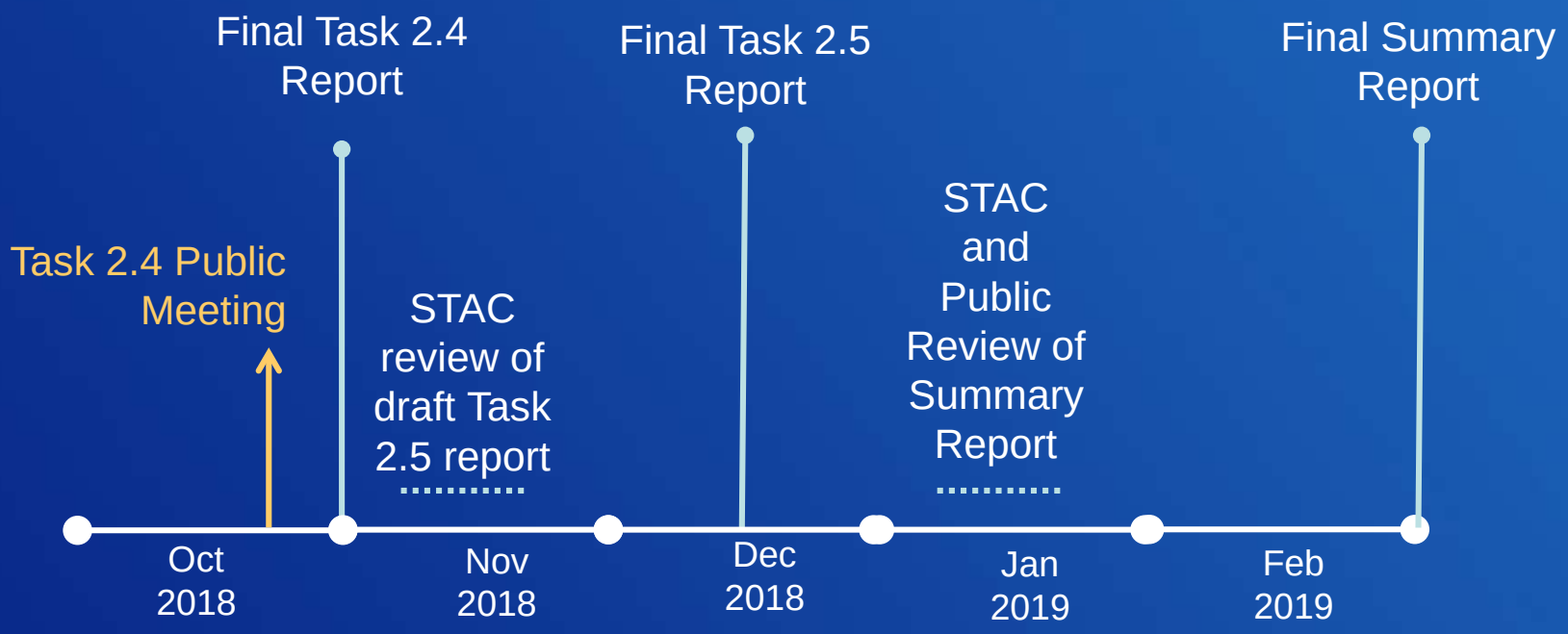
Study Status & Timeline



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Agenda

- Welcome & Introductions
- Study Overview and Update
- **Task 2.4 Background and Methods**
- Results by Impact Area

Break

- Results by Concept
- Next Steps
- Adjournment

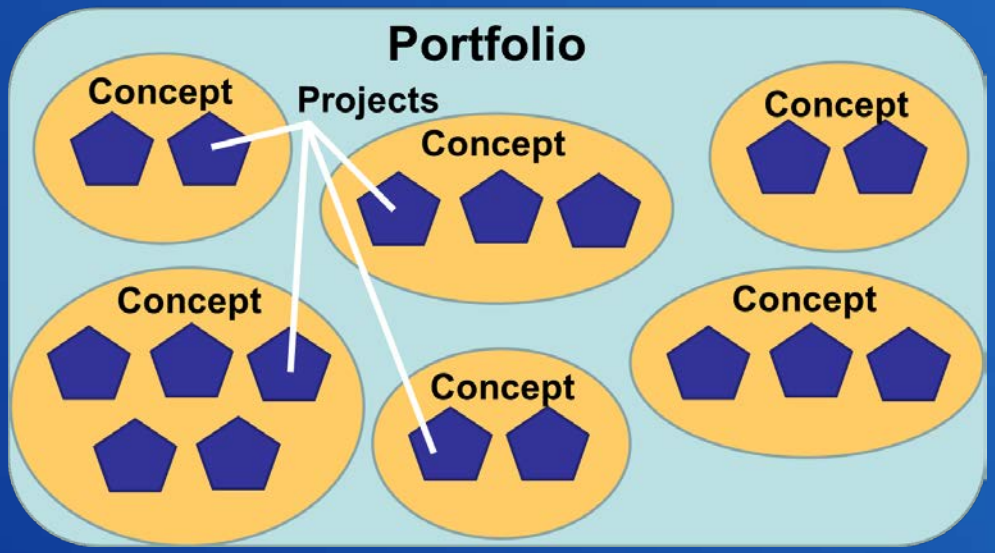
Task 2.4 Purpose

The purpose of Task 2.4 of the San Diego Basin Study was to analyze and explore differences in water deliveries, flood control, recreation, and energy among a range of approaches to meet water demands and address the impacts of increasing demand and climate variation through the 2050s.

San Diego Basin Study Portfolios

Portfolios **Handout 1**

- **Baseline (B)**
- **Baseline Plus (B+)**
- **Increase Supplies (IS)**
- **Enhanced Conservation (EC)**
- **Optimize Existing Facilities (OEF)**
- **Watershed Health and Ecosystem Restoration (WE)**



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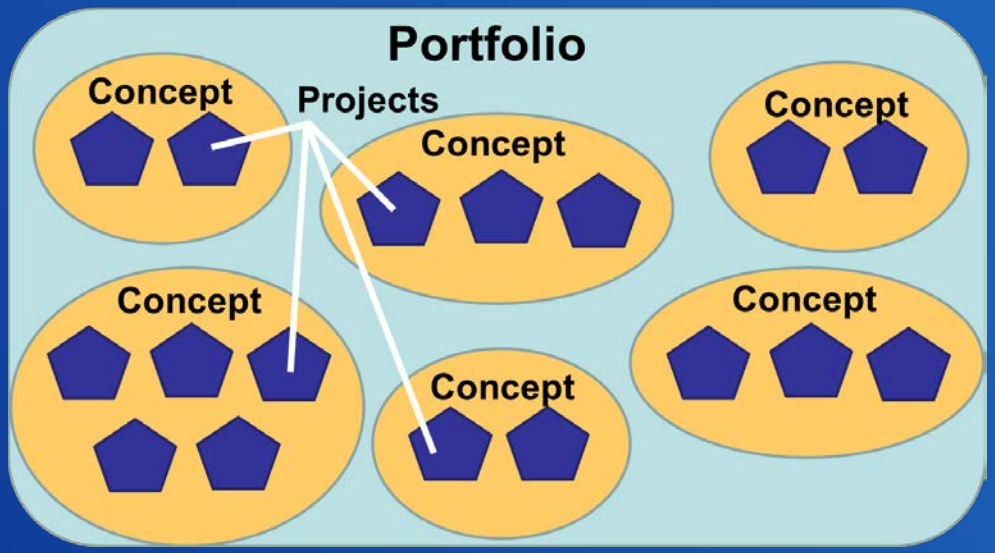
San Diego Basin Study Concepts

Concepts Handout 1

- Conveyance Improvements
- Drought Restriction/Allocation
- Firm Water Supply Agreements
- Gray Water Use
- Groundwater
- Imported Water Purchases
- Local Surface Water Reservoirs
- Potable Reuse
- Recycled Water
- Seawater Desalination
- Stormwater BMPs
- Stormwater Capture
- Urban & Ag. Water Use Efficiency
- Watershed and Ecosystem Management



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Baseline Portfolio (B)

Represents the system as it existed in 2015, with some minor modifications to include water supplies that have been or will be implemented (e.g., Carlsbad Desalination Plant and the full QSA annual transfer volume)

Concepts

- Conveyance Improvements
- Drought Restriction/Allocation
- Firm Water Supply Agreements
- Groundwater
- Imported Water Purchases
- Local Surface Water Reservoirs
- Potable Reuse
- Recycled Water
- Seawater Desalination
- Urban & Ag. Water Use Efficiency

Baseline Plus Portfolio (B+)

Baseline projects and projects that are being actively pursued or have received funding as of 2017 (e.g. Pure Water San Diego Phase 1, Hodges Water Quality Improvement Program, and Sweetwater Reservoir Wetlands Habitat Recovery)

Concepts

- All Baseline Portfolio Concepts
- Modified or New Concepts
  - Conveyance Improvements
  - Gray Water Use
  - Groundwater
  - Potable Reuse
  - Recycled Water
  - Stormwater Capture
  - Urban & Ag. Water Use Efficiency
  - Watershed and Ecosystem Management

Enhanced Conservation Portfolio (EC)

Looks at enhanced water conservation beyond currently planned levels (1% reduction in water demand per year, starting in 2020 when it is assumed that the 20x20 targets outlined in SBX7-7 are reached)

Concepts

- All Baseline Plus Portfolio Concepts
- Modified or New Concepts
  - Enhanced Conservation

Increase Supplies Portfolio (IS)

Projects that focus on increasing regional water supplies (e.g. Pure Water San Diego Phase 2, Re-rating of Carlsbad Desalination, and Rosarito Desalination)

Concepts

- All Baseline Plus Portfolio Concepts
- Modified or New Concepts
  - Gray Water Use
  - Groundwater
  - Imported Water Purchases
  - Potable Reuse
  - Recycled Water
  - Seawater Desalination

Optimize Existing Facilities Portfolio (OEF)

Focuses on enhancing the efficiency of existing facilities by replacing, repairing, or maintaining existing infrastructure to maximize its operation (e.g. San Diego County Reservoir Intertie and Dulzura Conduit Replacement)

Concepts

- All Baseline Plus Portfolio Concepts
- Modified or New Concepts
  - Conveyance Improvements

Watershed Health/Ecosystem Restoration Portfolio (WE)

Seeks to restore or create natural habitats and minimize environmental impacts (e.g. Rainwater Harvesting and Sweetwater River Park Bioretention)

Concepts

- All Baseline Plus Portfolio Concepts
- Modified or New Concepts
  - Stormwater BMPs
  - Stormwater Capture
  - Watershed and Ecosystem Management

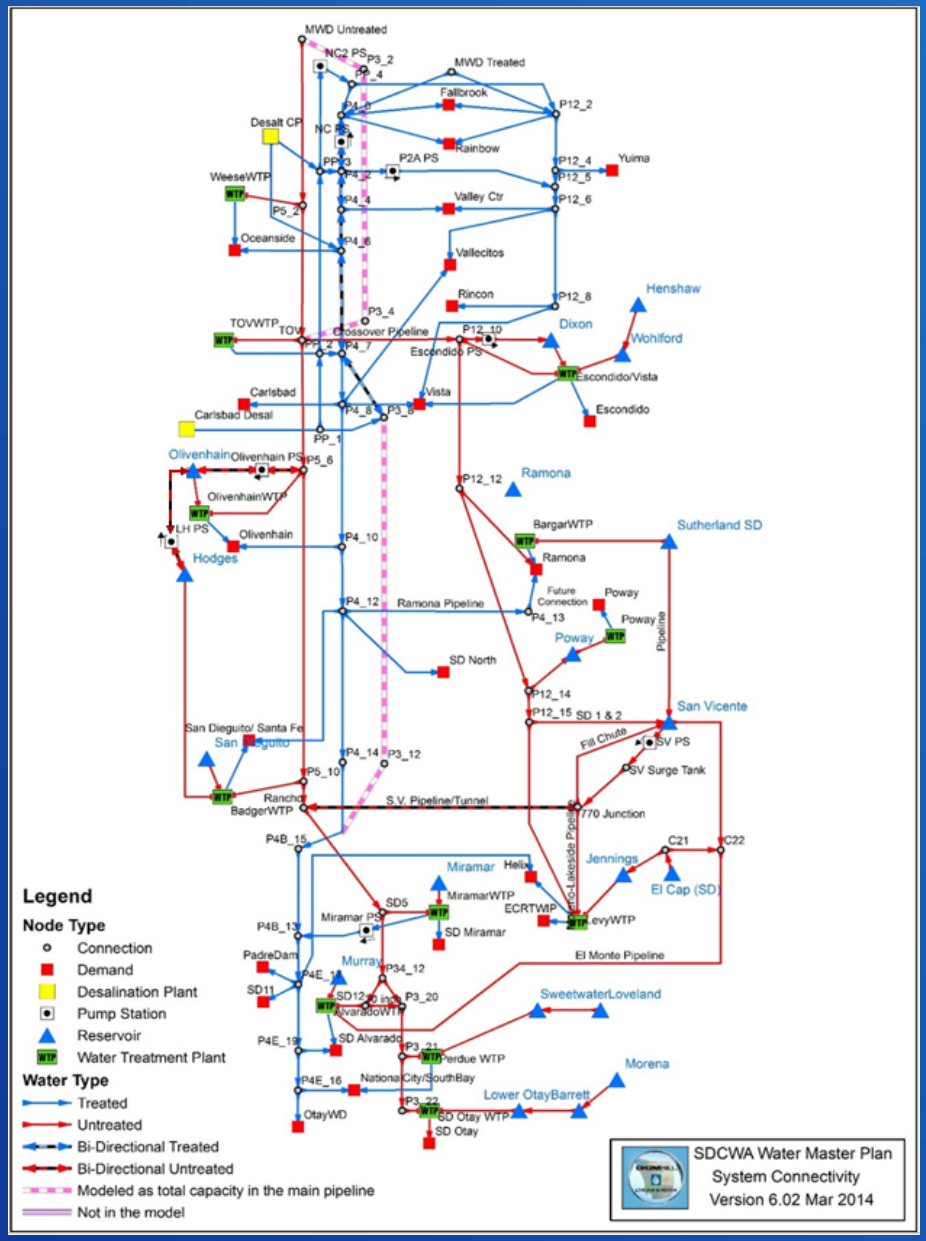
CWASim Model

Allows us to simulate future supply, demand, and infrastructure scenarios to identify impacts

Includes:

Demands for SDCWA member agencies except Camp Pendleton

Infrastructure and supplies that are connected to the SDCWA system



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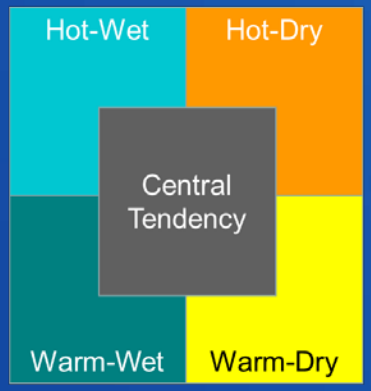
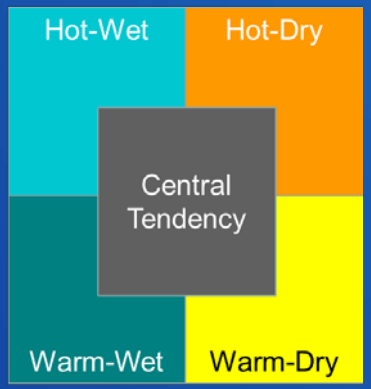
SDBS Demand and Climate Scenarios

2015 Demands + Current Climate

2025 Demands + Current Climate + 

2050 Demands + Current Climate + 

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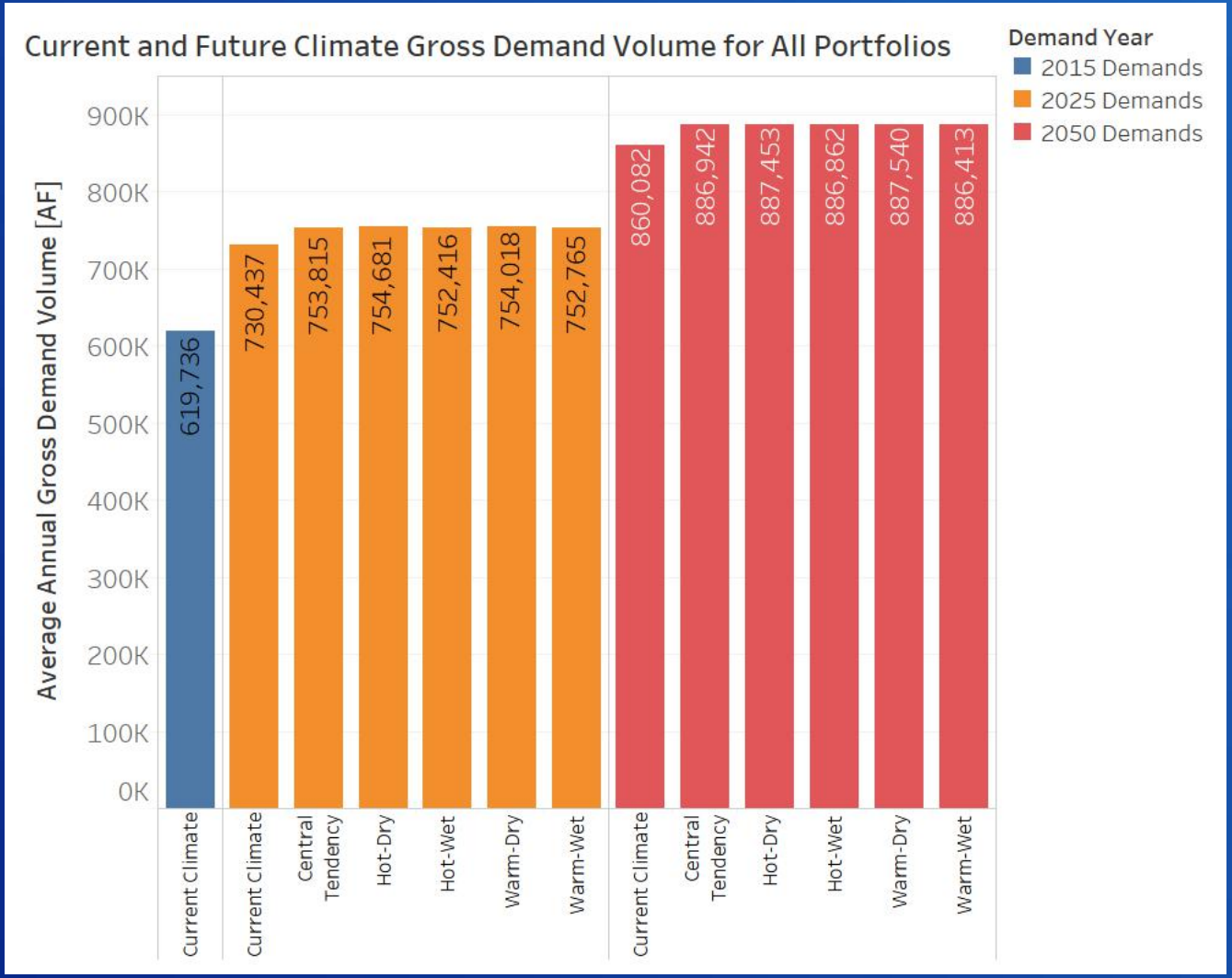
Water Demand Projections



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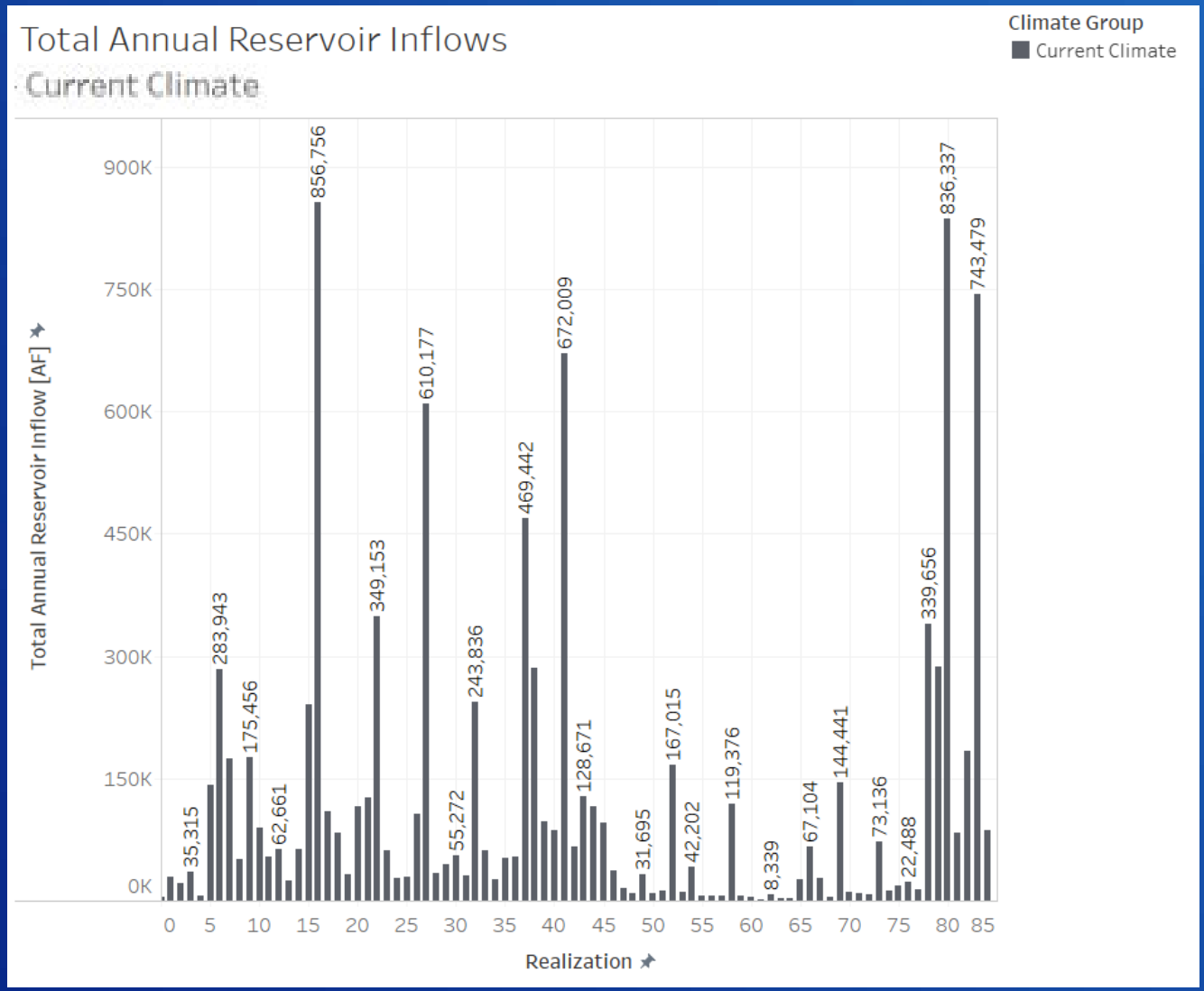
Water Supply Projections



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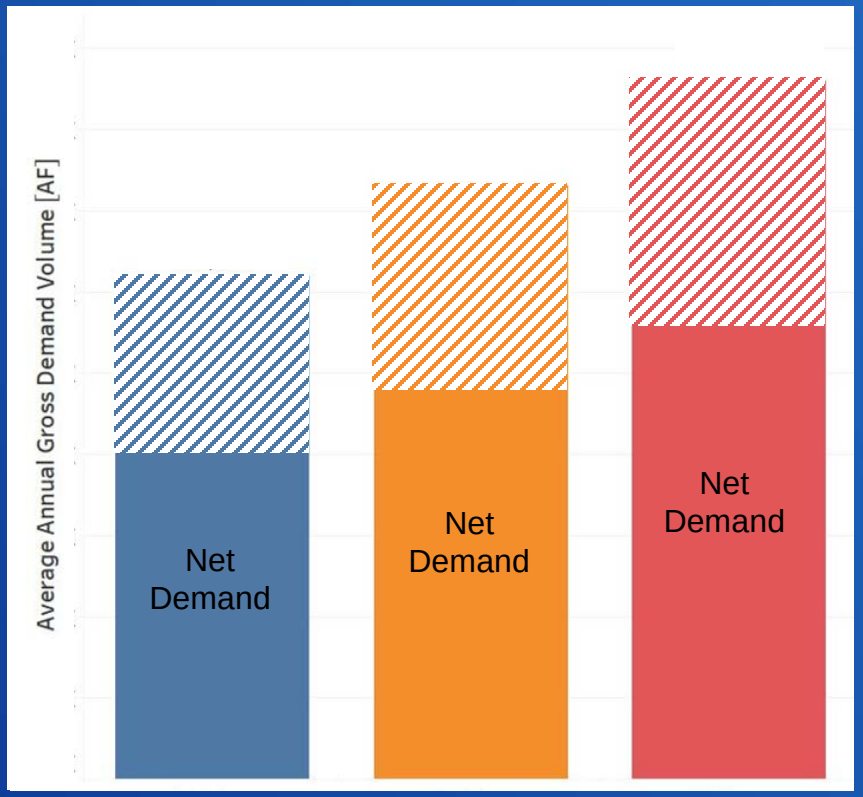
Implementation of Concepts in CWASim

- **Demand Reductions**
  - Enhanced Conservation
  - Gray Water Use
  - Groundwater
  - Imported Water Purchases (Cadiz)
  - Recycled Water
  - Potable Reuse (except Pure Water)
  - Seawater Desalination (Rosarito)
  - Stormwater BMPs
  - Stormwater Capture
  - Urban and Agricultural Water Use Efficiency
  - Watershed and Ecosystem Management



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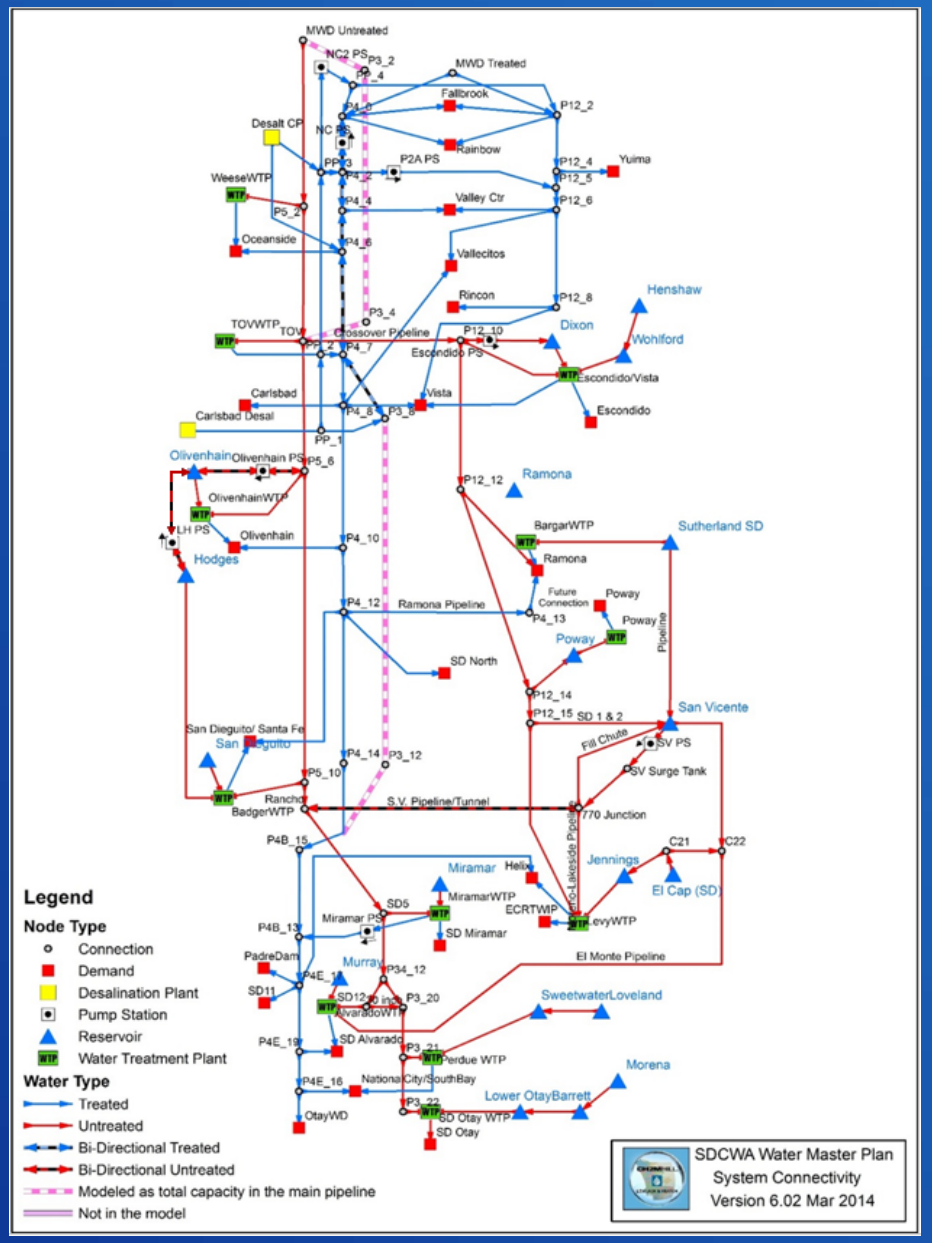
Implementation of Concepts in CWASim

- Dynamically Modeled Supplies
  - Conveyance Improvements
  - Drought Restriction/Allocation
  - Imported Water Purchases (MWD Imported Water)
  - Local Surface Water
  - Potable Reuse (Pure Water San Diego)
  - Seawater Desalination (except Rosarito)
  - Watershed and Ecosystem Management



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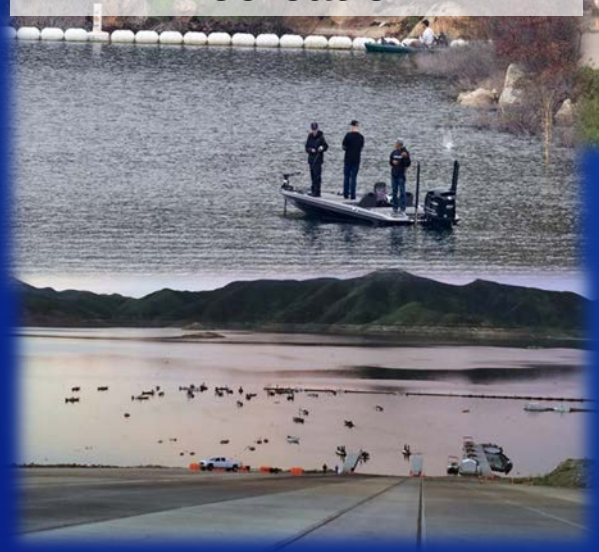
Impacts examined in Task 2.4 of the San Diego Basin Study (Environmental to be examined in Task 2.5)

Flood Control

Energy

Recreation



Water Delivery

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Analysis Methodology

- Metrics for each of the impact areas Handout 2
- Aggregated daily model simulations to monthly and annual outputs
- Analysis techniques:
  - Summary statistics (mean, min, max, % above a threshold)
  - Visualization (bar charts, box plots, time series plots, etc) in Tableau
  - Statistical analysis of differences (ANOVA and Wilcoxon Rank Sum Test)

Questions?

- **Questions about the methods?**
- **Feedback to consider for the Summary Report?**

Agenda

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- **Results by Impact Area**

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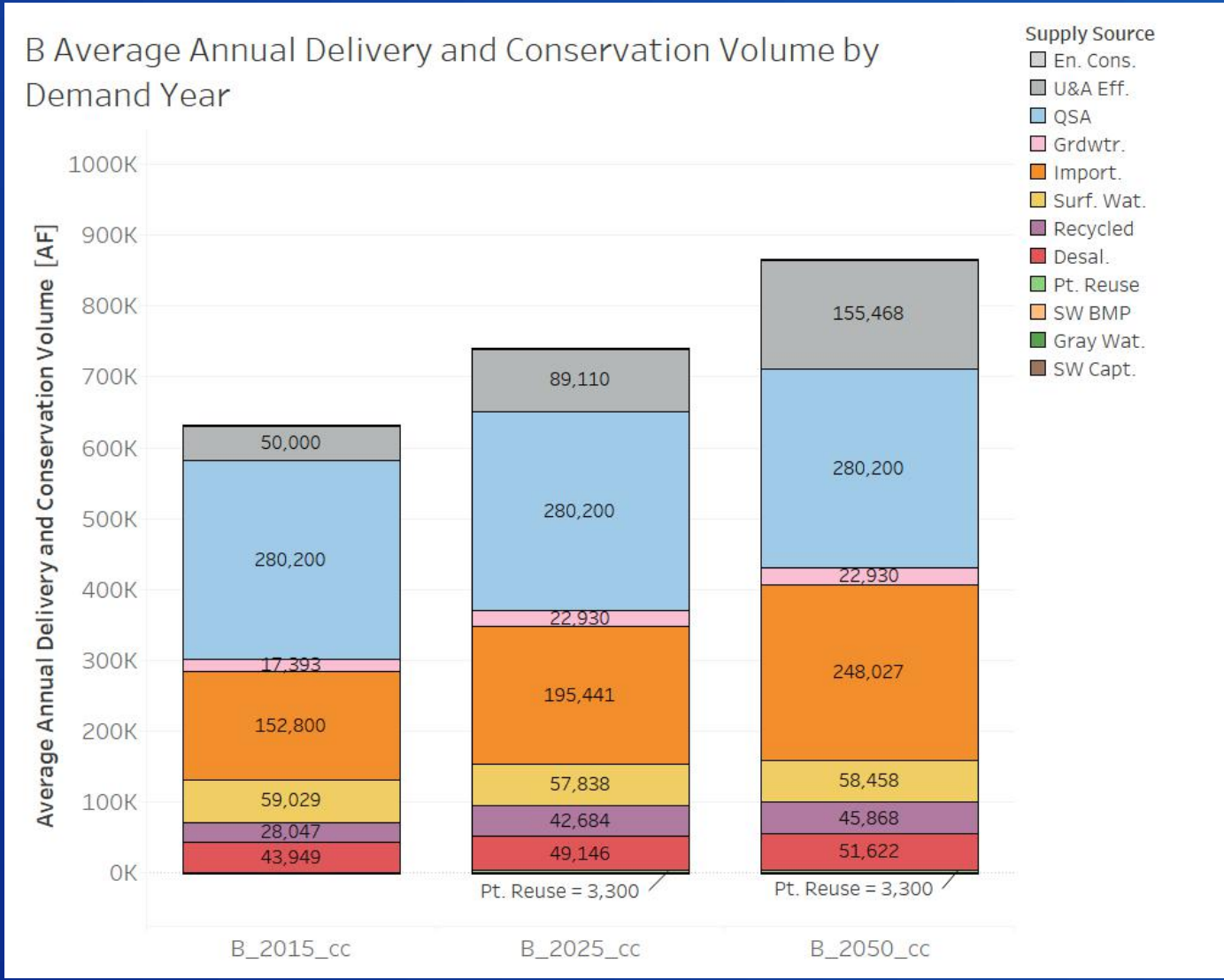
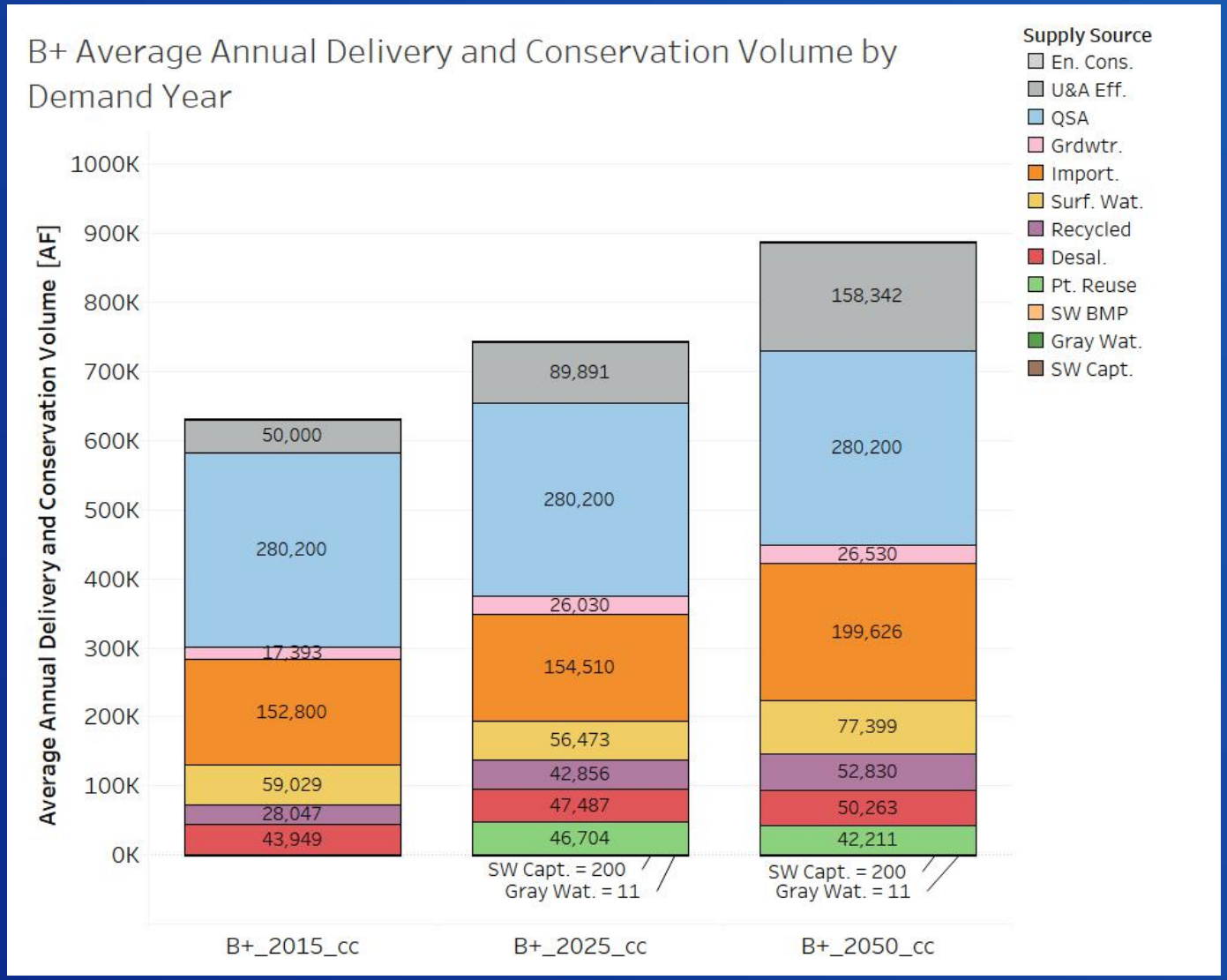
Water Delivery – Deliveries and Conservation

- Delivery volumes describe water volumes that are delivered to meet SDCWA member agency demands
- Types of deliveries correspond to Concepts
- Conservation was included with delivery metrics because it represents a demand reduction that affects the water volume that must be delivered to meet demands

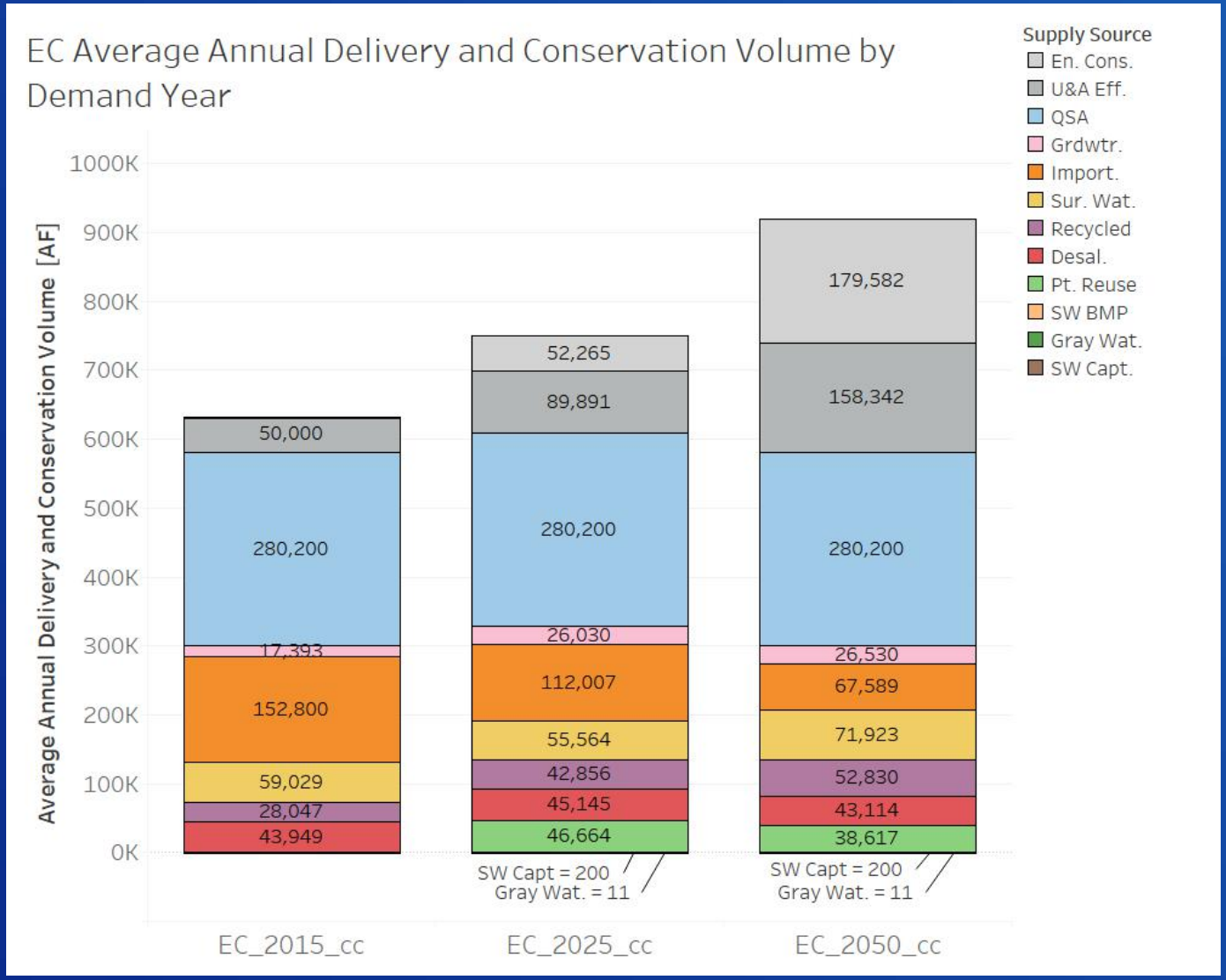
Deliveries & Conservation - B



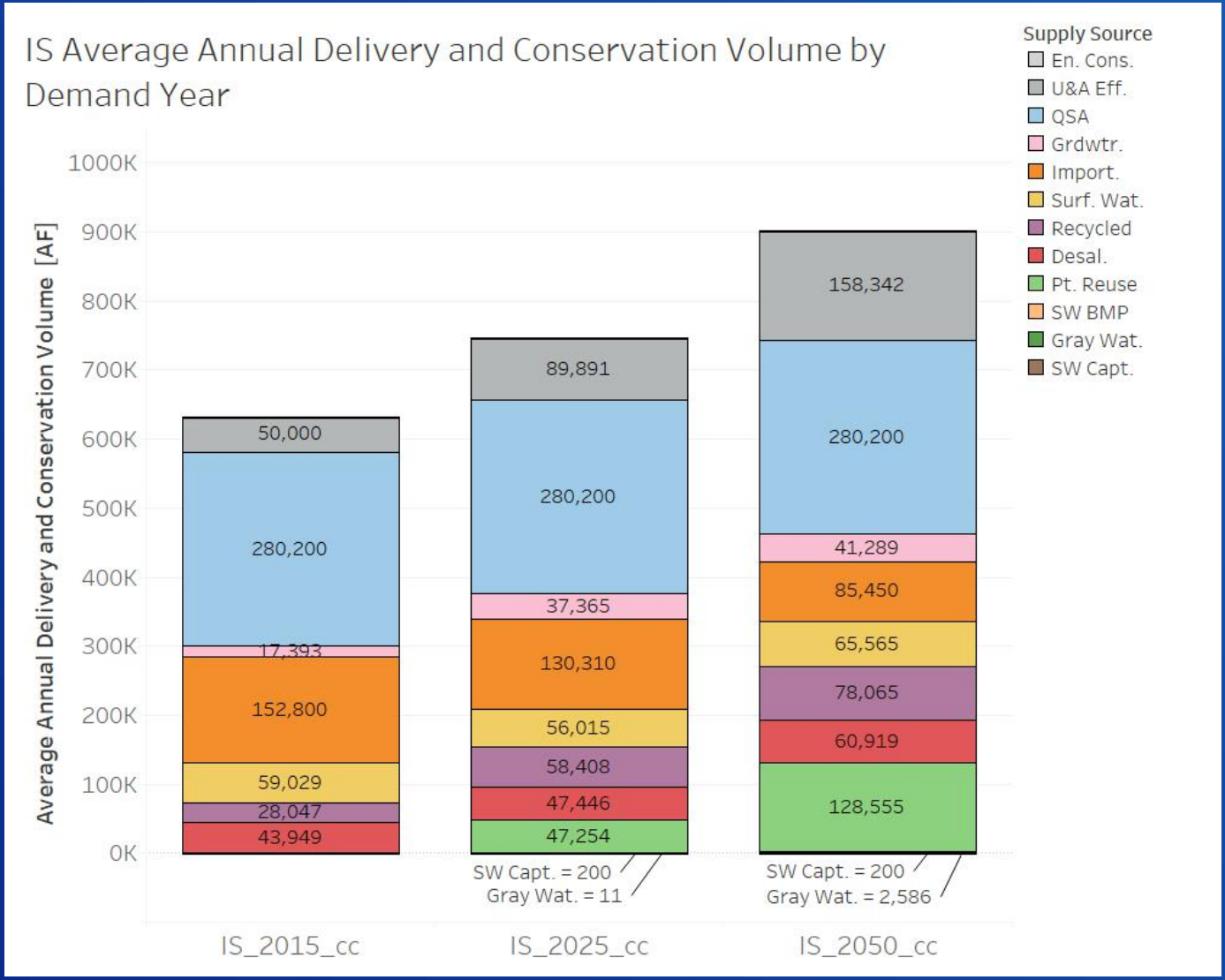
Deliveries & Conservation – B+



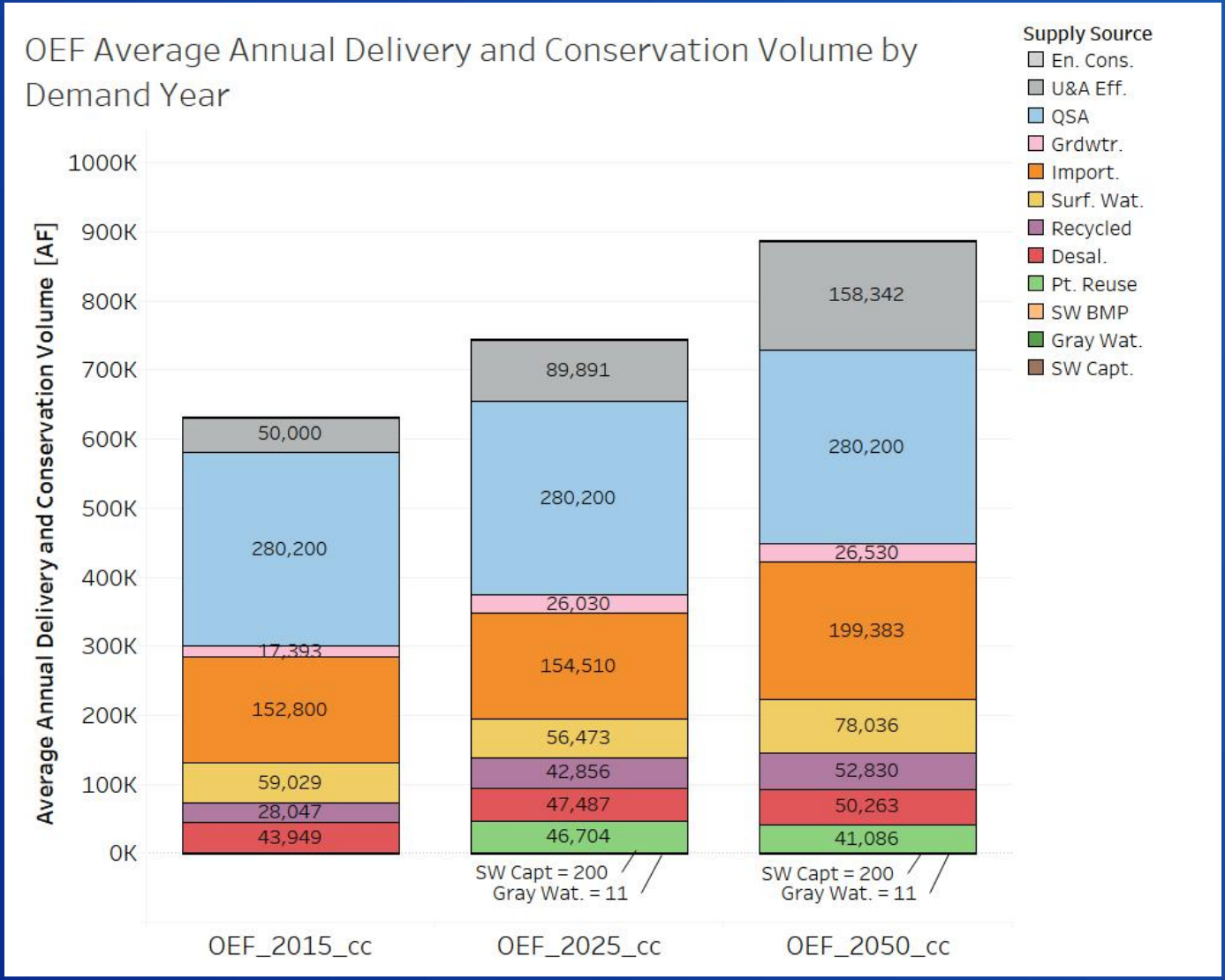
Deliveries & Conservation – EC



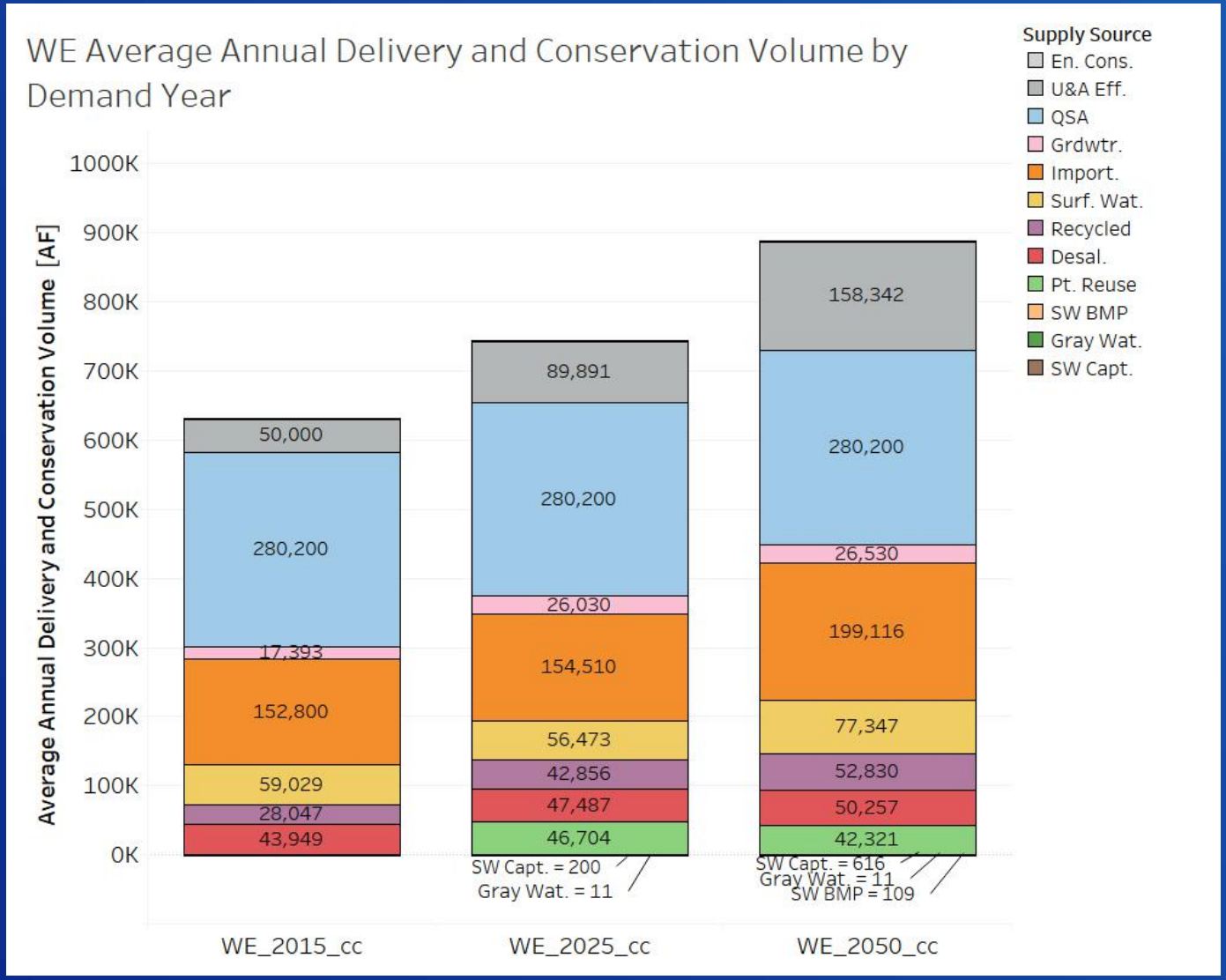
Deliveries & Conservation – IS



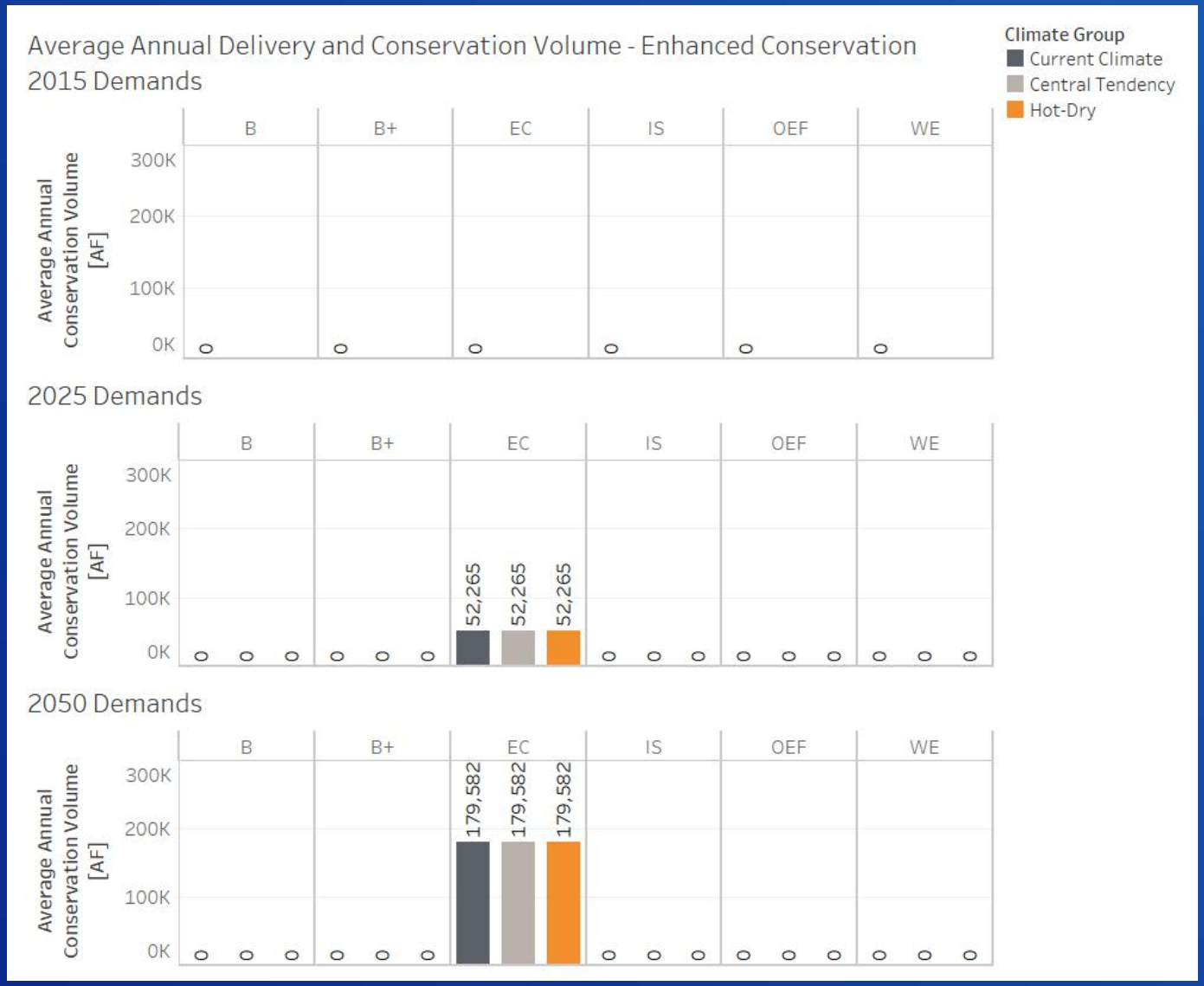
Deliveries & Conservation – OEF



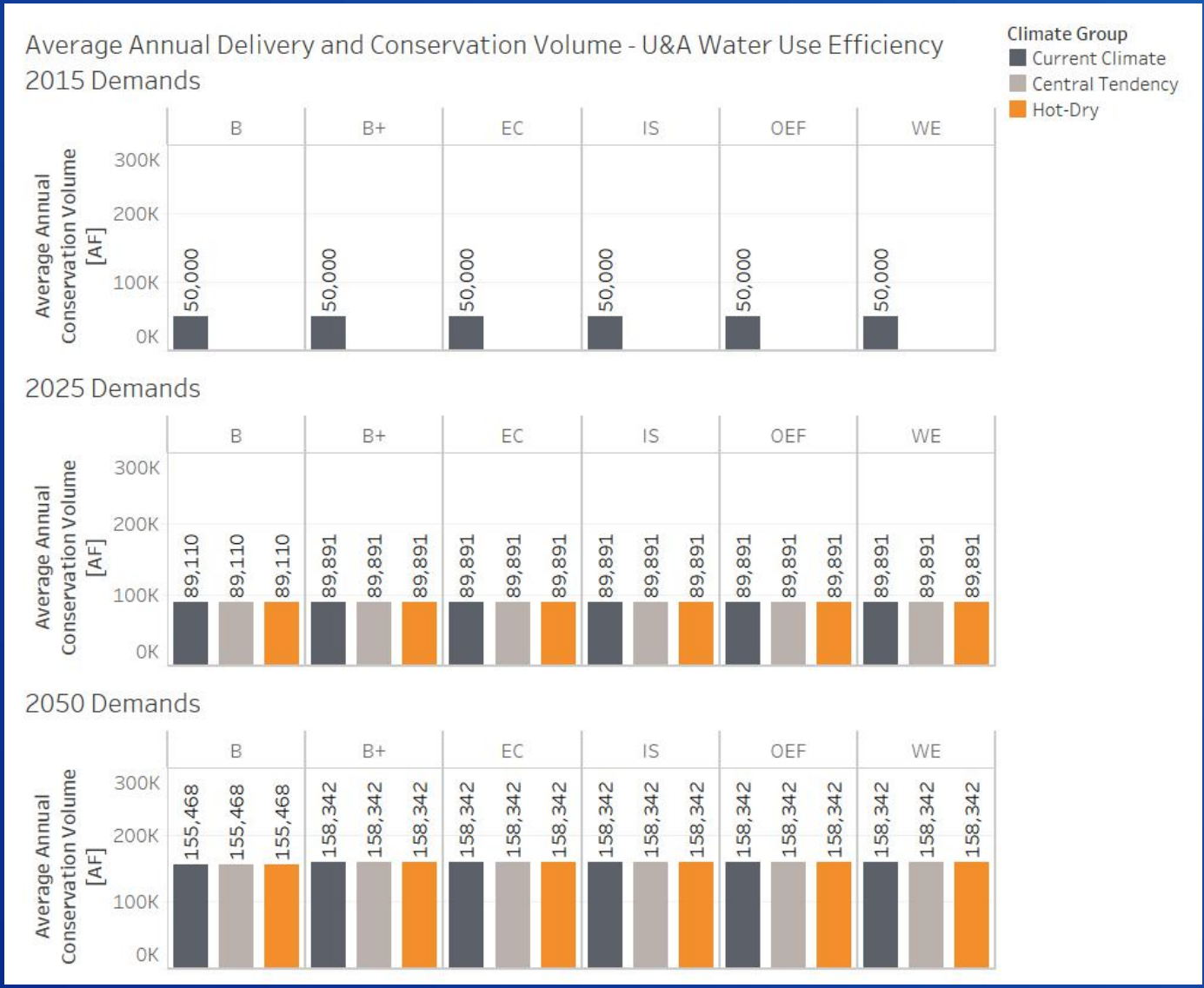
Deliveries and Conservation – WE



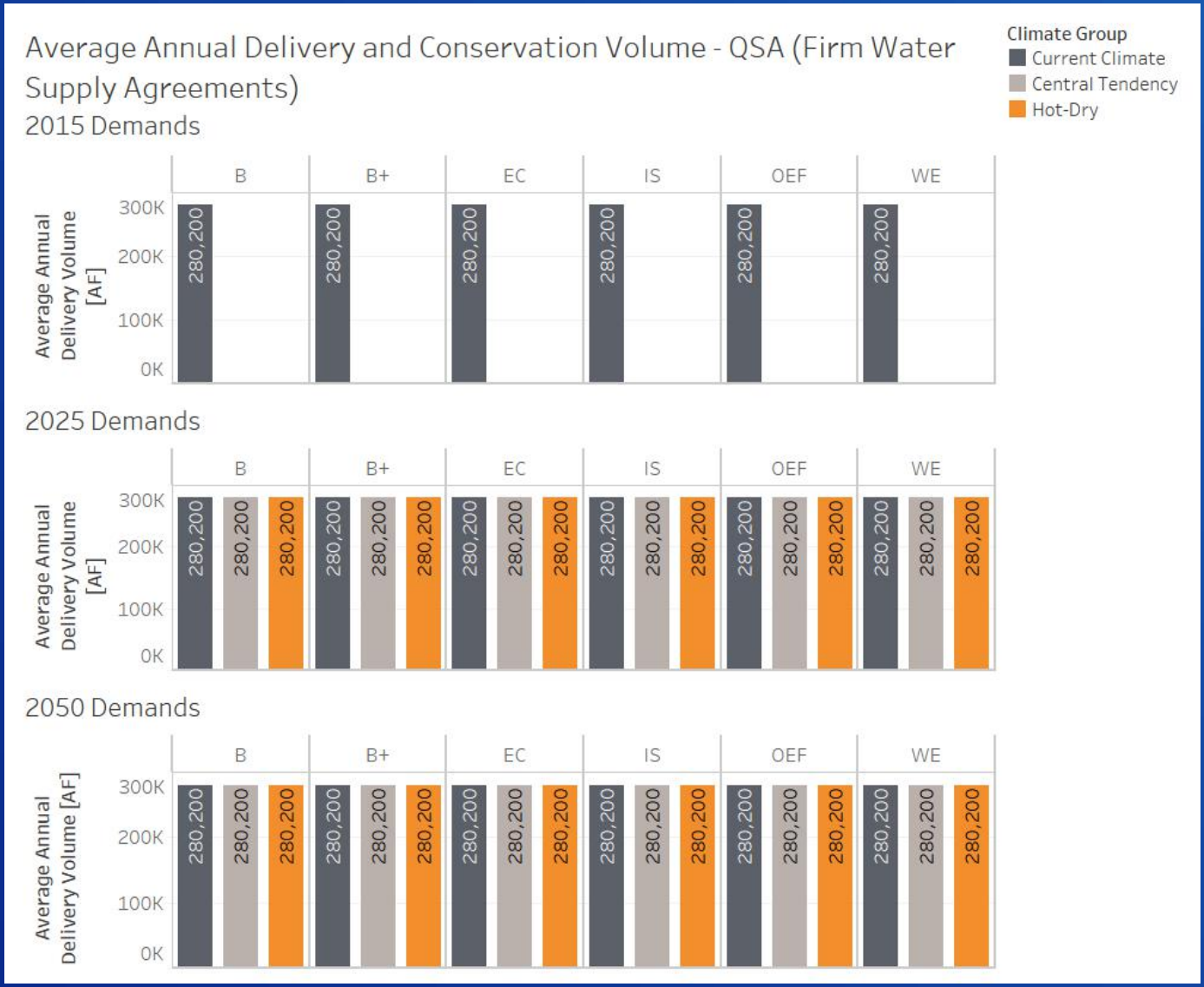
Water Delivery – Deliveries and Conservation – Enhanced Conservation



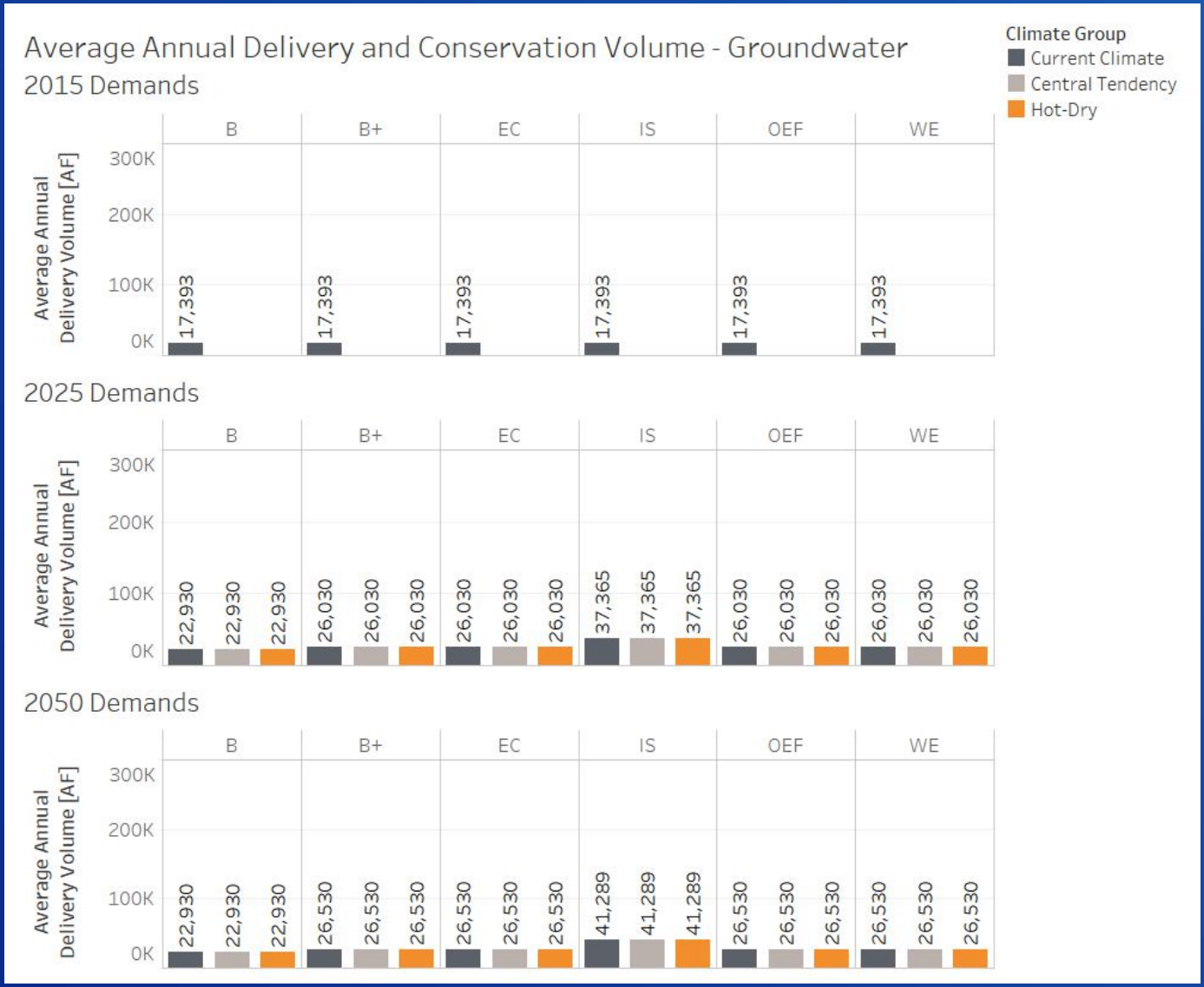
Water Delivery – Deliveries and Conservation – U&A Water Use Efficiency



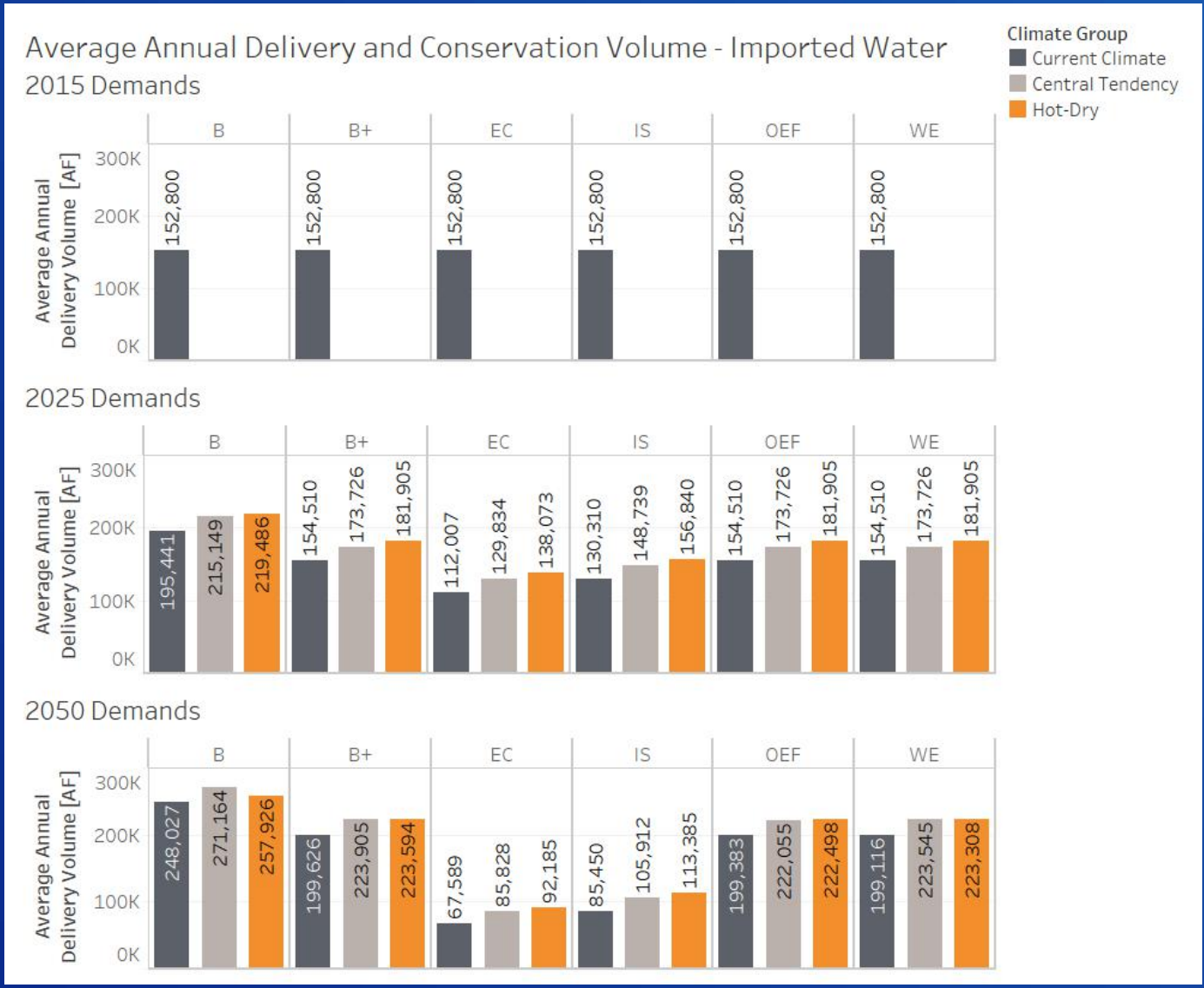
Water Delivery – Deliveries and Conservation – QSA (Firm Water Supply Agreements)



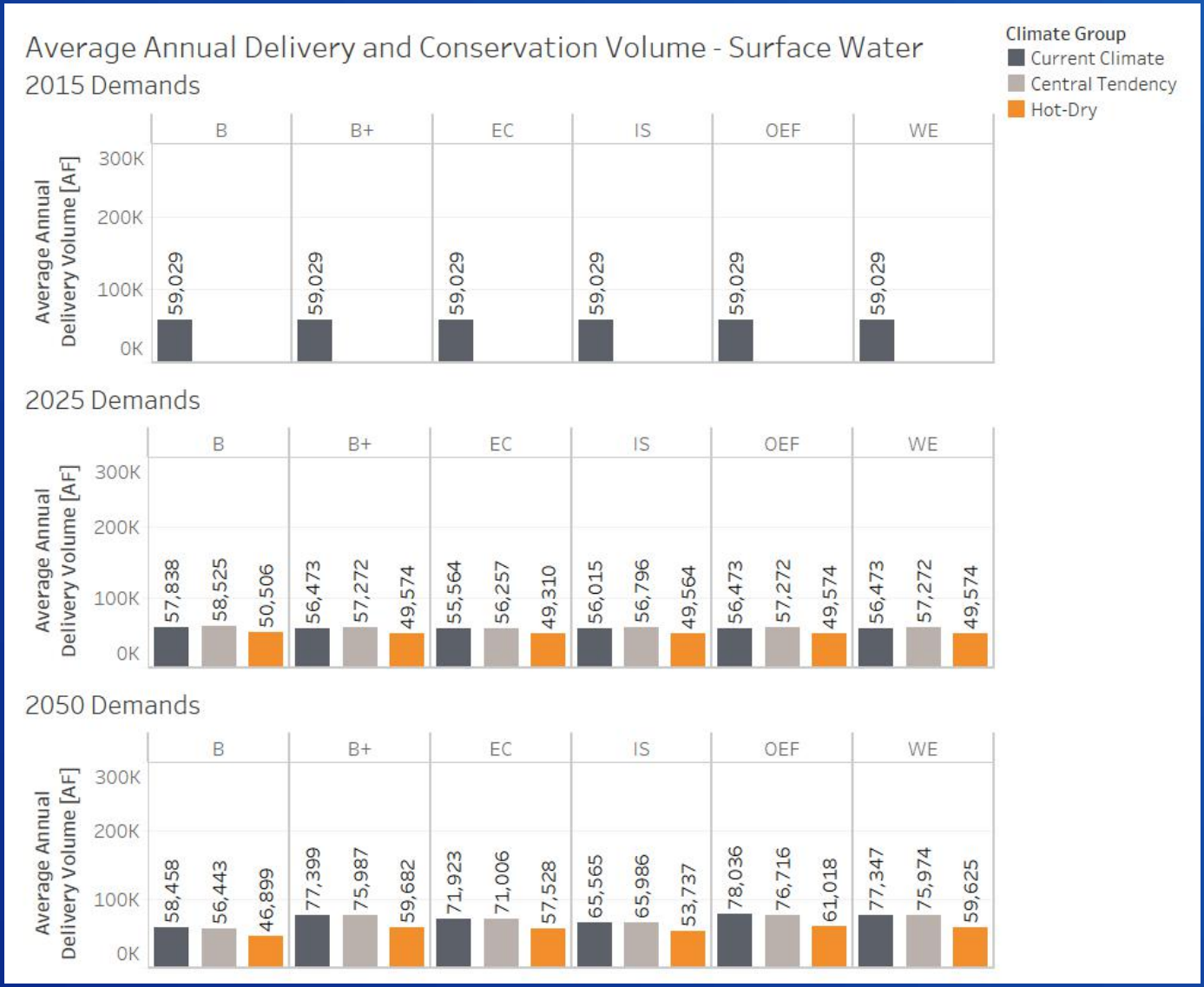
Water Delivery – Deliveries and Conservation - Groundwater



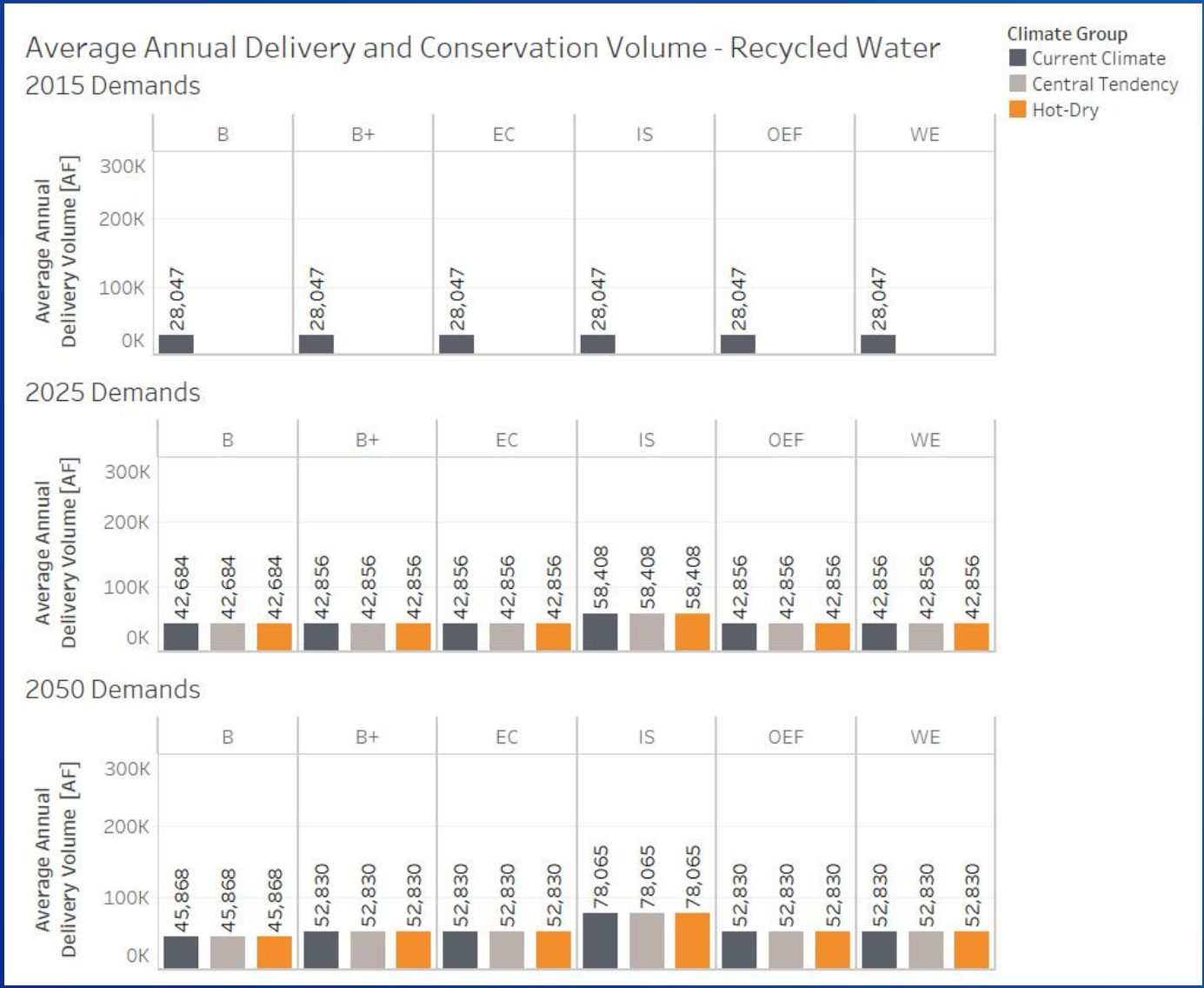
Water Delivery – Deliveries and Conservation – Imported Water



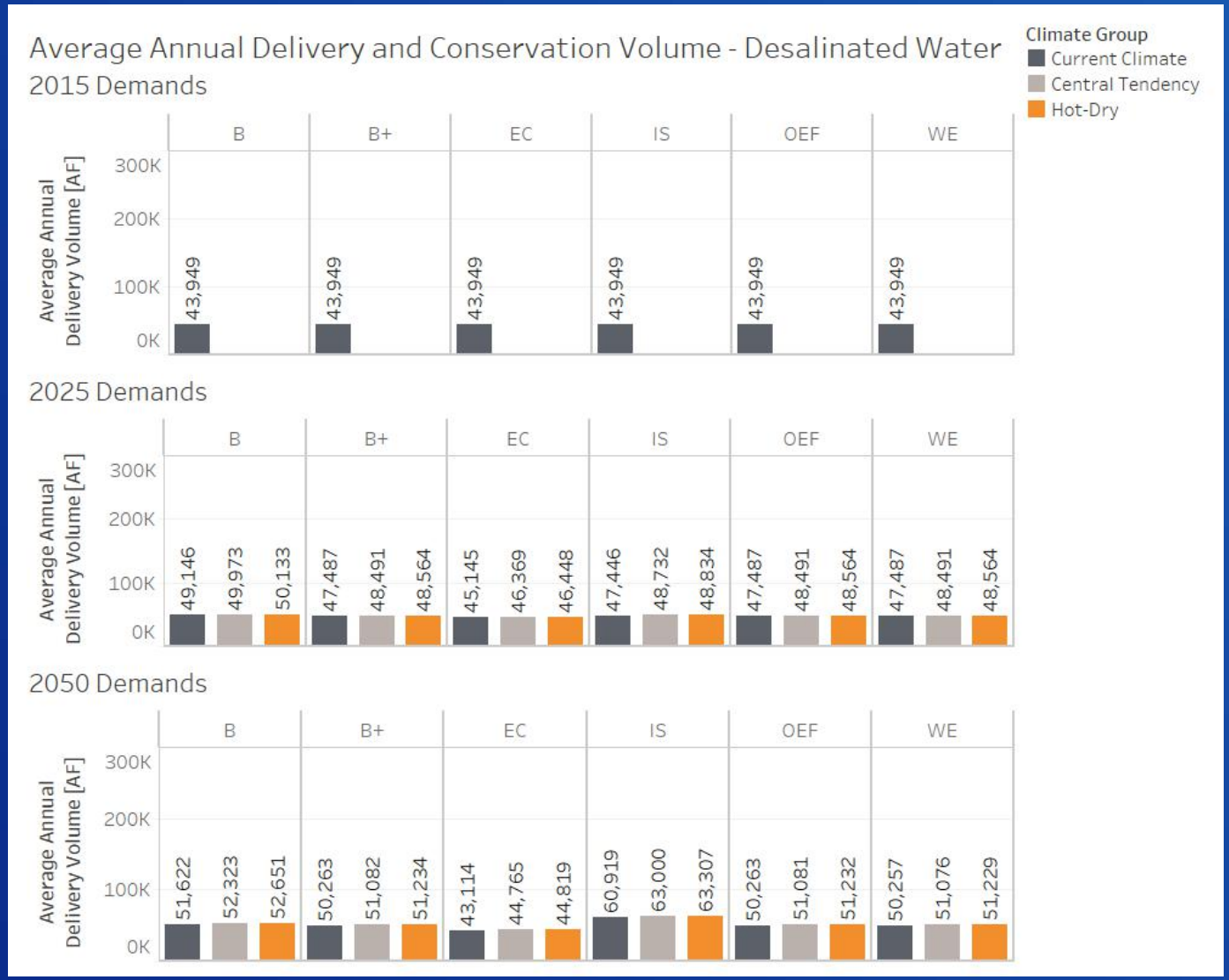
Water Delivery – Deliveries and Conservation – Surface Water



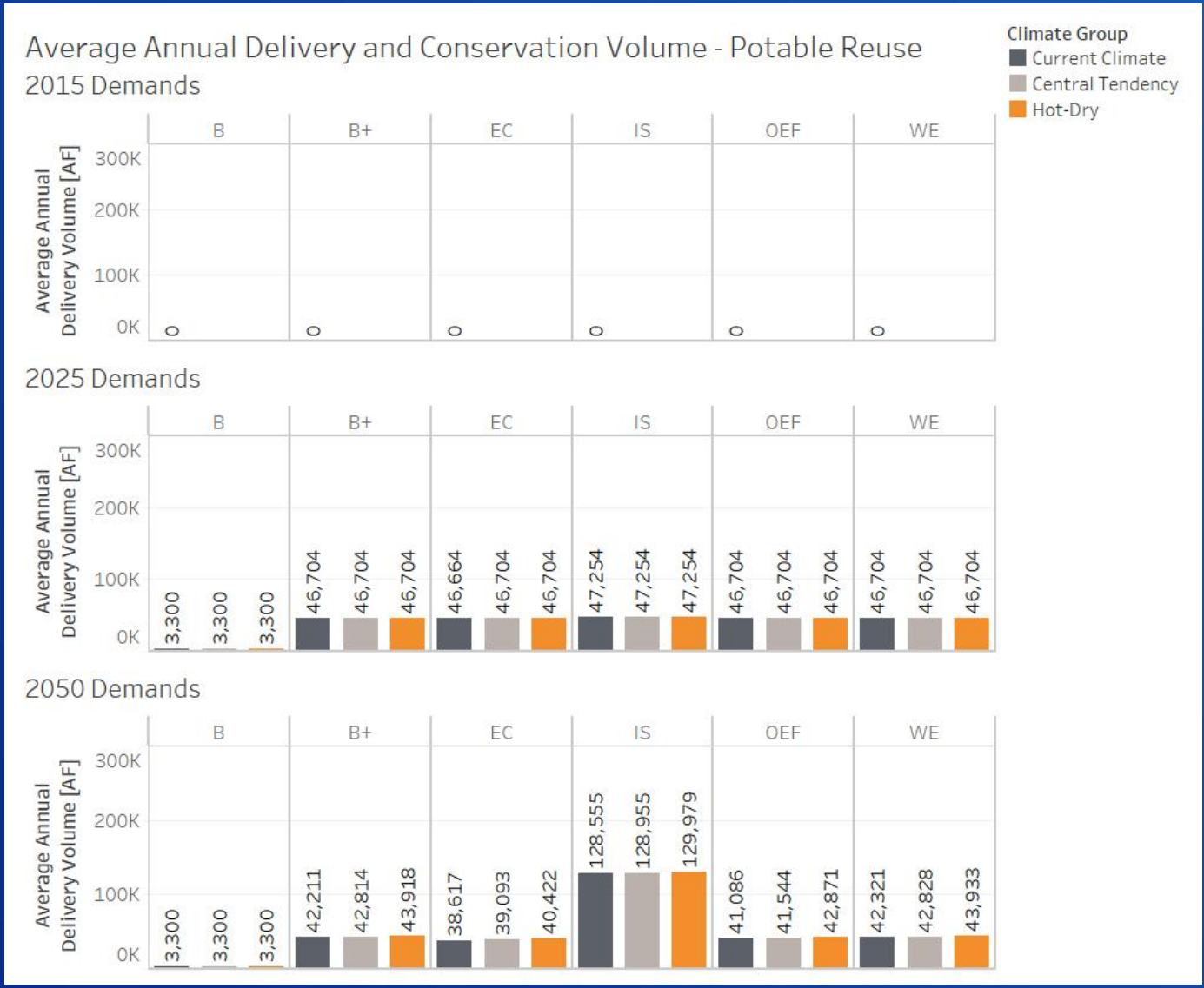
Water Delivery – Deliveries and Conservation – Recycled Water



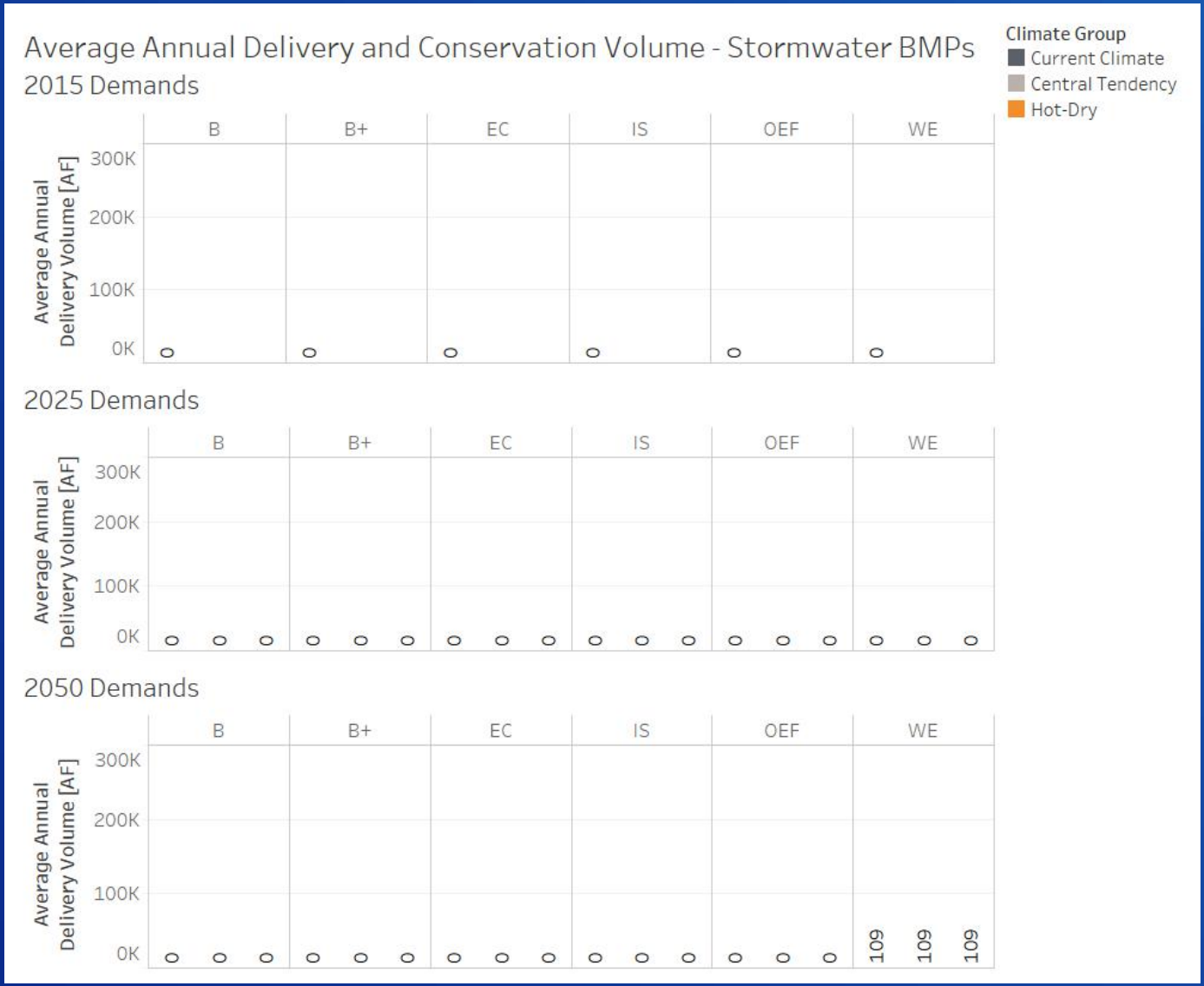
Water Delivery – Deliveries and Conservation - Desalination



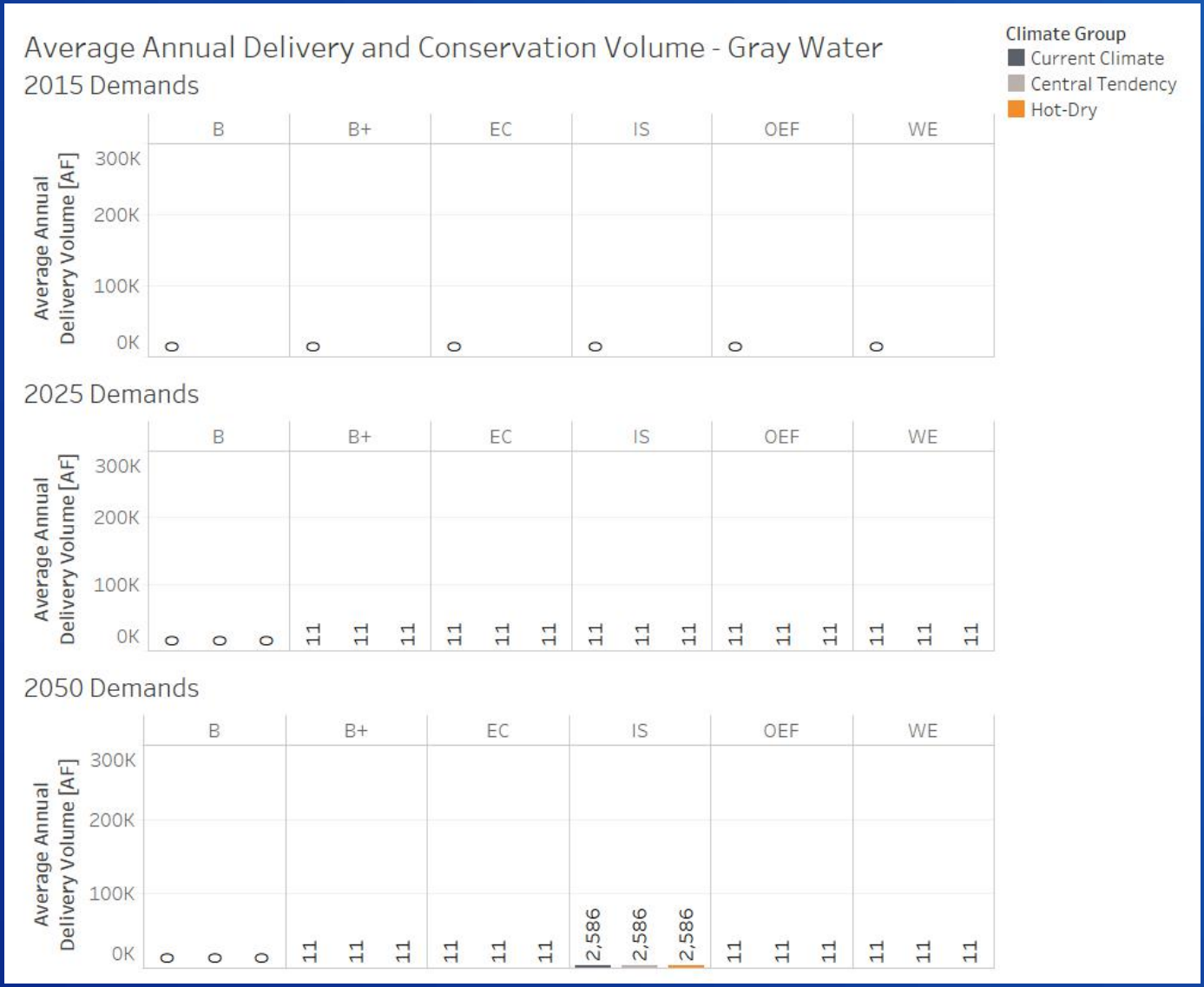
Water Delivery – Deliveries and Conservation – Potable Reuse



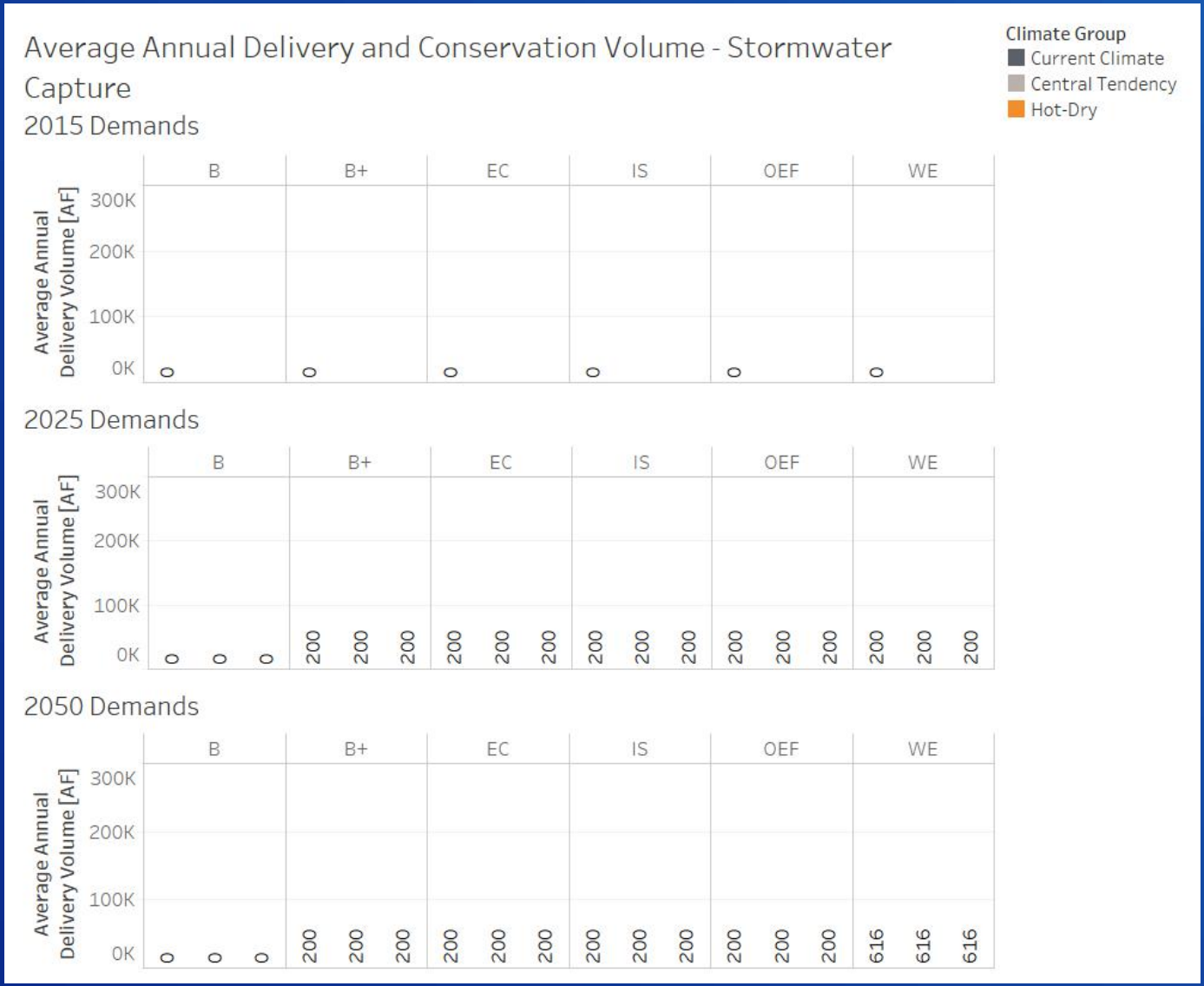
Water Delivery – Deliveries and Conservation – Stormwater BMPs



Water Delivery – Deliveries and Conservation – Gray Water



Water Delivery – Deliveries and Conservation – Stormwater Capture

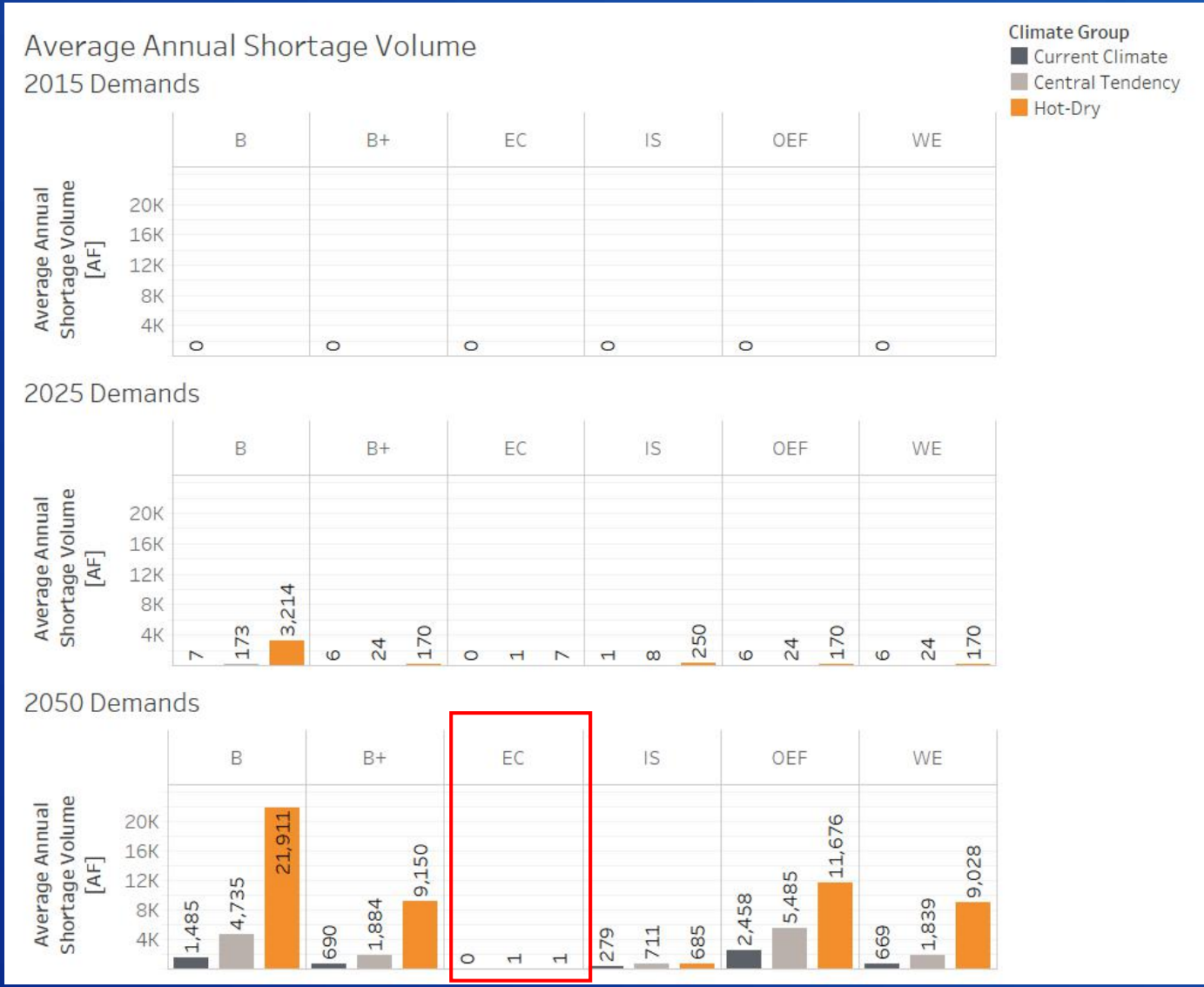


Water Delivery – Shortage Volume

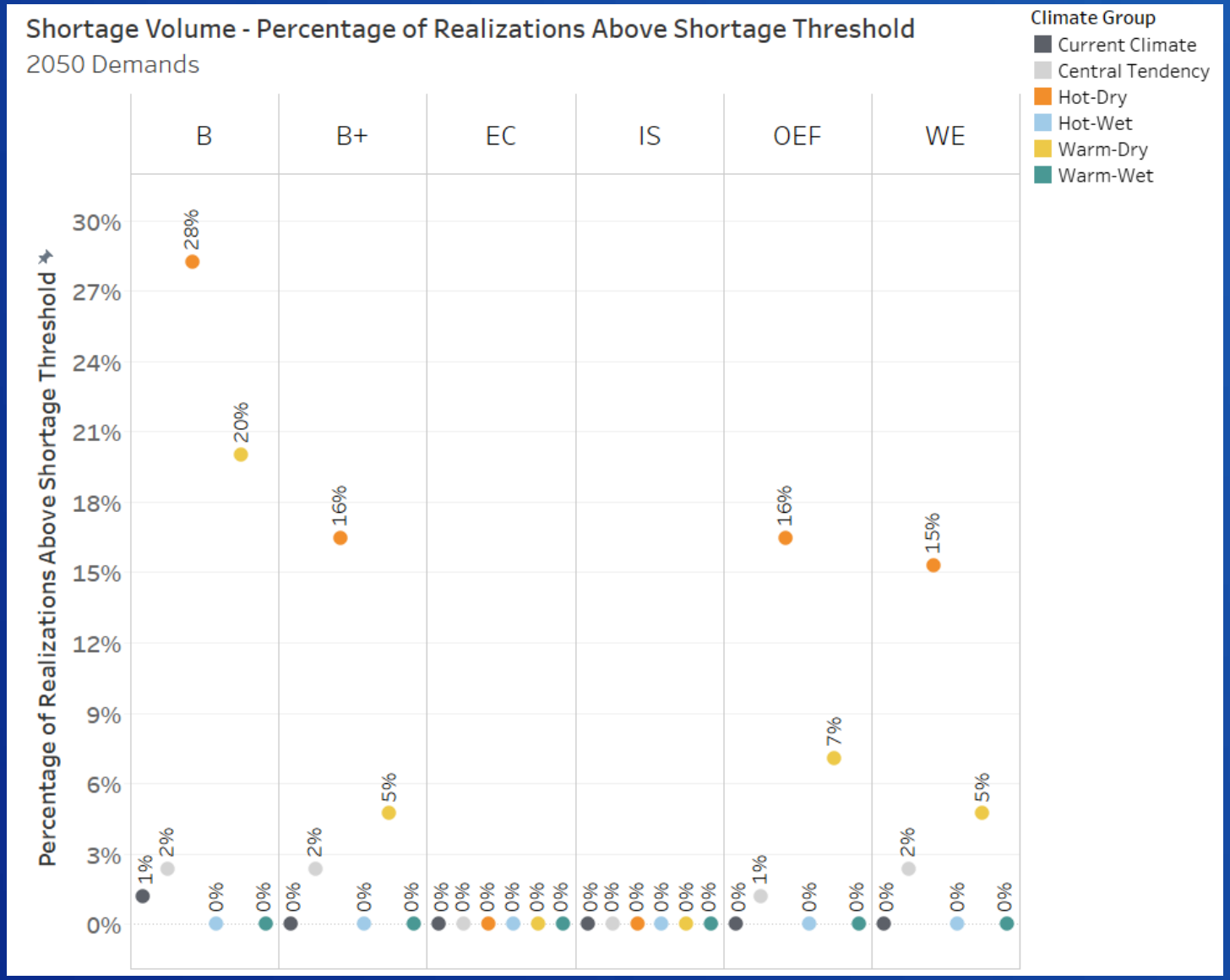
- **Measures the magnitude of regional demand that is unable to be met by the available supplies and/or limited by conveyance system capacity.**

- **A shortage threshold of 20,000 AF represents the shortage volume that could be mitigated within the San Diego system through short-term drought restrictions or operational changes**

Water Delivery – Shortage Volume



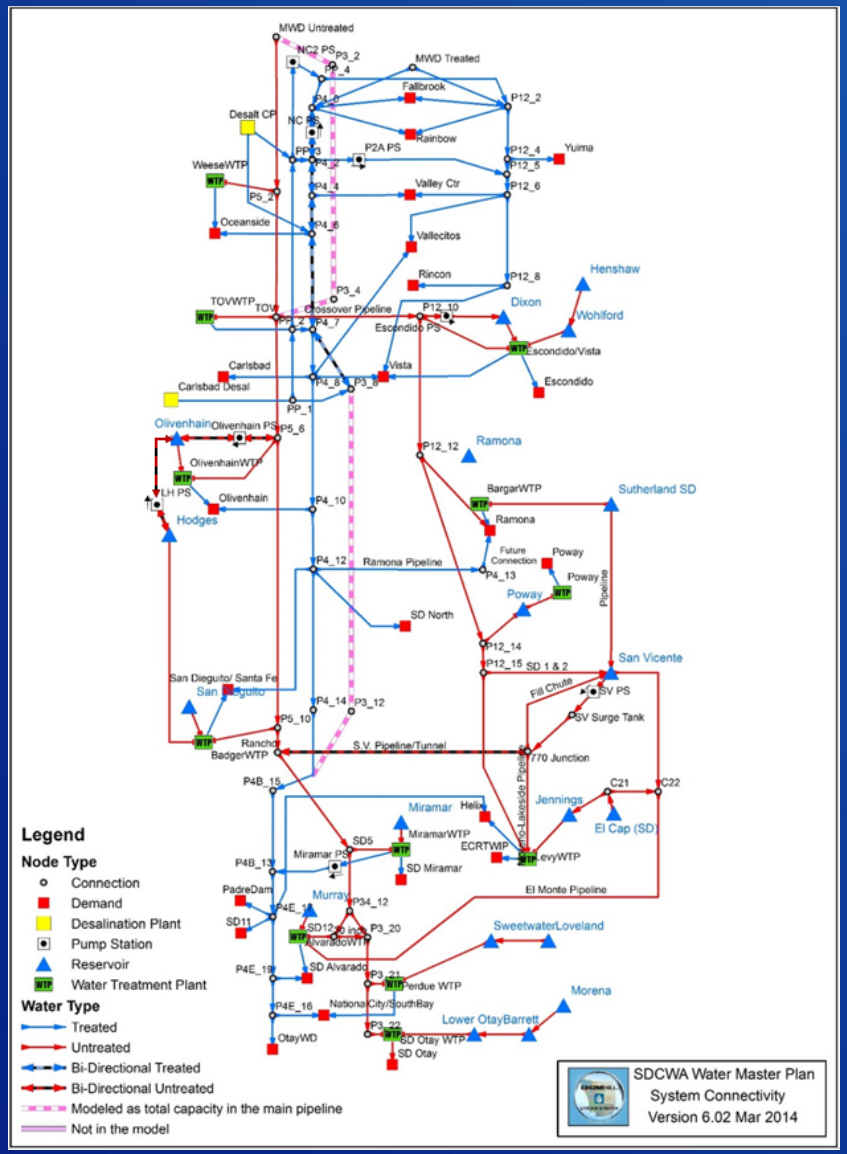
Water Delivery – Shortage Volume



Discussion

- **Questions?**
- **Any surprising delivery results?**
- **Any surprising shortage results?**
- **Feedback to consider for the Summary Report?**

Water Delivery – Conveyance



- **Types of Facilities**
  - **Pipelines**
  - **Pump Stations**
  - **Water Treatment Plants**
- **Metrics**
  - **Greater than 95% usage**

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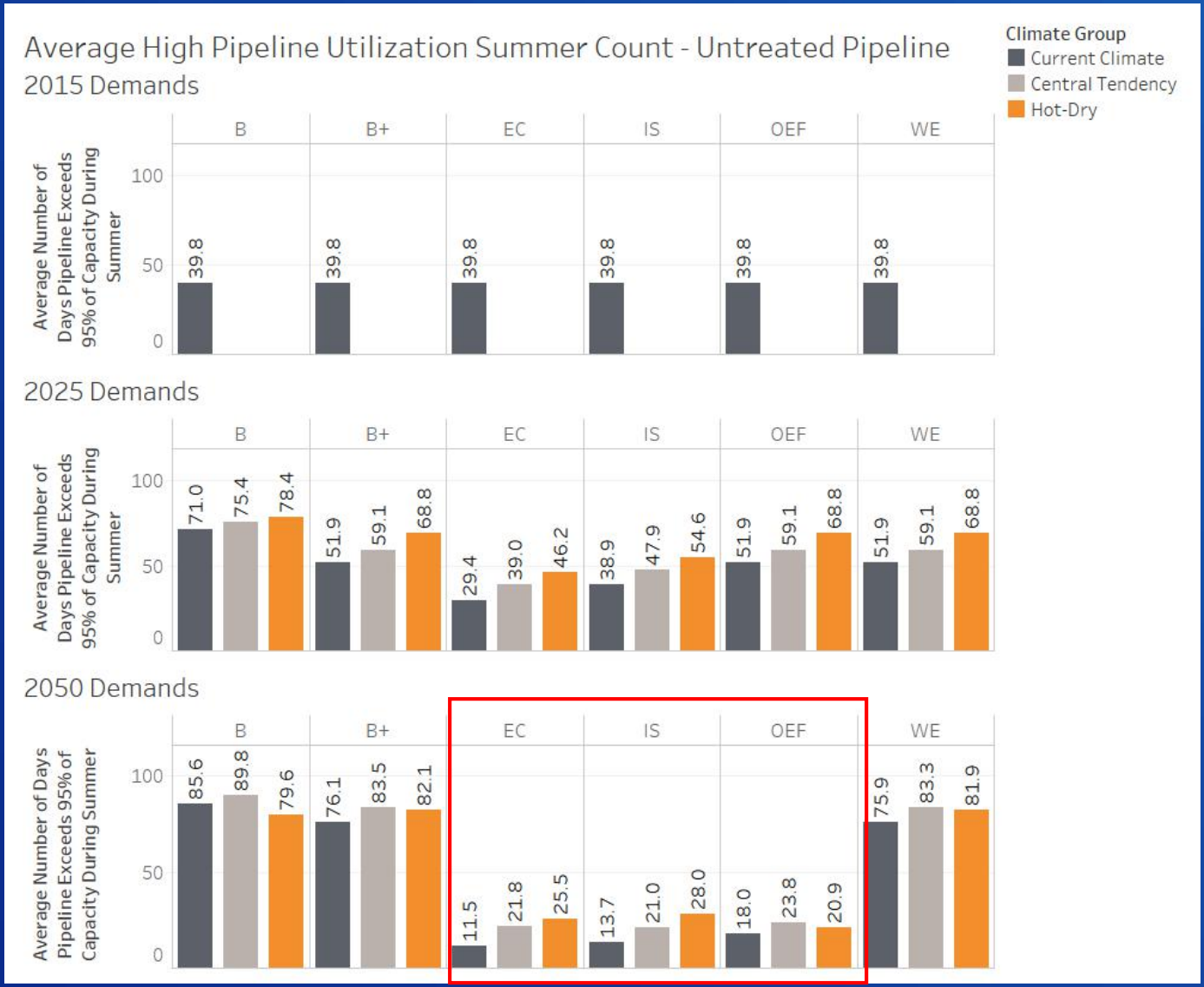
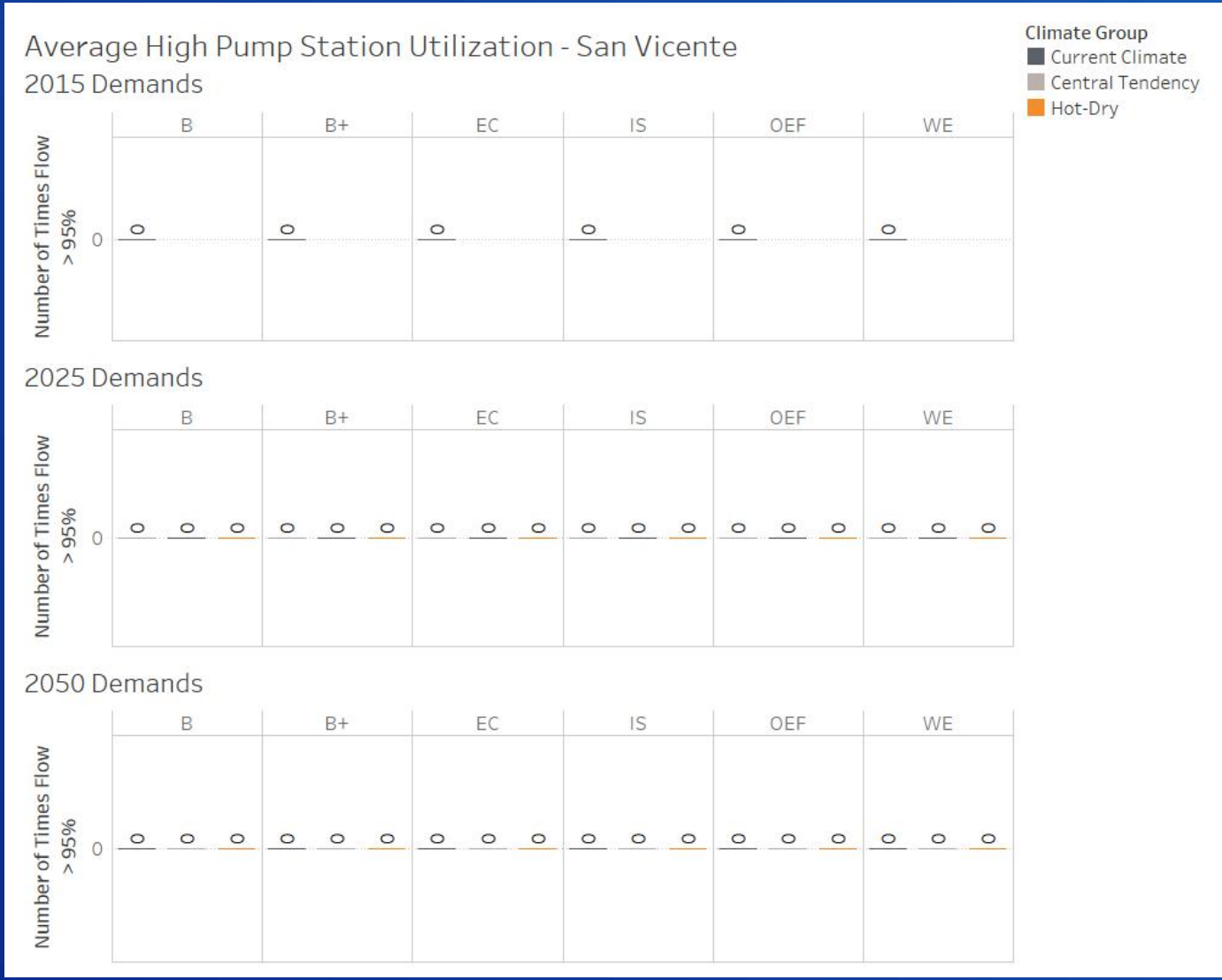
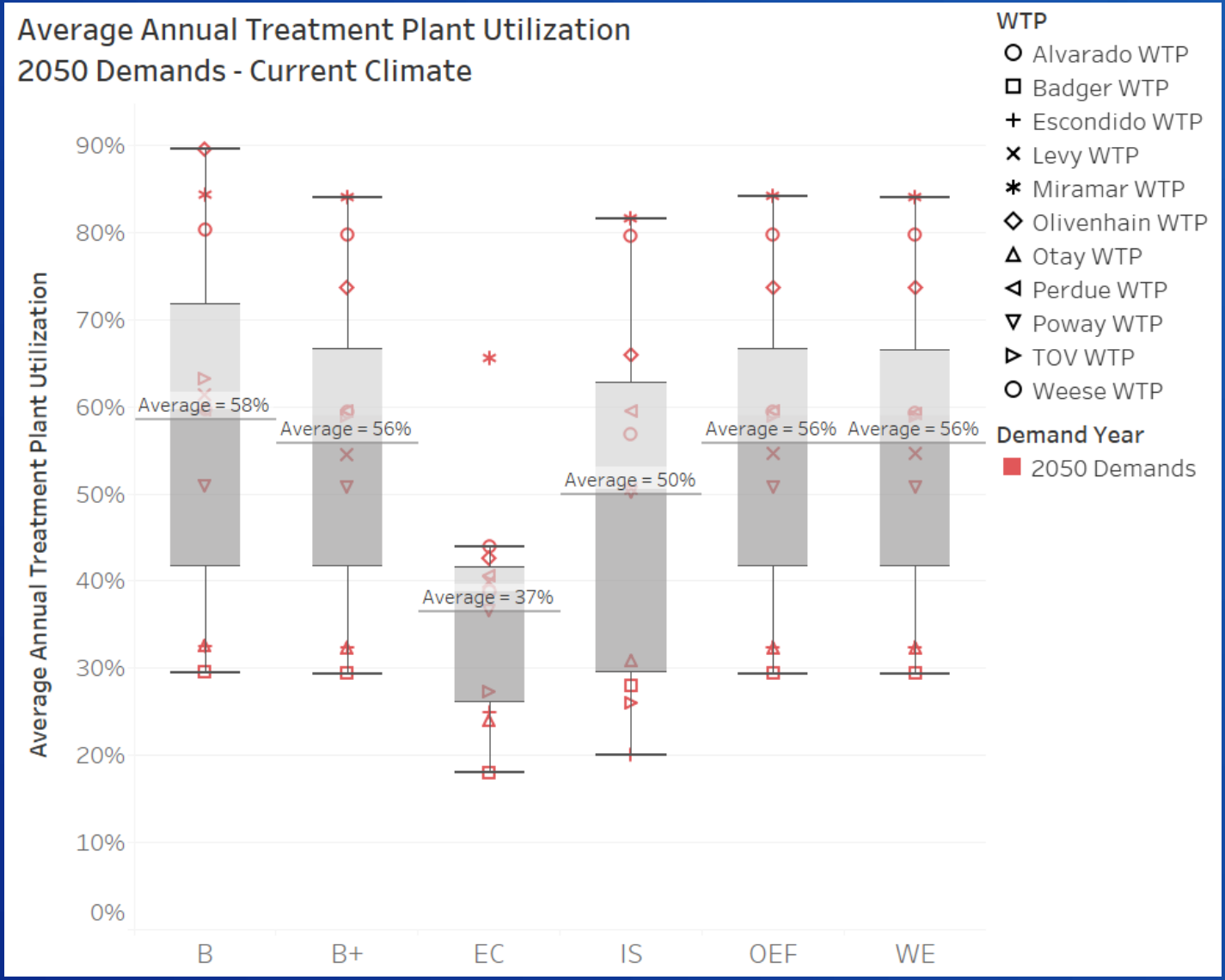
High Pipeline Utilization Summer Count



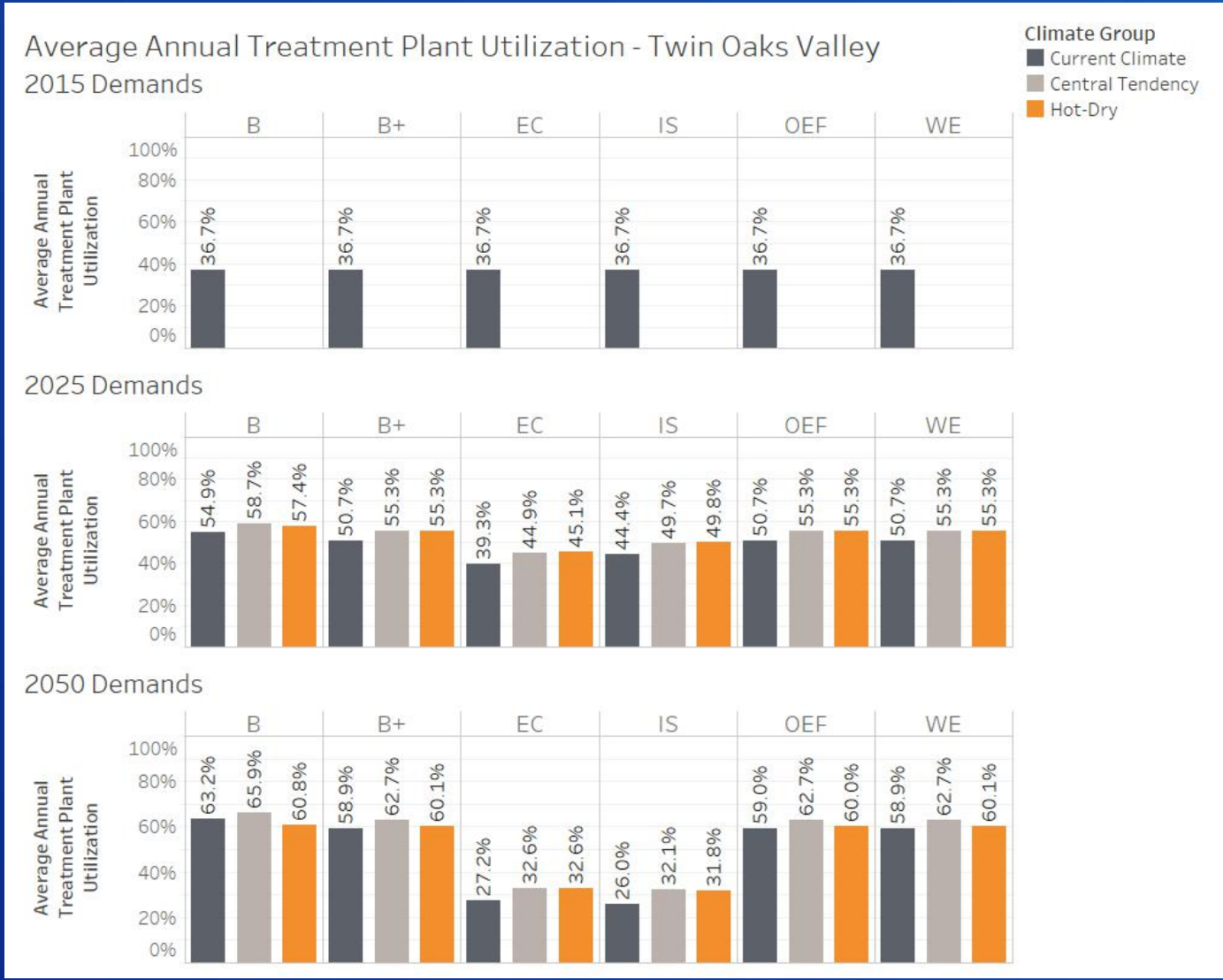
High Pump Station Utilization



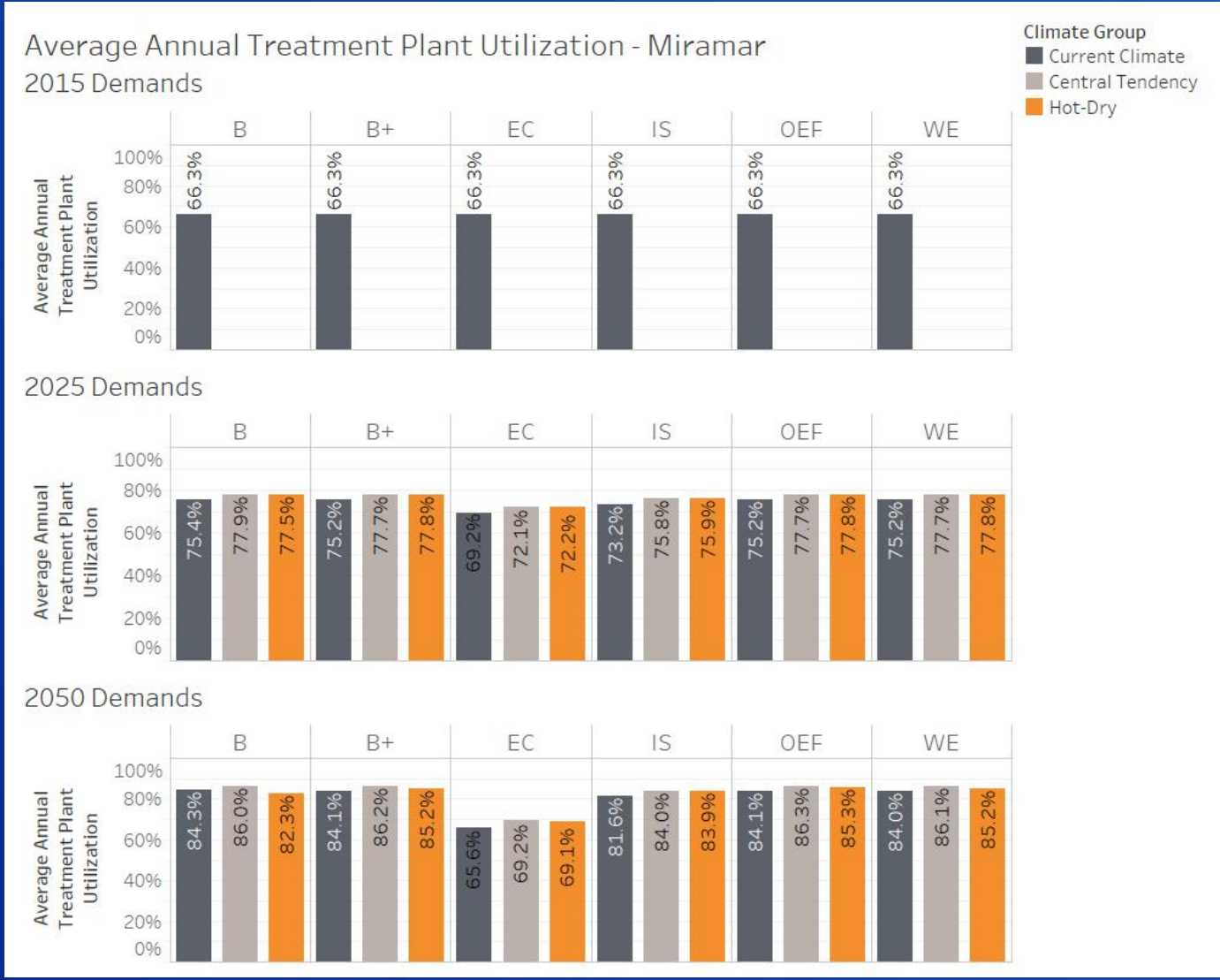
Treatment Plant Utilization



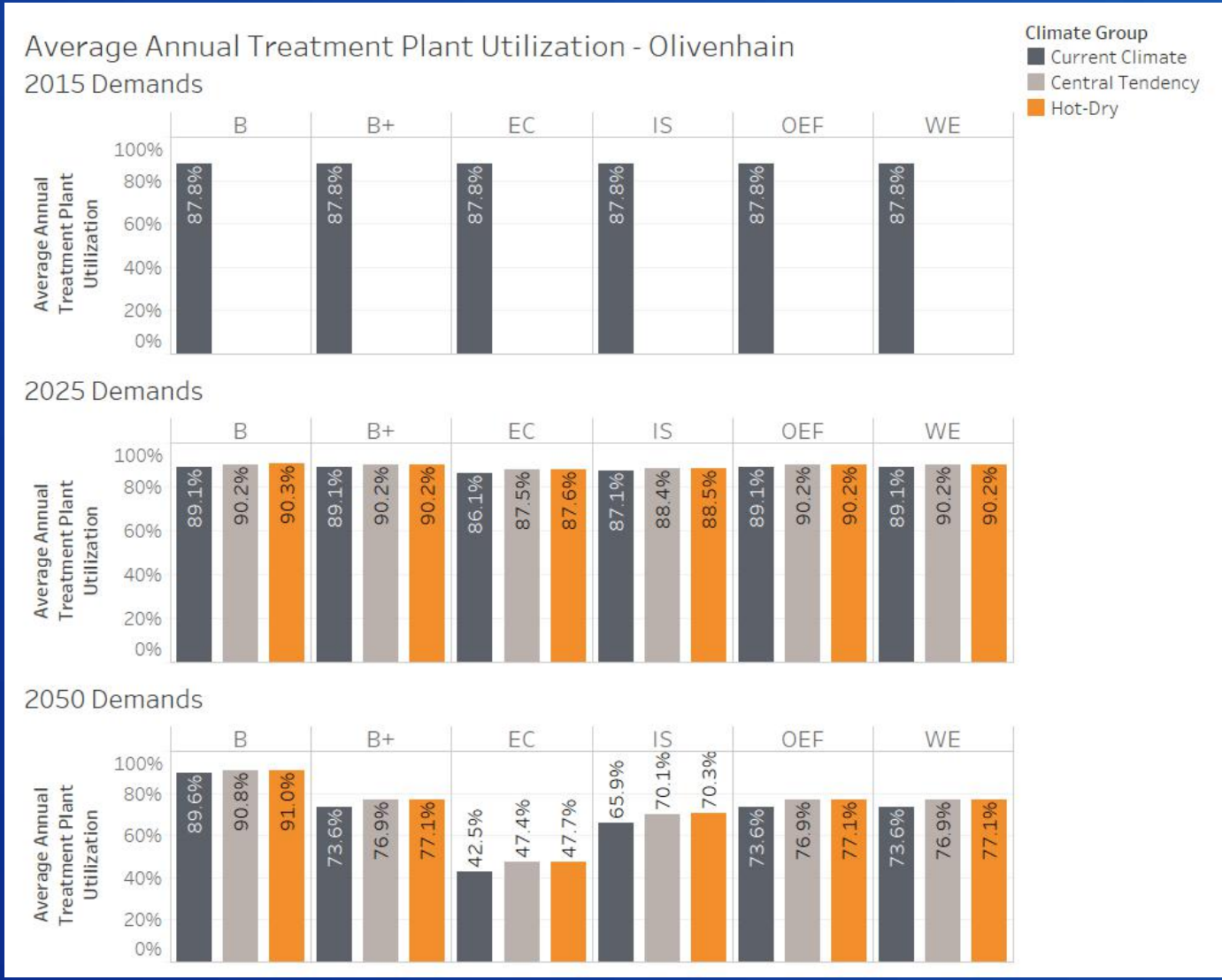
Treatment Plant Utilization



Treatment Plant Utilization

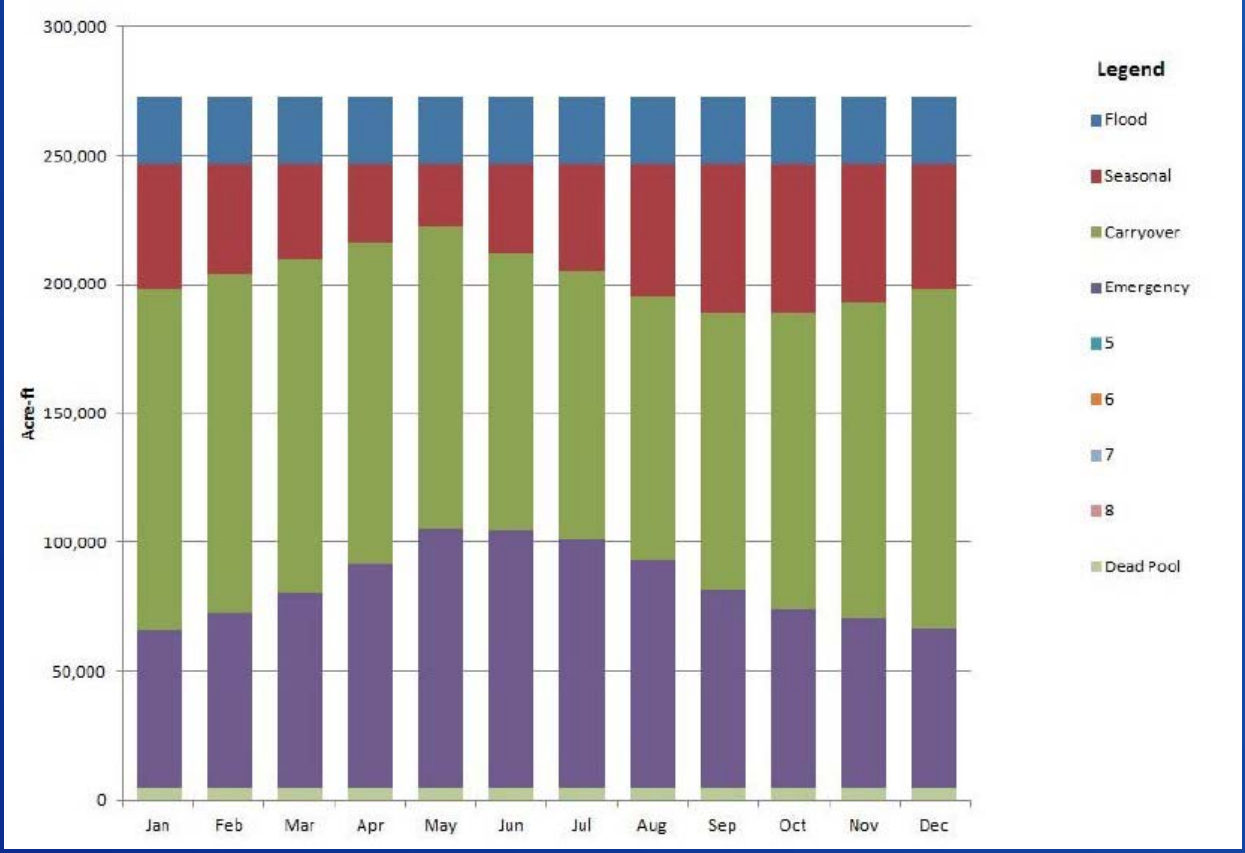


Treatment Plant Utilization



Reservoir Operations

- **Metrics summarize monthly Reservoir Storage and Releases for 11 of the 18 reservoirs, and End of September Storage for 5 of the 18 reservoirs**

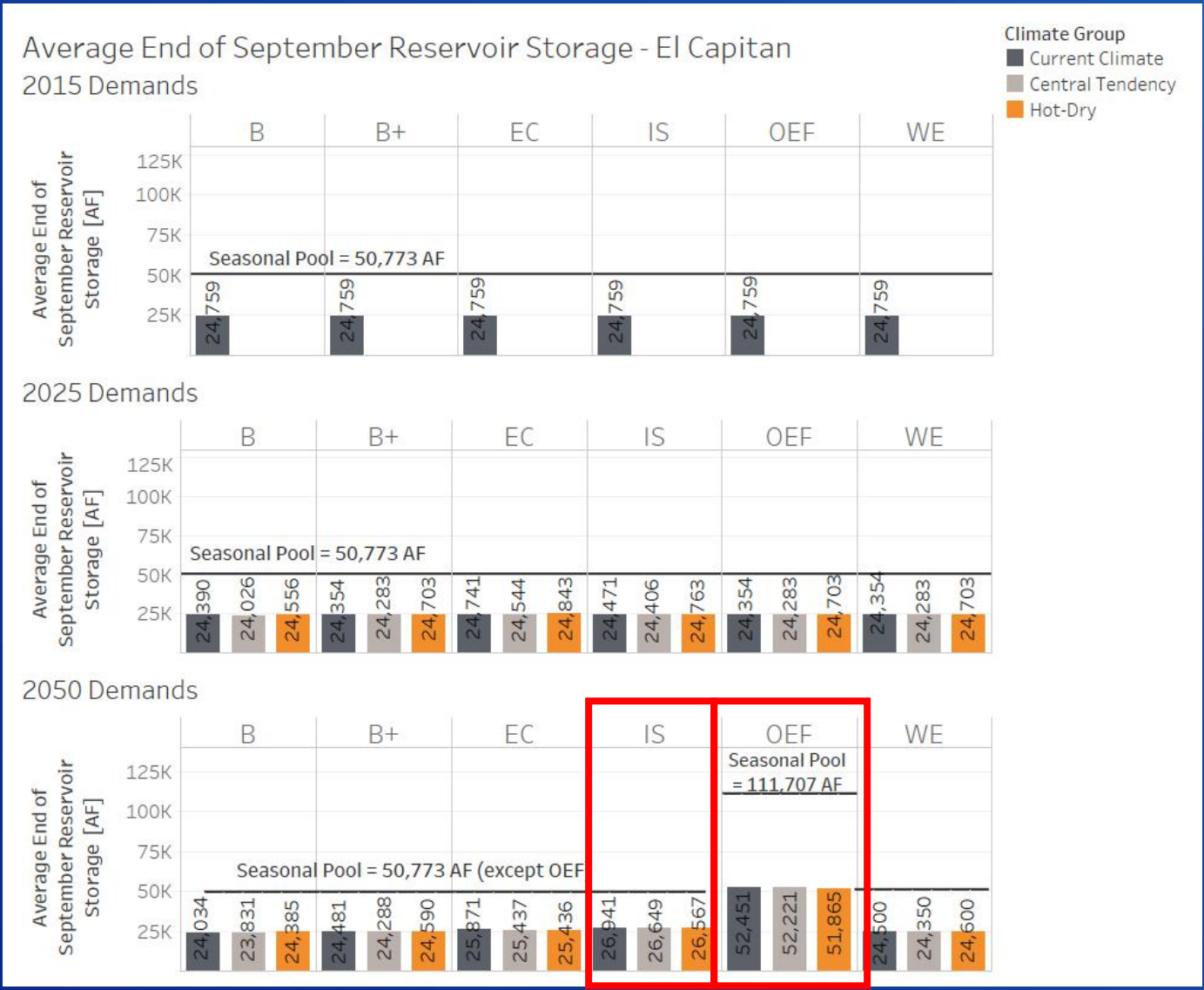


End of September Storage

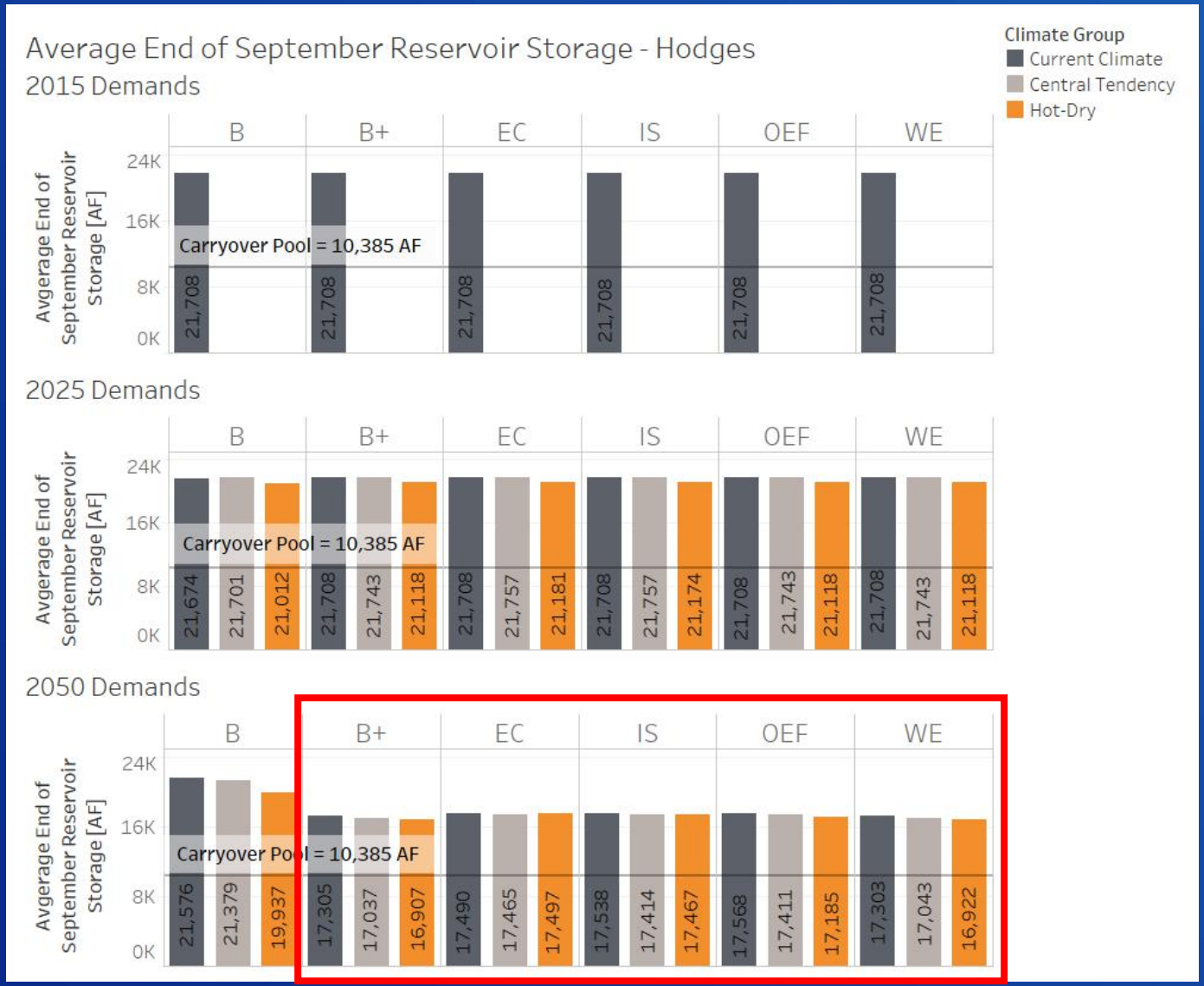
- Measures reservoir carryover storage that can be used for supply in the next year
- Used because September is at the end of summer, which is the season with the highest water demands

- Evaluated for five reservoirs:
  - El Capitan
  - Hodges
  - Lower Otay
  - Olivenhain
  - San Vicente

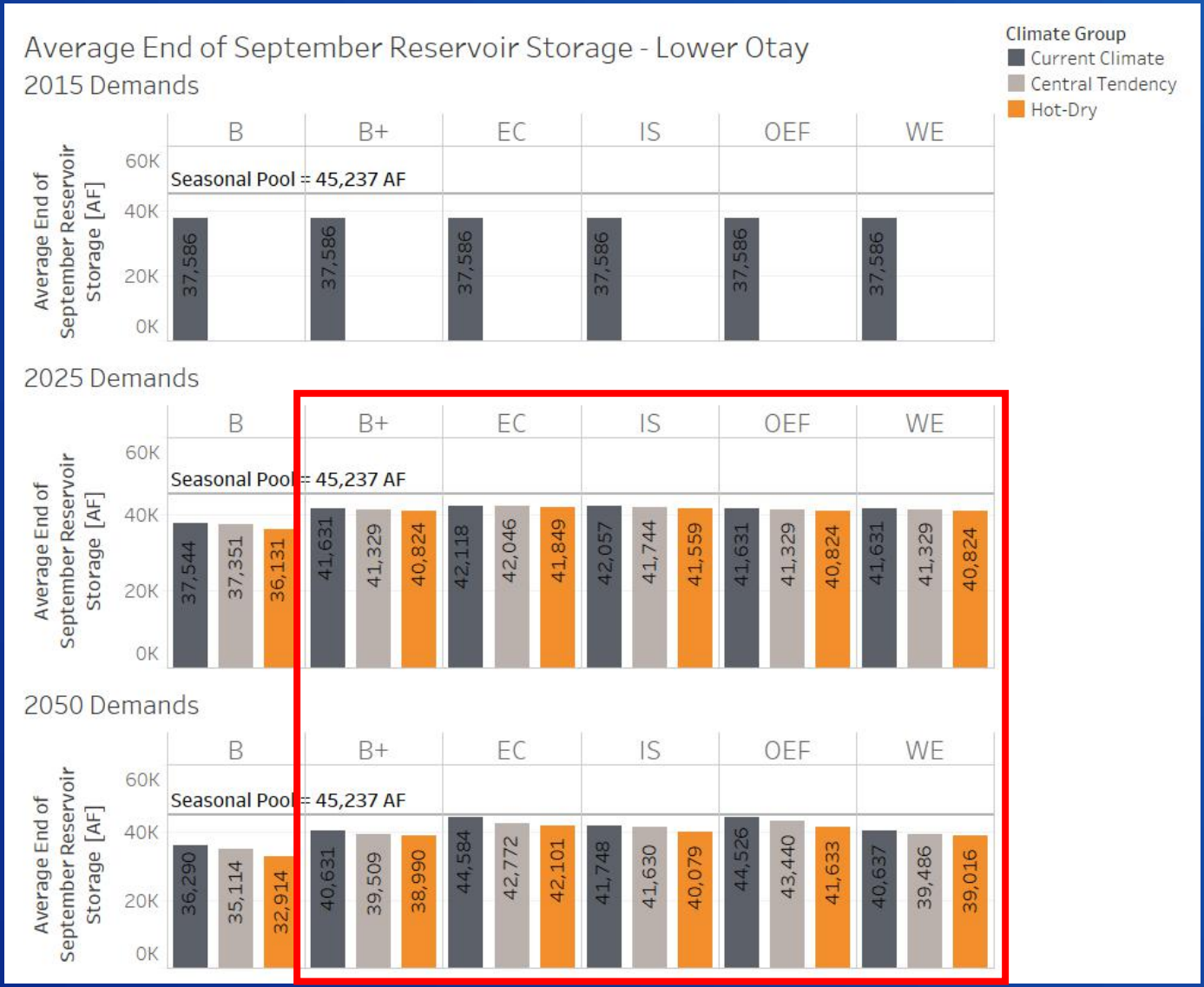
End of September Storage at El Capitan



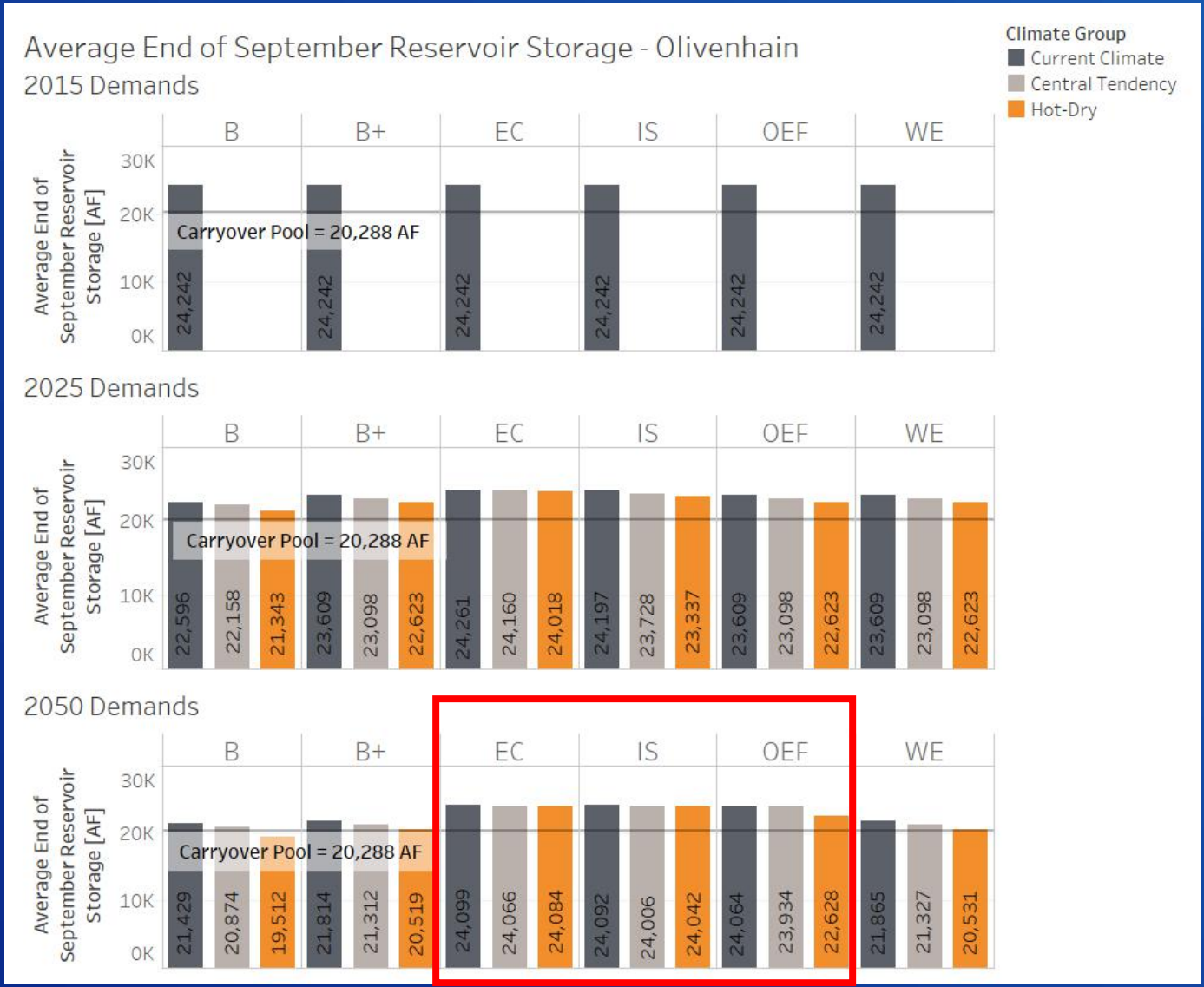
End of September Storage at Hodges



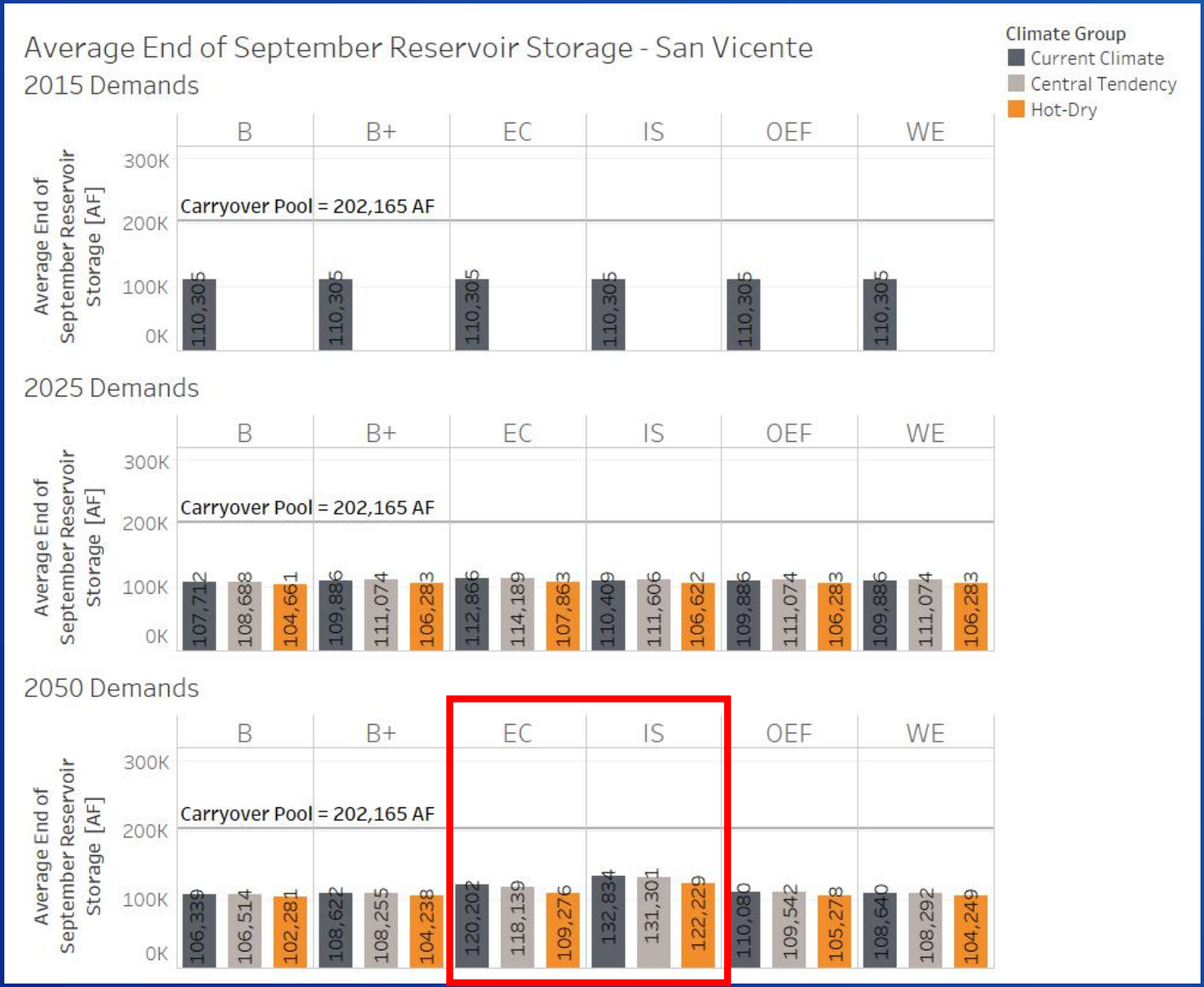
End of September Storage at Lower Otay



End of September Storage at Olivenhain



End of September Storage at San Vicente



Discussion

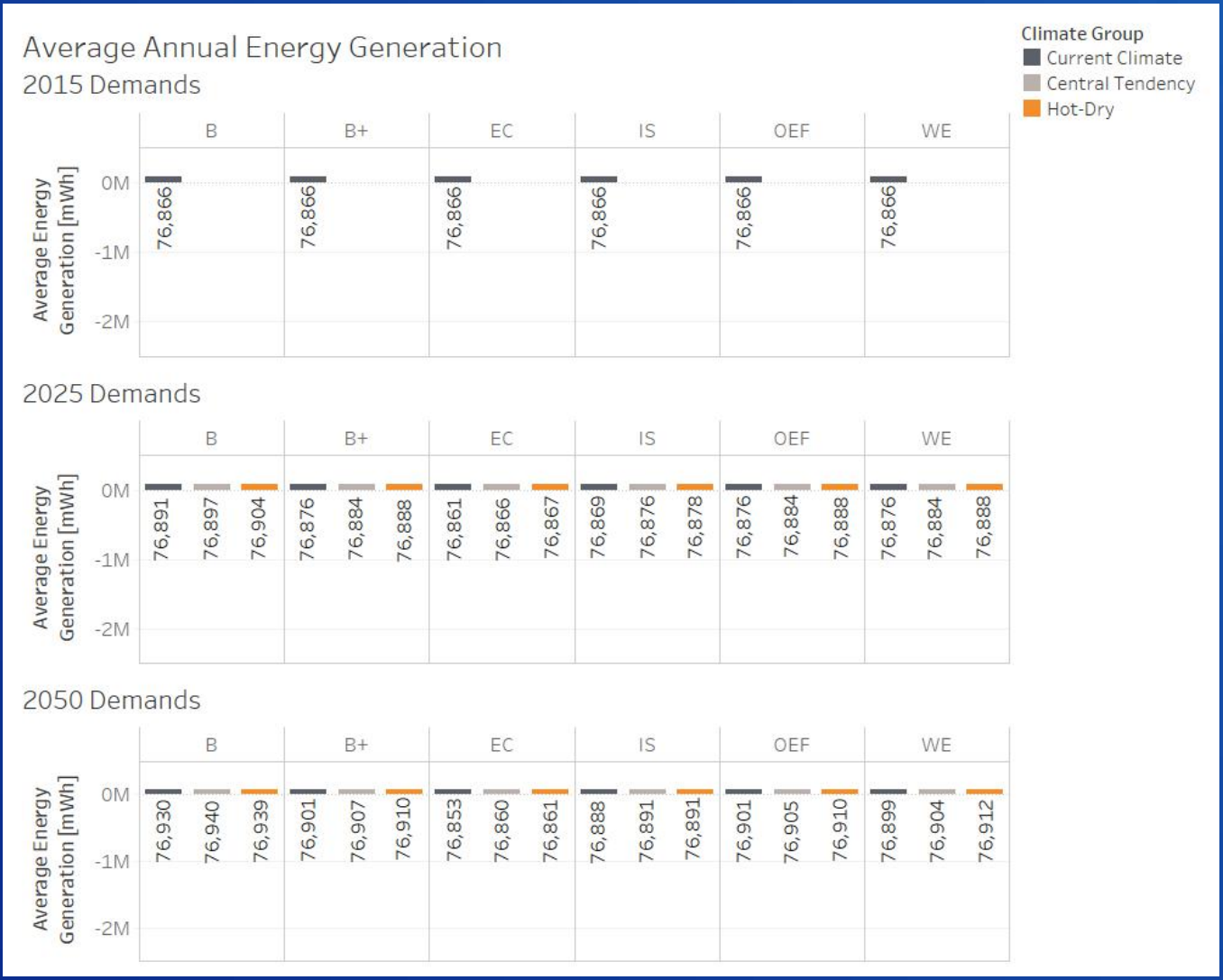
- **Questions?**
- **Any surprising Water Treatment Plant utilization results?**
- **Any surprising End of September Storage results?**
- **Feedback to consider for the Summary Report?**

Energy

- **Impacts to Energy are measured by power consumption to treat and convey water. Higher negative values of consumption indicate greater energy intensity of that Portfolio**

	Consumption	Generation
Supplies	4 specific facilities + 3 supplies by delivery volume	None
Pump Stations	6 facilities	1 facility
WTPs	12 WTPs	3 WTPs
Pumped Storage	1 facility	1 facility
Offices	2 offices	2 offices

Energy - Power Generation



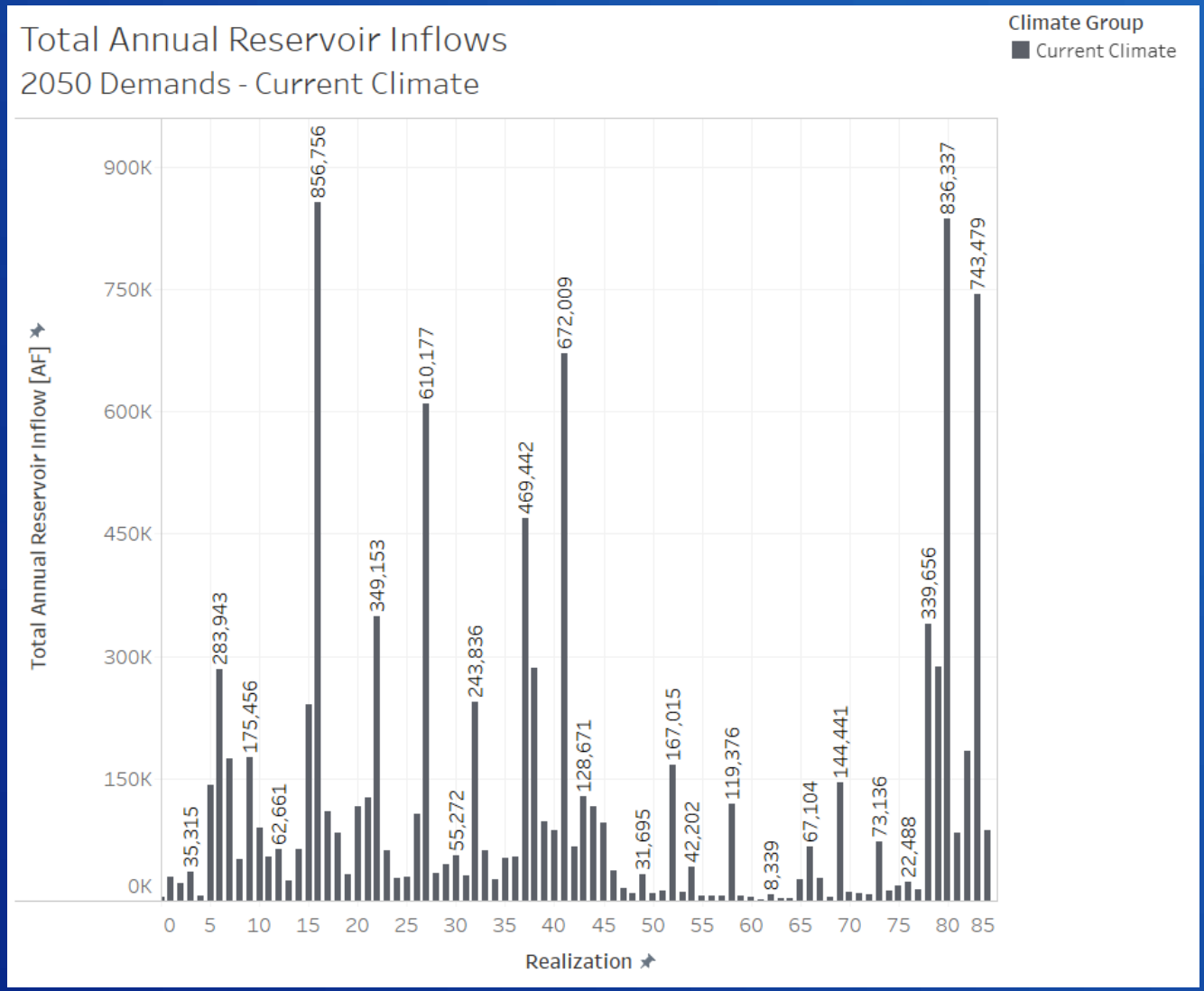
Energy - Power Consumption

Recreation

- **Impacts to Recreation were measured by boat ramp accessibility at the end of September for four reservoirs:**
  - **El Capitan**
  - **Hodges**
  - **Lower Otay**
  - **San Vicente**

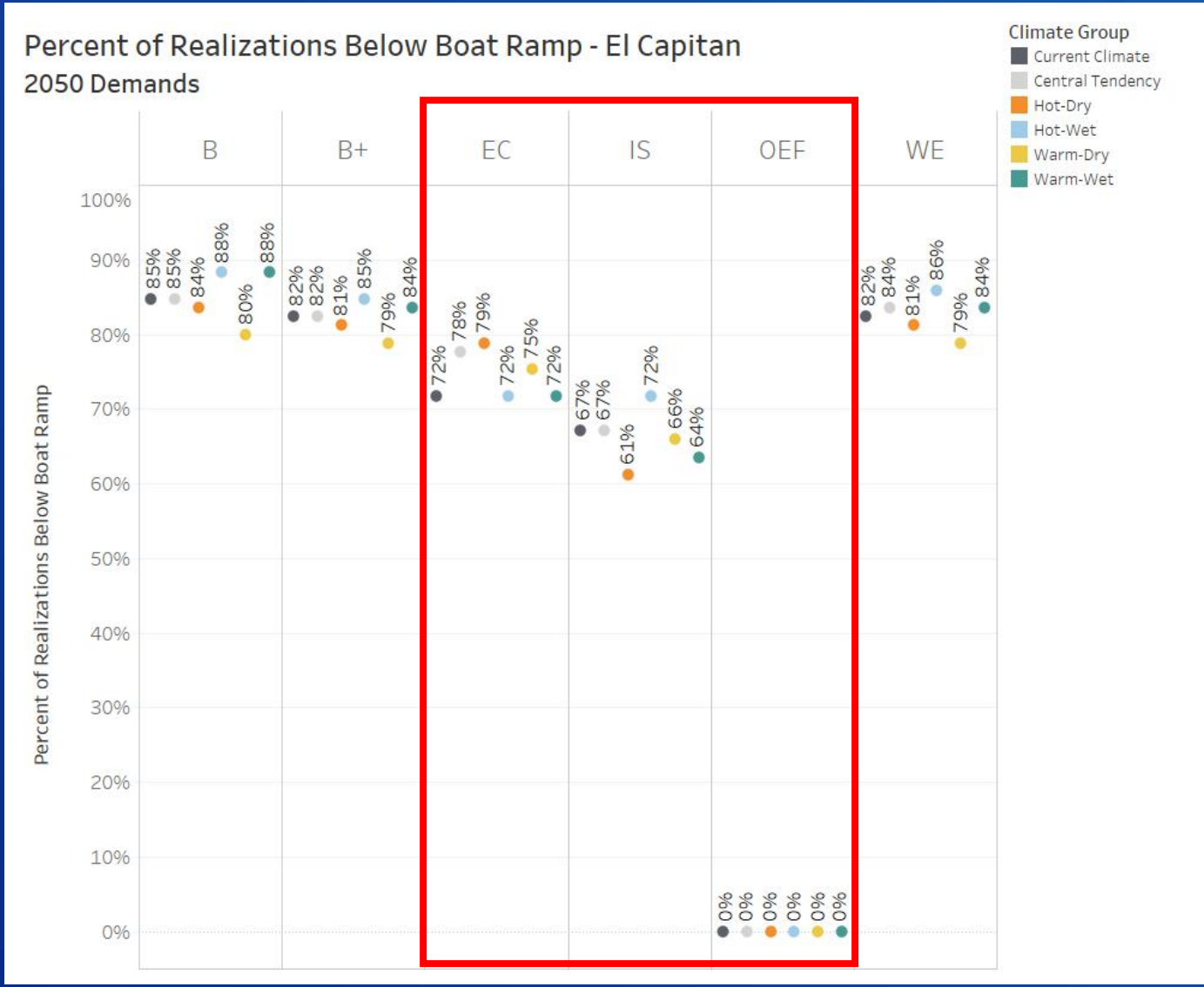
- **When End of September Elevation is greater than the boat ramp elevation, the boat ramp is considered accessible**

Reminder: What is a Realization?

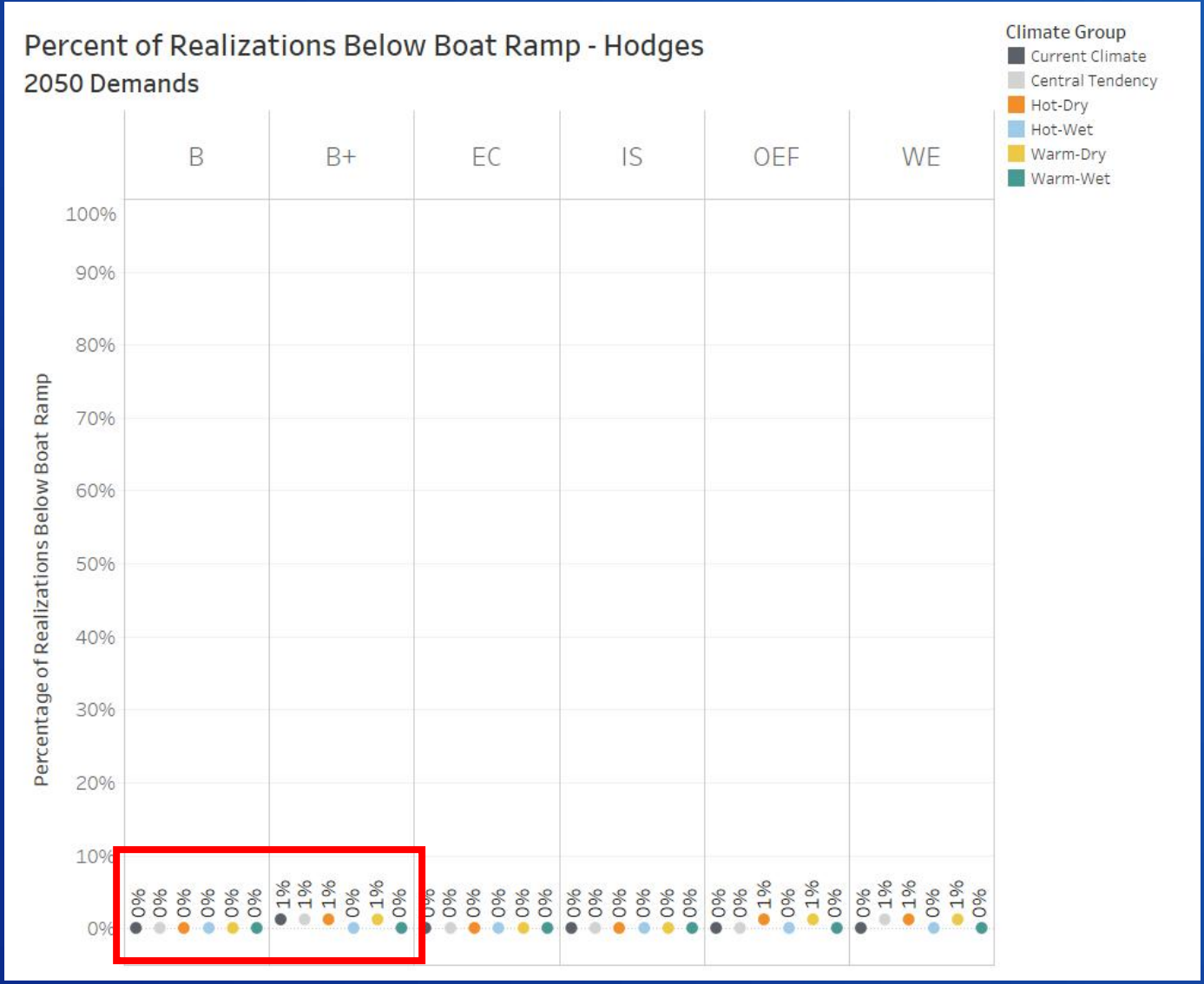


RECLAMATION

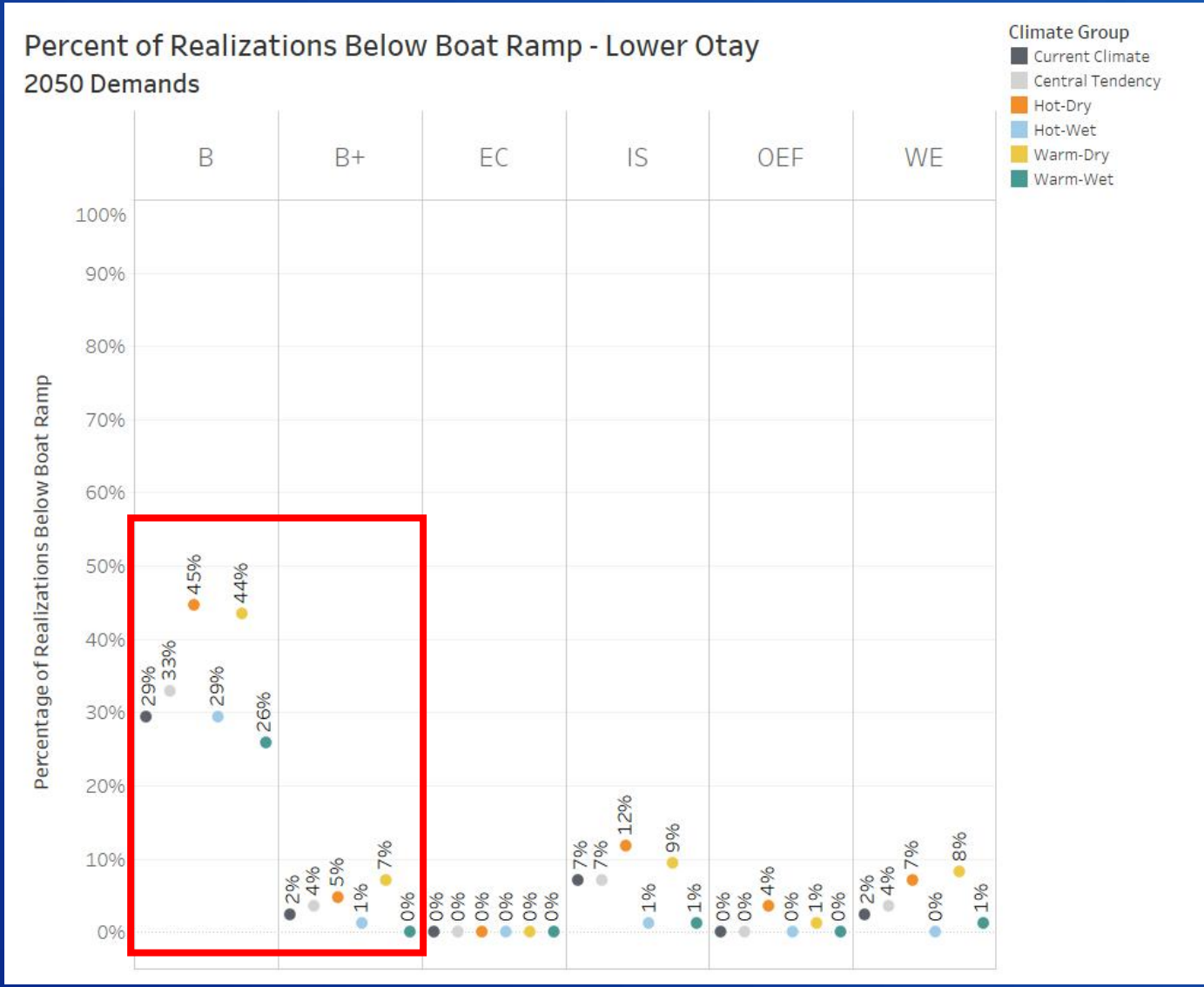
Recreation at El Capitan



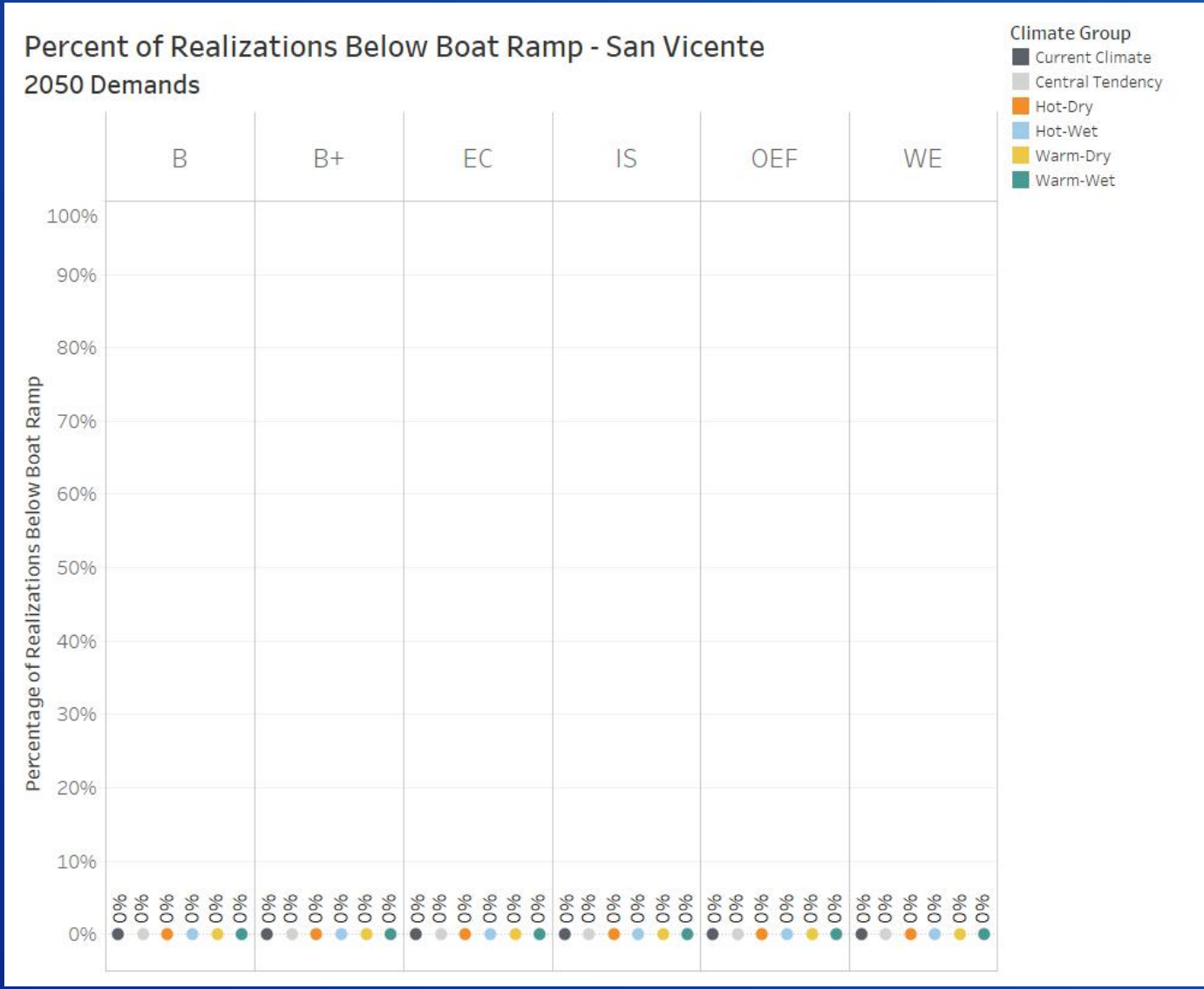
Recreation at Hodges



Recreation at Lower Otay



Recreation at San Vicente

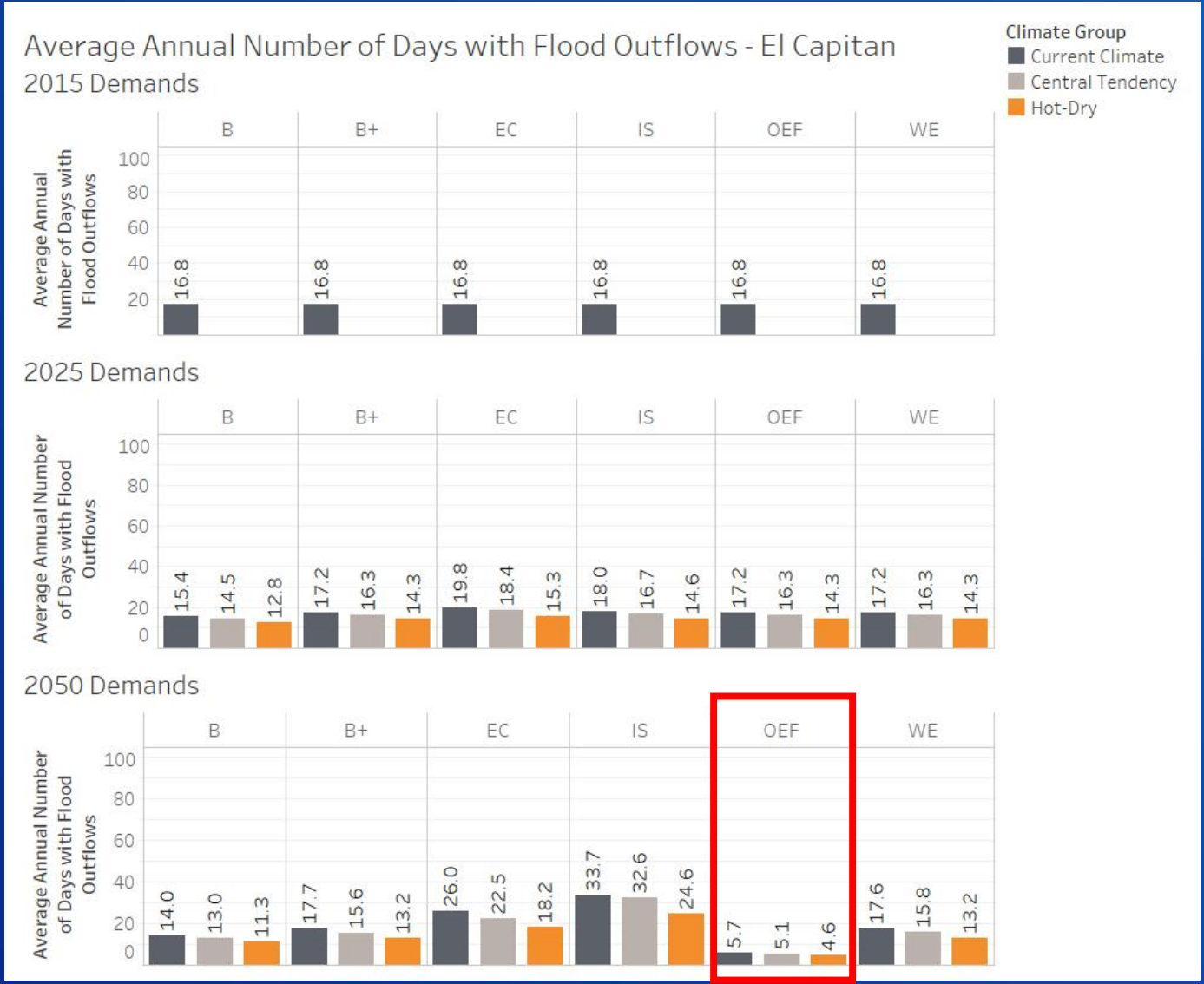


Flood Control

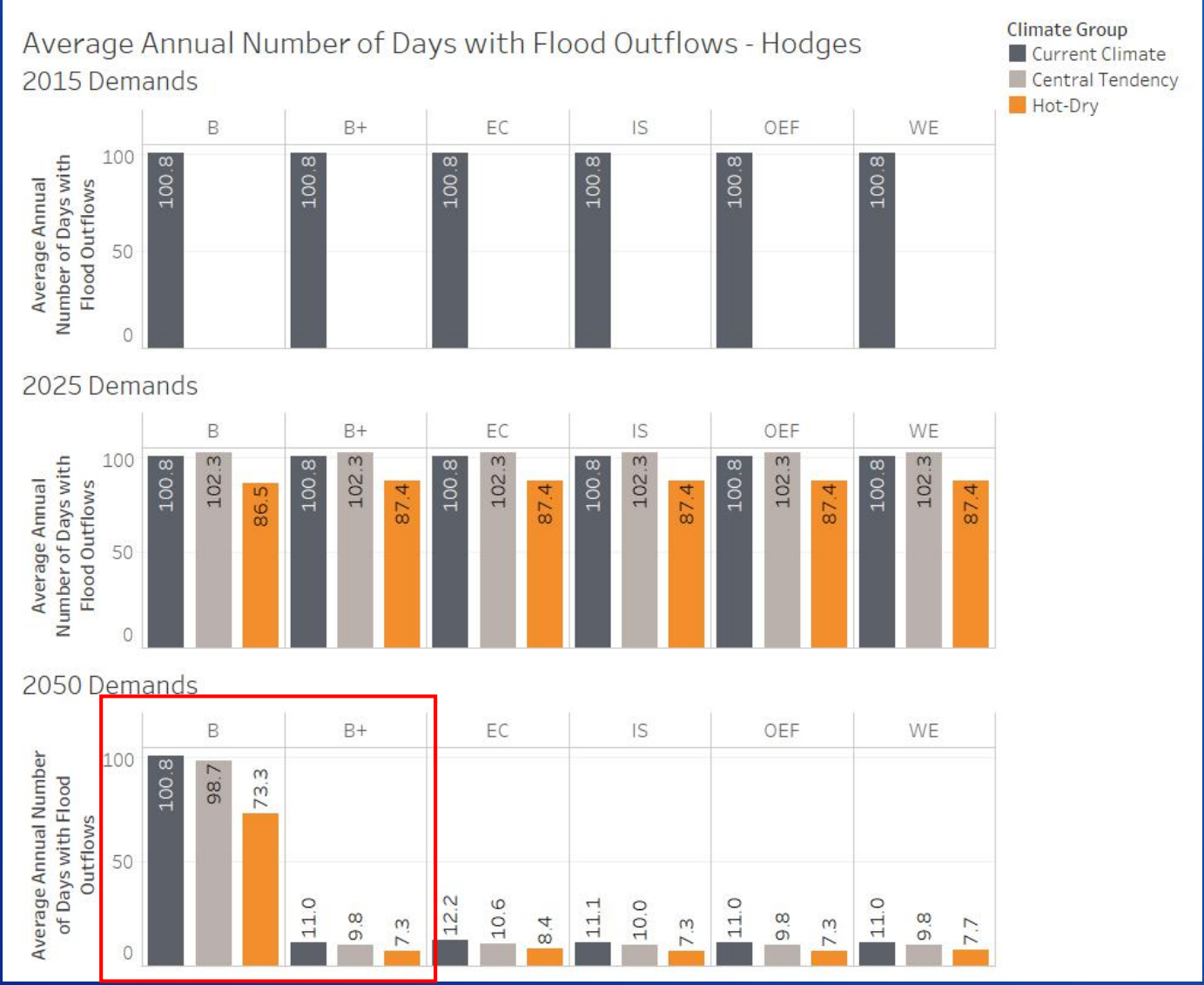
- **Measured by the Number of Days with Flood Outflows and the Flood Outflow Volume**
  - **Flood outflows occur when a reservoir's storage is within the flood pool**
  - **The Flood Outflow Volume metric includes the volume released to meet demands and the additional flood outflow volume**

- **Impacts measured at five reservoirs**
  - **El Capitan**
  - **Hodges**
  - **Lower Otay**
  - **San Vicente (no impacts observed)**
  - **Olivenahin (no impacts observed)**

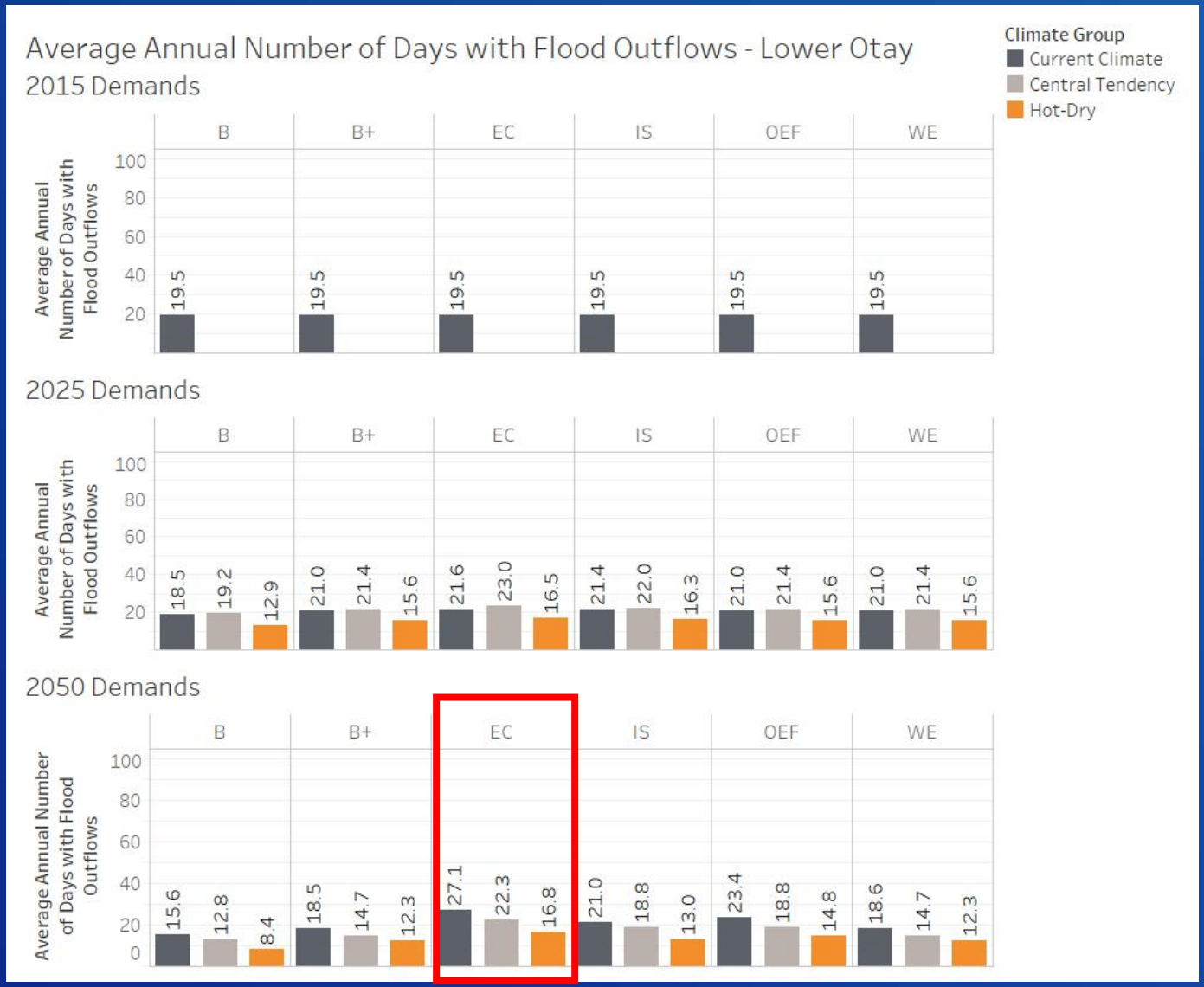
Flood Control at El Capitan



Flood Control at Hodges



Flood Control at Lower Otay



Discussion

- **Questions?**
- **Any surprising Energy results?**
- **Any surprising Recreation results?**
- **Any surprising Flood Control results?**
- **Feedback to consider for the Summary Report?**

Break

Agenda

- Welcome & Introductions
- Study Overview and Update
- Background and Methods
- Results by Impact Area

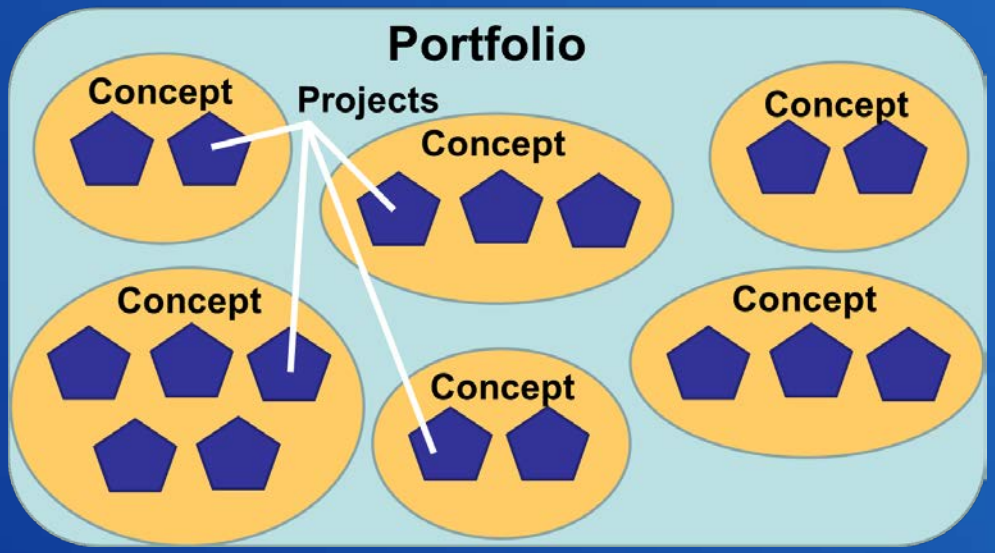
Break

- **Results by Concept**
- Next Steps
- Adjourn

San Diego Basin Study Concepts

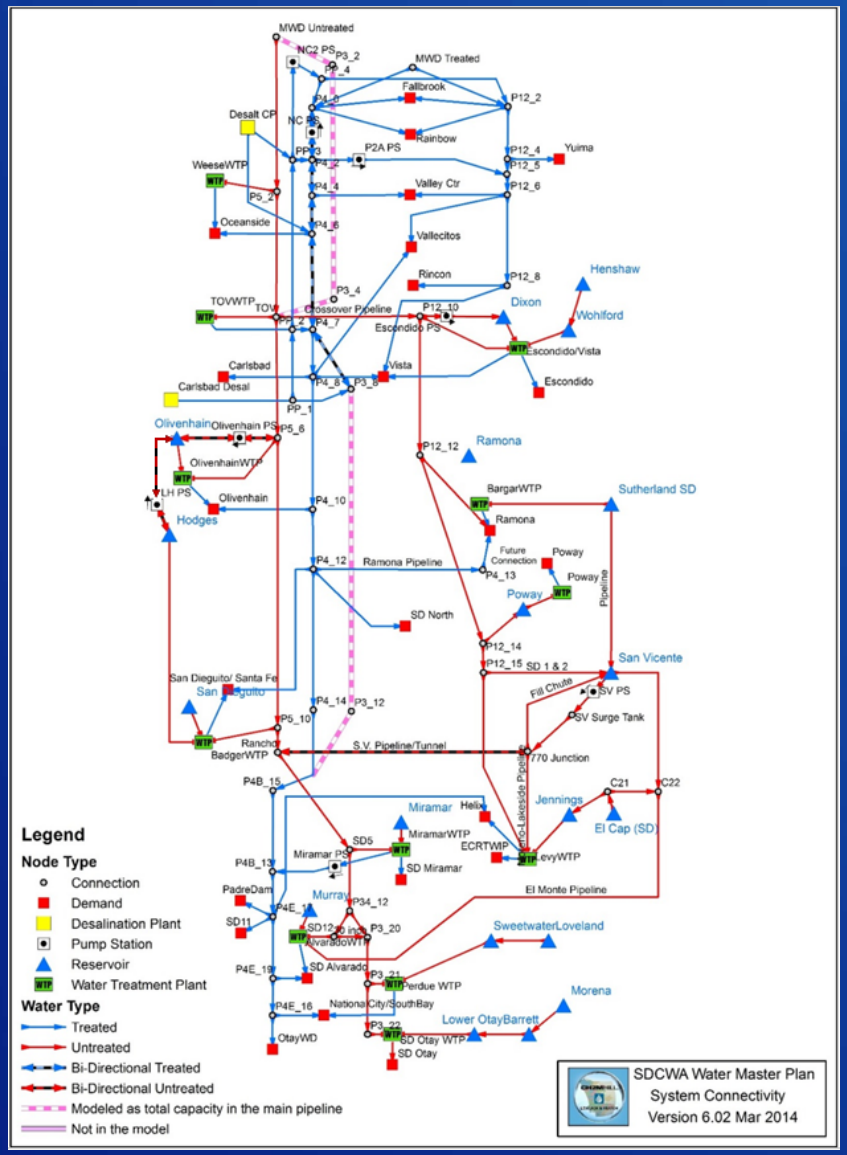
Concepts

- Conveyance Improvements
- Drought Restriction/Allocation
- Firm Water Supply Agreements
- Gray Water Use
- Groundwater
- Imported Water Purchases
- Local Surface Water Reservoirs
- Recycled Water
- Seawater Desalination
- Stormwater BMPs
- Stormwater Capture
- Urban & Ag. Water Use Efficiency
- Watershed and Ecosystem Management



RECLAMATION

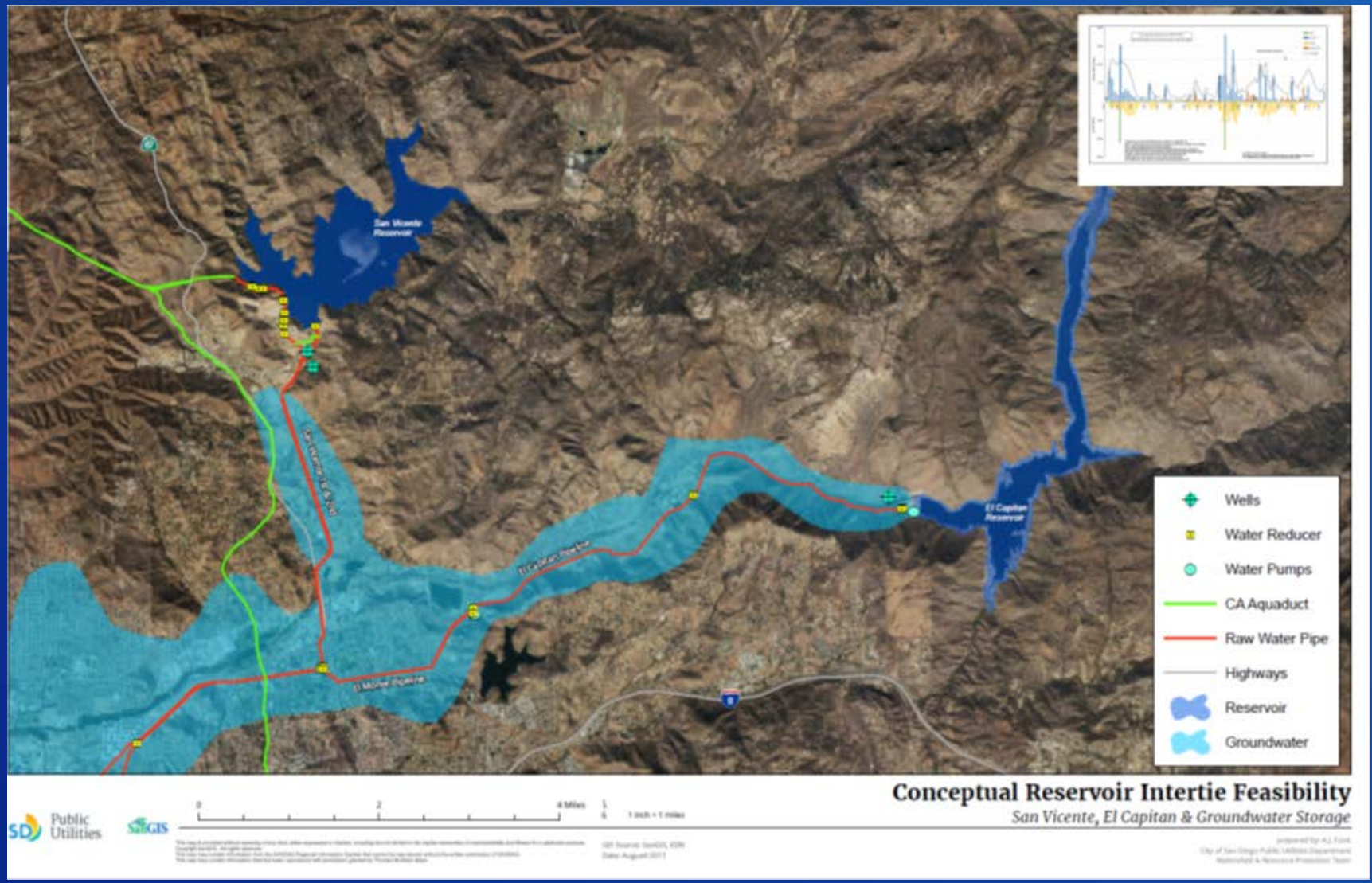
Conveyance Improvement



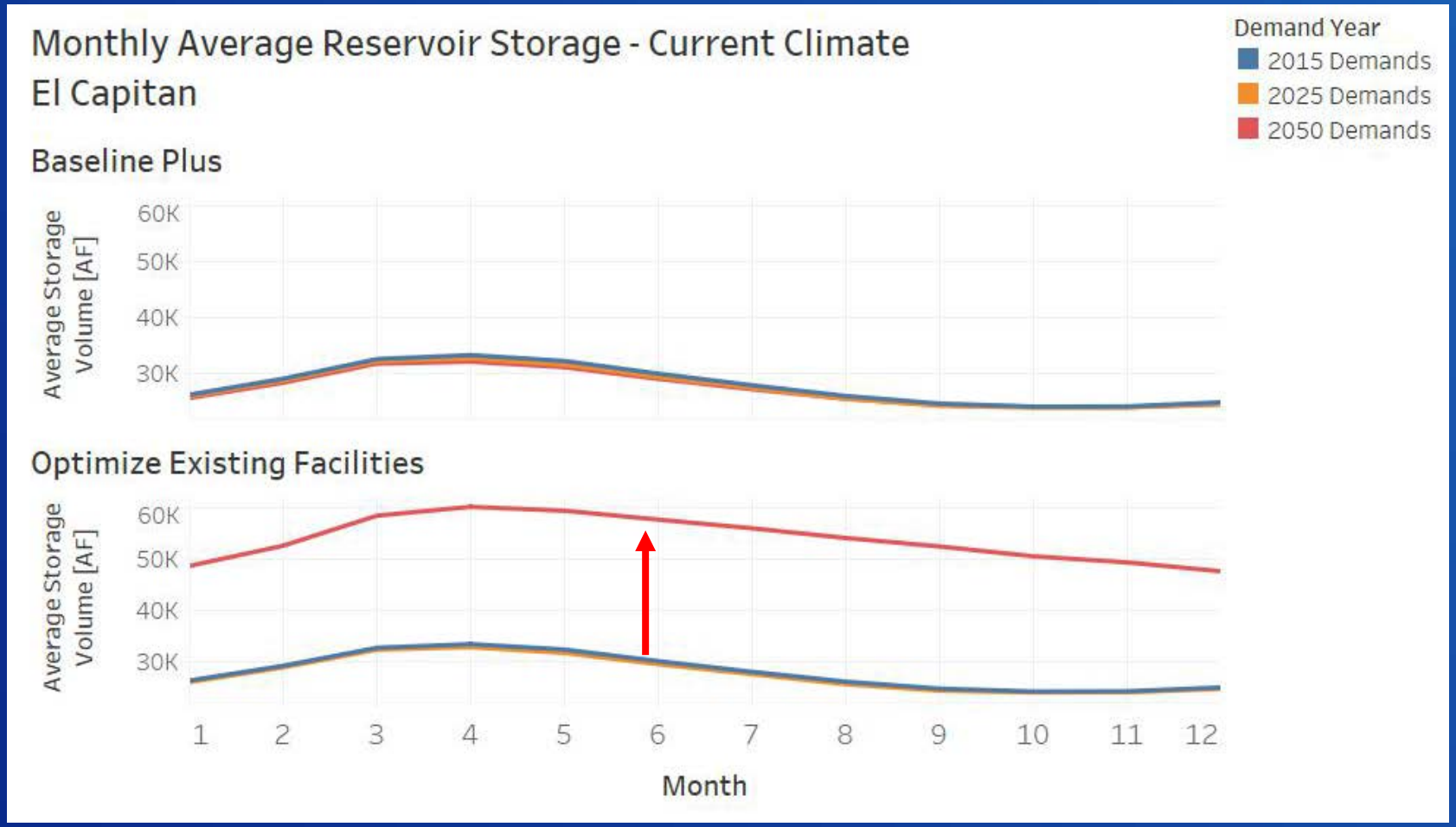
- **Projects that increase the amount of water that can be conveyed**
  - **Conveyance restrictions can lead to shortages**
  - **Results indicate potential restrictions at the MWD Untreated Pipeline**

RECLAMATION

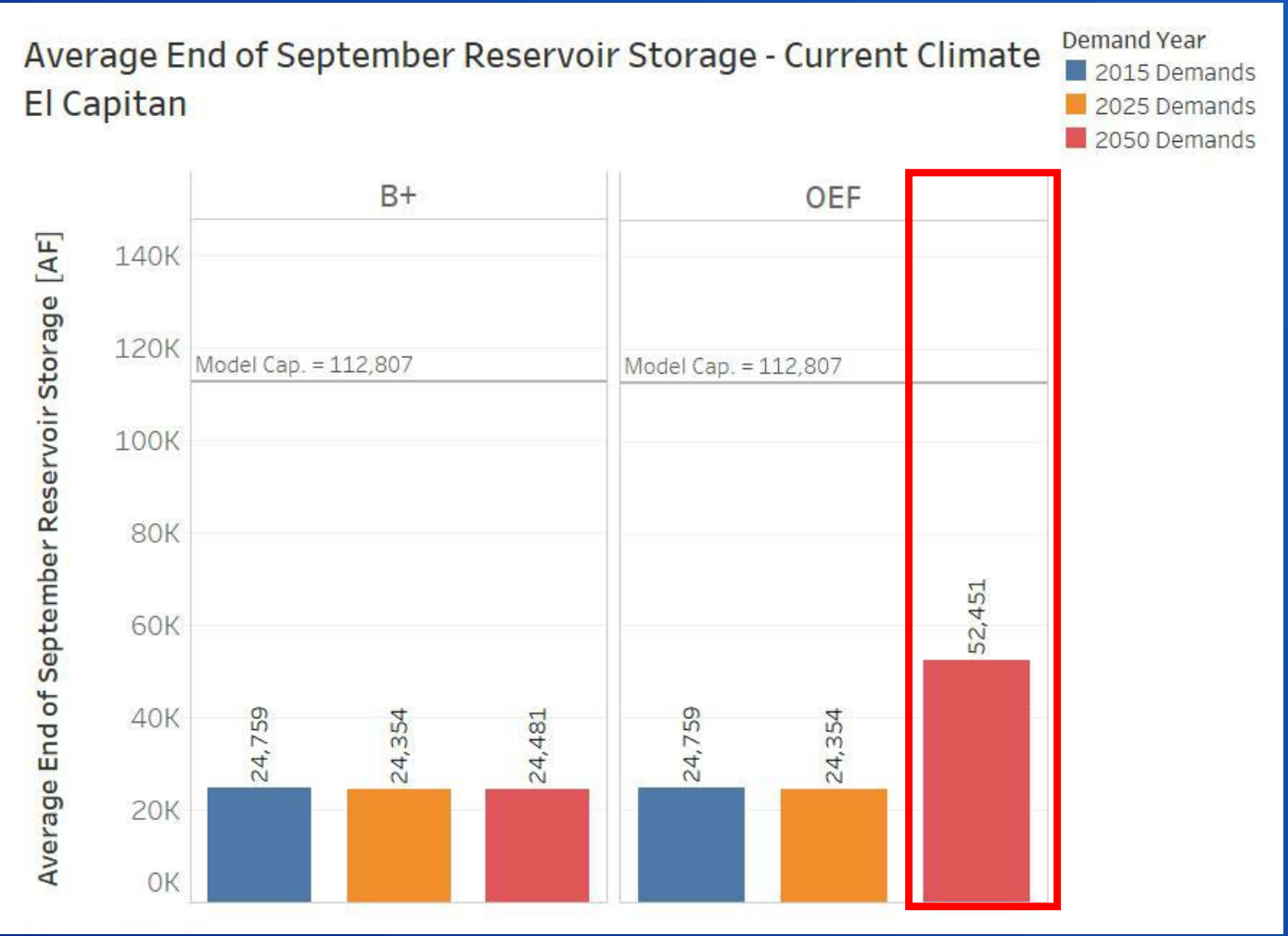
San Diego Reservoir Intertie



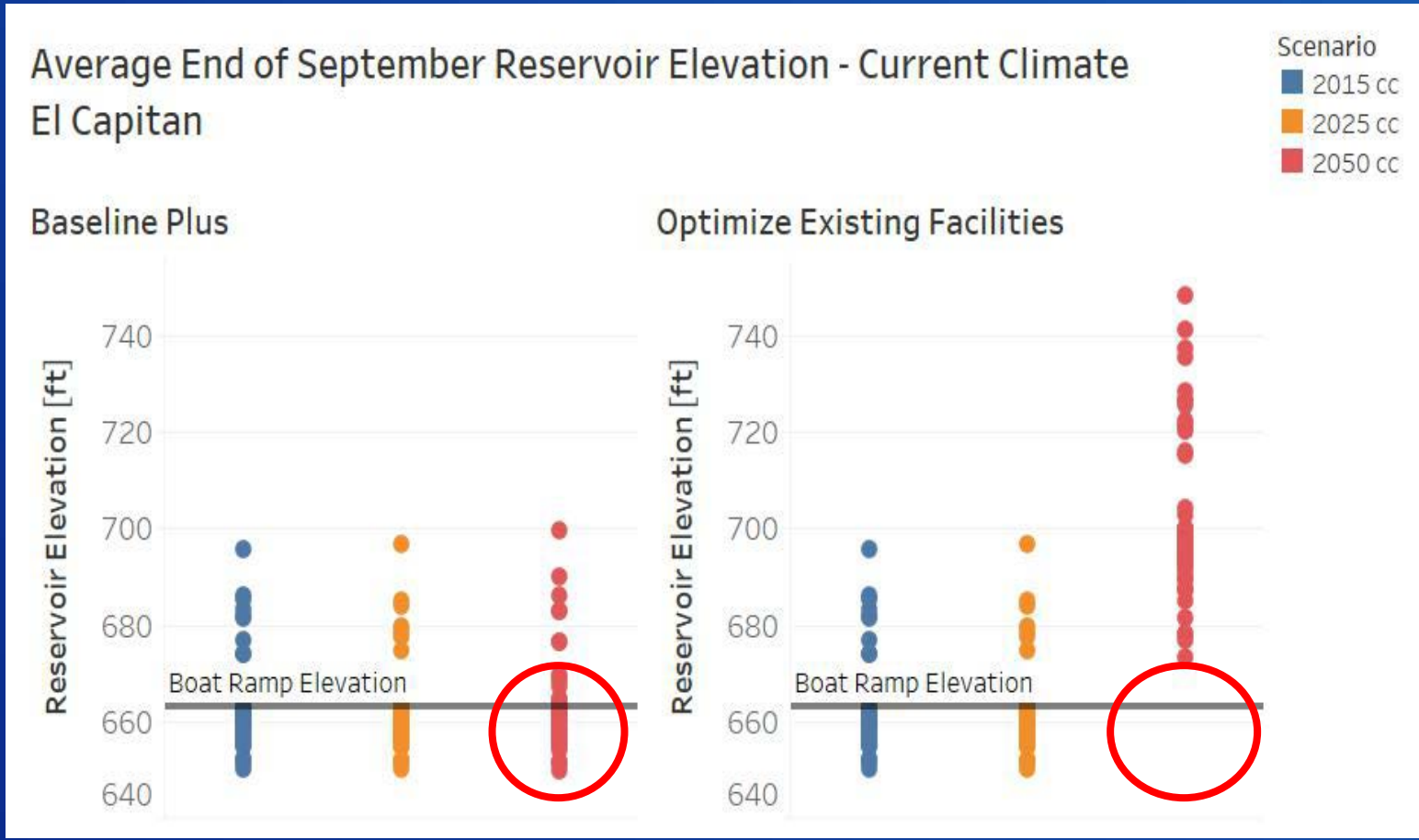
San Diego Reservoir Intertie



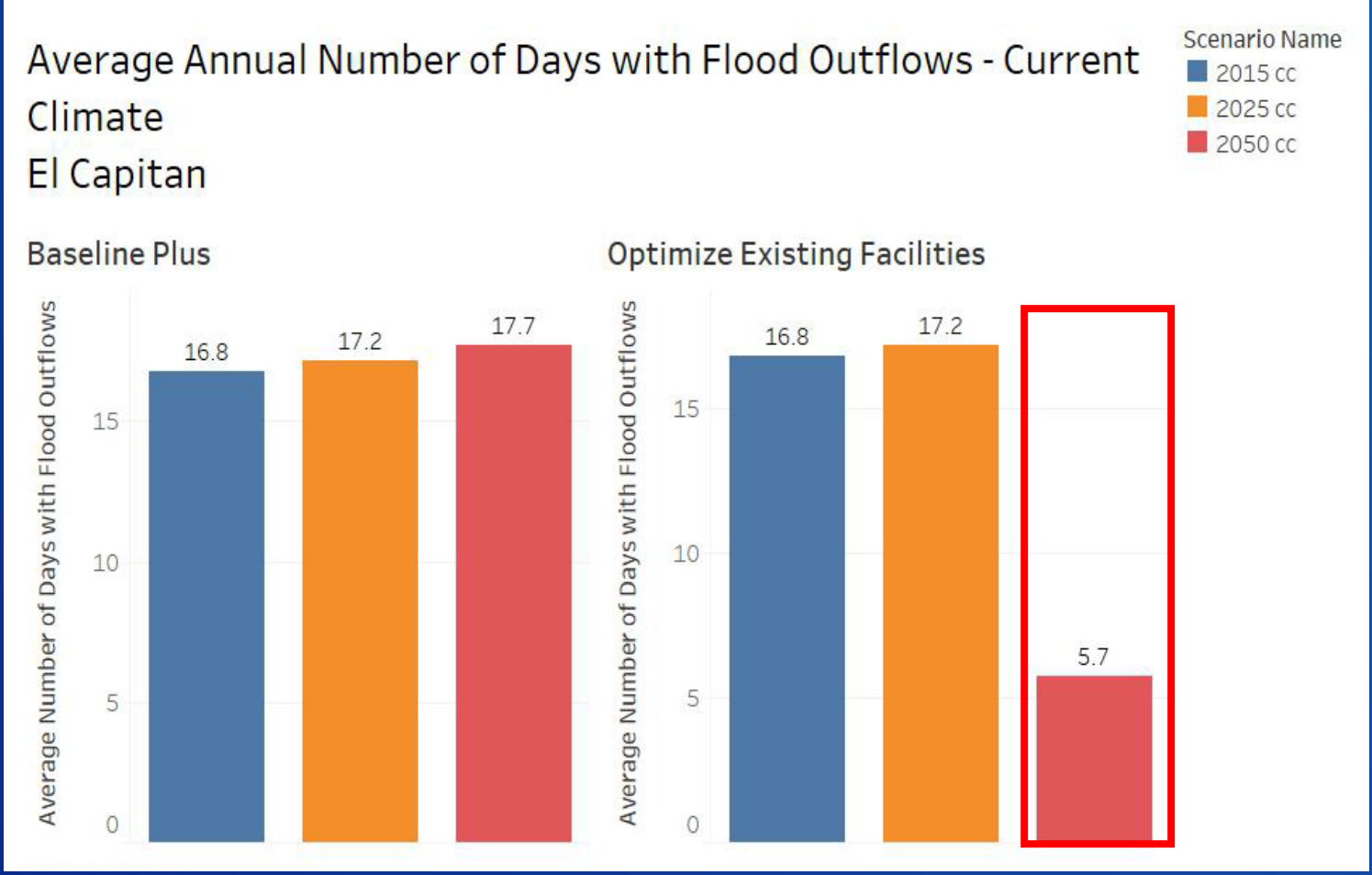
San Diego Reservoir Intertie



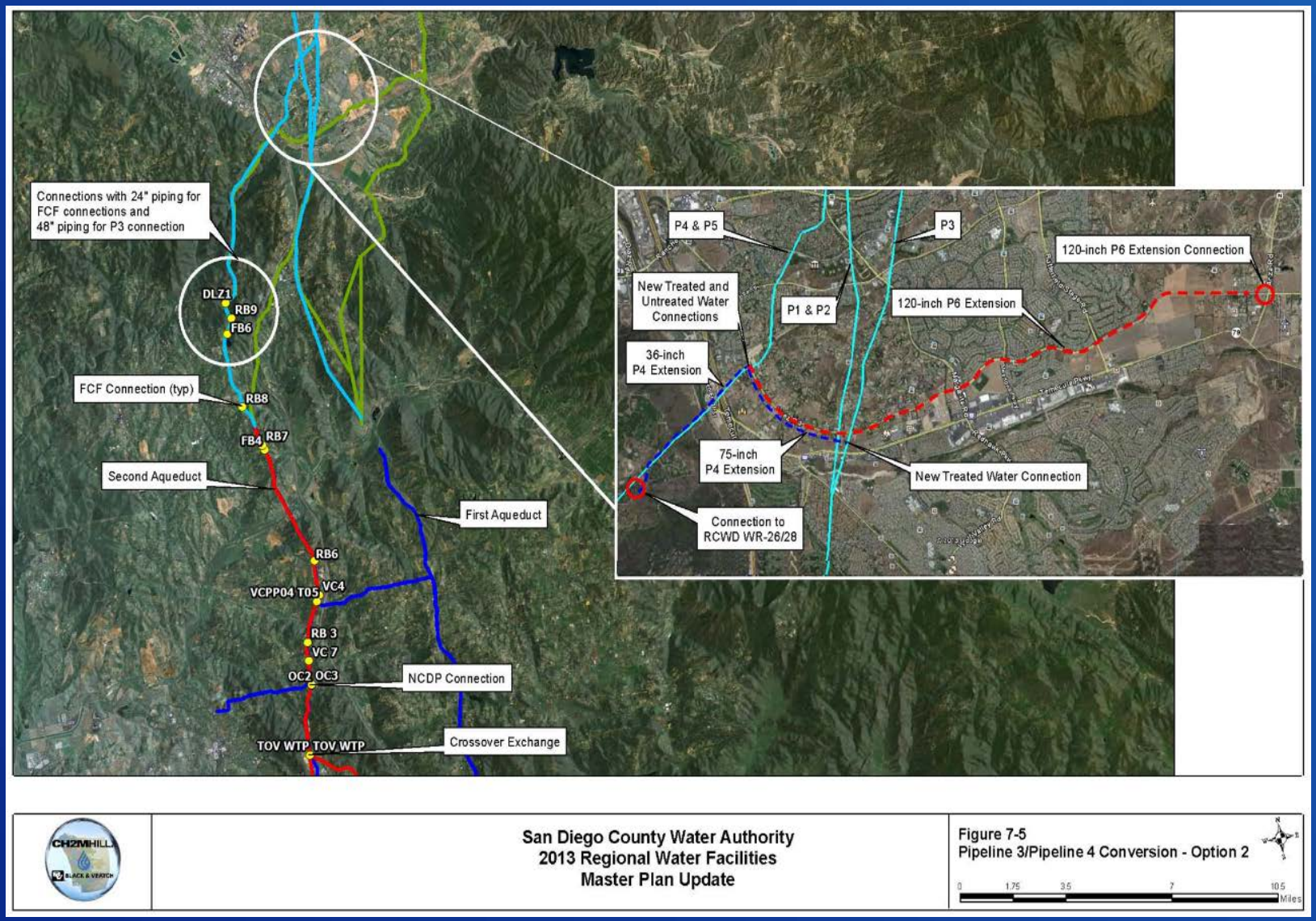
San Diego Reservoir Intertie



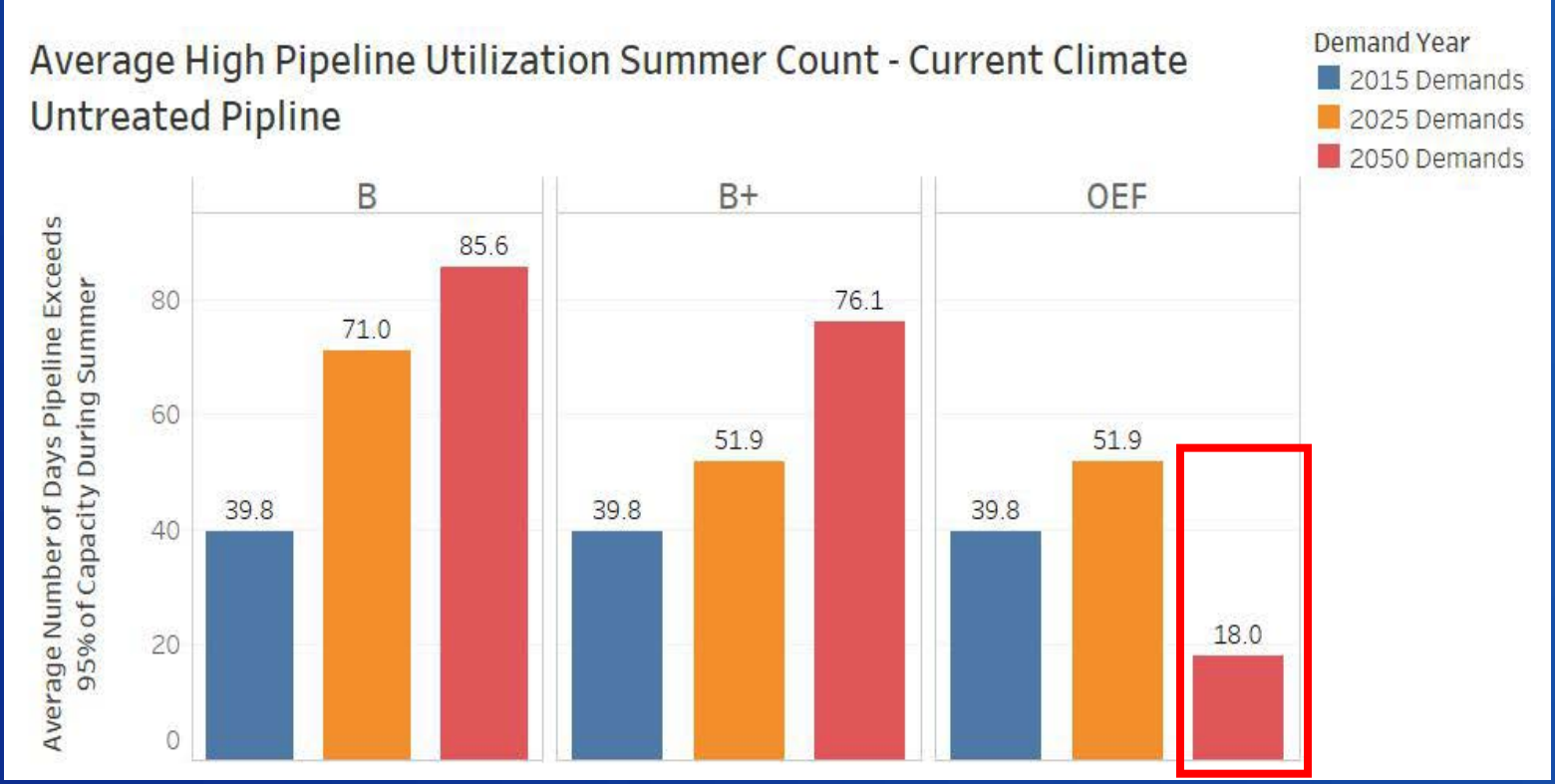
San Diego Reservoir Intertie



Pipeline 3/Pipeline 4 Conversion

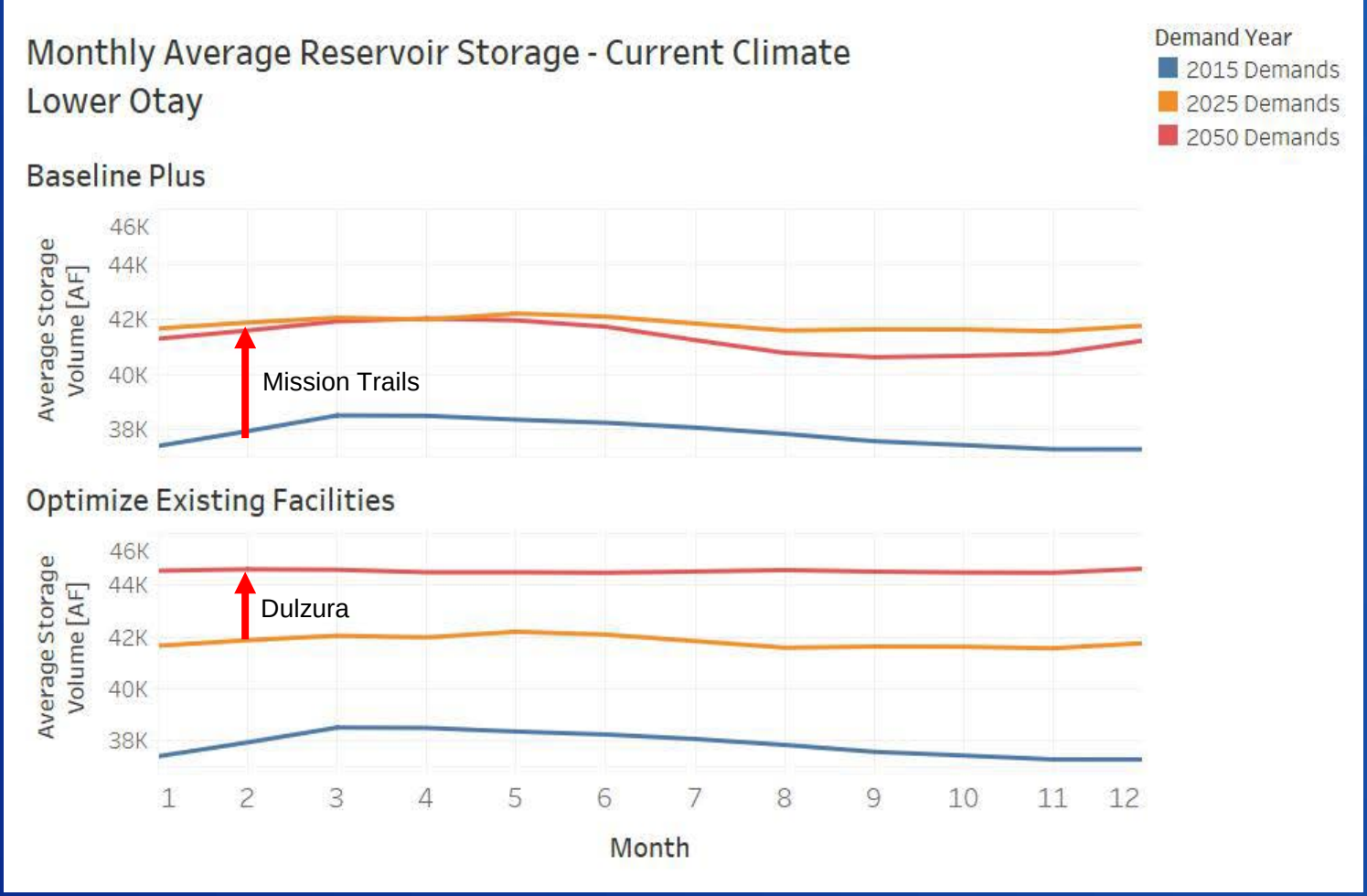


Pipeline 3/Pipeline 4 Conversion

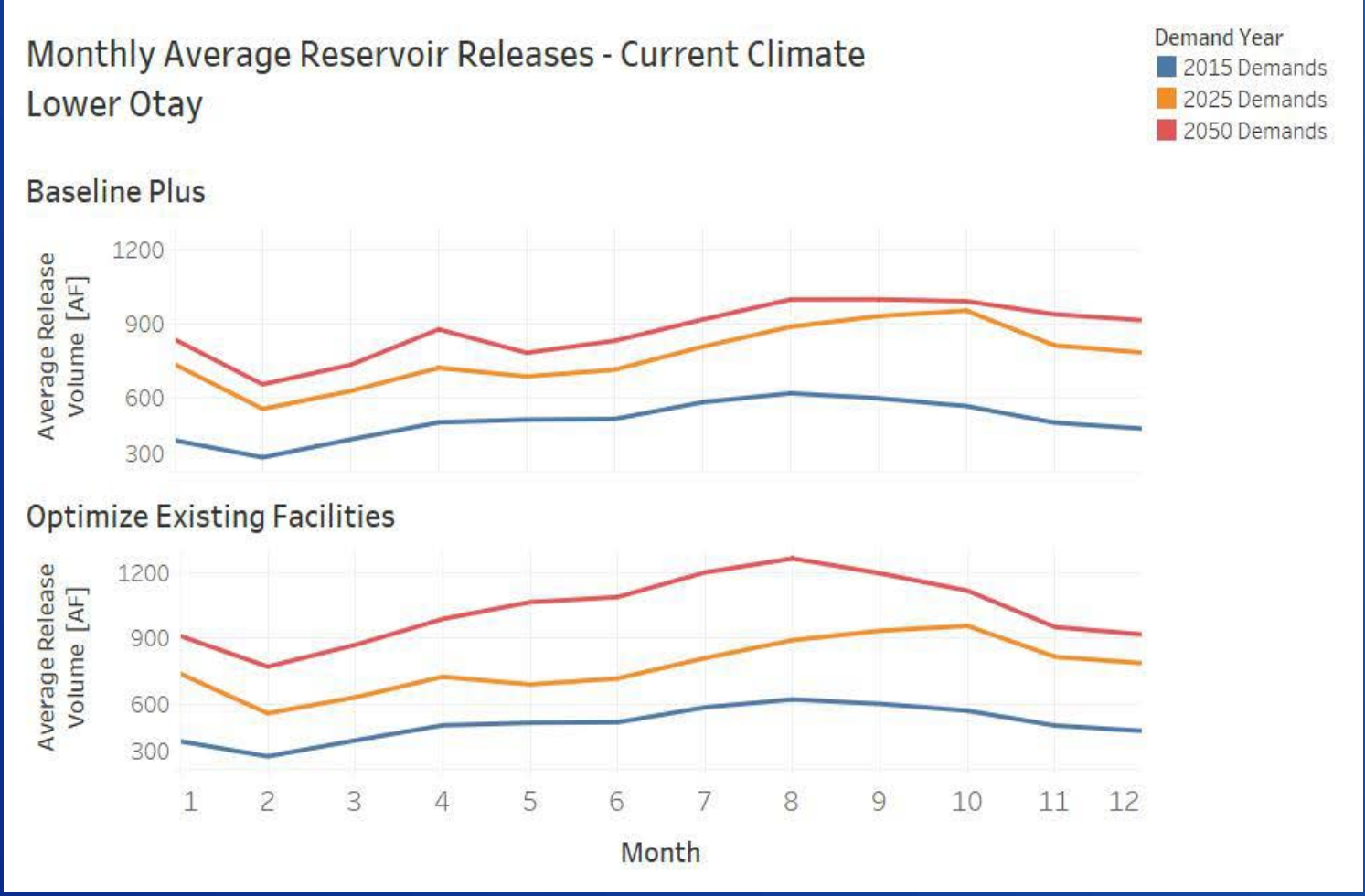


Dulzura Conduit Replacement

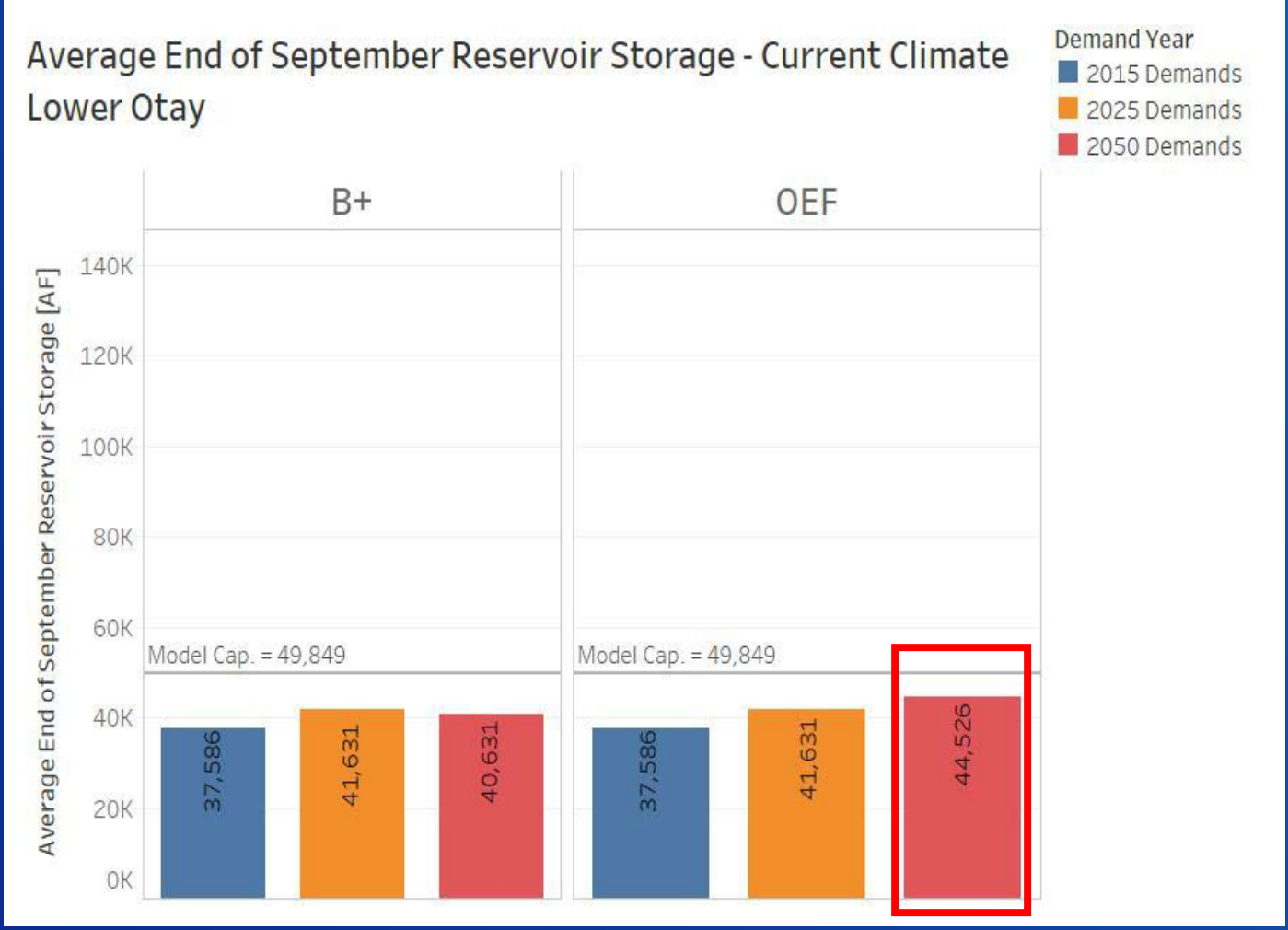
Dulzura Conduit Refurbishment



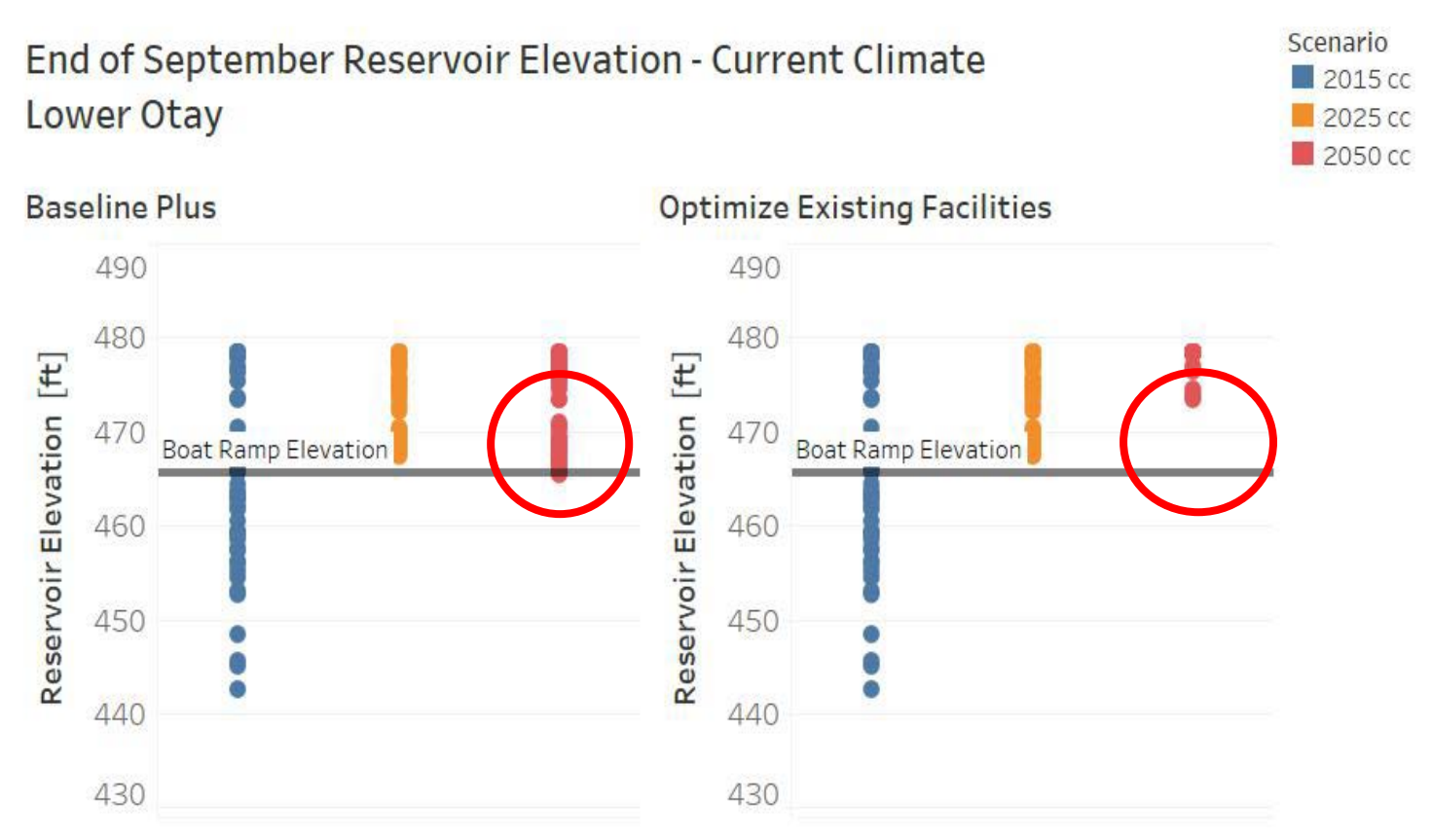
Dulzura Conduit Refurbishment



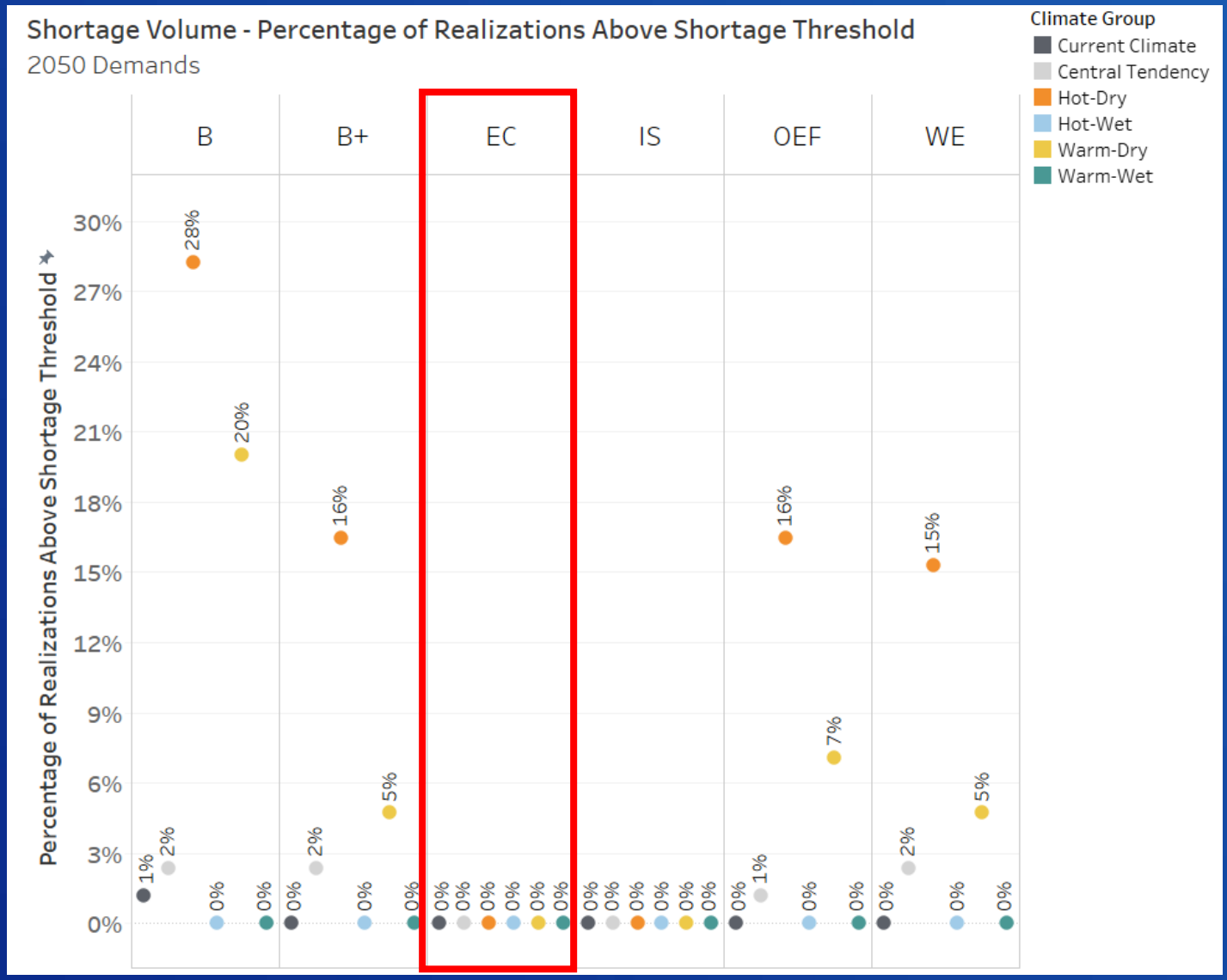
Dulzura Conduit Refurbishment



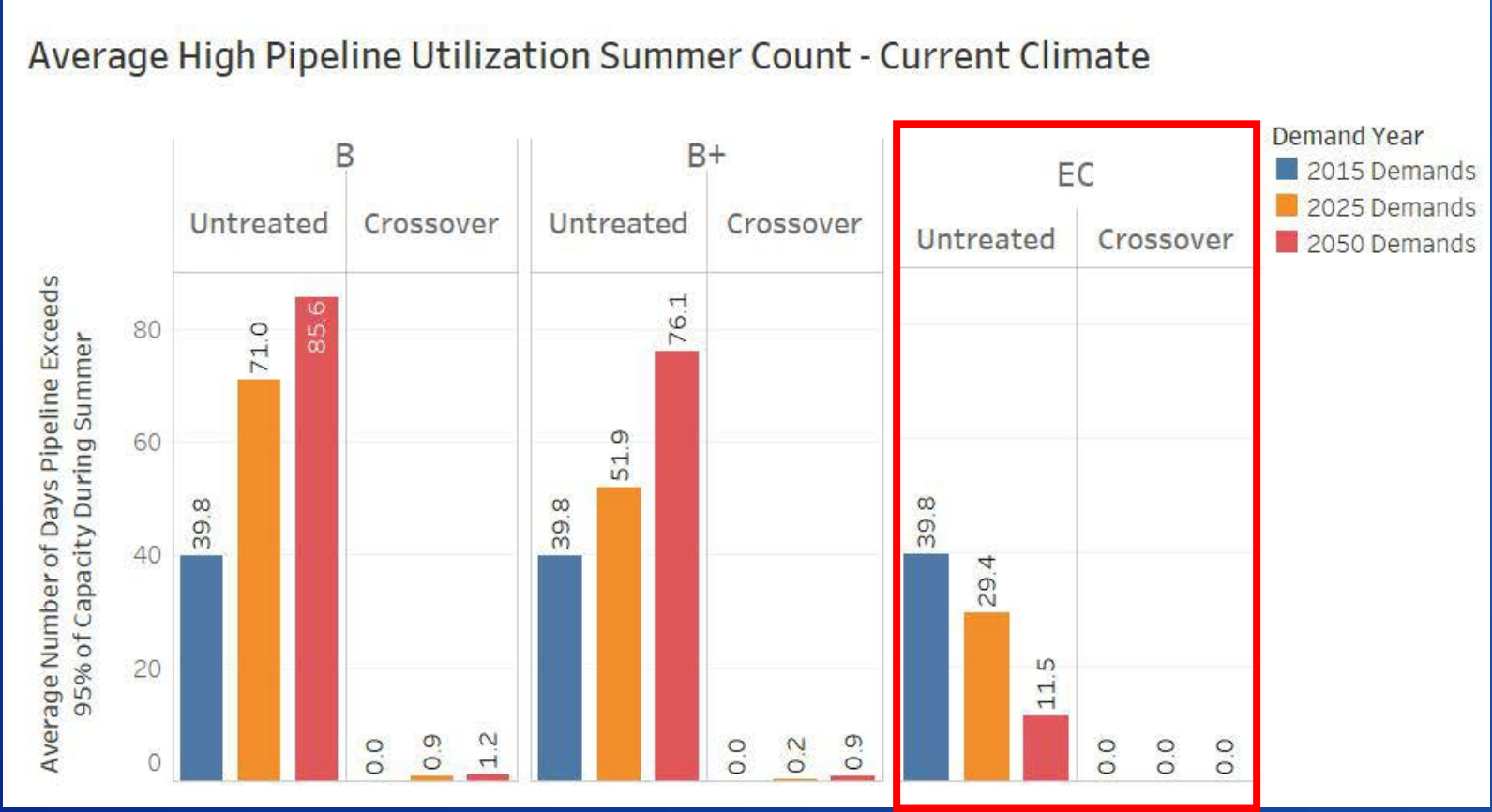
Dulzura Conduit Refurbishment



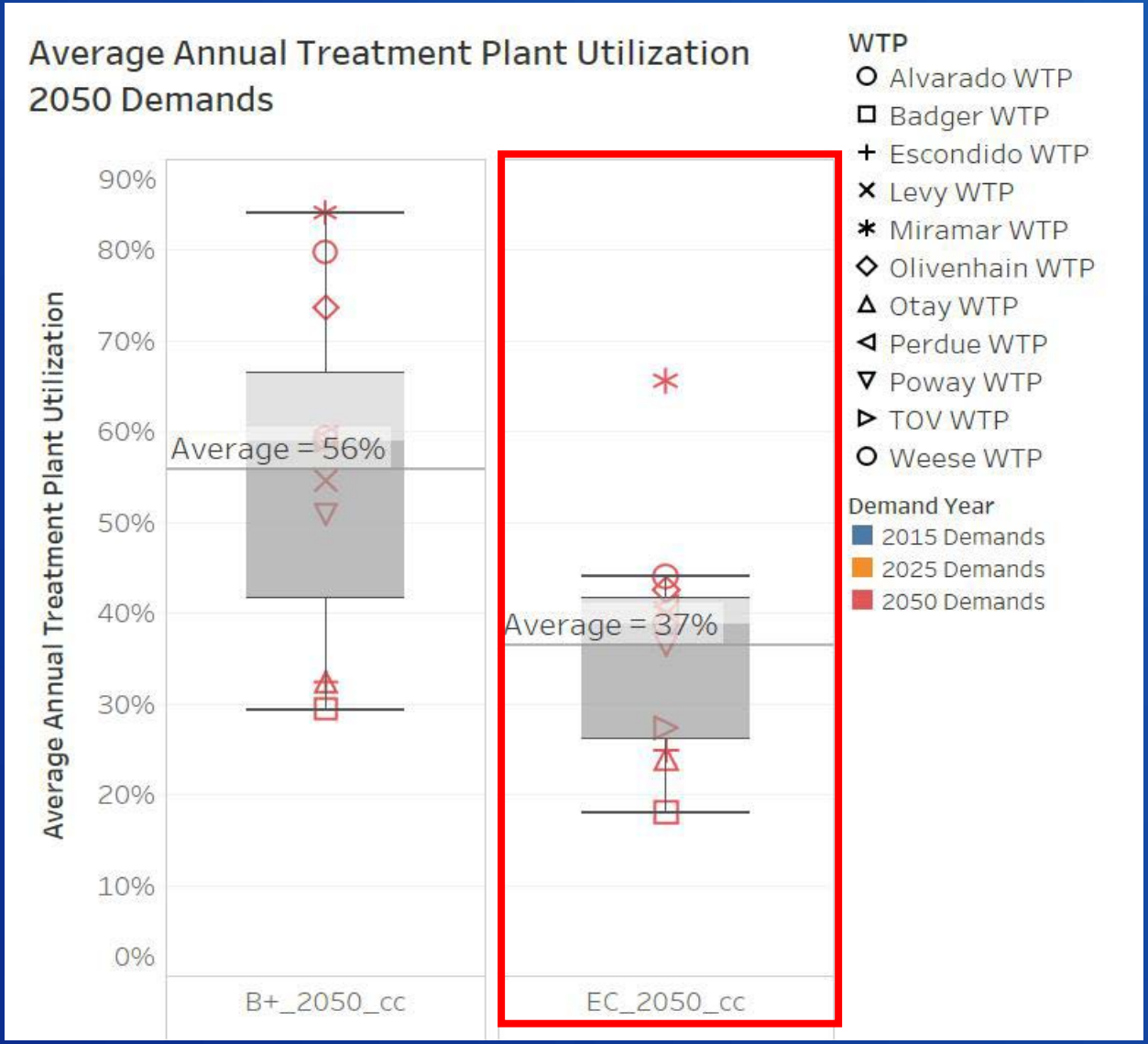
Enhanced Conservation



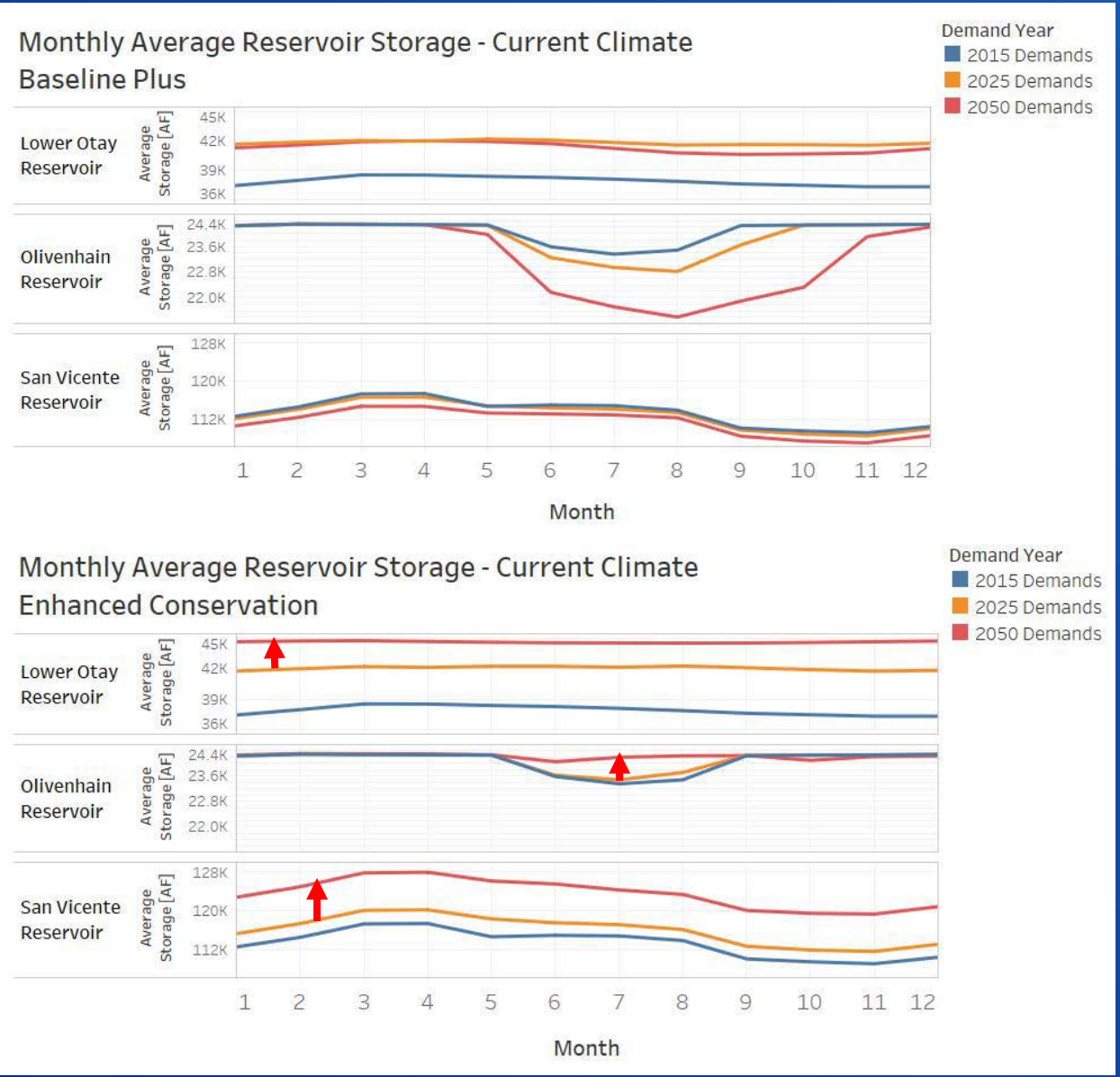
Enhanced Conservation



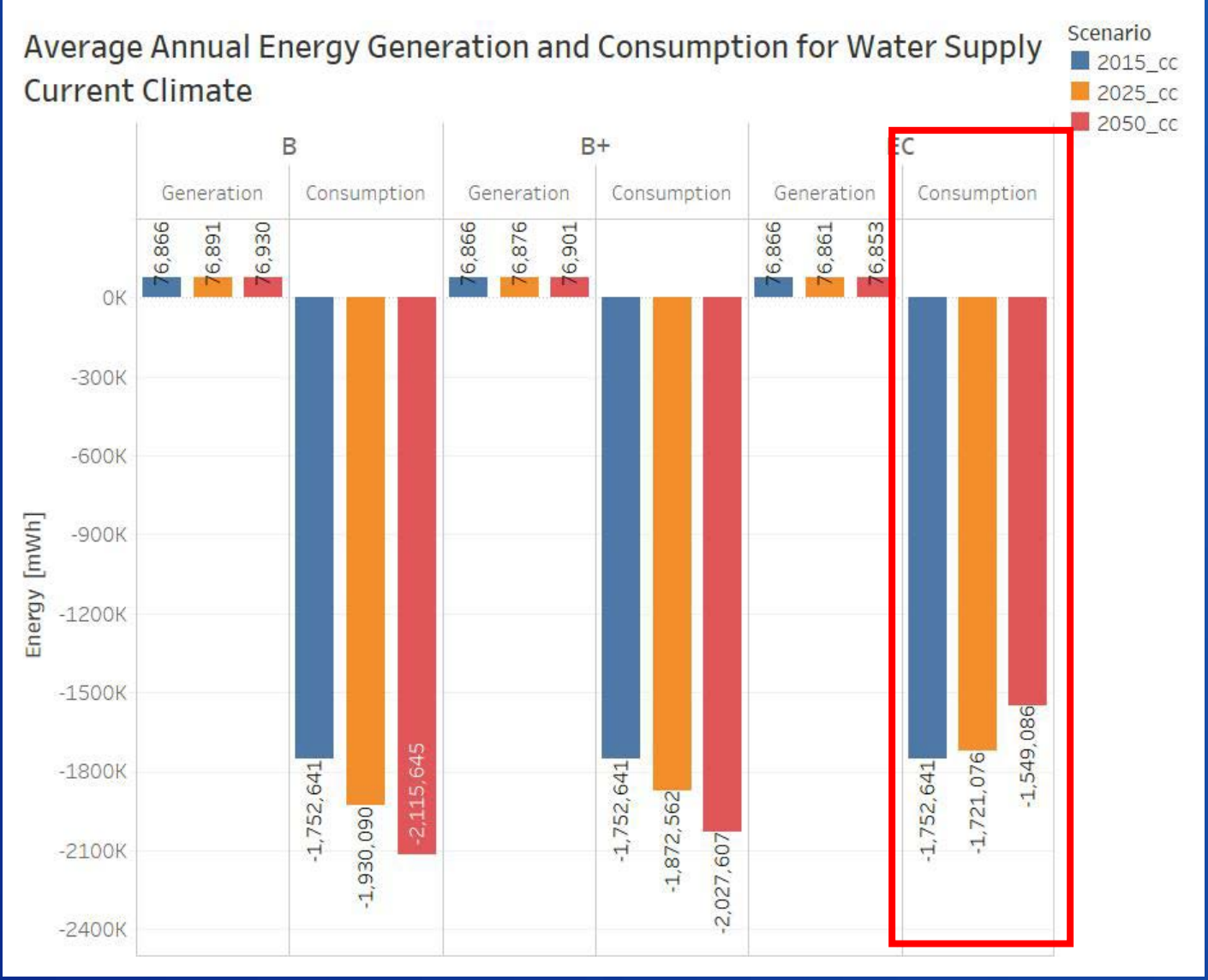
Enhanced Conservation



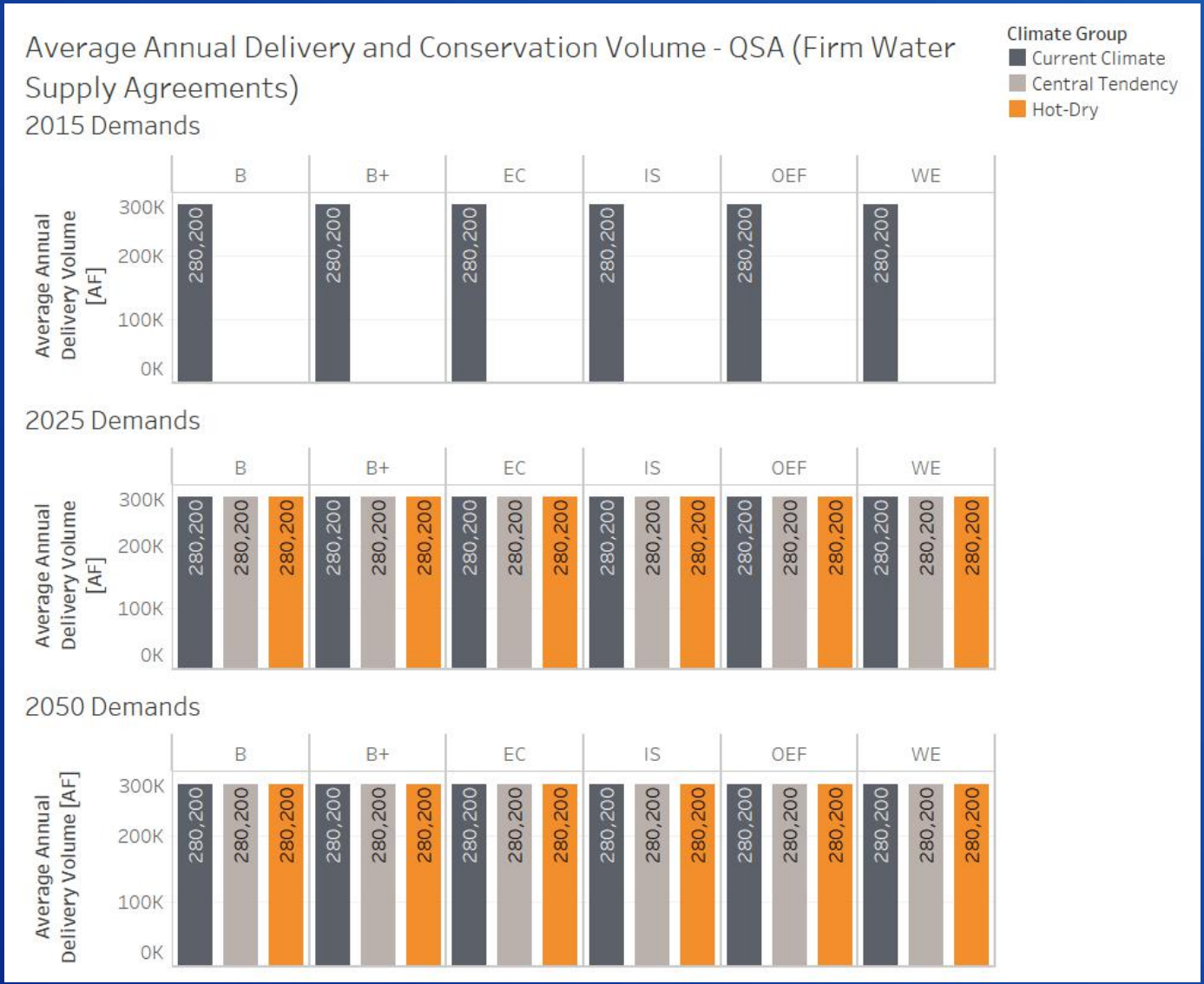
Enhanced Conservation



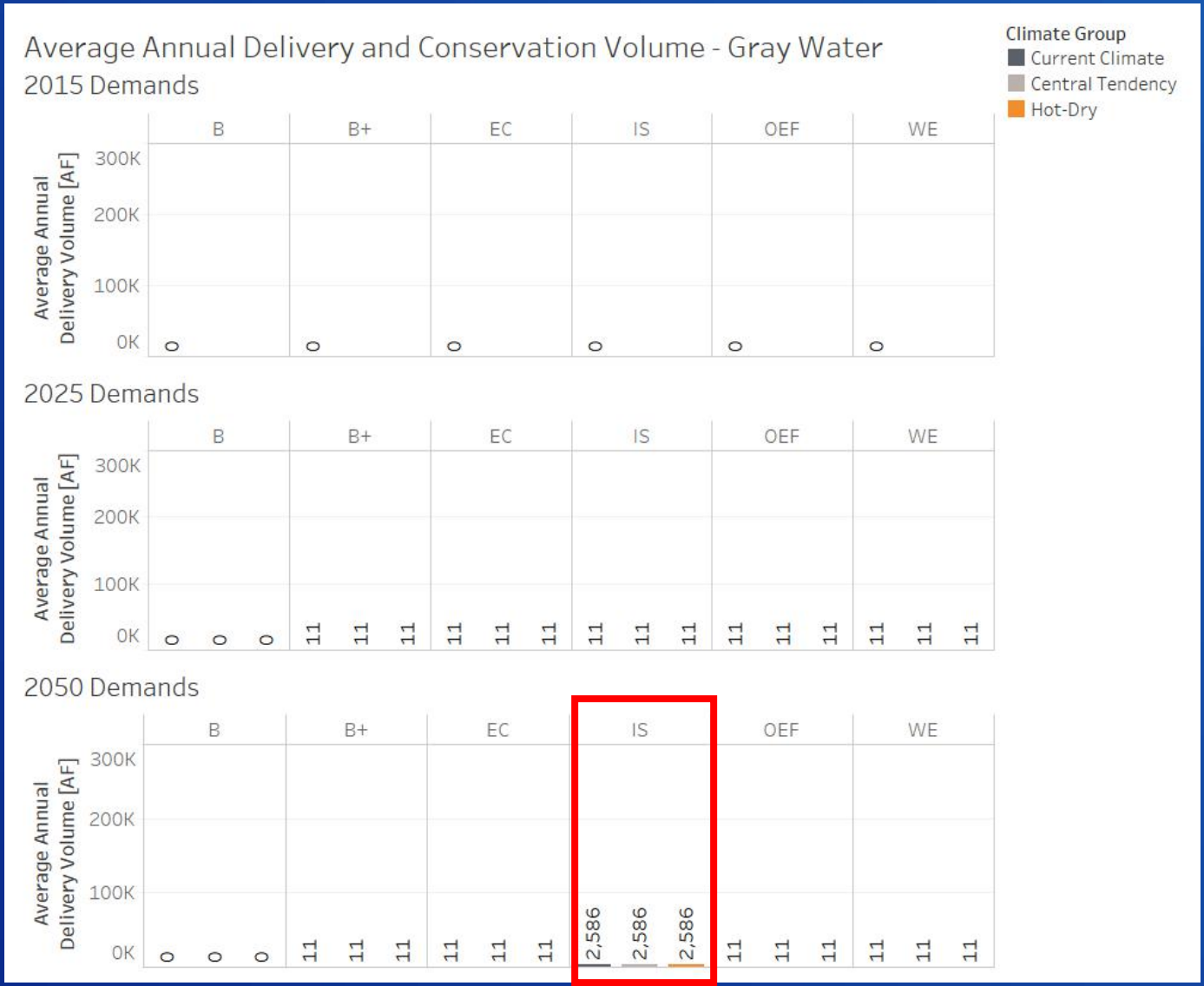
Enhanced Conservation



Firm Water Supply Agreements



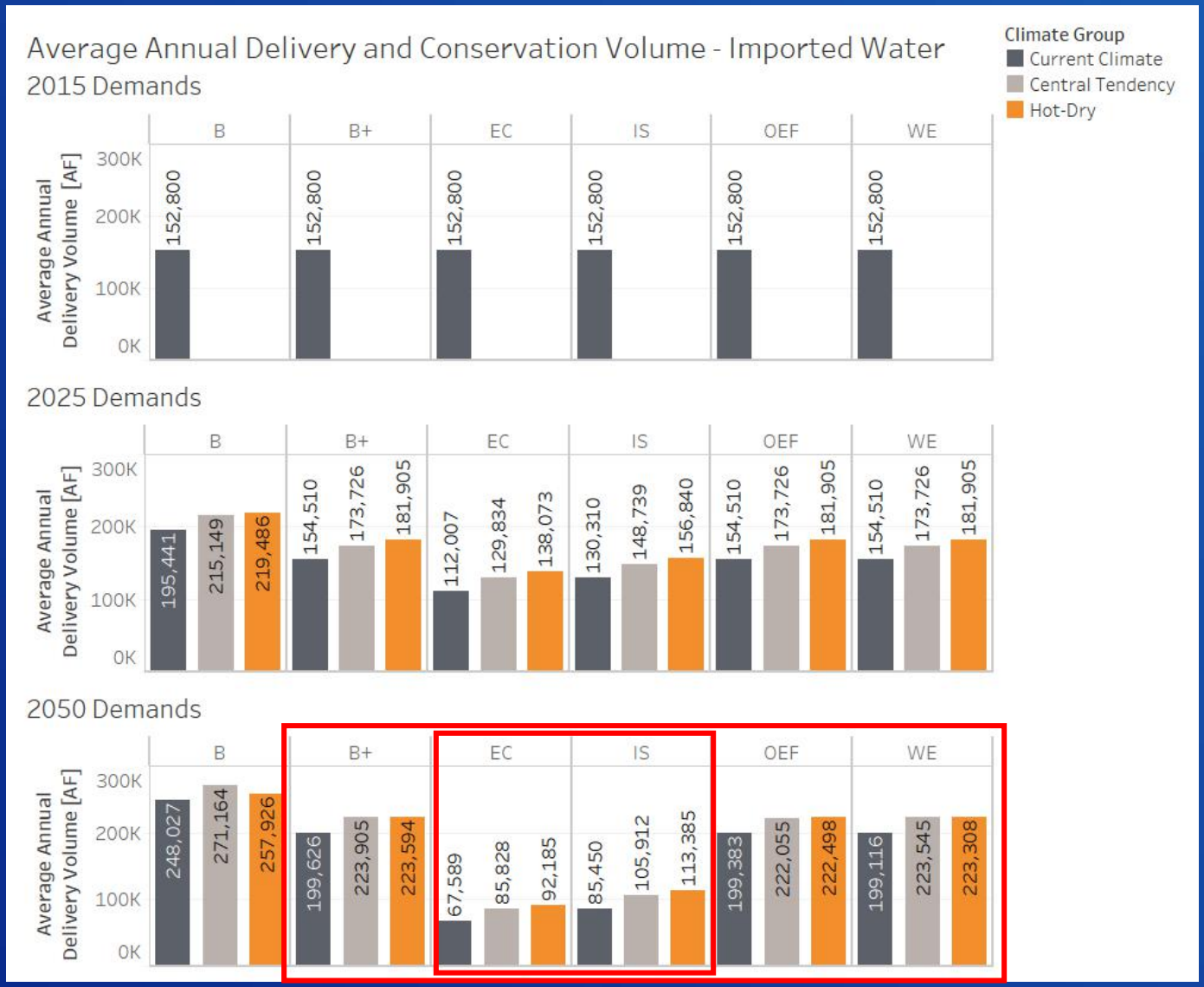
Gray Water Use



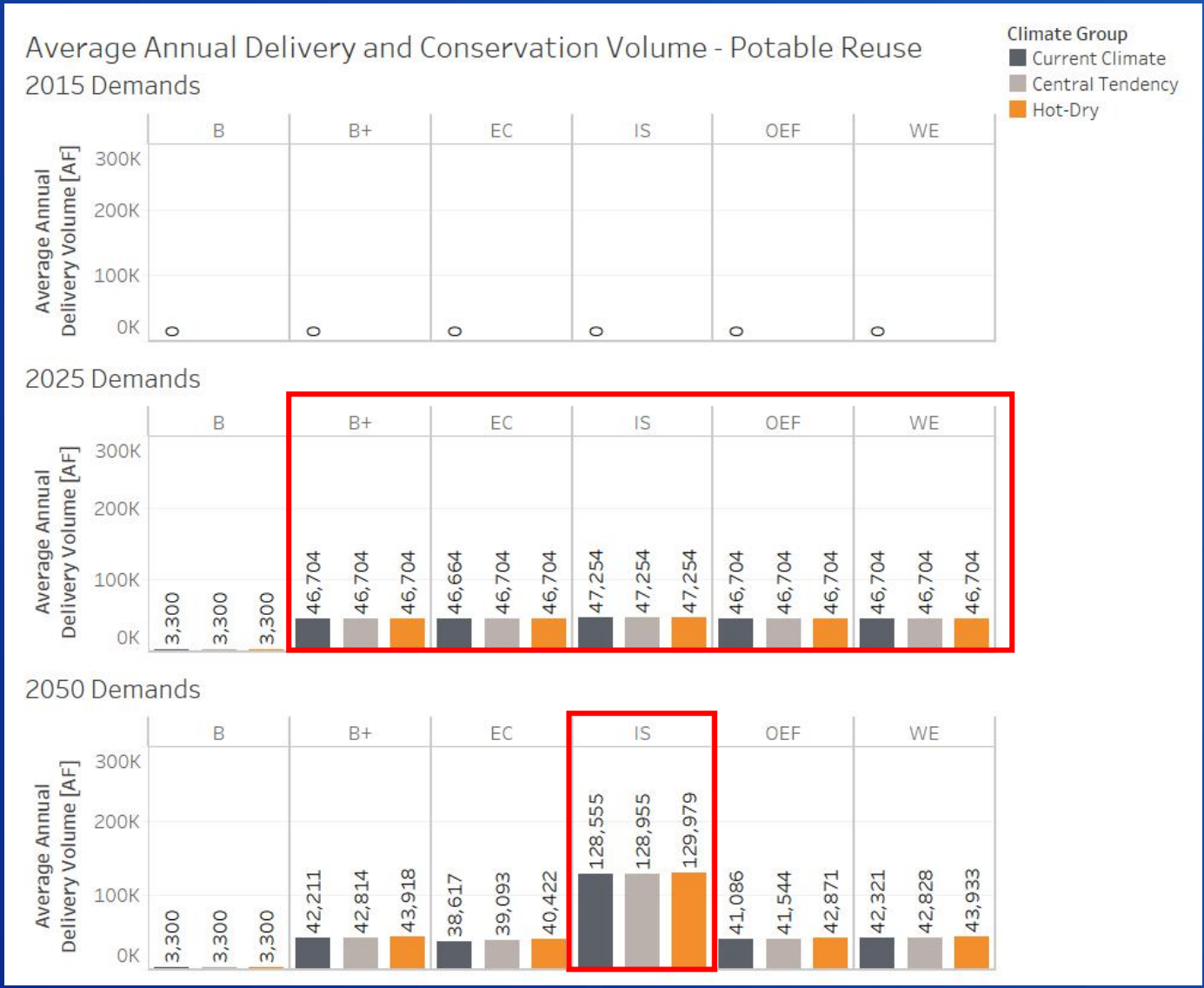
Groundwater

Images show the San Dieguito Lagoon (above) and San Dieguito Groundwater Study (right) associated with the San Dieguito River Basin Groundwater Recovery and Treatment project

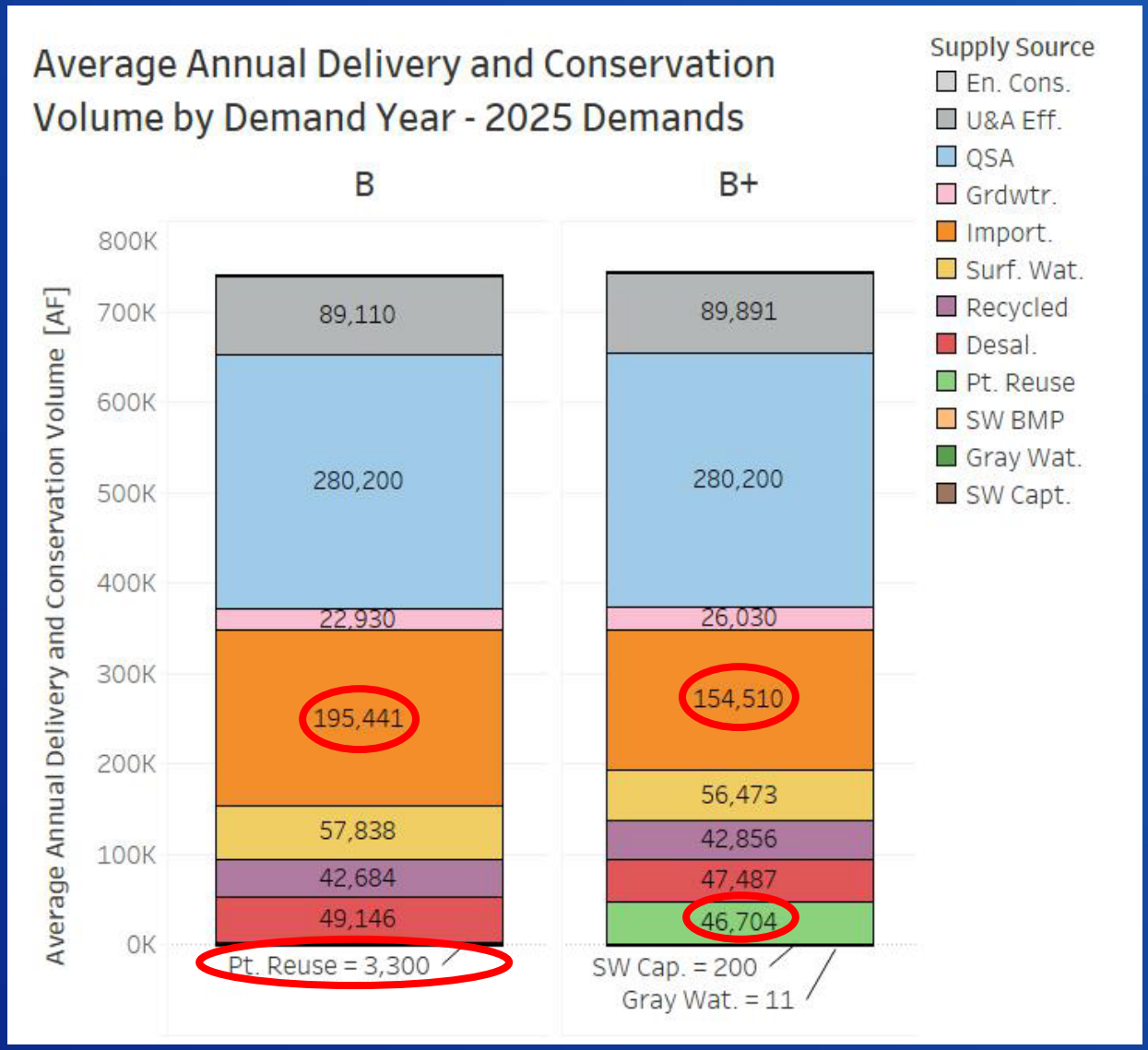
Imported Water Purchases



Potable Reuse

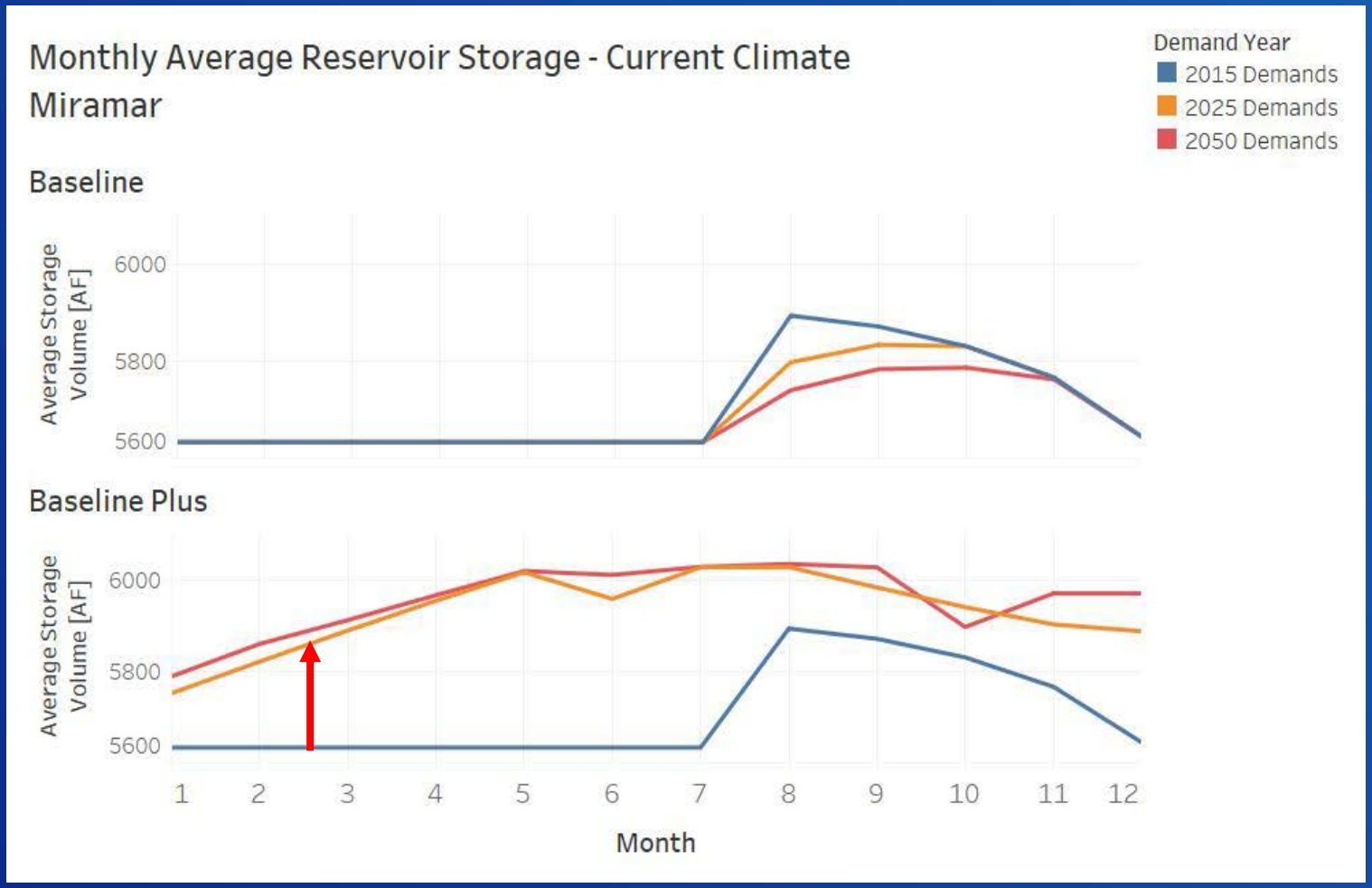


Potable Reuse

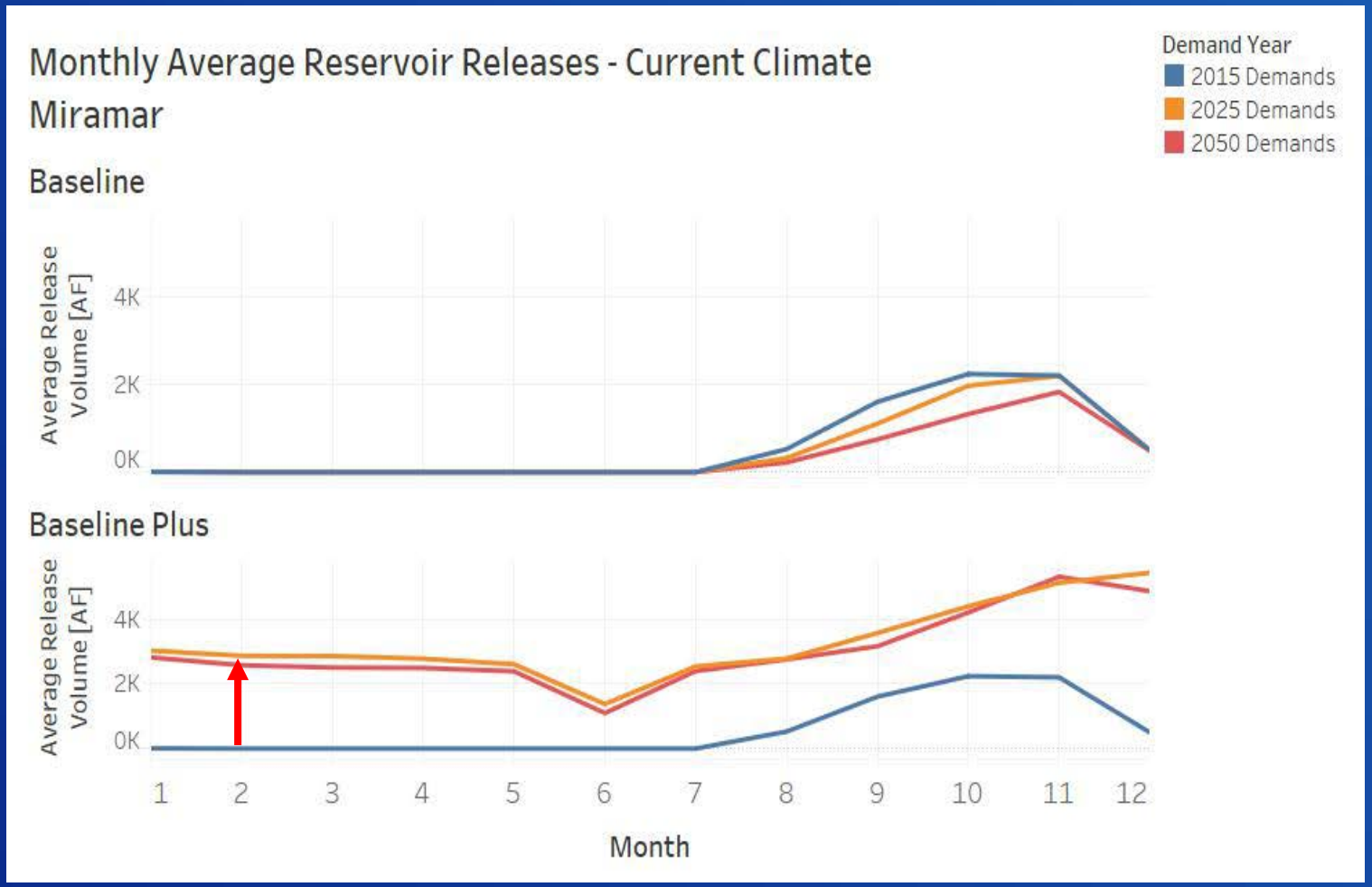


Pure Water San Diego Phase

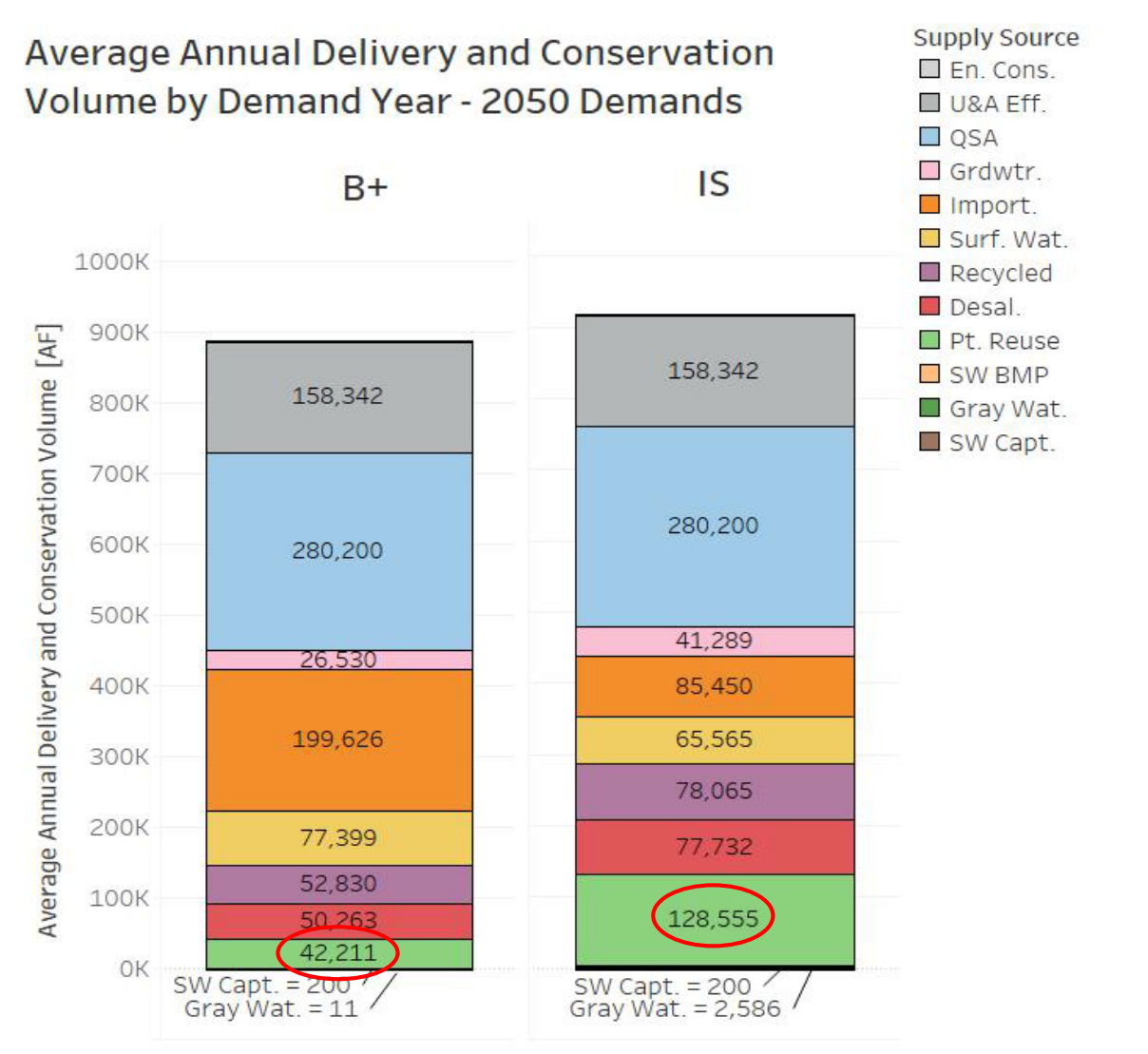
Pure Water San Diego Phase 1



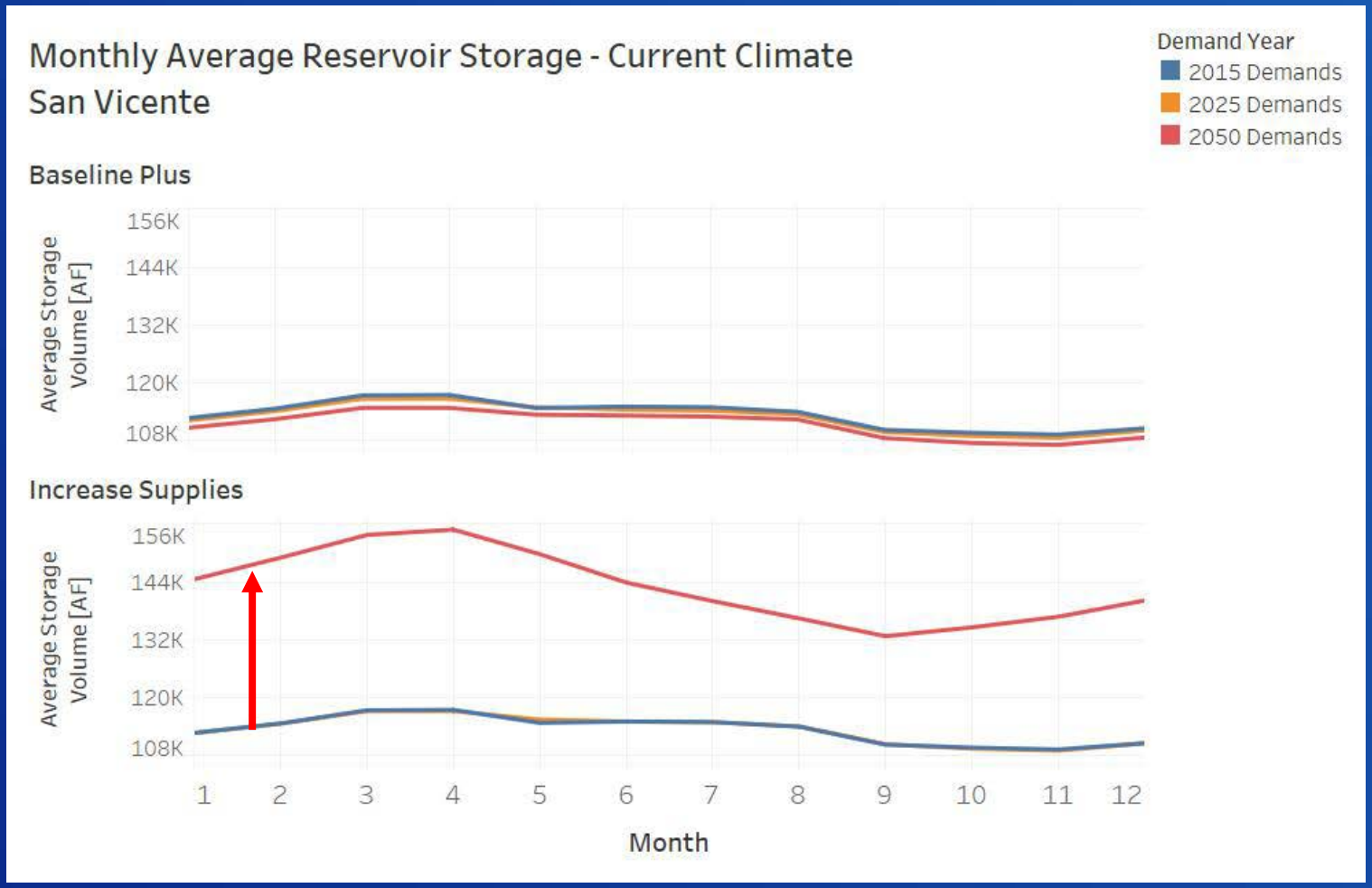
Pure Water San Diego Phase 1



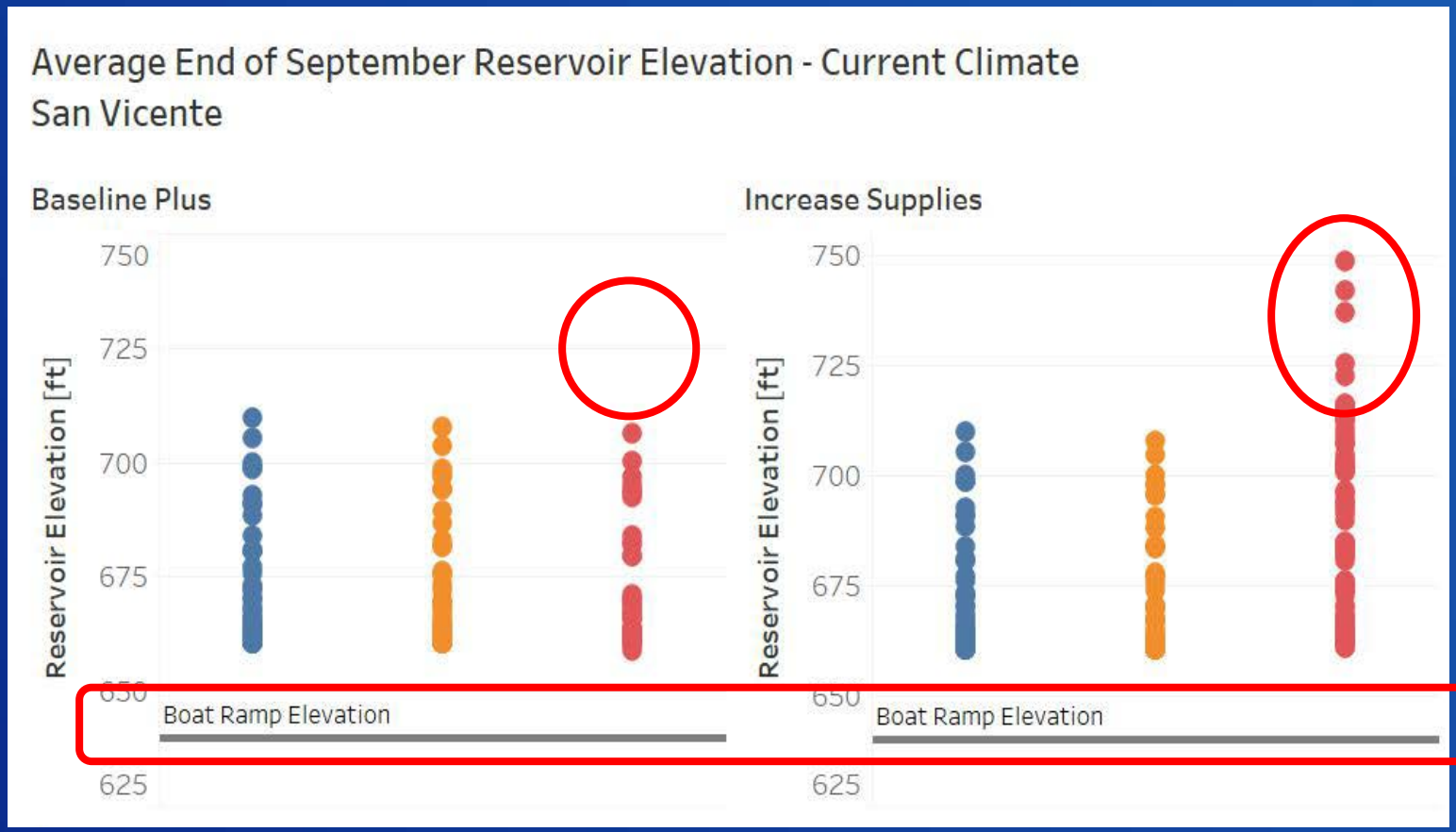
Pure Water San Diego Phase 2



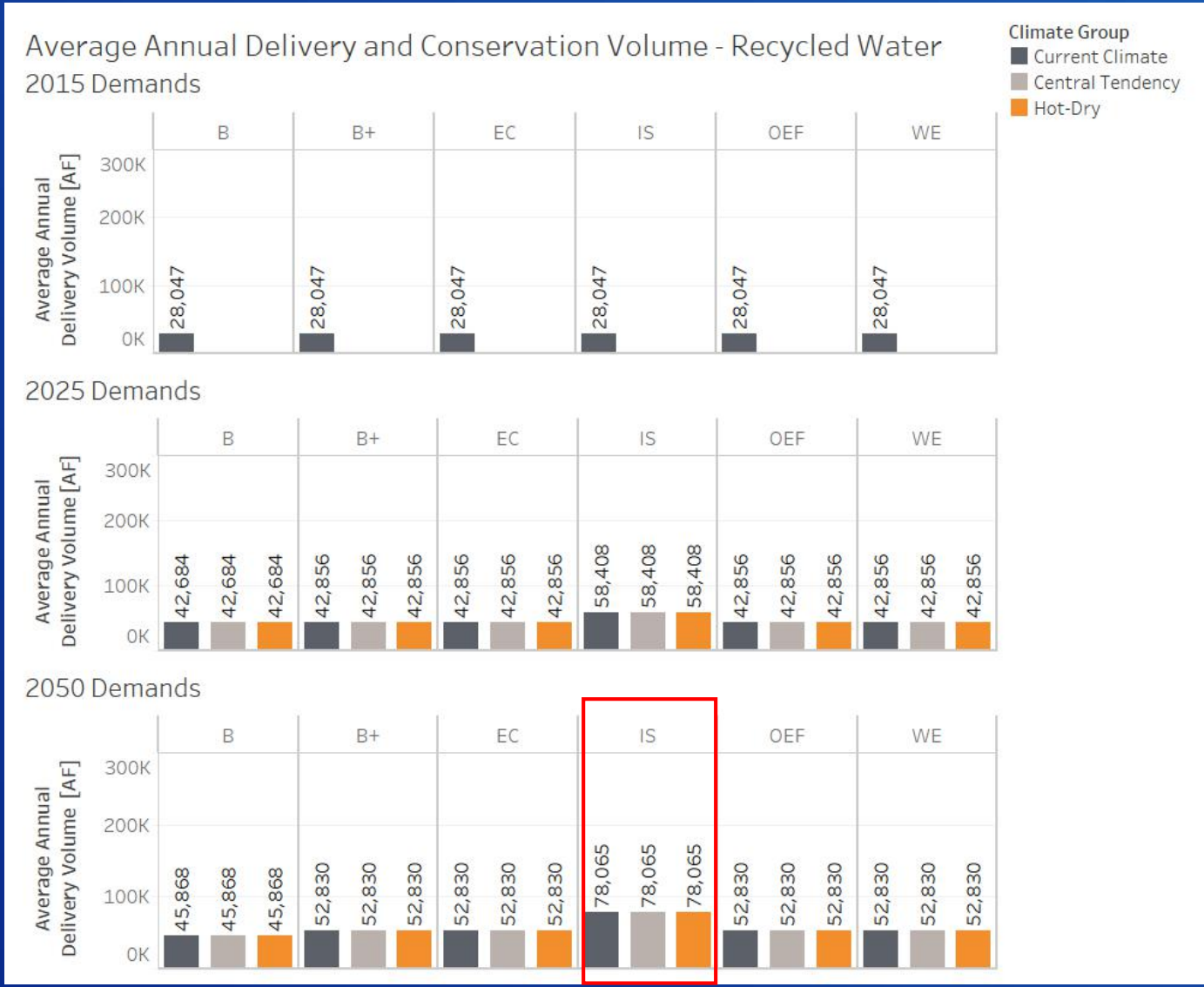
Pure Water San Diego Phase 2



Pure Water San Diego Phase 2



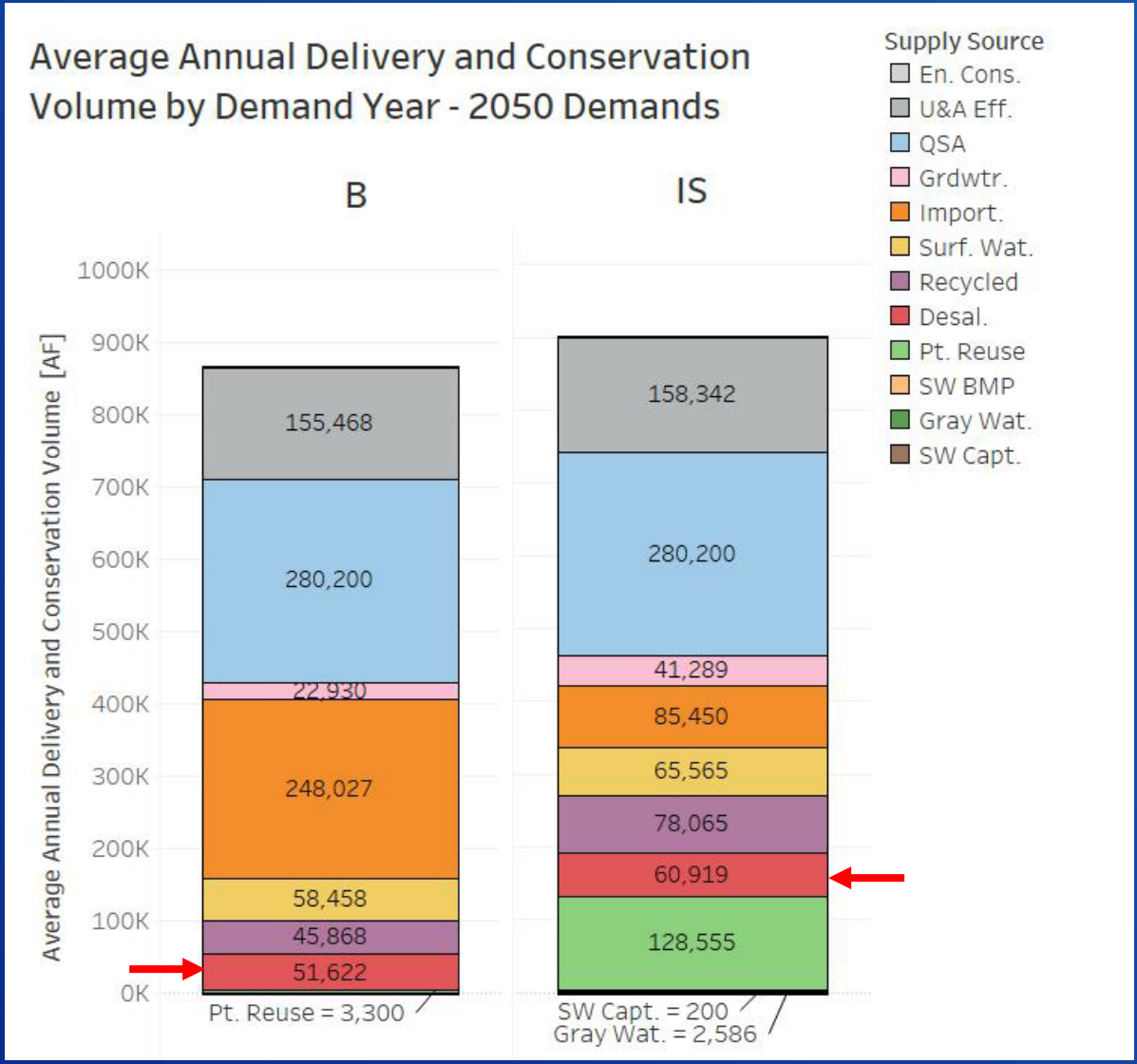
Recycled Water



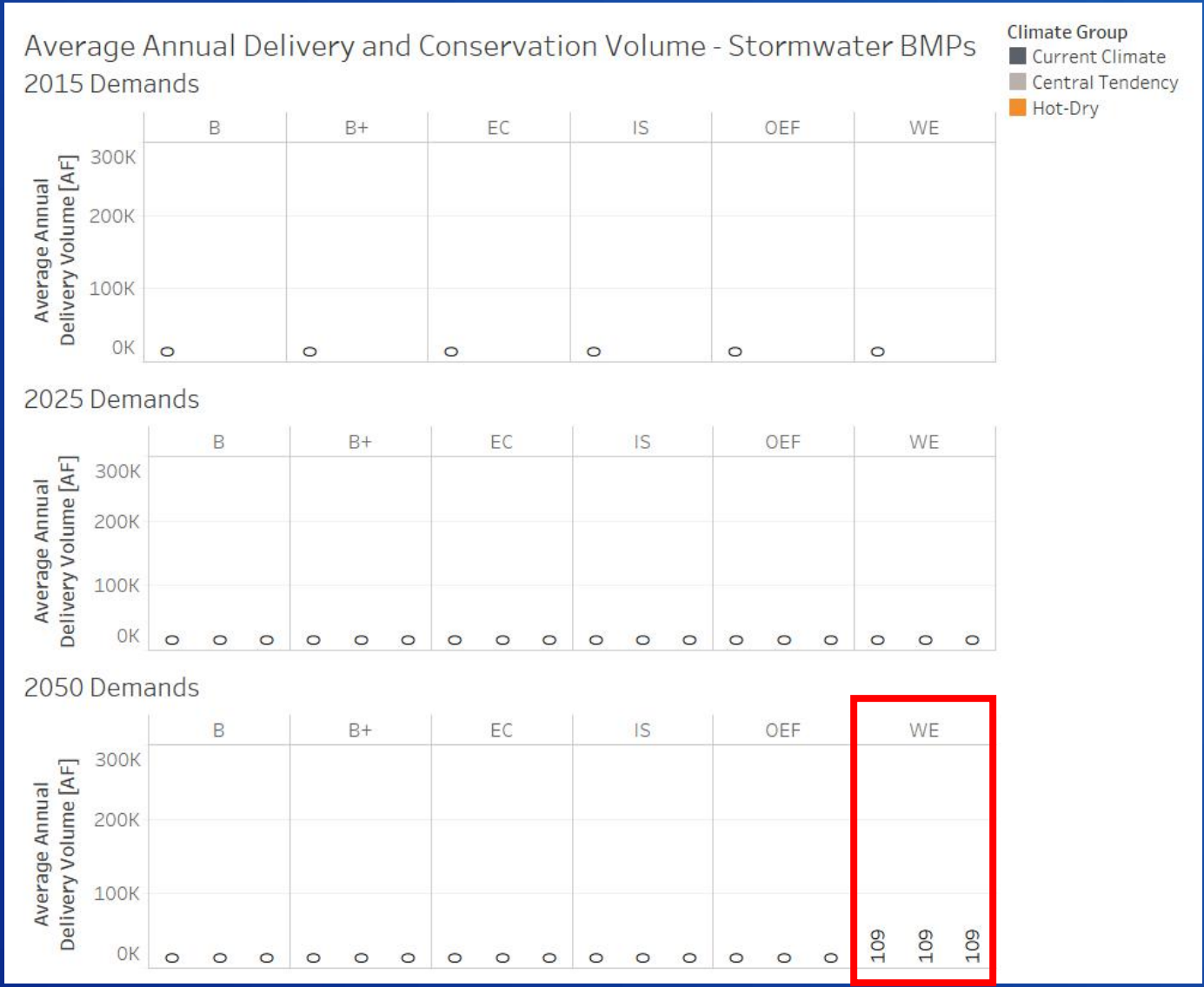
Seawater Desalination

Carlsbad Desalination Plant

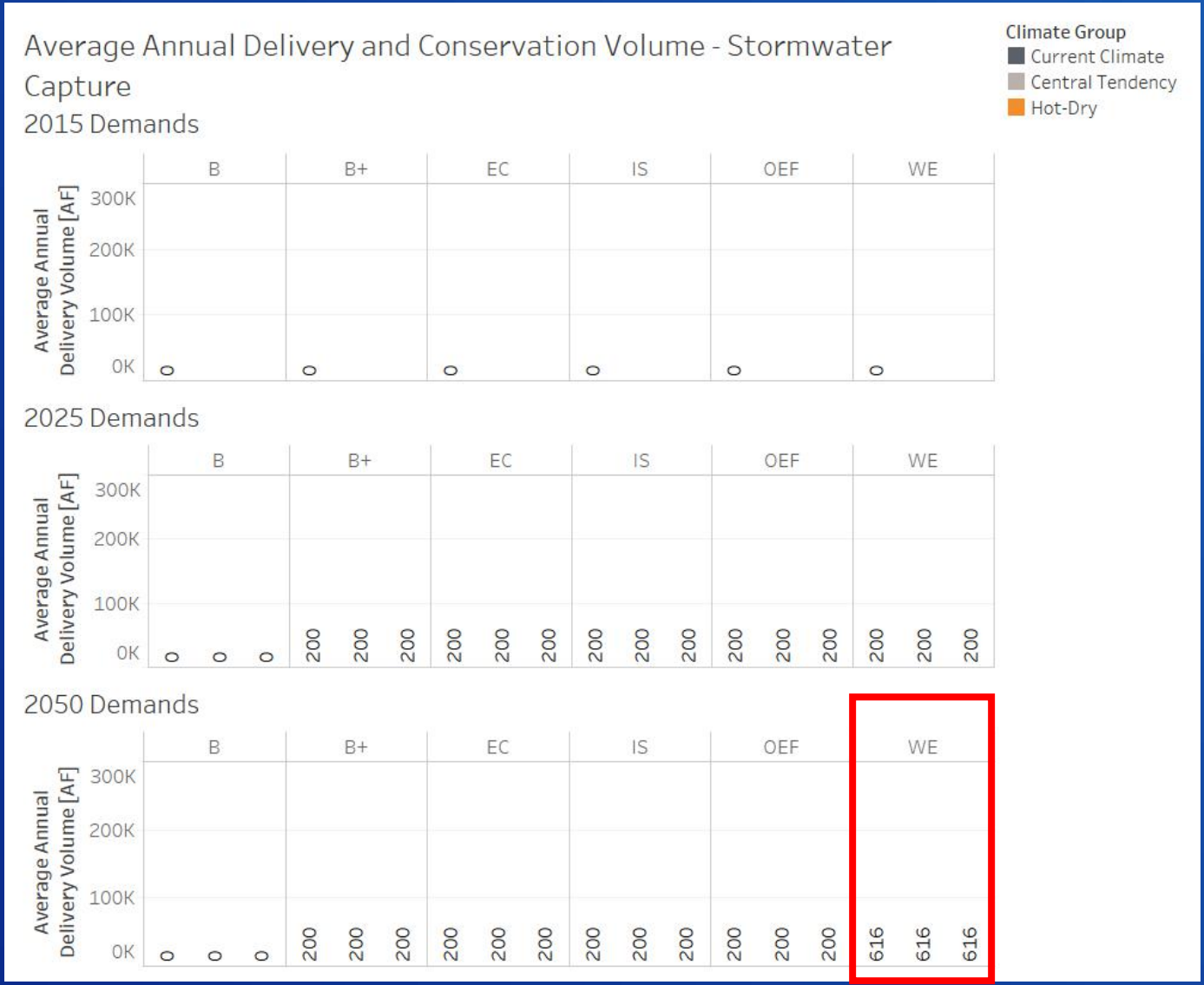
Seawater Desalination



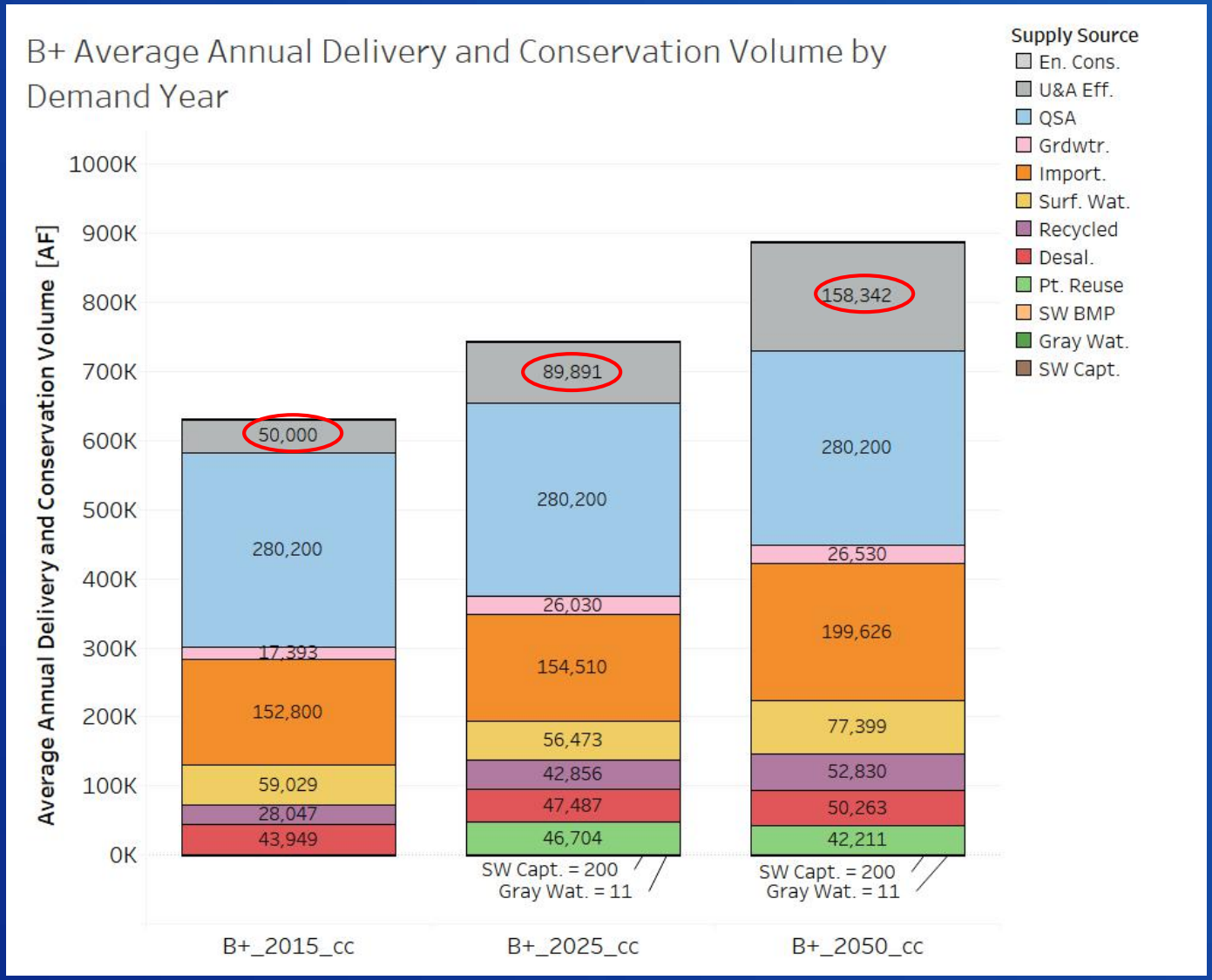
Stormwater BMPs



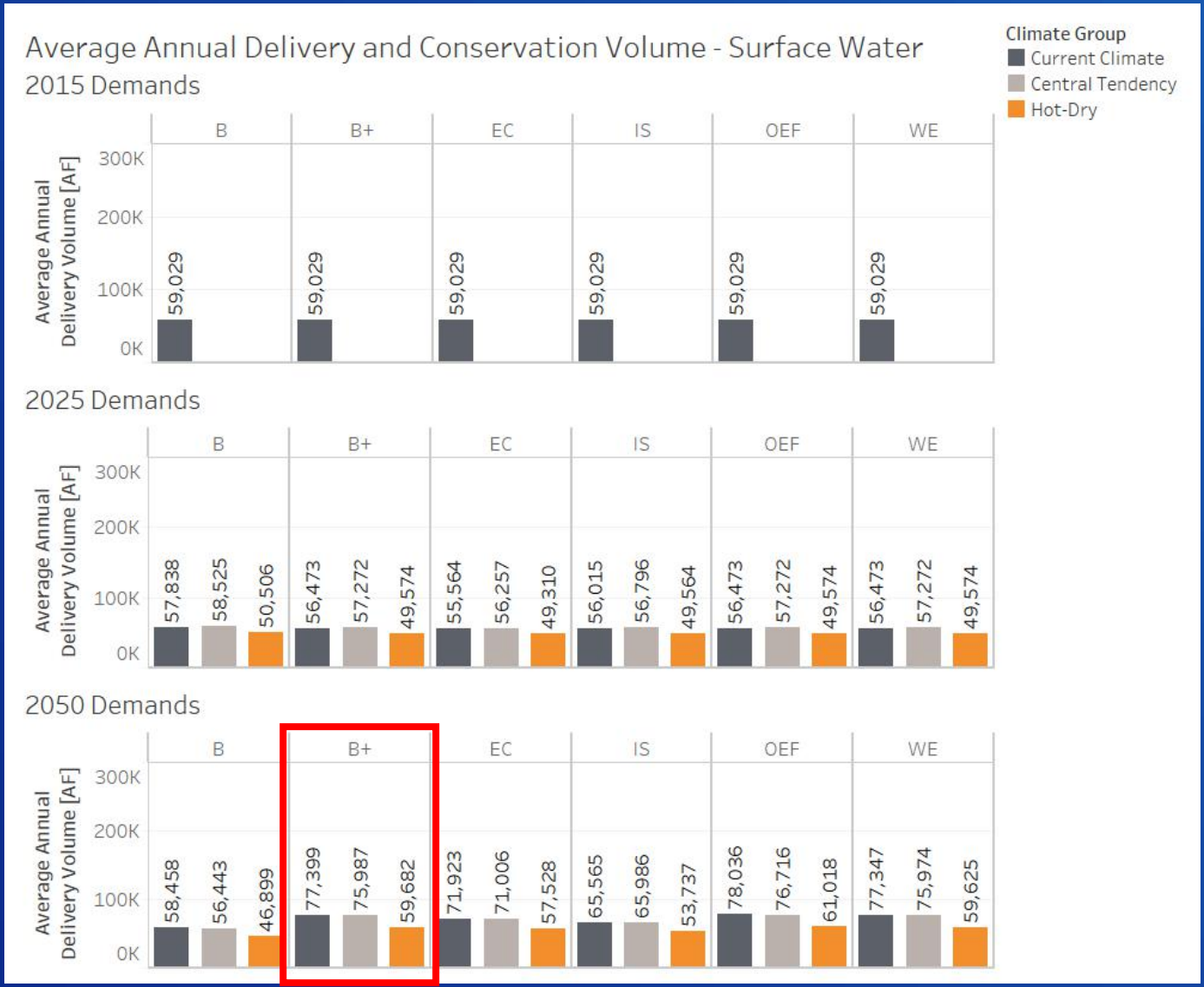
Stormwater Capture



Urban and Agricultural Water Use Efficiency

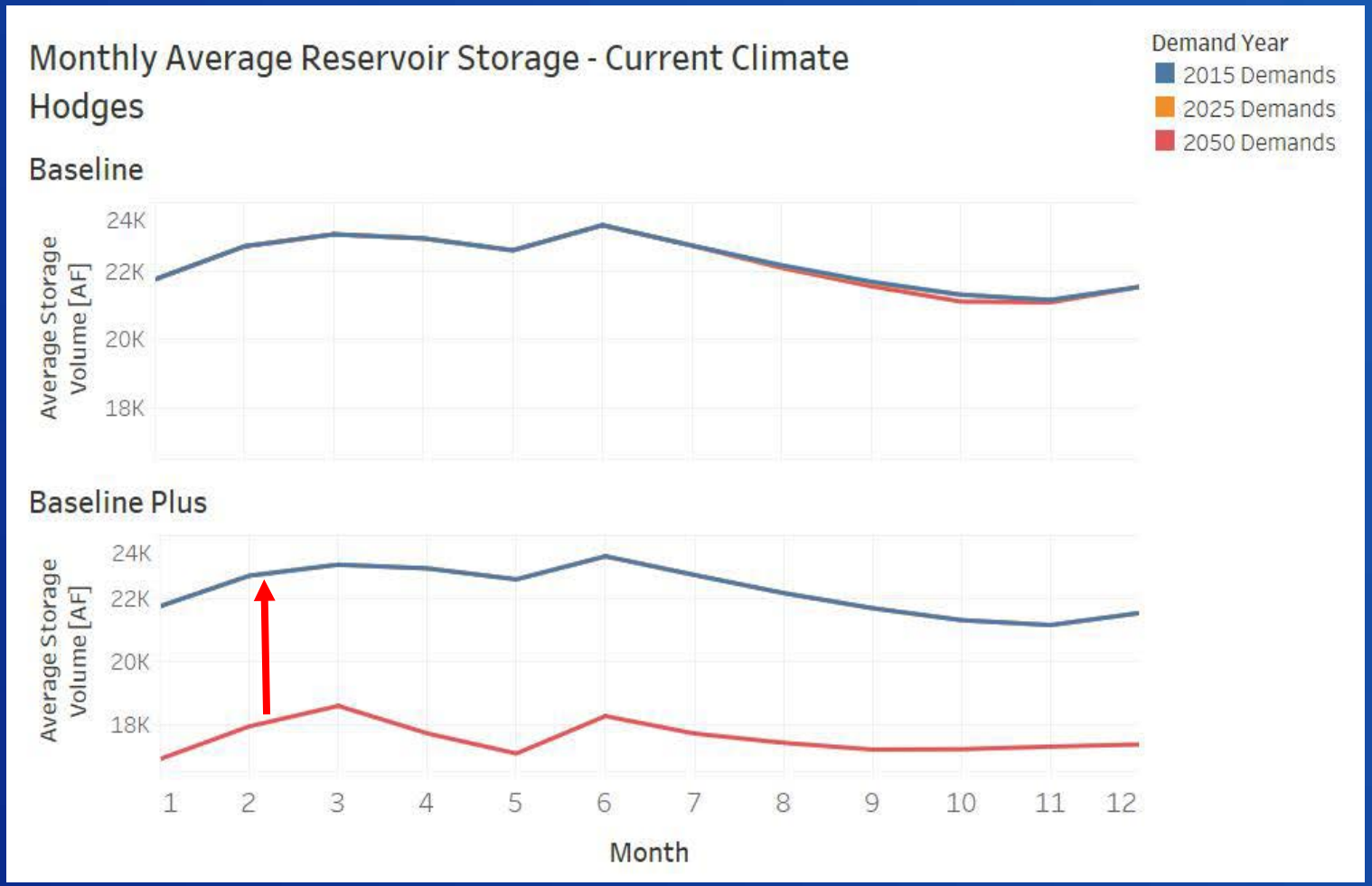


Watershed and Ecosystem Management

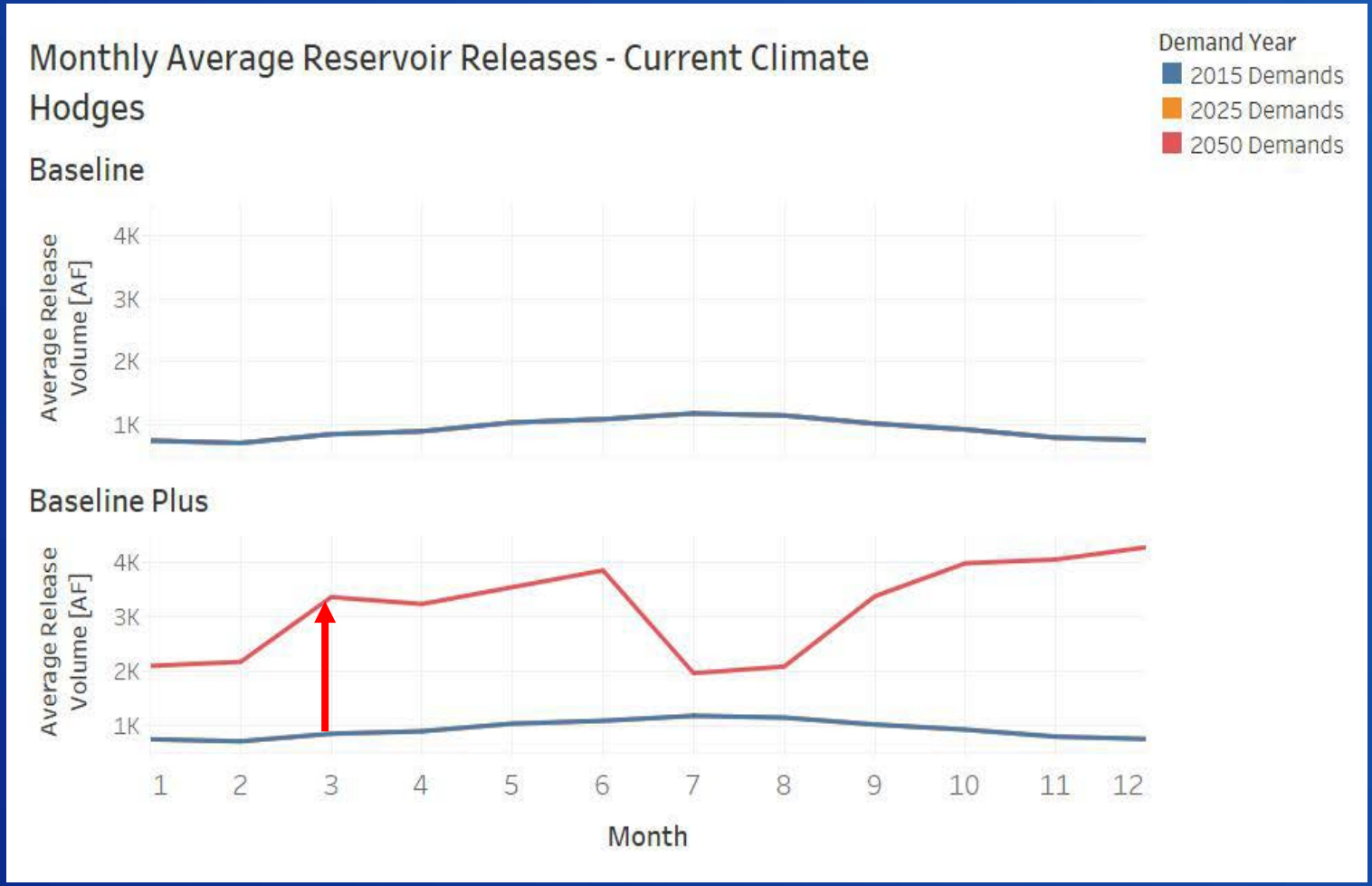


Hodges Water Quality Improvement Program

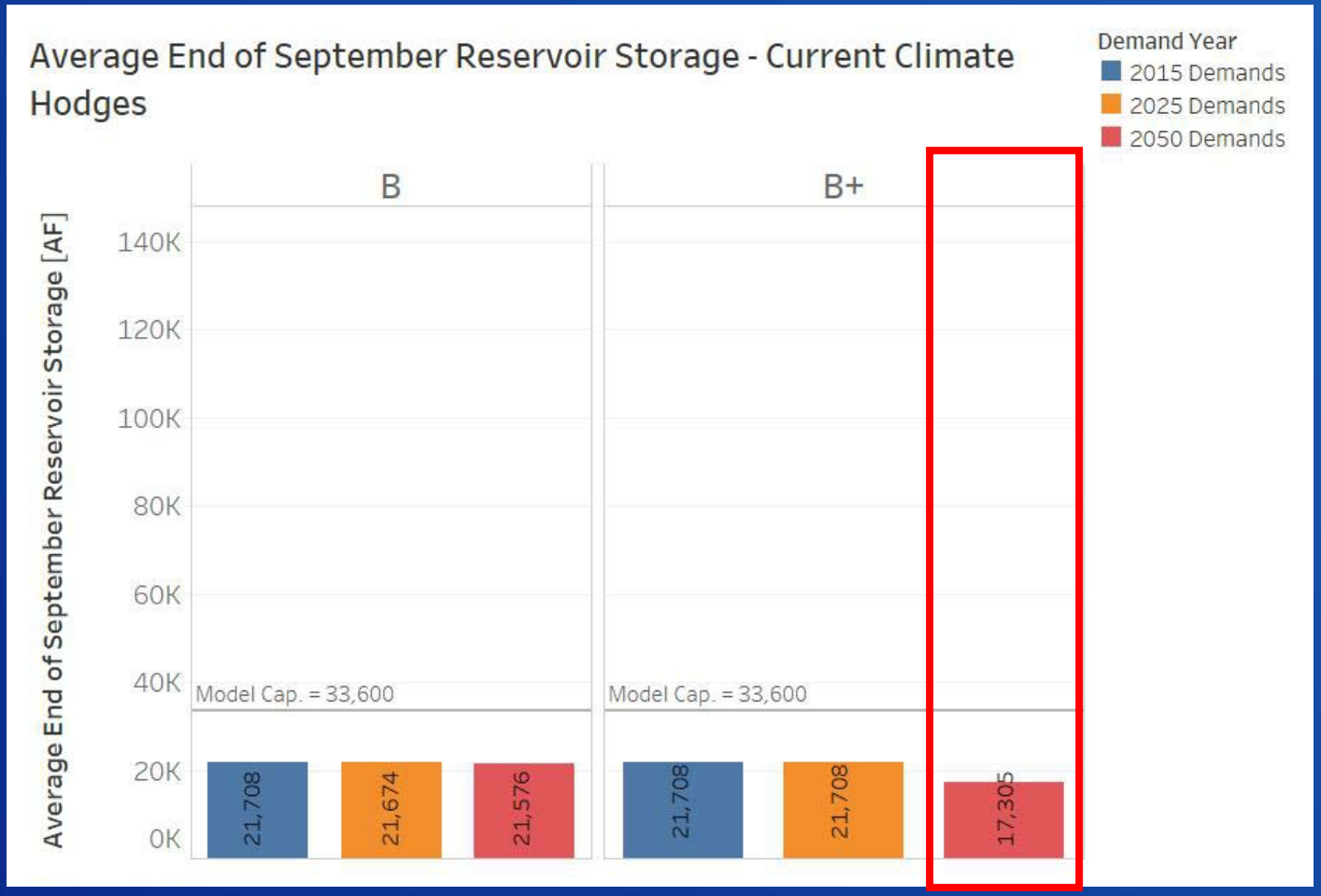
Hodges Water Quality Improvement Program



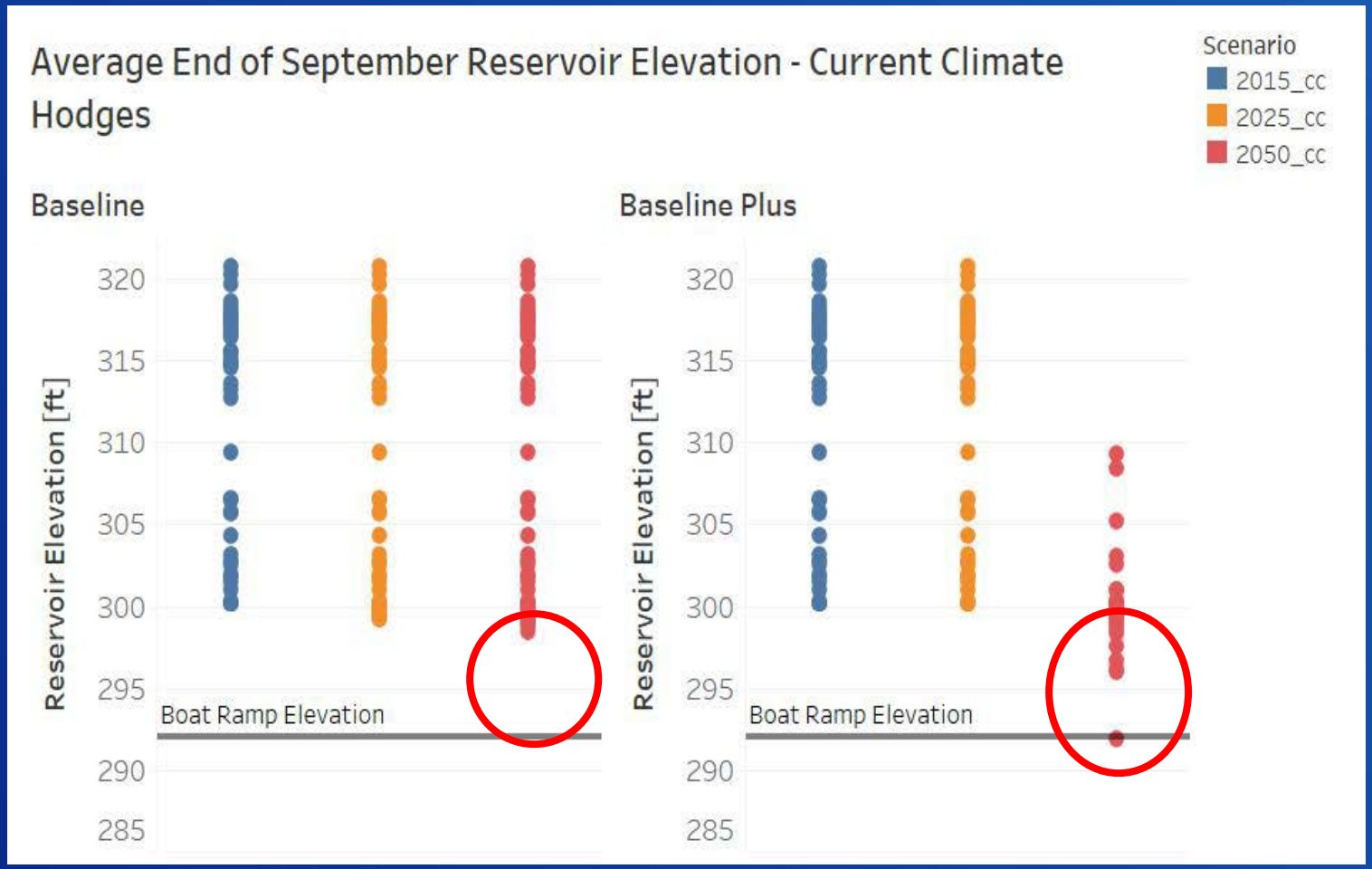
Hodges Water Quality Improvement Program



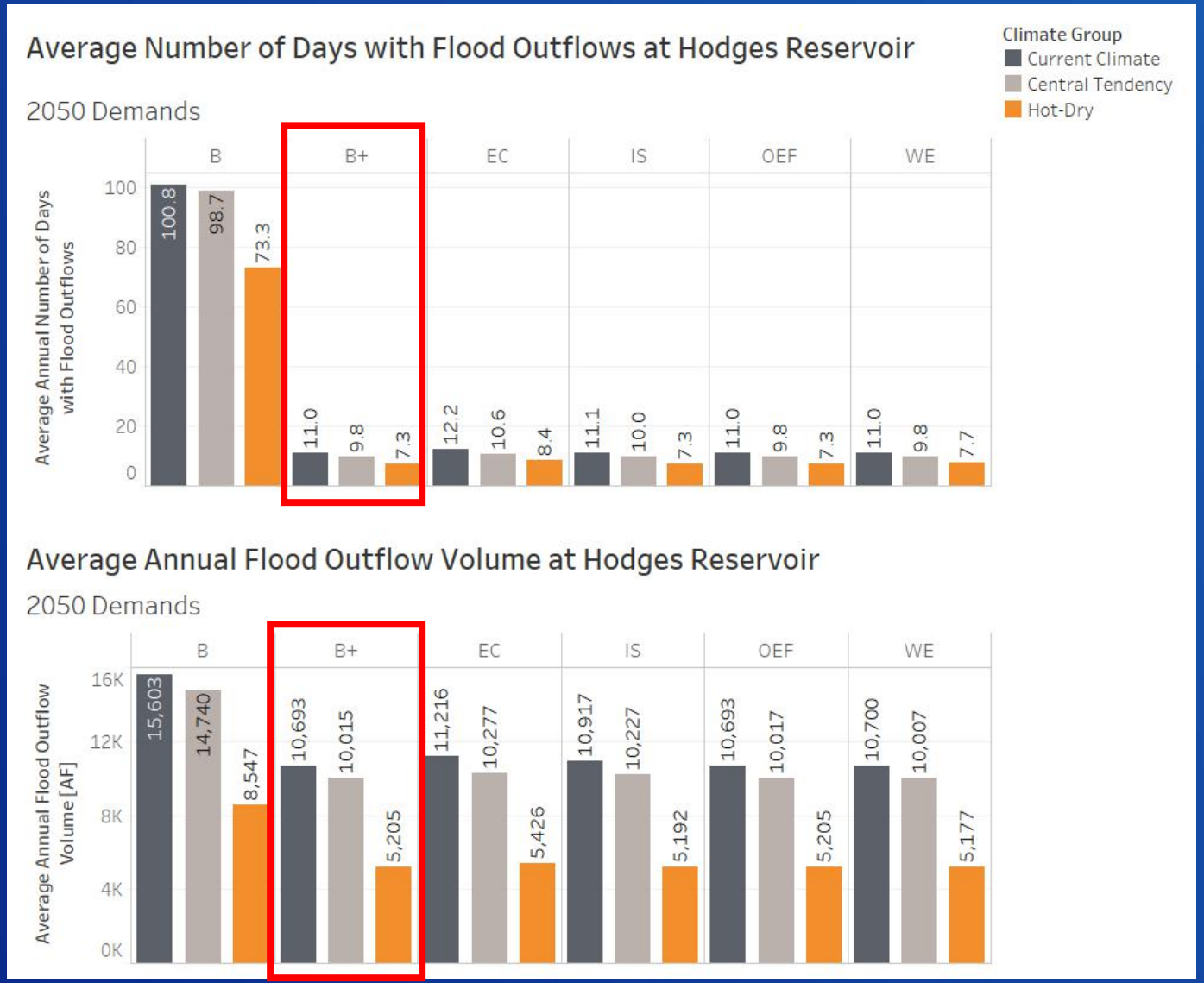
Hodges Water Quality Improvement Program



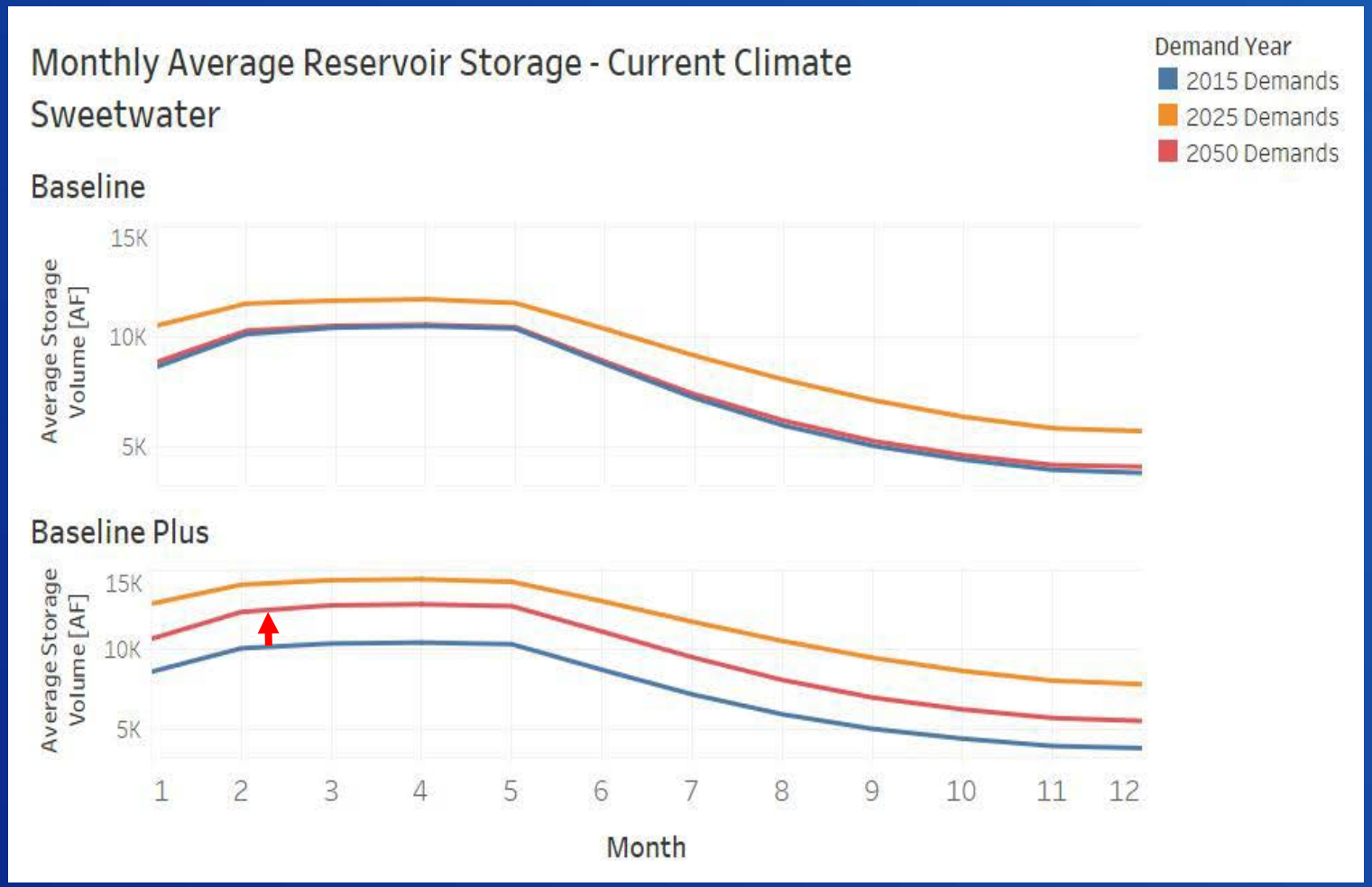
Hodges Water Quality Improvement Program



Hodges Water Quality Improvement Program



Sweetwater Reservoir Wetlands Habitat Recovery



Discussion

- **Questions?**
- **Any surprising results?**
- **Feedback to consider for the Summary Report?**

Agenda

- Welcome & Introductions
- Study Overview and Update
- Background and Methods
- Results by Impact Area
- Results by Concept
- **Next Steps**
- Adjourn

Next Steps

November 2018	STAC Review of Task 2.5 Interim Report
December 2018	Task 2.5 Interim Report Finalized Public Meeting on Task 2.5
January 2019	Draft Summary Report available for Public Review
February 2019	Study Summary Report Finalized

Questions?

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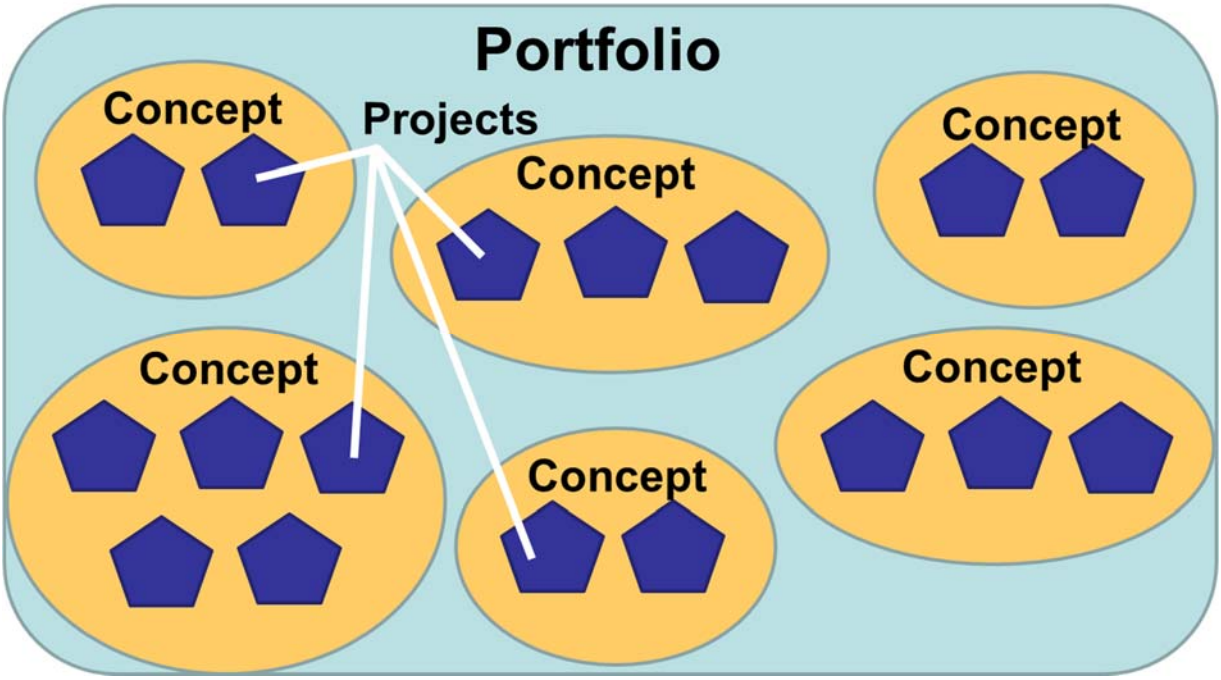
RECLAMATION

Portfolios, Concepts, and Projects

Portfolios are groups of Concepts that were developed for the purpose of simulating and analyzing groups of related Concepts. Each Portfolio contains a subset of Concepts. **Concepts** represent groups of similar strategies or projects that could be used to meet the water demands of the region. These Concepts are used as the basis for analysis in the Study. Concepts were defined to characterize existing and potential future water management strategies. Concepts were developed through review of existing studies and projects, as well as consultation with stakeholders at IRWM Regional Advisory Committee meetings and Basin Study Technical Advisory Committee (STAC) meetings in the fall of 2017. Concepts are defined by one or more **Projects** which represent actual, potential, or theoretical proposed modifications to existing facilities, construction of new facilities, modifications to system operations, modifications to policy, or other proposed activities. Most SDBS Projects are based on actual proposed projects, including projects listed as verifiable, additional planned, and conceptual in the 2015 SDCWA UWMP; the 2013 SDCWA Master Plan; the 2013 IRWM Plan; or other similar planning documents and lists. Other Projects represent a theoretical project idea or type of project but are not tied to a specific proposed implementation.



Concepts

Table 1. San Diego Basin Study Concepts

Concept	Narrative Concept Description
Conveyance Improvement	Improve local and regional conveyance systems to increase supply reliability, increase operational flexibility, and reduce GHG emissions by utilizing existing conveyance facilities and natural water courses and modifying existing pump stations, pipelines, interties and bypasses.
Drought Restriction/Allocation*	Implement temporary restrictions in water use to decrease demand or shift to other supply sources during periods of drought. Restrictions or allocations may be imposed at the local, regional, or State levels, and may include restrictions or allocations by water purveyors such as MWD.
Enhanced Conservation	Implement long-term or permanent restrictions in water use to decrease demand. Restrictions or allocations may be imposed at the local, regional, or State levels, and may include restrictions or allocations by water purveyors such as MWD.
Firm Water Supply Agreements*	Provide water supply by forming agreements for firm water supply volumes to be provided from external sources, such as the Quantification Settlement Agreement.
Gray Water Use	Offset potable water usage by encouraging, supporting and/or providing incentives for gray water system installation by residential customers.
Groundwater	Provide water supply by extracting and treating and/or desalinating groundwater from local freshwater and brackish aquifers and maintain sustainable groundwater supplies through implementation of projects to recharge groundwater basins with injected or infiltrated rainfall, recycled water, imported water, or a combination thereof.
Imported Water Purchases	Provide water supply by purchasing treated or untreated water from a water wholesaler outside of the region, such as MWD.
Local Surface Water Reservoirs*	Provide water supply by capturing, storing, and treating surface water runoff in lakes or reservoirs.
Potable Reuse	Provide water supply by producing advanced treated water from wastewater for direct or indirect (e.g., reservoir or groundwater augmentation) potable use.
Recycled Water	Offset potable water use by providing non-potable recycled water use for landscape irrigation, industrial purposes or to recharge groundwater.
Seawater Desalination	Provide water supply by utilizing or expanding existing facilities or constructing new facilities to remove salts from seawater.
Stormwater BMPs	Reduce adverse water quality impacts of stormwater through implementation of stormwater Best Management Practices (BMPs). BMPs are structural, vegetative, or management practices used to treat, prevent, or reduce stormwater runoff and pollution.

Concept	Narrative Concept Description
Stormwater Capture	Provide water supply by capturing stormwater through both centralized projects and regional decentralized efforts and treating it for both potable and non-potable uses.
Urban and Agricultural Water Use Efficiency	Increase water use efficiency by encouraging long-term behavioral change and implementing water use efficiency programs (e.g., rain barrel rebates, turf replacement credits, rebates for more efficient irrigation or plumbing fixtures, gray water system rebates).
Watershed and Ecosystem Management	Promote sustainable, high quality local water supplies through practices that support healthy ecosystems and improve or restore the condition of landscapes and biological communities. Such practices may include invasive species removal, restoration of native ecosystems, land acquisition for protection or enhancement, brush/forest management for wildfire risk reduction, remediation of aquifer and reservoir water quality through engineered or biological controls, management of non-point and point source pollution, and low impact development.

* These Concepts are included in the Baseline Portfolio and not modified in any subsequent Portfolios.

Baseline Portfolio

The Baseline Portfolio represents the system as it existed in 2015, with some minor modifications to include water supplies that have been or will be implemented (e.g., Carlsbad Desalination Plant and the full QSA annual transfer volume). Water supplies included in the Baseline Portfolio are those from projects that were designated as verifiable in SDCWA's 2015 UWMP. Infrastructure simulated in the CWASim model for the Baseline Portfolio includes 18 reservoirs connected to the regional system, the Carlsbad Desalination Plant, and pipelines, pump stations, and water treatment plants at 2015 facility capacities. Concepts included in this Portfolio are Firm Water Supply Agreements, Groundwater, Imported Water Purchases, Local Surface Water Reservoirs, Recycled Water, Seawater Desalination, and Urban and Agricultural Water Use Efficiency. Although Phase 1 of the Pure Water San Diego Program, a Potable Reuse project, is actively being pursued, it was not included in the Baseline Portfolio since it was not listed as verifiable in the 2015 SDCWA UWMP. The Baseline Portfolio was modeled in Task 2.3, but due to minor updates to the CWASim model since Task 2.3, such as added restrictions on Hodges Reservoir and dam safety restrictions for El Capitan Reservoir, Baseline results may differ slightly between the Task 2.3 Baseline and Task 2.4 Baseline Portfolio. Table 2 lists projects that are included in the Baseline Portfolio and the supply volumes associated with those projects for each demand scenario. Since the Baseline Portfolio represents existing infrastructure as of 2015, the Baseline Portfolio Concepts and Projects consist of infrastructure components that have already been constructed or agreements that are already in place, rather than future construction or operations projects.

Table 2. Summary of Baseline Portfolio Concepts and Projects

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Conveyance Improvement			
Alvarado Water Treatment Plant	134,506 AF/y (120 mgd) production capacity	Same as 2015	Same as 2015
Badger Water Treatment Plant	44,385 AF/y (40 mgd) production capacity	Same as 2015	Same as 2015
Crossover Pipeline	144,890 AF/y (200 cfs) capacity	Same as 2015	Same as 2015
El Monte Pipeline	108,667 AF/y (150 cfs) capacity	Same as 2015	Same as 2015
Escondido Pump Station	14,489 AF/y (20 cfs) capacity	Same as 2015	Same as 2015
Escondido-Vista Water Treatment Plant	100,880 AF/y (90 mgd) production capacity	Same as 2015	Same as 2015
La Mesa-Sweetwater Extension Treated	Modeled through ECRTWIP[1]	Modeled through ECRTWIP	Modeled through ECRTWIP

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Lake Hodges Pump Station	550,580 AF/y (760 cfs) capacity	Same as 2015	Same as 2015
Levy Water Treatment Plant	118,814 AF/y (106 mgd) production capacity	Same as 2015	Same as 2015
Miramar Pump Station	43,467 AF/y (60 cfs) capacity	Same as 2015	Same as 2015
Miramar Water Treatment Plant	161,408 AF/y (144 mgd) production capacity	Same as 2015	Same as 2015
Moreno-Lakeside Pipeline	67,374 AF/y (93 cfs) capacity	Same as 2015	Same as 2015
North County Distribution Pipeline	Modeled in aggregate fashion by delivery of water from Second Aqueduct	Modeled in aggregate fashion by delivery of water from Second Aqueduct	Modeled in aggregate fashion by delivery of water from Second Aqueduct
Olivenhain Pump Station	227,477 AF/y (314 cfs) capacity	Same as 2015	Same as 2015
Olivenhain Water Treatment Plant	38,110 AF/y (34 mgd) production capacity	Same as 2015	Same as 2015
Olivenhain-Hodges Pipeline	550,580 AF/y (760 cfs) capacity	Same as 2015	Same as 2015
Otay Water Treatment Plant	38,110 AF/y (34 mgd) production capacity	Same as 2015	Same as 2015
P12	137,645 AF/y (190 cfs) capacity	Same as 2015	Same as 2015
Perdue Water Treatment Plant	33,627 AF/y (30 mgd) production capacity	Same as 2015	Same as 2015
Pipeline 1 and 2 (First Aqueduct)	137,600 AF/y (190 cfs) at MWD Delivery Point	Same as 2015	Same as 2015
Pipeline 3 (Second Aqueduct)	P5 + P3 = 521,603 AF/y (720 cfs), 170,245 AF/y (235 cfs) downstream of TOV. Capacity before Pipeline 5 Relining Project of 565,100 AF/y (780 cfs)	Same as 2015	Same as 2015

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Pipeline 4 (Second Aqueduct)	340,300 AF/y (470 cfs) before Pipeline 4 Relining project	Same as 2015	Same as 2015
Pipeline 4 (Second Aqueduct) Relining	Reduces capacity at Delivery Point to 286,157 AF/y (395 cfs)	Same as 2015	Same as 2015
Pipeline 5 (Second Aqueduct)	P5 + P3 = 521,603 AF/y (720 cfs) Downstream of TOV conveyance capacity of 460,749 AF/y (636 cfs). Capacity before Pipeline 5 Relining Project of 565,100 AF/y (780 cfs)	Same as 2015	Same as 2015
Pipeline 5 (Second Aqueduct) Relining	Reduces capacity of P5 + P3 to 521,603 AF/y (720 cfs)	Same as 2015	Same as 2015
Pomerado Pipeline	159,379 AF/y (220 cfs) capacity	Same as 2015	Same as 2015
Ramona Pipeline	75,343 AF/y (104 cfs) capacity	Same as 2015	Same as 2015
Rancho Pipeline	434,669 AF/y (600 cfs) capacity	Same as 2015	Same as 2015
San Vicente Pump Station	217,334 AF/y (300 cfs) capacity	Same as 2015	Same as 2015
San Vicente Pipeline/Tunnel	321,655 AF/y (444 cfs) capacity	Same as 2015	Same as 2015
SD12 Pipeline	108,667 AF/y (150 cfs) capacity	Same as 2015	Same as 2015
Sutherland-San Vicente Conduit	36,222 AF/y (50 cfs) capacity	Same as 2015	Same as 2015
The 30-Inch Pipeline	54,334 AF/y (75 cfs) capacity	Same as 2015	Same as 2015
The 30-Inch Pipeline Relining	50,711 AF/y (70 cfs) capacity	Same as 2015	Same as 2015
Tri-Agency Pipeline	Modeled in aggregate fashion by delivery of water from Second Aqueduct.	Modeled in aggregate fashion by delivery of water from Second Aqueduct.	Modeled in aggregate fashion by delivery of water from Second Aqueduct.

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Twin Oaks Valley Pump Station	TOV minimum flow of 22,418 AF/y (20 mgd) to keep plant from shutting down. Downstream conveyance capacity of 460,749 AF/y (636 cfs).	Same as 2015	Same as 2015
Twin Oaks Valley Water Treatment Plant	112,090 AF/y (100 mgd) production capacity. Minimum flow of 22,418 AF/y (20 mgd) to keep plant from shutting down.	Same as 2015	Same as 2015
Valley Center (P2A) Pump Station	29,702 AF/y (41 cfs) capacity	Same as 2015	Same as 2015
Weese Water Treatment Plant	28,023 AF/y (25 mgd) production capacity	Same as 2015	Same as 2015
Drought Restriction/Allocation			
Local Drought Restriction/Allocation	Not modeled	Not modeled	Not modeled
MWD Allocation	Uses model logic	Uses model logic	Uses model logic
Firm Water Supply Agreements			
Quantification Settlement Agreement	Full agreement amount of 280,200 AF/y available	Same as 2015	Same as 2015
Groundwater			
Groundwater Production Well 101	93 AF/y	130 AF/y	Same as 2025
Groundwater Production Wells	6,480 AF/y	8,700 AF/y	9,740 AF/y
Mission Basin Desalter Facility - 1st & 2nd Phase of Desal Expansion & IPR	3,300 AF/y	3,700 AF/y	Same as 2025
Mutual Water Company wells within district	7,000 AF/y	Same as 2015	Same as 2015
National City Well Field	2,100 AF/y	Same as 2015	Same as 2015
Richard A. Reynolds Desalination Facility (for City of San Diego)	NA[2]	2,600 AF/y	Same as 2025

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Richard A. Reynolds Desalination Facility (for Sweetwater Authority)	3,600 AF/y	6,200 AF/y	Same as 2025
San Vicente GW Production Well	500 AF/y	Same as 2015	Same as 2015
Vine Street Groundwater Production Facility	700 AF/y	Same as 2015	Same as 2015
Imported Water Purchases			
MWD Imported Water	Uses model logic	Uses model logic	Uses model logic
Local Surface Water Reservoirs			
Barrett Reservoir	37,900 AF modeled capacity	Same as 2015	Same as 2015
Dixon Reservoir	2,610 AF modeled capacity	Same as 2015	Same as 2015
El Capitan Reservoir	112,807 AF modeled capacity	Same as 2015	Same as 2015
Hodges Reservoir	33,600 AF modeled capacity	Same as 2015	Same as 2015
Lake Henshaw	53,400 AF modeled capacity	Same as 2015	Same as 2015
Lake Jennings	9,790 AF modeled capacity	Same as 2015	Same as 2015
Lake Poway	3,320 AF modeled capacity	Same as 2015	Same as 2015
Lake Wohlford	6,940 AF modeled capacity	Same as 2015	Same as 2015
Loveland Reservoir	25,400 AF modeled capacity	Same as 2015	Same as 2015
Lower Otay Reservoir	49,849 AF modeled capacity	Same as 2015	Same as 2015
Miramar Reservoir	6,050 AF modeled capacity	Same as 2015	Same as 2015
Morena Reservoir	50,200 AF modeled capacity	Same as 2015	Same as 2015

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Murray Reservoir	5,200 AF modeled capacity	Same as 2015	Same as 2015
Olivenhain Reservoir	25,382 AF modeled capacity	Same as 2015	Same as 2015
San Dieguito Reservoir	883 AF modeled capacity	Same as 2015	Same as 2015
San Vicente Reservoir	272,528 AF modeled capacity	Same as 2015	Same as 2015
Sutherland Reservoir	31,960 AF modeled capacity	Same as 2015	Same as 2015
Sweetwater Reservoir	27,700 AF modeled capacity	Same as 2015	Same as 2015
Potable Reuse			
San Luis Rey WRF - Short/Long-Term Expansion	NA	3,300 AF/y	Same as 2025
Recycled Water			
4S Ranch WRF/Olivenhain MWD	915 AF/y	Same as 2015	Same as 2015
Carlsbad WRF/Carlsbad MWD	1,903 AF/y	2,831 AF/y	Same as 2025
Connection #1-North City Water Reclamation Plant/City of San Diego	356 AF/y	623 AF/y	Same as 2025
Connection #2-North City Water Reclamation Plant/City of San Diego	15 AF/y	20 AF/y	Same as 2025
Fallbrook Plant #1/Fallbrook PUD	600 AF/y	1,200 AF/y	Same as 2025
Gafner WRF/Leucadia CWD	247 AF/y	Same as 2015	Same as 2015
Hale Avenue RRF/WRF/City of Escondido (for City of Escondido)	600 AF/y	3,650 AF/y	4,400 AF/y
Hale Avenue RRF/WRF/City of Escondido (for Rincon del Diablo Municipal Water District)	3,300 AF/y	4,000 AF/y	Same as 2025

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Meadowlark WRF (via Mahr Reservoir)/Vallecitos WD	2,000 AF/y	Same as 2015	Same as 2015
North City WRP/City of San Diego (for City of Poway)	645 AF/y	Same as 2015	Same as 2015
North City WRP/City of San Diego (for City of San Diego)	7,029 AF/y	12,500 AF/y	Same as 2025
North WWTPs/USMC	Not modeled	Not modeled	Not modeled
Northwest Quadrant /Meadowlark WRF/Vallecitos WD	358 AF/y	459 AF/y	Same as 2025
R. W. Chapman WRF/Otay WD	1,100 AF/y	Same as 2015	Same as 2015
Ray Stoyer WRF (Existing)/Padre Dam MWD - Landscape (Existing Distribution System)	896 AF/y	Same as 2015	Same as 2015
Ray Stoyer WRF (Existing)/Padre Dam MWD - Replenishment of Santee Lakes	1,120 AF/y	Same as 2015	Same as 2015
San Elijo WRF/San Elijo JPA (for Santa Fe Irrigation District)	500 AF/y	Same as 2015	Same as 2015
San Elijo WRF/San Elijo JPA (for City of Del Mar)	90 AF/y	125 AF/y	150 AF/y
San Elijo WRF/San Elijo JPA (for San Dieguito Water District)	736 AF/y	800 AF/y	Same as 2025
San Luis Rey WWTP/City of Oceanside - Phase 1 Expansion	130 AF/y	1,700 AF/y	3,500 AF/y
San Vicente WRP/Ramona MWD	480 AF/y	525 AF/y	Same as 2025
Santa Fe Valley WRF/Rancho Santa Fe CSD	140 AF/y	Same as 2015	Same as 2015
Santa Maria WRP/Ramona MWD	230 AF/y	Same as 2015	Same as 2015

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
SEJPA1-Quail Gardens	144 AF/y	50 AF/y	50 AF/y
SEJPA2-Village Park, Manchester Phase I	NA	236 AF/y	Same as 2025
Sewage Treatment Plants #11 & #12/USMC	Not modeled	Not modeled	Not modeled
South Bay WRP/City of San Diego (for City of San Diego)	1,166 AF/y	1,150 AF/y	Same as 2025
South Bay WRP/City of San Diego (for Otay Water District)	3,300 AF/y	4,800 AF/y	5,400 AF/y
South WWTPs/USMC Baseline Recycled Water	Not modeled	Not modeled	Not modeled
Woods Valley Ranch WRF (Phase 2)	NA	175 AF/y	184 AF/y
Woods Valley Ranch WRF/VCMWD	47 AF/y	Same as 2015	Same as 2015
Seawater Desalination			
Carlsbad Desalination Plant	Production Capacity is 55,991 AF/y or 50 mgd	Same as 2015	Same as 2015
Urban and Agricultural Water Use Efficiency			
Conservation from 2015 UWMP	50,000 AF/y	89,110 AF/y	155,468 AF/y

[1] East County Regional Treated Water Improvement Program, which connects Helix's Levy Water Treatment Plant with Otay, Padre Dam, and Lakeside Water Districts.
[2] NA indicates that the project was not implemented during the demand scenario, but is implemented in later scenarios (i.e., not implemented in the 2015 scenario, but is implemented in the 2025 and 2050 scenarios).

Baseline Plus Portfolio

The Baseline Plus Portfolio contains projects from the Baseline Portfolio, as well as projects that are actively being pursued or have received funding between 2015 and 2017. Although these projects were not designated as verifiable in the SDCWA 2015 UWMP, it is believed that these projects are now close enough to verifiable status to be included in this Portfolio. Projects that are already in planning stages, but are not yet operational, such as Phase 1 of the Pure Water San Diego program, are included here. This will allow for a more direct comparison of Portfolios beyond the Baseline Plus Portfolio to the adaptation strategies that are already being utilized in the region. Infrastructure simulated in the CWASim model for the Baseline Plus Portfolio includes 18 reservoirs connected to the regional system, the Carlsbad Desalination Plant, and pipelines, pump stations, and water treatment plants. It also includes potable reuse, gray water use, and groundwater infrastructure that was not included in the Baseline Portfolio. In addition to Concepts from the Baseline Portfolio, new or modified Concepts included in the Baseline Plus Portfolio include Conveyance Improvements, Gray Water Use, Groundwater, Potable Reuse, Recycled Water, Stormwater Capture, Urban and Agricultural Water Use Efficiency, and Watershed and Ecosystem Management. Table 3 lists projects that in the Baseline Plus Portfolio and the supply volumes associated with those projects for each demand scenario.

Table 3. Summary of Baseline Plus Portfolio Concepts and Projects

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Conveyance Improvement			
All Baseline Conveyance Improvement Projects	See Table 2	See Table 2	See Table 2
Mission Trails Projects Alternative 1	NA[1]	Increases untreated conveyance capacity south of Miramar WTP from 159,379 to 268,046 AF/y (220 to 370 cfs) and south of Alvarado WTP from 50,711 to 101,423 AF/y (70 to 140 cfs)	Same as 2025
San Vicente 3rd Pump Drive and Power	NA	NA	Increases capacity from 217,334 to 321,655 AF/y (300 cfs to 444 cfs)
Total Change in Conveyance Capacity between the Baseline Plus and Baseline Portfolio	**No change**	**Conveyance capacity increased by 159,379 AF/y**	**Conveyance capacity increased by 263,700 AF/y**
Drought Restriction/Allocation			

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
All Baseline Drought Restriction/Allocation Projects	See Table 2	See Table 2	See Table 2
Firm Water Supply Agreements			
All Baseline Firm Water Supply Agreements	See Table 2	See Table 2	See Table 2
Gray Water Use			
Conservation Home Makeover in the Chollas Creek Watershed	NA	10.7 AF/y	Same as 2025
Total Change in Available Supply between the Baseline Plus and Baseline Portfolio	**No change**	**10.7 AF/y (No Gray Water Use in the Baseline Portfolio)**	**10.7 AF/y**
Groundwater			
All Baseline Groundwater Projects	See Table 2	See Table 2	See Table 2
Rancho del Rey Groundwater Well Development (capacity)	NA	NA	500 AF/y
Santa Margarita Conjunctive-Use Project - Local surface water recharge and expansion of Camp Pendleton groundwater recovery program	NA	3,100 AF/y	Same as 2025
Total Change in Available Supply between the Baseline Plus and Baseline Portfolio	**No change**	**3,100 AF/y**	**3,600 AF/y**
Imported Water Purchases			
All Baseline Imported Water Purchases projects	See Table 2	See Table 2	See Table 2
Local Surface Water Reservoirs			
All Baseline Local Surface Water Reservoirs	See Table 2	See Table 2	See Table 2
Potable Reuse			
All Baseline Potable Reuse Projects	See Table 2	See Table 2	See Table 2

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
East County Advanced Water Purification Program Phase 1	NA	3,920 AF/y	Same as 2025
East County Advanced Water Purification Program Phase 2	NA	7,616 AF/y	Same as 2025
Pure Water San Diego Phase 1 - North City	NA	33,627 AF/y (30 mgd) production capacity	Same as 2025
Total Change in Available Supply between the Baseline Plus and Baseline Portfolio	**No change**	**45,163 AF/y**	**45,163 AF/y**
Recycled Water			
All Baseline Recycled Water Projects	See Table 2	See Table 2	See Table 2
Integrated Water Resource Solutions for the Carlsbad Watershed	NA	100 AF/y	Same as 2025
North San Diego County Regional Recycled Water Project - Phase II	NA	NA	6,790 AF/y
Safari Drought Response and Outreach	NA	72 AF/y	Same as 2025
Total Change in Available Supply between the Baseline Plus and Baseline Portfolio	**No change**	**172 AF/y**	**6,962 AF/y**
Stormwater Capture			
Murray Urban Runoff Diversion System Capture	NA	200 AF/y	Same as 2025
Total Change in Available Supply between the Baseline Plus and Baseline Portfolio	**No change**	**200 AF/y (No Stormwater Capture in the Baseline Portfolio)**	**200 AF/y**
Seawater Desalination			
All Baseline Seawater Desalination projects	See Table 2	See Table 2	See Table 2
Urban and Agricultural Water Use Efficiency			

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
All Baseline Urban and Agricultural Water Use Efficiency Projects	See Table 2	See Table 2	See Table 2
Ms. Smarty-Plants Grows Water Wise Schools	NA	NA	6 AF/y
Regional Demand Management Program Expansion	Not modeled	Not modeled	Not modeled
Regional Drought Resilience Program	NA	NA	1,809 AF/y
Rincon Customer-Driven Demand Management Program	NA	400 AF/y	Same as 2025
San Diego Water Conservation Program	NA	NA	75 AF/y
San Diego Water Use Reduction Program	NA	381 AF/y	Same as 2025
UC San Diego Water Conservation and Watershed Protection	NA	NA	203 AF/y
Total Change in Available Supply between the Baseline Plus and Baseline Portfolio	**No change**	**781 AF/y**	**2,874 AF/y**
Watershed and Ecosystem Management			
Hodges Water Quality Improvement Program	NA	NA	Uses model logic
San Diego Healthy Headwaters Restoration	Not modeled	Not modeled	Not modeled
Sustaining Healthy Tributaries to the Upper San Diego River and Protecting Local Water Supplies	Not modeled	Not modeled	Not modeled
Sweetwater Reservoir Wetlands Habitat Recovery	NA	Allows for an additional 7,873 AF of storage in Sweetwater	Same as 2025
Total Change in Available Storage between the Baseline Plus and Baseline Portfolio	**No change**	**7,873 AF of additional storage (No Watershed and Ecosystem Management projects in Baseline)**	**7,873 AF of additional storage**

[1] NA indicates that the project was not implemented during the demand scenario, but is implemented in later scenarios (i.e., not implemented in the 2015 scenario, but is implemented in the 2025 and/or 2050 scenarios).

Enhanced Conservation Portfolio

The Enhanced Conservation Portfolio examined enhanced water conservation beyond currently planned levels. The purpose of this Portfolio is to explore the potential for demand reductions to improve delivery reliability in the future under climate and demand uncertainty. This Portfolio represents long-term or permanent restrictions in water use to decrease demand. Restrictions or allocations may be imposed at the local, regional, or State levels, and may include restrictions or allocations by water purveyors such as MWD. The demand reduction defined by this Portfolio represents additional conservation, beyond what is required by Senate Bill 7 of the Seventh Extraordinary Session of 2009, which aims for a 20 percent statewide reduction in urban per capita water use by 2020 (referred to as the 20x20 guidelines outlined in SBX7-7). The Portfolio does not specify or assume any particular projects or strategies to reduce demand, nor does it specify reductions in the per capita water use specific to an individual member agencies. The Portfolio is a high-level analysis of simulated demand reduction at the regional-scale, which may be achieved by broad range of demand reduction strategies or projects implemented by either the public or private sectors. This Portfolio represents and includes a single additional project and Concept beyond the Baseline Plus Portfolio, Enhanced Conservation. There are no other projects in the Basin Study that represent enhanced conservation beyond Baseline conditions (e.g., 20x20 guidelines). In May 2018 Governor Brown signed into law SB 606 and AB 1668 which set new long-term water efficiency goals through a mandate 55 gallons per capita day (GPCD) requirement for indoor usage and more efficient standards based on a percentage of evapotranspiration for outdoor use. At this time, it is not known what the effect of the new legislation will be on assumptions contained in SDCWA's 2015 UWMP. The additional conservation assumed in this Portfolio is consistent with the potential for more restrictive requirements of the new 2018 water use efficiency legislation. However, the analysis of conservation in thisthe Basin Study is not restricted to either indoor or outdoor use and does not reflect the demand reduction expected by these bills. While the results of the Enhanced Conservation Portfolio provide valuable information on the impact of conservation in various impact areas, it is important to note that the results reported herein should not be interpreted as representations of the conservation expected to be achieved by these bills.

Infrastructure simulated in the CWASim model for the Enhanced Conservation Portfolio includes 18 reservoirs connected to the regional system, the Carlsbad Desalination Plant, and pipelines, pump stations, water treatment plants, potable reuse, gray water use, and groundwater infrastructure. New infrastructure beyond what is presented in the Baseline Plus Portfolio is not introduced in this Portfolio. In addition to Concepts from the Baseline Plus Portfolio, the only new or modified Concept includes Enhanced Conservation. Table 4 lists projects in the Enhanced Conservation Portfolio and the supply volumes associated with those projects for each demand scenario.

Table 4. Summary of Enhanced Conservation Portfolio Concepts and Projects

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Conveyance Improvement			

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
All Baseline Plus Conveyance Improvement projects	See Table 3	See Table 3	See Table 3
Drought Restriction/Allocation			
All Baseline Plus Drought Restriction/Allocation projects	See Table 3	See Table 3	See Table 3
Enhanced Conservation			
Enhanced Conservation	NA[1]	52,265 AF/y	179,582 AF/y
Total Change in Conservation between the Baseline Plus and Enhanced Conservation	**No change**	**52,265 AF/y**	**179,582 AF/y**
Firm Water Supply Agreements			
All Baseline Plus Firm Water Supply Agreements projects	See Table 3	See Table 3	See Table 3
Gray Water Use			
All Baseline Plus Gray Water Use projects	See Table 3	See Table 3	See Table 3
Groundwater			
All Baseline Plus Groundwater projects	See Table 3	See Table 3	See Table 3
Imported Water Purchases			
All Baseline Plus Imported Water Purchases projects	See Table 3	See Table 3	See Table 3
Local Surface Water Reservoirs			
All Baseline Plus Local Surface Water Reservoirs projects	See Table 3	See Table 3	See Table 3
Potable Reuse			
All Baseline Plus Potable Reuse projects	See Table 3	See Table 3	See Table 3
Recycled Water			
All Baseline Plus Recycled Water projects	See Table 3	See Table 3	See Table 3
Stormwater Capture			
All Baseline Plus Stormwater Capture projects	See Table 3	See Table 3	See Table 3

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Seawater Desalination			
All Baseline Plus Seawater Desalination projects	See Table 3	See Table 3	See Table 3
Urban and Agricultural Water Use Efficiency			
All Baseline Plus Urban and Agricultural Water Use Efficiency projects	See Table 3	See Table 3	See Table 3
Watershed and Ecosystem Management			
All Baseline Plus Watershed and Ecosystem Management projects	See Table 3	See Table 3	See Table 3

[1] NA indicates that the project was not implemented during the demand scenario but is implemented in later scenarios (i.e., not implemented in the 2015 scenario, but is implemented in the 2025 and 2050 scenarios).

Increase Supplies Portfolio

The Increase Supplies Portfolio consists of conceptual projects that are focused on increasing regional water supplies, as well as projects that were included in the Baseline Plus Portfolio. These projects are typically in the pre-planning and pre-feasibility analysis phase. Infrastructure simulated in the CWASim model for the Increase Supplies Portfolio includes 18 reservoirs connected to the regional system, the Carlsbad Desalination Plant, and pipelines, pump stations, water treatment plants, potable reuse, gray water use, and groundwater infrastructure. It also includes infrastructure not accounted for in the Baseline Plus Portfolio, such as additional desalination facilities, and infrastructure associated with additional groundwater, gray water, and recycled water projects. In addition to Concepts from the Baseline Plus Portfolio, new or modified Concepts include Gray Water Use, Groundwater, Imported Water Purchases, Potable Reuse, Recycled Water, and Seawater Desalination. The Increase Supplies Portfolio is the only Portfolio beyond the Baseline Plus Portfolio to incorporate Potable Reuse projects. Table 5 lists projects that in the Increase Supplies Portfolio and the supply volumes associated with those projects for each demand scenario.

Table 5. Summary of Increase Supplies Portfolio Concepts and Projects

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Drought Restriction/Allocation			
All Baseline Plus Drought Restriction/Allocation Projects	See Table 3	See Table 3	See Table 3
Firm Water Supply Agreements			
All Baseline Plus Firm Water Supply Agreements projects	See Table 3	See Table 3	See Table 3
Gray Water Use			
All Baseline Plus Gray Water Use Projects	See Table 3	See Table 3	See Table 3
Gray water pilot project	NA[1]	NA	2,575 AF/y
Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio	**No change**	**No change**	**2,575 AF/y**
Groundwater			
All Baseline Plus Groundwater Projects	See Table 3	See Table 3	See Table 3
Santee/El Monte Groundwater Extraction	NA	NA	1,300 AF/y

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Middle Sweetwater River Basin Groundwater Well System	NA	NA	1,000 AF/y
Mission Valley Brackish Groundwater Recovery Project	NA	840 AF/y	1,680 AF/y
Otay Mesa Lot 7 Groundwater Well System (capacity)	NA	NA	400 AF/y
Otay River Valley GW Aquifer Studies & Field Investigations	NA	3,900 AF/y	Same as 2025
San Diego Formation - Southeastern San Diego, including Mt. Hope	NA	800 AF/y	1,600 AF/y
San Dieguito River Basin Brackish GW Recovery and Treatment	NA	560 AF/y	Same as 2025
San Luis Rey Groundwater Study	NA	4,000 AF/y	Same as 2025
San Pasqual Brackish Groundwater Recovery Project	NA	1,325 AF/y	Same as 2025
Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio	**No change**	**11,425 AF/y**	**15,765 AF/y**
Imported Water Purchases			
All Baseline Plus Imported Water Purchases Projects	See Table 3	See Table 3	See Table 3
Cadiz additional imported water	NA	NA	5,000 AF/y
Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio	**No change**	**No change**	**5,000 AF/y**
Local Surface Water Reservoirs			
All Baseline Plus Local Surface Water Reservoirs	See Table 3	See Table 3	See Table 3
Potable Reuse			
All Baseline Plus Potable Reuse Projects	See Table 3	See Table 3	See Table 3
East County Advanced Water Purification Program Phase 3	NA	NA	5,824 AF/y

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Encina Wastewater Reuse Project	NA	NA	16,802 AF/y
New Local Supply Rincon del Diablo - Hale Avenue RRF/City of Escondido/WRFs	NA	NA	1,000 AF/y
Potable Reuse/Hale Avenue Resource Recovery Facility (HARRF)	NA	NA	90 AF/y
Pure Water San Diego Phase 2	NA	NA	59,407 AF/y (53 mgd) production capacity
SFID/SDWD/SEJPA Potable Reuse Project	NA	550 AF/y	Same as 2025
South WWTP - Indirect Potable Recharge	Not modeled	Not modeled	Not modeled
Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio	**No change**	**550 AF/y**	**83,673 AF/y**
Recycled Water			
All Baseline Plus Recycled Water Projects	See Table 3	See Table 3	See Table 3
Carlsbad WRF - Landscape, Agriculture 2025	NA	328 AF/y	Same as 2025
Carlsbad WRF - Landscape, Agriculture 2050	NA	NA	616 AF/y
Extension 153 Phase I	NA	189 AF/y	Same as 2025
Extension 153 Phase II	NA	NA	300 AF/y
Hale Avenue Resource Recovery Facility (HARRF) - Landscape, Agriculture, Industrial, PR	NA	7,130 AF/y	8,130 AF/y
Integrated Water Resource Solutions for the Carlsbad Watershed	NA	NA	100 AF/y
Joint RW Transmission Project with SFID and OMWD	NA	400 AF/y	Same as 2025

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Lilac Hills Ranch WRF	NA	NA	294 AF/y
Lower Moosa Canyon WRF	NA	460 AF/y	700 AF/y
Meadowlark WRF	NA	NA	187 AF/y
Meadowood WRF	NA	100 AF/y	143 AF/y
North City WRP - Project 1	NA	100 AF/y	Same as 2025
North City WRP - Project 2	NA	50 AF/y	Same as 2025
North District Recycled System/ RW Chapman WRF	NA	NA	4,400 AF/y
North Village WRF	NA	NA	105 AF/y
North WWTP Landscape Application	Not modeled	Not modeled	Not modeled
Rancho Cielo	NA	NA	100 AF/y
Ray Stoyer WRF - Landscape, Irrigation, Dust Control	NA	1,008 AF/y	Same as 2025
Santa Maria WRP	NA	3,000 AF/y	Same as 2025
Shadowridge WRP	NA	1,800 AF/y	3,000 AF/y
South WWTP - Injection to Las Flores Basin	Not modeled	Not modeled	Not modeled
South WWTP - Injection to Santa Margarita Basin	Not modeled	Not modeled	Not modeled
TBD - Evaluation Multiple Options/TBD - Supply/Source Treatment Plant/Agency for Recycled Water	NA	50 AF/y	Same as 2025
Village Park Recycled Water Expansion Project	NA	127 AF/y	Same as 2025
W+157:181RP/Recycled Water Distribution System	NA	670 AF/y	1,600 AF/y
Welk WRF	NA	140 AF/y	Same as 2025
Woods Valley Ranch WRF Phase 3	NA	NA	168 AF/y

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio	**No change**	**15,552 AF/y**	**25,235 AF/y**
Stormwater Capture			
All Baseline Plus Stormwater Capture projects	See Table 3	See Table 3	See Table 3
Seawater Desalination			
All Baseline Plus Seawater Desalination Projects	See Table 3	See Table 3	See Table 3
Camp Pendleton Desalination Facility	NA	NA	168,133 AF/y (150 mgd) production capacity
Re-rating of Carlsbad Desalination for higher flow	NA (model uses Baseline production capacity of 55,991 AF/y or 50 mgd)	59,407 AF/y (53 mgd) production capacity (increased from 55,991 AF/y (50 mgd) in Baseline)	Same as 2025
Rosarito Beach Desalination	NA	NA	16,800 AF/y production capacity
Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio	**No change**	**3,416 AF/y**	**188,349 AF/y**
Urban and Agricultural Water Use Efficiency			
All Baseline Plus Urban and Agricultural Water Use Efficiency projects	See Table 3	See Table 3	See Table 3
Watershed and Ecosystem Management			
All Baseline Plus Watershed and Ecosystem Management projects	See Table 3	See Table 3	See Table 3

[1] NA indicates that the project was not implemented during the demand scenario, but is implemented in later scenarios (i.e., not implemented in the 2015 scenario, but is implemented in the 2025 and/or 2050 scenarios).

Optimize Existing Facilities Portfolio

The Optimize Existing Facilities Portfolio is focused on enhancing the efficiency of existing facilities by replacing, repairing, or maintaining existing infrastructure to maximize its operation. It consists of conceptual projects that are typically in the pre-planning and pre-feasibility analysis phase, as well as projects that were included in the Baseline Plus Portfolio. Infrastructure simulated in the CWASim model for the Optimize Existing Facilities Portfolio includes 18 reservoirs connected to the regional system, the Carlsbad Desalination Plant, and pipelines, pump stations, water treatment plants, potable reuse, gray water use, and groundwater infrastructure. This Portfolio does not introduce new infrastructure to the system, and solely focuses on optimizing the infrastructure already in place. The only new/modified Concept associated with this Portfolio is the Conveyance Improvements Concept. Table 6 lists projects in the Optimize Existing Facilities Portfolio and the supply volumes associated with those projects for each demand scenario.

Table 6. Summary of Optimize Existing Facilities Portfolio Concepts and Projects

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Conveyance Improvement			
All Baseline Plus Conveyance Improvement Projects	See Table 3	See Table 3	See Table 3
Dulzura Conduit Replacement	NA[1]	NA	Increases capacity from 21,300 to 44,800 AF/y (19 mgd to 40 mgd) and reduces loss from 10% to 0%
Pipeline 3/Pipeline 4 Conversion	NA	NA	Alleviates untreated water delivery constraint. P3 + P5 capacity is 521,600 AF/y (720 cfs) except for OEF Portfolio 2050s scenarios, when it is 648,400 AF/y (895 cfs) Pipeline 4 capacity is 286,200 AF/y (395 cfs) except for OEF Portfolio 2050s scenarios, when it is 97,800 AF/y (135 cfs).
San Diego County Reservoir Intertie	NA	NA	Uses model logic to integrate the San Vicente Reservoir, El Capitan Reservoir, and El Monte groundwater basin
Second Crossover Pipeline	NA	NA	Increases untreated water conveyance between the 2nd and 1st Aqueduct by approximately 94,000 AF

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Total Change in Conveyance Capacity between the Baseline Plus and Baseline Portfolio	**No change**	**No change**	**Conveyance capacity increased by 55,900 AF/y**
Drought Restriction/Allocation			
All Baseline Plus Drought Restriction/Allocation projects	See Table 3	See Table 3	See Table 3
Firm Water Supply Agreements			
All Baseline Plus Firm Water Supply Agreement projects	See Table 3	See Table 3	See Table 3
Gray Water Use			
All Baseline Plus Gray Water Use projects	See Table 3	See Table 3	See Table 3
Groundwater			
All Baseline Plus Groundwater projects	See Table 3	See Table 3	See Table 3
Imported Water Purchases			
All Baseline Plus Imported Water Purchases projects	See Table 3	See Table 3	See Table 3
Local Surface Water Reservoirs			
All Baseline Plus Local Surface Water Reservoirs projects	See Table 3	See Table 3	See Table 3
Potable Reuse			
All Baseline Plus Potable Reuse projects	See Table 3	See Table 3	See Table 3
Recycled Water			
All Baseline Plus Recycled Water projects	See Table 3	See Table 3	See Table 3
Stormwater Capture			
All Baseline Plus Stormwater Capture projects	See Table 3	See Table 3	See Table 3

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Seawater Desalination			
All Baseline Plus Seawater Desalination projects	See Table 3	See Table 3	See Table 3
Urban and Agricultural Water Use Efficiency			
All Baseline Plus Urban and Agricultural Water Use Efficiency projects	See Table 3	See Table 3	See Table 3
Watershed and Ecosystem Management			
All Baseline Plus Watershed and Ecosystem Management projects	See Table 3	See Table 3	See Table 3

[1] NA indicates that the project was not implemented during the demand scenario, but is implemented in later scenarios (i.e., not implemented in the 2015 scenario, but is implemented in the 2025 and/or 2050 scenarios).

Watershed Health and Ecosystem Restoration Portfolio

The Watershed Health and Ecosystem Restoration Portfolio is intended to restore or create natural habitats and minimize environmental impacts. It contains conceptual projects that are typically in the pre-planning and pre-feasibility analysis phase, as well as projects that were included in the Baseline Plus Portfolio. Infrastructure simulated in the CWASim model for the Watershed Health and Ecosystem Restoration Portfolio includes 18 reservoirs connected to the regional system, the Carlsbad Desalination Plant, and pipelines, pump stations, water treatment plants, potable reuse, gray water use, and groundwater infrastructure; as well as infrastructure specific to this Portfolio, such as stormwater and watershed and ecosystem management infrastructure. In addition to Concepts from the Baseline Plus Portfolio, new or modified Concepts include Stormwater BMPs, Stormwater Capture, and Watershed and Ecosystem Management. Although many of the Stormwater BMPs, Stormwater Capture, and Watershed and Ecosystem Management projects associated with this Portfolio may provide demonstrable benefits, they are unable to be modeled as they do not have a specific water supply volume or operational impact on the San Diego system that can be described with model inputs or logic. The Task 2.5 analysis will present a more complete assessment of the effects of the Concepts included in this Portfolio. Table 7 lists projects in the Watershed Health and Ecosystem Restoration Portfolio and the supply volumes associated with those projects for each demand scenario.

Table 7. Summary of Watershed Health and Ecosystem Restoration Portfolio Concepts and Projects

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Conveyance Improvement			
All Baseline Plus Conveyance Improvement projects	See Table 3	See Table 3	See Table 3
Drought Restriction/Allocation			
All Baseline Plus Drought Restriction/Allocation projects	See Table 3	See Table 3	See Table 3
Firm Water Supply Agreements			
All Baseline Plus Firm Water Supply Agreements projects	See Table 3	See Table 3	See Table 3
Gray Water Use			
All Baseline Plus Gray Water Use projects	See Table 3	See Table 3	See Table 3
Groundwater			
All Baseline Plus Groundwater projects	See Table 3	See Table 3	See Table 3

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Imported Water Purchases			
All Baseline Plus Imported Water Purchases projects	See Table 3	See Table 3	See Table 3
Local Surface Water Reservoirs			
All Baseline Plus Local Surface Water Reservoirs projects	See Table 3	See Table 3	See Table 3
Potable Reuse			
All Baseline Plus Potable Reuse projects	See Table 3	See Table 3	See Table 3
Recycled Water			
All Baseline Plus Recycled Water projects	See Table 3	See Table 3	See Table 3
Stormwater BMPs			
Alternative Compliance Retrofit Project El Norte Parkway and Rincon, Villa Drive, Escondido	Not modeled	Not modeled	Not modeled
Alternative Compliance Retrofit Project Mountain View Park, Escondido	Not modeled	Not modeled	Not modeled
Bakersfield Street and San Altos Channel Restoration	NA[1]	NA	12 AF/y
Broadway Channel Flood Risk Reduction and Water Quality Improvements	Not modeled	Not modeled	Not modeled
City of Oceanside Loma Alta Slough Restoration Project	Not modeled	Not modeled	Not modeled
Golden Ave Green Street	Not modeled	Not modeled	Not modeled
Las Colinas Channel Improvements	Not modeled	Not modeled	Not modeled
Lemon Grove Avenue Green Streets	Not modeled	Not modeled	Not modeled
Leucadia Roadside Park Stormwater Capture/Reuse Project	Not modeled	Not modeled	Not modeled
Lincoln St Green Street	Not modeled	Not modeled	Not modeled
Low Impact Development Urban Runoff Control Projects for the Tijuana Estuary	NA	NA	3 AF/y
Madera St Green Street	Not modeled	Not modeled	Not modeled
Main Street Promenade Expansion	NA	NA	23 AF/y

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Mapleview Street - Green Infrastructure and Stormwater Quality Improvement Program	Not modeled	Not modeled	Not modeled
Paradise Valley Creek Water Quality and Community Enhancement	Not modeled	Not modeled	Not modeled
Pure Water - Los Peñasquitos Creek Urban Dry-Weather Water Harvesting	Not modeled	Not modeled	Not modeled
Safari Park Stormwater Capture and Reuse Project	NA	NA	5 AF/y
Safari Park Water Reuse Sustainability and Watershed Protection Program	NA	NA	19 AF/y
San Marino Drive Green Street and Dry Weather Flow Management Vallecitos	NA	NA	2 AF/y
San Marino Drive Green Street and Dry Weather Flow Management Sweetwater	NA	NA	3 AF/y
San Miguel Green Street	Not modeled	Not modeled	Not modeled
Skyline Dr and Kempt St Green Streets	Not modeled	Not modeled	Not modeled
South Santa Fe Green Street Project	Not modeled	Not modeled	Not modeled
Spruce Street Channel Improvement Project	Not modeled	Not modeled	Not modeled
Stormwater Capture off San Diego River along Alvarado Canyon and Fairmont Canyon to Fish and Wildlife site	Not modeled	Not modeled	Not modeled
Sweetwater Rd Green Street	Not modeled	Not modeled	Not modeled
Sweetwater River Park Bioretention	NA	NA	43 AF/y
Telegraph Canyon Channel Improvement Project	Not modeled	Not modeled	Not modeled
Woodside Avenue Complete Green Street	Not modeled	Not modeled	Not modeled
Total Change in Available Supply between the Watershed Health and Ecosystem Restoration and Baseline Plus Portfolio	**No change**	**No change**	**110 AF/y**
Stormwater Capture			
All Baseline Plus Stormwater Capture Projects	See Table 3	See Table 3	See Table 3
Rainwater Harvesting	NA	NA	416 AF/y

Project	2015 Demand Scenario	2025 Demand Scenario	2050 Demand Scenario
Total Change in Available Supply between the Watershed Health and Ecosystem Restoration and Baseline Plus Portfolio	**No change**	**No change**	**416 AF/y**
Seawater Desalination			
All Baseline Plus Seawater Desalination projects	See Table 3	See Table 3	See Table 3
Urban and Agricultural Water Use Efficiency			
All Baseline Plus Urban and Agricultural Water Use Efficiency Projects	See Table 3	See Table 3	See Table 3
Watershed and Ecosystem Management			
All Baseline Plus Watershed and Ecosystem Management Projects	See Table 3	See Table 3	See Table 3
69th St Green Street	Not modeled	Not modeled	Not modeled
Alternative Compliance Retrofit Project Avenida Del Diablo Park, Escondido	Not modeled	Not modeled	Not modeled
Broadway/Federal Blvd Green Street	Not modeled	Not modeled	Not modeled
Canton Dr Green Street	Not modeled	Not modeled	Not modeled
Central Avenue Green Street	Not modeled	Not modeled	Not modeled
Federal Blvd Channel	Not modeled	Not modeled	Not modeled
Massachusetts Blvd Green Street	Not modeled	Not modeled	Not modeled
Mt. Vernon St Green Street	Not modeled	Not modeled	Not modeled
Nestor Creek Channel Restoration	Not modeled	Not modeled	Not modeled
North Ave and Grove Green Street	Not modeled	Not modeled	Not modeled
Palm St Green Street	Not modeled	Not modeled	Not modeled
Paradise Creek Restoration Phase II	Not modeled	Not modeled	Not modeled
Sycamore Creek Restoration	Not modeled	Not modeled	Not modeled
Tijuana River Floating Trash Capture System	Not modeled	Not modeled	Not modeled

[1] NA indicates that the project was not implemented during the demand scenario, but is implemented in later scenarios (i.e., not implemented in the 2015 scenario, but is implemented in the 2025 and/or 2050 scenarios).

Task 2.4 Impact Metrics

Metric Category	Metric Sub-category	Metric Group	Timestep	Description
Water Delivery	Demands	Gross Demand Volume	Annual Monthly	Gross demands of SDCWA member agencies
Water Delivery	Deliveries	Delivery and Conservation	Annual Monthly	Total conservation volume and total water deliveries to SDCWA member agencies from surface water reservoirs, groundwater, recycled water, potable reuse, gray water use, stormwater capture, stormwater BMPs, desalination, firm water supply agreements, and imported water purchases.
Water Delivery	Shortage	Shortage Volume	Annual	Magnitude of demand Water Authority-wide that is unable to be met by the available supplies and/or limited by conveyance system capacity
Water Delivery	Conveyance	Pipeline Flow Volume	Monthly	Average pipeline flow volumes during the month for five pipeline locations: • Pipeline 4 just south of Twin Oaks Valley WTP, which serves treated water to Carlsbad, Vista, and Vallecitos member agencies • Pipeline 3 30-inch interconnect, which conveys untreated water near Murray Reservoir • Crossover Pipeline, which conveys untreated water • MWD Delivery Point treated water conveyed through Pipelines 1, 2, and 4 • Untreated

Metric Category	Metric Sub-category	Metric Group	Timestep	Description
Water Delivery	Conveyance	High Pipeline Utilization Summer Count	Annual	Number of days that pipeline flow exceeds 95% of capacity during the summer for five pipeline locations: • Pipeline 4 just south of Twin Oaks Valley WTP, which serves treated water to Carlsbad, Vista, and Vallecitos member agencies • Pipeline 3 30-inch interconnect, which conveys untreated water near Murray Reservoir • Crossover Pipeline, which conveys untreated water • MWD Delivery Point treated water conveyed through Pipelines 1, 2, and 4 • Untreated
Water Delivery	Conveyance	High Pump Station Utilization	Annual	Number of times per year that pump station exceeds 95% of capacity for 70% of pumping days for the following pump station locations: • San Vicente; 70% of pumping days = 107 days • P2A; 70% of pumping days = 171 days
Water Delivery	Conveyance	Treatment Plant Utilization	Annual	Average annual treatment plant flow divided by annual treatment plant capacity, expressed as a percentage.
Water Delivery	Reservoir Operations	Reservoir Storage	Monthly	End of month reservoir storage volume
Water Delivery	Reservoir Operations	Reservoir Releases	Monthly	Total reservoir release volume used to meet demands during the month
Water Delivery	Reservoir Operations	End of September Reservoir Storage	Annual	Volume remaining in the reservoir at the end of September for Hodges, El Capitan, San Vicente, Lower Otay, Olivenhain, and Other reservoirs. Volume includes storage in all modeled reservoir pools.

Metric Category	Metric Sub-category	Metric Group	Timestep	Description
Energy	Generation	Power Generation	Annual Monthly	Total power generated at Miramar, Alvarado, and Twin Oaks Valley Water Treatment Plants, the Rancho Peñasquitos Hydroelectric Facility, Hodges Pump Storage Hydroelectric Facility, and the SDCWA offices in San Diego and Escondido
Energy	Consumption	Power Consumption	Annual Monthly	Total power consumed to treat and deliver water, including consumption by supply sources, conveyance, treatment, pumped storage, and offices
Recreation	Recreation	End of September Reservoir Elevation	Annual	Reservoir elevation on September 30th of each simulation year
Flood Control	Flood Outflow	Flood Outflow Volume	Annual Monthly	Total outflow volume from the reservoir on days when the reservoir is operating in the flood pool
Flood Control	Flood Outflow	Number of Days with Flood Outflows	Annual	Number of days with flood outflows from a reservoir

San Diego Basin Study Task 2.4 Conclusion Highlights

Water Delivery (Task 2.4 Report Section 7.1)

- Demands (Task 2.4 Report Section 7.1.1)
    - Increases in population and changes in socioeconomic factors had a larger effect on demand projections than climate change scenarios
- Deliveries and Conservation (Task 2.4 Report Section 7.1.2)
    - Differences in water deliveries between Portfolios and scenarios correspond to differences in demands
    - All Portfolios except the Enhanced Conservation Portfolio aim to increase water deliveries to meet increased demands, while the Enhanced Conservation Portfolio aims to decrease demands through conservation
    - Imported Water deliveries were lower in all other Portfolios than in the Baseline Portfolio due to greater availability of local supplies and/or additional conservation
    - Supply types modeled dynamically (Surface Water, Desalination, Potable Reuse, and some Imported Water) differ between Portfolios (depending on whether that project is included or not), between demand scenarios (higher demands due to population increases require larger deliveries), and climate scenarios (higher demands due to temperature and precipitation changes require higher deliveries).
    - Supply types modeled as demand reductions (Gray Water Use, Groundwater, some Imported Water Purchases, Recycled Water, some Potable Reuse, Stormwater BMPs, Stormwater Capture, Urban and Agricultural Water Use) differ between Portfolios (depending on whether that project is included or not) and demand scenarios (depending on projected supply volume from the project for a given demand scenario), but do not differ between climate scenarios.
- Shortage Volume (Task 2.4 Report Section 7.1.3)
    - A shortage threshold of 20,000 AF represents the shortage volume that could be mitigated within the San Diego system through short-term drought restrictions or operational changes. Modeled shortages above the shortage threshold of 20,000 AF occurred in 6% of the realizations in the 2015 demands with current climate scenario and in 28% of realizations in the 2050 demands with hot dry climate scenario.

  - The Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios all reduced the occurrence and magnitude of shortages above the threshold, while the Enhanced Conservation and Increase Supplies Portfolios eliminated shortages above the shortage threshold for all climate and demand scenarios

  - Available water supply sources (types), relative dryness of the year and preceding years, and conveyance system constraints all contribute to shortages

- Conveyance System Operations (Task 2.4 Report Section 7.1.4)

  - The Untreated Pipeline, which conveys imported water from the MWD delivery point into the San Diego region, was the only pipeline with an operationally significant number of days exceeding 95% usage during the summer

  - Untreated pipeline utilization was highest in the Baseline Portfolio and lower in the Enhanced Conservation, Increase Supplies due to reduced demands for imported water, and lower in the Optimize Existing Facilities Portfolios due to conveyance capacity increase from the Pipeline 3/Pipeline 4 Conversion Project

  - Pump Stations did not contribute to conveyance constraints

  - Water Treatment Plants were generally used least in the Enhanced Conservation Portfolio due to reduced water demands

  - Individual treatment plant usage depends on the source of water for the plant, which member agencies the plant serves, and what other water supplies are available in a given Portfolio

- Reservoir Operations (Task 2.4 Report Section 7.1.5)

  - Reservoirs operated within the ranges specified by the rule curves in all scenarios and Portfolios, indicating that operations are generally flexible enough to accommodate changes in demand and climate, as well as changes in operations of other components of the water system.

  - Climate change affected reservoir storage at some reservoirs but did not appear to have an effect at others, which may be attributed to the primary inflow source (i.e. local runoff versus imported water). For reservoirs that showed impacts from climate change, wet scenarios generally had higher reservoir storage than dry scenarios.

Energy (Task 2.4 Report Section 7.2)

- As modeled, energy generation offset approximately 4% of energy consumption for water supply in the San Diego region, with annual generation of 76,000 mWh and consumption of 1,732,000 mWh for the 2015 demand current climate scenarios.

- Consumption was lowest in the Enhanced Conservation Portfolio, indicating that demand is a driver of energy consumption.

- Due to supply priorities and availability of less energy intense supply sources, the Increase Supplies Portfolio consumed less energy than the Baseline and Baseline Plus Portfolios even though it included additional energy intense desalination projects. Lower usage of imported water contributed to the lower energy consumption

Recreation (Task 2.4 Report Section 7.3)

- The increased water availability and management flexibility associated with all Portfolios beyond Baseline generally appeared to raise the End of September Elevation of the reservoirs assessed for recreation impacts, except for Hodges

- Improvements to End of September Storage positively impacted boat ramp accessibility at Lower Otay and El Capitan, but had no effect for San Vicente, since boat ramps were accessible at that reservoir in all Portfolios and scenarios.

- The Hodges Water Quality Improvement Project had a slight negative impact on boat ramp accessibility, with 1% of realizations having End of September Elevation below the boat ramp elevation when it was implemented in the Baseline Plus Portfolio.

Flood Control (Task 2.4 Report Section 7.4)

- Flood impacts were only observed for El Capitan, Hodges, and Lower Otay. No flood outflows occurred at San Vicente or Olivenhain

- For El Capitan, flood outflows were larger in the Increase Supplies Portfolio than other Portfolios due to the greater supply availability resulting in higher storage and lower in the Optimize Existing Facilities Portfolio due to the enhanced ability to convey imported water to El Capitan

- For Hodges, the Hodges Water Quality Improvement Program had significant positive flood control impacts at Hodges Reservoir, reducing the volume of flood outflows and number of days with flood outflows.

- For Lower Otay, flood outflows occur more often in the Enhanced Conservation Portfolio due to lower water demands resulting in higher reservoir storage.