San Diego Basin Study

Task 2.4 – Structural & Operations Concepts
Mission Statements

The mission of the Department of the Interior is to protect and manage the Nation’s natural resources and cultural heritage; provide scientific and other information about those resources; and honor its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The mission of the City of San Diego Public Utilities Department is to provide reliable water utility services that protect the health of our communities and the environment.
San Diego Basin Study

Task 2.4 – Structural and Operations Concepts

Prepared by:
Bureau of Reclamation
Lower Colorado Region
Engineering Services Office

Prepared for:
City of San Diego
Public Utilities Department

Bureau of Reclamation
Lower Colorado Region
Southern California Area Office

Peer Reviewed by:
Bureau of Reclamation
Mid-Pacific Region
Michael Tansey, PhD
Climate Change Coordinator
### Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acronyms and Abbreviations</td>
<td>i</td>
</tr>
<tr>
<td>Modeled Portfolio and Climate Scenario Abbreviations</td>
<td>ii</td>
</tr>
<tr>
<td>Glossary</td>
<td>iv</td>
</tr>
<tr>
<td>Executive Summary</td>
<td>ES-1</td>
</tr>
<tr>
<td>Study and Task 2.4 Overview</td>
<td>ES-1</td>
</tr>
<tr>
<td>Methodology</td>
<td>ES-1</td>
</tr>
<tr>
<td>Results and Discussion</td>
<td>ES-4</td>
</tr>
<tr>
<td>Water Delivery</td>
<td>ES-4</td>
</tr>
<tr>
<td>Energy</td>
<td>ES-5</td>
</tr>
<tr>
<td>Recreation</td>
<td>ES-5</td>
</tr>
<tr>
<td>Flood Control</td>
<td>ES-6</td>
</tr>
<tr>
<td>Conclusion</td>
<td>ES-7</td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.1. Study Overview and Purpose</td>
<td>1</td>
</tr>
<tr>
<td>1.2. Overview of Task 2.4</td>
<td>1</td>
</tr>
<tr>
<td>1.3. Study Background</td>
<td>2</td>
</tr>
<tr>
<td>2. Study Area</td>
<td>4</td>
</tr>
<tr>
<td>2.1. Study Area Overview</td>
<td>4</td>
</tr>
<tr>
<td>2.2. Study Area Water Supplies</td>
<td>8</td>
</tr>
<tr>
<td>2.2.1. Surface Water</td>
<td>9</td>
</tr>
<tr>
<td>2.2.2. Groundwater</td>
<td>9</td>
</tr>
<tr>
<td>2.2.3. Recycled Water and Potable Reuse</td>
<td>10</td>
</tr>
<tr>
<td>2.2.4. Seawater Desalination</td>
<td>10</td>
</tr>
<tr>
<td>2.2.5. QSA Water</td>
<td>11</td>
</tr>
<tr>
<td>2.2.6. MWD Purchases</td>
<td>11</td>
</tr>
<tr>
<td>2.2.7. Other Water Supplies</td>
<td>11</td>
</tr>
<tr>
<td>2.3. Study Area Water Demands</td>
<td>11</td>
</tr>
<tr>
<td>2.4. Study Area Water Resources Infrastructure and Operations</td>
<td>12</td>
</tr>
<tr>
<td>3. San Diego Basin Study Portfolios</td>
<td>16</td>
</tr>
<tr>
<td>3.1. Concepts</td>
<td>16</td>
</tr>
<tr>
<td>3.2. Portfolios</td>
<td>18</td>
</tr>
<tr>
<td>3.3. Baseline Portfolio</td>
<td>19</td>
</tr>
<tr>
<td>3.3.1. Portfolio Overview</td>
<td>19</td>
</tr>
<tr>
<td>3.3.2. Portfolio Concepts</td>
<td>27</td>
</tr>
<tr>
<td>3.3.2.1 Conveyance Improvements</td>
<td>27</td>
</tr>
<tr>
<td>3.3.2.2 Drought Restriction/Allocation</td>
<td>28</td>
</tr>
<tr>
<td>3.3.2.3 Firm Water Supply Agreements</td>
<td>28</td>
</tr>
<tr>
<td>3.3.2.4 Groundwater</td>
<td>28</td>
</tr>
<tr>
<td>3.3.2.5 Imported Water Purchases</td>
<td>28</td>
</tr>
<tr>
<td>3.3.2.6 Local Surface Water Reservoirs</td>
<td>28</td>
</tr>
</tbody>
</table>
3.4.1. Portfolio Overview ................................................................. 29
3.4.2. Portfolio Concepts ............................................................... 33
  3.4.2.1 Conveyance Improvement ............................................... 33
  3.4.2.2 Gray Water Use ............................................................... 33
  3.4.2.3 Groundwater ................................................................. 34
  3.4.2.4 Potable Reuse ............................................................... 34
  3.4.2.5 Recycled Water ......................................................... 35
  3.4.2.6 Stormwater Capture ................................................... 35
  3.4.2.7 Urban and Agricultural Water Use Efficiency ............... 35
  3.4.2.8 Watershed and Ecosystem Management ...................... 35
3.5. Enhanced Conservation Portfolio .............................................. 38
  3.5.1. Portfolio Overview .......................................................... 38
  3.5.2. Portfolio Concepts .......................................................... 40
    3.5.2.1 Enhanced Conservation ........................................... 40
3.6. Increase Supplies Portfolio ...................................................... 42
  3.6.1. Portfolio Overview .......................................................... 42
  3.6.2. Portfolio Concepts .......................................................... 46
    3.6.2.1 Gray Water Use .......................................................... 46
    3.6.2.2 Groundwater .............................................................. 46
    3.6.2.3 Imported Water Purchases ......................................... 47
    3.6.2.4 Potable Reuse .............................................................. 47
    3.6.2.5 Recycled Water ........................................................... 48
    3.6.2.6 Seawater Desalination .............................................. 49
3.7. Optimize Existing Facilities Portfolio ........................................ 49
  3.7.1. Portfolio Overview .......................................................... 49
  3.7.2. Portfolio Concepts .......................................................... 51
    3.7.2.1 Conveyance Improvement ....................................... 51
3.8. Watershed Health and Ecosystem Restoration Portfolio ............. 54
  3.8.1. Portfolio Overview .......................................................... 54
  3.8.2. Portfolio Concepts .......................................................... 57
    3.8.2.1 Stormwater BMPs ...................................................... 57
    3.8.2.2 Stormwater Capture .................................................. 58
    3.8.2.3 Watershed and Ecosystem Management .................... 58
4. CWASim Model ........................................................................... 58
  4.1. CWASim Model Layout and Schematic ................................. 59
  4.2. Model Representation of System Infrastructure and Operations 62
    4.2.1. Reservoirs .................................................................. 62
    4.2.2. Conveyance Facilities ................................................ 65
      4.2.2.1 Pipelines and Pump Stations .................................. 65
    4.2.3. Seawater Desalination Plants .................................... 71
    4.2.4. Water Treatment Plants .......................................... 73
5. Portfolio Model Runs ........................................................................................................94
  5.1. Modeled Scenarios ........................................................................................................95
  5.2. Water Supply Projections ..............................................................................................96
    5.2.1. Surface Water Supply Projections ........................................................................96
      5.2.1.1. Source of Temperature, Precipitation, and Hydrology Projections ...............96
      5.2.1.2. Calculation of Change Factors ........................................................................97
      5.2.1.3. Calculation of Streamflow Projections for Change Factors ......................100
      5.2.1.4. Surface Water Projections for CWASim .....................................................100
    5.2.2. Imported Water Purchases Supply Projections ..................................................102
  5.3. Water Demand Projections ..........................................................................................105
    5.3.1. 2015 Gross Demands ............................................................................................106
5.3.2. Gross Demand Projections for 2025 and 2050..................................................106
  5.3.2.1 Current Climate Gross Demand Projections..............................................106
  5.3.2.2 Climate Change Adjusted Demand Projections........................................108
  5.3.2.3 Development of Climate Change Adjustment Factors for Demand
        Projections..................................................................................................110
6. Impacts Assessment Methodology........................................................................111
  6.1. Metrics .........................................................................................................111
       6.1.1. Water Delivery Metrics ..............................................................111
       6.1.2. Energy Metrics ...........................................................................120
       6.1.3. Recreation Metrics ......................................................................121
       6.1.4. Flood Control Metrics ..............................................................122
  6.2. Analysis Methodology ..................................................................................123
7. Impacts Assessment Results................................................................................124
  7.1. Water Delivery ............................................................................................125
       7.1.1. Demands .......................................................................................126
       7.1.2. Deliveries and Conservation ..........................................................128
            7.1.2.1 Enhanced Conservation .......................................................130
            7.1.2.2 Urban and Agricultural Water Use Efficiency .......................131
            7.1.2.3 Firm Water Supply Agreements .......................................132
            7.1.2.4 Groundwater ........................................................................132
            7.1.2.5 Imported Water Purchases ..................................................133
            7.1.2.6 Surface Water ......................................................................135
            7.1.2.7 Recycled Water ....................................................................138
            7.1.2.8 Desalination ..........................................................................139
            7.1.2.9 Potable Reuse ........................................................................141
            7.1.2.10 Stormwater BMPs ...............................................................143
            7.1.2.11 Gray Water Use ..................................................................144
            7.1.2.12 Stormwater Capture ............................................................145
       7.1.3. Shortage Volume ..................................................................................146
            7.1.3.1 Shortage Threshold Analysis ...............................................148
       7.1.4. Conveyance System Operations ..........................................................154
            7.1.4.1 Pipeline Flow Volume ...........................................................155
            7.1.4.2 High Pipeline Utilization Summer Count ................................156
            7.1.4.3 High Pump Station Utilization .............................................159
            7.1.4.4 Treatment Plant Utilization ....................................................159
                7.1.4.4.1. Alvarado .................................................................160
                7.1.4.4.2. Badger .................................................................162
                7.1.4.4.3. Escondido ............................................................163
                7.1.4.4.4. Levy .................................................................164
                7.1.4.4.5. Miramar ..............................................................165
                7.1.4.4.6. Olivenhain ..........................................................166
                7.1.4.4.7. Otay .................................................................168
                7.1.4.4.8. Poway ..............................................................169
                7.1.4.4.9. Perdue ..............................................................170
                7.1.4.4.10. Twin Oaks Valley ...............................................171
                7.1.4.4.11. Weese ..............................................................173
7.1.5.  Reservoir Operations
7.1.5.1  Reservoir Storage
  7.1.5.1.1  Barrett
  7.1.5.1.2  El Capitan
  7.1.5.1.3  Hodges
  7.1.5.1.4  Loveland
  7.1.5.1.5  Lower Otay
  7.1.5.1.6  Miramar
  7.1.5.1.7  Morena
  7.1.5.1.8  Olivenhain
  7.1.5.1.9  San Vicente
  7.1.5.1.10  Sweetwater
  7.1.5.1.11  Wohlford
7.1.5.2  Reservoir Releases
  7.1.5.2.1  Barrett
  7.1.5.2.2  El Capitan
  7.1.5.2.3  Hodges
  7.1.5.2.4  Loveland
  7.1.5.2.5  Lower Otay
  7.1.5.2.6  Miramar
  7.1.5.2.7  Morena
  7.1.5.2.8  Olivenhain
  7.1.5.2.9  San Vicente
  7.1.5.2.10  Sweetwater
  7.1.5.2.11  Wohlford
7.1.5.3  End of September Storage
  7.1.5.3.1  El Capitan
  7.1.5.3.2  Hodges
  7.1.5.3.3  Lower Otay
  7.1.5.3.4  Olivenhain
  7.1.5.3.5  San Vicente
7.2.  Energy
7.3.  Recreation
  7.3.1.  El Capitan
  7.3.2.  Hodges
  7.3.3.  Lower Otay
  7.3.4.  San Vicente
7.4.  Flood Control
  7.4.1.  El Capitan
  7.4.2.  Hodges
  7.4.3.  Lower Otay
  7.4.4.  San Vicente and Olivenhain
8.  Results Discussion by Concept
  8.1.  Conveyance Improvement
  8.2.  Drought Restriction/Allocation
  8.3.  Enhanced Conservation
8.4. Firm Water Supply Agreements ..............................................................273
8.5. Gray Water Use .......................................................................................273
8.6. Groundwater ..........................................................................................274
8.7. Imported Water Purchases .......................................................................275
8.8. Local Surface Water Reservoirs .............................................................276
8.9. Potable Reuse ..........................................................................................277
8.10. Recycled Water ......................................................................................287
8.11. Seawater Desalination ..........................................................................288
8.12. Stormwater BMPs ..................................................................................291
8.13. Stormwater Capture ..............................................................................292
8.14. Urban and Agricultural Water Use Efficiency .........................................292
8.15. Watershed and Ecosystem Management ..................................................294

9. Conclusion ..................................................................................................299
  9.1. Discussion of Results ............................................................................300
    9.1.1. Water Delivery ..................................................................................300
    9.1.2. Energy ..............................................................................................309
    9.1.3. Recreation .........................................................................................310
    9.1.4. Flood Control ....................................................................................312
  9.2. Limitations .............................................................................................313
  9.3. Opportunities and Next Steps .................................................................314
  9.4. Summary ................................................................................................315

References ......................................................................................................317

Appendices

Appendix A – Projects Spreadsheet
Appendix B – Model Implementation Details for Selected Projects
Appendix C – Energy Consumption and Generation Model Implementation
Appendix D – Detailed Model Results

Figures

Figure 1. Overview of the San Diego Basin Study Area ......................................6
Figure 2. SDCWA member agency boundaries. SDCWA services the areas for each member agency depicted .................................................................7
Figure 3. Surface and groundwater features in the San Diego Basin Study Area .........................13
Figure 4. Water and wastewater treatment and desalination features in the San Diego Basin Study Area ...............................................................15
Figure 5. System connectivity schematic ..................................................................60
Figure 6. Reservoir operating zones example .....................................................65
Figure 7. Projection groupings for developing climate change scenarios. Solid red lines represent 10th and 90th percentiles, while dashed gray lines represent 50th percentiles.

Figure 8. Natural reservoir inflow dataset, 1900-2011.

Figure 9. Current climate gross demand values averaged over all realizations. Gross demand projections remain the same for all Portfolios.

Figure 10. Current and future climate gross demands averaged across all realizations in each scenario. Gross demand projections remain the same for all Portfolios.

Figure 11. Gross Demands for 2015, 2025, and 2050 demands compared across climate scenarios for all Portfolios.

Figure 12. Average Annual Delivery Volume for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 13. Average annual Enhanced Conservation volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 14. Average annual Urban and Agricultural Water Use Efficiency conservation volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 15. Average annual Firm Water Supply Agreement deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 16. Average annual Groundwater deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 17. Average annual Imported Water deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 18. Average annual Surface Water deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 19. Average annual recycled water deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 20. Average annual Desalination delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Figure 21. Average annual Potable Reuse delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
Figure 22. Average annual Stormwater BMP delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ................................................................. 144

Figure 23. Average annual Gray Water delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ................................................................. 145

Figure 24. Average annual Stormwater Capture delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ............................................................................ 146

Figure 25. Shortage Volume for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ............................................................................ 147

Figure 26. Shortage Volume compared to the 20,000 AF shortage threshold for the Baseline Portfolio. .......................................................................................................................... 149

Figure 27. Shortage Volume compared to the 20,000 AF shortage threshold for the Baseline Plus Portfolio. .......................................................................................................................... 150

Figure 28. Shortage Volume compared to the 20,000 AF shortage threshold for the Watershed Health and Ecosystem Restoration Portfolio. ........................................................................ 151

Figure 29. Shortage Volume compared to the 20,000 AF shortage threshold for the Enhanced Conservation Portfolio .................................................................................................................. 152

Figure 30. Shortage Volume compared to the 20,000 AF shortage threshold for the Increase Supplies Portfolio.......................................................................................................................... 153

Figure 31. Shortage Volume compared to the 20,000 AF shortage threshold for the Optimize Existing Facilities Portfolio. .................................................................................................................. 154

Figure 32. Monthly Average Pipeline Flow Volume in the Baseline Portfolio under current climate................................................................. 156

Figure 33. High Pipeline Utilization Summer Count at the Untreated Pipeline location for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario............................................. 158

Figure 34. Alvarado WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.................................................................................................................. 161

Figure 35. Badger WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.................................................................................................................. 162

Figure 36. Escondido WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.................................................................................................................. 163
Figure 37. Levy WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 164

Figure 38. Miramar WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 166

Figure 39. Olivenhain WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 167

Figure 40. Otay WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 169

Figure 41. Poway WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 170

Figure 42. Perdue WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 171

Figure 43. Twin Oaks Valley WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 172

Figure 44. Weese WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 174

Figure 45. Monthly average reservoir storage for Barrett Reservoir for current climate for all demand scenarios and Portfolios ......................................................................................................................... 176

Figure 46. Monthly average reservoir storage for Barrett Reservoir for 2050 demands for all Portfolios and climate scenarios ......................................................................................................................... 177

Figure 47. Monthly average reservoir storage for El Capitan Reservoir for current climate for all demand scenarios and Portfolios ......................................................................................................................... 178

Figure 48. Monthly average reservoir storage for El Capitan Reservoir for 2050 demands for all Portfolios and climate scenarios ......................................................................................................................... 180

Figure 49. Monthly average reservoir storage for Hodges Reservoir for current climate for all demand scenarios and Portfolios ......................................................................................................................... 181

Figure 50. Monthly average reservoir storage for Hodges Reservoir for 2050 demands for all Portfolios and climate scenarios ......................................................................................................................... 182

Figure 51. Monthly average reservoir storage for Loveland Reservoir for current climate for all demand scenarios and Portfolios ......................................................................................................................... 183

Figure 52. Monthly average reservoir storage for Loveland Reservoir for 2050 demands for all Portfolios and climate scenarios ......................................................................................................................... 184
Figure 53. Monthly average reservoir storage for Lower Otay Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 186

Figure 54. Monthly average reservoir storage for Lower Otay Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 187

Figure 55. Monthly average reservoir storage for Miramar Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 188

Figure 56. Monthly average reservoir storage for Miramar Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 189

Figure 57. Monthly average reservoir storage for Morena Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 190

Figure 58. Monthly average reservoir storage for Morena Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 191

Figure 59. Monthly average reservoir storage for Olivenhain Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 192

Figure 60. Monthly average reservoir storage for Olivenhain Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 193

Figure 61. Monthly average reservoir storage for San Vicente Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 194

Figure 62. Monthly average reservoir storage for San Vicente Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 196

Figure 63. Monthly average reservoir storage for Sweetwater Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 197

Figure 64. Monthly average reservoir storage for Sweetwater Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 198

Figure 65. Monthly average reservoir storage for Wohlford Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 199

Figure 66. Monthly average reservoir storage for Wohlford Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 200

Figure 67. Monthly average reservoir releases for Barrett Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 201

Figure 68. Monthly average reservoir releases for Barrett Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 202

Figure 69. Monthly average reservoir releases for El Capitan Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 203

Figure 70. Monthly average reservoir releases for El Capitan Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 204

Figure 71. Monthly average reservoir releases for Hodges Reservoir for current climate for all demand scenarios and Portfolios. ................................................................. 205
Figure 72. Monthly average reservoir releases for Hodges Reservoir for 2050 demands for all Portfolios and climate scenarios. ................................................................. 206

Figure 73. Monthly average reservoir releases for Loveland Reservoir for current climate for all demand scenarios and Portfolios. .......................................................... 207

Figure 74. Monthly average reservoir releases for Loveland Reservoir for 2050 demands for all Portfolios and climate scenarios. .......................................................... 208

Figure 75. Monthly average reservoir releases for Lower Otay Reservoir for current climate for all demand scenarios and Portfolios. ....................................................... 209

Figure 76. Monthly average reservoir releases for Lower Otay Reservoir for 2050 demands for all Portfolios and climate scenarios. ....................................................... 210

Figure 77. Monthly average reservoir releases for Miramar Reservoir for current climate for all demand scenarios and Portfolios. ....................................................... 211

Figure 78. Monthly average reservoir releases for Miramar Reservoir for 2050 demands for all Portfolios and climate scenarios. ....................................................... 212

Figure 79. Monthly average reservoir releases for Morena Reservoir for current climate for all demand scenarios and Portfolios. ....................................................... 213

Figure 80. Monthly average reservoir releases for Morena Reservoir for 2050 demands for all Portfolios and climate scenarios. ....................................................... 214

Figure 81. Monthly average reservoir releases for Olivenhain Reservoir for current climate for all demand scenarios and Portfolios. ....................................................... 215

Figure 82. Monthly average reservoir releases for Olivenhain Reservoir for 2050 demands for all Portfolios and climate scenarios. ....................................................... 216

Figure 83. Monthly average reservoir releases for San Vicente Reservoir for current climate for all demand scenarios and Portfolios. ....................................................... 217

Figure 84. Monthly average reservoir releases for San Vicente Reservoir for 2050 demands for all Portfolios and climate scenarios. ....................................................... 218

Figure 85. Monthly average reservoir releases for Sweetwater Reservoir for current climate for all demand scenarios and Portfolios. ....................................................... 219

Figure 86. Monthly average reservoir releases for Sweetwater Reservoir for 2050 demands for all Portfolios and climate scenarios. ....................................................... 220

Figure 87. Monthly average reservoir releases for Wohlford Reservoir for current climate for all demand scenarios and Portfolios. ....................................................... 221

Figure 88. Monthly average reservoir releases for Wohlford Reservoir for 2050 demands for all Portfolios and climate scenarios. ....................................................... 222

Figure 89. End of September Storage at El Capitan for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ....................................................... 224
Figure 90. End of September Storage at Hodges for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario................................................................. 226

Figure 91. End of September Storage at Lower Otay for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ......................................................................................... 228

Figure 92. End of September Storage at Olivenhain for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ......................................................................................... 229

Figure 93. End of September Storage at San Vicente for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ......................................................................................... 231

Figure 94. Annual Energy Consumption for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario......................................................................................................................... 233

Figure 95. Energy Generation and Energy Consumption compared across 2015, 2025, and 2050 demand scenarios for current climate. ......................................................................................................................... 234

Figure 96. Energy Generation and Consumption for the Baseline Portfolio for all demand and climate scenarios. ........................................................................................................................ 235

Figure 97. Percent of realizations with El Capitan Reservoir Elevation below the boat ramp elevation for 2050 demands across all climate scenarios and Portfolios........................................... 237

Figure 98. End of September Elevation and Boat Ramp Accessibility at El Capitan for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario................................................................. 238

Figure 99. Percent of realizations with Hodges Reservoir Elevation below the boat ramp elevation for 2050 demands across all climate scenarios and Portfolios................................. 239

Figure 100. End of September Elevation and Boat Ramp Accessibility at Hodges for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario................................................................. 240

Figure 101. Percent of realizations with Lower Otay Reservoir Elevation below the boat ramp elevation for 2050 demands across all climate scenarios and Portfolios................................. 241

Figure 102. Lower Otay Reservoir Elevation compared to the boat ramp elevation for 2050 demands for Baseline Plus and Increase Supplies Portfolios. .................................................... 242

Figure 103. End of September Elevation and Boat Ramp Accessibility at Lower Otay for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario................................................................. 243

Figure 104. Percent of realizations with San Vicente Reservoir Elevation below the boat ramp elevation for 2050 demands across all climate scenarios and Portfolios................................. 244
Figure 105. End of September Elevation and Boat Ramp Accessibility at San Vicente for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. .............................................. 245

Figure 106. Flood control results for 2050 demands and all climate scenarios in the Baseline Plus Portfolio. ........................................................................................................................................... 247

Figure 107. Average Number of Days with Flood Outflows at El Capitan for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ........................................................................ 249

Figure 108. Average Annual Flood Outflow Volume at El Capitan for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ............................................................................. 251

Figure 109. Average Number of Days with Flood Outflows at Hodges for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ........................................................................... 252

Figure 110. Average Annual Flood Outflow Volume at Hodges for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ............................................................................. 253

Figure 111. Average Number of Days with Flood Outflows at Lower Otay for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ........................................................................... 254

Figure 112. Average Annual Flood Outflow Volume at Lower Otay for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ............................................................................. 256

Figure 113. Monthly Average Reservoir Storage at El Capitan for the Baseline Plus and Optimize Existing Facilities Portfolios. ...................................................................................... 256

Figure 114. Monthly Average Reservoir Storage at San Vicente for the Baseline Plus and Optimize Existing Facilities Portfolios. ...................................................................................... 257

Figure 115. End of September Storage at El Capitan in the Baseline Plus and Optimize Existing Facilities Portfolios. .................................................................................................................... 258

Figure 116. End of September Storage at San Vicente in the Baseline Plus and Optimize Existing Facilities Portfolios. .................................................................................................................... 259

Figure 117. End of September Elevation and Boat Ramp Accessibility at El Capitan in the Baseline Plus and Optimize Existing Facilities Portfolios. ................................................................. 259

Figure 118. End of September Elevation and Boat Ramp Accessibility at San Vicente in the Baseline Plus and Optimize Existing Facilities Portfolios. ................................................................. 260

Figure 119. Number of Flood Outflows at El Capitan in the Baseline Plus and Optimize Existing Facilities Portfolios. .................................................................................................................... 261

Figure 120. Pipeline Utilization at the Untreated Location for the Baseline, Baseline Plus, and Optimize Existing Facilities Portfolios. .................................................................................................................... 261
Figure 121. Monthly Average Reservoir Storage at Lower Otay Reservoir for the Baseline Plus and Optimize Existing Facilities Portfolio................................................................................................................................. 262

Figure 122. Monthly Average Reservoir Releases at the Lower Otay Reservoir for the Baseline Plus and Optimize Existing Facilities Portfolio................................................................................................................................. 263

Figure 123. Average End of September Storage at Lower Otay Reservoir for the Baseline Plus and Optimize Existing Facilities Portfolio................................................................................................................................. 264

Figure 124. End of September Elevation and Boat Ramp Accessibility at the Lower Otay Reservoir for the Baseline Plus and Optimize Existing Facilities Portfolio................................................................................................................................. 265

Figure 125. Annual Water Deliveries for the Enhanced Conservation Portfolio. ............................................ 266

Figure 126. Percentage of Realizations above the 20,000 AF Shortage Threshold in the Baseline Plus Portfolio. ................................................................................................................................................................................................. 267

Figure 127. Percentage of Realizations above the 20,000 AF Shortage Threshold in the Enhanced Conservation Portfolio. ................................................................................................................................................................................................. 268

Figure 128. Average Number of Days Pipeline Exceeds 95% of Capacity during Summer for the Baseline, Baseline Plus, and Enhanced Conservation Portfolio. ................................................................................................................................................................................................. 269

Figure 129. Average Treatment Plant Utilization for the 2050 Demand Scenario in the Baseline Plus Portfolio and the Enhanced Conservation Portfolio. ................................................................................................................................................................................................. 270

Figure 130. Monthly Average Reservoir Storage at Lower Otay, San Vicente, and Olivenhain for the Baseline Plus Portfolio................................................................................................................................................................................................. 271

Figure 131. Monthly Average Reservoir Storage at Lower Otay, San Vicente, and Olivenhain for the Enhanced Conservation Portfolio. ................................................................................................................................................................................................. 271

Figure 132. End of September Storage at San Vicente for the Baseline, Baseline Plus, and Enhanced Conservation Portfolio. ................................................................................................................................................................................................. 272

Figure 133. Energy Generation and Consumption for the Baseline, Baseline Plus, and Enhanced Conservation Portfolios. ................................................................................................................................................................................................. 273

Figure 134. Annual Deliveries of Gray Water for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ................................................................................................................................................................................................. 274

Figure 135. Annual Deliveries of Groundwater for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ................................................................................................................................................................................................. 275

Figure 136. Average Annual Delivery Volume for Imported Water for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ................................................................................................................................................................................................. 276

Figure 137. Average Annual Water Delivery Volume from Potable Reuse Projects for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ................................................................................................................................................................................................. 278

Figure 138. Monthly Average Reservoir Storage at Miramar Reservoir for the Baseline and Baseline Plus Portfolios. ................................................................................................................................................................................................. 279
Figure 139. Monthly Average Reservoir Releases at Miramar Reservoir for the Baseline and Baseline Plus Portfolios. ............................................................................................................. 280

Figure 140. Annual Deliveries for 2025 demands in the Baseline and Baseline Plus Portfolio. 281

Figure 141. Energy Generation and Consumption for the Baseline and Baseline Plus Portfolios. ........................................................................................................................................ 282

Figure 142. Miramar Treatment Plant Utilization for the Baseline and Baseline Plus Portfolios with current climate, central tendency climate, and hot-dry climate for the 2050 demand scenario. ...................................................................................................................................... 283

Figure 143. Annual Deliveries for 2050 demands in the Baseline Plus and Increase Supplies Portfolios. ............................................................................................................................................ 284

Figure 144. Monthly Average Reservoir Storage at San Vicente in the Baseline Plus and Increase Supplies Portfolios. ........................................................................................................................................ 285

Figure 145. End of September Storage at San Vicente in the Baseline Plus and Increase Supplies Portfolios. ........................................................................................................................................ 286

Figure 146. End of September Elevation and Boat Ramp Accessibility at San Vicente for the Baseline Plus and Increase Supplies Portfolios. ..................................................................................................................... 287

Figure 147. Annual water deliveries showing volumes associated with Recycled Water for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario. ........................................................................ 288

Figure 148. Annual water deliveries showing volumes associated with Seawater Desalination in the Baseline Portfolio and the Increase Supplies Portfolio. ........................................................................................................................................ 289

Figure 149. Energy Generation and Consumption in the Baseline Portfolio and the Increase Supplies Portfolio. ........................................................................................................................................ 290

Figure 150. Annual water deliveries showing volumes associated with Stormwater BMP projects and Stormwater Capture projects in the Watershed Health and Ecosystem Restoration Portfolio. ........................................................................................................................................ 291

Figure 151. Annual Delivery Volumes showing the conservation volumes associated with Urban and Agricultural Water Use Efficiency in the Baseline Portfolio. ........................................................................................................................................ 293

Figure 152. Annual Delivery Volumes showing the conservation volumes associated with Urban and Agricultural Water Use Efficiency in the Baseline Plus Portfolio. ........................................................................................................................................ 294

Figure 153. Reservoir Storage at Hodges for Baseline and Baseline Plus Portfolios. ................................................................................................................................................ 295

Figure 154. Reservoir Releases at Hodges for Baseline and Baseline Plus Portfolios. ................................................................................................................................................ 296

Figure 155. End of September Storage at Hodges for Baseline and Baseline Plus Portfolios. ................................................................................................................................................ 296

Figure 156. Hodges Boat Ramp Accessibility for Baseline and Baseline Plus Portfolios. ................................................................................................................................................ 297

Figure 157. Hodges Flood Outflows and Flood Outflow Volume for Baseline and Baseline Plus Portfolios with current climate, central tendency climate, and hot-dry climate for the 2050 demand scenario. ................................................................................................................................................ 298

Figure 158. Reservoir Storage at Sweetwater for the Baseline and Baseline Plus Portfolios. ................................................................................................................................................ 299
Figure 159. Gross Demand Projections for Current and Future Climate Scenarios for 2015, 2025, and 2050 ................................................... 301

Figure 160. Average Annual Water Delivery and Conservation Volume for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................... 302

Figure 161. Imported Water Deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 304

Figure 162. Average Annual Shortage Volume for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 306

Figure 163. Percent of realizations above the 20,000 AF shortage threshold for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 307

Figure 164. High Pipeline Utilization Summer Count for the Untreated Pipeline for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 308

Figure 165. Energy Consumption for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario ......................................................................................................................... 310

Tables

Table ES-1. San Diego Basin Study Task 2.4 Portfolios and Associated Concepts ............... ES-2
Table 2. SDCWA Member Agencies .................................................................................. 5
Table 3. Study Watersheds ......................................................................................... 8
Table 4. San Diego Basin Study Concepts ...................................................................... 16
Table 5. Task 2.4 Portfolios Including Concepts .......................................................... 18
Table 6. Summary of Baseline Portfolio Concepts and Projects ................................... 20
Table 7. Summary of Baseline Plus Portfolio Concepts and Projects .............................. 30
Table 8. Summary of Enhanced Conservation Portfolio Concepts and Projects .......... 39
Table 9. Enhanced Conservation Portfolio Regional Target Demands .......................... 40
Table 10. Conservation Volumes for Baseline, Baseline Plus, and Enhanced Conservation Portfolios ............................................................................ 41
Table 11. Gross Demands Minus Enhanced Conservation Portfolio Volume .............. 41
Table 12. Summary of Increase Supplies Portfolio Concepts and Projects ................. 42
Table 13. Summary of Optimize Existing Facilities Portfolio Concepts and Projects .......... 49
Table 14. Summary of Watershed Health and Ecosystem Restoration Portfolio Concepts and Projects

Table 15. System Connectivity Schematic Legend

Table 16.Abbreviations used in the CWASim Schematic

Table 17. San Diego Region Reservoirs

Table 18. San Diego Region Pipelines

Table 19. Major Pump Stations in the San Diego Region

Table 20-1. Baseline Capacities for Desalination Plants

Table 20-2. Increase Supplies Portfolio Capacities for Desalination Plants

Table 21. Water Treatment Plants

Table 22. Energy Consumption and Generation Values included in CWASim

Table 23. SDCWA Member Agencies Demand Nodes

Table 24. Water Sources and Priorities

Table 25. Member Agency Access to Source Groups

Table 26. Summary of Portfolio Scenarios

Table 27. Climate Time Periods

Table 28. Climate Change Projection Groups

Table 29. Average Annual Change Factors Applied to Historical Natural Inflows

Table 30. Climate-Adjusted Natural Inflows

Table 31. Comparison of Natural Inflow to Modeled Reservoir Capacity

Table 32. Mapping of Climate Scenarios Across San Diego, Sacramento-San Joaquin, and Colorado River Basin Studies

Table 33. MWD Imported Water Supply Projections

Table 34. Total Gross Demand Projections for All Member Agencies

Table 35. Average Climate Change Adjustment Factors and Resulting Average Gross Demand Projections

Table 36. Task 2.4 Impact Metrics

Table 37. Capacities for pipelines analyzed in the Pipeline Flow Volume and High Pipeline Utilization Summer Count Metrics

Boxes

Box 1. Project Highlight: Pure Water San Diego Phase 1

Box 2. Project Highlight: Hodges Water Quality Improvement Program
Box 3. Project Highlight: Sweetwater Reservoir Wetlands Habitat Recovery ........................................ 37
Box 4. Project Highlight: San Dieguito River Basin Brackish Groundwater Recovery and Treatment .......................................................... 47
Box 5. Project Highlight: Pure Water San Diego Phase 2 ........................................................................... 48
Box 6. Project Highlight: San Diego Reservoir Intertie ............................................................................. 52
Box 7. Project Highlight: Pipeline3/Pipeline 4 Conversion ........................................................................... 53
Box 8. Project Highlight: Dulzura Conduit Replacement ........................................................................... 53
Box 9. Model Implementation Highlight: San Diego Reservoir Intertie .................................................. 71
Box 10. Model Implementation Highlight: Pure Water Phases 1 and 2 ................................................... 75
Box 11. Impact Metric Description: Demands ......................................................................................... 114
Box 12. Impact Metric Description: Deliveries ......................................................................................... 114
Box 13. Impact Metric Description: Shortage Volume .............................................................................. 115
Box 14. Impact Metric Description: Pipeline Flow Volume ......................................................................... 116
Box 15. Impact Metric Description: High Pipeline Utilization Summer Count ........................................ 116
Box 16. Impact Metric Description: High Pump Station Utilization ..................................................... 118
Box 17. Impact Metric Description: Treatment Plant Utilization ......................................................... 118
Box 18. Impact Metric Description: Reservoir Storage ............................................................................ 119
Box 19. Impact Metric Description: Reservoir Releases ........................................................................ 119
Box 20. Impact Metric Description: End of September Storage ......................................................... 119
Box 21. Impact Metric Description: Energy Generation ............................................................................ 120
Box 22. Impact Metric Description: Energy Consumption ....................................................................... 121
Box 23. Impact Metric Description: End of September Elevation ....................................................... 121
Box 24. Impact Metric Description: Flood Outflow Volume ....................................................................... 122
Box 25. Impact Metric Description: Number of Days with Flood Outflows .......................................... 122
Box 26. Project Results Highlight: San Diego Reservoir Intertie ........................................................... 255
Box 27. Project Results Highlight: Pipeline 3/Pipeline 4 Conversion .................................................... 260
Box 28. Project Results Highlight: Dulzura Conduit Replacement ............................................ 261
Box 29. Project Results Highlight: Pure Water San Diego Phase 1 .............................................. 278
Box 30. Project Results Highlight: Pure Water San Diego Phase 2 .............................................. 283
Box 31. Project Results Highlight: Hodges Water Quality Improvement Program ...................... 295
Box 32. Project Results Highlight: Sweetwater Reservoir Wetlands Recovery .......................... 298
## Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF</td>
<td>acre-feet (1 AF = 43,560 cubic feet = 325,851 gallons)</td>
</tr>
<tr>
<td>AF/y or AF/d</td>
<td>acre-feet per year or acre-feet per day</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>Basin Study</td>
<td>San Diego Basin Study</td>
</tr>
<tr>
<td>BMPs</td>
<td>Best Management Practices</td>
</tr>
<tr>
<td>Cal-Am</td>
<td>California American Water Company</td>
</tr>
<tr>
<td>CAP</td>
<td>Climate Action Plan</td>
</tr>
<tr>
<td>cfs</td>
<td>cubic feet per second</td>
</tr>
<tr>
<td>CMIP Phases 3 &amp; 5</td>
<td>Coupled Model Intercomparison Project climate projections</td>
</tr>
<tr>
<td>CRA</td>
<td>Colorado River Aqueduct</td>
</tr>
<tr>
<td>CRBS</td>
<td>Colorado River Basin Study</td>
</tr>
<tr>
<td>DSOD</td>
<td>California Department of Water Resources, Division of Safety of Dams</td>
</tr>
<tr>
<td>DWR</td>
<td>California Department of Water Resources</td>
</tr>
<tr>
<td>ECRTWIP</td>
<td>East County Regional Treated Water Improvement Program</td>
</tr>
<tr>
<td>GCM</td>
<td>Global Climate Model</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
</tr>
<tr>
<td>GPCD</td>
<td>Gallons Per Capita Per Day</td>
</tr>
<tr>
<td>HARRF</td>
<td>Hale Avenue Resource Recovery Facility</td>
</tr>
<tr>
<td>IID</td>
<td>Imperial Irrigation District</td>
</tr>
<tr>
<td>IRP</td>
<td>Integrated Water Resources Plan</td>
</tr>
<tr>
<td>IRWM</td>
<td>Integrated Regional Water Management</td>
</tr>
<tr>
<td>kWh/MG</td>
<td>Kilowatt-hours per million gallons</td>
</tr>
<tr>
<td>M&amp;I</td>
<td>Municipal and Industrial</td>
</tr>
<tr>
<td>MAF</td>
<td>Million acre-feet</td>
</tr>
</tbody>
</table>
modeled portfolio and climate scenario abbreviations

<table>
<thead>
<tr>
<th>Abbr</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>baseline portfolio</td>
</tr>
<tr>
<td>B+</td>
<td>baseline plus portfolio</td>
</tr>
<tr>
<td>EC</td>
<td>enhanced conservation portfolio</td>
</tr>
<tr>
<td>IS</td>
<td>increase supplies portfolio</td>
</tr>
<tr>
<td>OEF</td>
<td>optimize existing facilities portfolio</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>WE</td>
<td>Watershed Health and Ecosystem Restoration Portfolio</td>
</tr>
<tr>
<td>cc</td>
<td>Current Climate</td>
</tr>
<tr>
<td>ct</td>
<td>Central Tendency Climate</td>
</tr>
<tr>
<td>hd</td>
<td>Hot-dry Climate</td>
</tr>
<tr>
<td>wd</td>
<td>Warm-dry Climate</td>
</tr>
<tr>
<td>hw</td>
<td>Hot-wet Climate</td>
</tr>
<tr>
<td>ww</td>
<td>Warm-wet Climate</td>
</tr>
</tbody>
</table>
Glossary

Concept: San Diego Basin Study 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 approaches. Concepts are defined by one or more Projects.

CWASim: A GoldSim model originally developed for SDCWA by CH2M in support of the 2013 Regional Facilities Optimization and Master Plan Update to simulate the regional water system. The model was adapted and updated for use in the San Diego Basin Study.

Fiscal Year (SDCWA): The 12-month period from July 1, for any given year, through June 30 of the following year. The fiscal year is designated by the calendar year in which it ends. Thus, the year ending June 30, 1999 is called the “1999” fiscal year.

GoldSim: A simulation software program for dynamically modeling complex systems in business, engineering, and science. GoldSim supports decision and risk analysis by simulating future performance while quantitatively representing the uncertainty and risks inherent in all complex systems.

IRWM Program: A California DWR program for supporting water resources planning under the Regional Water Management Planning Act (SB 1672). Integrated Regional Water Management (IRWM) is a collaborative effort to manage all aspects of water resources in a region. The San Diego IRWM Program works to develop long-term water supply reliability, improve water quality, and protect natural resources. The Program is implemented and administered by the Regional Water Management Group, which is comprised of three entities: City of San Diego, County of San Diego, and San Diego County Water Authority. A principle of IRWM is that regional water managers, who are organized into regional water management groups, are best suited and best positioned to manage water resources to meet regional needs.

Portfolios: Portfolios were developed for the purpose of simulating and analyzing groups of related Concepts. Each Portfolio contains a subset of Concepts that is modeled and analyzed to determine its impacts to water deliveries, flood control, energy, and recreation.

Projects: Projects represent actual or theoretical proposed modifications to existing facilities, construction of new facilities, modifications to system operations, modifications to policy, or other proposed activities. Most San Diego Basin Study 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.
San Diego Basin Study Area: The area bounded on the north, west, and south by the San Diego County boundary and on the east by the boundaries of 11 Study Watersheds. The Study Area is the same as the San Diego IRWM Planning Region.

San Luis Rey River Tribes: The La Jolla, Pala, Pauma, Rincon and San Pasqual Bands of Mission Indians

Study Watersheds: The entirety of the San Luis Rey, Carlsbad, San Dieguito, Peñasquitos, San Diego River, Pueblo, Sweetwater, and Otay watersheds and the portions of the San Juan, Santa Margarita, and Tijuana watersheds within San Diego County.

Urban Water Management Plans: Plans prepared and submitted to DWR by California’s urban water suppliers every five years to meet the requirements identified in the California Water Code, Sections 10608 and 10610-10656. Every urban water supplier that either provides over 3,000 acre-feet of water annually or serves more than 3,000 urban connections is required to assess the reliability of its water sources over a 20-year planning horizon and report its progress on 20% reduction in per-capita urban water consumption by the year 2020, as required in the Water Conservation Act of 2009. Urban Water Management Plans are required to discuss planned use of recycled water, demand management measures, and water shortage contingency plans.

Verifiable Projects: As defined in the SDCWA 2015 UWMP, projects with “substantial evidence and adequate documentation regarding implementation and supply utilization.”

Watershed: Surface drainage area upstream of a specified point on a watercourse. A geographical portion of the Earth’s surface from which water drains or runs off to a single point.

Water Year: The 12-month period from October 1, for any given year, through September 30 of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1999 is called the “1999” water year.

CWASim Model Terminology

Carryover: Carryover storage describes the minimum volume of water in a reservoir that should be carried over from year to year. The carryover pool or zone for a reservoir is designated by the reservoir’s rule curve. In the CWASim model, water stored in the carryover pool is available to meet demands under certain conditions.

Demand Node: Projected demands for the SDCWA member agencies are represented as single or multiple demand node containers in the CWASim model, depending on how the agency receives water (e.g., water source, treated vs untreated).

Demand Scenario: Specific time periods (2015, 2025, and 2050 for the Basin Study) in which demand projections were generated and simulated in the CWASim model.
Input_Demands spreadsheet: This spreadsheet is used to implement demands for each member agency in the CWASim model. This is the method used to simulate supply sources and projects that are represented as annual demand reductions in the CWASim model.

Inputs spreadsheet: This spreadsheet is used to simulate rule curves for each reservoir in the CWASim model. It is used to implement reservoir restrictions, as well as the maximum and initial storages for the reservoirs.

Model Loop: Model loops are used to allocate different water sources available to water agencies. Each loop distributes water supply sources to member agencies (represented by demand nodes) in a priority order that is set by the user.

Realizations: Daily water system simulations that were based on an 85-year-long time series of surface water inflows to reservoirs. Each model run was made up of 85 realizations, where each realization represents a set of historical hydrologic data (i.e., one year of the 85-year long time series). The 85 realizations were run consecutively through the model, and the order of the realizations was the same for all runs, allowing direct comparison between scenarios and realizations.

Rule Curve: Reservoirs in CWASim are controlled by rule curves. The rule curves divide the reservoir storage into nine reservoir zones or “pools”. The zones range from the Dead Pool Zone corresponding to the lowest possible water storage in the reservoir, to Zone 1 corresponding to the reservoir flood zone.

Streamflow Adjustment Factors spreadsheet: This spreadsheet is used to input climate change factors in the CWASim model by adjusting monthly inflow time series values for the reservoirs. It lists multiplicative factors for each month, for each of the 10 reservoirs with surface water inflows.

Timestep: The unit of time used for simulation modeling or analysis of results. The CWASim model uses a timestep of one day, meaning that the model simulates operations on a daily basis. The results of the daily simulations are aggregated to monthly or annual timesteps for analysis.
Executive Summary

Study and Task 2.4 Overview

The purpose of the San Diego Basin Study (Basin Study) is to determine potential climate change impacts on water supplies and demands within the San Diego region and to identify how potential adaptation strategies could mitigate supply shortages. The intent of Task 2.4 is to analyze and explore a range of approaches to meeting water demands and addressing the impacts of increasing demand and climate variation through the 2050s. Basin Studies are required to consider eight impact areas: Water Delivery, Hydroelectric Power, Recreation, Flood Control, Habitats, Endangered/Threatened Species, Water Quality, and Ecological Resiliency (Reclamation, 2016a). Task 2.4 of the Study assesses Water Delivery, Hydroelectric Power (as energy generation and consumption), Recreation, and Flood Control. Habitats, Endangered/Threatened Species, Water Quality, and Ecological Resiliency are assessed in Task 2.5 of the Basin Study. This Interim Report describes the methodologies and findings of this Task.

Methodology

Task 2.4 of the Basin Study used Concepts and Portfolios to describe the range of approaches explored in the Basin Study. Concepts represent groups of similar strategies or projects that could be used to meet the water demands of the region, and Portfolios were developed for the purpose of simulating and analyzing groups of related Concepts.

- 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 Colorado River Quantification Settlement Agreement [QSA] annual transfer volume).
- The Baseline Plus Portfolio represents the near-term future supply sources, infrastructure, and operations of the San Diego region water system. It contains all of the projects from the Baseline Portfolio, as well as projects that were actively being pursued as of 2017 and/or received funding between 2015 and 2017. Although these projects were not designated as verifiable in the San Diego County Water Authority (SDCWA) 2015 Urban Water Management Plan (UWMP), it is believed that they are now close enough to verifiable status to be included in this Portfolio. Projects that are in the advanced planning or design stages, but are not yet operational, such as Phase 1 of the Pure Water San Diego program, are included here.
- The Enhanced Conservation Portfolio represents additional water conservation beyond currently planned levels. Its purpose is to explore the potential for demand reductions to improve delivery reliability. This Portfolio also contains all of the projects from the Baseline Plus Portfolio.
• The Increase Supplies Portfolio consists of projects that are focused on increasing regional water supplies, as well as all of the projects that were included in the Baseline Plus Portfolio.
• The Optimize Existing Facilities Portfolio contains all of the Baseline Plus projects as well as additional projects that are focused on enhancing the efficiency of existing facilities by replacing, repairing, or maintaining existing infrastructure to maximize its operation.
• The Watershed Health and Ecosystem Restoration Portfolio contains all the projects from the Baseline Plus Portfolio as well as projects that are intended to restore or create natural habitats and minimize environmental impacts.

See Table ES-1 for a summary and list of Concepts that are analyzed in each Portfolio.

Table ES-1. San Diego Basin Study Task 2.4 Portfolios and Associated Concepts.

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Contained in Portfolio</th>
<th>Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Projects designated as verifiable in SDCWA’s 2015 UWMP</td>
<td>• Conveyance Improvements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Drought Restriction/Allocation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Firm Water Supply Agreements (e.g., QSA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Groundwater</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Imported Water Purchases (e.g., The Metropolitan Water District of Southern California [MWD])</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local Surface Water Reservoirs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Potable Reuse</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Recycled Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Seawater Desalination (e.g., Carlsbad)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Urban and Agricultural Water Use Efficiency</td>
</tr>
<tr>
<td>Baseline Plus</td>
<td>Baseline projects and projects that were actively being pursued as of 2017 or received funding between 2015 and 2017</td>
<td>• All Baseline Concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New or Modified Concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Conveyance Improvements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gray Water Use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Groundwater</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Potable Reuse (e.g., Pure Water San Diego Phase 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Recycled Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Stormwater Capture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Urban and Agricultural Water Use Efficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Watershed and Ecosystem Management (e.g., Hodges Water Quality Improvement Program)</td>
</tr>
<tr>
<td>Enhanced Conservation</td>
<td>All Baseline Plus projects as well as additional conservation volume beyond currently planned levels.</td>
<td>• All Baseline Plus Concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New or Modified Concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Conservation</td>
</tr>
<tr>
<td>Portfolio</td>
<td>Contained in Portfolio</td>
<td>Concepts</td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Increase Supplies            | All Baseline Plus projects, and planned and conceptual projects that focus on increasing regional water supplies | • All Baseline Plus Concepts  
• New or Modified Concepts  
  ○ Gray Water Use  
  ○ Groundwater  
  ○ Imported Water Purchases (e.g., Cadiz Additional Supplies)  
  ○ Potable Reuse (e.g., Pure Water San Diego Phase 2)  
  ○ Recycled Water  
  ○ Seawater Desalination (e.g., Rosarito and Camp Pendleton) |
| Optimize Existing Facilities | All Baseline Plus projects, and planned and conceptual projects that seek to enhance the efficiency of existing facilities | • All Baseline Plus Concepts  
• New or Modified Concepts  
  ○ Conveyance Improvements (e.g., San Diego Reservoir Intertie) |
| Watershed Health and Ecosystem Restoration | All Baseline Plus projects, and planned and conceptual projects that seek to minimize environmental impacts | • All Baseline Plus Concepts  
• New or Modified Concepts  
  ○ Stormwater BMPs  
  ○ Stormwater Capture  
  ○ Watershed and Ecosystem Management (e.g., Sycamore Creek Restoration) |

Each Portfolio was simulated in the CWASim model to assess impacts to the system. CWASim runs on a daily timestep and represents the San Diego regional water system with elements and connectors representing reservoirs, water treatment plants, pipelines, delivery points, and other water supply infrastructure components. The model includes the representation of local and imported supply sources, member agency demands, SDCWA facilities, and member agency facilities that are connected to the SDCWA system. It does not include representation of member agency facilities that are not connected to the SDCWA system. Operational logic describes how water is conveyed throughout the system at each simulation timestep. Input data provides the water supply and demand volumes that drive the operations of the system.

Model runs for each Portfolio included 13 simulations under a range of demand and climate conditions. Observed 2015 demands, SDCWA UWMP 2025 demand projections, and UWMP demand projections extended to 2050 make up the three demand scenarios (2015, 2025, and 2050) that were used in the analysis. Although SDCWA updated its demand forecast in 2018, the modeling for the Basin Study was started before the update and is therefore based on the demand projections in the 2015 UWMP, which are higher than the SDCWA 2018 demand forecast. A current climate scenario and five climate change scenarios (central tendency, warm-wet, warm-dry, hot-wet, and hot-dry) make up the climate scenarios. The Basin Study uses a period-in-time
approach in which simulations are performed for specific time periods (2015, 2025, and 2050) and climate and socioeconomic factors are held constant throughout the individual model runs.

Each model run was made up of 85 realizations of daily water system simulations that were based on an 85-year-long time series of surface water inflows to reservoirs under current and future climate conditions. The 85 realizations were run consecutively through the model, and the order of the realizations was the same for all runs, allowing direct comparison between scenarios and realizations.

Results and Discussion

Metric outputs from the CWASim model evaluate the performance of the San Diego regional water system in four impact categories: 1) Water Delivery; 2) Energy; 3) Recreation; and 4) Flood Control. Environmental impacts were unable to be accounted for by quantitative metrics in the CWASim model but are accounted for in Task 2.5. Result observations were verified using analysis of variance (ANOVA) to determine if observed differences were statistically significant.

Water Delivery

Water delivery impacts were measured by water delivery volume (total and by supply source), shortage volume, conveyance system operations (pipeline flows and treatment plant utilization), and reservoir storage and releases.

Over the range of modeled scenarios, water demands are projected to increase between 2015, 2025, and 2050 due to a combination of socioeconomic factors (e.g., population increases) and climate change. Total water deliveries are projected to increase to meet the increasing demands, but the mix of supplies used to meet these increasing demands depends on the Portfolio. Between the Baseline Portfolio and other Portfolios, there was a shift in water deliveries away from Imported Water Purchases. In the Enhanced Conservation Portfolio, the shift was due to reduced overall water demands, which allowed more of the demand to be met by local sources. Increases in local supply sources such as in the Baseline Plus, Increase Supplies, and Watershed Health and Ecosystem Restoration Portfolios, and improvements in system operations such as in the Optimize Existing Facilities Portfolio, enabled more demand to be met with local supplies instead of purchased water imports. The effect was particularly strong for the Increase Supplies and Enhanced Conservation Portfolios, indicating that both demand-side approaches (i.e., conservation) and supply side approaches (i.e., new water supply sources) can be effective at reducing dependence on imported water. Although an additional Imported Water supply of 5,000 acre-feet per year (AF/y) in the 2050 demand scenario was included in the Increase Supplies Portfolio (Cadiz Additional Imported Water project), the increase in local supplies in this Portfolio still allowed for a shift away from Imported Water Purchases. In addition to the reliability benefits of reducing dependence on imported water for meeting water demands, decreasing imported water use may also provide benefits to regional energy consumption.

Shortages occurred in some Portfolios but represented only up to 2% of the total annual demand on average, and were worse under Baseline conditions, future demand scenarios, and in hot-dry and warm-dry climate scenarios. A shortage threshold of 20,000 AF used in the Basin Study represents the shortage volume that could be mitigated within the San Diego system through
short-term drought restrictions or operational changes. In the Baseline Portfolio, shortages above this shortage threshold occurred 6% of the time in the hot-dry climate scenario for 2025 demands, and 28% of the time in the hot-dry climate scenario for 2050 demands. The Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios all reduced the occurrence and magnitude of shortage, and the Enhanced Conservation and Increase Supplies Portfolios eliminated shortages above the shortage threshold for all climate and demand scenarios.

Conveyance system limitations may contribute to shortages if capacity is not great enough to convey the water needed to meet demands. In the simulated system operations, pipeline flow appeared to be a possible constraint, but pump station utilization and treatment plant utilization did not appear to constrain operations of the system. The Untreated Pipeline, which conveys water from the MWD delivery point, conveyed the most flow and was the most highly used, with summer utilization frequently over 95% of capacity in all Portfolios. Utilization of the Untreated Pipeline was highest in the Baseline Portfolio and lower in the Enhanced Conservation (due to decreased demands), Increase Supplies (due to decreased demands on imported water compared to Baseline Plus), and Optimize Existing Facilities (most likely due to Pipeline 3/Pipeline 4 conversion) Portfolios for 2050 demands.

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. For reservoirs that showed impacts from climate change, wet scenarios generally had higher reservoir storage than dry scenarios.

**Energy**

Energy impacts were quantified by energy consumption to treat and deliver water, including supply sources, conveyance, treatment, pumped storage, offices, and by energy generation at water system facilities. In all Portfolios for 2015 demands and current climate, modeled energy generation offsets about 4% of the modeled consumption for the San Diego region, with average annual generation of approximately 76,000 megawatt-hours (MWh) and average annual consumption of approximately 1,732,000 MWh. For both 2025 demands and 2050 demands across all climate scenarios, the highest energy consumption occurs in the Baseline Portfolio (2,115,645 MWh average annual consumption for 2050 demands and current climate) and the lowest occurs in the Enhanced Conservation Portfolio (1,549,046 MWh average annual consumption for 2050 demands and current climate). The Increase Supplies Portfolio resulted in 1,859,337 MWh average annual consumption for 2050 demands and current climate. Lower usage of imported water contributes to the lower energy consumption in the Increase Supplies Portfolio, which consumes less energy than the Baseline and Baseline Plus Portfolios even though it includes projects that are typically considered energy intensive such as Seawater Desalination.

**Recreation**

Impacts to Recreation were quantified using boat ramp accessibility at the end of September by comparing the boat ramp elevation to the End of September Elevation for El Capitan, Hodges, Lower Otay, and San Vicente Reservoirs. End of September Elevation varies between Portfolios
for all reservoirs, but significant recreation impacts as measured by boat ramp inaccessibility only occur for El Capitan Reservoir and Lower Otay Reservoirs, and recreation is impacted to a very limited extent for Hodges and San Vicente Reservoirs.

At El Capitan, as many as 88% of realizations have End of September Elevation below the boat ramp in the Baseline Portfolio. The impacts are improved somewhat in the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios, improved somewhat more by the Enhanced Conservation and Increase Supplies Portfolio, and eliminated in the Optimize Existing Facilities Portfolio. For 2050 demands, the Optimize Existing Facilities Portfolio was the only Portfolio to have no realizations below the boat ramp elevation at El Capitan, which can be attributed to the San Diego Reservoir Intertie project that allows for greater flexibility in reservoir management and removes restrictions on the operable pool.

At Hodges there were no realizations below the boat ramp elevation in the Baseline Portfolio; however, 1.2% of realizations were below the boat ramp elevation in 2050 for three Portfolios: the Baseline Plus (central tendency, hot-dry, and warm-dry climate scenarios), Optimize Existing Facilities (hot-dry and warm-dry climate scenarios), and Watershed Health and Ecosystem Restoration (central tendency, hot-dry, and warm-dry climate scenarios) Portfolios. This can be attributed to the Hodges Water Quality Improvement Program, which improves water quality at Hodges, allowing for greater usage of water from this reservoir. This project also impacts End of September Elevation in the Increase Supplies and Enhanced Conservation Portfolios, but the additional projects in these Portfolios slightly offset the decrease in elevation, so there are no realizations below the boat ramp for all climate scenarios.

For Lower Otay, up to 45% of realizations have End of September Reservoir Elevation below the boat ramp in the Baseline Portfolio. This is improved in all Portfolios and completely eliminated in the Enhanced Conservation Portfolio. The Baseline Portfolio was the only Portfolio with realizations below the boat ramp elevation at Lower Otay for 2025 demands. The increased elevation in the Baseline Plus and subsequent Portfolios can be attributed to the Mission Trails Alternative 1 project, which allows for increased imported water storage at Lower Otay. For 2050 demands, some realizations were below the boat ramp elevation for Baseline Plus (less than 8%), Increase Supplies (less than 12%), Optimize Existing Facilities (less than 4%), and Watershed Health and Ecosystem Restoration (less than 9%).

There were no realizations below the boat ramp elevation in any of the Portfolios for San Vicente, although the elevation was significantly increased in 2050 in the Increase Supplies Portfolio due to implementation of Pure Water San Diego Phase 2.

**Flood Control**

Flood control impacts, as measured by number of days with flood outflows and annual flood outflow volume, were evaluated at five of the region’s reservoirs: El Capitan, Hodges, Lower Otay, San Vicente, and Olivenhain. Of these five reservoirs, flood impacts are only observed for El Capitan, Hodges, and Lower Otay Reservoirs. No flood outflows occur in any Portfolios at San Vicente or Olivenhain Reservoirs. At El Capitan, there are no differences between Portfolios or scenarios for 2025 demands, but there are more flood outflows in the Increase Supplies Portfolio, most likely due to increased water supplies requiring storage. There are also fewer flood outflows in the Optimize Existing Facilities Portfolio, most likely due to the San Diego
Reservoir Intertie, which allows for greater operational flexibility at El Capitan. For Hodges Reservoir, flood impacts are the same for all Portfolios for the 2015 and 2025 demand scenarios but differ in the 2050 demand scenarios due to implementation of the Hodges Water Quality Improvement Program, which allows higher releases of water from Hodges Reservoir to the regional water system. At Lower Otay, flood outflows are increased in the Enhanced Conservation Portfolio, most likely due to lower demand for water stored in the reservoir. For El Capitan, Hodges, and Lower Otay, flood impacts appear to vary between climate scenarios, with lower flood outflow volumes for hot-dry and warm-dry climates and higher flood outflow volumes in warm-wet and hot-wet climates, and central tendency being somewhat similar to current climate. At Hodges, there is also some statistical evidence that the number of flood outflows is greater for warm-wet climate than central tendency climate for 2050 scenarios in all Portfolios other than the Baseline.

Conclusion

Based on analysis completed in the San Diego Basin Study, the Concepts contained in Portfolios may be useful adaptation strategies that the region can employ when faced with water supply and demand imbalances. Simulations of all Portfolios beyond the Baseline resulted in shifts in water deliveries away from imported water and showed fewer realizations above the shortage threshold of 20,000 AF. This effect was particularly strong for the Increase Supplies and Enhanced Conservation Portfolios. A decrease in energy consumption was also observed in all Portfolios beyond the Baseline, which may be related to the decrease in imported water deliveries. The increased water availability and management flexibility associated with all Portfolios generally appears to raise the End of September Elevation of all reservoirs and improve boat ramp accessibility. Flood control impacts varied between Portfolios, but there did not appear to be significant increases in the number of flood outflows due to the increased water availability or operational changes.
1. **Introduction**

1.1. **Study Overview and Purpose**

The purpose of the San Diego Basin Study (Basin Study) is to determine potential climate change impacts on water supplies and demands within the San Diego region, and to analyze structural and non-structural concepts that can assist the region in adapting to the uncertainties associated with climate change. The Basin Study is investigating potential changes to existing operating policies for regional water supply facilities (i.e., dams, reservoirs, conveyance facilities, and water treatment and water recycling plants), modifications to existing facilities, and development of new facilities that could optimize reservoir systems, and additional new water supply options including desalination and indirect potable reuse options.

The Study’s two primary objectives are:

1. Determine how climate change will impact the current and future water supply portfolio of the San Diego region; and
2. Develop structural and non-structural concepts within the San Diego region that can serve as adaptation strategies to manage climate change impacts, focusing on improving operations of existing facilities and supplies, and further developing new core water supply sources.

The Basin Study is divided into two interrelated tasks. Task 1 comprises the project management aspects of the work, while Task 2 addresses the detailed scientific, engineering, and economic analyses that are being completed to meet the study objectives. Task 2 is further divided into the following sub-tasks 2.1 through 2.6:

2.1 – Water Supply and Water Demand Projections
2.2 – Downscaled Climate Change and Hydrologic Modeling
2.3 – Existing Structural Response and Operations Guidelines Analysis
2.4 – Structural and Operations Concepts
2.5 – Trade-Off Analysis and Opportunities
2.6 – Final Report

1.2. **Overview of Task 2.4**

This Interim Report (report) describes the methodologies and findings for the Study’s Task 2.4 – Structural and Operations Concepts. The purpose of Task 2.4 of the San Diego Basin Study was to analyze and explore impacts to water deliveries, flood control, recreation, and energy for a range of approaches to meeting water demands and addressing the impacts of increasing demand and climate variation through the 2050s. Basin Studies are required to consider eight impact areas: Water Delivery, Hydroelectric Power, Recreation, Flood Control, Habitats,
Endangered/Threatened Species, Water Quality, and Ecological Resiliency (Reclamation, 2016a). Task 2.4 of the Study assessed Water Delivery, Hydroelectric Power (as energy generation and consumption), Recreation, and Flood Control. Habitats, Endangered/Threatened Species, Water Quality, and Ecological Resilience are assessed in Task 2.5 of the Basin Study.

Chapter 2 of the report includes a summary of the San Diego regional water system supplies and demands, and water resources infrastructure. This builds upon the work completed for Task 2.1 – Water Supply and Water Demand Projections, Task 2.2 – Climate Change Impacts, and Hydrologic Modeling, and Task 2.3 – Existing Structural and Operation Guideline Response Analysis.

Chapter 3 of the report describes the Concepts and Portfolios used in this Study. San Diego Basin Study Concepts represent groups of similar strategies or projects that could be used to meet the water demands of the region. Portfolios of related Concepts were developed for the purpose of simulating and analyzing impacts.

Chapter 4 of the report describes CWASim, the model used in Task 2.3 and Task 2.4 to simulate operations of the San Diego regional water system to meet water demands with local and imported supply sources. It was originally developed for SDCWA by Jacobs (formerly CH2M) in support of the 2013 Regional Facilities Optimization and Master Plan Update to simulate the regional water system. It was revised for use in the Basin Study with improved modeling of imported water supplies and additional metrics that allow analysis of the supply and demand scenarios being examined in the Basin Study.

Chapter 5 of the report provides details on the water supply projections and water demand projections used in the model runs.

Chapter 6 of the report describes the methodology used in the impacts assessment. A set of metrics was used to quantify impacts as they relate to water deliveries, energy, recreation, and flood control. Statistical analysis was used to verify observed differences between demand and climate scenarios and comparison between Portfolios.

Chapter 7 of the report describes the model run results and findings as they relate to each impact metric described in Chapter 6.

Chapter 8 of the report discusses the model run results as they relate to each Concept. Specific projects with notable impacts to the system are highlighted throughout the Chapter.

The report concludes with a summary of key findings in Chapter 9.

### 1.3. Study Background

For more than 70 years, the San Diego area has relied on imported water as the primary source of supply for the region. With a strong military presence before, during, and immediately after World War II, San Diego’s growing population was in desperate need of water supply solutions. In response, the Department of the Navy and the Bureau of Reclamation (Reclamation) constructed the San Diego Project, two large-diameter pipelines that connect the area to The
Metropolitan Water District of Southern California’s (MWD) infrastructure system, to bring in supplemental supplies from the Colorado River. The first pipeline was completed in 1947 and the second in 1954 (together known as the ‘First Aqueduct’), which the San Diego County Water Authority (SDCWA) now owns and operates along with three additional large-diameter pipelines (collectively, the ‘Second Aqueduct’) that deliver imported supplies into the region. Imported supplies from the Colorado River Basin and State Water Project (SWP) remain the region’s predominant source of supply, comprising approximately 70% to 90% of the supplies utilized within the region. These imported supplies consist of water purchased from MWD and other imported supplies resulting from agreements that provide access to senior water rights on the Colorado River via long-term transfers. Imported water purchases are dependent on availability of water from MWD, while the long-term transfer agreements guarantee 100,000 acre-feet per year (AF/y), increasing by 30,000 AF/y in 2018, and then to 200,000 AF/y by 2021 of conserved water from the Imperial Irrigation District (IID) and an additional 80,200 AF/y of water conserved through canal lining projects. The imported water purchases and the IID transfer water and the canal lining water are wheeled through MWD’s conveyance facilities and delivered to SDCWA’s aqueducts.

Prior to the introduction of imported water supplies, surface water reservoirs served as the primary source of water supply for the region. Local surface water supplies remain an integral part of the region’s supply portfolio. As of 2015, local surface water (estimated to provide approximately 51,680 AF/y of supply, although it can vary substantially from year to year due to fluctuating hydrologic cycles) and seawater desalination (Carlsbad Desalination Plant, with a production capacity of 56,000 AF/y) provided the majority of local supplies (San Diego County Water Authority, 2016).

Two additional local supplies include recycled water and groundwater. Although groundwater provides some water supply to the San Diego region, unlike other large metropolitan areas within southern California, the region does not have large productive groundwater basins within its borders. This is due to a number of factors including limited productive sand and gravel (alluvial) aquifers, the relatively shallow nature of most existing alluvial aquifers, lack of rainfall and groundwater recharge, and degraded water quality resulting from human activities (San Diego County Water Authority, 2015).

While SDCWA and its member agencies have taken steps to diversify the region’s supply portfolio through the development of local supplies, through the formation of agreements to access senior water rights on the Colorado River, and through conservation and water use efficiency improvements, the region remains highly reliant on imported water sources. The reliability of imported water deliveries to the San Diego region is uncertain due to recurring droughts in northern California and the Colorado River Basin, regulatory restrictions related to endangered species in the Bay-Delta that limit State Water Project deliveries, the potential for catastrophic events such as earthquakes, and climate change. Over the last 25 years, multi-year supply cutbacks have been experienced on three separate occasions (San Diego County Water Authority, 2017).

Future changes are anticipated to affect both water supply and demand in the San Diego region. As the San Diego region continues to grow in population, water demands are anticipated to increase (San Diego County Water Authority, 2016; San Diego County Water Authority, 2018a).
Climate change is anticipated to increase median annual precipitation by 0% to 12% and increase median annual temperature by 1.5 to 4.5 degrees Fahrenheit, depending on the climate model selected (see Section 5.2.1), which will directly affect local water supply and demand. Climate change is also anticipated to affect imported water supplies as a result of climate change impacts on the Sacramento-San Joaquin (Reclamation, Bureau of, 2016b) and Colorado River (Reclamation, Bureau of, 2012) Basins. Together, these changes are anticipated to impact water deliveries, energy, recreation, and flood control in the San Diego region.

To meet current and future water supply reliability goals, it is essential that the region evaluate its existing system, identify ways to improve the ability to store imported and local water supplies when available, and develop new water supplies, making the region more resilient to drought, climate change, and water delivery service interruptions.

2. Study Area

2.1. Study Area Overview

The Study Area (Figure 1) delineates the area for which water supplies and demands are examined in the Basin Study. It is equivalent to the planning regions of the San Diego Integrated Regional Water Management (IRWM) Plan and the SDCWA 2015 Urban Water Management Plan (UWMP). The Study Area is bounded on the north, west, and south by the San Diego County boundary and on the east by the boundaries of 11 regional watersheds (the Study Watersheds) (Table 2). Eight of the Study Watersheds are completely within the Study Area (San Luis Rey, Carlsbad, San Dieguito, Los Peñasquitos, San Diego, Pueblo, Sweetwater, and Otay). Two northern watersheds (San Juan and Santa Margarita) and one southern watershed (Tijuana) are partially within the Study Area.

SDCWA and its member agencies (Table 2) are the primary suppliers of water within the Study Area. The SDCWA service area is entirely within the Study Area and encompasses most of the western portion of San Diego County. It is divided into 24 member agency service areas, the largest of which is the City of San Diego, which makes up approximately one-third of the SDCWA service area (Figure 2). The Study Area overlaps numerous other municipal and water agency boundaries. Many other ongoing planning efforts examine portions of the Study Area, such as the UWMP produced by the City of San Diego (City of San Diego, 2015) and Urban Water Management Plans produced by other individual SDCWA member agencies.
## Table 2. SDCWA Member Agencies

<table>
<thead>
<tr>
<th>SDCWA Member Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camp Pendleton Marine Corps Base</td>
</tr>
<tr>
<td>Carlsbad Municipal Water District</td>
</tr>
<tr>
<td>City of Del Mar</td>
</tr>
<tr>
<td>City of Escondido</td>
</tr>
<tr>
<td>City of Oceanside</td>
</tr>
<tr>
<td>City of Poway</td>
</tr>
<tr>
<td>City of San Diego</td>
</tr>
<tr>
<td>Fallbrook Public Utility District</td>
</tr>
<tr>
<td>Helix Water District</td>
</tr>
<tr>
<td>Lakeside Water District</td>
</tr>
<tr>
<td>Olivenhain Municipal Water District</td>
</tr>
<tr>
<td>Otay Water District</td>
</tr>
</tbody>
</table>

San Diego Basin Study
Task 2.4 – Structural and Operations Concepts
Figure 1. Overview of the San Diego Basin Study Area
Figure 2. SDCWA member agency boundaries. SDCWA services the areas for each member agency depicted.
Table 3. Study Watersheds

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Area (mi²)</th>
<th>Major Drainages in Study Area</th>
<th>Groundwater Basins</th>
<th>Reservoirs</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Juan</td>
<td>496 (150 in Study Area)</td>
<td>San Mateo Creek</td>
<td>San Mateo Valley</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>San Onofre Valley</td>
<td></td>
</tr>
<tr>
<td>Santa Margarita</td>
<td>750 (200 in Study Area)</td>
<td>Santa Margarita River</td>
<td>Santa Margarita Valley</td>
<td>None</td>
</tr>
<tr>
<td>San Luis Rey</td>
<td>562</td>
<td>San Luis Rey River</td>
<td>San Luis Rey Valley</td>
<td>Henshaw Turner</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Warner Valley</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ranchita Town Area</td>
<td></td>
</tr>
<tr>
<td>Carlsbad</td>
<td>211</td>
<td>small stream systems draining to coast</td>
<td>Batiquitos Lagoon Valley</td>
<td>Wohlford</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>San Elijo Valley</td>
<td>Dixon</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>San Marcos Area</td>
<td>Olivenhain</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Escondido Valley</td>
<td>San Dieguito</td>
</tr>
<tr>
<td>San Dieguito</td>
<td>346</td>
<td>San Dieguito River</td>
<td>San Pasqual Valley</td>
<td>Sutherland</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Santa Maria Valley</td>
<td>Ramona</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>San Dieguito Valley</td>
<td>Poway</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pamo Valley</td>
<td>Hodges</td>
</tr>
<tr>
<td>Peñasquitos</td>
<td>162</td>
<td>small streams</td>
<td>Poway Valley</td>
<td>Miramar</td>
</tr>
<tr>
<td>San Diego River</td>
<td>440</td>
<td>San Diego River</td>
<td>Mission Valley</td>
<td>El Capitan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>San Diego River Valley</td>
<td>San Vicente</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(including Santee-El Monte)</td>
<td>Cuyamaca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>El Cajon</td>
<td>Jennings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Murray</td>
</tr>
<tr>
<td>Pueblo</td>
<td>60</td>
<td>none</td>
<td>Sweetwater Valley</td>
<td>none</td>
</tr>
<tr>
<td>Sweetwater</td>
<td>230</td>
<td>Sweetwater River</td>
<td>Sweetwater Valley</td>
<td>Loveland</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sweetwater</td>
</tr>
<tr>
<td>Otay</td>
<td>160</td>
<td>Otay River</td>
<td>Otay Valley</td>
<td>Upper and Lower Otay</td>
</tr>
<tr>
<td>Tijuana</td>
<td>1,750 (467 in Study Area)</td>
<td>Tijuana River</td>
<td>Tijuana</td>
<td>Morena</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cottonwood Valley</td>
<td>Barrett</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Campo Valley</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Portrero Valley</td>
<td></td>
</tr>
</tbody>
</table>

2.2. Study Area Water Supplies

The Basin Study examines local supplies utilized within the Study Area by SDCWA and its member agencies, as well as imported supplies from other regions. Water supplies in the region were first characterized as part of Tasks 2.1 and 2.2, and subsequently updated as part of Tasks
2.3 and 2.4. As of 2015, local supplies included surface water originating in the Study Watersheds, local groundwater from some of the 24 groundwater basins in the region, locally recycled water, and local desalination. As of 2015, imported supplies included IID transfer water, conserved water from canal lining projects, and purchased MWD supplies imported from the State Water Project (SWP) through the California Aqueduct and from the Colorado River through the Colorado River Aqueduct (CRA). This section describes San Diego water supplies as they existed in 2015. Discussion of potential future water supply strategies can be found in Chapter 3 – San Diego Basin Study Portfolios.

2.2.1. Surface Water
Water supply from surface water runoff in the Study Watersheds is limited. San Diego County’s climate is relatively mild year-round and large precipitation events are rare due to the semiarid nature of the region. Annual rainfall varies between an average of 10 inches near the coast to 40 inches near the inland mountains. Over 80 percent of the average annual rainfall occurs between December and March. This rainfall contributes runoff to the major streams in the region, including the Otay River, San Diego River, San Dieguito River, San Mateo Creek, San Luis Rey River, Santa Margarita River, Santa Maria Creek, Sweetwater River, and Tijuana River. Many streams in the region are regulated by storage reservoirs whose primary purpose is to capture runoff as supply. Flood control is not a designated operating objective for these reservoirs, although operations for water supply can sometimes provide a secondary flood reduction benefit. For unregulated streams, more than 75% of the annual runoff volume generally occurs between December and April, and flows can drop to zero during the dry summer months. As of 2015, surface water runoff generated from rainfall represented the largest single local water source in the SDCWA service area; however, surface water runoff only averaged 7% of the region’s total annual water supply during the 2005-2015 years (San Diego County Water Authority, 2018).

2.2.2. Groundwater
There are 24 groundwater basins underlying the Study Watersheds. All municipal groundwater supplies for the region are operated by SDCWA member agencies rather than SDCWA itself. SDCWA member agencies have produced an annual average of 18,944 AF/y of water supply from groundwater (San Diego County Water Authority, 2016). Groundwater is produced from either brackish groundwater desalination or municipal wells. In addition to municipal supplies, privately owned groundwater wells may be used by individual irrigators or households, but those users are outside the scope of the Basin Study.

The potential for production of groundwater in the Study Area is limited. The most productive types of aquifers are alluvial deposits that formed in narrow river valleys, but the extent of these sand and gravel aquifers is small and most are at shallow depths. Groundwater may also be produced from fractured bedrock and sedimentary deposits, but yields are small. Further, the low rainfall in the region results in low groundwater recharge. There are also water quality concerns with available groundwater resources, such as contamination from septic tanks. High quality aquifers that produce water requiring minimal treatment have already been developed; therefore, future groundwater development in the region will be focused on brackish groundwater (San Diego County Water Authority, 2015).
2.2.3. Recycled Water and Potable Reuse
Recycled water is water which, as a result of wastewater treatment, is suitable for a planned direct beneficial use that would not otherwise occur. Under current permitting regulations, recycled water may be used for non-potable uses such as irrigation of parks and golf courses, dust control, cooling, and toilet flushing. Approximately 30,000 acre-feet of recycled water is reused annually by SDCWA member agencies and is distributed throughout the county through the “purple pipe” non-potable water system (San Diego County Water Authority, 2016).

Potable reuse is currently being implemented in California. In October 2017, the California Governor signed Assembly Bill 574 directing the State Water Resources Control Board (State Water Board) to create the future regulations that allow direct potable reuse by December 31, 2023. Although groundwater recharge projects using recycled water have been in place since 1962, comprehensive groundwater recharge regulations were not adopted until 2014, as was required by California’s Water Code section 13562 (California State Water Resources Control Board, 2018a) (California Legislative Information, 2011). Surface Water Augmentation Regulations (SBDDW-16-02) have been adopted by the State Water Board and are effective as of October 1, 2018 (California State Water Resources Control Board, 2018b). Several San Diego region water agencies are currently planning for and/or developing indirect potable reuse projects, in which advanced treated wastewater will be introduced into an environmental buffer such as a surface water reservoir or groundwater basin, then extracted and treated at a surface water treatment plant for distribution through the potable distribution system. The three projects at the most advanced stage of planning are the City of San Diego’s Pure Water, Padre Dam’s East County Advanced Water Purification Program, and the City of Oceanside’s Aquifer Augmentation project (San Luis Rey Water Reclamation Facility [WRF] - Short/Long-Term Expansion).

2.2.4. Seawater Desalination
In 2015, SDCWA added desalinated seawater to the water supply portfolio of the San Diego region. The Claude ‘Bud’ Lewis Carlsbad Desalination Plant (Carlsbad Desalination Plant) is adjacent to the Encina Power Station in Carlsbad, California. The plant was constructed and is operated through a public-private partnership between SDCWA and Poseidon Resources. Poseidon Resources financed the construction of the Plant and entered into a 30-year water purchase agreement with SDCWA. The Carlsbad Desalination Plant was designed to produce 56,000 AF/y (50 million gallons per day [mgd]) of desalinated drinking water.

Two other seawater desalination projects in the San Diego area were under consideration in 2015, Camp Pendleton and Rosarito Beach. These projects are not certain to proceed, but are included in the Basin Study as conceptual projects. The proposed Camp Pendleton Desalination Plant project involves the development of an initial 50 mgd (56,000 AF/y) seawater desalination plant, with subsequent expansions at 50 mgd increments up to a maximum capacity of 150 mgd (168,000 AF/y), as modeled in the 2050 scenario. The proposed Rosarito Desalination Plant includes the production of about 56,000 AF/y (50 mgd), expandable to 112,000 AF/y (100 mgd), in Mexico, with excess water produced made available to Otay Water District (Otay Water District, 2017).
2.2.5. QSA Water
In 2003, the Colorado River Quantification Settlement Agreement (QSA) was completed to settle longstanding disputes between IID, MWD, and Coachella Valley Water District related to priority, use, and transfer of Colorado River water. The agreement established terms for distribution of Colorado River water among the parties for up to 75 years and facilitated actions to enhance the reliability of Colorado River water supplies. Two actions identified in the QSA were the transfer of water made available by lining the All-American and Coachella Canals, and the transfer of water conserved by IID initially through land fallowing and then transitioning entirely to Imperial Valley system and on-farm conservation methods. These conservation efforts resulted in allocations of specific, firm annual volumes of water available to SDCWA.

2.2.6. MWD Purchases
In addition to QSA imported water, SDCWA imports water purchased from MWD. MWD is a regional water wholesaler that supplies water to its 26 member agencies, including SDCWA. MWD obtains its water from the SWP and the CRA and stores it in in-region surface water storage (Diamond Valley, Matthews, Skinner) and other local reservoirs, in-region groundwater storage, Colorado River storage (Lake Mead Intentionally Created Surplus), and Central Valley and State Water Project storage (SWP carryover, flexible storage programs at terminal reservoirs of the SWP, and Central Valley groundwater banks). MWD uses the stored water to meet the demands of its member agencies.

During wet and normal years, MWD available supplies generally exceed demands, allowing MWD storage to increase. During dry years, supplies are often insufficient to meet demands and water is extracted from MWD storage to meet member agency demands. When MWD storage reaches low levels, the MWD Board of Directors may implement water allocations to member agencies at less than full deliveries to protect against future dry years.

2.2.7. Other Water Supplies
Other potential future water supply sources such as gray water use and stormwater capture are evaluated in this report.

2.3. Study Area Water Demands
The Basin Study examines water demands in the SDCWA service area. Together, SDCWA member agencies make up approximately 95% of the demands for San Diego County. Unincorporated areas of the County that are not served by SDCWA but are within the Study Watersheds are included in the Study Area for purposes of accounting for local water supplies, but their water demands are not included because they are met by individual wells or small water systems.

Demand for water in the SDCWA service area falls into two classes of service: municipal and industrial (M&I), and agricultural. In fiscal year 2015, total demand was 539,361 acre-feet of which 92% was for M&I uses and 8% was for agricultural uses (San Diego County Water Authority, 2016). Agricultural demands have decreased significantly since 2007, when MWD implemented mandatory restrictions on water it sold under agricultural rates. Agricultural products produced in the San Diego region include avocados, citrus, cut flowers, and nursery
products, along with crops and livestock for local markets. In fiscal year 2005, agricultural demands made up 13% of water use, while in 2015, only 8% of the total water demand was for agricultural use (San Diego County Water Authority, 2015). In the future, M&I demands are expected to grow while agricultural demands are expected to continue to decrease, leading to an even larger dominance of M&I demands in the region.

2.4. Study Area Water Resources Infrastructure and Operations

The Basin Study examines water resources infrastructure and facilities operations within the Study Area that contribute to the storage, treatment, and distribution of local and imported water supplies (Figure 3 and Figure 4). The infrastructure components as they existed in 2015 are described briefly in this section, described in more detail in Section 3.3 – Baseline Portfolio, and, for their implementation in the CWASim model for analysis, further described in Section 4.2 – Model Representation of System Infrastructure and Operations. Infrastructure components and operational changes implemented after 2015, as well as potential future infrastructure or operational changes are described in Sections 3.4 – Baseline Plus Portfolio, Section 3.6 – Increase Supplies Portfolio, Section 3.7 – Optimize Existing Facilities Portfolio, Section 3.8 – Watershed Health and Ecosystem Restoration Portfolio, and Section 4.2 – Model Representation of System Infrastructure and Operations.

The San Diego region has 25 major reservoirs as shown in Figure 3. See Section 4.2.1 for a detailed discussion of reservoirs.
Figure 3. Surface and groundwater features in the San Diego Basin Study Area
Conveyance facilities (pipelines and pump stations) in the San Diego region transport water from imported water delivery points and water treatment plants to delivery points in the region. Water purchased from MWD or transferred via the QSA is imported into the San Diego region through MWD facilities. SDCWA takes delivery of treated and untreated imported water from MWD six miles south of the Riverside-San Diego County line at a point known as the “MWD Delivery Point.” Water then flows southward to the SDCWA service area through five large diameter pipelines owned and operated by SDCWA that make up the First Aqueduct and Second Aqueduct.

The First Aqueduct alignment includes Pipelines 1 and 2 and extends from the MWD Delivery Point to San Vicente Reservoir. The two pipelines are operated as a single unit. North of the Crossover Pipeline, Pipelines 1 and 2 deliver treated water from MWD. South of the Crossover Pipeline, Pipelines 1 and 2 deliver untreated water.

Pipelines 3, 4, and 5 make up the Second Aqueduct alignment. The pipelines are divided into several reaches. Depending on the pipeline and reach, these pipelines convey treated or untreated water and are operated independently or as a unit. Pipeline 3 conveys treated or untreated water between the MWD Delivery Point and Lower Otay Reservoir. Pipeline 4 conveys treated or untreated water from the MWD Delivery Point to the southern portion of San Diego County. Pipeline 5 conveys untreated water from the MWD Delivery Point to water treatment plants in the southern portion of San Diego County.

Lateral pipelines that run generally eastward or westward convey water throughout the San Diego region to treatment plants, reservoirs, or delivery points for member agencies. There are also a variety of smaller conveyance facilities in the water distribution system used for retail purposes which transport water to its point of use. For example, the City of San Diego oversees approximately 3,300 miles of distribution pipeline delivering water to approximately 276,000 service connections (City of San Diego, 2015).

Most of the treated and untreated water in San Diego County relies on gravity to flow through the conveyance system. The SDCWA and the City of San Diego also operate pump stations to move water uphill when necessary. The pumps aid the agencies in meeting daily, seasonal, and emergency needs. See Section 4.2.2 for a detailed discussion of conveyance facilities.

As of 2015, the San Diego region had one operational desalination plant (Carlsbad) and two others were being considered. See Section 2.2.4 (Study Area Water Supplies – Seawater Desalination) for more information about desalination facilities.

As of 2015, the San Diego regional water system had twelve water treatment plants which are used to remove contaminants from raw water and treat the water to produce water pure enough for human consumption. Water treatment plants within the Study Area are shown in Figure 4 and listed in Table 21 in Section 4.2.4.

As of 2015, the San Diego regional water system had 19 water reclamation facilities, which are used to treat water for non-potable uses. See Section 2.2.3 for more information about recycled water.
Figure 4. Water and wastewater treatment and desalination features in the San Diego Basin Study Area
San Diego Basin Study
Task 2.4 – Structural and Operations Concepts

3. San Diego Basin Study Portfolios

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. As in Task 2.3, the Baseline system was characterized by the 2015 SDCWA UWMP with minor modifications as described in Section 3.3. The Baseline system and additional Portfolios made up of existing and proposed strategies were simulated in the CWASim model, which is discussed in Chapter 4, to assess impacts to the system.

3.1. Concepts

San Diego Basin Study 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 Basin Study. Concepts were defined to characterize existing and potential future water management strategies. Concepts used in this study are listed in Table 4. These 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 projects in the Basin Study are based on actual proposed projects, including projects listed as verifiable, additional planned, and conceptual in the 2015 SDCWA UWMP (City of San Diego, 2015), the 2013 SDCWA Master Plan (San Diego County Water Authority, 2013), the 2013 IRWM Plan (Regional Water Management Group, 2013), 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. See Appendix A – Projects Spreadsheet for a complete list of projects.

Table 4. San Diego Basin Study Concepts

<table>
<thead>
<tr>
<th>Concept</th>
<th>Narrative Concept Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyance Improvement</td>
<td>Improve local / regional conveyance systems to increase supply reliability and operational flexibility, and reduce greenhouse gas (GHG) emissions by utilizing existing conveyance facilities and natural water courses and modifying existing pump stations, pipelines, interties and bypasses.</td>
</tr>
<tr>
<td>Drought Restriction/Allocation*</td>
<td>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.</td>
</tr>
<tr>
<td>Enhanced Conservation</td>
<td>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.</td>
</tr>
<tr>
<td>Concept</td>
<td>Narrative Concept Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Firm Water Supply Agreements*</td>
<td>Provide water supply by forming agreements for firm water supply volumes to be provided from external sources, such as the Quantification Settlement Agreement.</td>
</tr>
<tr>
<td>Gray Water Use</td>
<td>Offset potable water usage by encouraging, supporting and/or providing incentives for gray water system installation by residential customers.</td>
</tr>
<tr>
<td>Groundwater</td>
<td>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.</td>
</tr>
<tr>
<td>Imported Water Purchases</td>
<td>Provide water supply by purchasing treated or untreated water from a water wholesaler outside the region, such as MWD.</td>
</tr>
<tr>
<td>Local Surface Water Reservoirs*</td>
<td>Provide water supply by capturing, storing, and treating surface water runoff in lakes or reservoirs.</td>
</tr>
<tr>
<td>Potable Reuse</td>
<td>Provide water supply by producing advanced treated water from wastewater for direct or indirect (e.g., reservoir or groundwater augmentation) potable use.</td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Offset potable water use by providing non-potable recycled water use for landscape irrigation, industrial purposes or groundwater recharge.</td>
</tr>
<tr>
<td>Seawater Desalination</td>
<td>Provide water supply by utilizing or expanding existing facilities or constructing new facilities to remove salts from seawater.</td>
</tr>
<tr>
<td>Stormwater BMPs</td>
<td>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.</td>
</tr>
<tr>
<td>Stormwater Capture</td>
<td>Provide water supply by capturing stormwater through both centralized projects and regional decentralized efforts and treating it for both potable and non-potable uses.</td>
</tr>
<tr>
<td>Urban and Agricultural Water Use Efficiency</td>
<td>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).</td>
</tr>
<tr>
<td>Watershed and Ecosystem Management</td>
<td>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.</td>
</tr>
</tbody>
</table>

* These Concepts are included in the Baseline Portfolio and are not modified in any other Portfolios.
Portfolios were developed for the purpose of simulating and analyzing groups of related Concepts. Each Portfolio contains a subset of Concepts that is modeled and analyzed to determine its impacts to water deliveries, flood control, energy, and recreation. As described in Table 5, one Portfolio represents Baseline conditions, while five additional Portfolios consist of projects that are planned or conceptual. Portfolios were developed by consulting with public stakeholders and STAC members.

Portfolios and corresponding Concepts are described in Table 5, and a list of all projects associated with each Concept and Portfolio is provided in Appendix A – Projects Spreadsheet. Projects were implemented in the CWASim model scenarios (2015, 2025, and 2050) based on the anticipated date that water supply would be available from each project.

Selected projects are highlighted in Sections 3.3 through 3.8 to provide specific examples and additional detail on projects that are clearly visible in the model results. Impacts to the system from these projects are highlighted in Chapter 8.

Table 5. Task 2.4 Portfolios Including Concepts

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Contained in Portfolio</th>
<th>Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Projects designated as verifiable in SDCWA’s 2015 UWMP</td>
<td>● Conveyance Improvements&lt;br&gt;● Drought Restriction/ Allocation&lt;br&gt;● Firm Water Supply Agreements (e.g., QSA)&lt;br&gt;● Groundwater&lt;br&gt;● Imported Water Purchases (e.g., MWD)&lt;br&gt;● Local Surface Water Reservoirs&lt;br&gt;● Potable Reuse&lt;br&gt;● Recycled Water&lt;br&gt;● Seawater Desalination (e.g., Carlsbad)&lt;br&gt;● Urban and Agricultural Water Use Efficiency</td>
</tr>
<tr>
<td>Baseline Plus</td>
<td>Baseline projects and projects that are actively being pursued or have received funding between 2015 and 2017.</td>
<td>● All Baseline Concepts&lt;br&gt;● New or Modified Concepts&lt;br&gt;○ Conveyance Improvements&lt;br&gt;○ Gray Water Use&lt;br&gt;○ Groundwater&lt;br&gt;○ Potable Reuse (e.g., Pure Water San Diego Phase 1)&lt;br&gt;○ Recycled Water&lt;br&gt;○ Stormwater Capture&lt;br&gt;○ Urban and Agricultural Water Use Efficiency&lt;br&gt;○ Watershed and Ecosystem Management (e.g., Hodges Water Quality Improvement Program)</td>
</tr>
</tbody>
</table>
### 3.3. Baseline Portfolio

#### 3.3.1. Portfolio Overview

The Baseline Portfolio represents the system as it existed in 2015, with some minor modifications to include projects that have been implemented or for which there is very high confidence that they 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 6 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 6. Summary of Baseline Portfolio Concepts and Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conveyance Improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alvarado Water Treatment Plant</td>
<td>134,506 AF/y (120 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Badger Water Treatment Plant</td>
<td>44,385 AF/y (40 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Crossover Pipeline</td>
<td>144,890 AF/y (200 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>El Monte Pipeline</td>
<td>108,667 AF/y (150 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Escondido Pump Station</td>
<td>14,489 AF/y (20 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Escondido-Vista Water Treatment Plant</td>
<td>100,880 AF/y (90 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>La Mesa-Sweetwater Extension Treated</td>
<td>Modeled through ECRTWIP¹</td>
<td>Modeled through ECRTWIP</td>
<td>Modeled through ECRTWIP</td>
</tr>
<tr>
<td>Lake Hodges Pump Station</td>
<td>550,580 AF/y (760 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Levy Water Treatment Plant</td>
<td>118,814 AF/y (106 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Miramar Pump Station</td>
<td>43,467 AF/y (60 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Miramar Water Treatment Plant</td>
<td>161,408 AF/y (144 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Moreno-Lakeside Pipeline</td>
<td>67,374 AF/y (93 cfs) capacity west to east, 89,832 AF/y (124 cfs) capacity east to west</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>North County Distribution Pipeline</td>
<td>Modeled in aggregate fashion by delivery of water from Second Aqueduct</td>
<td>Modeled in aggregate fashion by delivery of water from Second Aqueduct</td>
<td>Modeled in aggregate fashion by delivery of water from Second Aqueduct</td>
</tr>
<tr>
<td>Olivenhain Pump Station</td>
<td>227,477 AF/y (314 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Olivenhain Water Treatment Plant</td>
<td>38,110 AF/y (34 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Olivenhain-Hodges Pipeline</td>
<td>550,580 AF/y (760 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Otay Water Treatment Plant</td>
<td>38,110 AF/y (34 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>P12</td>
<td>137,645 AF/y (190 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Perdue Water Treatment Plant</td>
<td>33,627 AF/y (30 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Pipeline 1 and 2 (First Aqueduct)</td>
<td>137,600 AF/y (190 cfs) at MWD Delivery Point</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Pipeline 3 (Second Aqueduct)</td>
<td>P5 + P3 = 521,603 AF/y (720 cfs), 170,245 AF/y (235 cfs) downstream of Twin Oaks Valley (TOV). Capacity before Pipeline 5 Relining Project of 565,100 AF/y (780 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Pipeline 4 (Second Aqueduct)</td>
<td>340,300 AF/y (470 cfs) before Pipeline 4 Relining project</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Pipeline 4 (Second Aqueduct) Relining</td>
<td>Reduces capacity at Delivery Point to 286,157 AF/y (395 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Pipeline 5 (Second Aqueduct)</td>
<td>P5 + P3 = 521,603 AF/y (720 cfs) Downstream of TOV conveyance capacity of 460,749 AF/y (636 cfs).</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Pipeline 5 (Second Aqueduct) Relining</td>
<td>Capacity before Pipeline 5 Relining Project of 565,100 AF/y (780 cfs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomerado Pipeline</td>
<td>Reduces capacity of P5 + P3 to 521,603 AF/y (720 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Ramona Pipeline</td>
<td>159,379 AF/y (220 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Rancho Pipeline</td>
<td>75,343 AF/y (104 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>San Vicente Pump Station</td>
<td>434,669 AF/y (600 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>San Vicente Pipeline/Tunnel</td>
<td>217,334 AF/y (300 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>SD12 Pipeline</td>
<td>321,655 AF/y (444 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Sutherland-San Vicente Conduit</td>
<td>108,667 AF/y (150 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>The 30-Inch Pipeline</td>
<td>36,222 AF/y (50 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>The 30-Inch Pipeline Relining</td>
<td>54,334 AF/y (75 cfs)</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Tri-Agency Pipeline</td>
<td>Modeled in aggregate fashion by delivery of water from Second Aqueduct.</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Twin Oaks Valley Pump Station</td>
<td>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).</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Twin Oaks Valley Water Treatment Plant</td>
<td>112,090 AF/y (100 mgd) production capacity. Minimum flow of 22,418</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Valley Center (P2A) Pump Station</td>
<td>29,702 AF/y (41 cfs) capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Weese Water Treatment Plant</td>
<td>28,023 AF/y (25 mgd) production capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
</tbody>
</table>

**Drought Restriction/Allocation**

<table>
<thead>
<tr>
<th>Local Drought Restriction/Allocation</th>
<th>Not modeled</th>
<th>Not modeled</th>
<th>Not modeled</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWD Allocation</td>
<td>Uses model logic</td>
<td>Uses model logic</td>
<td>Uses model logic</td>
</tr>
</tbody>
</table>

**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) | NA²                                                                                 | 2,600 AF/y           | Same as 2025         |
| 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

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWD Imported Water</td>
<td>Uses model logic</td>
<td>Uses model logic</td>
<td>Uses model logic</td>
</tr>
</tbody>
</table>

### Local Surface Water Reservoirs

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>2015 Model Capacity</th>
<th>2025 Model Capacity</th>
<th>2050 Model Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrett Reservoir</td>
<td>37,900 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Dixon Reservoir</td>
<td>2,610 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>112,807 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Hodges Reservoir</td>
<td>33,600 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Lake Henshaw</td>
<td>53,400 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Lake Jennings</td>
<td>9,790 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Lake Poway</td>
<td>3,320 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Lake Wohlford</td>
<td>6,940 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Loveland Reservoir</td>
<td>25,400 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Lower Otay Reservoir</td>
<td>49,849 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Miramar Reservoir</td>
<td>6,050 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Morena Reservoir</td>
<td>50,200 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Murray Reservoir</td>
<td>5,200 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Olivenhain Reservoir</td>
<td>25,382 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
</tbody>
</table>
## Project Summary

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Dieguito Reservoir</td>
<td>883 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>San Vicente Reservoir</td>
<td>272,528 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Sutherland Reservoir</td>
<td>31,960 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Sweetwater Reservoir</td>
<td>27,700 AF modeled capacity</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td><strong>Potable Reuse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Luis Rey WRF - Short/Long-Term Expansion</td>
<td>NA</td>
<td>3,300 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td><strong>Recycled Water</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4S Ranch WRF/Olivenhain MWD</td>
<td>915 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Carlsbad WRF/Carlsbad MWD</td>
<td>1,903 AF/y</td>
<td>2,831 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Connection #1-North City Water Reclamation Plant/City of San Diego</td>
<td>356 AF/y</td>
<td>623 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Connection #2-North City Water Reclamation Plant/City of San Diego</td>
<td>15 AF/y</td>
<td>20 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Fallbrook Plant #1/Fallbrook Public Utility District (PUD)</td>
<td>600 AF/y</td>
<td>1,200 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Gafner WRF/Leucadia County Water District</td>
<td>247 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Hale Avenue Resource Recovery Facility (RRF)/WRF/City of Escondido (for City of Escondido)</td>
<td>600 AF/y</td>
<td>3,650 AF/y</td>
<td>4,400 AF/y</td>
</tr>
<tr>
<td>Hale Avenue RRF/WRF/City of Escondido (for Rincon del Diablo Municipal Water District)</td>
<td>3,300 AF/y</td>
<td>4,000 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Meadowlark WRF (via Mahr Reservoir)/Vallecitos WD</td>
<td>2,000 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>North City Water Reclamation Plant (WRP)/City of San Diego (for City of Poway)</td>
<td>645 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>North City WRP/City of San Diego (for City of San Diego)</td>
<td>7,029 AF/y</td>
<td>12,500 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>North Wastewater Treatment Plant (WWTP)/USMC</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Northwest Quadrant /Meadowlark WRF/Vallecitos Water District (WD)</td>
<td>358 AF/y</td>
<td>459 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>R. W. Chapman WRF/Otay WD</td>
<td>1,100 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Ray Stoyer WRF (Existing)/Padre Dam Municipal WD - Landscape (Existing Distribution System)</td>
<td>896 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Ray Stoyer WRF (Existing)/Padre Dam Municipal WD - Replenishment of Santee Lakes</td>
<td>1,120 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>San Elijo WRF/San Elijo JPA (for Santa Fe Irrigation District)</td>
<td>500 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>San Elijo WRF/San Elijo JPA (for City of Del Mar)</td>
<td>90 AF/y</td>
<td>125 AF/y</td>
<td>150 AF/y</td>
</tr>
<tr>
<td>San Elijo WRF/San Elijo JPA (for San Dieguito Water District)</td>
<td>736 AF/y</td>
<td>800 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>San Luis Rey WWTP/City of Oceanside - Phase 1 Expansion</td>
<td>130 AF/y</td>
<td>1,700 AF/y</td>
<td>3,500 AF/y</td>
</tr>
<tr>
<td>San Vicente WRP/Ramona Municipal WD</td>
<td>480 AF/y</td>
<td>525 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Santa Fe Valley WRF/Rancho Santa Fe CSD</td>
<td>140 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Santa Maria WRP/Ramona Municipal WD</td>
<td>230 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>SEJPA1-Quail Gardens</td>
<td>144 AF/y</td>
<td>50 AF/y</td>
<td>50 AF/y</td>
</tr>
<tr>
<td>SEJPA2-Village Park, Manchester Phase I</td>
<td>NA</td>
<td>236 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Sewage Treatment Plants #11 &amp; #12/USMC</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>South Bay WRP/City of San Diego (for City of San Diego)</td>
<td>1,166 AF/y</td>
<td>1,150 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>South Bay WRP/City of San Diego (for Otay Water District)</td>
<td>3,300 AF/y</td>
<td>4,800 AF/y</td>
<td>5,400 AF/y</td>
</tr>
<tr>
<td>South WWTPs/USMC Baseline Recycled Water</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Woods Valley Ranch WRF (Phase 2)</td>
<td>NA</td>
<td>175 AF/y</td>
<td>184 AF/y</td>
</tr>
<tr>
<td>Woods Valley Ranch WRF/VCMWD</td>
<td>47 AF/y</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
</tr>
</tbody>
</table>

### Seawater Desalination

<table>
<thead>
<tr>
<th>Project</th>
<th>Production Capacity</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlsbad Desalination Plant</td>
<td>Production Capacity is 55,991 AF/y or 50 mgd</td>
<td>Same as 2015</td>
<td>Same as 2015</td>
<td></td>
</tr>
</tbody>
</table>

### Urban and Agricultural Water Use Efficiency

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation from 2015 UWMP</td>
<td>50,000 AF/y</td>
<td>89,110 AF/y</td>
<td>155,468 AF/y</td>
</tr>
</tbody>
</table>

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).

### 3.3.2. Portfolio Concepts

#### 3.3.2.1 Conveyance Improvements

The Conveyance Improvements Concept in the Baseline Portfolio represents water treatment plants, pump stations, and pipelines as they existed in the Study Area in 2015. Capacities for water treatment plants used in the Baseline Portfolio are held constant for the remaining Portfolio model runs. These capacities and modeled water treatment plants are listed in Section 4.2.4. Pipelines simulated in the CWASim model are listed in Section 4.2.2.1. All these pipelines, with exception of the Second Crossover Pipeline, are included in the Baseline Portfolio model runs. Pump stations that are available to the user in the CWASim model and included in the Baseline Portfolio are also listed in Section 4.2.2.1.
3.3.2.2 **Drought Restriction/Allocation**
The Drought Restriction/Allocation Concept in the Baseline Portfolio refers to actions currently being taken during periods of drought. These actions include short term restrictions on water use, which are detailed in the SDCWA Water Shortage Contingency Plan. Local water restriction/allocation during droughts was not accounted for in the model. MWD Allocation is also included in this Concept. This is implemented in the CWASim model using the dynamic allocation methodology for MWD purchases described in Section 4.4.2.4.

3.3.2.3 **Firm Water Supply Agreements**
In the Baseline Portfolio (and in all other Portfolios), the Firm Water Supply Agreement Concept includes one project that represents imported supplies from the QSA. This project is implemented in the CWASim model by model logic (see Section 4.4.2.5), but it is assumed that the supply is constant for all scenarios, at the full agreement value of 280,200 AF/y. Although it is possible that water supply agreements such as the QSA could change (i.e., changes in water supply availability could affect the supply volume) or be renegotiated in the future, the model runs assumed that the QSA would remain in place as described.

3.3.2.4 **Groundwater**
Projects included in the Groundwater Concept for the Baseline Portfolio are ‘pump & blend’ projects involving production wells (i.e., at the Helix Water District and City of San Diego), ‘pump & treat’ projects (i.e., Lakeside Vine Street Groundwater Production Facility, Camp Pendleton Groundwater Production Wells, and the Sweetwater Authority National City Well Field), brackish groundwater recovery projects (i.e., City of Oceanside Mission Basin Desalter Facility and the City of San Diego and Sweetwater Richard A. Reynolds Desalination Facility), and groundwater extraction (i.e., well within the Yuima Municipal Water District). These projects are implemented in the CWASim model as demand reductions (see Section 4.4.1).

3.3.2.5 **Imported Water Purchases**
Imported Water Purchases included in the Baseline Portfolio are MWD purchases from the Colorado River Basin and State Water Project. Delivery volumes used for these projects in the CWASim model were derived from the Colorado River Basin Supply and Demand Study and the Sacramento-San Joaquin Basin Study. See Section 4.4.2.4 for details regarding implementation of MWD purchases in the CWASim model.

3.3.2.6 **Local Surface Water Reservoirs**
Local surface water reservoirs simulated in the Baseline Portfolio are existing reservoirs. These reservoirs and their modeled capacities are listed in Section 4.2.1. The reservoirs included in the model store local surface water runoff, imported MWD water, water transferred from another reservoir, or a combination of water from multiple sources.

3.3.2.7 **Potable Reuse**
Potable reuse supplies for the Baseline Portfolio come from the City of Oceanside’s San Luis Rey WRF – Short/Long Term Expansion Project, the only verifiable potable reuse project in the 2015 SDCWA UWMP.
3.3.2.8 Recycled Water
Recycled water supply sources for the Baseline Portfolio are the same as those listed in the 2015 SDCWA UWMP. The UWMP lists verifiable recycled water supplies for 2015, 2025, and 2040. The 2050 recycled water supplies were assumed to be the same as the 2040 verifiable supplies. As described in Section 4.2.5, recycled water supplies are implemented in the CWASim model as demand reductions. An example of a recycled water supply source included in the Baseline Portfolio is the North City Water Reclamation Plant (see Table 6 for a list of the remaining recycled water supply sources included in the Baseline Portfolio). Three recycled water projects in the Baseline Portfolio were not modeled because they are projects for the Camp Pendleton member agency and the CWASim model does not include a demand node for Camp Pendleton.

3.3.2.9 Seawater Desalination
For the Baseline Portfolio, Seawater Desalination consisted of water supplied by the Carlsbad Desalination Plant. The desalination capacity of the Carlsbad Desalination Plant is 153 AF/d (50 mgd) for all demand and climate scenarios in the Baseline Portfolio. This is implemented in the CWASim model through model logic.

3.3.2.10 Urban and Agricultural Water Use Efficiency
Urban and Agricultural Water Use Efficiency for the Baseline Portfolio includes conservation of 50,000 AF/y in 2015 scenarios, 89,110 AF/y in 2025 scenarios, and 155,468 AF/y in 2050 scenarios. The 2015 volume was calculated as the difference between observed 2015 Gross and Adjusted Demands as reported in the SDCWA 2015 Annual Report. Projected future conservation savings for 2025 were taken from the SDCWA 2015 UWMP, which used the Alliance for Water Efficiency Water Conservation Tracking Tool to develop conservation projections. Conservation was assumed to increase for 2045 and 2050 at the same rate of increase from 2035 to 2040 reported by the 2015 UWMP. The conservation values were proportioned out to each member agency based on the amounts of conservation in the year 2020 as reported in the 2015 UWMP.

3.4. Baseline Plus Portfolio
3.4.1. Portfolio Overview
The Baseline Plus Portfolio represents the near-term future supply sources, infrastructure, and operations of the San Diego region water system. It contains projects from the Baseline Portfolio, as well as projects that were actively being pursued as of fall 2017 and/or 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 in advanced planning or design stages, but are not yet operational, such as Phase 1 of the Pure Water San Diego program, are included here. Since these projects have a high certainty of implementation, this Portfolio will allow for a direct comparison of conceptual strategies to the adaptation strategies that are already being pursued in the region. 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 7 lists projects that are
included in the Baseline Plus Portfolio and the supply volumes associated with those projects for each demand scenario.

### Table 7. Summary of Baseline Plus Portfolio Concepts and Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conveyance Improvement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Conveyance Improvement Projects</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td>Mission Trails Projects Alternative 1</td>
<td>NA&lt;sup&gt;1&lt;/sup&gt;</td>
<td>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)</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>San Vicente 3rd Pump Drive and Power</td>
<td>NA</td>
<td>NA</td>
<td>Increases capacity from 217,334 to 321,655 AF/y (300 cfs to 444 cfs)</td>
</tr>
<tr>
<td><strong>Total Change in Conveyance Capacity between the Baseline Plus and Baseline Portfolio</strong></td>
<td>No change</td>
<td>Conveyance capacity increased by 159,379 AF/y</td>
<td>Conveyance capacity increased by 263,700 AF/y</td>
</tr>
<tr>
<td><strong>Drought Restriction/Allocation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Drought Restriction/Allocation Projects</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td><strong>Firm Water Supply Agreements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Firm Water Supply Agreements</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td><strong>Gray Water Use</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservation Home Makeover in the Chollas Creek Watershed</td>
<td>NA</td>
<td>10.7 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply between the Baseline Plus and Baseline Portfolio</strong></td>
<td>No change</td>
<td>10.7 AF/y (No Gray Water Use in the Baseline Portfolio)</td>
<td>10.7 AF/y</td>
</tr>
<tr>
<td><strong>Groundwater</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Groundwater Projects</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Rancho del Rey Groundwater Well Development (capacity)</td>
<td>NA</td>
<td>NA</td>
<td>500 AF/y</td>
</tr>
<tr>
<td>Santa Margarita Conjunctive-Use Project - Local surface water recharge and expansion of Camp Pendleton groundwater recovery program</td>
<td>NA</td>
<td>3,100 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Total Change in Available Supply between the Baseline Plus and Baseline Portfolio</td>
<td>No change</td>
<td>3,100 AF/y</td>
<td>3,600 AF/y</td>
</tr>
<tr>
<td><strong>Imported Water Purchases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Imported Water Purchases projects</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td><strong>Local Surface Water Reservoirs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Local Surface Water Reservoirs</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td><strong>Potable Reuse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Potable Reuse Projects</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td>East County Advanced Water Purification Program Phase 1</td>
<td>NA</td>
<td>3,920 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>East County Advanced Water Purification Program Phase 2</td>
<td>NA</td>
<td>7,616 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Pure Water San Diego Phase 1 - North City</td>
<td>NA</td>
<td>33,627 AF/y (30 mgd) production capacity</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Total Change in Available Supply between the Baseline Plus and Baseline Portfolio</td>
<td>No change</td>
<td>45,163 AF/y</td>
<td>45,163 AF/y</td>
</tr>
<tr>
<td><strong>Recycled Water</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Recycled Water Projects</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td>Integrated Water Resource Solutions for the Carlsbad Watershed</td>
<td>NA</td>
<td>100 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>North San Diego County Regional Recycled Water Project - Phase II</td>
<td>NA</td>
<td>NA</td>
<td>6,790 AF/y</td>
</tr>
<tr>
<td>Safari Drought Response and Outreach</td>
<td>NA</td>
<td>72 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply between the Baseline Plus and Baseline Portfolio</strong></td>
<td>No change</td>
<td>172 AF/y</td>
<td>6,962 AF/y</td>
</tr>
<tr>
<td><strong>Stormwater Capture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Murray Urban Runoff Diversion System Capture</td>
<td>NA</td>
<td>200 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply between the Baseline Plus and Baseline Portfolio</strong></td>
<td>No change</td>
<td>200 AF/y (No Stormwater Capture in the Baseline Portfolio)</td>
<td>200 AF/y</td>
</tr>
<tr>
<td><strong>Seawater Desalination</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Seawater Desalination projects</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td><strong>Urban and Agricultural Water Use Efficiency</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Urban and Agricultural Water Use Efficiency Projects</td>
<td>See Table 6</td>
<td>See Table 6</td>
<td>See Table 6</td>
</tr>
<tr>
<td>Ms. Smarty-Plants Grows Water Wise Schools</td>
<td>NA</td>
<td>NA</td>
<td>6 AF/y</td>
</tr>
<tr>
<td>Regional Demand Management Program Expansion</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Regional Drought Resilience Program</td>
<td>NA</td>
<td>NA</td>
<td>1,809 AF/y</td>
</tr>
<tr>
<td>Rincon Customer-Driven Demand Management Program</td>
<td>NA</td>
<td>400 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>San Diego Water Conservation Program</td>
<td>NA</td>
<td>NA</td>
<td>75 AF/y</td>
</tr>
<tr>
<td>San Diego Water Use Reduction Program</td>
<td>NA</td>
<td>381 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>UC San Diego Water Conservation and Watershed Protection</td>
<td>NA</td>
<td>NA</td>
<td>203 AF/y</td>
</tr>
</tbody>
</table>
### 3.4.2. Portfolio Concepts

#### 3.4.2.1 Conveyance Improvement
Projects in the Baseline Plus Portfolio that are associated with Conveyance Improvement include Mission Trails Projects Alternative 1 and San Vicente 3rd Pump Drive and Power. The Mission Trails Projects Alternative 1 would increase the untreated water conveyance capacity south of the Miramar WTP from 159,379 to 268,046 AF/y (220 to 370 cubic-feet per second [cfs]). It was implemented in the 2025 and 2050 scenarios through model logic. The San Vicente 3rd Pump Drive and Power project will increase pumping capacity at the San Vicente Pump Station. This project is implemented in the 2050 scenarios through model logic that increases the capacity in the San Vicente Pump Station from 217,334 to 321,655 AF/y (300 to 444 cfs).

#### 3.4.2.2 Gray Water Use
The only Gray Water Use project included in the Baseline Plus Portfolio is Conservation Home Makeover in the Chollas Creek Watershed. This project is implemented in both the 2025 and 2050 scenarios as a demand reduction (see Section 4.4.1). It focuses on installing stormwater capture and gray water systems as well as landscape upgrades in low-income homes in the Encanto neighborhood.
3.4.2.3 **Groundwater**

The Rancho del Rey Groundwater Well Development and Santa Margarita Conjunctive-use project are groundwater projects included in the Baseline Plus Portfolio. The Santa Margarita Conjunctive-use project includes expansion of the Camp Pendleton groundwater recovery program. Both projects are implemented in the CWASim model as a demand reduction (see Section 4.4.1). While the Santa Margarita Conjunctive-use project is first implemented in the 2025 scenarios, the Rancho del Rey Groundwater Well Development project is not implemented until the 2050 scenarios.

3.4.2.4 **Potable Reuse**

Potable Reuse projects in the Baseline Plus Portfolio include the East County Advanced Water Purification Program (both Phase 1 and Phase 2), and Pure Water San Diego Phase 1. The East County Advanced Water Purification Program is implemented in the CWASim as a demand reduction, in 2025 and 2050 scenarios. Phase 3 of this Program is included in the Increase Supplies Portfolio. Pure Water San Diego Phase 1 is implemented through model logic, as described in Section 4.4.2.3. It is included in both the 2025 and 2050 scenarios. Phase 2 of Pure Water San Diego is included in the Increase Supplies Portfolio.

**Box 1. Project Highlight: Pure Water San Diego Phase 1**

*Project Highlight*

**Pure Water San Diego Phase 1**

Pure Water San Diego is the City of San Diego Public Utilities Department's proposed program to provide an additional safe, secure, and sustainable local drinking water supply for San Diego. The program plans to use advanced water purification technology to supply the San Diego regions of North City, Central Area and the South Bay with potable recycled water.

Pure Water San Diego includes construction of new advanced water purification facilities, a water reclamation plant, upgrades to existing water reclamation and wastewater treatment facilities, and construction of new pump stations and pipelines.

The program is expected to produce a cumulative total of 93,034 AF/y (83 mgd) of potable recycled water to be added to the City of San Diego’s supply portfolio by completion in 2035. It is also expected that this will decrease the region’s imported water demand and associated energy usage. In addition, the facilities associated with Pure Water Phase 1 are planned to generate a supplemental renewable energy source for the City while also decreasing reliance on other less sustainable energy supplies. This shift in energy sources will decrease the region’s GHG emissions, which is in alignment with the City’s Climate Action Plan guidelines. Pure Water San Diego Phase 1 is expected to convey 33,627 AF/y (30 mgd) from the North City Advanced Water Reclamation Plant to Miramar Reservoir by the year 2021. Pure Water San Diego Phase 2 is included in the Increase Supplies Portfolio, and discussed in Box 5 of Section 3.6.2.4.
3.4.2.5 **Recycled Water**

In addition to the recycled water supply projects included in the Baseline Portfolio, recycled water supplies in the Baseline Plus Portfolio include Integrated Water Resource Solutions for the Carlsbad Watershed, Phase II of the North San Diego County Regional Recycled Water Project, and Safari Drought Response and Outreach. These projects are implemented in the CWASim model as demand reductions (see Section 4.4.1). Phase II of the North San Diego County Regional Recycled Water Project is not implemented in the model runs until the 2050 scenarios. All other Recycled Water projects in the Baseline Plus Portfolio are implemented in both the 2025 and 2050 scenarios.

3.4.2.6 **Stormwater Capture**

Stormwater Capture in the Baseline Plus Portfolio is represented by the Murray Urban Runoff Diversion System Capture project, which is implemented in the 2025 and 2050 scenarios as a demand reduction (see Section 4.4.1). It is estimated that this will provide an additional 200 AF/y of water supply.

3.4.2.7 **Urban and Agricultural Water Use Efficiency**

In addition to the projected conservation savings in the Baseline Portfolio, the Baseline Plus Portfolio includes projected conservation from projects such as the Regional Drought Resilience Program and San Diego Water Use Reduction Program. These projects are associated with the Urban and Agricultural Water Use Efficiency Concept and are implemented in the model as demand reductions (see Section 4.4.1). While the San Diego Water Use Reduction Program is implemented in 2025 and 2050 scenarios, the remaining Urban and Agricultural Water Use Efficiency projects in this Portfolio are only implemented in the 2050 scenarios.

3.4.2.8 **Watershed and Ecosystem Management**

Unlike the Baseline Portfolio, the Baseline Plus Portfolio incorporates four projects associated with the Watershed and Ecosystem Management Concept. Two of these projects were unable to be accounted for in the CWASim model. These projects, however, are evaluated in Task 2.5. The other two projects associated with this Concept that were able to be modeled are Hodges Water Quality Improvement Program (previously referred to as ‘Fix Hodges’) and Sweetwater Reservoir Wetlands Habitat Recovery. Improving water quality in these reservoirs will help to optimize water supply utilization for these sources. The Sweetwater Reservoir Wetlands Habitat Recovery project was implemented in 2025 and 2050 scenarios through the input spreadsheet, where the user can input maximum and minimum storage values for modeled reservoirs (see Section 4.2.1), while the Hodges Water Quality Improvement Program was only implemented in the 2050 scenarios through model logic.
Box 2. Project Highlight: Hodges Water Quality Improvement Program

Project Highlight

Hodges Water Quality Improvement Program

The Hodges Water Quality Improvement Program is a combination of projects being implemented by the City of San Diego Public Utilities Department to improve the water quality within Hodges Reservoir, which is currently 303(d) listed by the Clean Water Act as impaired for color, manganese, mercury (in fish tissue), nitrogen, phosphorus, turbidity, and pH. Water quality issues reduce the use of water in Hodges Reservoir in the regional Emergency Storage Project and limit the City’s ability to move water stored at the reservoir to other parts of the distribution system. During wet weather events, Hodges Reservoir often overfills, and without the ability to move water from the reservoir to the regional water system, water spills from Hodges Dam and is thus underutilized. Projects included in this Program for which the City of San Diego and its partners were able to secure partial funding include the Hodges Hypolimnetic Oxygenation System and the Hodges Natural Treatment System.

Due to limitations or restrictions on water quality and reservoir operations, the maximum reservoir release for Hodges Reservoir was limited to 7,000 AF/y (6.245 mgd) in scenarios in which the project is not implemented in the CWASim model. In scenarios with the project implemented the maximum release is increased to 168,133 AF/y (150 mgd). The project is included in the Baseline Plus Portfolio and is implemented in the 2050 scenarios based on the projected timeline for reservoir water quality improvements.
Box 3. Project Highlight: Sweetwater Reservoir Wetlands Habitat Recovery

**Project Highlight**

**Sweetwater Reservoir Wetlands Habitat Recovery**

Sweetwater Reservoir Wetlands Habitat Recovery is a Sweetwater Authority project that will remove invasive species and restore and rehabilitate approximately 112.7 acres of primarily riparian habitat near Sweetwater Reservoir, including 75 acres of Least Bell’s Vireo habitat.

A multi-channel design and bridge installation will spread river flow more evenly and improve habitat quality in areas lacking sufficient hydrology. This effort will reestablish the river-floodplain connection and will enable full use of Sweetwater Reservoir to store an additional 7,873 AF of water when available. This project is simulated in the model using a restriction on Sweetwater Reservoir, making the capacity 20,206 AF when the project is not implemented, and 28,079 AF when implemented.

Project partners include SDCWA, California Conservation Corps, and Urban Corps.
3.5. Enhanced Conservation Portfolio

3.5.1. Portfolio Overview
The Enhanced Conservation Portfolio examines 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 individual member agencies. The Portfolio is a high-level analysis of simulated demand reduction at the regional-scale, which may be achieved by a 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.

In May 2018 Governor Brown signed into law SB 606 and AB 1668 which set new long-term water efficiency goals through a mandated 55 gallons per capita per 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 the 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.

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 8 lists projects in the Enhanced Conservation Portfolio and the supply volumes associated with those projects for each demand scenario.
Table 8. Summary of Enhanced Conservation Portfolio Concepts and Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyance Improvement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Conveyance Improvement</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Drought Restriction/Allocation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Drought Restriction/Allocation projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Enhanced Conservation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhanced Conservation</td>
<td>NA¹</td>
<td>52,265 AF/y</td>
<td>179,582 AF/y</td>
</tr>
<tr>
<td><strong>Total Change in Conservation between the Baseline Plus and Enhanced Conservation</strong></td>
<td>No change</td>
<td>52,265 AF/y</td>
<td>179,582 AF/y</td>
</tr>
<tr>
<td>Firm Water Supply Agreements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Firm Water Supply Agreements projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Gray Water Use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Gray Water Use projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Groundwater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Groundwater projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Imported Water Purchases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Imported Water Purchases</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Local Surface Water Reservoirs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Local Surface Water Reservoirs projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Potable Reuse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Potable Reuse projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Recycled Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Recycled Water projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
</tbody>
</table>
### 3.5.2. Portfolio Concept

#### 3.5.2.1 Enhanced Conservation

The Enhanced Conservation Portfolio is associated with the Enhanced Conservation Concept. It is defined as a 1% reduction in water demand (gallons per capita per day, GPCD) per year, starting in 2020 when it is assumed that the 20x20 targets outlined in SBX7-7 are reached. The additional conservation required to achieve Enhanced Conservation was calculated in a three-step process:

1. Calculate regional target demands for 2025 and 2050 assuming a 1% reduction in GPCD. To accomplish this, the 20x20 target (584,949 AF/y) was converted to GPCD and a 1% reduction in GPCD per year for future demand scenarios was calculated for 2025 and 2050. GPCD values for 2025 and 2050 were calculated using population projections provided by the 2015 UWMP and the SDCWA staff. These GPCD values were then converted to AF/y. Enhanced Conservation target demands are reported in Table 9.

<table>
<thead>
<tr>
<th>Target Demands</th>
<th>2025</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPCD (total)</td>
<td>148</td>
<td>115</td>
</tr>
<tr>
<td>AF/y</td>
<td>580,351</td>
<td>507,564</td>
</tr>
</tbody>
</table>

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).
2) Calculate total conservation volume required to achieve Enhanced Conservation regional target demands values.

3) Calculate Enhanced Conservation volume required in addition to Baseline and Baseline Plus conservation volumes to achieve total regional conservation volume for the Enhanced Conservation Portfolio (Table 10).

Table 10. Conservation Volumes for Baseline, Baseline Plus, and Enhanced Conservation Portfolios

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>2015 (AF/y)</th>
<th>2025 (AF/y)</th>
<th>2050 (AF/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Portfolio conservation volume</td>
<td>50,000</td>
<td>89,110</td>
<td>155,468</td>
</tr>
<tr>
<td>Baseline Plus Portfolio conservation volume (in addition to Baseline)</td>
<td>0</td>
<td>781</td>
<td>2,874</td>
</tr>
<tr>
<td>Enhanced Conservation Portfolio conservation volume (in addition to Baseline and Baseline Plus)</td>
<td>0</td>
<td>52,265</td>
<td>179,582</td>
</tr>
<tr>
<td>Total Enhanced Conservation Portfolio conservation volume</td>
<td>50,000</td>
<td>142,156</td>
<td>337,924</td>
</tr>
</tbody>
</table>

Note: Only includes Enhanced Conservation and Urban and Agricultural Water Use Efficiency Concepts. Other Concepts modeled as demand reductions in CWASim are not included in this table.

The total regional Enhanced Conservation amount was then split among member agency demand nodes for use in the CWASim model. The Enhanced Conservation Portfolio projected conservation volumes are incorporated in the model as demand reductions (see Section 4.4.1) for each time period of the model analysis: 2015, 2025, and 2050. The Gross Demand values, total Enhanced Conservation Portfolio conservation volumes, and the difference between Gross Demand and Conservation is shown in Table 11.

Table 11. Gross Demands Minus Enhanced Conservation Portfolio Volume

<table>
<thead>
<tr>
<th>Projected Conservation Volumes</th>
<th>2015 (AF/y)</th>
<th>2025 (AF/y)</th>
<th>2050 (AF/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Demand (Normal Years, no climate change)</td>
<td>619,739</td>
<td>722,507</td>
<td>845,488</td>
</tr>
<tr>
<td>Total Enhanced Conservation Portfolio conservation volume (includes conservation from the Baseline and Baseline Plus Portfolios)</td>
<td>50,000</td>
<td>142,156</td>
<td>337,924</td>
</tr>
<tr>
<td>Gross Demand minus Total Enhanced Conservation Portfolio conservation volume</td>
<td>569,739</td>
<td>580,351</td>
<td>507,564</td>
</tr>
</tbody>
</table>
3.6. Increase Supplies Portfolio

3.6.1. Portfolio Overview
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. 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 12 lists projects that are included in the Increase Supplies Portfolio and the supply volumes associated with those projects for each demand scenario.

Table 12. Summary of Increase Supplies Portfolio Concepts and Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drought Restriction/Allocation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Drought Restriction/Allocation Projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td><strong>Firm Water Supply Agreements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Firm Water Supply Agreements projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td><strong>Gray Water Use</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Gray Water Use Projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Gray water pilot project</td>
<td>NA(^1)</td>
<td>NA</td>
<td>2,575 AF/y</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio</strong></td>
<td>No change</td>
<td>No change</td>
<td>2,575 AF/y</td>
</tr>
<tr>
<td><strong>Groundwater</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Groundwater Projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Santee/El Monte Groundwater Extraction</td>
<td>NA</td>
<td>NA</td>
<td>1,300 AF/y</td>
</tr>
<tr>
<td>Middle Sweetwater River Basin Groundwater Well System</td>
<td>NA</td>
<td>NA</td>
<td>1,000 AF/y</td>
</tr>
<tr>
<td>Mission Valley Brackish Groundwater Recovery Project</td>
<td>NA</td>
<td>840 AF/y</td>
<td>1,680 AF/y</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Otay Mesa Lot 7 Groundwater Well System (capacity)</td>
<td>NA</td>
<td>NA</td>
<td>400 AF/y</td>
</tr>
<tr>
<td>Otay River Valley GW Aquifer Studies &amp; Field Investigations</td>
<td>NA</td>
<td>3,900 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>San Diego Formation - Southeastern San Diego, including Mt. Hope</td>
<td>NA</td>
<td>800 AF/y</td>
<td>1,600 AF/y</td>
</tr>
<tr>
<td>San Dieguito River Basin Brackish GW Recovery and Treatment</td>
<td>NA</td>
<td>560 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>San Luis Rey Groundwater Study</td>
<td>NA</td>
<td>4,000 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>San Pasqual Brackish Groundwater Recovery Project</td>
<td>NA</td>
<td>1,325 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio</strong></td>
<td>No change</td>
<td>11,425 AF/y</td>
<td>15,765 AF/y</td>
</tr>
</tbody>
</table>

**Imported Water Purchases**

| All Baseline Plus Imported Water Purchases Projects                     | See Table 7          | See Table 7          | See Table 7          |
| 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 7          | See Table 7          | See Table 7          |

**Potable Reuse**

| All Baseline Plus Potable Reuse Projects                                 | See Table 7          | See Table 7          | See Table 7          |
| East County Advanced Water Purification Program Phase 3                 | NA                   | NA                   | 5,824 AF/y           |
| 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           |
### Project Demand Scenarios

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potable Reuse/Hale Avenue Resource Recovery Facility (HARRF)</td>
<td>NA</td>
<td>NA</td>
<td>90 AF/y</td>
</tr>
<tr>
<td>Pure Water San Diego Phase 2</td>
<td>NA</td>
<td>NA</td>
<td>59,407 AF/y (53 mgd) production capacity</td>
</tr>
<tr>
<td>SFID/SDWD/SEJPA Potable Reuse Project</td>
<td>NA</td>
<td>550 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>South WWTP - Indirect Potable Recharge</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply</strong></td>
<td>No change</td>
<td>550 AF/y</td>
<td>83,673 AF/y</td>
</tr>
<tr>
<td><strong>Recycled Water</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Recycled Water Projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Carlsbad WRF - Landscape, Agriculture 2025</td>
<td>NA</td>
<td>328 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Carlsbad WRF - Landscape, Agriculture 2050</td>
<td>NA</td>
<td>NA</td>
<td>616 AF/y</td>
</tr>
<tr>
<td>Extension 153 Phase I</td>
<td>NA</td>
<td>189 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Extension 153 Phase II</td>
<td>NA</td>
<td>NA</td>
<td>300 AF/y</td>
</tr>
<tr>
<td>HARRF - Landscape, Agriculture, Industrial, PR</td>
<td>NA</td>
<td>7,130 AF/y</td>
<td>8,130 AF/y</td>
</tr>
<tr>
<td>Integrated Water Resource Solutions for the Carlsbad Watershed</td>
<td>NA</td>
<td>NA</td>
<td>100 AF/y</td>
</tr>
<tr>
<td>Joint RW Transmission Project with SFID and Olivenhain MWD</td>
<td>NA</td>
<td>400 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Lilac Hills Ranch WRF</td>
<td>NA</td>
<td>NA</td>
<td>294 AF/y</td>
</tr>
<tr>
<td>Lower Moosa Canyon WRF</td>
<td>NA</td>
<td>460 AF/y</td>
<td>700 AF/y</td>
</tr>
<tr>
<td>Meadowlark WRF</td>
<td>NA</td>
<td>NA</td>
<td>187 AF/y</td>
</tr>
<tr>
<td>Meadowood WRF</td>
<td>NA</td>
<td>100 AF/y</td>
<td>143 AF/y</td>
</tr>
<tr>
<td>North City WRP - Project 1</td>
<td>NA</td>
<td>100 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>--------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>North City WRP - Project 2</td>
<td>NA</td>
<td>50 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>North District Recycled System/RW Chapman WRF</td>
<td>NA</td>
<td>NA</td>
<td>4,400 AF/y</td>
</tr>
<tr>
<td>North Village WRF</td>
<td>NA</td>
<td>NA</td>
<td>105 AF/y</td>
</tr>
<tr>
<td>North WWTP Landscape Application</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Rancho Cielo</td>
<td>NA</td>
<td>NA</td>
<td>100 AF/y</td>
</tr>
<tr>
<td>Ray Stoyer WRF - Landscape, Irrigation, Dust Control</td>
<td>NA</td>
<td>1,008 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Santa Maria WRP</td>
<td>NA</td>
<td>3,000 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Shadowridge WRP</td>
<td>NA</td>
<td>1,800 AF/y</td>
<td>3,000 AF/y</td>
</tr>
<tr>
<td>South WWTP - Injection to Las Flores Basin</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>South WWTP - Injection to Santa Margarita Basin</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>TBD - Evaluation Multiple Options/TBD - Supply/Source Treatment Plant/Agency for Recycled Water</td>
<td>NA</td>
<td>50 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Village Park Recycled Water Expansion Project</td>
<td>NA</td>
<td>127 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>W+157:181RP/Recycled Water Distribution System</td>
<td>NA</td>
<td>670 AF/y</td>
<td>1,600 AF/y</td>
</tr>
<tr>
<td>Welk WRF</td>
<td>NA</td>
<td>140 AF/y</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Woods Valley Ranch WRF Phase 3</td>
<td>NA</td>
<td>NA</td>
<td>168 AF/y</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply between the Increase Supplies and Baseline Plus Portfolio</strong></td>
<td>No change</td>
<td>15,552 AF/y</td>
<td>25,235 AF/y</td>
</tr>
</tbody>
</table>

**Stormwater Capture**

- All Baseline Plus Stormwater Capture projects: See Table 7
- See Table 7
- See Table 7

**Seawater Desalination**

- All Baseline Plus Seawater Desalination Projects: See Table 7
- See Table 7
- See Table 7
### Table 1: Project Information and Scenarios

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camp Pendleton Desalination Facility</td>
<td>NA</td>
<td>NA</td>
<td>168,133 AF/y (150 mgd) production capacity</td>
</tr>
<tr>
<td>Re-rating of Carlsbad Desalination for higher flow</td>
<td>NA (model uses Baseline production capacity of 55,991 AF/y or 50 mgd)</td>
<td>59,407 AF/y (53 mgd) production capacity (increased from 55,991 AF/y (50 mgd) in Baseline)</td>
<td>Same as 2025</td>
</tr>
<tr>
<td>Rosarito Beach Desalination</td>
<td>NA</td>
<td>NA</td>
<td>16,800 AF/y production capacity</td>
</tr>
</tbody>
</table>

#### 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 7 | See Table 7 | See Table 7 |

### Watershed and Ecosystem Management

| All Baseline Plus Watershed and Ecosystem Management projects | See Table 7 | See Table 7 | See Table 7 |

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).

### 3.6.2 Portfolio Concepts

#### 3.6.2.1 Gray Water Use

The Gray Water Pilot Project is the only project associated with the Gray Water Use Concept in the Increase Supplies Portfolio. It involves retrofitting homes with simple gray water systems to allow gray water use for activities such as landscape irrigation. It is implemented as a demand reduction in the 2050 scenarios (see Section 4.4.1).

#### 3.6.2.2 Groundwater

Nine additional Groundwater projects are included in the Increase Supplies Portfolio relative to the Baseline Plus Portfolio, each implemented in the CWASim model as a demand reduction (see Section 4.4.1). While most of these projects are implemented in both the 2025 and 2050 scenarios, the Santee/El Monte Groundwater Extraction, Middle Sweetwater River Basin Groundwater Well System, and Otay Mesa Lot 7 Groundwater Well System projects are only implemented in the 2050 scenarios. Projects include brackish groundwater recovery projects and groundwater investigations.
3.6.2.3 **Imported Water Purchases**

In addition to MWD imported water accounted for in the Baseline Portfolio, the Increase Supplies Portfolio includes additional imported supplies from Cadiz, California, to the Otay Water District. These additional imported supplies are simulated in the 2050 scenarios as a demand reduction of 5,000 AF/y (see Section 4.4.1).

3.6.2.4 **Potable Reuse**

Potable Reuse projects in this Portfolio include Phase 3 of the East County Advanced Water Purification Program (Phases 1 and 2 were included in the Baseline Plus Portfolio), and Phase 2 of the Pure Water San Diego Program (Phase 1 was included in the Baseline Plus Portfolio). Five other potable reuse projects are also included in this Portfolio. Of these five projects, the South
San Diego Basin Study
Task 2.4 – Structural and Operations Concepts

WWTP - Indirect Potable Recharge project was unable to be modeled because it is a Camp Pendleton member agency project and the CWASim model does not include a demand node for Camp Pendleton. All potable reuse projects were implemented in the CWASim model as demand reductions, with exception of the Pure Water San Diego Program. Details on implementation of the Pure Water San Diego Program in the CWASim model are described in Section 4.2.6.2. The majority of the potable reuse projects in this Portfolio were only simulated in the 2050 scenarios. This includes Phase 2 of the Pure Water San Diego Program.

Box 5. Project Highlight: Pure Water San Diego Phase 2

<table>
<thead>
<tr>
<th>Project Highlight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pure Water San Diego Phase 2</strong></td>
</tr>
<tr>
<td>Pure Water San Diego is the City of San Diego Public Utilities Department’s proposed program to provide an additional safe, secure, and sustainable local drinking water supply for San Diego. The program is expected to add a cumulative total (Phase 1 and Phase 2) of 93,000 AF/y (83 mgd) of potable recycled water to the City of San Diego’s supply portfolio by completion in 2035. Pure Water San Diego Phase 2 consists of two options:</td>
</tr>
<tr>
<td>• Option 1*: 59,400 AF/y (53 mgd) from the Central Area Advanced Water Reclamation Plant to Murray Reservoir or San Vicente by 2035.</td>
</tr>
<tr>
<td>• Option 2: 16,800 AF/y (15 mgd) from South Bay Advanced Water Reclamation Plant to Lower Otay Reservoir by the year 2035. If completed, the production rate of 59,400 AF/y (53 mgd) would be reduced to 42,600 AF/y (38 mgd).</td>
</tr>
<tr>
<td>The City of San Diego is conducting an initial alternatives analysis which will provide additional definition to Pure Water Phase 2. This initial analysis will be completed in early 2019 and will result in a narrowed subset of candidate projects that will be further assessed to arrive at preferred alternatives.</td>
</tr>
<tr>
<td>*Note: Option 1 was implemented in the 2050 demand scenario in the Increase Supplies Portfolio.</td>
</tr>
</tbody>
</table>

3.6.2.5 **Recycled Water**

Twenty-seven additional Recycled Water projects are included in the Increase Supplies Portfolio relative to the Baseline Plus Portfolio. Of these projects, three were unable to be modeled because they are projects for the Camp Pendleton member agency and the CWASim model does not include a demand node for Camp Pendleton. An example of one of these projects is South WWTP Injection to the Santa Margarita Basin. The projects that were modeled were implemented in the CWASim model as demand reductions (see Section 4.4.1), and more than half of these projects were simulated in both 2025 and 2050 scenarios. Examples of Recycled Water projects implemented in the CWASim model include Woods Valley Ranch WRF Phase 3 (simulated in 2050), which is anticipated to bring the plant capacity up to 308 AF/y (275,000
gallons per day), from the current 84 AF/y (75,000 gallons per day) capacity, and Santa Maria WRP, simulated in both 2025 and 2050 with a modeled supply volume of 3,000 AF/y.

### 3.6.2.6 Seawater Desalination

The Increase Supplies Portfolio includes three Seawater Desalination projects: re-rating of the Carlsbad Desalination Facility for higher flow, the Camp Pendleton Desalination Facility, and the Rosarito Beach Desalination Facility. These projects are implemented through model logic (see Section 4.2.3). Re-rating of the Carlsbad Desalination Facility for higher flow is included in both the 2025 and 2050 scenarios, and the other projects are only implemented in the 2050 scenarios. Re-rating of the Carlsbad Desalination Facility increases the plant capacity from 153 AF/d to 163 AF/d. The proposed Camp Pendleton Desalination Plant project involves the development of an initial 50 mgd or 56,000 AF/y seawater desalination plant, with subsequent expansions at 50 mgd increments up to a maximum capacity of 150 mgd or 168,000 AF/y, as modeled in the 2050 scenario. The proposed Rosarito Desalination Plant includes the production of about 56,000 AF/y (50 mgd), expandable to 112,000 AF/y (100 mgd), in Mexico, with excess water produced made available to Otay Water District. This excess water was modeled as 16,800 AF/y in the 2050 scenarios. See Section 4.2.3 and Appendix B – Model Implementation Details for Selected Projects for more information.

### 3.7. Optimize Existing Facilities Portfolio

#### 3.7.1. Portfolio Overview

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. 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 13 lists projects in the Optimize Existing Facilities Portfolio and the supply volumes associated with those projects for each demand scenario.

**Table 13. Summary of Optimize Existing Facilities Portfolio Concepts and Projects**

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyance Improvement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Conveyance Improvement Projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Dulzura Conduit Replacement</td>
<td>NA¹</td>
<td>NA</td>
<td>Increases capacity from 21,300 to 44,800 AF/y (19 mgd to 40 mgd) and reduces loss from 10% to 0%</td>
</tr>
<tr>
<td>Pipeline 3/Pipeline 4 Conversion</td>
<td>NA</td>
<td>NA</td>
<td>Alleviates untreated water delivery constraint.</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Diego County Reservoir Intertie</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P3 + P5 capacity is 521,600 AF/y (720 cfs) except for Optimize Existing Facilities (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).</td>
</tr>
<tr>
<td>Second Crossover Pipeline</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Increases untreated water conveyance between the 2nd and 1st Aqueduct by approximately 94,000 AF</td>
</tr>
<tr>
<td>Total Change in Conveyance Capacity between the Baseline Plus and Baseline Portfolio</td>
<td>No change</td>
<td>No change</td>
<td>Conveyance capacity increased by 55,900 AF/y</td>
</tr>
</tbody>
</table>

### Drought Restriction/Allocation

| All Baseline Plus Drought Restriction/Allocation projects | See Table 7 | See Table 7 | See Table 7 |

### Firm Water Supply Agreements

| All Baseline Plus Firm Water Supply Agreement projects | See Table 7 | See Table 7 | See Table 7 |

### Gray Water Use

| All Baseline Plus Gray Water Use projects | See Table 7 | See Table 7 | See Table 7 |

### Groundwater

| All Baseline Plus Groundwater projects | See Table 7 | See Table 7 | See Table 7 |

### Imported Water Purchases

| All Baseline Plus Imported Water Purchases projects | See Table 7 | See Table 7 | See Table 7 |
### 3.7.2. Portfolio Concepts

#### 3.7.2.1 Conveyance Improvement

Conveyance Improvement projects in the Optimize Existing Facilities Portfolio are anticipated to increase water conveyance and delivery capacity. They include Pipeline 3/Pipeline 4 Conversion, San Diego County Reservoir Intertie, Second Crossover Pipeline, and Dulzura Conduit Replacement. These projects are implemented in the model runs via model logic. All four projects included in this Portfolio are only implemented in the 2050 scenarios. Pipelines
simulated in the CWASim model are displayed in Table 18 of Section 4.2.2.1. To simulate the Second Crossover Pipeline, the Crossover Pipeline Capacity was increased from 144,900 AF/y (200 cfs) in the Baseline Portfolio to 239,100 AF/y (330 cfs) in the Optimize Existing Facilities Portfolio. The Dulzura Conduit Replacement project will replace and renovate most of the 11-mile-long open channel concrete conduit, which is over 100 years old and is deteriorating. This project is implemented in the CWASim model through model logic in the 2050 scenarios by increasing the modeled capacity for the Dulzura Conduit from 21,300 to 44,800 AF/y (19 to 40 mgd) and reducing loss from 10% to 0%. Section 4.2.2 discusses implementation of the San Diego Reservoir Intertie in the CWASim model. This project is designed to optimize seasonal storage to prevent spills. Brief overviews of the San Diego County Reservoir Intertie, Pipeline 3/Pipeline 4 Conversion and the Dulzura Conduit projects are included in Project Highlight Box 6, Box 7, and Box 8, respectively.

Box 6. Project Highlight: San Diego Reservoir Intertie

Project Highlight
San Diego Reservoir Intertie

The goal of the reservoir intertie project is to improve water storage operations, supply reliability, and water yield through more effective interconnections between various water storage reservoirs. Based on discussions with the City of San Diego water planning and operations staff, the following reservoir intertie concept has been developed:

- **Storage Facilities**
  - El Capitan Reservoir
  - San Vicente Reservoir
  - Santee-El Monte Groundwater Basin
  - Murray Reservoir

- **Hydraulic/Conveyance Facilities**
  - New pump station to convey water from El Capitan to San Vicente Reservoir (reverse flow in San Vicente pipeline)
  - Upgraded flow control facility to permit simultaneous draw of water from El Capitan and San Vicente reservoirs, and to allow reverse flow on the El Capitan pipeline for period in which imported water storage in El Capitan is desired
  - Reconfigured inlet/outlet works at El Capitan to allow for imported water storage
  - Recharge/extraction wells to permit recharge of San Diego River water via El Capitan releases, and extraction of stored groundwater in the El Monte portion of the groundwater basin

The integration of these storage facilities and new/upgraded conveyance facilities would allow storage operations in San Vicente Reservoir, El Capitan Reservoir, and the El Monte groundwater basin to be optimized as a “reservoir system” for the benefit of water supply reliability. Local supply and imported supply could be stored and moved between any of these storage facilities to reduce spills and maximize imported water storage opportunities. Water from all three storage facilities can also be released through existing pipelines to Lake Murray and Alvarado Water Treatment Plant for distribution into the existing treated water system.
Box 7. Project Highlight: Pipeline3/Pipeline 4 Conversion

**Project Highlight**

**Pipeline 3/Pipeline 4 Conversion**

This project involves converting an existing portion of Pipeline 4 from treated water service to untreated water service and converting a similar portion of Pipeline 3 from untreated water service to treated water service. Since Pipeline 4 has a larger capacity than Pipeline 3 (340,500 vs 202,800 AF/y [470 cfs vs. 280 cfs]), this project is anticipated to increase the untreated water conveyance capacity in the Second Aqueduct north of Twin Oaks Valley. This project would alleviate an untreated water delivery constraint at the MWD delivery point.

Box 8. Project Highlight: Dulzura Conduit Replacement

**Project Highlight**

**Dulzura Conduit Replacement**

The proposed Dulzura Conduit Replacement project will renovate and replace the 11-mile-long concrete channel that was constructed by the City of San Diego in 1922. The Dulzura Conduit conveys water from Barrett Reservoir to Cottonwood Creek, which ultimately leads to Lower Otay Reservoir. The City of San Diego has water rights for the diversion of this water, which is important for City water supply. The conduit is also a significant component of the three-reservoir system of Morena, Barrett, and Otay Reservoirs and plays a role in local flood control.

Since its completion, various portions of the structure have been replaced or repaired to address material failures, widespread cave-ins of tunnels, boulder/landslide blockages, and damage caused by natural events. The deteriorated conditions have limited operational usage and have left this asset vulnerable to failure.

Based upon the current physical condition of the conduit, the modeled baseline capacity of the conduit is 21,300 AF/y (19 mgd) with 10% water loss. This represents the operational management of the conduit, though the conduit’s current conditions have resulted in it being unable to convey this capacity and, in some instances, the conduit has not been operable. The proposed Dulzura Conduit Replacement project is anticipated to be completed by 2050 and would increase the overall capacity of the conduit to 67,300 AF/y (60 mgd) with 0% loss. A conservative modeling approach was taken for the Basin Study, modeling total capacity for the completed project at 44,800 AF/y (40 mgd). This project is included in the 2050 scenarios in the Optimize Existing Facilities Portfolio.
3.8. Watershed Health and Ecosystem Restoration Portfolio

3.8.1. Portfolio Overview
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. 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 presents a more complete assessment of the effects of the Concepts included in this Portfolio. Table 14 lists projects in the Watershed Health and Ecosystem Restoration Portfolio and the supply volumes associated with those projects for each demand scenario.

Table 14. Summary of Watershed Health and Ecosystem Restoration Portfolio Concepts and Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyance Improvement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Conveyance Improvement projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Drought Restriction/Allocation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Drought Restriction/Allocation projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Firm Water Supply Agreements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Firm Water Supply Agreements projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Gray Water Use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Gray Water Use projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Groundwater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Groundwater projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Imported Water Purchases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Imported Water Purchases projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td><strong>Local Surface Water Reservoirs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Local Surface Water Reservoirs projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td><strong>Potable Reuse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Potable Reuse projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td><strong>Recycled Water</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Recycled Water projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td><strong>Stormwater BMPs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative Compliance Retrofit Project El Norte Parkway and Rincon, Villa Drive, Escondido</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Alternative Compliance Retrofit Project Mountain View Park, Escondido</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Bakersfield Street and San Altos Channel Restoration</td>
<td>NA¹</td>
<td>NA</td>
<td>12 AF/y</td>
</tr>
<tr>
<td>Broadway Channel Flood Risk Reduction and Water Quality Improvements</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>City of Oceanside Loma Alta Slough Restoration Project</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Golden Ave Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Las Colinas Channel Improvements</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Lemon Grove Avenue Green Streets</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Leucadia Roadside Park Stormwater Capture/Reuse Project</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Lincoln St Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Low Impact Development Urban Runoff Control Projects for the Tijuana Estuary</td>
<td>NA</td>
<td>NA</td>
<td>3 AF/y</td>
</tr>
<tr>
<td>Madera St Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Main Street Promenade Expansion</td>
<td>NA</td>
<td>NA</td>
<td>23 AF/y</td>
</tr>
<tr>
<td>Mapleview Street - Green Infrastructure and Stormwater Quality Improvement Program</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Project</td>
<td>2015 Demand Scenario</td>
<td>2025 Demand Scenario</td>
<td>2050 Demand Scenario</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Paradise Valley Creek Water Quality and Community Enhancement</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Pure Water - Los Peñasquitos Creek Urban Dry-Weather Water Harvesting</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Safari Park Stormwater Capture and Reuse Project</td>
<td>NA</td>
<td>NA</td>
<td>5 AF/y</td>
</tr>
<tr>
<td>Safari Park Water Reuse Sustainability and Watershed Protection Program</td>
<td>NA</td>
<td>NA</td>
<td>19 AF/y</td>
</tr>
<tr>
<td>San Marino Drive Green Street and Dry Weather Flow Management Vallecitos</td>
<td>NA</td>
<td>NA</td>
<td>2 AF/y</td>
</tr>
<tr>
<td>San Marino Drive Green Street and Dry Weather Flow Management Sweetwater</td>
<td>NA</td>
<td>NA</td>
<td>3 AF/y</td>
</tr>
<tr>
<td>San Miguel Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Skyline Dr and Kempt St Green Streets</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>South Santa Fe Green Street Project</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Spruce Street Channel Improvement Project</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Stormwater Capture off San Diego River along Alvarado Canyon and Fairmont Canyon to Fish and Wildlife site</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Sweetwater Rd Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Sweetwater River Park Bioretention</td>
<td>NA</td>
<td>NA</td>
<td>43 AF/y</td>
</tr>
<tr>
<td>Telegraph Canyon Channel Improvement Project</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Woodside Avenue Complete Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply between the Watershed Health and Ecosystem Restoration and Baseline Plus Portfolio</strong></td>
<td>No change</td>
<td>No change</td>
<td>110 AF/y</td>
</tr>
</tbody>
</table>

**Stormwater Capture**

<table>
<thead>
<tr>
<th>Stormwater Capture</th>
<th>All Baseline Plus Stormwater Capture Projects</th>
<th>Rainwater Harvesting</th>
<th>Total Change in Available Supply between the Watershed Health and Ecosystem Restoration and Baseline Plus Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Baseline Plus Stormwater Capture Projects</td>
<td>See Table 7</td>
<td>NA</td>
<td>No change</td>
</tr>
<tr>
<td>Rainwater Harvesting</td>
<td>NA</td>
<td>NA</td>
<td>416 AF/y</td>
</tr>
<tr>
<td><strong>Total Change in Available Supply between the Watershed Health and Ecosystem Restoration and Baseline Plus Portfolio</strong></td>
<td>No change</td>
<td>No change</td>
<td>416 AF/y</td>
</tr>
</tbody>
</table>
### San Diego Basin Study
#### Task 2.4 – Structural and Operations Concepts

<table>
<thead>
<tr>
<th>Project</th>
<th>2015 Demand Scenario</th>
<th>2025 Demand Scenario</th>
<th>2050 Demand Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seawater Desalination</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Seawater Desalination projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td><strong>Urban and Agricultural Water Use Efficiency</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Urban and Agricultural Water Use Efficiency Projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td><strong>Watershed and Ecosystem Management</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Baseline Plus Watershed and Ecosystem Management Projects</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>See Table 7</td>
</tr>
<tr>
<td>69th St Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Alternative Compliance Retrofit Project Avenida Del Diablo Park, Escondido</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Broadway/Federal Blvd Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Canton Dr Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Central Avenue Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Federal Blvd Channel</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Massachusetts Blvd Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Mt. Vernon St Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Nestor Creek Channel Restoration</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>North Ave and Grove Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Palm St Green Street</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Paradise Creek Restoration Phase II</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Sycamore Creek Restoration</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Tijuana River Floating Trash Capture System</td>
<td>Not modeled</td>
<td>Not modeled</td>
<td>Not modeled</td>
</tr>
</tbody>
</table>

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).

### 3.8.2. Portfolio Concepts

#### 3.8.2.1 Stormwater BMPs
A majority of the projects associated with the Watershed Health and Ecosystem Restoration Portfolio are associated with the Stormwater BMPs Concept. There are 29 total Stormwater BMP projects in this Portfolio. Of these projects, eight could be simulated in the CWASim model.
These were implemented as demand reductions (see Section 4.4.1) in the 2050 scenarios. Examples of these projects are Sweetwater River Park Bioretention, Safari Park Stormwater Capture and Reuse Project, and Bakersfield Street and San Altos Channel Restoration. Projects not implemented in the model are evaluated in Task 2.5.

### 3.8.2.2 Stormwater Capture

The Stormwater Capture Concept includes one project implementing rainwater harvesting. Most stormwater in the Study Area is impounded in existing inland surface water reservoirs, so this Concept only includes additional centralized or decentralized capture and treatment of stormwater runoff. It is implemented in the CWASim model in the 2050 demand scenarios as a demand reduction (see Section 4.4.1). According to the City of San Diego’s 2012 Long-Range Water Resources Plan, rainwater harvesting could yield between 100 and 416 AF/y in normal to wet years. The Basin Study used the maximum yield of 416 AF/y. This assumes that 20 percent of residential and non-residential customers participate.

### 3.8.2.3 Watershed and Ecosystem Management

The Watershed and Ecosystem Management projects associated with this Portfolio were unable to be implemented in the CWASim model since there is no specific water supply volume identified by them. There are 14 of these projects which may provide water quality and other benefits and include projects such as Sycamore Creek Restoration and the Tijuana River Floating Trash Capture System. The benefits of these projects are evaluated in Task 2.5.

### 4. CWASim Model

Task 2.4 of the Basin Study used the CWASim model to simulate operations of the water system in the study area. CWASim is a GoldSim model originally developed for SDCWA by Jacobs (formerly CH2M) in support of the 2013 Regional Facilities Optimization and Master Plan Update (San Diego County Water Authority, 2013; CH2M, 2015). GoldSim is a general purpose simulation software for dynamically modeling complex systems in business, engineering, and science. The original version of CWASim and a companion short-term operations model were extensively reviewed by SDCWA and were validated by comparison to historical measured monthly and annual flows at major delivery points and selected internal system flows.

CWASim simulates operations of the San Diego supply system by modeling water supplies, demands, and deliveries through a representation of the water supply infrastructure in the region. It runs on a daily timestep and represents the system with elements and connectors for reservoirs, water treatment plants, pipelines, delivery points, and other water supply infrastructure components. It includes representation of local and imported supply sources, member agency demands, SDCWA facilities, and member agency facilities that are connected to the SDCWA system. It does not include representation of member agency facilities that are not connected to the SDCWA system. Operational logic describes how water is distributed throughout the system at each simulation timestep. It is a daily demand-driven mass-balance model, meaning that at any time step, the model aggregates and tries to meet demands from SDCWA member agencies under constraints of water supply availability, conveyance capacities, and operational rules. Although CWASim is not a hydraulic model, it does have hydraulic properties built into the
logic. Input data provides the water supply and demand volumes that drive the operations of the system. Chapter 4 discusses specific elements of the CWASim model, such as modeled reservoir and infrastructure capacities, and Chapter 5 discusses the water supply and demand projections as well as the simulations for each Portfolio. Model specific terminology is defined in the Glossary at the beginning of this report.

4.1. CWASim Model Layout and Schematic

CWASim elements, connectors, and functions are grouped into containers. The water system is described by four containers (North, Central, Crossover, and South) that group system elements based on their physical location and a Network container with elements that further describe model water distribution operations. CWASim also has a container for dashboards used to interact with the model, a mass balance check container, a model input container, a requests container that contains water demands and performs allocations, and a results container.

Because of the complexity of the model, CWASim also contains a simplified model schematic (Figure 5, Table 15, and Table 16) that allows users to interact with and navigate the model based on the physical layout of the system rather than through the more abstract representation of the containers. The schematic does not contain any model logic or elements that perform model simulations. The schematic shows demand nodes, reservoirs, treated and untreated water pipelines, pipeline connections, desalination plants, water treatment plants, and pump stations. The schematic is updated and maintained separately from the model simulation elements.
Figure 5. System connectivity schematic
Table 15. System Connectivity Schematic Legend

<table>
<thead>
<tr>
<th>Schematic Element</th>
<th>Schematic Image</th>
<th>Schematic Element</th>
<th>Schematic Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td><img src="image" alt="Connection" /></td>
<td>Reservoir</td>
<td><img src="image" alt="Reservoir" /></td>
</tr>
<tr>
<td>Demand Node</td>
<td><img src="image" alt="Demand Node" /></td>
<td>Treated Water</td>
<td><img src="image" alt="Treated Water" /></td>
</tr>
<tr>
<td>Desalination Plant</td>
<td><img src="image" alt="Desalination Plant" /></td>
<td>Untreated Water</td>
<td><img src="image" alt="Untreated Water" /></td>
</tr>
<tr>
<td>Water Treatment Plant</td>
<td><img src="image" alt="WTP" /></td>
<td>Bi-Directional Treated Water</td>
<td><img src="image" alt="Bi-Directional Treated Water" /></td>
</tr>
<tr>
<td>Pump Station</td>
<td><img src="image" alt="Pump Station" /></td>
<td>Bi-Directional Untreated Water</td>
<td><img src="image" alt="Bi-Directional Untreated Water" /></td>
</tr>
</tbody>
</table>

Table 16. Abbreviations used in the CWASim Schematic

<table>
<thead>
<tr>
<th>Model Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP</td>
<td>Water Treatment Plant</td>
</tr>
<tr>
<td>SD</td>
<td>San Diego</td>
</tr>
<tr>
<td>SV</td>
<td>San Vicente</td>
</tr>
<tr>
<td>PS</td>
<td>Pump Station</td>
</tr>
<tr>
<td>NC</td>
<td>North County</td>
</tr>
<tr>
<td>WA</td>
<td>Water Authority</td>
</tr>
<tr>
<td>MWD</td>
<td>Metropolitan Water District</td>
</tr>
<tr>
<td>El Cap</td>
<td>El Capitan Reservoir</td>
</tr>
<tr>
<td>CP</td>
<td>Camp Pendleton</td>
</tr>
<tr>
<td>WD</td>
<td>Water District</td>
</tr>
<tr>
<td>LH</td>
<td>Lake Hodges</td>
</tr>
<tr>
<td>TOV</td>
<td>Twin Oaks Valley</td>
</tr>
<tr>
<td>AP</td>
<td>Annual Production</td>
</tr>
</tbody>
</table>
4.2. Model Representation of System Infrastructure and Operations

Sections 4.2.1 through 4.2.6 describe how water resources infrastructure is implemented in the CWASim model. The descriptions include model elements used to model Baseline conditions for the Basin Study, as well as additional elements and logic used to model Concepts that may be modified or implemented in the future. See Section 3.1 for further details on Concepts.

4.2.1. Reservoirs

Of the 25 reservoirs in the San Diego region, CWASim models the 18 reservoirs that are connected to the SDCWA system (Table 17). The remaining seven reservoirs shown in Table 17 are excluded from CWASim because of their small volume or because they are not connected to the SDCWA system and only serve local demands. The reservoirs included in the model store local surface water runoff, imported MWD water, water transferred from another reservoir, or a combination of water from multiple sources. The model user has the ability to set capacities for each reservoir.

Table 17. San Diego Region Reservoirs

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Owner</th>
<th>Water Source(s)</th>
<th>In CWASim Model?</th>
<th>Natural inflows received in CWASim?</th>
<th>Modeled Capacity (Total) AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Wohlford</td>
<td>City of Escondido</td>
<td>surface water transfers local runoff</td>
<td>Yes</td>
<td>Yes</td>
<td>6,940</td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>City of San Diego</td>
<td>local runoff</td>
<td>Yes8,9</td>
<td>Yes</td>
<td>50,7334</td>
</tr>
<tr>
<td>Hodges Reservoir</td>
<td>City of San Diego</td>
<td>imported untreated water local runoff</td>
<td>Yes8,9</td>
<td>Yes</td>
<td>33,600</td>
</tr>
<tr>
<td>Lower Otay Reservoir</td>
<td>City of San Diego</td>
<td>imported surface water transfers local runoff</td>
<td>Yes8,9</td>
<td>Yes</td>
<td>49,849</td>
</tr>
<tr>
<td>Morena Reservoir</td>
<td>City of San Diego</td>
<td>local runoff</td>
<td>Yes</td>
<td>Yes</td>
<td>50,200</td>
</tr>
<tr>
<td>Sutherland Reservoir</td>
<td>City of San Diego</td>
<td>local runoff</td>
<td>Yes7</td>
<td>Yes</td>
<td>31,960</td>
</tr>
<tr>
<td>San Vicente Reservoir</td>
<td>City of San Diego</td>
<td>imported untreated water local runoff</td>
<td>Yes8,9</td>
<td>Yes</td>
<td>272,528</td>
</tr>
<tr>
<td>Olivenhain Reservoir</td>
<td>SDCWA</td>
<td>local runoff imported water</td>
<td>Yes9</td>
<td>No</td>
<td>25,382</td>
</tr>
<tr>
<td>Reservoir</td>
<td>Owner</td>
<td>Water Source(s)</td>
<td>In CWASim Model?</td>
<td>Natural inflows received in CWASim?</td>
<td>Modeled Capacity (Total) AF</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------------</td>
<td>----------------------------------------</td>
<td>------------------</td>
<td>------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>San Dieguito Reservoir</td>
<td>San Dieguito Water District/ Santa Fe Irrigation District</td>
<td>imported water surface water transfers local runoff</td>
<td>Yes</td>
<td>No</td>
<td>883</td>
</tr>
<tr>
<td>Loveland Reservoir</td>
<td>Sweetwater Authority</td>
<td>local runoff</td>
<td>Yes</td>
<td>Yes</td>
<td>25,400</td>
</tr>
<tr>
<td>Sweetwater Reservoir</td>
<td>Sweetwater Authority</td>
<td>local runoff imported untreated water</td>
<td>Yes</td>
<td>Yes</td>
<td>20,207^6</td>
</tr>
<tr>
<td>Dixon Reservoir</td>
<td>City of Escondido</td>
<td>imported untreated water local runoff</td>
<td>Yes^7</td>
<td>No</td>
<td>2,610</td>
</tr>
<tr>
<td>Lake Jennings</td>
<td>Helix Water District</td>
<td>imported untreated water</td>
<td>Yes^7</td>
<td>No</td>
<td>9,790</td>
</tr>
<tr>
<td>Lake Poway</td>
<td>City of Poway</td>
<td>imported untreated water</td>
<td>Yes^7</td>
<td>No</td>
<td>3,320</td>
</tr>
<tr>
<td>Lake Ramona</td>
<td>Ramona Municipal Water District</td>
<td>imported untreated water</td>
<td>No^6</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Barrett Reservoir</td>
<td>City of San Diego</td>
<td>surface water transfers local runoff</td>
<td>Yes</td>
<td>Yes</td>
<td>37,900</td>
</tr>
<tr>
<td>Miramar Reservoir</td>
<td>City of San Diego</td>
<td>imported untreated water</td>
<td>Yes</td>
<td>No</td>
<td>6,050</td>
</tr>
<tr>
<td>Murray Reservoir</td>
<td>City of San Diego</td>
<td>imported water local runoff</td>
<td>Yes^7</td>
<td>No</td>
<td>5,200</td>
</tr>
<tr>
<td>Lake Henshaw</td>
<td>Vista Irrigation District</td>
<td>local runoff groundwater</td>
<td>Yes</td>
<td>No</td>
<td>53,400</td>
</tr>
<tr>
<td>Lake Cuyamaca</td>
<td>Helix Water District</td>
<td>local runoff</td>
<td>No^6</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Lake Turner</td>
<td>Valley Center Municipal Water District</td>
<td>imported water</td>
<td>No^6</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

1. See Section 5.2.1.4 for additional details on natural reservoir inflows.
2. Modeled reservoir capacities are different from 2015 SDCWA UWMP reservoir capacities in that the CWASim model simulates a flood surcharge pool for each reservoir. SDCWA UWMP capacities only account for usable storage, freeboard, and the dead pool zone, and do not account for a flood surcharge pool.
3. Unless otherwise noted, capacities remain the same for the remaining Portfolio model runs.
4. Capacity increased to 112,807 AF in the Optimize Existing Facilities Portfolio 2050 scenarios due to implementation of the San Diego Reservoir Intertie, which removes a restriction on El Capitan (storage level at El Capitan Dam was restricted to 700 feet elevation by the Division of Safety of Dams, which translates to a reservoir capacity of 50,733 AF).
Each reservoir in CWASim is modeled as an element containing functions that simulate water inflow, storage, and outflow. Maximum and minimum storage values and maximum releases are assigned to each reservoir, as well as evaporation losses and flood releases/spills.

Reservoirs in CWASim are controlled by rule curves. The rule curves divide the reservoir storage into nine reservoir zones or “pools”, of which only five are used in the CWASim model.

Reservoir rule curve zones are described as follows and an example is shown in Figure 6:

- Zone 1 – Flood Pool (blue zone in Figure 6) represents the reservoir flood zone. In this zone, water can be released immediately.
- Zone 2 – Seasonal Pool (red zone in Figure 6) represents the seasonal pool, which is available for normal use.
- Zone 3 – Carryover Pool (green zone in Figure 6) represents reservoir carryover storage that is used when consumption of all other sources at capacity would still result in a shortage.
- Zone 4 – Emergency Storage Pool (purple in Figure 6) represents emergency storage and is not used in the model runs. Emergency Storage in Olivenhain and San Vicente Reservoirs is associated with the Emergency Storage Project. This storage is not available for water supply in the CWASim model but would be made available in actual operations during emergency situations such as an interruption of imported water supplies.
- Zones 5 through 8 do not have storage allocated to them in the reservoirs implemented in CWASim for the San Diego Basin Study.
- Zone 9 – Dead Pool (light green in Figure 6) is water that is stored below the reservoir outlet. This zone is not used in the model runs.
4.2.2. Conveyance Facilities

4.2.2.1 Pipelines and Pump Stations
Pipelines (Table 18) are represented in CWASim by both elements and links connecting elements. Elements describe pipeline characteristics and operational logic, and links allow water to be transferred between elements by the model logic. Multiple elements and links may represent different reaches of the same pipeline. Detailed hydraulic characteristics such friction coefficients are not included in the CWASim model.

The First Aqueduct alignment includes Pipelines 1 and 2 and extends from the MWD Delivery Point to San Vicente Reservoir. The two pipelines are operated as a single unit. North of the Crossover Pipeline, Pipelines 1 and 2 deliver treated water from MWD. South of the Crossover Pipeline, Pipelines 1 and 2 convey untreated water.

Pipelines 3, 4, and 5 make up the Second Aqueduct alignment. The pipelines are divided into several reaches. Depending on the pipeline and reach, these pipelines convey treated or untreated water and are operated independently or as a unit. Pipeline 3 conveys treated or untreated water between the MWD Delivery Point and Lower Otay Reservoir. Pipeline 4 conveys treated or untreated water from the MWD Delivery Point to the southern portion of San Diego County. Pipeline 5 conveys untreated water from the MWD Delivery Point to water treatment plants in the southern portion of San Diego County stopping at Miramar.
## Table 18. San Diego Region Pipelines

<table>
<thead>
<tr>
<th>Pipeline Name</th>
<th>Owner</th>
<th>Water Type</th>
<th>Conveys water from</th>
<th>Conveys water to</th>
<th>In CWASim Model?</th>
<th>Modeled Capacity (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline 1 and 2 (First Aqueduct)</td>
<td>SDCWA</td>
<td>Treated (North of Crossover Pipeline) and Untreated (South of Crossover Pipeline)</td>
<td>MWD Delivery Point</td>
<td>San Vicente Reservoir</td>
<td>Yes</td>
<td>190 at MWD Delivery Point</td>
</tr>
<tr>
<td>Pipeline 3 (Second Aqueduct)</td>
<td>SDCWA</td>
<td>Treated or Untreated</td>
<td>MWD Delivery Point</td>
<td>Lower Otay Reservoir</td>
<td>Yes</td>
<td>P3 + P5 capacity is 720³ for OEF Portfolio 2050s scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P3 + P5 capacity is 895 in OEF Portfolio 2050s scenarios</td>
</tr>
<tr>
<td>Pipeline 4 (Second Aqueduct)</td>
<td>SDCWA</td>
<td>Treated or Untreated</td>
<td>MWD Delivery Point</td>
<td>Southern San Diego County</td>
<td>Yes</td>
<td>395 except for OEF Portfolio 2050s scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>135 in OEF Portfolio 2050s scenarios</td>
</tr>
<tr>
<td>Pipeline 5 (Second Aqueduct)</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>MWD Delivery Point</td>
<td>Southern San Diego County stopping at Miramar</td>
<td>Yes</td>
<td>P3 + P5 capacity is 720³ for OEF Portfolio 2050s scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P3 + P5 capacity is 895 in OEF Portfolio</td>
</tr>
<tr>
<td>Pipeline Name</td>
<td>Owner</td>
<td>Water Type</td>
<td>Conveys water from</td>
<td>Conveys water to</td>
<td>In CWASim Model?</td>
<td>Modeled Capacity (cfs)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------</td>
<td>------------</td>
<td>--------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
<td>------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Crossover Pipeline</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Second Aqueduct near Twin Oaks Valley Water Treatment Plant</td>
<td>First Aqueduct near Escondido-Vista Pipeline Pump Station</td>
<td>Yes</td>
<td>200</td>
</tr>
<tr>
<td>North County Distribution Pipeline</td>
<td>SDCWA</td>
<td>Treated</td>
<td>Second Aqueduct (Pipeline 4) near the Weese Filtration Plant</td>
<td>Oceanside, Vista, Vallecitos, and Rainbow member agencies</td>
<td>Yes, in aggregate fashion by delivery of water from Second Aqueduct</td>
<td>Modeled in aggregate fashion by delivery of water from Second Aqueduct</td>
</tr>
<tr>
<td>Tri-Agency Pipeline</td>
<td>SDCWA</td>
<td>Treated</td>
<td>Second Aqueduct</td>
<td>Vista, Carlsbad, and Oceanside member agencies</td>
<td>Yes</td>
<td>Modeled in aggregate fashion by delivery of water from Second Aqueduct</td>
</tr>
<tr>
<td>Ramona Pipeline</td>
<td>SDCWA</td>
<td>Treated</td>
<td>Second Aqueduct</td>
<td>Ramona, Olivenhain, and the City of San Diego member agencies</td>
<td>Yes</td>
<td>104</td>
</tr>
<tr>
<td>San Vicente Pipeline/Tunnel¹</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Second Aqueduct (Pipeline 5)</td>
<td>San Vicente, El Capitan, and Jennings Reservoirs and the Levy WTP</td>
<td>Yes</td>
<td>444 West to East</td>
</tr>
<tr>
<td>San Vicente Reservoir</td>
<td></td>
<td></td>
<td>San Vicente Reservoir</td>
<td>Second Aqueduct (Pipeline 5)</td>
<td>Yes</td>
<td>444 East to West⁶</td>
</tr>
<tr>
<td>Pipeline Name</td>
<td>Owner</td>
<td>Water Type</td>
<td>Conveys water from</td>
<td>Conveys water to</td>
<td>In CWASim Model?</td>
<td>Modeled Capacity (cfs)</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>------------</td>
<td>------------</td>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
<td>-----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Valley Center Pipeline</td>
<td>SDCWA</td>
<td>Treated</td>
<td>Second Aqueduct (Pipeline 4)</td>
<td>First Aqueduct (Pipelines 1 &amp; 2)</td>
<td>No⁷</td>
<td>N/A⁷</td>
</tr>
<tr>
<td>Olivenhain-Hodges Pipeline¹</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Lake Hodges</td>
<td>Olivenhain Reservoir</td>
<td>Yes</td>
<td>760</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Olivenhain Reservoir</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lake Hodges</td>
<td>Yes</td>
<td>760</td>
</tr>
<tr>
<td>El Monte Pipeline</td>
<td>City of San Diego</td>
<td>Untreated</td>
<td>San Vicente and El Capitan Reservoirs</td>
<td>Murray Reservoir or Alvarado WTP</td>
<td>Yes</td>
<td>150⁵</td>
</tr>
<tr>
<td>La Mesa-Sweetwater Extension</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>First Aqueduct</td>
<td>Sweetwater Reservoir</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Levy WTP</td>
<td>Yes, through ECRTWIP²</td>
<td>Modeled through ECRTWIP</td>
</tr>
<tr>
<td>Moreno-Lakeside Pipeline</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>San Vicente Pipeline/Tunnel</td>
<td>Levy WTP</td>
<td>Yes</td>
<td>93 West to East from San Vicente Pipeline¹ 124 East to West from San Vicente Pipeline¹</td>
</tr>
<tr>
<td>Sutherland-San Vicente Conduit</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Sutherland Reservoir</td>
<td>San Vicente Reservoir</td>
<td>Yes</td>
<td>50</td>
</tr>
<tr>
<td>Pomerado Pipeline</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Second Aqueduct (Pipeline 5)</td>
<td>Second Aqueduct (Pipelines 3 &amp; 4)</td>
<td>Yes</td>
<td>220</td>
</tr>
<tr>
<td>Rancho Pipeline</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Untreated conveyance downstream of Rancho Peñasquitos</td>
<td>Second Aqueduct (Pipeline 5)</td>
<td>Yes</td>
<td>600</td>
</tr>
<tr>
<td>Pipeline Name</td>
<td>Owner</td>
<td>Water Type</td>
<td>Conveys water from</td>
<td>Conveys water to</td>
<td>In CWASim Model?</td>
<td>Modeled Capacity (cfs)</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>------------</td>
<td>---------------------------------------------------------</td>
<td>----------------------------</td>
<td>------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>SD12 Pipeline (section of Pipeline 4)</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>30-inch interconnect connecting Pipelines 3 &amp; 4</td>
<td>Alvarado WTP</td>
<td>Yes</td>
<td>150</td>
</tr>
<tr>
<td>Second Crossover Pipeline</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Second Aqueduct near Twin Oaks Valley Water Treatment Plant</td>
<td>First Aqueduct near Escondido-Vista Pipeline Pump Station</td>
<td>No, but only implemented in the Optimize Existing Facilities Portfolio</td>
<td>130</td>
</tr>
<tr>
<td>The 30 Inch Pipeline</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>SD12 Pipeline 3</td>
<td>Yes</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

1. Capable of bi-directional flow
2. East County Regional Treated Water Improvement Program
3. Actual capacity was 780 cfs in 2015, but capacity was modeled as 720 cfs for 2015 and 2025 scenarios because capacity is expected to decrease to 720 cfs by 2025.
4. Theoretical maximum capacity was 90 cfs in 2015, but modeled as 70 cfs to reflect normal operating conditions.
5. Theoretical maximum capacity was 175 cfs and actual maximum was 124 cfs in 2015. Modeled as 150 cfs as an average operational maximum.
6. Actual capacity is 441 cfs.
7. Actual capacity is 140 cfs. CWASim models the Valley Center Pipeline indirectly through the allocation logic.

CWASim includes six elements representing the pump stations. Five elements were operational as of 2015, and one additional pump station (North County Pump Station 2) had not yet been constructed (Table 19). The model’s pump station elements include maximum flow capacities that are set by the user and distribute flows among the member agencies.

**Table 19. Major Pump Stations in the San Diego Region**

<table>
<thead>
<tr>
<th>Pump Station</th>
<th>Owner</th>
<th>Water Type</th>
<th>Use</th>
<th>In CWASim Model?</th>
<th>Baseline Modeled Capacity (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escondido</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>MWD untreated water enters the station from the Crossover Pipeline and P12_10 and is pumped to Dixon Reservoir.</td>
<td>Yes</td>
<td>20</td>
</tr>
<tr>
<td>Miramar</td>
<td>SDCWA</td>
<td>Treated</td>
<td>MWD treated water enters the station from the Miramar WTP and is pumped to San Diego 11.</td>
<td>Yes</td>
<td>60</td>
</tr>
</tbody>
</table>
### Pump Station Details

<table>
<thead>
<tr>
<th>Pump Station</th>
<th>Owner</th>
<th>Water Type</th>
<th>Use</th>
<th>In CWASim Model?</th>
<th>Baseline Modeled Capacity (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valley Center (P2A)</td>
<td>SDCWA</td>
<td>Treated</td>
<td>Used to deliver Twin Oaks Valley WTP treated water to north county agencies.</td>
<td>Yes</td>
<td>41</td>
</tr>
<tr>
<td>North County Pump Station 2</td>
<td>N/A</td>
<td>Treated</td>
<td>Did not exist as of 2015.</td>
<td>Yes, but only used in the New North Pipe Operation, which is not included in Task 2.4 model runs.</td>
<td>N/A</td>
</tr>
<tr>
<td>San Vicente</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>MWD untreated water is pumped from San Vicente Reservoir through a surge tank toward Junction 770.</td>
<td>Yes</td>
<td>300²</td>
</tr>
<tr>
<td>Olivenhain</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Can receive and/or deliver MWD untreated water between Olivenhain Reservoir and Pipe 5. When water is transferred from Olivenhain Reservoir into Hodges Reservoir, the process generates up to 40 megawatts of hydroelectricity, helping to offset some of the project operating costs.</td>
<td>Yes</td>
<td>314</td>
</tr>
<tr>
<td>Lake Hodges Pump Station</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Pumps MWD untreated water between Lake Hodges Reservoir and Olivenhain Reservoir.</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Twin Oaks Valley</td>
<td>SDCWA</td>
<td>Untreated</td>
<td>Used only as part of the Emergency Storage Project</td>
<td>No</td>
<td>N/A</td>
</tr>
</tbody>
</table>

1 Unless otherwise noted, capacities remain the same for the remaining Portfolio model runs.
2 Capacity increased to 444 cfs in the Baseline Plus 2050 scenario due to implementation of San Vicente 3rd Pump Drive and Power project. This capacity is used for 2050 scenarios in all Portfolios except Baseline.
As described in Box 6 in Section 3.7.2.1, as part of the Basin Study, new logic was added to allow implementation of the San Diego County Reservoir Intertie project. Prior to the modifications for the Reservoir Intertie, the existing CWASim model included storage operations for San Vicente Reservoir, El Capitan Reservoir, and Lake Murray. The model also included capacity limitations for the El Capitan Pipeline, San Vicente Pipeline, and El Monte Pipeline that limited the rate at which water could be released or exchanged between reservoirs. The model also limited the El Capitan operable pool to an elevation of 700 feet due to Division of Safety of Dams (DSOD) restrictions.

When the San Diego Reservoir Intertie options are selected in the model, the following modifications are implemented. Removal of DSOD restrictions on the operable pool at El Capitan. This modification reflects the achievement of meeting dam safety criteria through future dam improvements. These improvements may be identified through on-going investigations and addressed by potential future dam improvement projects.

- Enabling simultaneous draw of water from El Capitan and San Vicente reservoirs
- Enabling reverse flow in the El Capitan Pipeline during periods when imported water is being stored in El Capitan Reservoir.
- Addition of a new pump station to convey water from El Capitan pipeline to San Vicente Reservoir (reverse flow in the San Vicente pipeline). The capacity of the pump station was set at 55,100 AF/y (76 cfs), based on model calibration tests.
- Enabling imported water storage in El Capitan Reservoir using existing conveyance (SDCWA aqueduct).
- Simulation of approximately 7,000 AF of groundwater storage in the El Monte groundwater basin.
- Enabling release of water from El Capitan and San Vicente reservoirs to the El Monte groundwater basin through either river channel or recharge wells. Release was limited to 3,500 AF/y. These options reflect estimates of storage and injection considering Sustainable Groundwater Management Act requirements, water rights, and water use by other entities in the region.

See Appendix B – Model Implementation Details for Selected Projects for further details on implementation of the San Diego County Reservoir Intertie project.

4.2.3. Seawater Desalination Plants

The CWASim model has the capability to simulate seawater desalination supplies produced by the Carlsbad Desalination Plant, Camp Pendleton Desalination Plant, and Rosarito Desalination Plant. The user may specify which plants are active in a given model run, and the capacity of the plant if desired. Once the capacity of the plant is selected, it is held constant throughout the model run. Table 20-1 displays Baseline capacities. These capacities are used for all model runs, with exception of the Increase Supplies Portfolio model runs. Capacities used for the Increase Supplies Portfolio model runs are listed in Table 20-2.

The Carlsbad and Camp Pendleton Desalination Plants are implemented with model logic. They both have the ability to supply multiple member agencies and the user can set the plant capacity
and control plant operations using the Desalination dashboard in the CWASim model. The Rosarito Desalination Plant is implemented in the CWASim model as a demand reduction on Otay Water District, with a constant annual supply volume of 16,800 AF/y (15 mgd).

For additional details regarding implementation of the Camp Pendleton Desalination Plant and the Rosarito Desalination Plant, see Appendix B – Model Implementation Details for Selected Projects.

### Table 20-1. Baseline Capacities for Desalination Plants

<table>
<thead>
<tr>
<th>Desalination Plant</th>
<th>Recipients of Water</th>
<th>In CWASim Baseline Model Runs?</th>
<th>Baseline Modeled Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlsbad Desalination Plant</td>
<td>Carlsbad, Vallecitos, Ramona, Otay, San Diego Alvarado, San Diego North, San Diego SD11, San Dieguito/Santa Fe, Del Mar, Rincon, Padre Dam, Sweetwater, Vista, and Olivenhain</td>
<td>Yes</td>
<td>55,845 AF/y (153 AF/d)</td>
</tr>
<tr>
<td>Camp Pendleton Desalination Plant</td>
<td>Oceanside, Carlsbad, Ramona, San Diego North, Vista, Olivenhain, Padre Dam, San Diego 11, San Diego Alvarado, and Otay</td>
<td>No</td>
<td>N/A²</td>
</tr>
<tr>
<td>Rosarito Desalination Plant</td>
<td>Otay</td>
<td>No</td>
<td>N/A²</td>
</tr>
</tbody>
</table>

1 See Section 4.6 for definitions of member agency demand nodes  
2 The desalination plant is not implemented in the Baseline Portfolio

### Table 20-2. Increase Supplies Portfolio Capacities for Desalination Plants

<table>
<thead>
<tr>
<th>Desalination Plant</th>
<th>Recipients of Water</th>
<th>In CWASim Increase Supplies Model Runs?</th>
<th>Demand Scenario</th>
<th>Increase Supplies Modeled Capacity (AF/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlsbad Desalination Plant</td>
<td>Carlsbad, Vallecitos, Ramona, Otay, San Diego Alvarado, San Diego North, San Diego SD11, San Dieguito/Santa Fe, Del Mar, Rincon, Padre Dam, Sweetwater, Vista, and Olivenhain</td>
<td>Yes, with higher flow implemented in 2025 and 2050 scenarios</td>
<td>2015</td>
<td>55,845 AF/y (153 AF/d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2025</td>
<td>59,495 AF/y (163 AF/d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2050</td>
<td>59,495 AF/y (163 AF/d)</td>
</tr>
</tbody>
</table>
4.2.4. Water Treatment Plants

Eleven water treatment plants are modeled as elements within the CWASim model (Table 21). Treatment plant capacity determines how much water can be supplied by the treatment plant. The capacity value for each plant is set by the user and held constant throughout a run. Water treatment plant usage is determined by the demands of the agencies that have access to the treatment plant and the priority of sources that may supply water to that member agency. Most water treatment plants have only one or two member agency recipients so the capacity of the treatment plants is large enough to meet the demands without needing to prioritize between recipients. However, Twin Oaks Valley Water Treatment Plant is owned by SDCWA and can supply water to several member agencies. Therefore, member agencies are assigned priorities to Twin Oaks Valley treated water that determine the order for deliveries.

### Table 21. Water Treatment Plants

<table>
<thead>
<tr>
<th>Water Treatment Plant</th>
<th>Owner</th>
<th>Modeled Capacity (AF/d)</th>
<th>Location(s) of Source Water</th>
<th>Member Agency Recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alvarado</td>
<td>City of San Diego</td>
<td>368</td>
<td>Second Aqueduct, Lake Murray, San Vicente and El Capitan Reservoirs via the El Monte Pipeline</td>
<td>San Diego (Alvarado area)</td>
</tr>
<tr>
<td>Water Treatment Plant</td>
<td>Owner</td>
<td>Modeled Capacity (AF/d)</td>
<td>Location(s) of Source Water</td>
<td>Member Agency Recipients</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------</td>
<td>-------------------------</td>
<td>----------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Badger</td>
<td>Santa Fe ID and San Dieguito Water District</td>
<td>123</td>
<td>MWD, Lake Hodges, San Dieguito Reservoir</td>
<td>San Dieguito, Santa Fe</td>
</tr>
<tr>
<td>Escondido (Escondido-Vista)</td>
<td>City of Escondido</td>
<td>276</td>
<td>MWD via Crossover Pipeline, Lake Henshaw, Lake Wohlford, and Dixon Reservoir</td>
<td>Escondido, Vista</td>
</tr>
<tr>
<td>Levy</td>
<td>Helix Water District</td>
<td>325</td>
<td>Lake Jennings, El Capitan, and San Vicente Reservoir via the Moreno-Lakeside Pipeline</td>
<td>Helix, ECRTWIP1</td>
</tr>
<tr>
<td>Miramar</td>
<td>City of San Diego</td>
<td>441</td>
<td>Second Aqueduct, Miramar Reservoir, or from San Vicente</td>
<td>San Diego (Miramar area), San Diego (SD 11 area via Miramar Pump Station), Del Mar</td>
</tr>
<tr>
<td>Otay</td>
<td>City of San Diego</td>
<td>104</td>
<td>Lower Otay Reservoir, Second Aqueduct</td>
<td>San Diego (Otay area), Cal-Am</td>
</tr>
<tr>
<td>Olivenhain (McCollom)</td>
<td>Olivenhain</td>
<td>104</td>
<td>Olivenhain Reservoir, Second Aqueduct (Pipeline 5)</td>
<td>Olivenhain</td>
</tr>
<tr>
<td>Perdue</td>
<td>Sweetwater Authority</td>
<td>92</td>
<td>Sweetwater Reservoir, Loveland Reservoir, Second Aqueduct</td>
<td>National City/South Bay</td>
</tr>
<tr>
<td>Twin Oaks Valley (TOV)</td>
<td>SDCWA</td>
<td>307</td>
<td>Untreated MWD water from Second Aqueduct (Pipelines 4 or 5)</td>
<td>Vallecitos, Vista, Carlsbad, San Dieguito, Santa Fe, San Diego North, Del Mar, Ramona, Otay, Fallbrook, Helix, Padre Dam, San Diego, Sweetwater, and Olivenhain</td>
</tr>
<tr>
<td>Weese</td>
<td>City of Oceanside</td>
<td>77</td>
<td>Second Aqueduct</td>
<td>Oceanside</td>
</tr>
<tr>
<td>Poway (Berglund)</td>
<td>City of Poway</td>
<td>74</td>
<td>Lake Poway</td>
<td>Poway</td>
</tr>
</tbody>
</table>

1 East County Regional Treated Water Improvement Program, which connects Helix’s Levy Water Treatment Plant with Otay, Padre Dam, and Lakeside Water Districts.
4.2.5. **Recycled Water Facilities**

CWASim models recycled water as demand reductions. The total volume of recycled water supplies for a model run is subtracted from gross demands in the CWASim model. The total volume associated with demand reductions from recycled water varies by Portfolio (see Tables throughout Chapter 3 for recycled water projects and associated supply volumes in each Portfolio).

4.2.6. **Potable Reuse Facilities**

With the exception of Pure Water San Diego, CWASim models potable reuse water supplies as demand reductions. Pure Water San Diego was implemented with model logic rather than as a demand reduction due to its operational complexity compared to the other potable reuse projects (e.g., multiple demand nodes served, and multiple facilities impacted).

4.2.6.1 **Potable Reuse Modeled as Demand Reductions**

The total volume of Potable Reuse projects modeled as demand reductions is subtracted from gross demands. The total volume associated with demand reductions from potable reuse varies by Portfolio (see Tables throughout Chapter 3 for recycled water projects and associated supply volumes in each Portfolio).

4.2.6.2 **Dynamically Modeled Potable Reuse Projects**

Pure Water San Diego Phase 1 and Pure Water San Diego Phase 2 are the only potable reuse projects modeled dynamically in CWASim.

**Box 10. Model Implementation Highlight: Pure Water Phases 1 and 2**

The CWASim model includes user options to separately implement the Pure Water program for each reservoir mentioned in Box 1 in Section 3.4.2.4 and Box 5 in Section 3.6.2.4 (Miramar, San Vicente, Murray, and Lower Otay). See Appendix B – Model Implementation Details for Selected Projects for details on the implementation of Pure Water Phases 1 and 2 in the CWASim model. The user can perform a model simulation with any combination of the four reservoirs. A production rate is also included as a user input control for each of the reservoirs.

If the user implements the Miramar, Murray, or Otay reservoir options, the model logic will utilize the user-defined production rate to those reservoirs as long as there is available capacity in their seasonal pools (refer to Section 4.2.1 for a description of reservoir pools). The Miramar reservoir option is used to implement Pure Water San Diego Phase 1 with a supply volume of 33,600 AF/y (30 mgd) for 2025 and 2050 in the Baseline Plus Portfolio, discussed in Section 3.4. The CWASim model will utilize the Pure Water San Diego supply as first priority, reducing other supplies to fill the reservoir if needed.

The CWASim model uses the user-defined production rate associated with Pure Water San Diego Phase 2 to deliver water to the San Vicente Reservoir. There is currently no limit for Pure Water San Diego deliveries to San Vicente Reservoir. Preliminary results indicate San Vicente will always have capacity available to handle Pure Water inflows. The San Vicente Reservoir option is used to implement Pure Water San Diego Phase 2 in the Increase Supplies Portfolio with a supply volume of 59,499 AF/y (53 mgd) in the 2050 scenario, discussed in Section 3.6.
4.3. Other Model Features

4.3.1. Model Water Losses and Subtractions
Water losses from a water system may include reservoir seepage, reservoir evaporation, spills from reservoirs (which may be captured downstream), and distribution losses in pipelines and conveyance facilities. While these losses are generally unavailable to use for water supply, they may provide groundwater recharge or support environmental systems, and reservoir spills may be captured if downstream reservoirs exist. CWASim models three types of water losses: reservoir evaporation, reservoir spills, and other losses. CWASim also models water supply to the San Luis Rey River Tribes\(^1\) as a subtraction as described below.

Evaporation losses at reservoirs in CWASim are based on surface area and unit net evaporation rates. Reservoir spill losses are included in CWASim for all reservoirs, but primarily occur at Hodges, El Capitan, and Lower Otay. Other water losses and subtractions from the water simulated to be flowing through the system are included in CWASim as follows:

- 670 AF/y of losses in the Escondido Canal downstream of Lake Henshaw.
- 2,600 AF/y of water losses in the San Luis Rey River downstream of Lake Henshaw.
- 6 cfs of loss in October through June (3,250 AF over the nine-month period) and 3 cfs in July through September (540 AF over the 3-month period) for water supply to the San Luis Rey River Tribes downstream of Lake Henshaw\(^1\).
- 7% loss between Sutherland Reservoir and San Vicente Reservoir applied whenever there is flow between the two reservoirs.

4.3.2. Energy Generation/Consumption
CWASim calculates energy generation and consumption at major water supply facilities throughout the San Diego Basin. For calculation of energy in CWASim, facilities have been separated into five categories: supply sources, conveyance, treatment, pumped storage, and offices. The energy consumption and/or generation values are either linked to facility flows calculated in CWASim, or are a function of elapsed time based on historical average annual values developed during the San Diego County Water Authority Regional Facilities Master Plan (San Diego County Water Authority, 2013).

Supply source categories for energy generation and consumption include Potable Reuse (Pure Water San Diego only), Recycled Water, Groundwater, Imported Water, and Desalination (Carlsbad, Camp Pendleton, and Rosarito desalination plants). Energy consumption associated with Pure Water San Diego is a function of the volume of supplies that is conveyed to the reservoirs. Pure Water’s total energy consumption of 11,100 kilowatt-hours per million gallons (kWh/MG) is expected to run through its entire operations. This includes supply and conveyance, program treatment beyond secondary, program conveyance, water treatment, distribution and collection system and wastewater treatment. The model only includes energy

\(^1\) Actual water supply releases to the San Luis Rey River Tribes (the La Jolla, Pala, Pauma, Rincon and San Pasqual Bands of Mission Indians) vary between years and may be lower than the values used in the model. Releases typically occur primarily between June and October.
The study focuses on assessing the energy consumption and generation associated with the region’s water system, specifically distribution and collection systems. It is noted that waste water treatment is not included in these metrics. Furthermore, it is mentioned that greenhouse gas (GHG) emissions are not explicitly addressed in this section, as GHG inventories require knowledge of the energy supply mix. The San Diego Public Utilities Department (SDPUD) plans to pursue a renewable energy supply mix for the Pure Water project (Phases 1 and 2). The City of San Diego aims to achieve 100% renewable energy supply by 2035, which is expected to decrease GHG emissions. Recycled and groundwater consumption rates are a function of total deliveries input by the user. Energy consumed by the water treatment plants and generation by hydroelectric facilities are linked to their respective production rates. Each water treatment plant included in CWASim has an associated energy consumption rate linked to its production. Miramar and Alvarado also include energy generation values associated with their hydroelectric facilities. Twin Oaks Valley WTP includes energy generation values associated with the solar panels located at the plant. The pumped storage category only includes Hodges Pumped Storage Hydroelectric Facility. The only offices included in the CWASim model are the Administrative Office and the Operations Center. Note that energy sources associated with energy consumption are not defined in the Basin Study.
Table 22. Energy Consumption and Generation Values included in CWASim

<table>
<thead>
<tr>
<th>Facility</th>
<th>Energy Consumption Value</th>
<th>Energy Generation Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply Source</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure Water</td>
<td>7,300 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Recycled Water</td>
<td>1,228 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Groundwater</td>
<td>2,915 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Imported Water</td>
<td>10,000 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Carlsbad Desalination Plant</td>
<td>13,500 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Camp Pendleton Desalination Plant</td>
<td>13,500 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Rosarito Desalination Plant</td>
<td>12,889 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Conveyance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North County Pump Station</td>
<td>140 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>San Vicente Pump Station</td>
<td>1,310 kWh/MG or 12 MWh/yr when idle</td>
<td>NA</td>
</tr>
<tr>
<td>Valley Center Pump Station</td>
<td>346 kWh/MG or 690 MWh/yr when idle</td>
<td>NA</td>
</tr>
<tr>
<td>Olivenhain Pump Station</td>
<td>663 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Rancho Peñasquitos Hydroelectric Facility</td>
<td>21 MWh/yr</td>
<td>337 kWh/MG</td>
</tr>
<tr>
<td>Escondido Pump Station</td>
<td>31 MWh/yr</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alvarado WTP</td>
<td>161 kWh/MG</td>
<td>138 kWh/MG</td>
</tr>
<tr>
<td>Miramar WTP</td>
<td>250 kWh/MG</td>
<td>26 kWh/MG</td>
</tr>
<tr>
<td>Twin Oaks Valley WTP</td>
<td>318 kWh/MG</td>
<td>1,810 MWh/yr</td>
</tr>
<tr>
<td>Badger WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
</tr>
</tbody>
</table>
### San Diego Basin Study
Task 2.4 – Structural and Operations Concepts

<table>
<thead>
<tr>
<th>Facility</th>
<th>Energy Consumption Value</th>
<th>Energy Generation Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escondido WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Levy WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Otay WTP</td>
<td>248 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Perdue WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Weese WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Poway WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Bargar WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
</tr>
<tr>
<td>Olivenhain WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pumped Storage</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hodges Pumped Storage Hydroelectric Facility</td>
<td>100,000 MWh/yr</td>
<td>74,000 MWh/yr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Offices</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Authority San Diego Office</td>
<td>1,094 MWh/yr</td>
<td>676 MWh/yr</td>
</tr>
<tr>
<td>Water Authority Escondido Office</td>
<td>683 MWh/yr</td>
<td>252 MWh/yr</td>
</tr>
</tbody>
</table>

### Model Representation of Water Supply

The CWASim model has the ability to explicitly model local surface water runoff, local groundwater, local recycled water, desalination, potable reuse, imported QSA water, and imported water purchased from MWD. Some water supplies (local surface water, desalination, potable reuse, imported QSA water, and imported water purchased from MWD) are dynamically simulated in the model on a daily basis. Other water supplies (local groundwater, local recycled water) are modeled as annual demand reductions. Additional water supply types (e.g., stormwater capture and gray water) may also be simulated by treating the supply volume as demand reductions.
4.4.1. Supply Sources Represented as Annual Demand Reductions
Water supplies from Concepts listed below are represented as annual demand reductions in the model, as described in Section 4.6.2.2 (Net Demands):

- Gray Water Use (included as Conservation volume)
- Groundwater (included as Groundwater volume)
- Imported Water Purchases (only the Cadiz additional imported supplies project, included as Conservation volume)
- Recycled Water (included as Recycled Water volume)
- Potable Reuse (included as Recycled Water volume, with the exception of Pure Water San Diego which was implemented via model logic due to operational complexity)
- Stormwater BMPs (included as Conservation volume)
- Stormwater Capture (included as Conservation volume)
- Urban and Agricultural Water Use Efficiency (Included as Conservation volume)

Water supply projections from these Concepts are input as demand reductions for use in the model. See Section 4.6.3 (Demand Inputs and Settings) for more information.

4.4.2. Dynamically Modeled Supply Sources
Local surface water runoff, desalination, potable reuse, imported QSA water, and imported water purchased from MWD are dynamically simulated within the model on a daily basis.

4.4.2.1 Local Surface Water
Surface water supplies from precipitation runoff and stream baseflow are input as historical monthly reservoir inflow time series for 10 reservoirs. The monthly inflow time series values can be adjusted in the model by monthly climate change factors for each of the 10 reservoirs. The climate change factors are input from a spreadsheet that lists multiplicative factors from downscaled global climate model projections for each month for each of the 10 reservoirs with surface water inflows (see Section 5.1). A multiplicative factor value of 1 indicates no change from historical, while a value between 0 and 1 indicates a decrease in future inflow and a value greater than one indicates an increase in future inflow compared to historical. The historical monthly time series and monthly climate change factors are described in Section 5.2.1.

4.4.2.2 Seawater Desalination
The CWASim model includes the Carlsbad Desalination Plant, Camp Pendleton Desalination Plant, and Rosarito Beach Desalination Plant, described in Section 4.2.3. The capacity of each desalination plant is set by the user and limits the maximum amount of water that can be supplied from the plant. Requests from demand nodes determine the daily deliveries. Each desalination plant can be activated or deactivated for a model run.

4.4.2.3 Potable Reuse - Pure Water San Diego
One source of potable reuse supplies in the CWASim model is Pure Water San Diego. As discussed in Section 4.2.6.2, the user can perform a model simulation with any combination of the four reservoirs that can be linked to the project in the model (Miramar, San Vicente, Murray, and Lower Otay) and can set a production rate and implementation date when implementing Pure Water San Diego.
Other Potable Reuse water supplies are modeled as demand reductions (see Section 4.2.6.1).

4.4.2.4 MWD Purchases
MWD purchases are determined based on supply priorities and requests for treated and untreated water. The volume of imported water available for purchase from MWD is determined in the CWASim model by the logic for MWD supply allocation.

The CWASim model has three allocation options: No allocation, deterministic allocation, and dynamic allocation. The dynamic allocation methodology was added to the CWASim model as part of the San Diego Basin Study in order to better reflect actual operations, including the ability of MWD to store and release water that it receives from the SWP and CRA. This approach improves the estimation of MWD allocation timing by incorporating the quantitative estimates of supplies from the SWP and CRA and simulating MWD storage dynamics to characterize the delayed onset of allocation during drought periods.

The dynamic allocation methodology consists of a group of CWASim model elements that simulate inflows and outflows from MWD’s storage. Rather than modeling all the individual components of the MWD system, the CWASim model simplifies the system as a single storage reservoir element that represents cumulative MWD system storage in Diamond Valley Lake, terminal reservoirs of the State Water Project, groundwater banks, and other surface storage and agreements. The storage reservoir element can store a total of 2.7 million acre-feet (MAF).

Inflows into the storage element are the sum of supplies from the SWP and CRA, provided as monthly time series. The reservoir element calculates monthly and annual MWD storage. Outflows from the element are the releases made to meet MWD member agency annual demands (adjusted for allocation when applicable) and evaporation from surface storage reservoirs. For the Basin Study, MWD cumulative member agency demands were obtained from MWD’s 2015 Integrated Water Resources Plan (IRP) (Metropolitan Water District of Southern California, 2016). The MWD IRP demands were available to 2040, so for the Basin Study, the demands were linearly extrapolated to 2050 based on the demands for 2035 and 2040. Evaporation was calculated by multiplying a monthly evaporation in inches by the surface area of storage. During wet and normal years (combined Sacramento Valley and CRA water year types), the MWD supplies typically exceed demand and MWD storage is increased. However, during dry years, supplies are typically insufficient to meet demands and MWD storage is used to meet demands. When MWD storage reaches low levels, water must be allocated to member agencies at less than full delivery to protect against future dry years.

Through the dynamic allocation logic, the CWASim model uses an adjustable minimum target storage level to trigger the need for allocation. For the Basin Study, it was assumed that the minimum target was 1.0 MAF, as stated in MWD’s 2015 IRP. Therefore, in any year in which projected end of year storage levels fall below 1.0 MAF, the model implements MWD allocation such that a storage will not fall below this level.

When MWD shortage allocation is in place, the maximum amount of water that can be purchased from MWD by SDCWA to meet demands is set to a percentage of the annual total MWD storage. For the Basin Study, the percentage was assumed to be 18.7% based on projected annual preferential rights as described in Section 135 of MWD’s enabling legislation (California
State Legislature, 2008) and used in the 2015 SDCWA UWMP. The total volume available to SDCWA from MWD is calculated as the allocation percentage (18.7%) multiplied by the annual MWD storage above the storage target threshold of 1.0 MAF.

The inputs required for MWD purchases depend on the choice of MWD allocation method. For the dynamic allocation method, the CWASim model requires monthly and annual time series of inflows to MWD from the SWP and the CRA under each climate scenario.

### 4.4.2.5 QSA Water

QSA water is represented in the model by an annual time series of water supply volumes for each year in the model run. The annual QSA volume is added to the annual MWD purchase for SDCWA and then both are disaggregated to daily volumes that are delivered to meet demands according to the model priorities and logic.

Supplies from IID transfers and canal lining are input as annual time series of deliveries via the model dashboard. These values are added to the water available to purchase from MWD and the total is disaggregated to daily values to determine the volume available to meet demands from those two sources.

### 4.5. Model Representation of Conservation

Water conservation volumes are treated as demand reductions. See Section 4.6.2.2 (Net Demands) for further details.

### 4.6. Model Representation of Water Demand

The CWASim model simulated demands from SDCWA member agencies, which are represented as demand nodes. Gross annual demands represent member agency demands, while the net demands that are calculated by the CWASim model represent member agency demands after accounting for supply volumes that are treated as demand reductions (see Section 4.6.2.2). Water conservation volumes are treated as demand reductions.

#### 4.6.1. Demand Nodes

The model simulates water deliveries to all 24 SDCWA member agencies except Camp Pendleton (Table 23). It also simulates water deliveries to the Cal-American Water Company (Cal-Am), which is not a SDCWA member agency but receives local surface water from the City of San Diego through a water rights settlement. Demands for the member agencies are represented as single or multiple demand node containers depending on how the agency receives water (e.g., water source, treated vs untreated). Deliveries to Camp Pendleton are not simulated because the CWASim model does not include a demand node for Camp Pendleton.

The North container of the model contains demand nodes for City of Carlsbad, City of Oceanside, Fallbrook, Rainbow, Rincon, Vallecitos Water District, Valley Center Municipal Water District, Vista Irrigation District, and Yuima Irrigation District.
The Central container of the model contains demand nodes for Olivenhain Municipal Water District, City of Del Mar, San Dieguito Water District, and Santa Fe Irrigation District.

The Crossover container of the model contains demand nodes for the City of Escondido, Poway, and Ramona.

The South container of the model contains demand nodes for Helix, Padre Dam, Otay Water District, Lakeside, and Sweetwater Authority. Helix is represented with a single demand node. Demands for Padre Dam and Otay Water District are represented as two demand nodes each: one that receives water from the main system and one that receives water through the East County Regional Treated Water Improvement Program (ECRTWIP). Lakeside is represented by a single demand node that receives water through the ECRTWIP. Sweetwater Authority, consisting of the City of National City and South Bay Irrigation District, is represented as a single demand node.

The City of San Diego’s demands are divided into five nodes due to the differences in how various parts of the city receive water. San Diego North is located in the Crossover section of the model and San Diego Miramar, San Diego 11, San Diego Alvarado, and San Diego Otay are located in the South section of the model.

Camp Pendleton Marine Corps Base is not represented as a demand in the model because its demands are met almost exclusively by locally produced supplies (San Diego County Water Authority, 2016).

Table 23. SDCWA Member Agencies Demand Nodes

<table>
<thead>
<tr>
<th>Agency</th>
<th>CWASim Model Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Carlsbad</td>
<td>Carlsbad</td>
</tr>
<tr>
<td>City of Del Mar</td>
<td>Del Mar</td>
</tr>
<tr>
<td>City of Escondido</td>
<td>Escondido</td>
</tr>
<tr>
<td>City of National City¹</td>
<td>National City/South Bay</td>
</tr>
<tr>
<td>City of Oceanside</td>
<td>Oceanside</td>
</tr>
<tr>
<td>City of Poway</td>
<td>Poway</td>
</tr>
<tr>
<td>City of San Diego</td>
<td>SD 11</td>
</tr>
<tr>
<td></td>
<td>SD Alvarado</td>
</tr>
<tr>
<td></td>
<td>SD Miramar</td>
</tr>
<tr>
<td>Agency</td>
<td>CWASim Model Representation</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 4.6.2. Annual Member Agency Demand Volumes

#### 4.6.2.1 Gross Demands

Gross demands are the total water demands for each member agency. Demands are calculated outside the model and provided as a model input. Demands may be calculated using a variety of methods (e.g., demand models, regression projections), but should represent the total amount of water needed by each member agency to serve its customers. Demand calculations generally include M&I and agricultural demands and any adjustments for climate change.

#### 4.6.2.2 Net Demands

Net demands are calculated within the model and are the remaining demands after the following are subtracted from the gross demands:

- Groundwater supply volume
- Recycled Water supply volume
- Conservation Volume

Conservation Volume is a generic category in the CWASim model that can include the Urban and Agricultural Water Use Efficiency Concept as well as other Concepts such as Gray Water and Stormwater Capture, depending on the Concepts implemented in a model run.

These supplies and volumes are assumed to be used to meet demands prior to use of any other supply options and therefore they reduce demands on all other sources. They are assumed to be constant annual values that are subtracted from the gross demand volume inputs.

#### 4.6.3. Demand Inputs and Settings

CWASim is able to use demand values that represent projected demands for a time period or scenario of interest to the user. The demands may be stable or variable over the course of a run. Demands can also be adjusted within the CWASim model to account for climate change effects.

##### 4.6.3.1 Unadjusted Demand Inputs (No Climate Change)

The model receives demand inputs for each member agency via a Microsoft Excel spreadsheet. The inputs include demands in each hydrologic year type (see Section 5.3.2.1), along with the local supplies (or demand reductions) from groundwater, recycled water, and conservation for
each SDCWA member agency. The development of the demand values for the Basin Study is described in Section 5.3.

The CWASim model has options for selecting demands based on hydrologic year types, discussed in Section 5.3.2.1. It allows the user to select a particular hydrologic year type for the entire run or it allows the model to select the appropriate hydrologic year type based on the water year of input hydrology data. For the Basin Study, the selection of year type was linked to the water year. The CWASim model contains a table of water years and their corresponding hydrologic year type for each possible year of input hydrologic data. For every simulation timestep, the model checks the water year, determines the corresponding hydrologic year type, and sets the demands to the corresponding values.

4.6.3.2 Climate Change Demand Adjustment Factors
The CWASim model requires a table of demand adjustment factors corresponding to the climate change scenarios being analyzed in the model. This table is created in an Excel spreadsheet based on the demand adjustment model (see Section 5.3.2) and then manually copied to the corresponding GoldSim table element in the CWASim model.

4.7. Model Operational Logic for Water Deliveries and Shortages
At each model timestep, the model evaluates the available supplies and net water demands and determines water deliveries and shortages. The determination of deliveries is completed in loops based on the priority of supply sources. The model has eight loops: Loop zero for calculating daily demands from the annual demands and Loops 1-7 for calculating water deliveries for each of the supply sources. The supply source loops are completed in the priority order of the supply sources.

The water supply for the San Diego region is made up of local and imported water from a variety of source types. Of these source types, some are accounted for through the calculation of net demand (local groundwater and recycled water) and some are dynamically modeled. The dynamically modeled supply sources produce either untreated water that must be treated before it can be used to meet demands (surface water, purchases of MWD untreated water, and untreated QSA water), or treated water that can be used directly (desalinated water and purchases of MWD treated water).

4.7.1. Water Source Availability and Priorities
Source groupings are implemented in the CWASim model (Table 24) and are distributed during model loops 1 through 7 based on their priority order. Some of these source groups consist of untreated water, while others consist of treated water. Source priorities in the model describe the order in which sources are used to meet demands. For example, local surface supplies are always used before purchasing imported supplies. Two sets of priority orders are used depending on the time of year and storage in San Vicente Reservoir. Priority Order 1 is implemented from March 1 to September 30 if San Vicente is more than 70% full. Priority Order 2 covers the period from October 1 to February 28 or if San Vicente is less than 70% full. The priority settings for the CWASim model reflect the preference for locally treated supplies first, then imported raw water (in order to maximize local WTP use including Twin Oaks Valley WTP), then imported treated
water. Maintenance of storage in San Vicente in case of dry conditions is another high priority in the model logic.

Table 24 lists the priority order of water sources available to SDCWA member agencies for all model runs. Although water from the Camp Pendleton Desalination Plant is only used in the Increase Supplies Portfolio 2050 scenarios, it is still listed as a source in the CWASim model and given a priority order for all model runs. No water supply is available from this source during the model runs in which Camp Pendleton is not activated. Pure Water San Diego is assigned a priority equal to local supplies and is therefore used as first priority to fill reservoirs. If needed, this may involve reducing other supplies to fill a reservoir. Rosarito Beach Desalination Plant is not assigned a priority order since it is implemented as a demand reduction for the Otay Water District. This supply is used to meet demands prior to use of any other supply options for the Otay Water District when activated.

Table 24. Water Sources and Priorities

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
<th>Originates As</th>
<th>Priority Order 1</th>
<th>Priority Order 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local¹</td>
<td>Local surface water treated at local treatment plants. MWD water stored in local reservoirs (excluding San Vicente) is included in this source.</td>
<td>Untreated</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>MWD Untreated (Treated at local WTPs)¹</td>
<td>MWD untreated water treated at local WTPs and then delivered as treated water.</td>
<td>Untreated</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>SDCWA Treated (TOVWTP)¹</td>
<td>MWD Untreated water treated at Twin Oaks Valley WTP then delivered to selected agencies as treated water.</td>
<td>Untreated</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>MWD Treated¹</td>
<td>MWD treated water delivered to SDCWA.</td>
<td>Treated</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Pendleton¹</td>
<td>Treated ocean water delivered to select agencies from the Camp Pendleton Desalination Plant. Only included in priority order if option to use Camp Pendleton is selected in the model. Only used in model runs where Pendleton is activated.</td>
<td>Untreated</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Carlsbad Desalination Plant¹</td>
<td>Treated ocean water delivered to select agencies from the Carlsbad Desalination Plant.</td>
<td>Untreated</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Source</td>
<td>Description</td>
<td>Originates As</td>
<td>Priority Order 1</td>
<td>Priority Order 2</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>San Vicente Regional Carryover/ Seasonal¹</td>
<td>San Vicente seasonal storage pool treated at local WTPs then delivered. Carryover storage pool is used to supplement reduced supply due to drought, or shortages from MWD or State Water Project.</td>
<td>Untreated</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Pure Water San Diego</td>
<td>Treated recycled water delivered to Miramar Reservoir (Phase 1) and San Vicente Reservoir (Phase 2).</td>
<td>Untreated</td>
<td>Assigned a priority equal to local supplies (Priority of 1 in both priority orders). Does not deliver water directly to SDCWA member agencies, but it will be utilized at first priority to fill reservoirs if activated. This may involve reducing other supplies to fill a reservoir.</td>
<td></td>
</tr>
<tr>
<td>Rosarito Desalination Plant</td>
<td>Treated ocean water delivered to Otay Water District from the Rosarito Desalination Plant.</td>
<td>N/A</td>
<td>Implemented as a demand reduction and used to meet demands prior to use of any other supply options for the Otay Water District when activated</td>
<td></td>
</tr>
</tbody>
</table>
| Supply Sources Represented as Demand Reductions | • Gray Water Use (included as Conservation volume)  
• Groundwater (included as Groundwater volume)  
• Imported Water Purchases (only the Cadiz additional imported supplies project, included as Conservation volume)  
• Recycled Water (included as Recycled Water volume)  
• Potable Reuse (included as Recycled Water volume, with the exception of Pure Water San Diego)  
• Stormwater BMPs (included as Conservation volume)  
• Stormwater Capture (included as Conservation volume)  
• Urban and Agricultural Water Use Efficiency (Included as Conservation Volume) | N/A           | Implemented as demand reductions and used to meet demands prior to use of any other supply options | |

¹ Source is defined as a source group in CWASim. CWASim source groups have specific priorities within the model and are accessible to modeled member agencies as defined in Table 25.
SDCWA member agencies have access to some or all the source groups as shown in Table 25. Within a given source group, member agencies can receive water from that source group via one or more infrastructure elements (reservoirs, pipelines, pump stations, and treatment plants). The connections between infrastructure elements and member agency demand nodes are described in the model Network container. Note that not all source groups are activated in all Portfolios (i.e., Camp Pendleton Desalination Plant).
Table 25. Member Agency Access to Source Groups

<table>
<thead>
<tr>
<th>CWASim Model Representation</th>
<th>Local Surface Water (Treated at local WTPs)</th>
<th>MWD Untreated (Treated at local WTPs)</th>
<th>MWD Treated</th>
<th>SDCWA Treated (Twin Oaks Valley WTP)</th>
<th>Carlsbad Desalination Plant</th>
<th>Camp Pendleton Desalination Plant</th>
<th>San Vicente Regional Carryover/Seasonal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlsbad</td>
<td>--</td>
<td>--</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Del Mar</td>
<td>--</td>
<td>Miramar WTP</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Escondido</td>
<td>Wohlford Reservoir Treated at Wohlford WTP</td>
<td>First Aqueduct via Crossover Pipeline</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Oceanside</td>
<td>--</td>
<td>Pipeline 5, Treated at Weese WTP</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Poway</td>
<td>--</td>
<td>First Aqueduct via Crossover Pipeline, Treated at Poway WTP</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>SD11</td>
<td>--</td>
<td>Treated at Miramar WTP</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Treated at Miramar WTP</td>
</tr>
<tr>
<td>SD_Alvarado</td>
<td>San Vicente and El Capitan Reservoirs through El Monte System Treated at Alvarado WTP</td>
<td>Second Aqueduct Treated at Alvarado WTP</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>San Vicente Tunnel and Second Aqueduct Treated at Alvarado WTP</td>
</tr>
<tr>
<td>SD_Miramar</td>
<td>San Vicente Treated at Miramar WTP</td>
<td>Second Aqueduct Treated at Miramar WTP</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>San Vicente Tunnel and Second Aqueduct Treated at Miramar WTP</td>
</tr>
<tr>
<td>SD_North</td>
<td>--</td>
<td>--</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>CWASim Model Representation</td>
<td>Local Surface Water (Treated at local WTPs)</td>
<td>MWD Untreated (Treated at local WTPs)</td>
<td>MWD Treated</td>
<td>SDCWA Treated (Twin Oaks Valley WTP)</td>
<td>Carlsbad Desalination Plant</td>
<td>Camp Pendleton Desalination Plant</td>
<td>San Vicente Regional Carryover/Seasonal</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------</td>
<td>--------------------------------------</td>
<td>-------------</td>
<td>-------------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>SD_Otay</td>
<td>Barrett, Lower Otay and Morena Reservoirs Treated at Otay WTP</td>
<td>Second Aqueduct Treated at Otay WTP</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>San Vicente Tunnel and Second Aqueduct Treated at Otay WTP</td>
</tr>
<tr>
<td>Fallbrook</td>
<td>--</td>
<td>--</td>
<td>First Aqueduct and Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Helix</td>
<td>El Capitan Treated at Levy WTP</td>
<td>First Aqueduct via Crossover Pipeline Treated at Levy WTP or Second Aqueduct via San Vicente Tunnel, Treated at Levy WTP</td>
<td>Pipeline 4</td>
<td>x</td>
<td>--</td>
<td>--</td>
<td>Moreno- Lakeside Pipeline Treated at Levy WTP</td>
</tr>
<tr>
<td>ECRTWIP²</td>
<td>El Capitan Treated at Levy WTP</td>
<td>First Aqueduct via Crossover Pipeline Treated at Levy WTP or Second Aqueduct via San Vicente Tunnel, Treated at Levy WTP</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Moreno- Lakeside Pipeline, Treated at Levy WTP</td>
</tr>
<tr>
<td>Olivenhain</td>
<td>--</td>
<td>Pipeline 5 Treated at Olivenhain</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>OtayWD</td>
<td>--</td>
<td>--</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Padre_Dam</td>
<td>--</td>
<td>--</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Rainbow</td>
<td>--</td>
<td>--</td>
<td>First Aqueduct and Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>CWASim Model Representation</td>
<td>Local Surface Water (Treated at local WTPs)</td>
<td>MWD Untreated (Treated at local WTPs)</td>
<td>MWD Treated</td>
<td>SDCWA Treated (Twin Oaks Valley WTP)</td>
<td>Carlsbad Desalination Plant</td>
<td>Camp Pendleton Desalination Plant</td>
<td>San Vicente Regional Carryover/Seasonal</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------</td>
<td>---------------------------------------</td>
<td>-------------</td>
<td>-------------------------------------</td>
<td>-----------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Ramona</td>
<td>Sutherland Reservoir Treated at Bargar WTP</td>
<td>First Aqueduct and Crossover Pipeline treated at Bargar WTP</td>
<td>Ramona Pipeline</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Rincon</td>
<td>--</td>
<td>--</td>
<td>First Aqueduct</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>San Dieguito/Santa Fe</td>
<td>Lake Hodges and San Dieguito Reservoir Treated at Badger WTP</td>
<td>Pipeline 5 Treated at Badger</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>National City/South Bay</td>
<td>Sweetwater Reservoir and San Dieguito Reservoir treated at Perdue WTP</td>
<td>Pipeline 5 Treated at Perdue WTP</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>x</td>
<td>San Vicente Tunnel and Second Aqueduct Treated at Sweetwater WTP</td>
</tr>
<tr>
<td>Vallecitos</td>
<td>--</td>
<td>--</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Valley_Ctr</td>
<td>--</td>
<td>--</td>
<td>First Aqueduct and Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Vista</td>
<td>Henshaw Treated at Escondido WTP</td>
<td>First Aqueduct via Crossover Pipeline treated at Escondido WTP</td>
<td>Pipeline 4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Yuima</td>
<td>--</td>
<td>--</td>
<td>First Aqueduct</td>
<td>x</td>
<td>x</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
4.7.2. Distribution Logic
Water is distributed to member agency demand nodes on a daily timestep through model elements and logic representing the conveyance system. For untreated water distribution, water must first be treated at a WTP, so member agency requests are assigned to the corresponding treatment plant for the water source group and member agency. For treated water distribution, requests are made directly to the corresponding water source infrastructure rather than first requesting it through a WTP. The water treatment plant then transfers the request to the pipeline and/or reservoir elements that supply the water.

4.7.2.1 Constraints on Water Distribution

4.7.2.1.1. Pipeline capacity
When an agency requests water in the form of a demand, a pipe capacity limitation check is performed to ensure that pipe capacities are not exceeded. Model pipe capacities are shared equally by all member agencies. A percentage of the total pipe capacity is allocated to each member agency every time they make a request. As more requests are made, the available pipe capacities are reduced, thus limiting the amount of water an agency can receive through a particular pipeline.

4.7.2.1.2. Minimum flows of treated water
The First Aqueduct treated water pipelines and Pipeline 4 of the Second Aqueduct both have minimum flows that are implemented in the model to ensure that the MWD treated flow minimum requirements are met. Since the model is a demand-driven model, these flows must be used by a member agency to meet demands. The model has logic that is used at each timestep to identify agencies that could take the minimum flows, distribute the flows to those agencies and reduce the agencies’ demands, and allocate MWD treated water. Modeled minimum flows are 12.5 cfs for the First Aqueduct and 40 cfs for the Second Aqueduct².

4.7.2.1.3. Distribution to reservoirs
Water can only be stored in the reservoirs after the untreated water demands are met with the exception of the San Vicente emergency pool. Specific rules provide priority preference to the pool if it is below the rule curve, causing it to be refilled first. If Pure Water San Diego is turned on in a model run, the CWASim model will utilize the Pure Water San Diego supply in first priority, reducing other supplies to fill the reservoir if needed. The model will only supply water to those reservoirs beginning on and after the user-indicated implementation date.

4.8. Model Run Setup and Inputs
Model inputs and settings control how the model implements the available logic described by the network of model elements, links, and functions, and sets the supply and demand values that drive each simulation. Prior to starting a model run, the settings must be adjusted to describe the

---

² Note that between the time when the model was run and the publication of this report, the minimum flows on the Second Aqueduct were reduced to 10 cfs for April to November and 20 cfs for December to March.
supply, demand, and infrastructure conditions for the model run. CWASim offers a dashboard user interface that can be used for setting up and performing model runs. The Main Dashboard is where the user can create model scenarios, run a model scenario, and identify the Forecast Start Year. Dashboards for demand settings, supply settings, system settings, simulation settings and results can also be accessed from the Main Dashboard.

4.8.1. Model Run Setup Spreadsheet
An Excel spreadsheet called ‘CWASim Run Setup’ was developed for the San Diego Basin Study to provide an organizational tool for verifying that each model run includes the desired settings before the run begins. The spreadsheet walks the user through each of the user adjusted settings in each of the CWASim dashboards and includes a checklist for each category.

4.8.2. Scenario Manager
The Scenario Manager serves as a tool for managing the scenarios, or model runs with different input parameters, in a GoldSim model. Scenarios differ from one another by having different values for one or more data elements.

As part of setting up a scenario, CWASim provides a dropdown menu to select the climate change scenario for the run. The dropdown menu contains eleven options: one option for no climate change, five options for 2020s climate, and five options for 2050s climate. The climate and demand scenarios for each Portfolio are described further in Chapter 5. The dropdown menu is connected to a model element that controls the selection of climate change adjustment factors for supplies and demands (described in Sections 5.2.1.1 and 5.3.2.3). If a climate change scenario is selected using the dropdown, the corresponding adjustment factors will be applied to both the supply and demand inputs. CWASim also provides a dropdown menu that allows a user to select pre-set scenarios that correspond to each Portfolio and demand scenario.

4.9. Model Outputs
CWASim runs produce time series results that can be stored using result elements. CWASim displays model results in either the Results Dashboard, or by exporting the results to a spreadsheet. Results used for the San Diego Basin Study include sets of impact metrics. See Chapter 6 for further details.

5. Portfolio Model Runs
CWASim model runs were performed for each of the six Portfolios described in Chapter 3 with the demand and climate scenarios described below. There were three demand scenarios for each Portfolio, which included a scenario for 2015 demands, 2025 demands, and 2050 demands. Only current climate was simulated for the 2015 demand scenarios, while six climate scenarios (current climate, central tendency climate, hot-dry climate, warm-dry climate, hot-wet climate, and warm-wet climate) were simulated for 2025 and 2050 demand scenarios. This resulted in a set of 13 simulation runs for each of the six Portfolios (78 total model runs). These runs are further described in Section 5.1. Each run was made up of 85 realizations of daily water system
simulations. The 85 realizations were run consecutively through the model, and the order of the realizations was the same for all runs, allowing direct comparison between scenarios and realizations. A single realization is one year in the 85-year-long time series of surface water inflows, described in Section 5.1. Water Supply and Demand projections used in the model runs are discussed in Sections 5.1 and 5.3. The hydrologic modeling and climate change projections developed in Task 2.2 of the Basin Study were used as the basis for development of these projections, described in Section 5.1.

5.1. Modeled Scenarios

The Portfolios discussed in Chapter 3 were incorporated into the CWASim model in order to analyze and compare the water supply results corresponding to each Portfolio. Model runs for each Portfolio included 13 simulations under a range of demand and climate conditions. Observed 2015 demands, SDCWA Urban Water Management Plan (UWMP) 2025 demand projections, and UWMP demand projections extended to 2050 made up the three demand scenarios (2015, 2025, and 2050) that were used in the analysis. A current climate scenario and five climate change scenarios (central tendency, warm-wet, warm-dry, hot-wet, and hot-dry) made up the climate scenarios. These scenarios were used to capture a broad range of current and future climate conditions. Table 26 describes scenarios included in the Task 2.4 model runs. Abbreviations were used for each Portfolio name: Baseline (B), Baseline Plus (B+), Enhanced Conservation (EC), Increase Supplies (IS), Optimize Existing Facilities (OEF), and Watershed Health and Ecosystem Restoration (WE).

Table 26. Summary of Portfolio Scenarios

<table>
<thead>
<tr>
<th>Scenario Name</th>
<th>Supply Projections</th>
<th>Demand Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio1_2015-cc</td>
<td>current climate</td>
<td>2015 demands, current climate</td>
</tr>
<tr>
<td>Portfolio1_2025-cc</td>
<td>current climate</td>
<td>2025 demands, current climate</td>
</tr>
<tr>
<td>Portfolio1_2050-cc</td>
<td>current climate</td>
<td>2050 demands, current climate</td>
</tr>
<tr>
<td>Portfolio1_2025-ct-2020s</td>
<td>2020s central tendency climate</td>
<td>2025 demands, 2020s central tendency climate</td>
</tr>
<tr>
<td>Portfolio1_2025-ww-2020s</td>
<td>2020s warm-wet climate</td>
<td>2025 demands, 2020s warm-wet climate</td>
</tr>
<tr>
<td>Portfolio1_2025-wd-2020s</td>
<td>2020s warm-dry climate</td>
<td>2025 demands, 2020s warm-dry climate</td>
</tr>
<tr>
<td>Portfolio1_2025-hw-2020s</td>
<td>2020s hot-wet climate</td>
<td>2025 demands, 2020s hot-wet climate</td>
</tr>
<tr>
<td>Scenario Name</td>
<td>Supply Projections</td>
<td>Demand Projections</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Portfolio(^1) 2025-hd-2020s</td>
<td>2020s hot-dry climate</td>
<td>2025 demands, 2020s hot-dry climate</td>
</tr>
<tr>
<td>Portfolio(^1) _2050-ct-2050s</td>
<td>2050s central tendency climate</td>
<td>2050 demands, 2050s central tendency climate</td>
</tr>
<tr>
<td>Portfolio(^1) _2050-ww-2050s</td>
<td>2050s warm-wet climate</td>
<td>2050 demands, 2050s warm-wet climate</td>
</tr>
<tr>
<td>Portfolio(^1) _2050-wd-2050s</td>
<td>2050s warm-dry climate</td>
<td>2050 demands, 2050s warm-dry climate</td>
</tr>
<tr>
<td>Portfolio(^1) _2050-hw-2050s</td>
<td>2050s hot-wet climate</td>
<td>2050 demands, 2050s hot-wet climate</td>
</tr>
<tr>
<td>Portfolio(^1) _2050-hd-2050s</td>
<td>2050s hot-dry climate</td>
<td>2050s hot-dry climate</td>
</tr>
</tbody>
</table>

\(^1\) Abbreviations were used in the scenario names, replacing the term ‘Portfolio’: B, B+, EC, IS, OEF, WE.

### 5.2. Water Supply Projections

Water supply projections for the San Diego Basin Study Task 2.4 model runs include 85-year-long time series of surface water inflows to reservoirs under current and future climate conditions, 85-year-long time series of imported MWD supplies available to be purchased for use in the San Diego region, constant QSA water supply volumes for each time period, and other water supply volumes discussed in Chapter 4, dependent on Portfolio. The 85-year-long time series of daily water simulations was represented in the model as realizations that were simulated for each model run (i.e., the 85 realizations were simulated for the Baseline 2015 model run, then again in the Baseline 2025 model run, as well as for each of the other model runs). Realizations were generated based on historical hydrologic data from the period of 1900-1984.

#### 5.2.1. Surface Water Supply Projections

Surface water projections consist of inflows to the 10 reservoirs in the San Diego region that receive the majority of surface water flow. The projections were developed by multiplying historical reservoir inflows by change factors, representing percentage changes in reservoir inflows for future climate scenarios. The change factors were developed by comparing modeled historical reservoir inflows to modeled future reservoir inflows from archived simulations of streamflow under climate change scenarios, as described in more detail throughout this section.

#### 5.2.1.1 Source of Temperature, Precipitation, and Hydrology Projections

Projections of temperature, precipitation, and hydrological parameters were obtained from the Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections archive (Reclamation, 2013) which contains downscaled climate information (temperature and precipitation) and corresponding hydrology projections (e.g., surface runoff, baseflow, and evapotranspiration) for the contiguous United States. The archive is meant to provide access to climate and hydrologic...
projections at spatial and temporal scales relevant to watershed and basin-scale decisions facing water and natural resource managers and planners dealing with climate change. The archive includes both Coupled Model Intercomparison Project (CMIP) Phase 3 (CMIP3) climate projections of temperature and precipitation and CMIP Phase 5 (CMIP5) climate projections (Taylor et al., 2012; World Climate Research Programme, 2007; World Climate Research Programme, 2013), and corresponding hydrological simulations produced using the Variable Infiltration Capacity model (VIC) (Liang, X., E.F. Wood, and D.P. Lettenmaier, 1996; Liang, X., D. P. Lettenmaier, E.F. Wood, and S.J. Burges, 1994; Nijssen, B., D.P. Lettenmaier, X. Liang, S.W. Wetzel, and E. F. Wood, 1997). VIC is a large-scale, semi-distributed hydrologic model that calculates surface runoff and baseflow estimates for each grid cell and routes the flow to stream channels.

The CMIP5 hydrological projections were used for the Basin Study. The CMIP5 archive includes VIC model results for 97 climate projections representing 31 Global Climate Models (GCMs) and four emissions scenarios, known as Representative Concentration Pathways (RCPs). For the historical period, GCM models were constrained by observations of atmospheric conditions. Several alternative futures are reflected in the RCPs which vary by future atmospheric conditions. In addition, many GCM modeling groups provided projections from the same model initialized from multiple climate states in order represent uncertainties stemming from natural low frequency climate variability (Reclamation, 2013). For the San Diego Basin Study, all GCMs and all RCPs were used to develop the change factors.

5.2.1.2 Calculation of Change Factors
To obtain the change factors, climate change projection groups were identified from CMIP5 temperature and precipitation projections, and then monthly change factors were calculated for these groups from the streamflow projections. Projection groups consisted of 10 projections that were identified by calculating mean annual changes in precipitation (in percent) and temperature (in degrees Fahrenheit), between the 1990-1999 current climate period, the 2020s future time period (2020-2029) and the 2050s future time period (2050-2059) for all GCMs and RCPs in the CMIP5 archive (Table 27). The 10th, 50th, and 90th percentile values were calculated for temperature change and precipitation change and used to group the CMIP5 projections into five climate change projection groups (Table 28 and Figure 7). The 10 CMIP5 projections closest to the percentile intersections were used to inform to each climate change projection group for each time period.

Projected change for the two future periods compared with the current climate period for GCM grid cells that intersect the Basin Study region indicate the range of projected future precipitation and temperature changes. Across the San Diego region, annual precipitation is projected to increase by a range of 2% to 8% under RCP4.5 and increase by 1% to 3% under RCP8.5 in the 2020s future period. There is a broader range of projected change in the 2050s future period, ranging from no change to a 10% increase under RCP4.5 and ranging from no change to a 12% increase under RCP8.5. Annual temperature is projected to increase by a range of 1.5 to 1.8 degrees Fahrenheit under RCP4.5 and a range of 1.8 to 1.9 degrees Fahrenheit under RCP8.5 in the 2020s future period. In the 2050s future period even greater increases in temperature are projected, with a range of 3 to 3.4 degrees Fahrenheit under RCP4.5 and increases of 4.2 to 4.5 degrees under RCP8.5.
### Table 27. Climate Time Periods

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Years Included from Streamflow Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Climate</td>
<td>1990-1999</td>
</tr>
<tr>
<td>2020s</td>
<td>2020-2029</td>
</tr>
<tr>
<td>2050s</td>
<td>2050-2059</td>
</tr>
</tbody>
</table>

### Table 28. Climate Change Projection Groups

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Scenario abbreviation</th>
<th>Temperature Change (°F)</th>
<th>Precipitation Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>hot-dry</td>
<td>hd</td>
<td>90th percentile</td>
<td>10th percentile</td>
</tr>
<tr>
<td>hot-wet</td>
<td>hw</td>
<td>90th percentile</td>
<td>90th percentile</td>
</tr>
<tr>
<td>central tendency</td>
<td>ct</td>
<td>50th percentile</td>
<td>50th percentile</td>
</tr>
<tr>
<td>warm-dry</td>
<td>wd</td>
<td>10th percentile</td>
<td>10th percentile</td>
</tr>
<tr>
<td>warm-wet</td>
<td>ww</td>
<td>10th percentile</td>
<td>90th percentile</td>
</tr>
</tbody>
</table>
Figure 7. Projection groupings for developing climate change scenarios. Solid red lines represent 10th and 90th percentiles, while dashed gray lines represent 50th percentiles.
Monthly change factors were calculated from calculated natural streamflow for each of the selected groupings of projections. For each of the future time periods (2020s and 2050s), the mean change in streamflow across the 10 projections was computed, resulting in one change factor per month (e.g., January), per scenario (e.g., hot-dry), and per time period (e.g., 2020s). The average of the monthly change factors for each future time period and climate scenario for each reservoir is shown in Table 29.

5.2.1.3 Calculation of Streamflow Projections for Change Factors
The VIC hydrological projections from the downscaled CMIP5 Climate and Hydrology Projections CMIP5 archive were used to calculate modeled historical and future natural streamflow values that were then used to calculate the change factors. Historical and future natural streamflow was calculated for reservoir inflow locations at each of the 10 reservoirs that receive surface water inflows in the CWASim model. For each inflow location, the upstream grid cells reflecting the watershed of that point were identified using a digital elevation model. Summing the streamflow values for each grid cell within the watershed gave an estimate of the naturalized streamflow at that location. This streamflow does not reflect any management or operation within the watershed.

5.2.1.4 Surface Water Projections for CWASim
To obtain surface water projections for use in the CWASim model, the change factors were applied to an 85-year-long (1900-1984) set of historical reservoir inflows to calculate future reservoir inflows for the 2020s and 2050s. The historical reservoir inflow set (Figure 8) came from a reconstructed dataset of reservoir inflows developed for a previous basin simulation model called Confluence (San Diego County Water Authority, 2013). Calculated average annual natural reservoir inflows are shown in Table 30 and a comparison of natural inflow to reservoir capacity is shown in Table 31 as an indication.
Figure 8. Natural reservoir inflow dataset, 1900-2011

Table 29. Average Annual Change Factors Applied to Historical Natural Inflows

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Current climate</th>
<th>2020s ct</th>
<th>2020s ww</th>
<th>2020s wd</th>
<th>2020s hw</th>
<th>2020s hd</th>
<th>2050s ct</th>
<th>2050s ww</th>
<th>2050s wd</th>
<th>2050s hw</th>
<th>2050s hd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrett</td>
<td>1</td>
<td>1.01</td>
<td>1.15</td>
<td>0.86</td>
<td>1.09</td>
<td>0.85</td>
<td>0.92</td>
<td>1.17</td>
<td>0.83</td>
<td>1.04</td>
<td>0.81</td>
</tr>
<tr>
<td>El Capitan</td>
<td>1</td>
<td>0.98</td>
<td>0.96</td>
<td>0.99</td>
<td>1.01</td>
<td>0.97</td>
<td>0.97</td>
<td>1.00</td>
<td>0.94</td>
<td>1.01</td>
<td>0.94</td>
</tr>
<tr>
<td>Hodges</td>
<td>1</td>
<td>1.03</td>
<td>1.19</td>
<td>0.89</td>
<td>1.13</td>
<td>0.89</td>
<td>0.96</td>
<td>1.21</td>
<td>0.84</td>
<td>1.09</td>
<td>0.84</td>
</tr>
<tr>
<td>Loveland</td>
<td>1</td>
<td>1.01</td>
<td>1.17</td>
<td>0.85</td>
<td>1.10</td>
<td>0.86</td>
<td>0.93</td>
<td>1.19</td>
<td>0.82</td>
<td>1.06</td>
<td>0.81</td>
</tr>
<tr>
<td>Lower Otay</td>
<td>1</td>
<td>1.01</td>
<td>1.16</td>
<td>0.89</td>
<td>1.07</td>
<td>0.90</td>
<td>0.93</td>
<td>1.14</td>
<td>0.88</td>
<td>1.05</td>
<td>0.85</td>
</tr>
<tr>
<td>Morena</td>
<td>1</td>
<td>1.03</td>
<td>1.17</td>
<td>0.86</td>
<td>1.11</td>
<td>0.85</td>
<td>0.93</td>
<td>1.20</td>
<td>0.82</td>
<td>1.07</td>
<td>0.80</td>
</tr>
<tr>
<td>San Vicente</td>
<td>1</td>
<td>1.02</td>
<td>1.21</td>
<td>0.88</td>
<td>1.10</td>
<td>0.88</td>
<td>0.95</td>
<td>1.18</td>
<td>0.85</td>
<td>1.08</td>
<td>0.83</td>
</tr>
<tr>
<td>Sutherland</td>
<td>1</td>
<td>1.02</td>
<td>1.17</td>
<td>0.86</td>
<td>1.10</td>
<td>0.87</td>
<td>0.93</td>
<td>1.19</td>
<td>0.82</td>
<td>1.06</td>
<td>0.82</td>
</tr>
<tr>
<td>Sweetwater</td>
<td>1</td>
<td>1.02</td>
<td>1.17</td>
<td>0.88</td>
<td>1.10</td>
<td>0.87</td>
<td>0.93</td>
<td>1.17</td>
<td>0.84</td>
<td>1.06</td>
<td>0.82</td>
</tr>
<tr>
<td>Wohlford</td>
<td>1</td>
<td>1.04</td>
<td>1.28</td>
<td>0.84</td>
<td>1.15</td>
<td>0.85</td>
<td>0.96</td>
<td>1.28</td>
<td>0.80</td>
<td>1.15</td>
<td>0.78</td>
</tr>
</tbody>
</table>
Table 30. Climate-Adjusted Natural Inflows

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Historical Natural Inflow (AF)</th>
<th>Climate-Adjusted Natural Inflow (AF)</th>
<th>2020s</th>
<th>2050s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current Climate</td>
<td></td>
<td>ct</td>
<td>ww</td>
</tr>
<tr>
<td>Barrett</td>
<td>12,500</td>
<td></td>
<td>12,600</td>
<td>14,400</td>
</tr>
<tr>
<td>El Capitan</td>
<td>27,700</td>
<td></td>
<td>27,200</td>
<td>26,600</td>
</tr>
<tr>
<td>Hodges</td>
<td>19,000</td>
<td></td>
<td>19,600</td>
<td>22,600</td>
</tr>
<tr>
<td>Loveland</td>
<td>13,000</td>
<td></td>
<td>13,100</td>
<td>15,300</td>
</tr>
<tr>
<td>Lower Otay</td>
<td>6,700</td>
<td></td>
<td>6,700</td>
<td>7,800</td>
</tr>
<tr>
<td>Morena</td>
<td>10,200</td>
<td></td>
<td>10,500</td>
<td>11,900</td>
</tr>
<tr>
<td>San Vicente</td>
<td>8,400</td>
<td></td>
<td>8,600</td>
<td>10,100</td>
</tr>
<tr>
<td>Sutherland</td>
<td>11,600</td>
<td></td>
<td>11,800</td>
<td>13,600</td>
</tr>
<tr>
<td>Sweetwater</td>
<td>7,400</td>
<td></td>
<td>7,500</td>
<td>8,700</td>
</tr>
<tr>
<td>Wohlford</td>
<td>1,400</td>
<td></td>
<td>1,500</td>
<td>1,800</td>
</tr>
</tbody>
</table>

Table 31. Comparison of Natural Inflow to Modeled Reservoir Capacity

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Historical Natural Inflow (AF) Current Climate</th>
<th>Modeled Reservoir Capacity</th>
<th>Natural Inflow / Reservoir Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrett</td>
<td>12,500</td>
<td>37,900</td>
<td>33%</td>
</tr>
<tr>
<td>El Capitan</td>
<td>27,700</td>
<td>50,733</td>
<td>55%</td>
</tr>
<tr>
<td>Hodges</td>
<td>19,000</td>
<td>33,600</td>
<td>57%</td>
</tr>
<tr>
<td>Loveland</td>
<td>13,000</td>
<td>25,400</td>
<td>51%</td>
</tr>
<tr>
<td>Lower Otay</td>
<td>6,700</td>
<td>49,849</td>
<td>13%</td>
</tr>
<tr>
<td>Morena</td>
<td>10,200</td>
<td>50,200</td>
<td>20%</td>
</tr>
<tr>
<td>San Vicente</td>
<td>8,400</td>
<td>272,528</td>
<td>3%</td>
</tr>
<tr>
<td>Sutherland</td>
<td>11,600</td>
<td>31,960</td>
<td>36%</td>
</tr>
<tr>
<td>Sweetwater</td>
<td>7,400</td>
<td>20,207</td>
<td>37%</td>
</tr>
<tr>
<td>Wohlford</td>
<td>1,400</td>
<td>6,940</td>
<td>20%</td>
</tr>
</tbody>
</table>

5.2.2. Imported Water Purchases Supply Projections

The CWASim model requires time series of deliveries to MWD to simulate supplies available to San Diego from MWD. Deliveries to MWD from the State Water Project are derived from the modeling performed for the Sacramento-San Joaquin Basins Study (SSJBS) which extends from January 2015 through September 2099 (Reclamation, Bureau of, 2016b). Deliveries to MWD from the Colorado River are derived from the modeling performed for the Colorado River Basin Study (CRBS) which extends from January 2012 through December 2060 (Reclamation, Bureau of, 2012). The Colorado River deliveries were extended to cover the entire 85-year CWASim simulation period (85 realizations) by taking the average of deliveries from 2048 through 2060 and extending that figure through September 2099. This 13-year period was chosen to maintain consistency in the reduced deliveries expected beginning in 2048.
Because the SSJBS and CRBS used different scenarios than those in the San Diego Basin Study, prior to use in the CWASim model, the SSJBS and CRBS results were mapped to the scenarios for the San Diego Basin Study. Two areas were considered in the scenario mapping: temperature and precipitation conditions, and time period. Table 32 shows the San Diego Basin Study scenarios and the associated SSJBS and CRBS scenarios.

Temperature and precipitation scenario mapping was done using one method for the SSJBS and another for the CRBS. In the SSJBS, five ensemble-based climate scenarios were used representing warm-dry (WD), warm-wet (WW), hot-dry (HD), hot-wet (HW), and central tendency (CEN) change conditions. Although the methodology used to create the scenarios was different, these definitions are largely consistent with the definitions used in the San Diego Basin Study, such that modeling results for the State Water Project deliveries to MWD were utilized directly from the SSJBS for their respective climate scenarios. The CRBS utilized 112 individual climate projections, and did not have an ensemble-based set of results that could be directly mapped to the San Diego Basin Study scenarios. In this case, changes in annual temperature and annual precipitation were computed for all climate projections (period of 2036-2065 compared to 1971-2000), and each projection was assigned to one of four categories representing warm-dry, warm-wet, hot-dry, and hot-wet, based on the computed change in annual temperature and precipitation in comparison to the median change. Once the projections were assigned to the four categories, the MWD delivery results were averaged from the projections in each category. Finally, a fifth category was created from the median of all projections.

Table 32. Mapping of Climate Scenarios Across San Diego, Sacramento-San Joaquin, and Colorado River Basin Studies

<table>
<thead>
<tr>
<th>San Diego Basin Study Scenarios</th>
<th>Associated Sacramento-San Joaquin Basins Study Scenarios</th>
<th>Associated Colorado River Basin Study Scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Climate</td>
<td>Reference No Climate Change (RF)</td>
<td>Historical Climate</td>
</tr>
<tr>
<td>Central Tendency</td>
<td>Central Tendency (CEN)</td>
<td>Median estimate from 112 traces</td>
</tr>
<tr>
<td>Hot-Wet</td>
<td>Hot-Wet (HW)</td>
<td>Mean of traces with annual temperature and precipitation change greater than median (32 traces)</td>
</tr>
<tr>
<td>Hot-Dry</td>
<td>Hot-Dry (HD)</td>
<td>Mean of traces with annual temperature change greater than median and precipitation change less than median (24 traces)</td>
</tr>
<tr>
<td>Warm-Wet</td>
<td>Warm-Wet (WW)</td>
<td>Mean of traces with annual temperature change less than median and precipitation change greater than median (22 traces)</td>
</tr>
</tbody>
</table>
Time period mapping was done the same way for the SSJBS and CRBS. The SSJBS and CRBS both used a transient approach to time period in which climate and socioeconomic factors gradually changed as the simulation progressed through time (2012 to 2099 for SSJBS, and 2012-2060 for CRBS), whereas the San Diego Basin Study uses a period-in-time approach in which simulations are performed for specific time periods (2015, 2025, and 2050) and climate and socioeconomic factors are held constant throughout the individual simulations. Due to differences in the modeling approaches between the San Diego Basin Study and the SSJBS and CRBS, it was necessary to represent separate adjustments for the 2020 and 2050 set of scenarios for the San Diego Basin Study. The following process was performed in order to develop these adjusted MWD delivery results:

1. Deliveries were computed for each climate change scenario for 30-year periods centered around the projection year (e.g., 2035-2064 for the 2050 period).

2. Change factors were computed by dividing the period-average deliveries for a given climate change scenario by the “no climate change” scenario.

3. Annual time series of deliveries were ranked to calculate their corresponding percentile, and a rank-specific adjustment was applied to the “no climate” scenario deliveries to reflect the anticipated change for the particular scenario.

4. Since the CRBS simulations only extended to 2060, monthly average values from 2048-2060 were used to extend the time series for 2061-2099.

Through these steps, an adjusted set of MWD deliveries (Table 33) was developed that reflects the changes anticipated for the specific climate scenarios and timeframes that are consistent with the San Diego Basin Study period-in-time approach.

### Table 33. MWD Imported Water Supply Projections

<table>
<thead>
<tr>
<th>Demand Scenario</th>
<th>Climate Scenario</th>
<th>SWP Projections (AF/y)</th>
<th>CRA Projections (AF/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015, 2025, and 2050</td>
<td>current climate</td>
<td>1,411,197</td>
<td>712,030</td>
</tr>
</tbody>
</table>
5.3. Water Demand Projections

Gross water demand projections for the Basin Study consist of annual projections of agricultural and M&I demands for five hydrologic year types for each of the 13 time period and climate change projection group combinations. The projections were developed to quantify how demands in the Study Area may be expected to change between 2015 and 2050. From year to year, demands may increase or decrease based on annual weather conditions (e.g., dry or wet years). Over longer time periods such as the planning horizon of the Basin Study, demands may increase or decrease based on trends in factors such as population, demographics, and economic climate, changes in laws and regulations, shifts in demand type (e.g., shifts from agricultural demands to M&I demands), and changes in climate (e.g., long-term shifts in temperature or precipitation). The Basin Study demand projections account for these factors by using annual
gross demand projections from the SDCWA 2015 UWMP, extending them to 2050, and adjusting them for projected climate change impacts. These demand projections are used to generate the three demand scenarios used in the CWASim Model: the 2015 demand scenario representing 2015 demands, the 2025 demand scenario representing 2025 demands, and the 2050 demand scenario representing 2050 demands. Although there is inherent uncertainty in future demands resulting from uncertainties in projections of future population and socio-economic factors, analysis of this type of uncertainty was outside the scope of the Basin Study. Uncertainty in demands due to uncertainty in future climate was captured in the Basin Study through adjustment of the demand projections for climate change scenarios. Climate change adjustments that were used when implementing the climate scenarios are described in Sections 5.3.2.2 and 5.3.2.3. Although SDCWA updated its demand forecast in 2018, to reflect changes in demand trends since the publication of the 2015 UWMP, the update occurred too late in the Basin Study process to be incorporated into the Study. Therefore, the Basin Study used demand projections from the 2015 UWMP, which are higher than the SDCWA 2018 demand forecast (San Diego County Water Authority, 2018a).

5.3.1. 2015 Gross Demands
2015 gross demands were equivalent to actual demands in 2015 as documented in the SDCWA 2015 UWMP Annual Report. These demands were used when simulating the 2015 demand scenario in the CWASim model.

5.3.2. Gross Demand Projections for 2025 and 2050
Gross demand projections for 2025 and 2050 were based on the demand projections in the 2015 SDCWA UWMP, as modified for the Basin Study including extension of the demands to 2050 and adjustment for climate change. These demands were used when simulating the 2025 and 2050 demand scenarios in the CWASim model.

5.3.2.1 Current Climate Gross Demand Projections
Non-climate change-adjusted gross demands for 2020-2040 (Table 34 and Figure 9) were extracted from the 2015 SDCWA Urban Water Management Plan (San Diego County Water Authority, 2016). These demands were developed by SDCWA using demand models to calculate annual demands in five-year increments for each SDCWA member agency. These demands account for demographic and economic factors and year-to-year variability in weather conditions and remain the same for all Portfolio model runs.

The UWMP contained demands for three categories of demand: M&I demand, agricultural demand, and near-term annexations (known future potential annexations). The UWMP also included projections of demands from accelerated growth and demand reductions due to conservation savings, but these were not included in the Basin Study demand projections. Accelerated growth was not included as one of the scenarios to be analyzed for the Basin Study, and conservation savings were incorporated directly into the CWASim model rather than being implicitly included via the demand projections. M&I demands were calculated for the SDCWA UWMP using an econometric model (CWA-MAIN) that relates historical water demand patterns to climate, demographic, and economic variables. The UWMP projections were based upon demographic and economic projections from the San Diego Association of Governments (SANDAG) Series 13 Regional Growth Forecast (SANDAG, 2013). Climate variables for the UWMP CWA-MAIN M&I demand projections were based on historical observations.
Agricultural demands for the UWMP were based on historical water use factors and variables including irrigated acreage, crop type distribution, and projections of agricultural conversion to other uses from SDCWA member agencies, SANDAG, County of San Diego Agricultural Weights and Measures, and the California Avocado Commission.

The UWMP demands were given for three hydrologic year types: normal years, single dry years, and multiple (two and three consecutive) dry years. Normal year projections were based on hydrology for 1960-2013. Single dry years were based on 2015 weather. Multiple dry years assumed a 1 percent annual increase in water demand from the single dry year projections. For the Basin Study, the multiple dry year hydrologic year type was also extended to include a potential fourth consecutive dry year, and an additional hydrologic year type was added to account for demand differences in wet years. Wet year demands were assumed to be 5% less than normal year demands based on review of historic interannual demand variability.

To extend the non-climate change-adjusted demands to 2050, regression equations were developed for each member agency and hydrologic year type. The 2020-2040 long range demand projections for each hydrologic year type were linearly regressed against population projections for 2020 to 2040 from the SANDAG Series 13 (SANDAG, 2013) dataset. The regression coefficients were then used to project demands for 2045 and 2050.

Table 34. Total Gross Demand Projections for All Member Agencies

<table>
<thead>
<tr>
<th>Demand Scenario</th>
<th>Wet Year Gross Demand (AF/y)</th>
<th>Normal Year Gross Demand (AF/y)</th>
<th>First Dry Year Gross Demand (AF/y)</th>
<th>Second Dry Year Gross Demand (AF/y)</th>
<th>Third Dry Year Gross Demand (AF/y)</th>
<th>Fourth Dry Year Gross Demands (AF/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>619,736</td>
<td>619,736</td>
<td>619,736</td>
<td>619,736</td>
<td>619,736</td>
<td>619,736</td>
</tr>
<tr>
<td>2025</td>
<td>675,642</td>
<td>722,507</td>
<td>772,648</td>
<td>766,687</td>
<td>761,726</td>
<td>756,597</td>
</tr>
<tr>
<td>2050</td>
<td>779,456</td>
<td>845,488</td>
<td>919,919</td>
<td>916,305</td>
<td>919,506</td>
<td>922,673</td>
</tr>
</tbody>
</table>
5.3.2.2 Climate Change Adjusted Demand Projections

Climate change adjusted demands (Table 35 and Figure 10) were calculated by applying a set of climate change adjustment factors for each time period and climate change projection group to the unadjusted projections. The adjustment was done individually for each member agency demand node using the same adjustment factor for all hydrologic year types.

Table 35. Average Climate Change Adjustment Factors and Resulting Average Gross Demand Projections

<table>
<thead>
<tr>
<th>Demand Scenario/Climate Scenario</th>
<th>Average Member Agency Demand Climate Change Adjustment Factor</th>
<th>Total Average Gross Demand (AF/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015/Current Climate</td>
<td>1</td>
<td>619,736</td>
</tr>
<tr>
<td>Demand Scenario/Climate Scenario</td>
<td>Average Member Agency Demand Climate Change Adjustment Factor</td>
<td>Total Average Gross Demand (AF/y)</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>2025/Current Climate</td>
<td>1</td>
<td>730,437</td>
</tr>
<tr>
<td>2050/Current Climate</td>
<td>1</td>
<td>860,082</td>
</tr>
<tr>
<td>2025/Central Tendency Climate</td>
<td>1.0320</td>
<td>753,815</td>
</tr>
<tr>
<td>2025/Warm Wet Climate</td>
<td>1.0309</td>
<td>752,765</td>
</tr>
<tr>
<td>2025/Warm Dry Climate</td>
<td>1.0327</td>
<td>754,018</td>
</tr>
<tr>
<td>2025/Hot Wet Climate</td>
<td>1.0305</td>
<td>752,416</td>
</tr>
<tr>
<td>2025/Hot Dry Climate</td>
<td>1.0331</td>
<td>754,681</td>
</tr>
<tr>
<td>2050/Central Tendency Climate</td>
<td>1.0315</td>
<td>886,942</td>
</tr>
<tr>
<td>2050/Warm Wet Climate</td>
<td>1.0310</td>
<td>886,413</td>
</tr>
<tr>
<td>2050/Warm Dry Climate</td>
<td>1.0330</td>
<td>887,540</td>
</tr>
<tr>
<td>2050/Hot Wet Climate</td>
<td>1.0315</td>
<td>886,862</td>
</tr>
<tr>
<td>2050/Hot Dry Climate</td>
<td>1.0325</td>
<td>887,453</td>
</tr>
</tbody>
</table>
Figure 10. Current and future climate gross demands averaged across all realizations in each scenario. Gross demand projections remain the same for all Portfolios.

5.3.2.3 Development of Climate Change Adjustment Factors for Demand Projections

Demand adjustment factors were calculated with a spreadsheet model that relates projected changes in precipitation and potential evapotranspiration (PET) to changes in demand. The model was developed and calibrated as part of the analysis for the 2013 SDCWA Master Plan (San Diego County Water Authority, 2013) and applied to the San Diego Basin Study. The spreadsheet model requires input values of modeled historical and future precipitation and PET for grid cell locations representing each SDCWA member agency for each climate change scenario. For the San Diego Basin Study, the input precipitation and PET data was obtained from the same set of hydrology projections as the surface water supply projections (see Section 5.1).

The model calculates change factors based on the modeled precipitation and PET and then applies the change factors to a set of historical precipitation and evapotranspiration values for each member agency, resulting in climate change adjusted precipitation and PET values. The adjusted precipitation and PET values are then combined with calibration coefficients for irrigated area size, irrigation efficiency, and indoor use to produce multiplicative demand adjustment factors.
6. Impacts Assessment Methodology

Basin Studies are required to consider eight impact areas: Water Delivery, Hydroelectric Power, Recreation, Flood Control, Habitats, Endangered/Threatened Species, Water Quality, and Ecological Resiliency (Reclamation, Bureau of, 2016a). Task 2.4 of the Study assessed Water Delivery, Hydroelectric Power (as energy generation and consumption), Recreation, and Flood Control. Habitats, Endangered/Threatened Species, Water Quality, and Ecological Resiliency were not analyzed in Task 2.4, since the CWASim model does not have a method for quantifying environmental impacts. These impacts (Habitats, Endangered/Threatened Species, Water Quality, and Ecological Resiliency) are assessed in Task 2.5 of the Basin Study.

To quantify impacts to Water Delivery, Hydroelectric Power, Recreation, and Flood Control, a set of metrics summarized the CWASim model results for each climate and demand scenario and portfolio. The metrics were analyzed and compared across the modeled climate and demand scenarios and portfolios to identify how climate, demand, and water resources infrastructure affect the impact areas. Climate scenarios consisted of current climate, central tendency climate, hot-dry climate, warm-dry climate, hot-wet climate, and warm-wet climate. The three demand scenarios consisted of 2015 demands, 2025 demands, and 2050 demands.

6.1. Metrics

Impact metrics (Table 36) quantify the CWASim model simulation results for each of the impact areas (Water Delivery, Recreation, Energy, and Flood Control), and are divided into a Metric Category, Metric Subcategory, and Metric Group. Impacts areas (Water Delivery, Energy, Recreation, and Flood Control) serve as the Metric Category, and Metric Subcategories further divide the Metric Category. For example, the Metric Category Water Delivery is further subdivided into the Metric Subcategories of Demands, Deliveries, Shortage, Conveyance, and Reservoir Operations. The Metric Category Energy is subdivided into the Metric Subcategories of Generation and Consumption. Metric Subcategories can be further defined by Metric Groups (i.e., Pipeline Flow is within the Metric Subcategory of Conveyance, which is within the Metric Category of Water Delivery). Each impact metric group contains one or more metrics pertaining to a particular location, facility, water supply type, water demand type, or other specific feature (e.g., the metric group Treatment Plant Utilization contains separate metrics for Alvarado WTP, Miramar WTP, and the other treatment plants). Environmental impacts were not quantified by impact metrics, and therefore were not analyzed in Task 2.4 of the Basin Study. Environmental impacts are analyzed in Task 2.5.

Table 36. Task 2.4 Impact Metrics

<table>
<thead>
<tr>
<th>Metric Category</th>
<th>Metric Subcategory</th>
<th>Metric Group</th>
<th>Timestep</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Delivery</td>
<td>Demands</td>
<td>Gross Demand Volume</td>
<td>Annual</td>
<td>Gross demands of SDCWA member agencies</td>
</tr>
<tr>
<td>Metric Category</td>
<td>Metric Sub-category</td>
<td>Metric Group</td>
<td>Timestep</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
<td>----------------------------------</td>
<td>----------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Water Delivery</td>
<td>Deliveries</td>
<td>Delivery and Conservation</td>
<td>Annual</td>
<td>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.</td>
</tr>
<tr>
<td>Water Delivery</td>
<td>Shortage</td>
<td>Shortage Volume</td>
<td>Annual</td>
<td>Magnitude of demand Water Authority-wide that is unable to be met by the available supplies and/or limited by conveyance system capacity</td>
</tr>
<tr>
<td>Water Delivery</td>
<td>Conveyance</td>
<td>Pipeline Flow Volume</td>
<td>Monthly</td>
<td>Average pipeline flow volumes during the month for five pipeline locations:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Pipeline 4 just south of Twin Oaks Valley WTP, which serves treated water to Carlsbad, Vista, and Vallecitos member agencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Pipeline 3 30-inch interconnect, which conveys untreated water near Murray Reservoir</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Crossover Pipeline, which conveys untreated water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• MWD Delivery Point treated water conveyed through Pipelines 1, 2, and 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Untreated</td>
</tr>
<tr>
<td>Water Delivery</td>
<td>Conveyance</td>
<td>High Pipeline Utilization Summer Count</td>
<td>Annual</td>
<td>Number of days that pipeline flow exceeds 95% of capacity during the summer for five pipeline locations:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Pipeline 4 just south of Twin Oaks Valley WTP, which serves treated water to Carlsbad, Vista, and Vallecitos member agencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Pipeline 3 30-inch interconnect, which conveys untreated water near Murray Reservoir</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Crossover Pipeline, which conveys untreated water</td>
</tr>
<tr>
<td>Metric Category</td>
<td>Metric Sub-category</td>
<td>Metric Group</td>
<td>Timestep</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------</td>
<td>-----------------------------------</td>
<td>-------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 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 |
<p>| 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. |
| Energy               | Generation          | Energy Generation                 | Annual      | Total energy 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         | Energy Consumption                | Annual      | Total energy consumed to treat and deliver water, including consumption by supply sources, conveyance, treatment, pumped storage, and offices                                                                  |</p>
<table>
<thead>
<tr>
<th>Metric Category</th>
<th>Metric Subcategory</th>
<th>Metric Group</th>
<th>Timestep</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreation</td>
<td>Recreation</td>
<td>End of September Reservoir Elevation</td>
<td>Annual</td>
<td>Reservoir elevation on September 30th of each simulation year</td>
</tr>
<tr>
<td>Flood Control</td>
<td>Flood Outflow</td>
<td>Flood Outflow Volume</td>
<td>Annual Monthly</td>
<td>Total outflow volume from the reservoir on days when the reservoir is operating in the flood pool</td>
</tr>
<tr>
<td>Flood Control</td>
<td>Flood Outflow</td>
<td>Number of Days with Flood Outflows</td>
<td>Annual</td>
<td>Number of days with flood outflows from a reservoir</td>
</tr>
</tbody>
</table>

### 6.1.1. Water Delivery Metrics
Impact Metric groups included in the Water Delivery Impact Category are Demands, Deliveries, Shortage Volume, Pipeline Delivery, High Pipeline Utilization Summer Count, High Pump Station Utilization, Treatment Plant Utilization, Reservoir Storage, Reservoir Releases, and Storage: End of September. See Box 11 through Box 20 for details on each of these metrics.

#### Box 11. Impact Metric Description: Demands

<table>
<thead>
<tr>
<th>Water Delivery – Demands – Demand Volume</th>
</tr>
</thead>
</table>
| **Metric Time Step**                   | Annual
|                                        | Monthly
| **What it Measures**                   | Measures the gross annual demands of SDCWA member agencies as input into the model.
| **Meaning of Larger or Smaller Values**| Larger values indicate higher demand projections for SDCWA member agencies.
| **Why it is Measured**                 | Demands indicate the water supply needed for municipal, industrial, and agricultural uses.

#### Box 12. Impact Metric Description: Deliveries

<table>
<thead>
<tr>
<th>Water Delivery – Deliveries – Delivery and Conservation</th>
</tr>
</thead>
</table>
| **Metric Time Step**                                   | Annual
|                                                        | Monthly
**Water Delivery – Deliveries – Delivery and Conservation**

<table>
<thead>
<tr>
<th>What it Measures</th>
<th>Measures the 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. In addition, conservation (described by projects in the Enhanced Conservation and Urban and Agricultural Water Use Efficiency Concepts) is included with delivery metrics because it represents a demand reduction that affects the water volume that must be delivered to meet demands.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaning of Larger or Smaller Values</td>
<td>Larger values indicate that more water volume is being delivered to SDCWA member agencies or conserved by member agencies.</td>
</tr>
<tr>
<td>Why it is Measured</td>
<td>Deliveries indicate the amount of water supplied to SDCWA member agencies to meet demands. An imbalance between water demands and water deliveries may lead to shortages.</td>
</tr>
</tbody>
</table>

**Box 13. Impact Metric Description: Shortage Volume**

<table>
<thead>
<tr>
<th>Water Delivery - Shortage - Shortage Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metric Time Step</td>
</tr>
<tr>
<td>What it Measures</td>
</tr>
<tr>
<td>Meaning of Larger or Smaller Values</td>
</tr>
<tr>
<td>Why it is Measured</td>
</tr>
</tbody>
</table>
Box 14. Impact Metric Description: Pipeline Flow Volume

Water Delivery - Conveyance - Pipeline Flow Volume

<table>
<thead>
<tr>
<th>Metric Time Step</th>
<th>Monthly</th>
</tr>
</thead>
</table>
| What it Measures | Quantifies pipeline flow volumes for five pipeline locations:  
  - Pipeline 4 just south of Twin Oaks Valley WTP, which delivers treated water to Carlsbad, Vista, and Vallecitos member agencies  
  - The 30-Inch, an interconnect between the SD12 Pipeline (a section of Pipeline 4) and Pipeline 3  
  - Crossover Pipeline, which conveys untreated water between the Second and First Aqueducts  
  - MWD Treated, which conveys water from the MWD Delivery Point through Pipelines 1, 2, and 4  
  - Untreated, which is the combination of Pipeline 3 and Pipeline 5 and conveys water purchased from MWD from the MWD delivery point to connections with other facilities |
| Meaning of Larger or Smaller Values | Larger volumes indicate pipeline deliveries at a location is typically higher. |
| Why it is Measured | Pipeline Flow Volume indicates where pipeline flow volumes are higher on average. Higher pipeline flow volumes may lead to pipeline capacity constraints. |

Box 15. Impact Metric Description: High Pipeline Utilization Summer Count

Water Delivery - Conveyance - High Pipeline Utilization Summer Count

<table>
<thead>
<tr>
<th>Metric Time Step</th>
<th>Annual</th>
</tr>
</thead>
</table>
| What it Measures | Measures the number of days that pipeline flow exceeds 95% of capacity during the summer months (June through September) for five pipeline locations:  
  - MWD Treated (combination of Pipeline 12 and Pipeline 4), which conveys water from the MWD Delivery Point through Pipelines 1, 2, and 4  
  - Crossover Pipeline, which conveys untreated water between the Second and First Aqueducts  
  - Pipeline 4 just south of Twin Oaks Valley WTP, which serves treated water to Carlsbad, Vista, and Vallecitos member agencies |
The 30-Inch, an interconnect between the SD12 Pipeline (a section of Pipeline 4) and Pipeline 3
Untreated pipeline (combination of Pipeline 3 and Pipeline 5), which conveys water from the MWD delivery point to connections with other facilities

Table 37. Capacities for pipelines analyzed in the Pipeline Flow Volume and High Pipeline Utilization Summer Count Metrics

<table>
<thead>
<tr>
<th>Pipeline</th>
<th>Baseline Capacity</th>
<th>Portfolio Capacity Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWD Treated</td>
<td>34,810 AF/month (585 cfs)</td>
<td>22,909 AF/month (385 cfs) in the Optimize Existing Facilities Portfolio¹</td>
</tr>
<tr>
<td>Crossover</td>
<td>11,900 AF/month (200 cfs)</td>
<td>19,640 AF/month (330 cfs) in the Optimize Existing Facilities Portfolio²</td>
</tr>
<tr>
<td>Pipeline 4 South of TOV</td>
<td>26,780 AF/month (450 cfs)</td>
<td>None</td>
</tr>
<tr>
<td>30-Inch</td>
<td>4,170 AF/month (70 cfs)</td>
<td>8,330 AF/month (140 cfs) in the Baseline Plus and subsequent Portfolios³</td>
</tr>
<tr>
<td>MWD Untreated</td>
<td>42,850 AF/month (720 cfs)</td>
<td>53,360 AF/month (895 cfs) in the Optimize Existing Facilities Portfolio¹</td>
</tr>
</tbody>
</table>

¹ Capacity increased due to implementation of the Pipeline 3/Pipeline 4 Conversion project
² Capacity increased due to implementation of the Second Crossover Pipeline project
³ Capacity increased due to implementation of the Mission Trails Alternative 1 project

Meaning of Larger or Smaller Values
Larger numbers of days indicate that high summer pipeline utilization is more frequent.

Why it is Measured
High pipeline utilization indicates that pipeline capacity may be limiting water deliveries. Summer is when water usage is typically highest and pipeline capacity is most likely to be a limiting factor in water deliveries. Exceeding 95% of capacity is expected during the summer.
### Box 16. Impact Metric Description: High Pump Station Utilization

<table>
<thead>
<tr>
<th>Water Delivery - Conveyance - High Pump Station Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metric Time Step</strong></td>
</tr>
</tbody>
</table>
| **What it Measures** | Measures the number of times per year that pump station flow 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 |
| **Meaning of Larger or Smaller Values** | Larger numbers of days indicate that pump station maximum utilization is more frequent. |
| **Why it is Measured** | High pump station utilization indicates that pump stations are frequently operated near their pumping capacity, which could lead to difficulty moving water through the regional system. Although the system is primarily operated as a gravity system, some pump stations (San Vicente and P2A) are integrated into the system. These pump stations are needed when the system is under stress or during emergency events. |

### Box 17. Impact Metric Description: Treatment Plant Utilization

<table>
<thead>
<tr>
<th>Water Delivery - Conveyance - Treatment Plant Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metric Time Step</strong></td>
</tr>
<tr>
<td><strong>What it Measures</strong></td>
</tr>
<tr>
<td><strong>Meaning of Larger or Smaller Values</strong></td>
</tr>
<tr>
<td><strong>Why it is Measured</strong></td>
</tr>
</tbody>
</table>
### Box 18. Impact Metric Description: Reservoir Storage

<table>
<thead>
<tr>
<th>Water Delivery - Reservoir Operations - Reservoir Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metric Time Step</strong></td>
</tr>
<tr>
<td><strong>What it Measures</strong></td>
</tr>
<tr>
<td><strong>Meaning of Larger or Smaller Values</strong></td>
</tr>
<tr>
<td><strong>Why it is Measured</strong></td>
</tr>
</tbody>
</table>

### Box 19. Impact Metric Description: Reservoir Releases

<table>
<thead>
<tr>
<th>Water Delivery - Reservoir Operations - Reservoir Releases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metric Time Step</strong></td>
</tr>
<tr>
<td><strong>What it Measures</strong></td>
</tr>
<tr>
<td><strong>Meaning of Larger or Smaller Values</strong></td>
</tr>
<tr>
<td><strong>Why it is Measured</strong></td>
</tr>
</tbody>
</table>

### Box 20. Impact Metric Description: End of September Storage

<table>
<thead>
<tr>
<th>Water Delivery - Reservoir Operations - End of September Reservoir Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metric Time Step</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Delivery - Reservoir Operations - End of September Reservoir Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What it Measures</strong></td>
</tr>
<tr>
<td><strong>Meaning of Larger or Smaller Values</strong></td>
</tr>
<tr>
<td><strong>Why it is Measured</strong></td>
</tr>
</tbody>
</table>

6.1.2. Energy Metrics

Water delivery consumes energy for pumping groundwater, pumping water through the distribution system, desalination, and water treatment. Energy generation can be used to offset the energy required to deliver water. Basin Study metrics describe regional energy generation and consumption. See Box 21 and Box 22 for details on each of these metrics.

**Box 21. Impact Metric Description: Energy Generation**

<table>
<thead>
<tr>
<th>Energy - Energy Generation</th>
</tr>
</thead>
</table>
| **Metric Time Step** | Annual  
  Monthly |
| **What it Measures** | Measures energy generated at seven facilities associated with the water system: 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. |
| **Meaning of Larger or Smaller Values** | Larger values of generation indicate that there is more energy generated by facilities that are part of the water system that can offset consumption, which would otherwise have to be purchased or generated by another method. |
| **Why it is Measured** | Energy generation within the water system can offset some of the energy needed to convey and treat water. Consumption that is not offset must be purchased or generated by another method. |
Box 22. Impact Metric Description: Energy Consumption

<table>
<thead>
<tr>
<th>Energy - Energy Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metric Time Step</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>What it Measures</strong></td>
</tr>
<tr>
<td><strong>Meaning of Larger or Smaller Values</strong></td>
</tr>
<tr>
<td><strong>Why it is Measured</strong></td>
</tr>
</tbody>
</table>

6.1.3. Recreation Metrics

Although the primary beneficial use of reservoirs in the San Diego region is water supply and reservoirs in the San Diego region are not operated for recreation, recreation opportunities are an incidental benefit of some reservoirs. Analysis of recreation impacts for the Basin Study focused on reservoir boat ramp accessibility. Impacts to other recreation-related metrics such as reservoir surface area or reservoir inflow for fishing, boating, and other recreational activities may also be affected, but data to relate those metrics to recreational impacts were not readily available for examination. Access to boat ramps was measured by the End of September reservoir elevation compared to the elevation of the lowest boat ramp at that reservoir. See Box 23 for details on this metric.

Box 23. Impact Metric Description: End of September Elevation

<table>
<thead>
<tr>
<th>Recreation - End of September Reservoir Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metric Time Step</strong></td>
</tr>
<tr>
<td><strong>What it Measures</strong></td>
</tr>
<tr>
<td><strong>Meaning of Larger or Smaller Values</strong></td>
</tr>
<tr>
<td><strong>Why it is Measured</strong></td>
</tr>
</tbody>
</table>
6.1.4. Flood Control Metrics
Flood control impacts are measured by the number of days with flood outflows from reservoirs and the average volume of those flood outflows. See Box 24 and Box 25 for details on each of these metrics. In the San Diego region, reservoir releases are typically made only in response to water delivery requests. During situations of high inflows or high reservoir storage resulting from storms, additional water may need to be released from a reservoir as flood outflows if the storage in the reservoir is at or above the flood pool.

Box 24. Impact Metric Description: Flood Outflow Volume

<table>
<thead>
<tr>
<th>Metric Time Step</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>What it Measures</td>
<td>Measures the flood outflow volume from the reservoir during the year or month (depending on the timestep used). The Flood Outflow Volume is defined as the sum of the volume released on days when the reservoir is in the flood pool, and may include both releases for water deliveries and flood releases or spills.</td>
</tr>
<tr>
<td>Meaning of Larger or Smaller Values</td>
<td>Larger volumes indicate larger volumes of water that were released from the reservoir on days that the reservoir was operating in the flood pool (includes releases to meet demands as well as additional volume that needed to be released for the reservoir to operate below its flood pool).</td>
</tr>
<tr>
<td>Why it is Measured</td>
<td>Flood Outflows from these reservoirs are indicative of potential flood situations because they occur when the reservoir is operating in the flood pool. There are no minimum outflows from the reservoirs. Flood outflow volumes could represent an opportunity to capture additional local water supply.</td>
</tr>
</tbody>
</table>

Box 25. Impact Metric Description: Number of Days with Flood Outflows

<table>
<thead>
<tr>
<th>Metric Time Step</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>What it Measures</td>
<td>Measures the number of days when flood outflows occur. This is defined as the sum of the number of days per year in which the reservoir must release or spill water in excess of releases for water deliveries because the storage volume is at or above the flood pool.</td>
</tr>
</tbody>
</table>
Flood Control – Flood Outflow – Number of Days with Flood Outflows

<table>
<thead>
<tr>
<th>Meaning of Larger or Smaller Values</th>
<th>Larger numbers of days with flood outflows indicate higher frequency of potential flood situations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why it is Measured</td>
<td>Flood Outflows from these reservoirs are indicative of potential flood situations because they occur when the reservoir is operating in the flood pool. There are no minimum outflows from the reservoirs. If flood outflows occur often, it may indicate an opportunity to store additional water for water supply.</td>
</tr>
</tbody>
</table>

6.2. Analysis Methodology

The metric results were visualized using charts and graphs to aid in comparison between demand and climate scenarios and comparison between portfolios. Inspection of the plots yielded numerous observations regarding differences in impacts between scenarios and portfolios. For some of the annual metrics, the observations of differences were then verified using statistical analysis. This was performed for Surface Water Deliveries, Desalination Deliveries, Shortage Volume, High Pipeline Utilization for the Untreated location, Treatment Plant Utilization for all 11 locations (see Box 17), End of September Storage for all five locations (see Box 20), Energy Generation and Energy Consumption, End of September Reservoir Elevation for all four locations (Box 23), and Flood Outflow Volume and Number of Days with Flood Outflows for all four locations (see Box 24 and Box 25). Statistical analysis was not performed for Demands because it was a model input. Statistical Analysis was not performed for Delivery metrics for Enhanced Conservation, Urban and Agricultural Water Use Efficiency, Firm Water Supply Agreements, Groundwater, Imported Water Purchases, Recycled Water, Potable Reuse, Stormwater BMPs, Gray Water Use, or Stormwater Capture because they were modeled as demand reductions. Statistical Analysis was not done for High Pipeline Utilization, except for the Untreated Pipeline, or High Pump Station Utilization because the results of those metrics were zero or nearly zero for all Portfolios and scenarios. Statistical analysis was not performed for the monthly metrics.

Two statistical techniques were used: analysis of variance (ANOVA) and the non-parametric Wilcoxon Rank Sum test. For a given annual metric (e.g., Shortage Volume) and set of scenarios or portfolios (e.g., Baseline 2015 demands current climate, Baseline 2025 demands current climate, and Baseline 2050 demands current climate), the difference in means between the scenarios or portfolios was checked with both ANOVA and the Wilcoxon Rank Sum Test. Both tests produce p-values (numbers between 0 and 1) indicating the strength of the evidence that the two means are different, with a low p-value indicating strong evidence and a high p-value indicating weak or no statistical evidence. A threshold of a p-value less than 0.05 was selected to indicate statistically significant differences, a range of p-values between 0.05 and 0.1 was defined to indicate some statistical evidence of a difference, and a p-value above 0.1 was defined to indicate no statistical evidence of a difference.
Both tests make the assumption of independence of groups, while ANOVA also assumes that the two groups have equal variance, and that the values are normally distributed. As is frequently the case for hydrologic data, the assumptions of normality and equal variance are not met for all metrics analyzed in the Basin Study. Based on quantile-quantile plots of the data, which provide a visual method for assessing normality of a dataset, approximately 90% of the metrics are not normally distributed. The Energy Generation and Energy Consumption metrics and the Treatment Plant Utilization for Levy and Twin Oaks Valley most clearly meet the assumptions of ANOVA. Surface Water Deliveries, Desalination Deliveries, Treatment Plant Utilization for Alvarado, Bader, Escondido, Miramar, Otay, Poway, and Perdue appear to only weakly meet the assumptions of ANOVA. Shortage Volume, High Pipeline Utilization Summer Count for the Untreated location, Treatment Plant Utilization for Olivenhain and Weese, End of September Storage for all five reservoirs analyzed, End of September Elevation for all four reservoirs analyzed, and Flood Outflow Volume and Number of Flood Outflows for all four reservoirs analyzed do not appear to meet the assumptions.

Despite the assumptions of normality and equal variance not being met for many of the metrics, both ANOVA and the Wilcoxon Rank Sum tests result in the same conclusions for about half of the annual metrics. There is no difference in the conclusions for Imported Water Deliveries, Surface Deliveries, or Desalination Deliveries. Using the Wilcoxon Rank Sum Test results in more conclusions of significant differences in means for Potable Reuse Deliveries, Pipeline Utilization at the Untreated location, Treatment Plant Utilization for Alvarado, Badger, Levy, Olivenhain, Otay, Poway, Perdue, and Weese, and Energy Generation, and Number of Flood Outflows for Lower Otay. Using the Wilcoxon Rank Sum Test results in mixed increases or decreases in significance compared to ANOVA for Shortage Volume, Treatment Plant Utilization at Miramar, and Twin Oaks Valley, End of September Storage for Hodges, Lower Otay, and Olivenhain, End of September Elevation at Hodges and Lower Otay, and Flood Outflow Volume at Hodges and Lower Otay. Using the Wilcoxon Rank Sum Test results in losses of significance for End of September Storage at El Capitan, End of September Reservoir Elevation at San Vicente, and Number of Flood Outflows at El Capitan. For simplicity and because ANOVA generally represents the more conservative conclusion for significance, only ANOVA results are reported in the text of this report and in Appendix D – Detailed Model Results. Wilcoxon results are available upon request as a supplemental material to the report. For a majority of the comparisons, the differences in scenarios indicated by the ANOVA p-values correlate to the differences that are observed in the results by inspection of the plots, but there are some instances where this is not the case. In these instances, the Wilcoxon Rank Sum Test may be a more applicable analysis technique due to the assumptions of ANOVA. This situation could also result from numerical differences between scenarios or Portfolios on an operationally irrelevant order of magnitude, such as differences in the tens of acre-feet for annual volumes totaling tens of thousands.

7. Impacts Assessment Results

The sections in this Chapter describe the impacts assessment results for each of the four impact metric categories described in Chapter 6: Section 7.1 discusses Water Delivery, Section 7.2...
discusses Energy, Section 7.3 discusses Recreation, and Section 7.4 discusses Flood Control. Impact metrics are further divided into subcategories and groups as shown in Table 36. For each metric group, the text describes key similarities and differences within and across Portfolios and climate (current, central tendency, hot-dry, warm-dry, hot-wet, and warm-wet) and demand (2015 demands, 2025 demands, and 2050 demands) scenarios. Where possible, differences between Portfolios and demand scenarios are attributed to Concepts (and specific projects in some cases) that can be identified as drivers. The differences between climate scenarios are attributed to differences in the supply and demand inputs associated with the scenarios. Key model results are discussed and supported with figures. Detailed model results and additional figures can be found in Appendix D – Detailed Model Results.

7.1. Water Delivery

The primary purpose of the San Diego regional water system is to deliver water supplies to meet the demands of member agencies. Therefore, water delivery impacts are related to the amount of water delivered to meet demands and the quantity of unmet demand. Conveyance system and reservoir operations support water delivery, thus, quantification of impacts to those infrastructure components also provides greater understanding of impacts to water delivery. Water delivery impacts were measured by demands, water delivery volumes, shortage volume and frequency, conveyance system operations (pipeline flows and treatment plant utilization), and reservoir storage and releases.

Overall, as demands increased due to increasing population, water deliveries also increased to meet the demands. Between the Baseline Portfolio and other Portfolios, there was a shift in water deliveries away from Imported Water Purchases. In the Enhanced Conservation Portfolio, the shift was due to reduced overall water demands, which allowed more of the demand to be met by local sources. Increases in local supply sources such as in the Baseline Plus, Increase Supplies, and Watershed Health and Ecosystem Restoration Portfolios, and improvements in system operations such as in the Optimize Existing Facilities Portfolio, enabled more demand to be met with local supplies instead of purchased water imports. Shortages occurred in some Portfolios but represented only up to 2% of the total annual demand on average. Shortages were worst under Baseline conditions, future demand scenarios, and in hot-dry and warm-dry climate scenarios. In the Baseline Portfolio, shortages above the 20,000 AF shortage threshold (Box 13) occurred in 6% of the realizations in the hot-dry climate scenario for 2025 demands, and 28% of the realizations in the hot-dry climate scenario for 2050 demands, due in part to an increase in demands but largely due to a drier climate. As discussed in Section 5.1, the realizations represent an 85-year-long time series of hydrologic data, so these results indicate that a shortage would occur in 28% of this series (realizations) in the Baseline Portfolio under hot-dry climate for the 2050 demand scenario. The Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios all reduced the occurrence and magnitude of shortage, and the Enhanced Conservation and Increase Supplies Portfolios eliminated shortages above the shortage threshold for all climate and demand scenarios. Conveyance system limitations may contribute to shortages if capacity is not great enough to convey the water needed to meet demands. In the simulated system operations, pipeline flow appeared to be a possible constraint, but pump station utilization and treatment plant utilization did not appear to constrain operations of the system. The Untreated Pipeline, which conveys water from the MWD delivery point,
conveyed the most flow and was the most highly used, with summer utilization frequently over 95% of capacity in all Portfolios. Utilization of the Untreated Pipeline was highest in the Baseline Portfolio and lower in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios for 2050 demands. 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.

### 7.1.1. Demands

Demands (Box 11) indicate the water supply needed for municipal, industrial, and agricultural uses. The demands metric measures the gross annual demands of SDCWA member agencies as input into the model. Larger values indicate higher demand projections for SDCWA member agencies. Gross demands are a model input calculated as described in Section 5.3. Demand projections were modeled for various climate scenarios: current climate, hot-dry climate, warm-dry climate, hot-wet climate, warm-wet climate, and central tendency climate. Current climate 2015 demands were actual demands from 2015, the current climate 2025 demand projections were taken from the SDCWA 2015 UWMP, and the current climate 2050 demand projections were extended from the projections in the SDCWA 2015 UWMP. Although there is inherent uncertainty in future demands resulting from uncertainties in projections of future population and socio-economic factors, analysis of this type of uncertainty was outside the scope of the Basin Study. SDCWA updated its demand forecast in 2018 to account for changes in socioeconomic trends, but the update was developed too late to be incorporated in the Basin Study process. Uncertainty in demands due to uncertainty in future climate was captured in the Basin Study through adjustment of the demand projections for climate change scenarios. 2025 and 2050 demand projections for the climate change scenarios were calculated by adjusting the current climate demands with factors developed using a spreadsheet model that relates projected changes in precipitation and potential evapotranspiration (PET) to changes in demand (see Section 5.3). Demand inputs were the same for all Portfolios but varied with demand scenario and climate scenario.
Current climate 2015 demands were 619,736 AF, and demands were higher for the 2025 demand scenario (increase of 110,000 AF) than for the 2015 demand scenario, and higher for the 2050 demand scenario (increase of 180,000 AF) than for the 2025 demand scenario, due to increases in population and other socioeconomic factors (see Section 5.3.2.1). Central tendency demands were higher than current climate (increase of 23,000 AF for 2025 and increase of 27,000 AF for 2050) due to changes in temperature and precipitation (see Sections 5.3.2.2 and 5.3.2.3). Although demand values differ between central tendency climate and other future climate scenarios (hot-dry, hot-wet, warm-dry, or warm-wet), the differences are small (Figure 11). These results indicate that the increase in population from 2015 to 2025 and 2050 has a larger effect on overall demand than climate change. Climate change does have an effect on demand, but the effect is only apparent when comparing between current climate and future climate scenarios within a demand scenario (e.g., comparing 2025 current climate to 2025 central tendency or 2025 hot-dry).
7.1.2. Deliveries and Conservation

Delivery metrics (Box 12) describe water volumes that are delivered to meet SDCWA member agency demands. The metrics measure the 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. As described in Section 4.4, some supply sources are modeled dynamically through model logic (firm water supply agreements, some imported water purchases, surface water, some desalination, and some potable reuse) and others are modeled as demand reductions (recycled water, groundwater, some imported water purchases, some desalination, some potable reuse, stormwater BMPs, gray water use, and stormwater capture). In addition, conservation (described by projects in the Enhanced Conservation and Urban and Agricultural Water Use Efficiency Concepts) is included with delivery metrics because it represents a demand reduction that affects the water volume that must be delivered to meet demands. Larger values of delivery metrics indicate that more water volume is being delivered to SDCWA member agencies or conserved by member agencies.

Deliveries and conservation volumes vary depending on climate and demand scenario and Portfolio (see Figure 12, which shows the average annual delivery and conservation volumes associated with each Portfolio for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario).

Overall, total deliveries increase as demands increase\(^3\), but the types of water delivered varies depending on Portfolio and demand scenario, and climate change scenarios may shift delivery amounts up or down relative to current climate. Firm Water Supply Agreements (QSA) deliveries are assumed to be the same across all Portfolios, demand scenarios, and climate scenarios. Conservation (Urban and Agricultural Water Use Efficiency and Enhanced

---

\(^3\) Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. Delivery metrics for individual supply types sum to a larger volume than the total demand minus shortage, resulting in an apparent oversupply of between 1% and 7%. However, the impacts of this discrepancy are negligible in the overall conclusions of the San Diego Basin Study. While some specific reported delivery values (primarily imported water and surface water) are slightly too large, the trends and changes observed in the delivery results are accurate. Because this issue only impacts water delivery accounting, no other metrics are impacted.

The CWASim model is carefully mass-balanced at all reservoirs and demand nodes such that each demand unit in the model is never oversupplied. The apparent oversupply is the result of inconsistencies in water accounting assumptions that assign deliveries to supply sources. For example, imported water deliveries from QSA and MWD purchases are measured as total volume imported to the San Diego County water system, but other deliveries are counted after release from reservoirs. MWD untreated water imported to reservoirs is subject to evaporation, but this evaporation is not accounted for in the delivery amount, resulting in an apparent oversupply. In addition, imported water also mixes with local supplies such as surface water and potable reuse water in reservoirs, resulting in double-counting in certain situations and at certain reservoirs, again resulting in an apparent oversupply. Analysis of the model logic and results indicates that for 2015 and 2025 scenarios, 95-99% of the apparent oversupply can be accounted for by subtracting two double-counts in the model related to the above issues. After these corrections, the maximum apparent oversupply drops to a difference of less than 0.1%. Approximately half of the oversupply in 2050 demand scenarios remains to be accounted for, but is likely due to similar double-counting issues. Because all the oversupply could not be specifically identified and corrected, no corrections have been made to the 2015, 2025, or 2050 delivery results.
Conservation) is unaffected by climate but varies between Portfolios. Delivery types modeled as demand reductions (such as recycled water and groundwater, see Section 4.4.1) are not affected by climate change scenarios, but do change based on Portfolio (projects may be included or not included in a particular Portfolio) and demand scenario (projects may not be implemented in all demand scenarios, or the supply amount may vary between demand scenarios as projects are assumed to expand). Supply types modeled dynamically 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 (increased demands due to temperature and precipitation changes require increased deliveries). Supply types modeled as demand reductions (see Section 4.4.1) 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.

![Figure 12. Average Annual Delivery Volume for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.](image)

Overall, between the Baseline Portfolio and other Portfolios, there was a shift in water deliveries away from Imported Water Purchases (see Section 7.1.2.5). In the Enhanced Conservation
San Diego Basin Study
Task 2.4 – Structural and Operations Concepts

Portfolio, the shift was due to reduced overall water demands, which allowed more of the demand to be met by local sources. Increases in local supply sources such as potable reuse (see Section 7.1.2.9), desalination (7.1.2.8), and gray water (7.1.2.11) in the Baseline Plus, Increase Supplies and Watershed Health and Ecosystem Restoration Portfolios, and improvements in system operations such as in the Optimize Existing Facilities Portfolio, enabled more demand to be met with local supplies instead of purchased water imports. These results show that both demand-side and supply-side options were effective in reducing reliance on imported water.

7.1.2.1 Enhanced Conservation
The Enhanced Conservation Concept includes a single project called Enhanced Conservation that is only implemented in the Enhanced Conservation Portfolio (see Section 3.5). Therefore, conservation described by the Enhanced Conservation Concept is zero in all scenarios and Portfolios except for the 2025 and 2050 Enhanced Conservation Portfolio runs. Enhanced Conservation conservation volumes for each Portfolio compared across selected climate scenarios and all demand scenarios is shown in Figure 13. The conservation volume for Enhanced Conservation is a model input assigned a value of 52,265 AF/y for 2025 demand scenarios and 179,582 AF/y for 2050 demand scenarios.

![Average Annual Delivery and Conservation Volume - Enhanced Conservation](image)

**Figure 13.** Average annual Enhanced Conservation volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand

130
7.1.2.2 **Urban and Agricultural Water Use Efficiency**  
Urban and Agricultural Water Use Efficiency describes projects and programs that achieve water conservation, such as rain barrel rebates, turf replacement credits, and rebates for more efficient irrigation or plumbing fixtures. The Urban and Agricultural Water Use Efficiency concept includes eight projects with associated conservation volumes. One project represents the conservation volume included in the 2015 UWMP that is implemented in the Baseline Portfolio (see Table 6), and the remaining seven represent additional planned conservation projects that are implemented in the Baseline Plus Portfolio (see Table 7). Urban and Agricultural Water Use Efficiency conservation volumes for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 14. Conservation described by the projects in the Urban and Agricultural Water Use Efficiency Concept is equal to 50,000 AF/y for all 2015 demand scenarios. The Baseline Portfolio conservation volume is 89,110 AF/y for 2025 demands and 89,891 AF/y for 2025 demands in all other Portfolios. For 2050 demands, the Baseline Portfolio conservation volume is 155,468 AF/y and 158,342 AF/y for all other Portfolios.

![Figure 14. Average annual Urban and Agricultural Water Use Efficiency conservation volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario.](image)
demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.1.2.3 **Firm Water Supply Agreements**
The Firm Water Supply Agreements concept includes a single project describing the Quantification Settlement Agreement (QSA). The QSA volume is assumed to be the full agreement value of 280,200 AF/y for all demand and climate scenarios and all Portfolios (see Table 6). It is modeled with a high source priority and is assumed to be fully utilized in every year. Therefore, the delivery volume for Firm Water Supply Agreements is the same for all scenarios and Portfolios. Firm Water Supply Agreement (QSA) deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 15.

![Figure 15. Average annual Firm Water Supply Agreement deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.](image)

7.1.2.4 **Groundwater**
Groundwater deliveries come from projects described by the Groundwater Concept (see Table 6, Table 7, and Table 12). This Concept is implemented as a demand reduction (see Section 4.4.1). Groundwater deliveries for each Portfolio compared across all demand scenarios and selected
climate scenarios are shown in Figure 16. The delivery volume is 17,393 AF/y for 2015 demands across all Portfolios. For 2025 demands the delivery volume is 22,900 AF/y for the Baseline Portfolio, 26,030 AF/y for Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios, and 37,365 AF/y for Increase Supplies. The Baseline delivery volume for 2050 demands is the same as for 2025 demands, but the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios each have slightly larger deliveries than 2025 demands, equaling 26,530 AF/y. The delivery volume for Increase Supplies for 2050 is 41,289 AF/y.

![Figure 16. Average annual Groundwater deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.](image)

7.1.2.5 Imported Water Purchases

The Imported Water Purchases concept describes the water purchased from sources outside the San Diego Basin. It includes two projects. The MWD Imported Water project represents the water that can be purchased from MWD and is implemented as a dynamic supply source in all Portfolios as described in Section 4.4.2.4. The Cadiz Additional Imported Supplies project is implemented as a demand reduction (see Section 4.4.1) of 5,000 AF/y for the Otay Water
District and is only implemented in the Increase Supplies Portfolio in the 2050 demands scenarios. MWD purchases are a low priority supply, so they typically are used in the model only when other supply sources cannot provide sufficient volume to meet demand at a particular time or location. Imported Water purchase deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 17. Baseline Portfolio Imported Water deliveries range from 152,800 AF/y for 2015 demands under current climate to 248,027 AF/y for 2050 demands under current climate. Imported Water deliveries in all other Portfolios are smaller than Baseline deliveries across both 2025 and 2050 demands and all climate scenarios. Imported Water deliveries in the Enhanced Conservation Portfolio and Increase Supplies Portfolio are significantly lower than in the Baseline Plus Portfolio. For the Enhanced Conservation Portfolio, this is likely due to the lower demands resulting from the Enhanced Conservation project, which can then be met by other water supplies and reduce demand on imported supplies. For the Increase Supplies Portfolio, the reduced delivery of Imported Water can be attributed to the availability of alternate supply sources that are used at a higher priority than Imported Water. Deliveries in the Optimize Existing Facilities and Watershed Health and Ecosystem Restoration Portfolios are the same as the Baseline Plus Portfolio.
7.1.2.6 Surface Water

Surface Water deliveries result from water stored in reservoirs described by the Local Surface Water Reservoirs Concept. All reservoirs included in this Concept are implemented in the Baseline Portfolio (see Table 6) and are therefore implemented in all other Portfolios, but there are modifications to some reservoirs in some Portfolios, which affect Surface Water deliveries. Surface water deliveries do not include deliveries of untreated imported water that is stored in reservoirs, as this is accounted for in the Imported Water Purchases (see Section 7.1.2.5). Surface

---

4 Imported Water Deliveries are slightly overstated due to a water accounting inconsistency in the CWASim model. Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. Delivery metrics for individual supply types sum to a larger volume than the total demand minus shortage, resulting in an apparent oversupply of between 1% and 7%. However, the impacts of this discrepancy are negligible in the overall conclusions of the San Diego Basin Study. While some specific reported delivery values (primarily imported water and surface water) are slightly too large, the trends and changes observed in the delivery results are accurate. Because this issue only impacts water delivery accounting, no other metrics are impacted.
Water deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 18. The average surface water delivery volume for 2015 demands and current climate for all Portfolios is 59,000 AF/y. There is no statistical evidence of a difference in surface water deliveries between the 2015, 2025, and 2050 demand scenarios for the Baseline Portfolio and limited statistical evidence of difference in the Increase Supplies Portfolio based on the ANOVA analysis. However, for the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios there is statistical evidence that Surface Water deliveries are larger for the 2050 demand scenario than the 2025 demand scenario based on the ANOVA analysis. The larger 2050 Surface Water Deliveries in the Baseline Plus Portfolio than the Baseline Portfolio can be attributed to the Hodges Water Quality Improvement Program, which improves water quality at Hodges such that it meets standards to move water into the Regional Aqueduct System, allowing for greater releases from Hodges Reservoir (see Section 8.15) to meet demands. Additionally, larger 2050 Surface Water Deliveries in the Baseline Plus Portfolio may be attributable to the Sweetwater Reservoir Wetlands Habitat Recovery project which allows for increased storage in Sweetwater Reservoir (see Section 8.15). Although higher deliveries in the Increase Supplies Portfolio would be expected for the same reason (and the average delivery value appears to be higher), there is only limited statistical evidence based on the ANOVA analysis that surface water deliveries are larger in 2050 than 2025 and no statistical evidence that they are larger in 2025 than in 2015. A possible explanation for the lack of significance in the increase in Surface Water Deliveries between 2015, 2025, and 2050 for Increase Supplies is the concurrent increase in availability of other supply sources in this Portfolio, such as groundwater, recycled water, potable reuse, and desalination. Although surface water from local runoff is the first priority supply source in the CWASim model (Table 24), supply sources modeled as demand reductions, including groundwater, recycled water, potable reuse (other than Pure Water San Diego), and the Rosarito Desalination Plant, are used prior to any surface water deliveries (see Section 4.4.1). Pure Water San Diego was also assigned the first priority in CWASim since it can be used to fill reservoirs (see Section 4.7.1). Therefore, the difference between demand scenarios in Surface Water Deliveries is less than anticipated. Variability in surface water deliveries between realizations may also contribute to the limited statistical significance.

Comparing between the Baseline Plus Portfolio and other Portfolios under current climate, there is no statistical evidence of a difference based on the ANOVA analysis in surface water deliveries between the Baseline Plus Portfolio and the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands, with current climate deliveries of approximately 56,000 AF/y. There is also no statistical evidence of a difference in Surface Water deliveries between the Baseline Plus Portfolio and the Optimize Existing Facilities and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands and current climate, with those Portfolios having deliveries of approximately 78,000 AF/y. Although there appears to be a difference in the average annual delivery volume between the Baseline Plus Portfolio and the Enhanced Conservation Portfolio (Surface Water Delivery of approximately 72,000 AF/y) or the Baseline Plus Portfolio and Increase Supplies Portfolio (Surface Water Delivery of approximately 66,000 AF/y) for 2050 demands, there is no statistical evidence of a difference in Surface Water deliveries. This lack of statistical significance despite the appearance of differences may be due to the problems associated with the ANOVA assumptions.
Climate scenarios appear to have some impact on Surface Water Delivery volumes, but there is only statistical evidence of differences between some of the 2050 climate scenarios. In all Portfolios, current climate is similar to central tendency climate. In the Baseline Portfolio, there is slight statistical evidence based on the ANOVA analysis that surface water deliveries are lower for hot-dry climate and higher for warm-wet climate than central tendency climate. However, in all Portfolios beyond the Baseline, there is stronger statistical evidence that surface water deliveries are lower for hot-dry climate and higher for warm-wet climate than for central tendency climate. Local surface water deliveries in the hot-dry climate are on average 20% lower than central tendency climate, a pattern that is consistent across Portfolios beyond the Baseline (the percent decrease from central tendency to hot-dry climate in Baseline is 17%). This reduction is 11,600 AF in the Baseline, and ranges from 11,800 AF in the Increase Supplies Portfolio to 17,700 AF in the Watershed Health and Ecosystem Restoration Portfolio, with a reduction of 17,700 AF in Baseline Plus, 14,400 AF in Enhanced Conservation, and 17,000 AF in Optimize Existing Facilities. These results indicate that a hot-dry climate is likely to reduce the availability of local surface water for water supply delivery.
San Diego Basin Study  
Task 2.4 – Structural and Operations Concepts

7.1.2.7 Recycled Water

Recycled water deliveries come from projects described by the Recycled Water concept (see Table 6, Table 7, and Table 12). Projects in this Concept are all implemented as demand reductions (see Section 4.4.1). Recycled Water deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 19. The delivery volume is 28,047 AF/y for 2015 demands across all Portfolios. For 2025 demands the delivery volume is

---

5 Surface Water Deliveries are slightly overstated due to a water accounting inconsistency in the CWASim model. Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. Delivery metrics for individual supply types sum to a larger volume than the total demand minus shortage, resulting in an apparent oversupply of between 1% and 7%. However, the impacts of this discrepancy are negligible in the overall conclusions of the San Diego Basin Study. While some specific reported delivery values (primarily imported water and surface water) are slightly too large, the trends and changes observed in the delivery results are accurate. Because this issue only impacts water delivery accounting, no other metrics are impacted.
42,684 AF/y for the Baseline Portfolio and 42,856 AF/y for all other Portfolios except Increase Supplies, which has a delivery volume of 58,408 AF/y. The Baseline delivery volume is 45,868 AF/y for 2050, changing to 52,830 AF/y for the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios, and increasing to 78,065 AF/y for the Increase Supplies Portfolio.

7.1.2.8 Desalination
The Seawater Desalination Concept consists of four projects representing three desalination plants. Two of the plants (Carlsbad and Camp Pendleton Desalination Plants) are dynamically implemented and one (Rosarito Desalination Plant) is treated as a demand reduction (see Section 4.7.1). The Carlsbad Desalination Plant is implemented in the Baseline Portfolio (see Table 6), and the Camp Pendleton and Rosarito Desalination plants are implemented in the Increase Supplies portfolio (for 2050 demand scenarios), along with an increase in the capacity of Carlsbad (for 2025 and 2050 demand scenarios) (see Table 12). Desalinated Water deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 19.

Figure 19. Average annual recycled water deliveries for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
Figure 20. Deliveries of desalinated water average 43,900 AF/y in all Portfolios for 2015 demands under current climate. For the Baseline Portfolio, there is statistical evidence based on the ANOVA analysis that deliveries are larger for 2025 demands than for 2015 demands, and larger for 2050 demands than 2025 demands. This is also true within the Baseline Plus, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. However, in the Enhanced Conservation Portfolio there is statistical evidence that desalination deliveries are slightly larger for 2025 demands than for 2015 demands and are slightly lower for 2050 demands than for 2025 demands. This is likely due to lower demands that can be met by other higher priority supplies. Because the deliveries for other Portfolios are larger for 2025 than 2015 and larger for 2050 than 2025 while deliveries in the Enhanced Conservation do not vary by demand scenario, deliveries of desalinated water are lower in the Enhanced Conservation Portfolio compared to all other Portfolios. The Increase Supplies Portfolio for 2050 demands has the largest deliveries of desalinated water, ranging from 60,900 AF/y for current climate to 63,300 AF/y for hot-dry climate. This can be attributed to the availability of water from the Rosarito Desalination Plant, along with some deliveries from the Camp Pendleton Desalination Plant. Because it was modeled as a demand reduction, Rosarito Desalination Plant delivered its full volume of 16,800 AF/y in the Increase Supplies Portfolio. However, although the Camp Pendleton Desalination Plant was modeled at a plant capacity of 168,000 AF/y, it only delivered approximately 7,300 AF/y in the Increase Supplies Portfolio 2050 current climate scenario. In addition, deliveries from Carlsbad Desalination Plant were approximately 14,900 AF/y lower in the Increase Supplies Portfolio for the 2050 current climate scenario than in the Baseline Portfolio. The relatively small delivery from Camp Pendleton Desalination Plant and the decrease in deliveries from Carlsbad Desalination Plant can be attributed to their lower source priority compared to other available water sources in the Increase Supplies Portfolio (see Section 4.7.1).
Figure 20. Average annual Desalination delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

### 7.1.2.9 Potable Reuse

The Potable Reuse Concept includes Pure Water San Diego Phases 1 and 2 modeled dynamically as well as eight other projects modeled as demand reductions (see Section 4.2.6). One Potable Reuse project, San Luis Rey WRF - Short/Long-Term Expansion, is implemented in the Baseline Portfolio for 2025 and 2050 demands. Pure Water San Diego Phase 1 is implemented in the Baseline Plus Portfolio for both the 2025 and 2050 demand scenarios along with East County Advanced Water Purification Phases 1 and 2. Pure Water San Diego Phase 2 and the five other projects (including East County Advanced Water Purification Phase 3) are implemented only in the Increase Supplies Portfolio, with Pure Water San Diego Phase 2 and four of the five other projects (such as Encina Wastewater Reuse Project) only implemented in the 2050 demands scenario and the fifth project implemented in both 2025 and 2050 demand scenarios. See Table 6, Table 7, and Table 12 in Chapter 3 for a list of Potable Reuse projects included in the Basin Study. Potable Reuse deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 21. Potable Reuse deliveries are zero in all Portfolios for 2015 demands under current climate. The Potable Reuse delivery volume is
significantly lower in the Baseline Portfolio than in all other Portfolios for both 2025 and 2050 demands, which can be attributed to the implementation of Pure Water San Diego, discussed in Section 8.9. Due to the high source priority of Pure Water supplies relative to other supply types (See Section 4.7.1), Potable Reuse deliveries are the same for the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios, and slightly larger for the Increase Supplies Portfolio due to the single project implemented in 2025. There is somewhat more variation in Potable Reuse deliveries for the 2050s for the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios, but not enough to provide statistical evidence of a difference between the results based on the ANOVA analysis. Potable Reuse Deliveries are slightly lower in the Enhanced Conservation Portfolio than in the Baseline Plus Portfolio for 2050 demands across all climate scenarios, most likely due to decreased demands. Potable Reuse deliveries for the Increase Supplies Portfolio are significantly larger for 2050 demands across all climate scenarios. This is due to the implementation of Pure Water San Diego Phase 2, discussed in Section 8.9.

Comparing between demand scenarios, Potable Reuse deliveries are higher in 2025 than in 2015 for all Portfolios due to the lack of Potable Reuse projects in the 2015 demand scenario and the presence of at least one in all 2025 scenarios. Potable Reuse deliveries are significantly higher in 2050 than in 2025 for the Increase Supplies Portfolio, but surprisingly they are lower in 2050 than in 2025 for all other Portfolios besides Baseline. This may be due to the Hodges Water Quality Improvement Program, which is implemented in 2050 Baseline Plus and subsequent Portfolios. Water from Hodges Reservoir is able to serve some of the same demands as water from Miramar Reservoir, which receives water from the Pure Water Phase 1 project. With the increase in supply availability from Hodges in the 2050 scenarios due to its increased release capacity, some of the demands that were met with Potable Reuse water in 2025 are likely met with Hodges water in the 2050 scenarios. In reality, the region would have the option to utilize the Potable Reuse supplies from Miramar Reservoir prior to using water supplies from Hodges if the region were to prioritize potable reuse.
Figure 21. Average annual Potable Reuse delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.1.2.10 Stormwater BMPs
Stormwater BMPs are a very small component of water deliveries. Stormwater BMP deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 22. The only Portfolio that includes Stormwater BMPs is the Watershed Health and Ecosystem Restoration Portfolio (see Section 3.8), which includes eight projects modeled as demand reductions (see Section 4.4.1) for a total of 109 AF/y in the 2050 demand scenario. A majority of the Stormwater BMP projects included in the Basin Study were unable to be modeled, due to a lack of available supply volumes, but are discussed in Task 2.5.
Figure 22. Average annual Stormwater BMP delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

### 7.1.2.11 Gray Water Use

Gray Water deliveries, although larger than Stormwater BMP deliveries in the Increase Supplies Portfolio, are still a small component of the total water deliveries, and were implemented as demand reductions (see Section 4.4.1). Gray Water deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 23. One Gray Water Use project is included in the Baseline Plus Portfolio (Conservation Home Makeover in the Chollas Creek Watershed with 11 AF/y in the 2025 and 2050 demand scenarios, see Table 7) and another is included in the Increase Supplies Portfolio (City of San Diego’s Gray Water Pilot Project with 2,575 AF/y in the 2050 demands scenario, see Table 12). Although these projects would not aim to replace potable water supplies, they would be able to reduce the amount of potable water used for activities such as landscape irrigation.
Figure 23. Average annual Gray Water delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.1.2.12 Stormwater Capture
Since most stormwater in the Study area is impounded in existing inland surface water reservoirs, the Stormwater Capture Concept represents rainwater harvesting and urban runoff diversion. It is a very small component of water deliveries and was implemented as a demand reduction (see Section 4.4.1). Two Stormwater Capture projects are included in the model. One is implemented in the Baseline Plus and subsequent Portfolios for 2025 and 2050 demands (see Table 7), and the other is implemented only in the Watershed Health and Ecosystem Restoration Portfolio for 2050 demands (see Table 14). The Stormwater Capture deliveries for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 24. Delivery volumes are zero for all 2015 demand scenarios and all Baseline Portfolio runs. Delivery volumes are 200 AF/y for the non-Baseline 2025 demand scenarios and for the non-Baseline 2050 demand scenarios except in the Watershed Health and Ecosystem Restoration Portfolio, which has a delivery volume of 616 AF/y for 2050 demands.
Figure 24. Average annual Stormwater Capture delivery volumes for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.1.3. Shortage Volume

Shortages indicate that demands cannot be met by the available supplies due to an imbalance between water supply and demand or limits of the conveyance system. The Shortage Volume metric (Box 13) measures the magnitude of regional demand that is unable to be met by the available supplies and/or limited by conveyance system capacity. Non-zero shortage volume indicates that supplies are insufficient to meet demands or that conveyance system capacity limits deliveries. Larger values indicate larger supply-demand imbalances or capacity limitations.

Average Annual Shortage Volumes for each Portfolio compared across all demand scenarios and selected climate scenarios are shown in Figure 25. There were no shortages for any Portfolios for 2015 demand scenarios. For 2025 and 2050 demand scenarios, all Portfolios had shortages in at least one climate scenario, with hot-dry climate scenarios having the most shortages. The highest annual average shortage volume was 22,000 AF (about 2% of annual demand) for the Baseline Portfolio 2050 demands and hot-dry climate scenario, indicating that climate change and changes in demand may have a significant effect on water reliability in the region. Conversely, large
shortages are avoided in the Increase Supplies and Enhanced Conservation portfolios, indicating that there are options available to prevent shortages, even in a hot-dry climate. The Shortage Volume is zero for all Portfolios for 2015 demands under current climate. On a monthly scale, shortage volumes are smallest from December through May. The largest shortage volumes typically occur during the months of June through November, with peak shortages in August and September.

Comparing between demand scenarios (Figure 25), Shortage Volume is higher for 2025 demands than for 2015 demands. It is also higher for 2050 demands than for 2025 demands in all Portfolios for current climate, central tendency climate, and hot-dry climate, except for the Enhanced Conservation Portfolio. In the Enhanced Conservation Portfolio, Shortage Volume is lower for 2050 demands than for 2025 demands with hot-dry climate. However, the magnitude of the shortage volume is small in the Enhanced Conservation Portfolio (less than 10 AF/y) so the difference is likely inconsequential.
Comparing Portfolios (Figure 25), shortage volumes are smallest in the Enhanced Conservation Portfolio, with shortages averaging less than 10 AF/y for both 2025 and 2050 demands for current, central tendency, and hot-dry climate. Shortage Volumes are larger in the Baseline Portfolio than in other Portfolios for both 2025 and 2050 demands, except for the Optimize Existing Facilities Portfolio for 2050 demands. Average shortage volumes appear to differ between Baseline Plus and Optimize Existing Facilities, but the ANOVA statistical results are inconclusive, likely because the metric results do not meet the normality and equal variance assumptions. For 2050 demands under current climate, the Shortage Volume is higher in the Optimize Existing Facilities Portfolio than the Baseline and Baseline Plus Portfolios. The same is true under central tendency climate, but only for the Baseline Plus Portfolio. For hot-dry climate, Optimize Existing Facilities has lower shortages than Baseline, but there is no statistical evidence of a difference between Optimize Existing Facilities and Baseline Plus, despite the appearance of a difference. Investigation of the daily model results indicates that the higher shortages in Optimize Existing Facilities can be attributed to lower deliveries of treated water from Pipeline 4 to the SD11 demand node for the City of San Diego, which is in the southern portion of the region. One project that may contribute to this result is the Pipeline3/Pipeline 4 Conversion Project, which converts a portion of the capacity of Pipeline 4 from treated water to treated water service. However, no specific connection between the change in treated water conveyance due to the Pipeline3/Pipeline 4 Conversion and the change in treated water in Pipeline 4 to the SD11 demand node for the City of San Diego in the Optimize Existing Facilities deliveries to SD11 could be identified in the model results. Therefore, it is likely that a combination of projects in the Optimize Existing Facilities Portfolio results in the observed increase in shortages.

A number of factors influence shortage volumes between scenarios and Portfolios, as well as differences between realizations within the same model run. Comparing scenarios and Portfolios, the shortage volumes observed in the Basin Study results are dependent on the available water supply in each modeled scenario and Portfolio. For example, all Portfolios assume a consistent availability of imported water from the QSA and imported purchases while each Portfolio differs in the volumes of other supply types. Both within a given model run and between model runs, larger shortage volumes (such as those observed in the Baseline Portfolio) are typically associated with water supply shortages, while smaller shortage volumes (such as those observed in the Increase Supplies Portfolio) appear to be caused by conveyance system limitations (see Section 7.1.4). Comparing realizations within a given model run, another factor that may be a driver of shortage volume is the relative dryness or wetness of a year compared to normal. Generally, drier year types, as characterized by reservoir inflows, correspond with larger shortage volumes. However, the dryness of preceding years also appears to influence shortage volume in some cases. Examining the Baseline Portfolio, the realization with the largest shortage volume was preceded by six dry years. Other realizations do not follow this pattern, however, indicating that while dryness of a particular year and the dryness of preceding years generally corresponds to larger shortage volumes, other factors such as conveyance capacity and supply availability also influence shortage volume.

7.1.3.1 Shortage Threshold Analysis

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. To better understand the frequency of shortage above the shortage threshold, the total number of
realizations (years) within each model run with shortages above the threshold was calculated and plotted as a percentage of the 85 realizations in each model run.

Average Annual Shortage Volumes for each Portfolio compared across all demand scenarios and all climate scenarios are shown in Figure 26. The Baseline Portfolio yielded no realizations above the shortage threshold of 20,000 AF for current climate 2015 and 2025 demands but showed two realizations above the shortage threshold for 2025 demands under warm-dry climate and multiple realizations above the shortage threshold for 2025 demands under hot-dry climate. For 2050 demands there was one realization above the shortage threshold for the current climate, two realizations above the shortage threshold for central tendency climate, and multiple realizations above the shortage threshold for hot-dry and warm-dry climates.

![Figure 26. Shortage Volume compared to the 20,000 AF shortage threshold for the Baseline Portfolio.](image)

Average Annual Shortage Volumes for the Baseline Plus Portfolio compared across all demand scenarios and all climate scenarios are shown in Figure 27. In the Baseline Plus Portfolio there were no realizations above the shortage threshold for current climate in 2015, 2025, or 2050 demands; however, there was one realization above the shortage threshold for central tendency
climate in 2050 demands, and multiple realizations above the shortage threshold for hot-dry climate and warm-dry climates in 2050 demands. The Watershed Health and Ecosystem Restoration Portfolio (Figure 28) was similar to the Baseline Plus Portfolio.

Figure 27. Shortage Volume compared to the 20,000 AF shortage threshold for the Baseline Plus Portfolio.
Figure 28. Shortage Volume compared to the 20,000 AF shortage threshold for the Watershed Health and Ecosystem Restoration Portfolio.

Average Annual Shortage Volumes for the Watershed Health and Ecosystem Restoration Portfolio compared across all demand scenarios and all climate scenarios are shown in Figure 28. Like the Baseline Plus Portfolio (Figure 27), there were no realizations above the shortage threshold for current climate in 2015, 2025, or 2050 demands in the Watershed Health and Ecosystem Restoration Portfolio; however, there was one realization above the shortage threshold for central tendency climate in 2050 demands, and multiple realizations above the shortage threshold for hot-dry climate and warm-dry climates in 2050 demands.

No realizations were close to or above the shortage threshold for the Enhanced Conservation Portfolio (Figure 29). Although there was one realization close to the shortage threshold in 2025 demands under hot-dry climate for the Increase Supplies Portfolio, no realizations were above the shortage threshold for this Portfolio (Figure 30).
Figure 29. Shortage Volume compared to the 20,000 AF shortage threshold for the Enhanced Conservation Portfolio
Average Annual Shortage Volumes for the Optimize Existing Facilities Portfolio compared across all demand scenarios and all climate scenarios are shown in Figure 31. In the Optimize Existing Facilities Portfolio, there was one realization above the shortage threshold for central tendency climate and many realizations above the shortage threshold in the hot-dry climate and warm-dry climate in 2050 demands. The percentage of realizations above the Shortage Threshold was slightly lower in this Portfolio compared to the Baseline Portfolio (Figure 26), but there were no significant differences in realizations above the Shortage Threshold between this Portfolio and the Baseline Plus Portfolio (Figure 27) for current climate, central tendency climate, and hot-dry climate (although the average Shortage Volume was higher in the Optimize Existing Facilities Portfolio, it did not have more realizations above the 20,000 AF shortage threshold).

Figure 30. Shortage Volume compared to the 20,000 AF shortage threshold for the Increase Supplies Portfolio.
7.1.4. Conveyance System Operations

The conveyance system includes pipelines, pump stations, and water treatment plants that move water throughout the San Diego Basin and treat raw water for use in meeting demands. Without adequate conveyance capacity, the system may not be able to move water supplies from their source to storage, treatment plants, or water users. Even in cases where water supply is not limiting, conveyance capacity may be a constraint on the system and could result in shortage. Larger shortage volumes are typically associated with water supply shortages, while smaller shortage volumes appear to be caused by conveyance system limitations, as is the case for the low shortage volume observed with the Increase Supplies Portfolio for 2050 demands under hot-dry climate. Conveyance-based shortages occur when pipelines, pump stations, or water treatment plants are operating at or near full capacity, causing a bottleneck in the supply system. In order for the system to work effectively, it is important to have some excess capacity in the conveyance system. If there is insufficient capacity, conveyance issues could be exacerbated in the case of unexpected pipeline or pump station failures or during maintenance outages.
Overall, pipeline flow was a possible constraint on the system and potentially contributed to shortages, but pump station utilization and treatment plant utilization did not appear to constrain operations of the system. The Untreated Pipeline, which conveys water from the MWD delivery point, conveyed the most flow and was the most highly used, with summer utilization frequently over 95% of capacity in all Portfolios. Utilization of the Untreated Pipeline was highest in the Baseline Portfolio and lower in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios for 2050 demands.

### 7.1.4.1 Pipeline Flow Volume
The Pipeline Flow Volume metric (Box 14) describes the average monthly pipeline total flow volume for five pipeline locations: Pipeline 4 just south of Twin Oaks Valley WTP, which conveys treated water for Carlsbad, Vista, and Vallecitos member agencies; the 30-Inch, an interconnect which conveys untreated water near Murray Reservoir; the Crossover Pipeline, which conveys untreated water between the Second and First Aqueducts; the MWD Treated Pipeline, which conveys water from the MWD Delivery Point through Pipelines 1, 2, and 4; and the Untreated pipeline that conveys water purchased from MWD that requires further treatment at San Diego-area Water Treatment Plants before it can be delivered to customers. The Pipeline Flow Volume metric indicates where pipeline flow volumes are higher on average. Higher pipeline flow volumes may lead to pipeline capacity constraints. Larger volumes indicate pipeline deliveries at a location are typically higher. Capacities for these Pipelines are listed in Table 37.

Current climate Monthly Average Pipeline Flow Volumes for the Baseline Portfolio for all pipelines compared across all demand scenarios are shown in Figure 32 and additional figures showing pipeline delivery metrics for individual pipelines for all demand and climate scenarios can be found in Appendix D – Detailed Model Results. The relative magnitude of water volume conveyed by each of the five pipelines was consistent across Portfolios, with flows in the Untreated pipeline (just south of the MWD delivery point) consistently the largest, followed by MWD Treated, Pipeline 4 just south of Twin Oaks Valley (TOV) WTP, Crossover, and the 30-Inch. Flows in the Untreated pipeline are almost equal to the other four pipeline flows combined, with an average monthly flow of about 31,000 AF (approximately 72% of the pipeline capacity) for Baseline. MWD Treated and Pipeline 4 (just south of TOV) deliver nearly equal amounts of water, with an approximate monthly average of 9,000 AF (26% of capacity) and 10,000 AF (37% of capacity), respectively for Baseline. The crossover pipeline conveys a lesser monthly average of approximately 5,000 AF (42% of capacity) for Baseline, and the 30-inch pipeline conveys even less with a monthly average of approximately 1,000 AF (24% of capacity) for Baseline. Averaging across all months, the volume conveyed by each pipeline was similar across climate scenarios for four of the five pipelines. For the 30-Inch Pipeline, there was generally more conveyance in the hot-dry and warm-dry scenarios than the hot-wet and warm-wet scenarios. The Baseline Portfolio had the largest flow volumes for the pipelines, followed closely by the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios, which had similar flow volumes. The flow volumes for the Increase Supplies Portfolio were slightly less than for Baseline Plus. Enhanced Conservation had the lowest flow volumes for all evaluated pipelines.

Most of the pipeline locations analyzed in the Basin Study deliver the largest flow volumes in the summer months, with a peak in flow occurring between June and September. This is true for the
MWD Treated, Pipeline 4 (just south of TOV), and Untreated pipelines, which are the three pipelines with the highest flow volume. Although the Crossover pipeline does not have a significant peak like the other pipelines, Pipeline Flow Volume is higher in June and September than in December and March. For the 30-Inch pipeline, flow peaks twice: once in May and again in September. Figure 32 shows the Monthly Average Pipeline Flow Volume for the Baseline Portfolio.

Although there are some differences in Pipeline Flow Volume between Portfolios for 2025 and 2050 demands, the monthly trend is similar for all Portfolios. Pipeline Utilization is analyzed for summer months in Section 7.1.4.2 based on this trend (higher flow volume in summer months).

Figure 32. Monthly Average Pipeline Flow Volume in the Baseline Portfolio under current climate.

7.1.4.2 High Pipeline Utilization Summer Count
The High Pipeline Utilization Summer Count metric (Box 15) describes the number of days that pipeline flow exceeds 95% of capacity (Table 37) during the summer months (June through September) for five pipeline locations: Pipeline 4 just south of Twin Oaks Valley WTP, which serves treated water to Carlsbad, Vista, and Vallecitos member agencies; the 30-Inch, an interconnect which conveys untreated water near Murray Reservoir; the Crossover Pipeline,
which conveys untreated water between the Second and First Aqueducts; the MWD Treated Pipeline, which conveys water from the MWD Delivery Point through Pipelines 1, 2, and 4; and the MWD Untreated pipeline that conveys water purchased from MWD that requires further treatment at San Diego-area water treatment plants before it can be delivered to customers. It is important to quantify high pipeline utilization because it may indicate that pipeline capacity is limiting water deliveries, which could lead to shortages in the region. Water usage is typically highest in the summer, which means that pipeline capacity is most likely to be a limiting factor in water deliveries during the summer. Larger numbers of days indicate that high summer pipeline utilization is more frequent. The Untreated pipeline is the only pipeline with an operationally significant number of days when pipeline utilization exceeds 95%. The other four pipelines average less than 2 days of exceedance for all Portfolios and climate scenarios, with many Portfolios and scenarios having zero days of exceedance.

Average High Pipeline Utilization Summer Count for the Untreated Pipeline compared across all demand scenarios and selected climate scenarios is shown in Figure 33. For the Baseline Portfolio, under current climate, the number of days with flow greater than 95% of capacity is higher for 2025 demands (average of 71 days) than for 2015 demands (average of 40 days) for the Baseline Portfolio. There is also a difference in number of days of exceedance between 2025 demands (average of 71 days) and 2050 demands (average of 86 days) for the Baseline Portfolio, although this result is not supported by the ANOVA statistical analysis.

Similarly, for Baseline Plus (Figure 33), the High Pipeline Utilization Summer Count metric appears to be higher for 2025 demands than for 2015 demands, but ANOVA statistical evidence of a difference is limited. However, there is statistical evidence that the number of days of exceedance is higher for 2050 demands than for 2025 demands. For the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios, there is no statistical evidence of a difference in Pipeline Utilization between 2015 and 2025 demands, but the number of days of exceedance is lower for 2050 demands than for 2025 demands. The Watershed Health and Ecosystem Restoration Portfolio is very similar to Baseline Plus when comparing number of pipeline capacity exceedances across demand scenarios for current climate scenarios.
Figure 33. High Pipeline Utilization Summer Count at the Untreated Pipeline location for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Comparing Untreated pipeline utilization between the Baseline and Baseline Plus Portfolios under current climate (Figure 33), there is no statistical evidence based on the ANOVA analysis of a difference for 2015 or 2050 demands, but Baseline shows a higher number of days of exceedance for 2025 demands. Comparing Baseline Plus to the other Portfolios, for 2025, Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration are very similar, while Enhanced Conservation and Increase Supplies have fewer days of capacity exceedance than Baseline Plus. For 2050, Watershed Health and Ecosystem Restoration is again similar to Baseline Plus, but Optimize Existing Facilities has a lower number of exceedances, as do Enhanced Conservation and Increase Supplies. The difference between the Baseline Plus and Enhanced Conservation Portfolio can be attributed to the Enhanced Conservation Concept discussed in Section 8.3 which increases the conservation volume and consequently decreases the volume of water that must be delivered through pipelines. The difference between the Baseline Plus Portfolio and the Increase Supplies Portfolio may be attributable to the Increase Supplies Portfolios wider range of water supply sources, which may reduce the system’s dependence on MWD untreated water supplies. The difference in Untreated
pipeline utilization between the Baseline Plus and Optimize Existing Facilities Portfolio can be attributed to the Pipeline 3/Pipeline 4 Conversion project discussed in Section 8.1 which increases the capacity of the system to deliver MWD Untreated supplies while reducing the capacity for MWD Treated supplies (this does not appear to cause an increase in the number of days with exceedances for the MWD Treated pipeline).

Comparing climate scenarios (Figure 33), there is statistical evidence based on the ANOVA analysis of differences in Pipeline Utilization at the Untreated location only in the Enhanced Conservation Portfolio for 2050 demands. In the Enhanced Conservation Portfolio for 2050 demands, utilization is lower for the current climate than for central tendency climate. Climate scenarios do not appear to have a significant impact for all other demands and Portfolios.

These results indicate that the possibility of shortages caused by pipeline capacity limitations occurs during summer months, and that the impact of increased demand from 2015 to 2025 to 2050 has a larger impact on pipeline utilization than the impact of climate scenarios. The number of days where MWD Untreated pipeline utilization exceeded 95% capacity is lower in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios than in the Baseline, Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios. This indicates that water shortages caused by conveyance limitations are less likely to occur in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios, based on results for the MWD Untreated pipeline.

7.1.4.3 High Pump Station Utilization
The High Pump Station Utilization metric (Box 16) measures the number of times per year that pump station flow exceeds 95% of capacity for 70% of pumping days for two pump station locations: San Vicente and Valley Center (P2A). High pump station utilization indicates that pump stations are frequently operated near their pumping capacity which could lead to difficulty moving water through the regional system. Larger numbers of days indicate that pump station maximum utilization is more frequent. Under current climate, there are no occurrences of greater than 95% pump station usage for either of the two pump stations analyzed (San Vicente Pump Station or P2A Pump Station) for 2015, 2025, or 2050 demands. This is expected, since the San Vicente Pump Station is sized for high emergency service volumes, and the P2A pump station primarily serves agricultural demands that have been declining. Climate scenarios do not have a significant impact on pump station utilization as there are no occurrences of greater than 95% pump station usage in any of the climate scenarios.

7.1.4.4 Treatment Plant Utilization
Raw water supplies such as surface water and untreated imported water must be treated before use. The Treatment Plant Utilization metric (Box 17) describes the percentage of treatment plant capacity that is used on an annual basis. This is a measure of whether the treatment plant capacity is large enough to support the demand for water supplies that require treatment or can be used to identify treatment facilities that may be underutilized. Both high and low utilization can be problematic, as high utilization could indicate insufficient treatment capacity and low utilization could indicate stranded capacity. Significant expansion of treatment plant capacity in the region occurred in the early to mid-2000s, prior to system-wide decreases in demand from conservation legislation and changes in consumer water use and landscaping. Additional local treated supplies, such as desalination, and recycled water supplies that offset treated water use
also contribute to excess capacity at treatment plants, even during peak season. Shifts from imported to local untreated supplies may change utilization at individual plants, would not be expected to affect overall treatment plant utilization.

Utilization is calculated individually for 11 treatment plants in the San Diego system: Alvarado, Badger, Escondido, Levy, Miramar, Olivenhain, Otay, Poway, Perdue, Twin Oaks Valley, and Weese. The system-wide average treatment plant utilization is the average of the individual treatment plant utilization metrics for the 11 treatment plants. Since treatment plant utilization is calculated in the model, it only accounts for treating raw water from supplies implemented as model logic. This includes supplies such as Pure Water San Diego Phase 1, which is discharged to Miramar Reservoir, then treated at the Miramar WTP. This does not include supplies modeled as demand reductions, such as potable reuse projects other than Pure Water, recycled water, groundwater, and others as described in Section 4.4.1. These supplies would require treatment and should be considered when interpreting results. Treatment plant utilization metrics are not analyzed for the Carlsbad, Camp Pendleton, or Rosarito desalination plants which supply treated water to meet member agency demands.

Figures showing system-wide treatment plant utilization can be found in Appendix D – Detailed Model Results. Comparing demand scenarios, the largest increase in the system wide average treatment plant utilization between 2015, 2025, and 2050 occurs in the Baseline Portfolio (54% average utilization in 2015 demands, 55% in 2025 demands, and 58% in 2050 demands), while the largest decrease occurs in the Enhanced Conservation Portfolio (54% average utilization in 2015 demands, 49% in 2025 demands, and 37% in 2050 demands), followed by the Increase Supplies Portfolio (54% average utilization in 2015 demands, 52% in 2025 demands, and 50% in 2050 demands). The system wide average for treatment plant utilization is similar between 2015, 2025, and 2050 demand scenarios for the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios (54% in 2015 demands, 54% in 2025 demands, and 56% in 2050 demands). The increase in utilization in the Baseline Portfolio can be attributed to the increase in water demand, which is primarily met by increases in imported raw water. The decrease in utilization in the Enhanced Conservation Portfolio can be attributed to the decrease in water demand resulting from the Portfolio’s large conservation volume. The decrease in utilization in the Increase Supplies Portfolio can be attributed to the additional recycled water and groundwater projects implemented in that Portfolio, which are modeled as demand reductions and not included in treatment plant utilization values, along with the addition of Camp Pendleton and Rosarito Desalination Plants, which are also not included in treatment plant utilization values. The lack of trend across demand scenarios in the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios can be attributed to the addition of a number of projects in Baseline Plus that are modeled as demand reductions, thereby reducing demand on water supplies that are included in the modeled treatment plant utilization.

7.1.4.4.1. Alvarado

Alvarado Water Treatment Plant receives water from the Second Aqueduct, Lake Murray, San Vicente Reservoir, and El Capitan Reservoir and treats it to meet demands for the City of San Diego. Average Annual Treatment Plant Utilization for the Alvarado Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 34. Under current climate, utilization of Alvarado WTP is higher for 2025 demands than for 2015 demands, and higher for
2050 demands than for 2025 demands in all Portfolios other than the Enhanced Conservation Portfolio, in which utilization is lower for 2050 demands than for 2025 demands. This can be attributed to the Enhanced Conservation Concept, discussed in Section 8.3. Utilization of Alvarado WTP is slightly lower in the Increase Supplies Portfolio for 2050 demands than the Baseline, Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios.

Climate scenarios appear to have some impact on utilization of Alvarado WTP. There is statistical evidence based on the ANOVA analysis that Treatment Plant Utilization is lower for current climate than for central tendency climate in all Portfolios for both 2025 and 2050 demands, but there is no statistical evidence of a difference between central tendency climate and any of the other climate scenarios, which is consistent with the limited effect of climate scenarios on overall demands (see Section 7.1.1).

Figure 34. Alvarado WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
7.1.4.2. **Badger**

Badger Water Treatment Plant receives water from MWD, Lake Hodges, and San Dieguito Reservoir and treats it to meet demands for San Dieguito Water District and Santa Fe Irrigation District. Average Annual Treatment Plant Utilization for the Badger Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 35. Under current climate, utilization of Badger WTP is lower for 2025 demands than for 2015 demands, and lower for 2050 demands than for 2025 demands in all Portfolios. Utilization of Badger WTP is lowest in the Enhanced Conservation Portfolio (18%), followed by the Increase Supplies Portfolio (28%), compared to utilization in the other Portfolios (29.5% for Baseline Portfolio and 29.4% for Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios).

Climate scenarios appear to have some impact on utilization of Badger WTP. There is statistical evidence based on the ANOVA analysis that Treatment Plant Utilization is lower for current climate than for central tendency climate in all Portfolios for 2025 demands, and slight statistical evidence that current climate is lower in 2050 demands. There is no statistical evidence of a difference between central tendency climate and any of the other climate scenarios. This is consistent with the limited effect of climate scenarios on overall demands (see Section 7.1.1).

![Figure 35. Badger WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.](image)
7.1.4.4.3. **Escondido**

Escondido Water Treatment Plant (Escondido-Vista WTP) receives water from MWD, Lake Henshaw, Lake Wohlford, and Dixon Reservoir and treats it to meet demands for the City of Escondido and Vista Irrigation District. Average Annual Treatment Plant Utilization for the Escondido Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 36. Under current climate, utilization of Escondido WTP is lower for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands in all Portfolios. Utilization is similar between Baseline, Baseline Plus, Optimize Existing Facilities, and Watershed and Ecosystem Restoration Portfolios and lower in the Enhanced Conservation and Increased Supplies Portfolios for both 2025 and 2050 demands. This is likely related to the decrease in imported water use in the Enhanced Conservation and Increase Supplies Portfolios compared to the other Portfolios, since imported water from MWD is a lower priority water source than local surface water that can be treated from Lake Henshaw, Lake Wohlford, and Dixon Reservoir.

Climate scenarios appear to have some impact on utilization of Escondido WTP. There is statistical evidence based on the ANOVA analysis that Treatment Plant Utilization is lower for current climate than for central tendency climate in all Portfolios for 2025 and 2050 demands, but there is no statistical evidence of a difference between central tendency climate and any of the other climate scenarios, which is consistent with the limited effect of climate scenarios on overall demands.

![Figure 36. Escondido WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.](image-url)
7.1.4.4.4. Levy

Levy Water Treatment Plant receives water from Lake Jennings, El Capitan Reservoir, and San Vicente Reservoir and treats it to serve demands for Helix Water District, Otay Water District, Padre Dam Municipal Water District and Lakeside Water District. Average Annual Treatment Plant Utilization for the Levy Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 37. Under current climate, utilization of Levy WTP is higher for 2025 demands than for 2015 demands, and higher for 2050 demands than for 2025 demands in the Baseline, Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. In the Enhanced Conservation Portfolio, utilization of Levy WTP is lower for 2025 demands than for 2015 demands, and lower for 2050 demands than for 2025 demands. In the Increase Supplies Portfolio, there is statistical evidence based on the ANOVA analysis that utilization of Levy is higher for 2025 demands than for 2015 demands, but there is no statistical evidence of a difference between 2025 demands and 2050 demands.

Climate scenarios appear to have some impact on utilization of Levy WTP. There is statistical evidence based on the ANOVA analysis that Treatment Plant Utilization is lower for current climate than for central tendency climate in all Portfolios for 2025 and 2050 demands, but there is no statistical evidence of a difference between central tendency climate or any other climate scenario, which is consistent with the limited effect of climate scenarios on overall demands (see Section 7.1.1).

Figure 37. Levy WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
7.1.4.4.5. Miramar

Miramar Water Treatment Plant receives water from the Second Aqueduct, Miramar Reservoir, and San Vicente Reservoir and treats it to meet demands for the City of San Diego. Average Annual Treatment Plant Utilization for the Miramar Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 38. Under current climate, utilization of Miramar WTP is higher for 2025 demands than for 2015 demands, and higher for 2050 demands than for 2025 demands in all Portfolios other than the Enhanced Conservation Portfolio, in which utilization of Miramar WTP is higher for 2025 demands than for 2015 demands but lower for 2050 demands than for 2025 demands. This can be attributed to the Enhanced Conservation Concept discussed in Section 8.3.

Climate scenarios have an impact on utilization of Miramar WTP. In all Portfolios for both 2025 and 2050 demands, utilization of Miramar is lower for current climate than for central tendency climate. In the Baseline Portfolio for 2050 demands, utilization is lower for the hot-dry climate (82.3%) than central tendency climate (86.0%). There are no differences between central tendency climate and hot-dry climate in the other Portfolios, and no differences between central tendency climate and warm-dry, warm-wet, or hot-wet climate scenarios in any Portfolios. The decrease in utilization in the hot-dry climate that was observed in the Baseline 2050 scenario is
no longer observed when Pure Water San Diego Phase 1 is implemented in the Baseline Plus and subsequent Portfolios, most likely due to a more steady supply from Miramar Reservoir.

Figure 38. Miramar WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.1.4.4.6. Olivenhain
Olivenhain (McCollom) Water Treatment Plant receives water from Olivenhain Reservoir and the Second Aqueduct (Pipeline 5) and treats it to meet demands for Olivenhain Municipal Water District. Average Annual Treatment Plant Utilization for the Olivenhain Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 39. Under current climate, utilization of Olivenhain WTP increases from 2015 to 2025, then stays the same for 2025 and 2050 demands in the Baseline Portfolio; however, in the Baseline Plus Portfolio, utilization of Olivenhain WTP is lower for 2050 demands than for 2025 demands. Because all Baseline Plus projects are included in other Portfolios besides Baseline, the lower utilization in 2050 is also observed in the Enhanced Conservation, Increase Supplies, Optimize Existing
Facilities, and Watershed Health and Ecosystem Restoration Portfolios. The decrease in utilization for 2050 despite increasing demands can be attributed to the additional supplies available in Baseline Plus that are modeled as demand reductions and are therefore not captured in the treatment plant utilization metrics. There is an additional slight decrease in utilization in the Increase Supplies Portfolio for the same reason, and an additional significant decrease in utilization in the Enhanced Conservation Portfolio which can be attributed to the Enhanced Conservation Concept discussed in Section 8.3.

Climate scenarios have an impact on utilization of Olivenhain WTP for 2025 and 2050 demands for all Portfolios, with higher utilization for all climate change scenarios than for central tendency climate. There is no statistical evidence based on the ANOVA analysis of a difference in utilization between central tendency climate and other climate scenarios. This is consistent with the limited effect of climate scenarios on overall demands (see Section 7.1.1).

Figure 39. Olivenhain WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
7.1.4.4.7. **Otay**

Otay Water Treatment Plant receives water from Lower Otay Reservoir and the Second Aqueduct and treats it to meet demands in the City of San Diego, which then provides some of the water to Cal-Am. Average Annual Treatment Plant Utilization for the Otay Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 40. Under current climate, utilization of Otay WTP is higher for 2025 demands than for 2015 demands, and higher for 2050 demands than for 2025 demands in all Portfolios other than the Enhanced Conservation Portfolio in which utilization is only minimally higher for 2025 demands than for 2015 demands, and minimally lower for 2050 demands than for 2025 demands. This can be attributed to the Enhanced Conservation Concept discussed in Section 8.3. Utilization of Otay WTP is slightly lower in the Increase Supplies Portfolio for 2050 demands than the Baseline, Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios which can be attributed to the additional supplies available in Increase Supplies that are modeled as demand reductions and are therefore not captured in the treatment plant utilization metrics.

Climate scenarios have an impact on utilization of Otay WTP for all Portfolios with higher utilization for central tendency climate than for current climate for both 2025 and 2050 demands. There is no statistical evidence based on the ANOVA analysis of a difference in utilization between central tendency climate and other climate scenarios. This is consistent with the limited effect of climate scenarios on overall demands (see Section 7.1.1).
7.1.4.4.8. Poway
Poway (Berglund) Water Treatment Plant receives water from Lake Poway and treats it to meet demands for the City of Poway. Average Annual Treatment Plant Utilization for the Poway Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 41. Under current climate, utilization of Poway WTP is higher for 2025 demands than for 2015 demands, and higher for 2050 demands than for 2025 demands in all Portfolios other than the Enhanced Conservation Portfolio in which utilization is higher for 2025 demands than for 2015 demands, but lower for 2050 demands than for 2025 demands. This can be attributed to the Enhanced Conservation Concept discussed in Section 8.3.

Climate scenarios have an impact on utilization of Poway WTP for all Portfolios, with higher utilization for central tendency climate than for current climate for both 2025 and 2050 demands. There is no statistical evidence based on the ANOVA analysis of a difference in utilization between central tendency climate and other climate scenarios. This is consistent with the limited effect of climate scenarios on overall demands (see Section 7.1.1).
Perdue Water Treatment Plant receives water from Sweetwater Reservoir, Loveland Reservoir, and the Second Aqueduct and treats it to meet demands for the Sweetwater Authority (City of National City and South Bay Irrigation District). Average Annual Treatment Plant Utilization for the Perdue Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 42. Under current climate, utilization of Perdue WTP is lower for 2025 demands than for 2015 demands, but higher for 2050 demands than for 2025 demands in all Portfolios. This decrease in utilization from 2015 to 2025 followed by an increase from 2025 to 2050 corresponds to a decrease in Sweetwater Authority demands from 2015 to 2025 followed by an increase in Sweetwater Authority demands from 2025 to 2050. Utilization of Perdue WTP is lower in the Enhanced Conservation Portfolio for 2025 and 2050 demands than the other Portfolios which can be attributed to the Enhanced Conservation Concept discussed in Section 8.3.
Climate scenarios have an impact on utilization of Perdue WTP only in the Enhanced Conservation Portfolio for 2025 demands. In this Portfolio, utilization is lower for current climate than central tendency climate.

![Figure 42. Perdue WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.](image)

7.1.4.4.10. **Twin Oaks Valley**

Twin Oaks Valley Water Treatment Plant receives water from the Second Aqueduct and treats it to meet demands for Escondido, Vallecitos, Vista, Carlsbad, San Dieguito, Santa Fe, San Diego North, Del Mar, Ramona, Otay, Helix, Padre Dam, San Diego, Sweetwater, and Olivenhain. Average Annual Treatment Plant Utilization for the Twin Oaks Valley Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 43. Under current climate, utilization of Twin Oaks Valley WTP is higher for 2025 demands than for 2015 demands, and higher for 2050 demands than for 2025 demands in all Portfolios other than Enhanced Conservation and Increase Supplies. In the Enhanced Conservation and Increase Supplies
Portfolios, utilization is higher for 2025 demands than for 2015 demands, but lower for 2050 demands than for 2025 demands. This result is likely due to a combination of increases in demand resulting in greater use of imported water in 2025 scenarios and the shift to local supplies and conservation that begins in the 2025 scenarios and continues in the 2050 scenarios. Utilization of Twin Oaks Valley WTP is higher in the Baseline Portfolio than Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 and 2050 demands.

Climate scenarios have an impact on utilization of Twin Oaks Valley WTP in all Portfolios for both 2025 and 2050 demands. For 2025 and 2050 demands, utilization is higher for central tendency climate than for current climate in all Portfolios. In the Baseline, Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands, utilization is lower for the hot-dry climate than central tendency climate, and in just the Baseline Portfolio utilization is lower for warm-dry climate than central tendency climate.

Figure 43. Twin Oaks Valley WTP Utilization for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
7.1.4.4.11. Weese

Weese Water Treatment Plant receives water from the Second Aqueduct and treats it to meet demands for the City of Oceanside. Average Annual Treatment Plant Utilization for the Weese Plant compared across all demand scenarios and selected climate scenarios is shown in Figure 44. Under current climate, utilization of Weese WTP is higher for 2025 demands than for 2015 demands, and lower for 2050 demands than for 2025 demands in the Baseline Portfolio. The decrease in the 2050 utilization is likely due to an increase in available supply volumes modeled as demand reductions which are not accounted for in the utilization metrics. In the Baseline Plus, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios, utilization is similar for 2015 and 2025 demands then lower for 2050 demands than for 2025 demands. The Enhanced Conservation Portfolio has the lowest utilization for Weese compared to the other Portfolios, and utilization in the Enhanced Conservation Portfolio utilization is lower for 2025 demands than for 2015 demands, and lower for 2050 demands than for 2025 demands which can be attributed to the Enhanced Conservation Concept discussed in Section 8.3.

Climate scenarios have an impact on utilization of Weese WTP in all Portfolios for 2025 demands and only in the Enhanced Conservation Portfolio for 2050 demands. In all Portfolios for 2025 demands, utilization is lower in current climate than central tendency climate. For 2050 demands, utilization is slightly lower for current climate than central tendency climate only for the Enhanced Conservation Portfolio.
7.1.5. Reservoir Operations
San Diego region reservoirs store local surface water and/or imported water as shown in Table 17 of Section 4.2.1 for use in meeting water demands. Reservoirs are generally operated to store inflows for water supply and may therefore store peak flows during flood situations. In doing so, they may prevent flooding of downstream communities, but they are not operated specifically for flood control. Reservoir Operations metrics include monthly Reservoir Storage, monthly Reservoir Releases, and End of September Storage. Storage and Release metrics are available for 11 of the 18 reservoirs in CWASim and End of September Storage is analyzed for 5 of the 18 reservoirs. Although CWASim simulates all 18 reservoirs, the model was not configured to output metric values for all reservoirs. The other reservoirs that are not described by metric outputs are some of the smaller reservoirs (see Section 4.2.1). These metrics are used to understand impacts to water delivery, such as the amount of stored water available to meet demands and the amount of water actually released to meet demands.
As discussed in Section 4.2.1, reservoirs in CWASim are controlled by rules curves which divide reservoir storage into different reservoir zones or “pools”, such as the flood zone, seasonal pool, carryover storage, emergency pool, and dead pool. The seasonal pool is available for normal use in meeting water demands, while the carryover pool describes the minimum volume of water that should be carried over from year to year and is only used as a “last resort” for meeting demands. The emergency pool is not utilized in the Basin Study model runs, and the dead pool represents storage that cannot be accessed for water supply. These reservoir pools were developed based on actual reservoir operations and may vary throughout the year to account for seasonal differences in operating policies. Reservoir releases described in Section 7.1.5.2 are made to meet demands. Releases made in addition to those used to meet demands (such as those that occur when the reservoir is operating in its flood pool) are described in Section 7.4.

Overall, 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. For reservoirs that showed impacts from climate change, wet scenarios generally had higher reservoir storage than dry scenarios.

### 7.1.5.1 Reservoir Storage

The Reservoir Storage metric (Box 18) describes the volume of water stored in the reservoir. Reservoir storage can provide information about normal water supply storage, emergency storage, and/ or flood storage, depending on the value of storage relative to the reservoir’s rule curve. The monthly Reservoir Storage metric reports the average end of month storage value from the daily model simulation. Values should be compared to rule curves and reservoir releases to interpret the potential impact of higher or lower storage. In accordance with the rule curves, for most reservoirs, reservoir storage peaks in March or April and declines through December, with exceptions at Hodges and Loveland. Storage at Hodges peaks in June, while storage at Loveland is at its peak from April to December, then declines to its lowest storage level in January.

#### 7.1.5.1.1 Barrett

Barrett Reservoir stores local runoff and surface water transfers from Morena reservoir. Its storage peaks in March and April and declines through December. The reservoir’s seasonal pool is 34,760 AF for the entire year. Of that volume, between 19,702 AF (in December) and 22,201 AF (in May) is designated as carryover storage. Within the carryover storage, no volume is designated as emergency storage, and 6,500 AF is dead pool. The Monthly Average Reservoir Storage for Barrett ranges from 12,000 AF to 20,000 AF in all Portfolios, remaining above the dead pool zone and within the carryover zone.

Monthly Average Reservoir Storage for Barrett compared across all demand scenarios for current climate is shown in Figure 45. Under current climate, Monthly Average Reservoir Storage appears to be lower for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands in the Baseline, Baseline Plus, Increase Supplies, and Watershed Health and Ecosystem Restoration Portfolios. There appear to be minimal differences in Monthly Average Reservoir Storage between demand scenarios for the Enhanced Conservation and Optimize Existing Facilities Portfolios. The lower 2025 and 2050 storage in
the Baseline, Baseline Plus, Increase Supplies, and Watershed Health and Ecosystem Restoration Portfolios can be attributed to increasing demands resulting in greater releases of water for meeting water demands (see Section 7.1.5.2.1). The lack of differences in 2025 and 2050 storage in the Enhanced Conservation Portfolio can be attributed to the conservation associated with the Enhanced Conservation project, described in Section 8.3, and in the Optimize Existing Facilities Portfolio it can be attributed to a shift in water demands from Barrett to El Capitan and San Vicente as a result of the San Diego Reservoir Intertie Project, described in Section 8.1.

Monthly Average Reservoir Storage - Barrett Current Climate

![Monthly Average Reservoir Storage - Barrett Current Climate](image)

Figure 45. Monthly average reservoir storage for Barrett Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Storage typically appears to be higher for current climate than for central tendency climate for 2050 demands but similar to central tendency climate with 2025 demands (see Figure 46). This is a result of the 2020s inflow projection being very similar to the current climate projection and the 2050s inflow projection being somewhat lower than the current climate projection (See Table 30). Monthly Average Reservoir Storage appears to be higher with hot-wet and warm-wet climate scenarios than with central tendency climate and lower with hot-dry and warm-dry climate scenarios than with central tendency climate in all Portfolios and demand scenarios. The wet scenarios have somewhat higher surface water runoff than central tendency and dry scenarios which contributes to this result.
Figure 46. Monthly average reservoir storage for Barrett Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.1.2. **El Capitan**

El Capitan Reservoir stores local runoff in all Portfolios, and is also able to store imported water in the Optimize Existing Facilities Portfolio due to the San Diego Reservoir Intertie project. As modeled in CWASim, El Capitan Reservoir Storage peaks in April and declines through December following the monthly pattern described by its rule curve. As seen in Figure 47, for all Portfolios and demand scenarios other than 2050 demands in the Optimize Existing Facilities Portfolio, El Capitan’s rule curve sets the seasonal pool at 50,773 AF for January through November, and 45,479 AF in December. The emergency storage zone ranges from 23,438 AF in January to 25,551 AF in June, with a value of 23,677 AF in September. The bottom 2,820 AF of the reservoir is dead pool. None of the seasonal pool is designated as carryover storage, so it is available to meet normal demands and does not have to be carried over from year to year. The modeled Monthly Average Reservoir Storage for El Capitan ranges from 24,000 AF (lowest from September to December) to 35,000 AF (highest from March to May) in the Baseline, Baseline Plus, Enhanced Conservation, and Watershed Health and Ecosystem Restoration Portfolios. In the Increase Supplies Portfolio, El Capitan storage ranges from 26,000
AF to 38,000 AF for 2050 demands. This indicates that during the fall and winter months the Reservoir Storage is close to the designated emergency storage, as would be expected to conserve the emergency storage while making excess water available to meet demands.

Due to implementation of the San Diego Reservoir Intertie in the Optimize Existing Facilities Portfolio for 2050 demands discussed in Section 8.1, El Capitan’s seasonal storage increases, with a modified range of 111,707 AF for April to September, and drawdown to 52,314 AF in December. The Reservoir Intertie project also includes other modifications that enable El Capitan Reservoir to receive imported water. The combination of these changes gives El Capitan both the storage capacity and necessary conveyance facilities to receive and store imported water, thereby increasing flexibility within the system. Of the modified seasonal storage volume, the emergency storage zone ranges from 48,666 AF in January to 53,363 AF in June, with a value of 49,198 AF in September. As in the other Portfolios, 2,820 AF is dead pool and none of the seasonal pool is designated as carryover storage. With the modified rule curve, modeled El Capitan storage in the Optimize Existing Facilities Portfolio for 2050 demands ranges from 55,000 AF to 60,000 AF, which is above the emergency storage zone and within the carryover storage zone.

![Month average reservoir storage - El Capitan current climate](image)

**Figure 47. Monthly average reservoir storage for El Capitan Reservoir for current climate for all demand scenarios and Portfolios.**
Monthly Average Reservoir Storage for El Capitan compared across all demand scenarios for current climate is shown in Figure 47. Monthly Average Reservoir Storage at El Capitan appears similar between 2015, 2025, and 2050 demands in the Baseline, Baseline Plus, Enhanced Conservation, and Watershed Health and Ecosystem Restoration Portfolios. In the Increase Supplies and Optimize Existing Facilities Portfolio, Monthly Average Reservoir Storage at El Capitan appears larger in 2050 demands than for 2025 and 2015 demands. The larger 2050s storage in the Increase Supplies Portfolio can be attributed to an increased availability of water supplies. The larger 2050s storage in the Optimize Existing Facilities Portfolio can be attributed to the San Diego Reservoir Intertie project discussed in Section 8.1 which enables El Capitan to store imported water that it was previously unable to receive. Monthly Average Reservoir Storage at El Capitan appears higher in the Optimize Existing Facilities and Increase Supplies Portfolios than in the Baseline and Baseline Plus Portfolios for 2050 demands and appears higher in the Optimize Existing Facilities Portfolio than in the Increase Supplies Portfolio.

Climate scenarios do not appear to have a significant impact on Monthly Average Reservoir Storage at El Capitan (see Figure 48). There appears to be minimal differences in Monthly Average Reservoir Storage between the current climate and central tendency climate, and minimal differences between central tendency climate and any of the other climate scenarios. This is most likely due to a lack of difference in reservoir inflows between climate scenarios. For reservoirs except for El Capitan, climate change results in a maximum 15% to 28% increase or decrease in natural inflows for the 2050s, depending on the scenario (See Table 30). For El Capitan, the maximum increase or decrease in natural inflows is 6%, or less than half of what is expected for other reservoirs. The lack of sensitivity in natural inflows to climate change results in lack of effect of climate change on Monthly Average Reservoir Storage.
Figure 48. Monthly average reservoir storage for El Capitan Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.1.3. Hodges

Hodges Reservoir stores imported water and local runoff. As modeled in CWASim, its storage starts to peak in March but then declines slightly through May, then peaks again in June and declines through December. The reservoir’s seasonal pool is 27,998 AF for the entire year. Of that volume, 10,385 AF for June through January and 13,433 AF for February through May is designated as carryover storage. Within the carryover storage, no volume is designated as emergency storage, and 5,590 AF is dead pool. The Monthly Average Reservoir Storage for Hodges ranges from 21,000 AF to 24,000 AF in the Baseline Portfolio, and 16,000 AF to 24,000 AF in all other Portfolios, remaining above the dead pool and carryover storage zones.

Monthly Average Reservoir Storage for Hodges compared across all demand scenarios for current climate is shown in Figure 49. Monthly Average Reservoir Storage at Hodges appears similar for 2015, 2025, and 2050 demands in the Baseline Portfolio. In the Baseline Plus Portfolio, Monthly Average Reservoir Storage appears lower for 2050 demands than for 2025 and 2015 demands. This can be attributed to the Hodges Water Quality Improvement Program discussed in Section 8.15 which improves water quality such that it can be moved out of Hodges...
and into the regional aqueduct system to be used for water supply. In this case, lower monthly reservoir storage indicates that with the improved water quality, more of the water stored in Hodges is available to meet water demands. Because all Baseline Plus projects are included in the other Portfolios besides Baseline, the lower Monthly Average Reservoir Storage in 2050 is also observed in the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios.

Climate scenarios appear to have an impact on Monthly Average Reservoir Storage at Hodges in all Portfolios (see Figure 50). Although there does not appear to be a difference between current climate and central tendency climate, there does appear to be differences between central tendency climate and other climate scenarios. Typically, hot-wet and warm-wet climates appear to have a larger reservoir storage than central tendency climate, and hot-dry and warm-dry climates appear to have a smaller reservoir storage. Since it does not appear that there are higher imported water deliveries during the wetter climate scenarios (see Section 7.1.2.5), this can be

---

Figure 49. Monthly average reservoir storage for Hodges Reservoir for current climate for all demand scenarios and Portfolios.
attributed to the differences in local runoff between the climate scenarios, with dry climate scenarios having less local runoff than wet scenarios.

![Monthly Average Reservoir Storage - Hodges](image)

**Figure 50. Monthly average reservoir storage for Hodges Reservoir for 2050 demands for all Portfolios and climate scenarios.**

**7.1.5.1.4. Loveland**

Loveland Reservoir stores local runoff. As modeled in CWASim, reservoir storage at Loveland increases from January to March, then decreases from December to January. The monthly Average Reservoir Storage pattern for Loveland Reservoir is different from other San Diego region reservoirs in that there is a large decrease in water storage in December and January, which is due to releases from Loveland Reservoir to Sweetwater Reservoir to prepare for anticipated high precipitation in February (see Section 7.1.5.2.4, which discusses Loveland Reservoir Releases). During this operation, the Sweetwater Authority aims to release approximately 70% of total water storage from Loveland Reservoir while maintaining approximately 7,000 AF in the reservoir.

Loveland’s seasonal pool is 25,400 AF for January and February, then 22,975 AF from March to December. Of that volume, 8,192 AF for January and February, and 22,975 AF from March to
December is carryover storage. This means that the entire seasonal pool is designated as carryover storage from March to December. Within the carryover storage, no volume is designated as emergency storage, and 1,150 AF is dead pool. Monthly Average Reservoir Storage for Loveland compared across all demand scenarios for current climate is shown in Figure 51. The Monthly Average Reservoir Storage for Loveland ranges from 8,000 AF to 12,000 AF from January to March, and 12,000 AF to 14,000 AF from March to December, in all Portfolios, remaining above the dead pool zone.

![Graph showing Monthly Average Reservoir Storage for Loveland](image)

**Figure 51. Monthly average reservoir storage for Loveland Reservoir for current climate for all demand scenarios and Portfolios.**

Under current climate, Monthly Average Reservoir Storage at Loveland (see Figure 51) appears higher for 2025 demands than for 2015 demands but lower for 2050 demands than for 2025 demands in all Portfolios other than Enhanced Conservation. In the Enhanced Conservation Portfolio, Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands. As mentioned, the monthly trend in reservoir storage at Loveland is due to large releases in December to prepare for anticipated high precipitation in February.
Monthly Average Reservoir Storage for Loveland compared across all climate scenarios for the 2050 demand scenario is shown in Figure 52. Climate scenarios appear to have some impact on Monthly Average Reservoir Storage at Loveland with differences for 2050 scenarios and between wet and dry scenarios. Monthly Average Reservoir Storage appears similar between current climate and central tendency climate for 2025 demands but higher for current climate than central tendency climate for 2050 demands indicating that most of the effect of climate change is not seen until the 2050 scenarios. For both 2020s and 2050s, there are differences between wet and dry climates. For 2025 demands, warm-wet climate appears to have larger reservoir storage than central tendency climate while hot-wet climate appears similar to central tendency climate, but for 2050 demands both warm-wet and hot-wet climates appear to have larger reservoir storage than central tendency climate. For both 2025 and 2050 demands hot-dry and warm-dry climate appear to have smaller reservoir storage than central tendency climate. The climate scenarios still follow the monthly trend in reservoir storage at Loveland, where large releases in December to prepare for anticipated high precipitation in February cause a decrease in storage between December and January.

Figure 52. Monthly average reservoir storage for Loveland Reservoir for 2050 demands for all Portfolios and climate scenarios.
7.1.5.1.5. Lower Otay

Lower Otay Reservoir stores imported water, surface water transfers from Barrett Reservoir (conveyed by the Dulzura Conduit), and local runoff. As modeled in CWASim, reservoir storage at Lower Otay peaks in March and April and declines through December. The reservoir’s seasonal pool is 45,237 AF for the entire year. Of that volume, the designated emergency storage pool ranges from 31,609 AF in December to 38,181 AF in May, with a value of 34,225 AF in September. Of the emergency storage volume, 3,730 AF is dead pool. No carryover storage pool is designated at Lower Otay. Average annual inflow of local runoff is 13% of the reservoir storage capacity (Table 31). Lower Otay is operated in conjunction with Barrett and Morena reservoirs, with Morena transferring local inflows to Barrett and Barrett transferring to Lower Otay. Because it is the terminal reservoir for the Second Aqueduct, Lower Otay is able to serve as an operational storage reservoir for imported water, which is only used to fill the seasonal pool.

Monthly Average Reservoir Storage for Lower Otay compared across all demand scenarios for current climate are shown in Figure 53. For current climate scenarios, the Monthly Average Reservoir Storage at Lower Otay ranges from approximately 36,000 AF from September to January to approximately 38,000 AF in March and April in the Baseline Portfolio and in 2015 scenarios for all Portfolios. Reservoir storage peaks at approximately 43,000 AF in the Baseline Plus, Increase Supplies, and Watershed Health and Ecosystem Restoration Portfolios from March to May for 2025 and 2050 demands, with the low storage at approximately 37,000 AF. In the Enhanced Conservation and Optimize Existing Facilities Portfolios, storage is approximately 45,000 AF throughout the entire year in 2050 demands. The Monthly Average Reservoir Storage is highest when the designated emergency storage pool is highest, so the Monthly Average Reservoir Storage at Lower Otay remains within the seasonal pool throughout the year.

Under current climate, Monthly Average Reservoir Storage at Lower Otay appears lower for 2050 demands than for 2025 and 2015 demands in the Baseline Portfolio (see Figure 53). In the Baseline Plus Portfolio, Monthly Average Reservoir Storage at Lower Otay appears higher for 2025 and 2050 demands than for 2015 demands. This can be attributed to the Mission Trails Projects Alternative 1 project, which increases the amount of imported water that can be delivered to the southern portion of San Diego County, increasing the amount that can be stored in Lower Otay Reservoir. Since Baseline Plus projects are included in all other Portfolios besides Baseline, this higher Monthly Average Reservoir Storage is also observed in the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. In the Enhanced Conservation and Optimize Existing Facilities Portfolios, Monthly Average Reservoir Storage appears higher for 2050 demands than for 2025 demands. This can be attributed to the Enhanced Conservation Concept (see Section 8.3) in the Enhanced Conservation Portfolio and the Dulzura Conduit Replacement, which improves conveyance of releases from Barrett Reservoir to Lower Otay (see Section 8.1), in the Optimize Existing Facilities Portfolio.
Monthly Average Reservoir Storage for Lower Otay compared across all climate scenarios for the 2050 demand scenario is shown in Figure 54. Climate scenarios have some impact on Monthly Average Reservoir Storage. There generally do not appear to be any differences among climate scenarios for 2025 demands except in the Baseline Portfolio, which has lower storage for hot-dry and warm-dry climates and is likely due to lower precipitation and higher water demands in that scenario. For 2050 demands, reservoir storage appears highest with current climate for Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. All climate change scenarios in these Portfolios have lower storage than current climate, likely due to higher demands. For the Baseline and Increase Supplies Portfolios, the wet scenarios are somewhat higher than current climate storage, while central tendency and dry scenarios are slightly lower. For Baseline, this indicates that increased precipitation in wet scenarios can counterbalance the demands in current climate, central tendency, and dry climate scenarios. For the Increase Supplies Portfolio, the additional supply sources likely also contribute to the counterbalancing effect.
7.1.5.1.6. Miramar

Miramar Reservoir stores imported water, and in all Portfolios except for Baseline, it can store water from the Pure Water San Diego Phase 1 project. Miramar’s Reservoir Storage peaks from August to November and remains constant from January to July. The reservoir’s seasonal pool is 6,045 AF throughout the entire year. Of that volume, the carryover pool ranges from 5,656 AF in December and January to 5,958 AF in June. Of that volume, 1,130 AF is dead pool. There is no designated emergency storage at Miramar. Monthly Average Reservoir Storage for Miramar compared across all demand scenarios for current climate is shown in Figure 55. The Monthly Average Reservoir Storage at Miramar is approximately 5,600 AF from December through July, then starts to increase to its peak at approximately 5,900 AF in the Baseline Portfolio. In the Baseline Plus and subsequent Portfolios, Miramar Storage is higher in 2025 and 2050 demands and ranges from approximately 5,750 AF in January to just over 6,000 AF from May to September. The Monthly Average Reservoir Storage remains in the seasonal and carryover pools and stays above the dead pool in all Portfolios. Aside from the Baseline Portfolio, there is a decrease in Miramar Reservoir Storage from December to January for 2025 and 2050 demand scenarios, which corresponds to higher releases in December (see Section 7.1.5.2.6) made to
follow the reservoir’s rule curve while the reservoir is receiving additional inflows from the Pure Water Phase 1 project. With actual Pure Water San Diego Phase 1 operations, it is expected that storage at Miramar Reservoir will be higher and at a more consistent storage volume to comply with the Surface Water Augmentation permit.

![Monthly Average Reservoir Storage - Miramar](image)

**Figure 55. Monthly average reservoir storage for Miramar Reservoir for current climate for all demand scenarios and Portfolios.**

Under current climate in the Baseline Portfolio, Monthly Average Reservoir Storage appears to be the same for 2015, 2025, and 2050 demands from November to July, and from August to October storage appears lower for 2025 demands than for 2015 demands, and lower for 2050 demands than for 2025 demands (see Figure 55). In the Baseline Plus Portfolio, Monthly Average Reservoir Storage appears significantly higher for 2025 and 2050 demands than for 2015 demands due to implementation of Pure Water San Diego Phase 1, which delivers 30 mgd to Miramar from the North City Advanced Water Reclamation Plant. Additional impacts from Pure Water San Diego Phase 1 are discussed in Section 8.9. Because all Baseline Plus projects are included in the other Portfolios besides Baseline, the higher Monthly Average Reservoir Storage in 2025 and 2050 is also observed in the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios.
Climate scenarios do not appear to have a significant impact on Monthly Average Reservoir Storage at Miramar other than in the Baseline Portfolio, where central tendency climate appears slightly lower than current climate, hot-dry climate, and warm-dry climate for 2025 demands and central tendency appears slightly higher than hot-wet and warm-wet climates for 2050 demands (see Figure 56).

Figure 56. Monthly average reservoir storage for Miramar Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.1.7. Morena

Morena Reservoir stores local runoff. Morena Reservoir Storage peaks from April to June and declines through December. The reservoir’s seasonal pool ranges from 35,000 AF in November and December, to 42,768 AF January to March, 45,245 AF in April, and 50,200 AF from May to October. Of that volume, the carryover pool ranges from 10,563 AF in January to 22,950 AF May to September, and 16,756 AF in December. Of that volume, 654 AF is dead pool. There is no designated emergency storage pool at Morena. Monthly Average Reservoir Storage for Morena compared across all demand scenarios for current climate is shown in Figure 57. The Monthly Average Reservoir Storage at Morena ranges from approximately 11,000 AF in January to 16,000 AF when storage peaks from April to June indicating that the Monthly Average Reservoir Storage remains in the seasonal and carryover pools and stays above the dead pool.
Under current climate, there appear to be only minimal differences for Monthly Average Reservoir Storage at Morena between 2015, 2025, and 2050 demands in all Portfolios (see Figure 57).

Figure 57. Monthly average reservoir storage for Morena Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Storage for Morena compared across all climate scenarios for the 2050 demand scenario is shown in Figure 58. Climate scenarios appear to have an impact on Monthly Average Reservoir Storage at Morena. There appears to be larger storage for 2050 demands with current climate than with central tendency climate, and typically there appears to be more storage with hot-wet and warm-wet climate and less storage with hot-dry and warm-dry climates.
7.1.5.1.8. Olivenhain

Olivenhain Reservoir stores both local runoff and imported water. It is operated primarily for emergency storage, and also operated in conjunction with Hodges Reservoir. The CWASim model contains logic for transfers of water from Olivenhain to Hodges, and also has logic for pumped storages of Hodges water in Olivenhain. The logic for transfers from Olivenhain to Hodges was activated in the Basin Study model runs, but the pumped storage capability was not. Olivenhain Reservoir Storage remains relatively constant throughout the year in some Portfolios and demand scenarios, but dips in May through December for other demand scenarios and Portfolios. This decrease in storage in May is due to releases from Olivenhain to Hodges Reservoir, which can be made from May through December in the CWASim model (although these releases are not accounted for in the Reservoir Releases metric, described in Section 7.1.5.2.8). The reservoir’s seasonal pool is 24,333 AF throughout the year. Of that volume, the carryover pool ranges from 19,331 AF from October to January to 24,115 in April and May. All of the carryover is designated as emergency storage. The bottom 43 AF of the reservoir are dead pool. The Monthly Average Reservoir Storage ranges from approximately 21,000 AF to 24,000 AF across all Portfolios and climate scenarios.
Monthly Average Reservoir Storage for Olivenhain compared across all demand scenarios for current climate is shown in Figure 59. Comparing 2015, 2025, and 2050 demand scenarios under current climate, there appear to be no differences in Monthly Average Reservoir Storage from December to May in the Baseline, Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios. The Monthly Average Reservoir Storage appears lower for 2025 demands than for 2015 demands from June to October and lower for 2050 demands than for 2025 demands from June to November, in the Baseline Portfolio. In the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios there appear to be no differences in Monthly Average Reservoir Storage from December to May, while the Monthly Average Reservoir Storage appears lower for 2025 demands than for 2015 demands from June to September and lower for 2050 demands than for 2025 demands from June to November. The differences most likely occur between these months due to the ability of Olivenhain to release water to Hodges Reservoir from May to December in the CWASim model.

Figure 59. Monthly average reservoir storage for Olivenhain Reservoir for current climate for all demand scenarios and Portfolios.

Under current climate in the Enhanced Conservation and Increase Supplies Portfolios, there appear to be minimal differences in Monthly Average Reservoir Storage between 2015, 2025,
and 2050 demands from September to May, and the Monthly Average Reservoir Storage appears higher in 2050 demands than in 2025 and 2015 demands from June to August.

Under current climate in the Optimize Existing Facilities Portfolio there appear to be no differences in Monthly Average Reservoir Storage from October to May. The Monthly Average Reservoir Storage appears lower for 2025 demands than for 2015 demands from June to September, and higher for 2050 demands than for 2025 demands from June to August.

Monthly Average Reservoir Storage for Olivenhain compared across all climate scenarios for the 2050 demand scenario is shown in Figure 60. Climate scenarios have an impact on Olivenhain for both 2025 and 2050 demands in all Portfolios. Typically, Monthly Average Reservoir Storage is lower in hot-dry climate and warm-dry climate than in central tendency climate when a difference is observed, and Monthly Average Reservoir Storage is higher in warm-wet climate and hot-wet climate than in central tendency climate when a difference is observed.

![Monthly Average Reservoir Storage - Olivenhain](image)

**Figure 60.** Monthly average reservoir storage for Olivenhain Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.1.9. **San Vicente**

San Vicente Reservoir stores both imported water and local runoff, although average annual
natural inflows under the current climate scenario only make up 3% of the total storage capacity of the reservoir (Table 31), and thus, imported water inflows are the primary influence on reservoir storage. San Vicente Reservoir Storage peaks in March and April and declines through December. The reservoir’s seasonal pool is 246,018 AF for the entire year. Of that volume, 187,763 AF in January, 210,397 AF in June, and 202,165 AF in September is designated as carryover storage. Of the carryover storage volume, emergency storage ranges from 87,763 AF in January, to 110,397 AF in July, and 102,165 AF in September. Of the emergency storage volume, 5,228 AF is dead pool. Monthly Average Reservoir Storage for San Vicente compared across all demand scenarios for current climate is shown in Figure 61. The Monthly Average Reservoir Storage for San Vicente ranges from 105,000 AF to 150,000 AF depending on the Portfolio and demand scenario. The peak storage volume in San Vicente occurs from March to April and the lowest storage volume occurs from September to December. The Monthly Average Reservoir Storage is close to the emergency storage zone from June through August for 2050 demands in the Baseline Portfolio. Monthly Average Storage Volumes are above the emergency zone for all demand scenarios and Portfolios.

![Figure 61. Monthly average reservoir storage for San Vicente Reservoir for current climate for all demand scenarios and Portfolios.](image)
Under current climate, Monthly Average Reservoir Storage at San Vicente appears slightly lower for 2025 demands than for 2015 demands and slightly lower for 2050 demands than for 2025 demands in the Baseline Portfolio (Figure 61). In the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios, storage appears similar between 2015 and 2025 demands but lower for 2050 demands than for 2025 demands, while in the Optimize Existing Facilities Portfolio, storage only appears lower for 2050 demands than for 2025 demands from January to April. In the Enhanced Conservation Portfolio, Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands due to the Enhanced Conservation Concept discussed in Section 8.3. In the Increase Supplies Portfolio, Monthly Average Reservoir Storage appears to be significantly higher for 2050 demands than for 2025 demands which can be attributed to Pure Water San Diego Phase 2 discussed in Section 8.9.

Monthly Average Reservoir Storage for San Vicente compared across all climate scenarios for the 2050 demand scenario is shown in Figure 62. Climate scenarios have an impact on Monthly Average Reservoir Storage at San Vicente in all Portfolios where Monthly Average Reservoir Storage is typically lower for hot-dry and wet-dry climates, and higher for hot-wet and warm-wet climate. There is no difference in Monthly Average Reservoir Storage between current climate and central tendency in all Portfolios.
Figure 62. Monthly average reservoir storage for San Vicente Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.1.10. Sweetwater
Sweetwater Reservoir stores local runoff and imported water. Sweetwater Reservoir Storage is relatively stable from February to May, declines through December, and then increases between December and January. The increase in storage between December and January can be attributed to releases from Loveland Reservoir to Sweetwater Reservoir that typically occur during this period (see Section 7.1.5.1.4). In the Baseline Portfolio, the reservoir’s seasonal pool is 20,207 AF throughout the entire year. Of that volume, the carryover pool ranges from 5,414 AF in January and 19,122 AF in May to 4,066 AF from June to December. Of that volume, 1,650 AF is dead pool. There is no designated emergency storage pool at Sweetwater. In all Portfolios except for the Baseline the reservoir’s seasonal pool is 25,416 AF. Of that volume, the carryover pool ranges from 4,066 AF from June to December, 10,624 AF in January, and 24,332 AF in May. Of the carryover pool, 1,650 AF is dead pool, and there is no designated emergency storage pool. Monthly Average Reservoir Storage for Sweetwater compared across all demand scenarios for current climate is shown in Figure 63. The Monthly Average Reservoir Storage for Sweetwater ranges from approximately 3,000 AF in December to 15,000 AF during peak storage from
February to May in all Portfolios, remaining above the dead pool zone and within either the seasonal pool or carryover zone depending on the month.

Under current climate, the Monthly Average Reservoir Storage at Sweetwater appears higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands in all Portfolios, which is due to decreased demand for Sweetwater Authority in 2025 followed by increased demands in 2050 (see Figure 63). Storage for 2050 demands appears higher in the Baseline Plus and subsequent Portfolios than in the Baseline Portfolio due to implementation of the Sweetwater Reservoir Wetlands Habitat Recovery project discussed in Section 8.15. The Monthly Average Reservoir Storage appears higher for 2050 demands in the Enhanced Conservation Portfolio than in the Baseline Plus Portfolio.

![Monthly Average Reservoir Storage - Sweetwater](image)

**Figure 63. Monthly average reservoir storage for Sweetwater Reservoir for current climate for all demand scenarios and Portfolios.**

Monthly Average Reservoir Storage for Sweetwater compared across all climate scenarios for the 2050 demand scenario is shown in Figure 64. Climate scenarios appear to have an impact on Monthly Average Reservoir Storage at Sweetwater in that storage typically appears higher for
hot-wet and warm-wet climates than central tendency climate and lower for hot-dry and warm dry climates than central tendency climate.

**Figure 64.** Monthly average reservoir storage for Sweetwater Reservoir for 2050 demands for all Portfolios and climate scenarios.

### 7.1.5.1.11. Wohlford

Wohlford Reservoir Storage peaks in April and declines through December. The reservoir’s seasonal pool ranges from 2,821 AF in January, 5,293 AF in April, and 2,597 AF from October to December. Of that volume, 1,174 AF in January, 1,998 AF in April, and 1,062 AF October to December is designated as carryover storage. Within carryover storage, no volume is designated as emergency storage, and 350 AF is dead pool. The Monthly Average Reservoir Storage for Monthly Average Reservoir Storage for Wohlford compared across all demand scenarios for current climate is shown in Figure 65. Wohlford ranges from about 1,000 AF in January, to close to 1,400 AF in April, and down to 900 AF from October to December in all Portfolios remaining above the dead pool zone and within either the seasonal pool or carryover zone depending on the month.
Under current climate, there appear to be only minimal differences for Monthly Average Reservoir Storage at Wohlford between 2015, 2025, and 2050 demands in all Portfolios except for in the Increase Supplies Portfolio, where 2050 demands appear higher than 2025 and 2015 demands from January to July (see Figure 65).

Monthly Average Reservoir Storage for Wohlford compared across all climate scenarios for the 2050 demand scenario are shown in Figure 66. Climate scenarios have an impact on Monthly Average Reservoir Storage at Wohlford in all Portfolios in that storage is typically higher for hot-wet and warm-wet climates and lower in hot-dry and warm-dry climates.
Figure 66. Monthly average reservoir storage for Wohlford Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.2 Reservoir Releases
The Reservoir Releases metric (Box 19) quantifies the volume released from reservoirs each month for water supply. This does not include flood outflows above the water supply volume, which occur when the reservoir is in the flood pool. Further analysis of flood outflows can be found in Section 7.4. Values should be compared to rule curves and reservoir storage to interpret the potential impact of larger or smaller releases. Larger releases generally mean more water is being used for water supply. Smaller releases may mean that there is a lack of water stored in the reservoir that can be released, that operational rules such as the rule curve or release restrictions prevent higher releases of stored water, or that the demand for water does not require higher releases, either because the demand is small or because it is being met by other sources of water.

7.1.5.2.1 Barrett
Releases from Barrett Reservoir peak in summer months then decline through March. These releases are transferred to Lower Otay via the Dulzura Conduit. Releases from Lower Otay are treated at the Otay Water Treatment Plant and are used to meet demands of the City of San Diego (Otay area) and the Cal-American Water Company, which, although it is not a SDCWA
member agency, receives local surface water from the City of San Diego through a water rights settlement.

Monthly Average Reservoir Releases for Barrett compared across all demand scenarios for current climate are shown in Figure 67. Under current climate, there appears to be higher Reservoir Releases at Barrett for 2025 demands than for 2015 demands for November through December (and January for the Baseline Portfolio). There also appears to be higher releases for 2050 demands than for 2015 and 2025 demands from December to May in the Baseline, Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios (see Figure 67). In the Enhanced Conservation Portfolio, releases appear lower in 2050 demands from January to March. In the Increase Supplies Portfolio releases appear higher for 2025 and 2050 demands than for 2015 demands in November and December, and in the Optimize Existing Facilities Portfolio releases appear higher for 2050 demands than for 2025 and 2015 demands from June to September and higher for 2025 demands than for 2050 and 2015 demands in November and December.

Figure 67. Monthly average reservoir releases for Barrett Reservoir for current climate for all demand scenarios and Portfolios.
Monthly Average Reservoir Releases for Barrett compared across all climate scenarios for the 2050 demand scenario are shown in Figure 68. Climate scenarios have an impact on Monthly Average Reservoir Releases at Barrett in all Portfolios for 2025 and 2050 demands between June and December, when releases are lower for hot-dry climate and warm-dry climate than for central tendency climate from June to December. For 2050 demands, releases are higher for warm-wet and hot-wet climate than for central tendency climate from June to December.

![Figure 68. Monthly average reservoir releases for Barrett Reservoir for 2050 demands for all Portfolios and climate scenarios.](image)

**7.1.5.2.2. El Capitan**

Water stored at El Capitan Reservoir is released to meet water demands and is treated at Alvarado Water Treatment Plant and at Levy Water Treatment Plant, which provide water supply to the City of San Diego (Alvarado area), Helix Water District, and ECRTWIP. Water may also be released to Lake Jennings to maintain specified reservoir storage levels in Lake Jennings, and then subsequently released to Levy Water Treatment Plant. Releases from El Capitan are generally highest in March, then decline through November.
Monthly Average Reservoir Releases for El Capitan compared across all demand scenarios for current climate are shown in Figure 69. Under current climate, there appears to be minimal differences in Monthly Average Reservoir Releases at El Capitan between 2015, 2025, and 2050 demands for all Portfolios other than the Increase Supplies and Optimize Existing Facilities Portfolios. In the Increase Supplies Portfolio releases appear to be lower for 2050 demands than for 2025 and 2015 demands in May, and higher for 2050 demands than 2025 and 2015 demands from July to September. In the Optimize Existing Facilities Portfolio, Monthly Average Reservoir Releases appear to be similar for 2015 and 2025 demands but lower for 2050 demands than for 2025 demands from February to April, and higher for 2050 demands than for 2025 demands from October to December. This can be attributed to the San Diego Reservoir Intertie, discussed in Section 8.1.

Figure 69. Monthly average reservoir releases for El Capitan Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Releases for El Capitan compared across all climate scenarios for the 2050 demand scenario are shown in Figure 70. Climate scenarios do not appear to have a significant impact on Monthly Average Reservoir Releases at El Capitan for 2025 and 2050 demands. This is most likely due to a lack of difference in reservoir inflows between climate
scenarios. For reservoirs except for El Capitan, climate change results in a maximum 15% to 28% increase or decrease in natural inflows for the 2050s, depending on the scenario (See Table 30). For El Capitan, the maximum increase or decrease in natural inflows is 6%, or less than half of what is expected for other reservoirs. The lack of sensitivity in natural inflows to climate change results in lack of effect of climate change on Monthly Average Reservoir Releases.

Figure 70. Monthly average reservoir releases for El Capitan Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.2.3. Hodges

Reservoir releases from Hodges are treated at the Badger Water Treatment Plant, which serves San Dieguito and Santa Fe. Releases are also able to be routed to Miramar Water Treatment Plant. The Hodges Water Quality Improvement Program will allow for additional water supplies from Hodges to be used to meet regional demands such as Emergency Storage Project storage or seasonal pool storage in Olivenhain Reservoir. In the Baseline Portfolio, releases peak during summer months. When the Hodges Water Quality Improvement Program is implemented in the Baseline Plus Portfolio in 2050, releases are highest from March to June and September to December.
Monthly Average Reservoir Releases for Hodges compared across all demand scenarios for current climate are shown in Figure 71. Under current climate, there appear to be minimal differences in Monthly Average Reservoir Releases at Hodges between 2015, 2025, and 2050 demands in the Baseline Portfolio. Minimal differences in releases may be attributed to the low release capacity of the reservoir without the implementation of the Hodges Water Quality Improvement Program. In the Baseline Plus Portfolio and subsequent Portfolios, Monthly Average Reservoir Releases appear higher for 2050 demands than for 2025 and 2015 demands. This can be attributed to the Hodges Water Quality Improvement Program discussed in Section 8.15 which increases the release capacity of the reservoir.

![Figure 71. Monthly average reservoir releases for Hodges Reservoir for current climate for all demand scenarios and Portfolios.](image)

Monthly Average Reservoir Releases for Hodges compared across all climate scenarios for the 2050 demand scenario are shown in Figure 72. Climate scenarios do not appear to have an impact on Monthly Average Reservoir Releases at Hodges in the Baseline Portfolio for 2025 and 2050 demands and in the other Portfolios for 2025 demands. In the Baseline Plus and subsequent Portfolios for 2050 demands, Monthly Average Reservoir Releases appear higher for hot-wet climate and warm-wet climate than for central tendency climate and lower for hot-dry and warm-
dry climate than for central tendency climate, while central tendency climate appears similar to current climate.

Figure 72. Monthly average reservoir releases for Hodges Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.2.4. Loveland

Releases from Loveland are highest in January, then decline through February and are minimal from March to December in all Portfolios. Releases from Loveland are routed to Sweetwater Reservoir, and Sweetwater Reservoir releases are routed to Perdue Water Treatment Plant, which serves Sweetwater Authority.

Monthly Average Reservoir Releases for Loveland compared across all demand scenarios for current climate are shown in Figure 73. Under current climate, there appears to be minimal differences in Monthly Average Reservoir Releases at Loveland between 2015, 2025, and 2050 demands for all Portfolios, indicating that the projects included in the Baseline Plus and subsequent Portfolios do not have a noticeable impact on this reservoir.
Figure 73. Monthly average reservoir releases for Loveland Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Releases for Loveland compared across all climate scenarios for the 2050 demand scenario are shown in Figure 74. Climate scenarios appear to impact Monthly Average Reservoir Releases at Loveland in January while releases are occurring. Releases appear to be lower for hot-dry and warm-dry climates than central tendency climate and larger for hot-wet and warm-wet climates than central tendency climate, while current climate is similar to central tendency climate. In the remaining months, climate scenarios do not appear to have a significant impact on Monthly Average Reservoir Releases at Loveland for 2025 and 2050 demands.
Figure 74. Monthly average reservoir releases for Loveland Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.2.5. Lower Otay

Releases from Lower Otay are treated at the Otay Water Treatment Plant and are used to meet demands of the City of San Diego (Otay area) and the Cal-American Water Company, which, although it is not a SDCWA member agency, receives local surface water from the City of San Diego through a water rights settlement.

Monthly Average Reservoir Releases for Lower Otay compared across all demand scenarios for current climate are shown in Figure 75. Under current climate, Monthly Average Reservoir Releases at Lower Otay appear higher for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands. The Monthly Average Reservoir Releases appear higher in the Baseline Plus Portfolio and subsequent Portfolios than in the Baseline Portfolio for 2025 and 2050 demands. This can be attributed to the Mission Trails Projects Alternative 1 project which increases the amount of imported water that can be delivered to the southern portion of San Diego County, thereby increasing the amount that can be released from Lower Otay Reservoir. In the Optimize Existing Facilities Portfolio, the Dulzura Conduit Replacement
project also contributes to the increased releases from Lower Otay Reservoir (since there is more water being supplied to Lower Otay via the Dulzura Conduit, more water can be released).

Figure 75. Monthly average reservoir releases for Lower Otay Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Releases for Lower Otay compared across all climate scenarios for the 2050 demand scenario are shown in Figure 76. Although there appear to be minimal differences between climate scenarios for 2025 demands, climate scenarios have an impact on Monthly Average Reservoir Releases at Lower Otay for 2050 demands.

In the Baseline Portfolio, releases appear to be higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climates, with minimal differences between current climate and central tendency climate (see Figure 76). In the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios, releases appear lower for hot-dry and warm-dry climates than for central tendency climate from May to October but similar between central tendency climate and other climate scenarios. In the Increase Supplies Portfolio for 2050 demands, releases appear higher for hot-wet climate and warm-wet climate than for central tendency climate throughout the entire year,
while releases for hot-dry and warm-dry climates appear lower. In the Optimize Existing Facilities Portfolio releases appear lower for hot-dry climate from May to October as well, but releases for warm-dry climate only appear lower from May to July.

![Monthly Average Reservoir Releases - Lower Otay Reservoir](image)

**Figure 76.** Monthly average reservoir releases for Lower Otay Reservoir for 2050 demands for all Portfolios and climate scenarios.

### 7.1.5.2.6. Miramar

Releases from Miramar are treated at the Miramar Water Treatment Plant and used to serve the City of San Diego (Miramar and SD 11 areas). In the Baseline Portfolio, these releases only occur between August and December. In the Baseline Plus Portfolio in 2025, Pure Water San Diego Phase 1 is implemented which increases the amount of water supply stored at Miramar, thereby increasing the demands from this source. In the Baseline Plus and subsequent Portfolios, reservoir releases are highest in November and December and lowest in June but occur throughout the entire year.

Monthly Average Reservoir Releases for Miramar compared across all demand scenarios for current climate are shown in Figure 77. In the Baseline Portfolio under current climate, there are almost no reservoir releases from Miramar Reservoir from January to July for 2015, 2025, and
2050 demands. From August to November, current climate Baseline Portfolio releases are lower for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands in the Baseline Portfolio. In the Baseline Plus and subsequent Portfolios, Monthly Average Reservoir Releases are higher for both 2025 and 2050 demands than for 2015 demands due to implementation of Pure Water San Diego Phase 1 discussed in Section 8.9 which delivers approximately 30 mgd of supply to Miramar Reservoir and therefore allows more water supply to come from Miramar Reservoir. Releases appear significantly higher in the Baseline Plus and subsequent Portfolios than in the Baseline Portfolio for this reason.

![Figure 77. Monthly average reservoir releases for Miramar Reservoir for current climate for all demand scenarios and Portfolios.](image)

Monthly Average Reservoir Releases for Miramar compared across all climate scenarios for the 2050 demand scenario are shown in Figure 78. Climate scenarios appear to have some effect on Monthly Average Reservoir Releases at Miramar. In the Baseline Portfolio, releases appear lower for central tendency and hot-wet and warm-wet climate scenarios than for current climate and hot-dry and warm-dry climate scenarios from August to December (releases are close to zero for central tendency and hot-wet and warm-wet climate scenarios) for both 2025 demands. For 2050 demands, releases appear lower for only hot-wet and warm-wet climate scenarios than for
central tendency climate, current climate and hot-dry and warm-dry climate scenarios from August to December (releases are close to zero for hot-wet and warm-wet climate scenarios). In the Baseline Plus and subsequent Portfolios there appear to be minimal differences between climate scenarios for 2025 demands, but for 2050 demands, releases appear lower for warm-wet climate and higher for hot-dry than other climates scenarios in November and December.

![Graph](image-url)

**Figure 78.** Monthly average reservoir releases for Miramar Reservoir for 2050 demands for all Portfolios and climate scenarios.

### 7.1.5.2.7. Morena

Releases from Morena are transferred to Barrett Reservoir. As discussed in Section 7.1.5.2.1, releases from Barrett are transferred to Lower Otay via the Dulzura Conduit, and releases from Lower Otay are treated at Otay Water Treatment Plant to meet demands of the City of San Diego (Otay area) and the Cal-American Water Company. Releases are highest in January and low for the remainder of the year.

Monthly Average Reservoir Releases for Morena compared across all demand scenarios for current climate are shown in Figure 79. In the Baseline Portfolio Under current climate, there
appear to be minimal differences in Monthly Average Reservoir Releases at Morena between 2015, 2025, and 2050 demands for all Portfolios.

Figure 79. Monthly average reservoir releases for Morena Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Releases for Morena compared across all climate scenarios for the 2050 demand scenario are shown in Figure 80. Climate scenarios do not appear to have a significant impact on Monthly Average Reservoir Releases at Morena for 2025 and 2050 demands, although hot-dry and warm-dry climates appear to have slightly lower releases from June to December (as well as January to March in 2050) and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.
7.1.5.2.8. **Olivenhain**

Releases from Olivenhain are treated at the Olivenhain (McCollom) Water Treatment Plant, which serves Olivenhain. Releases from Olivenhain may also be transferred to Hodges Reservoir from May to December, although these releases are not accounted for in this metric.

Monthly Average Reservoir Releases for Olivenhain compared across all demand scenarios for current climate are shown in Figure 81. Under current climate, Monthly Average Reservoir Releases at Olivenhain appear lower for 2025 demands than for 2015 demands from May to October and lower for 2050 demands than for 2025 demands from May to November in the Baseline Portfolio. In the Baseline Plus and subsequent Portfolios, Monthly Average Reservoir Releases appears similar for 2025 demands and 2015 demands and lower for 2050 demands than for 2025 and 2015 demands (although this is only the case from September to June for the Increase Supplies Portfolio and from October to May in the Optimize Existing Facilities Portfolio).
Monthly Average Reservoir Releases for Olivenhain compared across all climate scenarios for the 2050 demand scenario are shown in Figure 82. Climate scenarios appear to have some impact on Monthly Average Reservoir Releases at Olivenhain. There appear to be minimal differences between climate scenarios in the Enhanced Conservation and Increase Supplies Portfolios, but in the Baseline, Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios for both 2025 and 2050 demands, releases appear to be lower with hot-dry and warm-dry climate than with central tendency climate. This occurs from April to December for 2025 demands and for the entire year for 2050 demands in the Baseline Portfolio, and from May to October for 2025 demands and April to November for 2050 demands in the Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios. In the Optimize Existing Facilities Portfolio both hot-dry climate and warm-dry climate appear lower than central tendency climate from May to October for 2025 demands, but only hot-dry climate appears lower than central tendency climate for 2050 demands (from April to December).
7.1.5.2.9. **San Vicente**

Releases from San Vicente are used to meet regional demands and are treated at Alvarado, Levy, and Miramar Water Treatment Plants, which serve the City of San Diego, Helix Water District, and ECRTWIP. In all Portfolios and demands except for 2050 demands in the Increase Supplies Portfolio, releases peak in September and are steady for the remainder of the year. In the Increase Supplies Portfolio, releases are significantly larger in 2050 due to implementation of Pure Water San Diego Phase 2, and peak in May and June.

Monthly Average Reservoir Releases for San Vicente compared across all demand scenarios for current climate are shown in Figure 83. Under current climate, there appears to be minimal differences in Monthly Average Reservoir Releases at San Vicente for 2015, 2025, and 2050 demands in the Baseline Portfolio. In the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios, Monthly Average Reservoir Releases appear to be lower for 2025 and 2050 demands than for 2015 demands in May but similar for the remainder of the year. In the Increase Supplies Portfolio, Monthly Average Reservoir Releases appear significantly higher for 2050 demands than for
2025 and 2015 demands due to implementation of Pure Water San Diego Phase 2, discussed in Section 8.9, which is anticipated to send 59,400 AF/y (53 mgd) to San Vicente Reservoir for water supply use.

Figure 83. Monthly average reservoir releases for San Vicente Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Releases for San Vicente compared across all climate scenarios for the 2050 demand scenario are shown in Figure 84. Climate scenarios have an impact on Monthly Average Reservoir Releases in all Portfolios, with lower releases for hot-dry and warm-dry climate than central tendency climate and higher releases for hot-wet and warm-wet climate than central tendency climate. This occurs from January to August in all Portfolios for 2025 demands and from January to September in all Portfolios except Enhanced Conservation, where the differences occur from November to August for 2050 demands. For 2050 demands, releases appear slightly higher for hot-dry climate than for central tendency climate from October to December in the Baseline Portfolio and in October for the Baseline Plus, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. In the Increase Supplies Portfolio for 2050 demands, releases appear higher for hot-wet and warm-wet climates and lower for hot-dry and warm-dry climates from May to September.
Figure 84. Monthly average reservoir releases for San Vicente Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.2.10. Sweetwater

Sweetwater Reservoir releases peak in June then steadily decline through May. They are routed to Perdue Water Treatment Plant, which serves Sweetwater Authority.

Monthly Average Reservoir Releases for Sweetwater compared across all demand scenarios for current climate are shown in Figure 85. Under current climate, Monthly Average Reservoir Releases at Sweetwater appear lower for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands from June to August, and lower for both 2025 and 2050 demands than for 2015 demands in January, in the Baseline, Baseline Plus, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. This decrease in releases from 2015 to 2025 followed by an increase from 2025 to 2050 corresponds to a decrease in demands from 2015 to 2025 for Sweetwater Authority (which represents the City of National City and South Bay Irrigation District) followed by an increase in demands from 2025 to 2050 (demands based on projected populations). In the Enhanced Conservation Portfolio, Monthly Average Reservoir Releases appear lower for both 2025 and 2050 demands than for 2015 demands from June to August. The decreased releases from Sweetwater Reservoir

218
for 2050 demands in the Enhanced Conservation Portfolio are most likely due to reduced demands.

Figure 85. Monthly average reservoir releases for Sweetwater Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Releases for Sweetwater compared across all climate scenarios for the 2050 demand scenario are shown in Figure 86. Climate scenarios appear to have an impact on Monthly Average Reservoir Releases at Sweetwater for 2050 demands, but only a slight impact for 2025 demands. For 2025 demands, releases appear slightly lower for hot-dry and warm-dry climates from September to December in all Portfolios except for Enhanced Conservation. For 2050 demands, releases appear higher for hot-wet and warm-wet climates and lower for hot-dry and warm-dry climates in all Portfolios.
Figure 86. Monthly average reservoir releases for Sweetwater Reservoir for 2050 demands for all Portfolios and climate scenarios.

7.1.5.2.11. Wohlford
Wohlford releases peak in March, followed by additional, smaller peaks in October and January. Wohlford releases are treated at the Escondido Water Treatment Plant, which serves the City of Escondido and Vista Irrigation District.

Monthly Average Reservoir Releases for Wohlford compared across all demand scenarios for current climate are shown in Figure 87. Under current climate, there appear to be minimal differences in Monthly Average Reservoir Releases at Wohlford between 2015, 2025, and 2050 demands for the Baseline, Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. In the Enhanced Conservation and Increase Supplies Portfolios, releases appear lower for 2050 demands than for 2025 and 2015 demands from January to March and higher for 2050 demands than for 2025 and 2015 demands from April to May in the Enhanced Conservation Portfolio and from April to September in the Increase Supplies Portfolio. This indicates that water supply from Wohlford Reservoir may be lower in the Enhanced Conservation and Increase Supplies Portfolios at the beginning of the year but
higher in the spring for Enhanced Conservation and higher in the spring and summer for Increase Supplies.

Figure 87. Monthly average reservoir releases for Wohlford Reservoir for current climate for all demand scenarios and Portfolios.

Monthly Average Reservoir Releases for Wohlford compared across all climate scenarios for the 2050 demand scenario are shown in Figure 88. Climate scenarios have an impact on Monthly Average Reservoir Releases at Wohlford in all Portfolios, with higher releases for hot-wet and warm-wet climates than for central tendency climate and lower releases for hot-dry and warm-dry climates than for central tendency climate. In most Portfolios this impact is only observed during the first half of the year, but for 2050 demands in the Increase Supplies Portfolio, this impact is observed for a majority of the year.
7.1.5.3 End of September Storage

The End of September Storage metric (Box 20) is a measure of reservoir carryover storage that can be used for supply in the next year. End of September Storage is used because September is at the end of summer, which is the season with the highest water demands. End of September Storage is calculated for five reservoirs: El Capitan, Hodges, Lower Otay, Olivenhain, and San Vicente. For reservoirs with a designated carryover pool (see Section 4.2.1) (Hodges, Olivenhain, and San Vicente), the carryover pool describes the minimum volume of water that should be carried over from year to year. For reservoirs with no designated carryover pool (El Capitan and Lower Otay), water may be carried over in the seasonal pool. Seasonal pool storage can also supplement carryover storage in reservoirs with a designated carryover pool. For some reservoirs, a portion of the volume in the carryover pool is made up of emergency storage that is only available in drought situations and/or dead pool volume that cannot be accessed for normal water supply.

Overall, End of September Storage is above the carryover pool (if it exists) or above the emergency storage and within the seasonal pool (if there is no designated carryover pool) for all
reservoirs, except for San Vicente which is above the emergency storage pool but below the carryover pool. Climate scenarios have no or limited impacts on End of September Storage. Although it might be expected that there would be more visible effects of climate change (e.g., End of September Storage would be lower for hot-dry and warm-dry climates and higher for warm-wet and hot-wet climate than central tendency climate), this is not necessarily the case. The lack of effect of climate change is likely due to the availability of diverse supply sources that enable reservoir operations to follow the rule curves while the overall system meets demands. Some scenarios may have somewhat higher or lower storage due to increases or decreases in precipitation, but all reservoirs meet the operational targets of the rule curves in all scenarios.

### 7.1.5.3.1. El Capitan

El Capitan has no designated carryover pool. Its seasonal pool is 50,773 AF in September for all Portfolios and scenarios except Optimize Existing Facilities for 2050 demands, in which the seasonal pool is 111,707 AF in September. The emergency storage pool is 23,677 AF in September and dead pool is 2,280 AF.

Average End of September Storage at El Capitan for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 89. Under current climate, there are no differences in End of September Storage between demand scenarios in the Baseline, Baseline Plus, Enhanced Conservation, or Watershed Health and Ecosystem Restoration Portfolios, but there is statistical evidence based on the ANOVA analysis that End of September Storage is slightly higher in the Increase Supplies Portfolio and significantly higher in the Optimize Existing Facilities Portfolio for 2050 demands. For all Portfolios, El Capitan End of September Storage averages 25,000 AF for 2015 demands, 24,000 AF for 2025 demands, and 24,000 for 2050 demands, except for the Increase Supplies Portfolio (average of 27,000 AF) and Optimize Existing Facilities Portfolio (average of 52,000 AF). Water volume above the emergency storage pool is stored in the seasonal pool. The somewhat greater carryover storage in the Increase Supplies Portfolio may be attributable to that Portfolio’s wider range of water supply sources, which may reduce the system’s need to draw water from El Capitan. The much greater carryover storage in Optimize Existing Facilities Portfolio can be attributed to the San Diego Reservoir Intertie, discussed in Section 8.1, which lifts the DSOD restriction on reservoir storage capacity and enables imported water to be conveyed to El Capitan, making it possible for more water to be stored at El Capitan.

Climate scenarios do not appear to have a significant impact on End of September Storage in El Capitan (Figure 89). There is no statistical evidence based on the ANOVA analysis of differences in End of September Storage between the current climate and central tendency climate, and there is no statistical evidence of a difference in End of September Storage between the central tendency climate and any other future climate scenarios.
Figure 89. End of September Storage at El Capitan for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.1.5.3.2. Hodges

Hodges carryover pool is 10,385 AF for June through January and 13,433 AF in February, April, and May. Of that volume, none is designated as emergency storage and 5,590 AF is dead pool. Hodges End of September Storage averages 22,000 AF for all Portfolios for the 2015 demand scenario as well as for all Portfolios for 2025 demands and for the Baseline Portfolio for 2050 demands. End of September Storage averages 17,000 AF for the remaining Portfolios for 2050 demands. In all cases, the End of September Storage is significantly above the designated carryover pool. This could indicate an opportunity to make more water available to meet demands, if other operational constraints such as release capacity limitations were modified.
for 2050 demands than 2015 and 2025 demands. This decrease can be attributed to the Hodges Water Quality Improvement Project as discussed in Section 8.15 which improves water quality and, thus, enables more water to be stored at Hodges to be used to meet regional demands. Because all Baseline Plus projects are included in the other Portfolios besides Baseline, the lower End of September Storage in 2050 is also be observed in the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios.

In all Portfolios and scenarios, including the 2050 scenarios for Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration that include the Hodges Water Quality Improvement Program project, the End of September Storage is significantly above the designated carryover pool (Figure 90). This could indicate a further opportunity to make more water available from Hodges to meet demands by further modification of Hodges operations, if downstream conveyance capacity was available and member agencies had sufficient demand.

Climate scenarios do not appear to have a significant impact on End of September Storage in Hodges (Figure 90). There is no statistical evidence based on the ANOVA analysis of differences in End of September Storage between the current climate and central tendency climate, and there is no statistical evidence of a difference in End of September Storage between the central tendency climate and any of the other climate scenarios.
7.1.5.3.3. Lower Otay

Lower Otay has no designated carryover pool. The seasonal storage pool is 45,237 AF, the emergency storage pool is 34,225 AF, and dead pool is 3,730 AF in September. In all Portfolios for 2015 demands, Lower Otay End of September Storage averages 38,000 AF. End of September Storage also averages approximately 38,000 AF for the Baseline Portfolio for 2025 demands, and averages 42,000 AF for all other Portfolios for 2025 demands. End of September Storage averages 36,000 AF for the Baseline Portfolio in 2050 demands, and averages between 40,000 AF and 44,000 AF for the other Portfolios for 2050 demands. All values are above the designated emergency storage pool and within the seasonal pool.

Average End of September Storage at Lower Otay for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 91. Under current climate, there is no statistical evidence based on the ANOVA analysis of differences in End of September Storage between demand scenarios in the Baseline Portfolio. In the Baseline Plus Portfolio, there is
statistical evidence that End of September Storage is higher for 2025 demands than for 2015 demands. This can be attributed to the Mission Trails Projects Alternative 1 project, which increases the amount of imported water that can be delivered to the southern portion of San Diego County, thereby increasing the available amount to be stored in Lower Otay Reservoir. Since Baseline Plus projects appear in all other portfolios beyond Baseline, the higher storage is also seen in Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. The differences between 2025 demands and 2050 demands vary across portfolios, with statistical evidence of higher End of September Storage in 2050 demands than in 2025 demands for Enhanced Conservation and Optimize Existing Facilities Portfolios. In the Enhanced Conservation Portfolio, this can be attributed to the Enhanced Conservation Concept (see Section 8.3) in the Enhanced Conservation Portfolio, and in the Optimize Existing Facilities Portfolio this can be attributed to the Dulzura Conduit Replacement, which improves conveyance of releases from Barrett Reservoir to Lower Otay (see Section 8.1). No difference was found between 2025 and 2050 demands for Baseline Plus, Increase Supplies, and Watershed Health and Ecosystem Restoration Portfolios.

Climate scenarios do not appear to have a significant impact on End of September Storage in Lower Otay (Figure 91). There is generally no statistical evidence based on the ANOVA analysis of differences in End of September Storage between current climate and central tendency climate for the 2020s or 2050s, with the exception of 2050 demands in the Optimize Existing Facilities Portfolio where storage is higher under current climate than under central tendency climate. There is also generally no statistical evidence of differences between End of September Storage for central tendency climate compared to the other future climate scenarios, with exception of the Increase Supplies and Optimize Existing Facilities Portfolios. In both of these Portfolios storage is lower with hot-dry climate than central tendency climate, and in the Increase Supplies Portfolio, storage is higher with hot-wet and warm-wet climate than with central tendency climate.
Figure 91. End of September Storage at Lower Otay for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.1.5.3.4. Olivenhain

Olivenhain carryover pool has a value of 20,288 AF in September. All of the carryover is designated as emergency storage, and its dead pool volume is 43 AF. For 2015 demands across all Portfolios, Olivenhain End of September Storage averages 24,000 AF. For 2025 demands and current climate, End of September Storage averages 22,000 AF for the Baseline Portfolio and slightly higher (23,000 to 24,000 AF) for all other Portfolios. For 2050 demands and current climate, End of September Storage averages 21,000 for the Baseline Portfolio, 22,000 for the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios, and 24,000 AF for the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios.

Average End of September Storage at Olivenhain for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 92. Under current climate, there is statistical evidence based on the ANOVA analysis that End of September Storage is lower for 2025 than for 2015 and lower for 2050 than for 2025 in the Baseline, Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios for the 2020s and 2050s. This difference
does not appear in the Enhanced Conservation or Increase Supplies Portfolio between 2015 and 2025 demand scenarios, but it is present between the 2025 and 2050 demand scenarios. There is also statistical evidence of differences in End of September Storage in the Optimize Existing Facilities Portfolio between 2015, 2025, and 2050 demands.

Climate scenarios have some impact on End of September Storage in Olivenhain as discussed in Section 7.1.5.3 depending on Portfolio and demand scenario (Figure 92). For the Baseline and Optimize Existing Facilities Portfolios for 2050 demands, there is statistical evidence based on the ANOVA analysis that End of September Storage in the hot-dry scenario is lower than the central tendency climate, but only some or no statistical evidence of other differences in other Portfolios.

![Figure 92. End of September Storage at Olivenhain for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.](image)

7.1.5.3.5. **San Vicente**
San Vicente carryover pool ranges from 187,763 AF in January to 210,397 AF in July, with a value of 202,165 AF in September. This represents 100,000 AF of designated carryover storage.
volume in every month, plus emergency storage volume ranging from 82,535 AF in January to 105,169 AF in July, and dead pool of 5,228 AF. San Vicente End of September Storage averages 110,000 AF in the 2015 demand current climate scenario for all Portfolios. This is above the emergency storage pool, but below the designated carryover pool, indicating that San Vicente has additional capacity for carryover storage that is not being used.

Average End of September Storage at San Vicente for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 93. Although the average values are slightly different between Portfolios, under current climate there is no statistical evidence based on the ANOVA analysis of a difference in End of September Storage for 2015, 2025, and 2050 demands for San Vicente in the Baseline, Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. There is also no statistical evidence of a difference in End of September Storage between 2015 demands and 2025 demands for Enhanced Conservation and Increases Supplies, but there is statistical evidence that End of September Storage is higher for 2050 demands than for 2025 demands in Enhanced Conservation and Increased Supplies, with an average value of 118,000 AF in the Enhanced Conservation Portfolio and 132,000 AF in the Increase Supplies Portfolio for 2050 demands.

Climate scenarios appear to have a mixed impact on End of September Storage in San Vicente (Figure 93). There is no statistical evidence based on the ANOVA analysis of a difference between current climate and central tendency climate for 2020s or 2050s, but hot-dry and warm-dry climates generally have lower End of September Storage than central tendency for the 2020s and 2050s. Based on inspection of plots, hot-wet and warm-wet climates appear to generally have higher End of September Storage than central tendency climates for the 2020s and 2050s, but ANOVA analysis indicates that only some of the differences are supported by ANOVA p-values between 0.05 and 0.07.
Figure 93. End of September Storage at San Vicente for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.2. Energy

Energy is used for conveying water supplies through pipelines by pumping, for treating raw water for potable use, for treating wastewater for non-potable or potable reuse, and for desalinating seawater. As described in Section 4.3.2 and Appendix C – Energy Consumption and Generation Model Implementation, the Energy Generation metric (Box 21) measures energy generated at seven facilities associated with the water system: Miramar, Alvarado, and Twin Oaks Valley Water Treatment Plants; the Rancho Peñasquitos Hydroelectric Facility and Hodges Pump Storage Hydroelectric Facility; and the SDCWA offices in San Diego and Escondido. As described in Section 4.3.2 and Appendix C – Energy Consumption and Generation Model Implementation, the Energy Consumption metric (Box 22) measures the energy consumed to treat and deliver water, including consumption by supply sources, conveyance, treatment, pumped storage, and offices. Energy generation at water system facilities can offset some of the consumption by facilities in the water system.
Average Annual Energy Consumption for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 94. Annual Energy Consumption for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario, and Average Annual Energy Generation can be seen in Appendix D – Detailed Model Results. In all Portfolios for 2015 demands and current climate, modeled energy generation offsets about 4% of the modeled consumption for the San Diego region, with average annual generation of approximately 76,000 MWh and average annual consumption of approximately 1,732,000 MWh. For both 2025 demands and 2050 demands across all climate scenarios, the highest energy consumption occurs in the Baseline Portfolio (2,115,645 MWh average annual consumption for 2050 demands and current climate) and the lowest occurs in the Enhanced Conservation Portfolio (1,549,046 MWh average annual consumption for 2050 demands and current climate), followed by the Increase Supplies Portfolio (1,859,337 MWh average annual consumption for 2050 demands and current climate). Average annual consumption for the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios (approximately 2,025,000 MWh for current climate) is lower than consumption in the Baseline for current climate and central tendency climate, but similar to the Baseline with hot-dry climate for 2050 demands.
Figure 94. Annual Energy Consumption for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

A comparison of Average Annual Generation and Consumption for the Baseline, Enhanced Conservation, and Increase Supplies Portfolios compared across all demand scenarios for current climate is shown in Figure 95. Under current climate, there is statistical evidence based on the ANOVA analysis that Energy Generation is higher in the Baseline Portfolio than all other Portfolios for both 2025 and 2050 demands; however, these differences are minimal compared to the order of magnitude of the Energy Generation. In the Baseline Portfolio, Energy Consumption is larger for 2025 demands (1,930,090 MWh average annual consumption) than for 2015 demands and larger for 2050 demands (2,115,645 MWh average annual consumption) than for 2025 demands, which may be attributed to increased demand and energy needed to treat and convey water to a growing population. Consumption is also larger for 2025 and 2050 demands than for 2015 demands in the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. However, there is no difference in consumption between 2015 and 2025 demands in the Enhanced Conservation Portfolio, and 2050 demands are lower than 2025 demands. In the Increase Supplies Portfolio, Energy Consumption is higher for 2025 demands than for 2015 demands yet there is no difference between 2025 and 2050 demands.
The lower energy consumption in the Enhanced Conservation Portfolio (Figure 95) indicates that demand is a major driver of energy consumption; when demands on the system are smaller due to the Enhanced Conservation project, energy consumption decreases. Reduced water demand in the Enhanced Conservation Portfolio translates into reduced need for imported water and lower utilization of water conveyance facilities and treatment plants (see Section 8.3), and thus, reduced energy consumption. The lower energy consumption in the Increase Supplies Portfolio (Figure 95) indicates that the additional supply projects implemented in that Portfolio, such as Pure Water Phase 2 and additional Recycled Water and Groundwater Projects, do not necessarily increase energy consumption, and in fact may be able to provide water using equal or less energy than supply sources such as imported water in the Baseline Portfolio. Offsetting some supply volume with a lower energy intensive supply option reduces the energy required to meet the demand. Also, shifting the water supply mix to locally controlled supplies enables the energy supply mix of projects as well as the potential to incorporate energy generation into projects to be considered as part of regional project planning and design, rather than dependent on external decision-makers.

Figure 95. Energy Generation and Energy Consumption compared across 2015, 2025, and 2050 demand scenarios for current climate.

A comparison of Average Annual Generation and Consumption for the Baseline Portfolio compared across all demand scenarios and all climate scenarios is shown in Figure 96. Climate
scenarios appear to have a slight impact on energy consumption, with consumption increasing between current climate and all future climate scenarios based on the ANOVA analysis. In all Portfolios energy consumption was lower with current climate than with central tendency climate, but there was no statistical evidence of differences between central tendency and hot-wet, hot-dry, warm-wet, or warm-dry climates for either 2020s climate or 2050s climate.

![Energy Generation and Consumption for Water Supply - Current Climate](image)

**Figure 96. Energy Generation and Consumption for the Baseline Portfolio for all demand and climate scenarios.**

### 7.3. Recreation

Impacts to Recreation are measured by boat ramp accessibility at the end of September for four reservoirs popular with recreational users. When the End of September Elevation metric (Box 23) is greater than the boat ramp elevation, the boat ramp is considered accessible. Water demands are highest during the summer months, so End of September Elevation is a measure of reservoir elevation when there is typically less storage. Recreation impacts were evaluated at El Capitan, Hodges, Lower Otay, and San Vicente. Both individual realizations and the average for all realizations are evaluated.
Overall, End of September elevation varies between Portfolios for all reservoirs, but significant recreation impacts as measured by boat ramp inaccessibility only occur for El Capitan and Lower Otay Reservoirs, and recreation is impacted to a very limited extent for Hodges Reservoir. At El Capitan, as many as 88% of realizations have End of September Elevation below the boat ramp in the Baseline Portfolio. The impacts are improved somewhat in the Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios, improved somewhat more by the Enhanced Conservation and Increase Supplies Portfolio, and eliminated in the Optimize Existing Facilities Portfolio. For Lower Otay, up to 45% of realizations have End of September Reservoir Elevation below the boat ramp. This is improved in all Portfolios and completely eliminated in the Enhanced Conservation Portfolio. At Hodges there were no realizations below the boat ramp elevation in the Baseline Portfolio; however, up to 1.2% of realizations were below the boat ramp elevation in 2050 for the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. Reservoir elevation never drops below the boat ramp for San Vicente. Individual reservoirs are described below in Sections 7.3.1 through 7.3.4.

7.3.1. El Capitan
The boat ramp elevation for El Capitan was modeled at 663 feet above sea level. The percent of realizations below the boat ramp at El Capitan for all Portfolios compared across all climate scenarios for the 2050 demand scenario is shown in Figure 97. Under current climate, simulated El Capitan average End of September water elevation is at or above the actual boat ramp elevation (i.e., accessible) in all Portfolios for 2015 demands, and in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios for 2050 demands. For 2025 demands, the average End of September Elevation is lower than the boat ramp elevation for all Portfolios, making the boat ramp inaccessible. For 2050 demands, average El Capitan End of September Elevation is slightly higher than the boat ramp elevation in the Enhanced Conservation Portfolio and the Increase Supplies Portfolio for 2050 demands, and significantly higher in the Optimize Existing Facilities Portfolio. These results indicate that reduced demands, an increase in water supply sources, and conveyance flexibility all have a positive impact on recreation. Looking at individual realizations instead of averages leads to similar results. Boat ramps at El Capitan reservoir are inaccessible in many realizations (between 61-81% of realizations) for 2015, 2025, and 2025 demands in all Portfolios except the Optimize Existing Facilities Portfolio. In the Optimize Existing Facilities Portfolio, there are no realizations below the El Capitan boat ramp elevation in 2050. The higher average End of September Elevation in Increase Supplies may be attributable to the Increase Supplies Portfolio’s wider range of water supply sources which may reduce the system’s need to draw water from El Capitan. The much greater average End of September Elevation in Optimize Existing Facilities can be attributed to the San Diego Reservoir Intertie as discussed in Section 8.1.
Average End of September Elevation at El Capitan for all Portfolios compared to the boat ramp elevation across all demand scenarios for selected climate scenarios is shown in Figure 98. Climate scenarios do not appear to have a significant impact on average End of September Elevation at El Capitan based on the ANOVA analysis. There is no statistical evidence of differences in average End of September Elevation between the current climate and central tendency climate, and there is no statistical evidence of a statistical difference between central tendency climate and any of the other climate scenarios for the ANOVA analysis. Based on observations, however, the boat ramp is inaccessible under current climate and central tendency climate scenarios for 2025 demands in the Increase Supplies and Enhanced Conservation Portfolios, but is accessible in the hot-dry climate scenario for these Portfolios.
Figure 99. End of September Elevation and Boat Ramp Accessibility at El Capitan for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.3.2. Hodges
The Boat Ramp Elevation for Hodges Reservoir was modeled at 292 feet above sea level. The percent of realizations below the boat ramp at Hodges for all Portfolios compared across all climate scenarios for the 2050 demand scenario is shown in Figure 99. On average, boat ramps at Hodges remain accessible for all demand scenarios in all Portfolios, with exceptions in individual realizations in the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. In the Optimize Existing Facilities Portfolio, there is one realization in the hot-dry scenario and one realization in the warm-dry scenarios that are below the boat ramp elevation. The Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios each have one realization below the boat ramp for central tendency, hot-dry, and warm-dry climates.
Average End of September Elevation at Hodges for all Portfolios compared to the boat ramp elevation across all demand scenarios for selected climate scenarios is shown in Figure 100. Under current climate, there are no differences in Hodges average End of September Elevation between demand scenarios for the Baseline Portfolio. However, for the Baseline Plus Portfolio, the elevation is lower for 2050 demands than for 2015 or 2025 demands. This decrease can be attributed to the Hodges Water Quality Improvement Project as discussed in Section 8.15. Because all Baseline Plus projects are included in all Portfolios besides Baseline, the lower average End of September Elevation in 2050 is also observed in the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios.

Climate scenarios do not appear to have a significant impact on End of September Elevation at Hodges based on the ANOVA analysis. There is no statistical evidence of differences in the average End of September Elevation between the current climate and central tendency climate, and there is no statistical evidence of a difference between central tendency climate and any of the other climate scenarios.
Figure 100. End of September Elevation and Boat Ramp Accessibility at Hodges for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.3.3. Lower Otay

The Boat Ramp Elevation for Lower Otay was modeled at 465.7 feet above sea level. The percent of realizations below the boat ramp at Lower Otay for all Portfolios compared across all climate scenarios for the 2050 demand scenario is shown in Figure 101. All Baseline Portfolio runs have some realizations when End of September Reservoir Elevation is below the boat ramp elevation (25-33% for 2025 demands and 26-45% for 2050 demands). This is improved in all Portfolios and completely eliminated in the Enhanced Conservation Portfolio. Interestingly, the Increase Supplies Portfolio shows an improvement compared to Baseline but is worse than Baseline Plus. Since there is more supply diversity in Increase Supplies, it might be expected that Increase Supplies would be equal or better for recreation than Baseline Plus. However, based on the ANOVA analysis, there is only statistical evidence that average End of September Reservoir Elevation is lower at Lower Otay in Increase Supplies compared to Baseline Plus (i.e., more realizations below the boat ramp in Increase Supplies). This indicates that the combination of projects in the Increase Supplies Portfolio results in lower End of September Reservoir Elevation in some years (see Figure 102).
In the Increase Supplies Portfolio, there are no realizations below the boat ramp for 2025 climate, but there are some realizations below the boat ramp for 2050 current climate, central tendency, hot-dry, and warm-dry climate and one realization below the boat ramp elevation for 2050 hot-wet and warm-wet climate. The remaining realizations are above the boat ramp elevation.

Figure 101. Percent of realizations with Lower Otay Reservoir Elevation below the boat ramp elevation for 2050 demands across all climate scenarios and Portfolios.
Figure 102. Lower Otay Reservoir Elevation compared to the boat ramp elevation for 2050 demands for Baseline Plus and Increase Supplies Portfolios.

Average End of September Elevation at Lower Otay for all Portfolios compared to the boat ramp elevation across all demand scenarios for selected climate scenarios is shown in Figure 102. Under current climate, there are no differences in Lower Otay average End of September Elevation between demand scenarios for the Baseline Portfolio; however, the elevation is significantly higher in 2025 and 2050 demands than 2015 demands for the Baseline Plus Portfolio. This can be attributed to the Mission Trails Projects Alternative 1 project which increases the amount of imported water that can be delivered to the southern portion of San Diego County, increasing the amount that can be stored in Lower Otay Reservoir. Because all Baseline Plus projects are included in the other Portfolios besides Baseline, the higher average End of September Elevation in 2025 and 2050 is also observed in the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. Additional projects in the Enhanced Conservation (Enhanced Conservation Concept) and Optimize Existing Facilities Portfolios (Dulzura Conduit Replacement, which improves conveyance from Barrett to Lower Otay) increase the average End of September Elevation further in 2050.

Climate scenarios have an impact on average End of September Elevation at Lower Otay in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios for 2050 demands based on the ANOVA analysis (Figure 102). In the Enhanced Conservation Portfolio, there is statistical evidence that elevation is higher for current climate than central tendency climate for 2050 demands. In the Increase Supplies Portfolio, hot-wet climate and warm-wet climate are higher than central tendency climate for 2050 demands. In the Optimize Existing Facilities Portfolio for 2050 demands, current climate is higher than central tendency climate, and hot-dry climate is lower than central tendency climate. In the Increase Supplies Portfolio,
hot-wet climate and warm-wet climate are higher than central tendency climate for 2050 demands.

Figure 103. End of September Elevation and Boat Ramp Accessibility at Lower Otay for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.3.4. San Vicente
The Boat Ramp Elevation for San Vicente was modeled at 640 feet above sea level. The percent of realizations below the boat ramp at San Vicente for all Portfolios compared across all climate scenarios for the 2050 demand scenario is shown in Figure 104. Boat ramps at San Vicente reservoir are accessible in all climate and demand scenarios for every Portfolio, but the end of September elevation is highest in the Increase Supplies Portfolio 2050 scenario.
Average End of September Elevation at San Vicente for all Portfolios compared to the boat ramp elevation across all demand scenarios for selected climate scenarios is shown in Figure 104. Under current climate, there are no differences in San Vicente End of September Elevation between demand scenarios for the Baseline, Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. However, the elevation is slightly higher for 2050 demands than 2025 demands for the Enhanced Conservation Portfolio, and significantly higher for 2050 demands than 2025 demands for the Increase Supplies Portfolio. The significant increase in the Increase Supplies Portfolio can be attributed to Pure Water San Diego Phase 2 as discussed in Section 8.9.

Climate scenarios have an impact on End of September Elevation at San Vicente in all Portfolios for both 2025 and 2050 demands (Figure 105). For 2025 demands in all Portfolios, there are no differences between current climate and central tendency climate, and hot-dry and warm-dry climates are lower than central tendency climate. In addition, warm-wet climate is higher than central tendency climate in the Baseline Portfolio for 2025 demands. For 2050 demands, there are no differences between End of September Elevation for current climate and central tendency climate.
climate in all Portfolios, and End of September Elevation for hot-dry climate is lower than for central tendency climate for all Portfolios. In addition, End of September Elevation for warm-dry climate is lower than End of September Elevation for central tendency climate in 2050 demands for the Baseline, Enhanced Conservation, and Increase Supplies Portfolios. Both hot-wet climate and warm-wet climate are higher than central tendency climate in the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios. Only hot-wet climate is higher than central tendency climate in the Enhanced Conservation Portfolio, and only warm-wet climate is higher than central tendency climate in the Baseline Portfolio.

Figure 105. End of September Elevation and Boat Ramp Accessibility at San Vicente for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.4. Flood Control

In the San Diego region, reservoir releases are primarily made in response to water delivery requests, and there are no required minimum outflows from reservoirs. Although reservoirs are primarily operated for water supply, during situations of high inflows or high reservoir storage resulting from storms, water may be released or spilled as flood outflows from the reservoir. In
the CWASim model, flood outflows occur when a reservoir’s storage is within the flood pool. Flood control impacts are measured by the Number of Days with Flood Outflows metric (Box 25) and by the Flood Outflow Volume metric (Box 24), which includes the volume released to meet demands and the additional flood outflow volume. Flood outflows may indicate constraints in the conveyance system to move water for optimal storage, as well as a lack of demand during high inflow periods. Larger flood outflow volumes indicate larger volumes of water that could not be stored in the reservoir. Larger numbers of days with flood outflows indicate higher frequency of insufficient storage volume. Flood outflows could represent an opportunity to capture additional local water supply. A high flood outflow volume may indicate high water loss.

Reservoirs evaluated for flood control impacts are El Capitan, Hodges, Lower Otay, San Vicente, and Olivenhain.

The overall impacts on flood control vary by reservoir due to the effects of specific projects or Concepts on those reservoirs. Flood impacts are only observed for El Capitan, Hodges, and Lower Otay Reservoirs. No flood outflows occur in any Portfolios at San Vicente or Olivenhain Reservoirs. At El Capitan, there are no differences between Portfolios or scenarios for 2025 demands, but there are more flood outflows in the Increase Supplies Portfolio most likely due to increased water supplies requiring storage, and fewer flood outflows in the Optimize Existing Facilities Portfolio most likely due to the San Diego Reservoir Intertie. For Hodges Reservoir, flood impacts are the same for all Portfolios for the 2015 and 2025 demand scenarios but differ in the 2050 demand scenarios due to the implementation of the Hodges Water Quality Improvement Program. At Lower Otay, flood outflows are increased in the Enhanced Conservation Portfolio most likely due to lower demand for water stored in the reservoir.

Specific results for each reservoir are described in Sections 7.4.1 through 7.4.4.

Climate change does not have a strong effect on flood control impacts, although inspections of the plots indicate some differences. For San Vicente and Olivenhain there are no flood outflows in any scenarios, so the impacts cannot be assessed. For El Capitan, Hodges, and Lower Otay, number of flood outflows and flood outflow volumes appear to vary between climate scenarios (see Figure 106), with lower flood outflow volumes for hot-dry and warm-dry climates and higher flood outflow volumes in warm-wet and hot-wet climates, and central tendency being somewhat similar to current climate. The observed differences at these reservoirs are not supported by the ANOVA analysis, which indicates no statistical evidence of a difference between current climate and central tendency climate or between central tendency climate and any other climate change scenarios. Variability and skew in the number of flood outflows and flood outflow volume are the likely cause of the lack of statistical significance based on ANOVA.
7.4.1. El Capitan
Average Annual Number of Days with Flood Outflows at El Capitan for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 107. Under current climate, there are no differences in the Average Number of Days with Flood Outflows at El Capitan between demand scenarios for the Baseline, Baseline Plus, Enhanced Conservation, and Watershed Health and Ecosystem Restoration Portfolios, while the Increase Supplies Portfolio is greater for 2050 demands than for 2025 and 2015 demands. The Average Number of Days with Flood Outflows is lower in 2050 demands than 2025 and 2015 demands for the Optimize Existing Facilities Portfolio which can be attributed to the San Diego Reservoir Intertie discussed in Section 8.1. The Intertie Project allows water to move out of El Capitan and into other storage basins including San Vicente and the Santee/El Monte groundwater basin, which prevents flood outflows and water loss by allowing for optimized reservoir management.

Average Annual Flood Outflow Volume at El Capitan for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 108. Under current climate, there are no statistical differences in the Average Annual Flood Outflow Volume at El Capitan.
between demand scenarios for any Portfolios. As characterized by the ANOVA analysis, climate scenarios do not have a statistically significant impact on either the Average Number of Days with Flood Outflows or the Average Annual Flood Outflow Volume at El Capitan, although visual inspection of the plots provides some indication that there may be differences. As discussed in Section 7.4, there is no ANOVA statistical evidence of differences in the Average Number of Days with Flood Outflows or the Average Annual Flood Outflow Volume between the current climate and central tendency climate, and there is no ANOVA statistical evidence of a difference between central tendency climate and any of the other climate scenarios, although visual inspection of the plots show lower flood outflow volumes for hot-dry and warm-dry climates and higher flood outflows in warm-wet and hot-wet climates.

Figure 107. Average Number of Days with Flood Outflows at El Capitan for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
Figure 108. Average Annual Flood Outflow Volume at El Capitan for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

7.4.2. Hodges

Hodges is historically the reservoir most prone to spills due to the relatively large ratio of natural inflow to reservoir capacity (57% under current climate scenarios, see Table 31). Average Annual Number of Days with Flood Outflows at Hodges for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 109. Under current climate, there are no differences in the Average Number of Days with Flood Outflows at Hodges between 2015, 2025, and 2050 demand scenarios for the Baseline Portfolio, but the Average Number of Days with Flood Outflows is lower in 2050 demands than 2025 and 2015 demands for the Baseline Plus Portfolio which can be attributed to the increase in discharge capacity resulting from the Hodges Water Quality Improvement Program discussed in Section 8.15. Because all Baseline Plus projects are included in the other Portfolios besides Baseline, the lower Average Number of Days with Flood Outflows at Hodges in 2050 is also observed in the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. Average Annual Flood Outflow Volume at Hodges for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in
Figure 110. Under current climate, there is no ANOVA statistical evidence of a difference in the Average Annual Flood Outflow Volume at Hodges within Portfolios or across Portfolios, although based on visual inspection the flood outflow volume is higher in the Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios than in the Baseline Portfolio.

The Hodges Water Quality Improvement Program allows more water to be released from Hodges on a given day. In normal water supply operations, this means that more water can be released to meet demands, which results in a corresponding decrease in reservoir storage. Decreased reservoir storage as well as the increased release capacity from the project have flood control benefits, since the reservoir can store more flood water and release more of it as controlled releases for water supply rather than as part of flood outflows. In flood situations, the increased releases for water supply reduces the total number of days required to evacuate the excess storage resulting in a lower number of days with flood outflows (see Figure 109).

Although the differences in flood outflow volumes were not statistically significant based on the ANOVA analysis, the flood outflow volumes were observed to be lower in the Baseline Plus and subsequent Portfolios than in the Baseline (see Figure 110), which is also a result of the Hodges Water Quality Improvement Program (a Baseline Plus Portfolio project). The reduced flood outflow volumes resulted in a water savings of 2,900 to 5,700 AF/y compared to the Baseline Portfolio, depending on the Portfolio and climate scenario (see Box 31 in Section 8.15). The Wilcoxon Rank Sum Test analysis supports the observed reduction in flood outflow volumes.

Climate scenarios have some impact on Average Number of Days with Flood Outflows and the Average Annual Flood Outflow Volume at Hodges for some Portfolios and climate scenarios under 2050 demands, although the ANOVA statistical evidence is limited. There is no evidence of statistical differences in the Average Number of Days with Flood Outflows or the Average Annual Flood Outflow Volume between the current climate and central tendency climate. There is some ANOVA statistical evidence that the number of flood outflows is greater for warm-wet climate than central tendency climate for 2050 scenarios in all Portfolios other than Baseline and Baseline Plus, but no statistical evidence of a difference between central tendency climate and any of the other climate scenarios. Visual inspection of the plots shows lower flood outflow volumes for hot-dry and warm-dry climates and higher flood outflow volumes in warm-wet and hot-wet climates, but there is only statistical evidence for a difference in the Baseline Plus.
Figure 109. Average Number of Days with Flood Outflows at Hodges for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
Figure 110. Average Annual Flood Outflow Volume at Hodges for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

### 7.4.3. Lower Otay

Average Annual Number of Days with Flood Outflows at Lower Otay for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 111 and Average Annual Flood Outflow Volume at Lower Otay for all Portfolios compared across all demand scenarios for selected climate scenarios is shown in Figure 112. Under current climate, there are no statistically significant differences in the Average Number of Days with Flood Outflows or Average Annual Flood Outflow Volume at Lower Otay between 2015, 2025, and 2050 demand scenarios for any Portfolios, as characterized by the ANOVA analysis. Comparing Portfolios, the Average Number of Days with Flood Outflows is higher in the Enhanced Conservation Portfolio than in the Baseline Portfolio which can be attributed to the Enhanced Conservation Concept discussed in Section 8.3. The lower demands in the Enhanced Conservation Portfolio mean that stored water is not used as quickly as in other Portfolios, leading to more flood outflows. A larger number of flood outflows might also be expected to occur in the Optimize Existing Facilities Portfolio because of the similarities in Reservoir Storage between the two Portfolios. However, the higher Average Number of Days with Flood Outflows...
Outflows is only observed in the Enhanced Conservation Portfolio, likely because the increased storage in the Optimize Existing Facilities Portfolio can be used to meet demands. This can be seen with the higher releases for water supply from Lower Otay in the Optimize Existing Facilities, while the Enhanced Conservation Portfolio has lower water demands resulting in more flood outflows.

Climate scenarios do not have a statistically significant impact on either the Average Number of Days with Flood Outflows or the Average Annual Flood Outflow Volume at Lower Otay based on the ANOVA analysis, although visual inspection of the plots provides some indication that there may be differences (Figure 111 and Figure 112). As discussed in Section 7.4, there is no statistical evidence based on the ANOVA analysis of differences in the Average Number of Days with Flood Outflows or the Average Annual Flood Outflow Volume between the current climate and central tendency climate, and there is no statistical evidence of a difference between central tendency climate and any of the other climate scenarios, although visual inspection of the plots show lower flood outflow volumes for hot-dry and warm-dry climates and higher flood outflows in warm-wet and hot-wet climates.

Figure 111. Average Number of Days with Flood Outflows at Lower Otay for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
7.4.4. San Vicente and Olivenhain
There are no flood outflows at San Vicente or Olivenhain Reservoirs in any of the scenarios included in the San Diego Basin Study.

8. Results Discussion by Concept

The following sections provide a discussion of model results by Concept. Concepts are defined in Section 3.1 and the Concepts and associated projects for each Portfolio are described in Sections 3.3 to 3.8. The sections throughout this Chapter describe the impacts of each Concept on the system and highlight the impacts of specific projects within the Concept.
8.1. Conveyance Improvement

While Conveyance Improvement projects do not directly supply additional water to the region, they are able to increase the amount of water that can be delivered. As discussed in Section 7.1.4, some of the shortages observed can be attributed to conveyance restrictions caused by pipelines operating at their full capacity. Although pump station capacity did not appear to be a constraint during the model runs (see Section 7.1.4.3), pipeline utilization appeared to be a constraint in the MWD Untreated pipeline (see Section 7.1.4.2). Aside from the projects included in the Baseline Plus Portfolio, the only projects included in the Optimize Existing Facilities Portfolio are Conveyance Improvement projects. No Conveyance Improvement Projects are included in any other Portfolios. Therefore, comparing the Optimize Existing Facilities 2050 scenario model runs to the Baseline and Baseline Plus 2050 model runs provides insight into the impacts of the Conveyance Improvement projects. Specific impacts from the San Diego Reservoir Intertie, Pipeline 3/Pipeline 4 Conversion, and Dulzura Conduit Replacement projects are discussed further in the following sections.

Box 26. Project Results Highlight: San Diego Reservoir Intertie

The San Diego Reservoir Intertie is a Conveyance Improvement project included in the Optimize Existing Facilities Portfolio. An overview of the project is found in Box 6 of Section 3.7.2.1, and modeling methodology for the Intertie is described in Box 9 of Section 4.2.2 and Appendix B – Model Implementation Details for Selected Projects. This project integrates El Capitan Reservoir, San Vicente Reservoir, and the El Monte groundwater basin to allow for an optimized “reservoir system” with the goal of maximizing storage and reducing the number of flood outflows. Impacts from this project can been observed in the 2050 scenarios for the Optimize Existing Facilities model runs. Relative to the 2050 Baseline Plus scenarios, there are differences in impacts to Monthly Average Reservoir Storage, End of September Storage, Recreation, and Flood Control.

Monthly Average Reservoir Storage in El Capitan appears to be significantly higher in the Optimize Existing Facilities Portfolio for 2050 demands than in the Baseline Plus Portfolio for 2050 demands (see Figure 113). This increased storage is observed for all months of the year. This increased storage in the El Capitan is available due to the San Diego Reservoir Intertie, which removes DSOD restrictions on reservoir storage. The increased storage at El Capitan also has an impact on Recreation and Flood Control.

Monthly Average Reservoir Storage at San Vicente appears to be slightly higher in the Optimize Existing Facilities Portfolio than in the Baseline Plus Portfolio for 2050 demands, demonstrating the water supply benefit of the Intertie between El Capitan and San Vicente. At El Capitan, the water storage benefits are much larger than those observed at San Vicente (see Figure 114).
Figure 113. Monthly Average Reservoir Storage at El Capitan for the Baseline Plus and Optimize Existing Facilities Portfolios.

Figure 114. Monthly Average Reservoir Storage at San Vicente for the Baseline Plus and Optimize Existing Facilities Portfolios.
End of September Storage at El Capitan Reservoir is significantly higher in 2050 demands for the Optimize Existing Facilities Portfolio than for the Baseline Plus Portfolio (see Figure 115), due to removal of the DSOD restrictions. These results indicate that the implementation of this project would likely increase operational flexibility and, in turn, enable increased water storage. There are no significant differences in the End of September Storage between the two Portfolios for San Vicente (see Figure 116).

Figure 115. End of September Storage at El Capitan in the Baseline Plus and Optimize Existing Facilities Portfolios.
Results indicate that the San Diego Reservoir Intertie minimizes the impacts to Recreation at El Capitan. In the Baseline Plus Portfolio, there are many realizations below the boat ramp elevation in the 2050 scenario, but in the Optimize Existing Facilities Portfolio in the 2050 scenario when the San Diego Reservoir Intertie is implemented, there are no realizations below the boat ramp elevation (see Figure 117). There are minimal differences in Recreation impacts between the Baseline Plus and Optimize Existing Facilities Portfolios at San Vicente Reservoir (see Figure 118).
Impacts to Flood Control were compared between the Baseline Plus and Optimize Existing Facilities Portfolios. Although there were no statistically significant changes in the Average Annual Flood Outflow Volume between the two Portfolios with the ANOVA analysis, there was a significant difference in the Average Number of Days with Flood Outflows. As seen in Figure 119, fewer flood outflows occur in the 2050 scenario in the Optimize Existing Facilities Portfolio when the San Diego Reservoir Intertie is
implemented than in the Baseline Plus Portfolio, which indicates that implementation of this project would likely reduce water loss. There were no flood outflows at San Vicente in any of the Portfolios, so there is no impact to flood outflows at San Vicente due to the San Diego Reservoir Intertie. Overall, Flood Control impacts were improved due to the San Diego Reservoir Intertie, which provides greater operational flexibility.

**Average Annual Number of Days with Flood Outflows - Current Climate**

**El Capitan**

<table>
<thead>
<tr>
<th>Scenario Name</th>
<th>2015 cc</th>
<th>2025 cc</th>
<th>2050 cc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Plus</td>
<td>16.8</td>
<td>17.2</td>
<td>17.7</td>
</tr>
<tr>
<td>Optimize Existing Facilities</td>
<td>16.8</td>
<td>17.2</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Figure 119. Number of Flood Outflows at El Capitan in the Baseline Plus and Optimize Existing Facilities Portfolios.

**Box 27. Project Results Highlight: Pipeline 3/Pipeline 4 Conversion**

**Project Results Highlight**

**Pipeline 3/Pipeline 4 Conversion**

The Pipeline 3/Pipeline 4 Conversion project is a Conveyance Improvement project that is included in the 2050 scenarios in the Optimize Existing Facilities Portfolio (see Box 7 in Section 3.7.2.1) and aims to convert portions of Pipeline 3 and Pipeline 4 from treated water to untreated water conveyance to alleviate constraints on untreated water delivery. Based on results from the Baseline Portfolio current climate 2050 demands model runs, the Untreated pipeline location exceeded 95% of capacity during the summer an average of 86 days during the summer, while the Treated pipelines never exceeded 95% of capacity on any days (Figure 120). In the Baseline Plus Portfolio, the number of days that the Untreated Pipeline exceeds 95% capacity decreases to 76 days for current climate and 2050 demands (Figure 120). For the Optimize Existing Facilities Portfolio, the number of days that the Untreated Pipeline exceeds 95% of capacity decreases to 18 days during the summer (Figure 120), indicating that the increase in untreated water capacity alleviates some of the capacity constraints. These results indicate that supply shortages caused by pipeline utilization are more likely to be caused by the pipelines carrying untreated water rather
than treated water. While the Treated pipeline location never exceeds 95% capacity in any Portfolios for any demand or climate scenarios, the average number of days where Untreated pipeline exceeds 95% capacity in 2050 is between 80 and 90 days in the Baseline Portfolio. This number drops to between 70 and 80 days in the Baseline Plus Portfolio for 2050, and then is reduced to less than 20 days in the Optimize Existing Facilities Portfolio. No effect is observed at the Treated pipeline location based on the Pipeline Utilization metric, even with a reduced treated water conveyance capacity due to the Pipeline 3/Pipeline 4 Conversion project.

Shortage Volume results indicate a potential for higher shortages in the Optimize Existing Facilities compared to the Baseline Plus Portfolio (see Section 7.1.3). Broadly, this can be attributed to fewer MWD treated water deliveries to the SD11 demand node, but this could not be specifically attributed to the reduced MWD Treated Pipeline capacity at the location where the Pipeline 3/Pipeline 4 project was implemented. Therefore, the higher shortages may be due to a combination of projects in the Optimize Existing Facilities Portfolio, rather than just the reduced treated water capacity from the Pipeline 3/Pipeline 4 Conversion project.

Figure 120. Pipeline Utilization at the Untreated Location for the Baseline, Baseline Plus, and Optimize Existing Facilities Portfolios.

Box 28. Project Results Highlight: Dulzura Conduit Replacement

**Project Results Highlight**

**Dulzura Conduit Replacement**

The Dulzura Conduit Replacement project involves replacement and renovation of the 11 mile-long Dulzura Conduit that conveys water from Barrett Reservoir to Cottonwood Creek, which ultimately leads to Lower Otay Reservoir. This project was implemented in the model by increasing the conduit capacity from 21,300 AF/y (19 mgd) in the Baseline Portfolio to 44,800 AF/y (40 mgd) in the Optimize Existing Facilities Portfolio and reducing loss from 10% to 0% (see Box 8 in Section 3.7.2.1). Since this project was only implemented in the Optimize Existing Facilities 2050 scenarios, impact to the system can be observed by comparing these plots to those of the 2050 scenario Baseline Plus plots. Impacts from this project are
observed when looking at the Monthly Average Reservoir Storage, Monthly Average Reservoir Releases, End of September Storage, and Recreation results for Lower Otay Reservoir (since the project is anticipated to improve conveyance to Lower Otay Reservoir). The Dulzura Conduit Replacement project is the only project in the Optimize Existing Facilities Portfolio that is anticipated to directly impact Lower Otay Reservoir.

Figure 121 compares the Monthly Average Reservoir Storage in the Lower Otay Reservoir from the Baseline Plus Portfolio to the Optimize Existing Facilities Portfolio. This shows that the Monthly Average Reservoir Storage is approximately 2,000 AF to 3,000 AF higher in 2050 in the Optimize Existing Facilities (OEF) Portfolio than in the Baseline Plus Portfolio, most likely due to increases conveyance to the Lower Otay Reservoir from the Dulzura Conduit Replacement project. These results indicate the OEF increases water supply availability for delivery to Lower Otay. As a result of the increased water supply being delivered to Lower Otay via the Dulzura Conduit Replacement, more water can be released from Lower Otay to meet water demands. Compared to the Baseline Plus Portfolio, more releases occur at Lower Otay in the Optimize Existing Facilities Portfolio for 2050 demands when the Dulzura Conduit Replacement is implemented (see Figure 122). The releases are highest for the summer months of July through September.

![Figure 121. Monthly Average Reservoir Storage at Lower Otay Reservoir for the Baseline Plus and Optimize Existing Facilities Portfolio.](image_url)
Figure 122. Monthly Average Reservoir Releases at the Lower Otay Reservoir for the Baseline Plus and Optimize Existing Facilities Portfolio.

Figure 123 compares the End of September Storage in Lower Otay Reservoir from the Baseline Plus Portfolio to the Optimize Existing Facilities Portfolio. Close to 45,000 AF are stored in the Lower Otay Reservoir in 2050 when implementing the Optimize Existing Facilities Portfolio, while only about 40,000 AF are stored when implementing the Baseline Plus Portfolio in 2050. These results show that the Dulzura Conduit Replacement project is anticipated to increase the water stored in Lower Otay, and thus make more water supply is available from Lower Otay.
Figure 123. Average End of September Storage at Lower Otay Reservoir for the Baseline Plus and Optimize Existing Facilities Portfolio.

Figure 124 compares End of September Elevation and Boat Ramp Accessibility for Lower Otay Reservoir in the Baseline Plus Portfolio to the Optimize Existing Facilities Portfolio. End of September Elevation is higher in the Optimize Existing Facilities Portfolio for 2050 than in the Baseline Plus Portfolio, indicating that the increased conveyance to Lower Otay Reservoir via the Dulzura Conduit eliminates impacts to recreation that were present in 2050.
8.2. **Drought Restriction/Allocation**

The Drought Restriction/Allocation concept is included in the Baseline Portfolio. It is not included in any other Portfolios as a new or modified concept (note that Baseline Portfolio projects are included in all Portfolios beyond Baseline). This concept differs from Urban and Agricultural Water Use Efficiency and Enhanced Conservation because it represents only temporary restrictions in water use and demand, or a temporary shift to other supply sources, during periods of drought. The two projects included in this concept are Local Drought Restriction/Allocation and MWD Allocation. Since this concept does not introduce new or modified projects to any Portfolios, comparisons across the Portfolios cannot be made. Only MWD Allocation could be modeled (see Section 4.4.2.4).

8.3. **Enhanced Conservation**

Enhanced Conservation for the Basin Study is defined as a 1% reduction in water demand (gallons per capita per day, GPCD) per year, starting in 2020 when it is assumed that the 20x20 targets outlined in SBX7-7 are reached as discussed in Section 3.5. The Enhanced Conservation Concept is the only Concept included in the Enhanced Conservation Portfolio; therefore, impacts to the system from this Concept are the same impacts to the system from the Enhanced Conservation Portfolio.
Water deliveries are significantly lower in the Enhanced Conservation Portfolio compared to the Baseline and Baseline Plus Portfolios. With the Enhanced Conservation Portfolio, deliveries are lower for 2050 demands than for 2025 demands (see Figure 125). The decreased delivery volumes are due to the decreased demands after accounting for the conservation volume. The decreased demands have significant impacts on the system as can be observed in the model results discussed in Chapter 7, most notably for Shortage Volume, Pipeline Utilization, Treatment Plant Utilization, Reservoir Storage, and Energy.

Figure 125. Annual Water Deliveries for the Enhanced Conservation Portfolio.

The Shortage Volume is zero for 2050 demands only in the Enhanced Conservation Portfolio due to the decreased demands on the system, as shown in Section 7.1.3. Figure 126 and Figure 127 show that there are some realizations above the shortage threshold in the Baseline Plus Portfolio for central tendency climate, hot-dry climate, and warm-dry climate in the 2050 scenarios, while there are zero realizations above the shortage threshold in the Enhanced Conservation Portfolio. The only other Portfolio to have zero shortages above the shortage threshold when considering the climate scenarios is the Increase Supplies Portfolio.
Figure 126. Percentage of Realizations above the 20,000 AF Shortage Threshold in the Baseline Plus Portfolio.
Pipeline Utilization is also impacted by the Enhanced Conservation Concept. Utilization of pipelines at the Untreated location and Crossover location is lower in the Enhanced Conservation Portfolio than in both the Baseline and Baseline Plus Portfolio (see Figure 128). Similar to the case for Shortage Volume, the decreased Pipeline Utilization is a result of fewer demands on the system.
Water Treatment Plant Utilization is significantly impacted by the Enhanced Conservation Concept. Utilization for all 11 water treatment plants is lower in the Enhanced Conservation Portfolio than in both the Baseline and Baseline Plus Portfolios in 2025 and 2050 demands for current climate, central tendency climate, and hot-dry climate. Figure 129 shows the system-wide Treatment Plant Utilization for the Baseline Plus and Enhanced Conservation Portfolios. In the 2050 scenarios, the treatment plant utilizations observed in the Enhanced Conservation Portfolio are at levels such that temporary shutdown of treatment plant operations could occur (or occur more often), resulting in operational challenges and/or potential water quality issues in the distribution system. The reduced treatment plant utilization results are consistent with the result of lower energy consumption by Enhanced Conservation. The reduced Treatment Plant Utilization is a direct result of the decreased demands from the member agencies that the treatment plants serve, calculated as described in Section 3.5.2.1 and in Appendix B – Model Implementation Details for Selected Projects.
Figure 129. Average Treatment Plant Utilization for the 2050 Demand Scenario in the Baseline Plus Portfolio and the Enhanced Conservation Portfolio.

The Enhanced Conservation Portfolio’s lower demands also impact Monthly Average Reservoir Storage, which is higher in the Enhanced Conservation Portfolio than in the Baseline and Baseline Plus Portfolios at Lower Otay and San Vicente for all months and Olivenhain from June to October for the 2050 demand scenario (see Figure 130 and Figure 131).
Of the reservoirs analyzed in the End of September Storage analysis, the reservoir impacted the most from the Enhanced Conservation Concept is San Vicente (see Figure 132). End of September Storage is higher at San Vicente in the Enhanced Conservation Portfolio than in the Baseline and Baseline Plus Portfolios for 2050 demands. The impact may be observed most at San Vicente compared to the other reservoirs because San Vicente storage is more dependent on imported supplies than local supplies (which average only 3% of the reservoir’s capacity). Since local supplies take priority over imported water for meeting demands, the reservoirs that store more local supplies would take priority to meet the reduced demands of the Enhanced Conservation Portfolio, resulting in lower demands for San Vicente supply.
Energy Consumption in the Enhanced Conservation Portfolio is lower for both 2025 and 2050 demands than Energy Consumption in both the Baseline and Baseline Plus Portfolios. The lower energy consumption in the Enhanced Conservation Portfolio indicates that demand is a major driver of energy consumption; thus, when demands on the system are smaller due to the Enhanced Conservation project, energy consumption decreases. These results are consistent with the finding of reduced treatment plant utilization by Enhanced Conservation, indicating a link between demand, treatment plant and conveyance facility utilization, and energy consumption. Energy Consumption is shown for the three Portfolios in Figure 133.
8.4. Firm Water Supply Agreements

The Firm Water Supply Agreements concept is included in the Baseline Portfolio and is therefore included in all Portfolios beyond Baseline. The only project associated with the Firm Water Supply Agreements concept is the QSA (see Section 3.3). The QSA available volume was assumed to be constant for all demand and climate scenarios and for all Portfolios, and was modeled such that the full agreement volume was delivered in every year. Therefore, the impact of the QSA and the Firm Water Supply Agreements Concept is the same across all Portfolios, essentially acting as a demand reduction.

8.5. Gray Water Use

Two Gray Water Use projects were included in the Basin Study. These projects include Conservation Home Makeover in the Chollas Creek Watershed which is implemented in the Baseline Plus Portfolio, and Gray Water Pilot Project which is implemented in the Increase
Supplies Portfolio. These projects are implemented in the CWASim model as demand reductions (see Section 4.4.1). The two Gray Water Use projects help increase the amount of local water supply available in 2050 when the Increase Supplies Portfolio is implemented. Although specific impacts from Gray Water Use are not directly observed, it contributes to the overall benefits of the Increase Supplies Portfolio, such as fewer shortages and less dependence on Imported Water than in the Baseline and Baseline Plus Portfolios (see Figure 134).

![Figure 134. Annual Deliveries of Gray Water for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.](image)

8.6. Groundwater

Groundwater projects were included in the Baseline Portfolio, and additional projects were added as part of the Baseline Plus and Increase Supplies Portfolios, such as the San Dieguito River Basin Brackish Groundwater Recovery and Treatment project implemented in the Increase Supplies Portfolio for 2025 and 2050 demands (see Box 4 in Section 3.6.2.2). Groundwater projects were implemented as demand reductions (see Section 4.4.1). These projects help to increase the amount of local water supply available in the Baseline Plus and Increase Supplies
Portfolios, with a majority of the additional groundwater supply beyond the Baseline Portfolio in the Increase Supplies Portfolio. See Figure 135 for groundwater supply volumes included in the Increase Supplies Portfolio. Although specific impacts from Groundwater are not directly observed in the same manner as water deliveries that are modeled as additional supplies, it contributes to the overall benefits of the Increase Supplies Portfolio, such as fewer shortages and less dependence on Imported Water than in the Baseline and Baseline Plus Portfolios.

Figure 135. Annual Deliveries of Groundwater for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

8.7. Imported Water Purchases

The two Imported Water projects in the Basin Study were MWD Imported Water and Cadiz Additional Imported Supplies. MWD Imported Water is included in the Baseline Portfolio and is not modified in any of the Portfolios beyond the Baseline (see Section 4.4.2.4 for implementation of MWD Purchases in the CWASim model). The Cadiz Additional Imported
Supplies project (5,000 AF/y) is included in the Increase Supplies Portfolio for the 2050 scenarios.

Dependence on Imported Water in the 2050 demands is lowest in the Enhanced Conservation and Increase Supplies Portfolios as shown in Figure 136. This indicates that even with the Cadiz Additional Imported Supplies project in 2050 demands in the Increase Supplies Portfolio, Imported Water use still decreases since less water supply is required from MWD. Water delivery figures in Appendix D – Detailed Model Results show that in all Portfolios, Imported Water is still an important supply source.

![Average Annual Delivery and Conservation Volume - Imported Water 2015 Demands](chart)

Figure 136. Average Annual Delivery Volume for Imported Water for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

### 8.8. Local Surface Water Reservoirs

The Local Surface Water Reservoirs concept is included in the Baseline Portfolio and is therefore included in all Portfolios beyond Baseline. This concept represents the reservoirs that are simulated in CWASim. Although modifications are made to reservoir systems by some
projects (for example, the Sweetwater Reservoir Wetlands Habitat Recovery project discussed in Section 8.15), they are not associated with the Local Surface Water Reservoirs concept. Therefore, an impact to the system from Local Surface Water Reservoirs based on Portfolio model result comparisons cannot be made.

8.9. Potable Reuse

One Potable Reuse project, the San Luis Rey WRF - Short/Long-Term Expansion project, is included in the Baseline Portfolio with a supply volume of 3,300 AF for 2025 and 2050 demands implemented as a demand reduction (see Section 4.4.1 and Figure 137). In the Baseline Plus Portfolio, the following three additional Potable Reuse projects are included: East County Advanced Water Purification Program Phase 1 (implemented as demand reduction); East County Advanced Water Purification Program Phase 2 (implemented as demand reduction); and Pure Water Phase 1 (implemented through model logic). The Increase Supplies Portfolio includes an additional nine Potable Reuse projects, with five implemented as demand reductions, one (Pure Water Phase 2) implemented through model logic, and three not implemented in the model. Potable Reuse deliveries under current climate are 46,704 AF in the 2025 demand scenario and 42,211 AF in the 2050 demand scenario for the Baseline Plus Portfolio, primarily due to Pure Water Phase 1 as described in Box 29. In the Increase Supplies Portfolio under current climate, 47,254 AF is delivered in the 2025 demand scenario and 128,555 AF is delivered in the 2050 demand scenario. The increased 2050 delivery can be attributed to the Pure Water Phase 2 project as described in Box 30. Potable Reuse represents the third largest delivery volume in the Increase Supplies Portfolio for 2050 demands (meaning that it has a larger delivery volume than Imported MWD Water), with only the QSA and Urban and Agricultural Water Use Efficiency Volumes larger than Potable Reuse.

Comparing between demand scenarios, Potable Reuse deliveries are higher in 2025 than in 2015 for all Portfolios due to the lack of Potable Reuse projects in the 2015 demand scenario and the presence of at least one in all 2025 scenarios. Potable Reuse deliveries are significantly higher in 2050 than in 2025 for the Increase Supplies Portfolio, but surprisingly they are lower in 2050 than in 2025 for all other Portfolios besides Baseline. This may be due to the Hodges Water Quality Improvement Program, which is implemented in 2050 Baseline Plus and subsequent Portfolios. Water from Hodges Reservoir is able to serve some of the same demands as water from Miramar Reservoir, which receives water from the Pure Water Phase 1 project. With the increase in supply availability from Hodges in the 2050 scenarios due to its increased release capacity, some of the demands that were met with Potable Reuse water in 2025 are likely met with Hodges water in the 2050 scenarios.
Box 29. Project Results Highlight: Pure Water San Diego Phase 1

**Project Results Highlight**

**Pure Water San Diego Phase 1**

Pure Water San Diego Phase 1 described in Box 1 of Section 3.4.2.4 is included in the Baseline Plus Portfolio and all subsequent Portfolios and is implemented in the 2025 and 2050 demand scenarios. Thirty mgd (33,600 AF/y) of new water supply from the North City Advanced Water Reclamation Plant is to be transferred to Miramar Reservoir on a daily basis when the reservoir is below its seasonal capacity rule curve. Monthly Average Reservoir Storage at Miramar Reservoir is significantly higher in the Baseline Plus Portfolio than the Baseline Portfolio for both 2025 and 2050 demands, which is directly related to the 30 mgd water delivery from Pure Water Phase 1 (see Figure 138).
In addition to the increase in Monthly Average Reservoir Storage, there is also an increase in Monthly Average Reservoir Releases at Miramar Reservoir when Pure Water San Diego Phase 1 is implemented (see Figure 139). This indicates that more water stored in Miramar Reservoir can be released to meet demands when Pure Water San Diego Phase 1 is implemented. This increase in releases does not cause a decrease in storage due to availability of the Pure Water San Diego Phase 1 supply. Surface Water Augmentation regulations, effective October 1, 2018, will need to be considered for Miramar operations.
280

Figure 139. Monthly Average Reservoir Releases at Miramar Reservoir for the Baseline and Baseline Plus Portfolios.

As displayed in Figure 140, the addition of Pure Water San Diego Phase 1 results in a significant increase in Potable Reuse Deliveries from the Baseline Portfolio (3,300 AF) to the Baseline Plus Portfolio (46,704 AF) for 2025 demands. This increase in Potable Reuse (43,404 AF increase) causes a corresponding decrease in Imported Water deliveries (40,931 AF decrease). There are some differences in the water deliveries of other supply sources between the Baseline and Baseline Plus Portfolios for 2025 demands, but these are minor compared to the difference in Potable Reuse and Imported Water. This indicates that implementation of Pure Water Phase 1 has the potential to decrease the region’s reliance on imported water.
With the implementation of Pure Water Phase 1, a decrease in the amount of energy consumed would be expected between the Baseline and Baseline Plus Portfolios due to the lower energy consumption rate of Pure Water compared to imported water (see Table 22). This decrease is observed for both 2025 and 2050 demand scenarios (Figure 141). However, the difference is larger for 2050 than for 2025 despite no change in Pure Water Phase 1 capacity. This is likely because changes in other water sources, such as surface water, also contribute to the differences in energy consumption.
Another anticipated impact of Pure Water Phase 1 is on treatment plant utilization. However, although it might be expected that Miramar WTP Utilization would increase due to increased releases of water from Miramar Reservoir, it does not, as displayed in Figure 142. This is likely due to the fact that Miramar WTP takes water from both Miramar Reservoir and Pipeline 5 and can reroute excess flows to a 24-million-gallon tank. The Pipeline 5 supply sources might have been offset by the Pure Water supplies and/or buffered with flows to the 24-million-gallon storage tank since, without expanding its service area, demands from Miramar WTP would remain the same with and without implementation of Pure Water Phase 1.
Box 30. Project Results Highlight: Pure Water San Diego Phase 2

*Project Results Highlight*

**Pure Water San Diego Phase 2**

Pure Water San Diego Phase 2, described in Box 5 of Section 3.6.2.4, is included in the Increase Supplies Portfolio and implemented in the 2050 demand scenario. This project was implemented in the CWASim model by sending 53 mgd (59,400 AF/y) from the Central Area Advanced Water Reclamation Plant to San Vicente in the 2050 Increase Supplies Portfolio scenarios. The impacts of this project are observed for Deliveries, Monthly Average Reservoir Storage, End of September Storage, and Recreation.

As shown in Figure 143, there is a significant increase in Potable Reuse Deliveries from the Baseline Plus Portfolio (42,200 AF) to the Increase Supplies Portfolio (128,600 AF) for 2050 demands. There is approximately 86,300 AF of additional Potable Reuse deliveries in the Increase Supplies Portfolio for 2050 compared to the Baseline Plus Portfolio. Pure Water San Diego Phase 2 represents 57,200 AF, or 66%, of the additional Potable Reuse supplies in Increase Supplies Portfolio, which is larger than the delivery volume for all groundwater projects (41,300 AF) in 2050 for the Increase Supplies Portfolio.
Figure 143. Annual Deliveries for 2050 demands in the Baseline Plus and Increase Supplies Portfolios.

Monthly Average Reservoir Storage at San Vicente in the 2050 scenarios is significantly higher in the Increase Supplies Portfolio than in the Baseline Plus Portfolio due to implementation of Pure Water San Diego Phase 2. Figure 144 shows that approximately 20,000 AF of additional water is stored in San Vicente Reservoir when the project is implemented. This is similar to the increase in reservoir storage at El Capitan between the Baseline Plus and Optimize Existing Facilities, where the implementation of the San Diego Reservoir Intertie also results in an increase in storage of approximately 20,000 AF. This indicates that, when needed, additional water supply would be available from San Vicente Reservoir due to implementation of Pure Water San Diego Phase 2. Monthly Average Reservoir Releases were also increased as a result of the increased storage (see Section 7.1.5.2.9).
Similar to the Monthly Average Reservoir Storage, the End of September Storage at San Vicente is higher in 2050 demands for the Increase Supplies Portfolio than for the Baseline Plus Portfolio (see Figure 145).
The increased storage in San Vicente Reservoir also results in higher End of September Reservoir Elevation (Figure 146). However, since the End of September Reservoir Elevation at San Vicente is always above the boat ramp elevation, implementation of Pure Water San Diego Phase 2 does not increase access to boat ramps. Despite the lack of a measurable increase in boat ramp access, increased reservoir storage and elevation may still provide positive recreation impacts, such as increased shoreline and surface area for boating.
Even with the additional storage at the San Vicente Reservoir in 2050 for the Increase Supplies Portfolio, there is still not an increase in the number of flood outflows from the reservoir. No flood outflows occur at the San Vicente Reservoir in any of the Portfolios, indicating that there is sufficient storage capacity in San Vicente in all scenarios for all added water supply to be stored or released to meet demands.

8.10. Recycled Water

Recycled Water projects are included in the Baseline, Baseline Plus, and Increase Supplies Portfolios. All Recycled Water projects were implemented as demand reductions (see Section 4.4.1). Figure 147 shows delivery volumes associated with the Recycled Water Concept when compared to other water supply sources for the Baseline, Baseline Plus, and Increase Supplies Portfolios. Since the Recycled Water projects are implemented as demand reductions, the CWASim model results are not able to indicate impacts to a specific infrastructure component (such as the Untreated Pipeline or Hodges Reservoir). Recycled Water, however, makes up a large portion of the water supply in the Increase Supplies Portfolio for 2050 demands, and contributes to the overall benefit of the Increase Supplies Portfolio, such as fewer shortages and less dependence on Imported Water. Energy consumption in the Increase Supplies Portfolio was lower than in the Baseline Portfolio which indicates that the additional supply projects such as Recycled Water projects which may increase energy needed for water treatment do not necessarily increase regional energy consumption, and in fact may be significantly less energy intensive than some water supplies in the Baseline Portfolio, such as imported water deliveries.
Figure 147. Annual water deliveries showing volumes associated with Recycled Water for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

8.11. Seawater Desalination

The Seawater Desalination Concept consists of the Carlsbad Desalination Plant in the Baseline Portfolio, along with three additional projects (Re-rating of the Carlsbad Desalination Plant, the Camp Pendleton Desalination Plant, and the Rosarito Desalination Plant) introduced in the Increase Supplies Portfolio.

The delivery volume for Seawater Desalination increases by approximately 9,300 AF/y in 2050 from the Baseline Portfolio to the Increase Supplies Portfolio (Figure 148). Seawater Desalination makes up a large portion of the water supply in the Increase Supplies Portfolio for 2050 demands and contributes to the overall benefit of the Increase Supplies Portfolio, such as fewer shortages and less dependence on Imported Water Purchases (See Section 7.1).
In general, Seawater Desalination is a more energy intensive supply source than traditional sources of potable water, and therefore, an increase in energy consumption would be expected in the Increase Supplies Portfolio when the additional Seawater Desalination projects are implemented. Based on the analysis, however, there are minimal differences in energy consumption in the Increase Supplies Portfolio between demand scenarios, and the energy consumption in the Increase Supplies Portfolio is actually less than the energy consumption in the Baseline Portfolio for both 2025 and 2050 demands (see Figure 149). The reason for this is that neither the Carlsbad Desalination Plan nor the Camp Pendleton Desalination Plant operates at full capacity during the model runs due to their low supply source priority in the CWASim model (see Section 4.7.1). Although the Camp Pendleton Desalination Plant was modeled at a plant capacity of 168,000 AF/y, Camp Pendleton Desalination only delivers approximately 7,300 AF/y in the Increase Supplies Portfolio 2050 current climate scenario. Deliveries from Carlsbad
Desalination Facility were also approximately 14,900 AF/y lower in the Increase Supplies Portfolio for the 2050 current climate scenario than in the Baseline Portfolio. If Carlsbad and Camp Pendleton Desalination Plants were to operate at full capacity, energy impacts would most likely differ from the results observed here. These results still indicate, however, that shifting from imported water to local water supply sources that are less energy intensive may have a net benefit to energy, even when the Portfolio includes more energy intensive supply sources such as Desalination. This reduction in energy consumption is in addition to the water reliability benefits associated with local water supply sources.

Figure 149. Energy Generation and Consumption in the Baseline Portfolio and the Increase Supplies Portfolio.
8.12. Stormwater BMPs

Stormwater BMP projects are only included in the Watershed Health and Ecosystem Restoration Portfolio. Of the 29 Stormwater BMP projects included in the Basin Study, eight are implemented in the CWASim model. The total water supply volume modeled from these eight projects is 98 AF/y, which will not show a significant impact on the system based on the CWASim model. Figure 150 indicates that the water delivery volume from Stormwater BMP projects is much less than other supply sources. Task 2.5 better captures impacts to the system from this Concept, since many of the benefits of Stormwater BMP projects cannot be simulated in the CWASim model. Model results do not indicate significant differences between the Baseline Plus Portfolio and Watershed Health and Ecosystem Restoration Portfolio.

Figure 150. Annual water deliveries showing volumes associated with Stormwater BMP projects and Stormwater Capture projects in the Watershed Health and Ecosystem Restoration Portfolio.
8.13. Stormwater Capture

There are two Stormwater Capture projects in the Basin Study: Murray Urban Runoff Diversion System Capture which is included in the Baseline Plus Portfolio and implemented in the 2025 and 2050 demand scenarios, and Rainwater Harvesting which is included in the Watershed Health and Ecosystem Restoration Portfolio and implemented only in the 2050 demand scenarios. Small water supply volumes are associated with these projects (200 AF/y and 416 AF/y, respectively). Figure 150 in Section 8.12 indicates that the water supply volume associated with these projects is significantly less than other supply sources. The Trade-Off Analysis in Task 2.5 better represents impacts to the system from this Concept, since many of the benefits of Stormwater Capture projects cannot be simulated in the CWASim model.

8.14. Urban and Agricultural Water Use Efficiency

Urban and Agricultural Water Use Efficiency refers to projects that achieve water conservation by encouraging long-term behavioral change and implementing water use efficiency programs. This Concept is included in the Baseline Portfolio and expanded in the Baseline Plus Portfolio. Baseline conservation volume from this Concept is 50,000 AF/y in the 2015 demand scenarios, increasing to 89,110 AF/y in the 2025 demand scenarios and 155,468 AF/y in the 2050 demand scenarios. The additional annual conservation volume from this Concept in the Baseline Plus Portfolio is 781 AF/y for 2025 demands and 2,874 AF/y for 2050 demands (see Figure 151 and Figure 152). Projects in this Concept are implemented as demand reductions (see Section 4.4.1), so the CWASim model results reflect reduced member agency demands, which decreases use of imported and local supplies.
Figure 151. Annual Delivery Volumes showing the conservation volumes associated with Urban and Agricultural Water Use Efficiency in the Baseline Portfolio.
Figure 152. Annual Delivery Volumes showing the conservation volumes associated with Urban and Agricultural Water Use Efficiency in the Baseline Plus Portfolio.

8.15. Watershed and Ecosystem Management

Watershed and Ecosystem Management projects are included in the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios. Of the four Watershed and Ecosystem Management projects included in the Baseline Plus Portfolio, two are implemented in the CWASim model. Impacts observed from these two projects, Hodges Water Quality Improvement Program and Sweetwater Reservoir Wetlands Habitat Recovery, are discussed in Box 31 and Box 32, respectively. None of the Watershed and Ecosystem Management projects included in the Watershed Health and Ecosystem Restoration Portfolio were implemented in the CWASim model since they do not have a supply volume or operational impact associated with them that could be modeled. These projects are accounted for in Task 2.5.
Box 31. Project Results Highlight: Hodges Water Quality Improvement Program

**Project Results Highlight**

**Hodges Water Quality Improvement Program**

Impacts to the system from the Hodges Water Quality Improvement Program (discussed in Box 2 in Section 3.4.2.8), which is included in all non-Baseline Portfolio runs for the 2050 demand scenario, can be observed when looking at reservoir storage, reservoir releases, end of September storage, recreation, and flood control results. This project allows for increased use of Hodges Reservoir for water supply by improving its water quality which is currently not meeting the requirements to be conveyed to the regional aqueduct system. This project allows higher releases of water from Hodges Reservoir to other parts of the regional water system, such as Emergency Storage Project storage or seasonal pool storage in Olivenhain Reservoir, where it can then be used to meet demands.

Due to the improved water quality, more water can be used from Hodges Reservoir, causing the monthly average reservoir storage to decrease by approximately 5,000 AF each month (about a 30% decrease) and average reservoir releases (which are releases used to meet demands in the regional water system) to increase between 1,000 AF per month and 3,000 AF per month each month depending on the month (there are fewer releases from January to February and July to August) when this project is implemented. This amounts to an approximately 100% - 300% increase in the volume of reservoir releases from Hodges. Figure 153 and Figure 154 compare reservoir storage and releases between the Baseline and Baseline Plus Portfolios. This is also supported by the end of September elevation results (Figure 155), which show that the end of September elevation for Hodges Reservoir decreases from 2025 to 2050.

![Figure 153. Reservoir Storage at Hodges for Baseline and Baseline Plus Portfolios.](image)
Figure 154. Reservoir Releases at Hodges for Baseline and Baseline Plus Portfolios.

Figure 155. End of September Storage at Hodges for Baseline and Baseline Plus Portfolios.
As shown in Figure 156, End of September Reservoir Elevation changes due to the Hodges Water Quality Improvement Program have only a small impact on boat ramp accessibility at Hodges Reservoir. Of all the projects included in the Baseline Plus Portfolio and implemented only in the 2050 scenario, the Hodges Water Quality Improvement Program is the only project that will specifically impact Hodges Reservoir. In the Baseline Portfolio, all realizations are above the boat ramp elevation. However, in the Baseline Plus Portfolio there is a single realization below the boat ramp elevation and other realizations, while still well above the boat ramp, are lower as well.

The Hodges Water Quality Improvement Program also has an impact on Flood Control. Based on the model results, this project is expected to create a 90% decrease in the Average Number of Days with Flood Outflows from the reservoir (from approximately 100 days in the Baseline Portfolio to 11 days in the Baseline Plus Portfolio with current climate, see Figure 157). The decrease in the number of flood outflows is expected, since there would be more storage available in Hodges during precipitation events.

Overall, the decreased frequency in flood outflows due to implementation of Hodges Water Quality Improvement Program is anticipated to result in a water savings of 2,900 to 5,700 AF/y, compared to the Baseline Portfolio, depending on the Portfolio and climate scenario. Compared to the Baseline Portfolio, the Baseline Plus Portfolio would provide a water savings of approximately 4,700 AF/y with current climate and 4,500 AF/y with central tendency climate. The highest water savings between Baseline and Baseline Plus Portfolios was observed with hot-wet climate (approximately 5,700 AF/y) and the lowest with hot-dry climate (2,900 AF/y). The subsequent Portfolios produced a similar water savings as the Baseline Plus Portfolio under current climate, with the lowest volume of water savings observed in the Enhanced Conservation Portfolio (approximately 3,800 AF/y under current climate).

The overall impact of this project is to prevent water loss by improved conveyance. There is an increase in water supply available from Hodges due to the improved water quality, and the higher use of water from Hodges results in more reservoir storage space, which reduces the number of flood outflows.
Figure 157. Hodges Flood Outflows and Flood Outflow Volume for Baseline and Baseline Plus Portfolios with current climate, central tendency climate, and hot-dry climate for the 2050 demand scenario.

Box 32. Project Results Highlight: Sweetwater Reservoir Wetlands Recovery

**Project Results Highlight**

**Sweetwater Reservoir Wetlands Habitat Recovery**

The Sweetwater Reservoir Wetlands Habitat Recovery program is introduced in the Baseline Plus Portfolio 2025 scenarios. As described in Box 3 of Section 3.4.2.8, this project would increase the available storage in Sweetwater Reservoir by 7,873 AF.

Figure 158 shows that the Monthly Average Reservoir Storage is higher for both 2025 demands and 2050 demands in the Baseline Plus Portfolio than in the Baseline Portfolio. This indicates that the increased available storage in Sweetwater Reservoir created by the Sweetwater Reservoir Wetlands Habitat Recovery Program is being utilized. The increase in storage between December and February in all
scenarios can be attributed to releases from Loveland Reservoir to Sweetwater Reservoir, which does not change when the Sweetwater Reservoir Wetlands Habitat Recovery program is implemented (see Sections 7.1.5.1.4 and 7.1.5.1.10).

Figure 158. Reservoir Storage at Sweetwater for the Baseline and Baseline Plus Portfolios.

9. Conclusion

The purpose of Task 2.4 of the San Diego Basin Study was to explore the types and magnitudes of impacts of existing and potential future water management strategies on water delivery, energy, recreation, and flood control under a variety of climate and demand scenarios. This information is intended to help guide regional decision-makers in identification and selection of projects for design or further study.

Fifteen Concepts representing various water management strategies, including Seawater Desalination, Recycled Water, Urban and Agricultural Water Use Efficiency, Potable Reuse, and Groundwater were identified through a stakeholder process. Regional planning documents helped develop a list of 225 projects that were categorized by Concept and divided into one of six Portfolios: Baseline, Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration. Projects were assigned to Portfolios based on their implementation status and type of project. The Baseline Portfolio was used to represent regional conditions as of 2015 as a basis of comparison for other Portfolios. To account for adaptation strategies that the region had begun deploying between 2015 and 2017,
the Baseline Plus Portfolio was assembled, to include projects such as Pure Water San Diego Phase 1 and the Hodges Water Quality Improvement Program. The four remaining Portfolios described in Chapter 3 – Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration – include similar strategies. All Baseline projects were included in the Baseline Plus Portfolio, and all Baseline and Baseline Plus projects were included in the four remaining Portfolios.

The San Diego regional water system, as described by the Portfolios, was simulated using the CWASim model, which is described in detail in Chapter 4. Modeled scenarios and input data are described in Chapter 5. The results of the model simulations were analyzed to evaluate impacts to Water Delivery, Energy, Recreation, and Flood Control using the methodology described in Chapter 6. Environmental impacts were not assessed in Task 2.4 due to the inability of the CWASim model to evaluate such impacts. These impacts are evaluated in Task 2.5.

Discussion of the results indicates the relative potential impacts of different Concepts on the San Diego region.

9.1. Discussion of Results

9.1.1. Water Delivery

Water delivery impacts were measured by demands, water delivery volumes, shortage volume and frequency, conveyance system operations (pipeline flows and treatment plant utilization), and reservoir storage and releases.

Differences in water deliveries under current climate correspond to the changes in demands. As the population is expected to increase from 2015 to 2025 to 2050, so do the demand projections which averaged 619,736 AF/y in 2015, 730,437 AF/y in 2025, and 860,082 AF/y in 2050. Demand projections were modeled for various climate scenarios: current climate, hot-dry climate, warm-dry climate, hot-wet climate, warm-wet climate, and central tendency climate. The current climate 2015 demands were actual demands from 2015, the current climate 2025 demand projections were taken from the SDCWA 2015 UWMP, and the current climate 2050 demand projections were extended from the projections in the SDCWA 2015 UWMP. Although there is inherent uncertainty in future demands resulting from uncertainties in projections of future population and socio-economic factors, analysis of this type of uncertainty was outside the scope of the Basin Study. Uncertainty in demands due to uncertainty in future climate was captured in the Basin Study through adjustment of the demand projections for climate change scenarios. 2025 and 2050 demand projections for the climate change scenarios were calculated by adjusting the current climate demands with factors developed using a spreadsheet model that relates projected changes in precipitation and potential evapotranspiration (PET) to changes in demand (see Section 5.3). Results indicate that the projected increase in population and changes in socioeconomic factors may have a more significant impact on demand projections than the effect of climate change. This is expected, given that the components of demand that make up a large part of San Diego’s demand (e.g., indoor residential water use and commercial and industrial water use) are less sensitive to climate change (i.e., changes in precipitation and PET) than others (e.g., agricultural water use, which would be impacted by changes in precipitation and PET) (see Sections 2.3 and 5.3.2). In fiscal year 2015, 92% of the total demand was for M&I
uses and 8% was for agricultural uses (San Diego County Water Authority, 2016). While demands were lower with current climate than central tendency climate and the other climate scenarios, this difference is minimal compared to the difference caused by population increase from 2015 to 2025 to 2050 (Figure 159).

Figure 159. Gross Demand Projections for Current and Future Climate Scenarios for 2015, 2025, and 2050.

Water deliveries are projected to increase as a result of the increased demands from 2015 to 2025 to 2050 for all Portfolios except the Enhanced Conservation Portfolio, where conservation volumes make up for the decreased delivery volumes (Figure 160). 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.
A challenge that the region faces is its dependence on Imported Water which represents 70% of the region’s water supply in all Portfolios for 2015 demands, 64% in the Baseline Portfolio for 2025 demands, and 61% in the Baseline Portfolio for 2050 demands. The reliability of imported water deliveries to the San Diego region is uncertain due to occasional droughts in northern California and the Colorado River Basin, regulatory restrictions related to endangered species in the Bay-Delta that limit State Water Project deliveries, the potential for catastrophic events such as earthquakes, and climate change impacts. In the Study, imported water supplies were represented by the Firm Water Supply Agreements Concept (QSA) and the Imported Water Purchases Concept (primarily made up of MWD purchases). Due to the introduction of

---

6 Note that Average Total Annual Delivery and Conservation Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
additional local supplies and conservation, imported water deliveries were lower in the Baseline Plus (58% for 2025 and 54% for 2050) and other Portfolios than in the Baseline Portfolio. The effect was particularly strong for the Increase Supplies and Enhanced Conservation Portfolios, indicating that both demand-side approaches (i.e., conservation) and supply side approaches (i.e., new water supply sources) may be effective at reducing dependence on imported water. In addition to the reliability benefits of reducing dependence on imported water for meeting water demands, decreasing imported water use may also provide benefits to regional energy consumption as described in Section 9.1.2.

New local water supplies introduced in the Basin Study for Portfolios beyond the Baseline include gray water and stormwater. Although supply volumes associated with these sources were not large compared to other supply sources such as groundwater, surface water, or imported water, they did contribute to the overall benefits that were seen in Portfolios beyond the Baseline and would allow the region to increase its water supply diversity. Another local water supply, potable reuse, was included in the Baseline Portfolio, but was utilized to a much greater extent in the Portfolios beyond Baseline. Potable reuse deliveries in the Baseline were small (3,300 AF) compared to the increased amount of potable reuse that was introduced in Baseline Plus (42,211 AF in 2050) and further increased in Increase Supplies (128,555 AF in 2050). A large portion of the potable reuse deliveries in the Basin Study were a result of Pure Water San Diego (approximately 65% in 2050 for both Baseline Plus and Increase Supplies Portfolios). Other local supply sources that were further utilized beyond Baseline include surface water, groundwater, and recycled water. The Increase Supplies Portfolio also included additional desalination deliveries. The addition of these local supplies allows the region to decrease its use of imported water in all Portfolios beyond Baseline. This effect was strongest in the Increase Supplies Portfolio, when these supplies were further increased, and in the Enhanced Conservation Portfolio, indicating that reduced demands may be a comparable approach to increasing supplies when it comes to reducing imported water deliveries.

Climate change impacts were only observed in the results for some supply sources. Climate change did not impact deliveries of supply sources that were implemented in CWASim as demand reductions (see Section 4.4.1). However, climate change impacts were observed for Imported Water, Surface Water, Seawater Desalination, and Potable Reuse deliveries. Both Imported Water (see Figure 161) and Seawater Desalination deliveries were higher under central tendency climate than under current climate, which may correspond to the increased demands under central tendency climate compared to current climate. Surface Water deliveries appeared to have the greatest impact from climate change scenarios, with lower surface water deliveries (by approximately 20% on average) for hot-dry climate and higher deliveries from warm-wet climate compared to central tendency climate, indicating that a hot-dry climate is likely to reduce the availability of local surface water. Potable Reuse deliveries were lower for warm-wet climate than central tendency climate, most likely due to the increased surface water deliveries under warm-wet climate being used to meet the same demands as the potable reuse deliveries.
Another challenge potentially faced by the San Diego region is water shortage, which may be exacerbated by increases in demands due to population increase and climate change. In the Basin Study, the magnitude of regional demand that is unable to be met by water deliveries due to lack of available supplies and/or limits by conveyance system capacity is measured by Shortage Volume (see Figure 162 for average shortage volumes associated with each Portfolio). Since it may be possible to mitigate some shortages by operational changes or short-term drought restrictions, a shortage threshold of 20,000 AF was used to identify shortages that could potentially have significant impacts on the region (see Figure 163 for the percent of realizations above this threshold in each Portfolio). No shortages were observed in the model simulations for the current climate 2015 scenario, but shortages occurred in both 2025 and 2050 scenarios in the Baseline Portfolio, including some shortages above the Shortage Threshold. To a lesser extent, shortages also occurred in the Baseline Plus and other Portfolios, but the additional supply and conservation projects in those portfolios reduced the occurrence of shortages. No shortages over the shortage threshold occurred in non-Baseline Portfolios for 2025 scenarios, and the number of
shortages was lower for the 2050 scenarios as more projects were implemented. Hot-dry climate scenarios generally had larger Shortage Volumes than central tendency and current climate in all Portfolios except for Enhanced Conservation and Increase Supplies Portfolios in 2050 demands. These results highlight the potential for decreased water supply reliability under conditions of increased warming and drought. The Enhanced Conservation Portfolio performed best in reducing shortages, followed by Increase Supplies, Baseline Plus, and Watershed Health and Ecosystem Restoration, and Optimize Existing Facilities. The reduction in shortage in the Enhanced Conservation Portfolio is due to lower demands resulting from the large conservation volume included in the Portfolio. The lack of difference in Shortage Volume between hot-dry and central tendency or current climate in the Increase Supplies Portfolio may indicate that supply sources included in this Portfolio are less impacted by climate, such as Seawater Desalination or Potable Reuse. In hot-dry climate, Baseline Plus and Optimize Existing Facilities had a similar number of shortages, but the shortage volume was higher in Optimize Existing Facilities with current climate and central tendency climate. Since the Portfolios are intended to implement projects that have a beneficial effect, this may indicate that some aspects of the Optimize Existing Facilities Portfolio could increase shortages rather than decrease them under certain conditions. Investigation of the daily model results indicates a possible conveyance constraint for treated water in Pipeline 4 to the SD11 demand node for the City of San Diego in the Optimize Existing Facilities runs, but this could not be attributed to a specific project. Further study and analysis may provide insight into potential solutions to reduce or eliminate this potential negative effect of the Optimize Existing Facilities Portfolio.

Shortages can be caused by supply and/or conveyance issues. A supply shortage may occur when the available water supply is lower than demands, and a conveyance shortage may be caused by limitations in the conveyance system such as limited pipeline or water treatment plant capacity. Model results indicate that large shortage volumes, such as those seen in the Baseline Portfolio for 2050 demands under hot-dry climate, are typically associated with supply shortages, while smaller shortage volumes, such as those in the Increase Supplies Portfolio for 2050 demands under hot-dry climate, are typically associated with conveyance limitations.
Figure 162. Average Annual Shortage Volume for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.
As mentioned previously, shortages can be caused by conveyance limitations such as pump station and pipeline utilization. Results showed that, although there were zero days when pump station utilization exceeded 95% capacity during summer months, there were some days when pipeline capacity exceeded 95% during summer months. Analyzing the monthly trend in Pipeline Flow Volume indicates that Pipeline Utilization is typically highest during summer months of June to September when water demand is at its seasonal high. In the Basin Study, five pipeline locations were analyzed: MWD Untreated, Crossover, 30-Inch, Pipeline 4 (just south of TOV), and MWD Treated (see Figure 164). The average number of summer days when pipeline capacity exceeded 95% capacity was minimal at all pipeline locations other than Untreated. For 2050 demands at the Untreated location, the average number of summer days when pipeline capacity exceeded 95% was lower in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios (which are similar) than in the Baseline, Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios (which were similar). The lower pipeline utilization in the Enhanced Conservation and Increase Supplies Portfolios at the
Untreated pipeline location is most likely due to less dependence on Imported Water in these Portfolios, meaning that less MWD Untreated water would be delivered to the region through the Untreated location. The lower pipeline utilization in the Optimize Existing Facilities Portfolio is due to the Pipeline 3/ Pipeline 4 Conversion project, which provides a higher capacity for MWD Untreated water. Climate change scenarios did not appear to have a significant impact on pipeline utilization.

Figure 164. High Pipeline Utilization Summer Count for the Untreated Pipeline for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

Treatment Plant Utilization is another potential conveyance constraint on the system. Because treatment plants are sized for a specified range of design flows, utilization above or below the typical operating range may be problematic. High utilization does not appear to be an issue for the San Diego region, but low utilization may be a concern. Low utilization could result in temporary shutdown of treatment plant operations, potential water quality issues in the distribution system, and/or other operational challenges. These impacts are not able to be directly captured in the CWASim model results, but the potential for these types of impacts is indicated.
by the treatment plant utilization results. None of the treatment plants exceeded 90% utilization in any of the Portfolios, which can be attributed to current excess capacity resulting from a significant drop in demand experienced since peak utilization in 2007. The system-wide average of treatment plant utilization in the Baseline Portfolio was 54% in 2015, 55% in 2025, and 58% in 2050. The Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios had similar averages to the Baseline Portfolio, with 54% utilization in 2015 and 2025, and 56% utilization in 2050. System wide averages were lowest in the Enhanced Conservation Portfolio, with 54% in 2015, 49% in 2025, and 37% in 2050, followed by the Increase Supplies Portfolio, with 54% in 2015, 52% in 2025, and 50% in 2050. The lower utilization in the Enhanced Conservation Portfolio is due to lower demands, and the lower utilization in the Increase Supplies Portfolio is due to the availability of local supply sources that do not require treatment at the existing surface water treatment facilities. In the 2050 scenarios, the treatment plant utilizations observed in the Enhanced Conservation Portfolio are at levels that could cause operational challenges. In most treatment plants, utilization was higher with central tendency climate than current climate for all Portfolios.

Water supply storage is an important factor in providing water deliveries, as stored water can be released when needed to meet demands. Monthly Average Reservoir Storage and Releases for water supply were analyzed for reservoirs to look for changes in reservoir performance relative to their operational rules as described by their rule curves. Overall, reservoirs operated within the ranges specified by their 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. Water demands are typically highest in the summer months, so End of September Reservoir Storage was analyzed as a measure of reservoir carryover storage that can be used for supply in the following year (a higher carryover storage indicates a higher water supply for the following year). For three of the four reservoirs analyzed, End of September Storage was above the reservoir’s carryover pool (if it exists) or above the reservoir’s emergency storage pool and within the seasonal pool (if there is no designated carryover pool). However, San Vicente End of September Storage was above the emergency storage pool but below the designated carryover pool in all Portfolios and scenarios, indicating that it has additional capacity for carryover storage that is not used even with a range of possible additional water supply sources and conveyance system improvements. End of September Storage at San Vicente was highest in the Increase Supplies Portfolio, but still had a storage that was below the designated carryover storage volume.

9.1.2. Energy

Energy is used for conveying water supplies through pipelines by pumping, for treating raw water for potable use, for treating wastewater for non-potable or potable reuse, and for desalinating seawater. Results show that energy consumption is slightly lower in the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios than in the Baseline Portfolio (see Figure 165), which indicates that energy consumed by the additional projects in these Portfolios is offset in other areas of the system, most likely by the reduction of Imported Water usage compared to the Baseline Portfolio. Energy consumption in the Enhanced Conservation Portfolio is significantly less than in the Baseline and Baseline Plus Portfolios due to the reduction in deliveries, and thus use of treatment plants and conveyance facilities, indicating that demands are a major driver of energy consumption (i.e., reduced demands lead to reduced energy consumption). As discussed in Section 9.1.1, the Enhanced
Conservation and Increase Supplies Portfolio actually use less Imported Water to meet 2050 demands than they do to meet 2025 demands. This may be one of the reasons that the Increase Supplies Portfolio consumes less energy than the Baseline and Baseline Plus Portfolios. The Increase Supplies Portfolio includes projects that are typically considered energy intensive such as Seawater Desalination that appear to be offset by the reduction in Imported Water usage compared to the Baseline Portfolio. Climate scenarios simulated indicate that energy consumption is higher with central tendency climate than with current climate for 2025 and 2050 demands; however, this difference is minimal compared to the difference in energy consumption that was observed between the various Portfolios.

Figure 165. Energy Consumption for each Portfolio with current climate, central tendency climate, and hot-dry climate for the 2015 demand scenario, 2025 demand scenario, and 2050 demand scenario.

9.1.3. Recreation
Although the primary beneficial use of reservoirs in the San Diego region is water supply and reservoirs are not specifically operated for recreation, recreation opportunities are an incidental benefit of reservoirs. Impacts to Recreation were quantified using boat ramp accessibility at the
end of September by comparing the boat ramp elevation to the End of September Elevation for El Capitan, Hodges, Lower Otay, and San Vicente Reservoirs. In general, impacts to recreation were observed in Baseline, Baseline Plus, and Watershed Health and Ecosystem Restoration. Other Portfolios reduce or eliminate these impacts and recreation is either unaffected or minimally impacted. End of September Elevation is typically higher in the Optimize Existing Facilities Portfolio (this is the case for El Capitan, Lower Otay, and San Vicente) due to improved conveyance and reservoir management. The higher End of September Elevation is also observed with the Increase Supplies and Enhanced Conservation Portfolios (this is the case for El Capitan, Lower Otay, and San Vicente), due to the increased water supply availability for Increase Supplies and the decreased demands for Enhanced Conservation.

At El Capitan, boat ramps are inaccessible in many realizations (between 61-81% of realizations) for 2015, 2025, and 2050 demands in all Portfolios except the Optimize Existing Facilities Portfolio. In the Optimize Existing Facilities Portfolio, there are no realizations below the El Capitan boat ramp elevation in 2050. The average End of September Elevation is just below the boat ramp elevation in the Baseline, Baseline Plus, and Watershed Health and Ecosystem Restoration Portfolios, just above the boat ramp for the Enhanced Conservation and Increase Supplies Portfolios, and significantly above the boat ramp in the Optimize Existing Facilities Portfolio.

The average End of September Elevation at Hodges remains above the boat ramp elevation in all Portfolios and demand scenarios. The same is true looking at individual realizations, with the exception of one realization in the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands that is at the boat ramp elevation. End of September elevation is shown to decrease in the Baseline Plus Portfolio for 2050 demands when the Hodges Water Quality Improvement Program is implemented; however, since the reservoir still operates at or above the boat ramp elevation for all realizations, this impact is not significant.

At Lower Otay, all Baseline Portfolio runs have some realizations when End of September Reservoir Elevation is below the boat ramp elevation (25-33% for 2025 demands and 26-45% for 2050 demands). This is improved in all Portfolios and completely eliminated in the Enhanced Conservation Portfolio. The average End of September elevation is higher in the Baseline Plus and subsequent Portfolios than in the Baseline Portfolio due to the Mission Trails Alternative 1 project, which increases the amount of imported water that can be delivered to the southern portion of San Diego County, increasing the amount that can be stored in Lower Otay Reservoir. End of September Elevation is slightly higher in Enhanced Conservation than Baseline Plus in 2050 due to decreased demands. It is also higher in the Optimize Existing Facilities Portfolio in 2050 due to the Dulzura Conduit Replacement, which improves capacity of the Dulzura Conduit that delivers water to Lower Otay. These two Portfolios are the only Portfolios in which all realizations are completely above the boat ramp elevation for current climate with 2050 demands. There are still some realizations below the boat ramp elevation in the Optimize Existing Facilities Portfolio for hot-dry climate (4% of realizations) and warm-dry climate (1% of realizations).

Boat ramps remain accessible in all scenarios for San Vicente when looking at average elevation and individual realizations. End of September Elevations are highest in the Increase Supplies Portfolio for 2050 demands due to implementation of Pure Water San Diego Phase 2, which
Supplies 59,400 AF/y (53 mgd) from Central Area Advanced Water Reclamation Plant to San Vicente Reservoir.

9.1.4. Flood Control

Flood control impacts were measured by the number of days with flood outflows and the average annual flood outflow volume at El Capitan, Hodges, Lower Otay, San Vicente, and Olivenhain Reservoirs. The number of days with flood outflows represents a sum of the number of days per year in which the reservoir must release or spill water in excess of releases for water deliveries because the storage volume is at or above the flood pool. The Flood Outflow Volume is the annual sum of the volume released on days when the reservoir is in the flood pool, and may include both releases for water deliveries and flood releases or spills. Flood Outflows may indicate constraints in the conveyance system to move water for optimal storage, as well as a lack of demand during high water availability periods.

At El Capitan, there were no significant differences in the number of days with flood outflows or the average annual flood outflow volume between the Baseline, Baseline Plus, Enhanced Conservation, or Watershed Health and Ecosystem Restoration Portfolios. The number of days with flood outflows was larger in the Increase Supplies Portfolio than in the Baseline and Baseline Plus Portfolios, which can be attributed to the increased water supplies in the region, which may cause storage at El Capitan to increase. The number of days with flood outflows was lower in the Optimize Existing Facilities Portfolio than in the Baseline Plus Portfolio due to implementation of the San Diego Reservoir Intertie, indicating that the greater operational flexibility created by the Intertie has positive impacts on flood management. There are no statistical differences in flood outflow volume between Portfolios.

At Hodges, which is historically the most prone to spills, the average number of flood outflows is significantly decreased in the Baseline Plus Portfolio compared to the Baseline Portfolio, which can be attributed to the Hodges Water Quality Improvement Program. Once the water quality at Hodges meets standards to move into the Regional Aqueduct System due to this project, it can be utilized more in the system causing the storage to decrease so that the reservoir’s normal operating conditions are farther from the flood zone. This decrease in the number of flood outflows is also observed in the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios since all projects included in the Baseline Plus Portfolio are included in these Portfolios.

At Lower Otay there are no significant differences between all Portfolios other than the Baseline and Enhanced Conservation Portfolios, where the number of flood outflows at Lower Otay is higher in the Enhanced Conservation Portfolio than in the Baseline Portfolio. This is due to the increased storage at Lower Otay in the Enhanced Conservation Portfolio, and the increased storage is possible since less water at Lower Otay is needed to meet demands. Although the higher storage at Lower Otay is observed in both the Enhanced Conservation and Optimize Existing Facilities Portfolios, releases are also higher in the Optimize Existing Facilities Portfolio since the water is used to meet demands, so the reservoir storage does not contribute to flood outflows.

There were no flood outflows occurring at San Vicente in any of the Portfolios for 2015, 2025, and 2050 demands, which is expected as it has a small watershed and operationally has the
greatest flexibility of the local reservoirs to move water throughout the regional water supply system. There were also no flood outflows at Olivenhain.

There were no statistical differences between climate scenarios in the average number of flood outflows or flood outflow volume based on the ANOVA analysis. However, based on observations, there are more flood outflows and higher flood outflow volumes associated with the warm-wet and hot-wet scenarios, and less flood outflows and lower flood outflow volumes associated with the hot-dry and warm-dry scenarios. This would be due to decreased reservoir storage in the hot-dry and warm-dry climates and more extreme precipitation simulated in the warm-wet and hot-wet scenarios.

9.2. Limitations

Simulation modeling of future water system operations is a powerful tool for providing insights into potential impacts of factors such as climate change and increasing demand. In order to perform simulation modeling, studies must also incorporate simplifications of system operations and assumptions about future conditions. The assumptions and simplifications that were made for the San Diego Basin Study have been documented in Chapters 3, 4, and 5; some key assumptions are highlighted here. Although these simplifications and assumptions were implemented, rigorous testing of the CWASim model was performed to ensure that results are representative of the conditions and trends that could be expected as a result of the scenarios examined in the Study.

Demands used in this Study were characterized by the 2015 SDCWA UWMP water supply and demand assumptions with minor modifications. Although SDCWA updated its demand forecast in 2018 to reflect changes in demand trends since the publication of the 2015 UWMP, the update occurred too late in the Basin Study process to be incorporated into the Study. Therefore, the Basin Study used demand projections from the 2015 UWMP, which are higher than the SDCWA 2018 demand forecast (San Diego County Water Authority, 2018a). Additionally, SDCWA will conduct a full re-estimation of demand forecast for the 2020 UWMP, which will most likely differ from demands used in the Basin Study.

It was assumed that the QSA would remain constant through 2050 with a supply volume of 280,000 AF/y. However, users of the Basin Study should consider the potential for renegotiation of the agreement and/or changes in water supply availability that could affect the supply volume. Other imported water supplies, such as MWD supplies from the SWP and CRA, were also assumed to remain available for the duration of the Study; however, reliability of imported water deliveries to the San Diego region is uncertain due to recurring droughts in northern California and the Colorado River Basin, regulatory restrictions related to endangered species in the Bay-Delta that limit SWP deliveries, the potential for catastrophic events such as earthquakes, and impacts of climate change. If the availability of one or both of these imported supplies was reduced, the region could experience greater shortage impacts than those observed in the Basin Study results.

Although supplies from projects modeled as demand reductions (e.g., recycled water, groundwater, some potable reuse, etc.) may need to be conveyed, treated, and/or stored within
the San Diego system, the CWASim model is not able to simulate the potential effects of these projects on the conveyance system or reservoirs. Therefore, metrics for Pipeline Flow Volume, High Pipeline Utilization Summer Count, High Pump Station Utilization, Treatment Plant Utilization, Reservoir Storage, Reservoir Releases, End of September Storage, Energy Consumption and Generation, End of September Elevation, Number of Days with Flood Outflows, and Flood Outflow Volume do not include the effects of these projects. However, because most of these projects are local projects for single member agencies, the regional effects that are the primary focus of the CWASim model are likely to be limited in scope.

Projects were modeled based on the best available information about their capacities and water supply volumes at the time the model runs were performed. These volumes are described in Chapters 3 and 4 and in Appendix A – Projects Spreadsheet. However, since many projects were at a very early stage of planning, there have been changes to anticipated volumes or capacities for some projects after the model runs for the Study were completed. Users of the Basin Study should consider the projects to be examples of the types of projects that could be implemented and approximations of potential impacts.

9.3. Opportunities and Next Steps

Projects modeled in the San Diego Basin Study represent a wide range of strategies that could be implemented individually or in combination to address the impacts of increasing demand and climate change. For the purposes of analysis, projects and Concepts were grouped into distinct Portfolios based on consultation with public stakeholders and STAC members. Baseline and Baseline Plus projects were included in all other Portfolios because they currently exist, are known to be near completion, or are very certain to proceed. Conceptual projects, however, were only modeled in one of the other Portfolios (Increase Supplies, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios). The Portfolio approach simplified analysis and aided in understanding the causes of changes in metric values, but it does not reflect the actual future for water system development and adaptation. Instead, it is likely that San Diego’s future water system will contain a mix of conceptual projects from some or all Portfolios. Based on the results, the Increase Supplies Portfolio may provide for more water reliability due to the increase of local supply sources and decreased dependence on imported water; however, it may not reduce the number of flood outflows from reservoirs. Implementing an intertie project from the Optimize Existing Facilities Portfolio may pair well with projects from the Increase Supplies Portfolio to increase water supply reliability while at the same time allowing for better management of reservoir storage to decrease the number of flood outflows. Although the Optimize Existing Facilities Portfolio did not reduce potential Shortage Volumes, its conveyance improvement did allow for increased storage for some reservoirs and fewer conveyance limitations. Since the Enhanced Conservation Portfolio only included the Concept of Enhanced Conservation, it may be beneficial to use the results to predict what may occur when this Portfolio is combined with Concepts like Potable Reuse and Recycled Water from the Increase Supplies Portfolio. Trade-offs between Concepts are examined in Task 2.5.

The interaction of Concepts and Portfolios may also cause impacts that were not observed in the Basin Study, such as the interaction of conservation with Potable Reuse. While the results of the
Enhanced Conservation Portfolio indicate that conservation is a promising option for addressing water delivery needs, the increase in conservation may have an adverse effect in decreasing the amount or quality of wastewater available for Potable Reuse. This type of interaction could also possibly occur with Gray Water Use. However, projected volumes of Gray Water Use are likely not high enough to have an appreciable impact to the wastewater available for Potable Reuse. In addition, temporary shutdown of treatment plant operations may occur (or occur more often) with Enhanced Conservation, resulting in operational challenges and/or potential water quality issues in the distribution system. These challenges were not reflected in the CWASim model results.

Although Environmental impacts were not considered in Task 2.4 due to model limitations, these impacts are important to consider within the region. For many of the metrics examined here, the Watershed Health and Ecosystem Restoration Portfolio had similar results to the Baseline Plus Portfolio due to modeling limitations of projects that did not have specific supply volumes. The projects from the Watershed Health and Ecosystem Restoration Portfolio are likely to have positive environmental benefits that should be considered when comparing Portfolios and interpreting results. Environmental benefits and impacts are addressed in Task 2.5.

9.4. Summary

Based on analysis completed in the San Diego Basin Study, the Portfolios analyzed may be useful adaptation strategies that the region can employ when faced with water supply and demand imbalances. The results of this analysis can be used by stakeholders to identify promising opportunities for addressing the impacts of increasing demand and climate change on water delivery, energy, recreation, and flood control.

If no additional adaptation strategies are employed in the region beyond the infrastructure and policies that were in place as of 2015 as represented by the Baseline Portfolio, the CWASim model indicates that increasing demand and changing climate may result in shortages within the region above the level that can generally be mitigated by short term drought response. If the region were to experience climate conditions similar to the hot-dry or warm-dry climate scenarios, the shortages could be further exacerbated. In addition to the increased possibility of shortages in the region, the Baseline Portfolio shows an increase in issues associated with high pipeline utilization for the untreated MWD pipeline, and higher energy consumption, which may be associated with increased operating and repair costs. The Baseline Portfolio was also associated with higher dependence on imported water.

By continuing to support the region’s active investments as simulated in the Baseline Plus Portfolio, improvements in water supply reliability are possible, as indicated by a decreased occurrence of shortages (although shortages may not be completely eliminated), while also having less dependence on imported water when compared to the Baseline. Analysis of results for the other Portfolios beyond Baseline Plus demonstrates that there are promising options that the San Diego region may consider for future investments to further secure reliable water supplies. Results for the Enhanced Conservation Portfolio, which represents long-term or permanent restrictions in water use to decrease demand, demonstrate the direct benefits of conservation, as no shortages occurred in the model results. The Enhanced Conservation
Portfolio also demonstrates indirect benefits of conservation, such as reduced energy consumption, fewer pipeline capacity issues due to high utilization, increased reservoir storage that provides a direct benefit to recreation, and less dependence on imported water. The Increase Supplies Portfolio addresses challenges such as water reliability and dependence on imported water while providing benefits such as decreased shortages, fewer issues associated with high pipeline utilization, and increased reservoir storage that provides a direct benefit to recreation, without implementation of the conservation associated with the Enhanced Conservation Portfolio. While the Optimize Existing Facilities Portfolio may not address challenges such as water reliability or reduced dependence on imported water (compared to Baseline Plus), it does provide benefits by maximizing the region’s existing infrastructure and allowing for improved reservoir management that may provide flood control benefits that were not seen in other Portfolios. Similar impacts were observed for the Watershed Health and Ecosystem Restoration Portfolio compared to the Baseline Plus Portfolio, since many of the environmental projects included in this Portfolio were unable to be simulated in the CWASim model due to the lack of available supply volumes. In addition to the benefits that were exhibited by the Baseline Plus Portfolio, this Portfolio would likely exhibit positive environmental impacts.
References


with preceding Information, and Summary of User Needs: https://gdo-dcp.ucllnl.org/downscaled_cmip_projections/


Taylor et al. (2012). An Overview of CMIP5 and the Experiment Design.

World Climate Research Programme. (2007). *Coupled Model Intercomparison Project Phase 3 (CMIP3).*

World Climate Research Programme. (2013). *Coupled Model Intercomparison Project Phase 5 (CMIP5).*
Appendices

Appendix A – Projects Spreadsheet
Appendix B – Model Implementation of Selected Projects
Appendix C – Energy Consumption and Generation Model Implementation
Appendix D – Run Results
Appendix A - Projects Spreadsheet

Appendix A contains a spreadsheet listing all the projects analyzed in the San Diego Basin Study. The spreadsheet indicates which Portfolio each Project belongs to, whether it was modeled, and if so, provides information on the model implementation of the project.
<table>
<thead>
<tr>
<th>Project Name</th>
<th>Source</th>
<th>Project Type</th>
<th>Model/Concept</th>
<th>Status</th>
<th>Verify Demands Spreadsheet</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alvarado Water Treatment Plant</td>
<td>City of San Diego</td>
<td>Conveyance Improvement</td>
<td>Existing Yes Included Model</td>
<td>942</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Badger Water Treatment Plant</td>
<td>Santa Fe Irrigation District</td>
<td>Conveyance Improvement</td>
<td>Existing Yes Included Model</td>
<td>123</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Bakersfield Street and San Altos Channel Restoration</td>
<td>Sweetwater Authority</td>
<td>Stormwater BMPs</td>
<td>Planned Yes Included Model</td>
<td>12</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Barrett Reservoir</td>
<td>City of San Diego</td>
<td>Local Surface Water Reservoir</td>
<td>Existing Yes Included Input Spreadsheet</td>
<td>37,900</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Broadway Channel Flood Risk Reduction and Water Quality Improvements</td>
<td>Helix Water District</td>
<td>Stormwater BMPs</td>
<td>Planned No Not Able to Model</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Broadway/Federal Blvd Green Street</td>
<td>Sweetwater Authority</td>
<td>Watershed and Ecosystem Management</td>
<td>Planned No Not Able to Model</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Camp Pendleton Desalination Facility</td>
<td>Carlsbad Municipal Water District</td>
<td>Seawater Desalination</td>
<td>Planned Yes Included Model</td>
<td>328</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Carlsbad WRF/Carlsbad MWD</td>
<td>Carlsbad Municipal Water District</td>
<td>Recycled Water</td>
<td>Verifiable Yes Included Model</td>
<td>2,831</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Canton Dr Green Street</td>
<td>Sweetwater Authority</td>
<td>Watershed and Ecosystem Management</td>
<td>Planned No Not Able to Model</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Central Avenue Green Street</td>
<td>Sweetwater Authority</td>
<td>Watershed and Ecosystem Management</td>
<td>Planned No Not Able to Model</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>City of Oceanside Loma Alta Slough Restoration Project</td>
<td>City of Oceanside</td>
<td>Stormwater BMPs</td>
<td>Included Not Able to Model</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Carlsbad WRF – Landscape, Agriculture 2025</td>
<td>Carlsbad Municipal Water District</td>
<td>Recycled Water</td>
<td>Planned Yes Included Model</td>
<td>328</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Carlsbad WRF – Landscape, Agriculture 2050</td>
<td>Carlsbad Municipal Water District</td>
<td>Recycled Water</td>
<td>Conceptual Yes Included Model</td>
<td>616</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Carlsbad WRF – Landscape, Agriculture 2025</td>
<td>Carlsbad Municipal Water District</td>
<td>Recycled Water</td>
<td>Planned Yes Included Model</td>
<td>328</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Carlsbad WRF – Landscape, Agriculture 2050</td>
<td>Carlsbad Municipal Water District</td>
<td>Recycled Water</td>
<td>Conceptual Yes Included Model</td>
<td>616</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Carlsbad WRF/Carlsbad MWD</td>
<td>Carlsbad Municipal Water District</td>
<td>Recycled Water</td>
<td>Verifiable Yes Included Model</td>
<td>2,831</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Cadiz additional imported supplies</td>
<td>Otay Water District</td>
<td>Imported Water Purchases</td>
<td>Conceptual Yes Included Model</td>
<td>5,000</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>City of San Diego</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Name</td>
<td>Source</td>
<td>Type of Activity</td>
<td>Project Description</td>
<td>Status</td>
<td>Model Implementation</td>
<td>Demolition Dates</td>
<td>Water Source</td>
<td>Modelled/Spreadsheets</td>
<td>Modelled/Spreadsheets</td>
<td>Source to Modelled</td>
<td>2015</td>
<td>2020</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>-----------------</td>
<td>---------------------</td>
<td>--------</td>
<td>----------------------</td>
<td>-----------------</td>
<td>--------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Capitan Reservoir</td>
<td>El Capitan Reservoir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Name</td>
<td>Concept</td>
<td>Source Agency</td>
<td>Document</td>
<td>Source to Model?</td>
<td>Model Logic</td>
<td>Model Implementation</td>
<td>Demand Scenario</td>
<td>Modelling Notes/Questions</td>
<td>UWMP/SDCWA Water Shortage Contingency</td>
<td>Source to Model?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>--------------</td>
<td>----------</td>
<td>-----------------</td>
<td>------------</td>
<td>----------------------</td>
<td>----------------</td>
<td>--------------------------</td>
<td>---------------------------------</td>
<td>--------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hodges Water Quality Improvement Program</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhanced and Enhancements Management</td>
<td>City of San Diego</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Name</td>
<td>Concept</td>
<td>Source Agency</td>
<td>Document</td>
<td>Source to Model?</td>
<td>Model Logic</td>
<td>Model Implementation</td>
<td>Demand Scenario</td>
<td>Modelling Notes/Questions</td>
<td>UWMP/SDCWA Water Shortage Contingency</td>
<td>Source to Model?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDCWA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Optimize Existing Facilities

Watershed Health & Ecosystem Resetoration

Increase Supplies

Enhanced Conservation

Baseline

Project Name

Projects Spreadsheet

Baseline+

Projects_082318

Concept

CWASim SDCWA Member Agency

Project Source Document

Status

To be Modeled?

CWASim Model Status

Main Street Promenade Extension

X

Stormwater BMPs

Sweetwater Authority

SWRP ‐ Listed

Planned

Yes

Included ‐ Approved

Mapleview Street ‐ Green
Infrastructure and Stormwater
QualityImprovement Project

X

Stormwater BMPs

County of San Diego

SWRP ‐ Listed

Planned

No

Not Able to Model

Massachusetts Blvd Green Street

X

Meadowlark WRF
Meadowlark WRF (via Mahr Reservoir)
/Vallecitos WD

X
X

X

X

Meadowood WRF
Middle Sweetwater River Basin
Groundwater Well System
Miramar Pump Station

X

X

X

X

Watershed and Ecosystem Management Sweetwater Authority
Recycled Water

X

X

Recycled Water

X

Recycled Water

X

Groundwater

X

X

X

Conveyance Improvement

10/31/2018

Model Implementation

Demand Scenario

Input Demands Spreadsheet

2050

Modeling Notes/Questions

Confirmed by

Scenario Model Input

2015

2020

2025

23

Water Supply Volume (AF/yr)

‐

‐

‐

N/A

N/A

UWMP

N/A

‐

‐

‐

‐

‐

‐

‐

N/A

N/A

UWMP

N/A

‐

‐

‐

‐

‐

‐

‐

‐

‐

‐

‐

Planned

No

Not Able to Model

Carlsbad Municipal Water District

Conceptual

Yes

Included ‐ Approved

Input Demands Spreadsheet

2050

Addition to Carlsbad's recycled supply

UWMP

Water Supply Volume (AF/yr)

Carlsbad Municipal Water District

UWMP Verifiable ‐ Recycled
Water

Verifiable

Yes

Included ‐ Approved

Input Demands Spreadsheet

2015

Recycled supply for Carlsbad

UWMP

Water Supply Volume (AF/yr)

Conceptual

Yes

Included ‐ Approved

Input Demands Spreadsheet

2025

Addition to Valley Center's recycled supply

UWMP

Water Supply Volume (AF/yr)

‐

‐

Conceptual

Yes

Included ‐ Approved

Input Demands Spreadsheet

2050

Addition to Otay's groundwater supply

UWMP

Water Supply Volume (AF/yr)

‐

‐

Existing

Yes

Included ‐ Approved

Model Logic

2015

Capacity 60 cfs

UWMP

Pump Station Capacity

‐

‐

‐

2015

Capacity in the model 6,050 AF, is based on
SDCWA Reservoir Summary Report (March
1990). Does not include dead pool.

SDCWA Reservoir Summary Report (1990)

Reservoir Capacity

‐

‐

‐

Otay Water District
SDCWA

2040

UWMP

SWRP ‐ Listed

Valley Center Municipal Water District

2035

Add to conservation for Sweetwater Authority

UWMP Project Concept ‐
Recycled Water

UWMP Project Concept ‐
Recycled Water
UWMP Project Concept ‐
Groundwater
N/A

2030

2050
(assumed
equivalen
t to 2040
unless a
2050
value is
known)

2,000

2,000

23

187
2,000

100

23

187

2,000

187

2,000

2,000

143

143

143

143

1,000

1,000

1,000

1,000

‐

‐

‐

‐

‐

‐

‐

‐

‐

Miramar Reservoir

X

X

X

X

X

X

Local Surface Water Reservoirs

City of San Diego

N/A

Existing

Yes

Included ‐ Approved

Miramar Water Treatment Plant

X

X

X

X

X

X

Conveyance Improvement

City of San Diego

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

Capacity 531 AF/day (144 mgd).

UWMP

Treatment Plant Capacity

‐

‐

‐

‐

‐

‐

‐

Mission Basin Desalter Facility ‐ 1st &
2nd Phase of Desal Expansion & IPR

X

X

X

X

X

X

Groundwater

City of Oceanside

UWMP Verifiable ‐
Groundwater

Verifiable

Yes

Included ‐ Approved

Input Demands Spreadsheet

2015

Groundwater supply for Oceanside

UWMP

Water Supply Volume (AF/yr)

3,300

3,300

3,700

3,700

3,700

3,700

3,700

X

X

X

X

X

Conveyance Improvement

SDCWA

CWA Facilities Master Plan

Conceptual

Yes

Included ‐ Approved

Model logic

2025

Implemented per Regional Facilities Master
Plan modeling as increase in conveyance
capacity. Include for 2025 level as CWA is
currently requesting bids for design.

UWMP

Conveyance capacity

Groundwater

City of San Diego

UWMP Project Concept ‐
Groundwater

Conceptual

Yes

Included ‐ Approved

Input Demands Spreadsheet

2025

Addition to City of San Diego's groundwater
supply

UWMP

Water Supply Volume (AF/yr)

City of San Diego

N/A

Existing

Yes

Included ‐ Approved

Input Spreadsheet

2015

Capacity in the model 50,200 AF, is based on
SDCWA Reservoir Summary Report (March
1990). This is does not include deadpool.

SDCWA Reservoir Summary Report (1990)

Reservoir Capacity

‐

‐

‐

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

93 cfs

SDCWA CIP Water Facilities System
Schematic

Pipeline Capacity

‐

‐

‐

City of San Diego

IRWM ‐ Prop 84.4

Planned

Yes

Included ‐ Approved

Input Demands Spreadsheet

2050

Added to City of San Diego conservation table

UWMP

N/A

‐

‐

‐

SWRP ‐ Listed

Planned

No

Not Able to Model

N/A

UWMP

N/A

‐

‐

‐

Mission Trails Projects Alternative 1

Mission Valley Brackish Groundwater
Recovery Project

X

Morena Reservoir

X

X

X

X

X

X

Local Surface Water Reservoirs

Moreno‐Lakeside Pipeline

X

X

X

X

X

X

Conveyance Improvement

X

X

X

X

X

Urban and Agricultural Water Use
Efficiency

Ms. Smarty‐Plants Grows Water‐Wise
Schools

Mt. Vernon St Green Street
Murray Reservoir

X

N/A

Total Modeled Capacity 5,200 AF. Includes
surcharge capacity.
Addition to City of San Diego's conservation
volume

X

X

X

X

X

Local Surface Water Reservoirs

City of San Diego

N/A

Existing

Yes

Included ‐ Approved

Input Spreadsheet

2015

X

X

X

X

X

Stormwater Capture

City of San Diego

N/A

Conceptual

Yes

Included ‐ Approved

Input Demands Spreadsheet

2025

X

X

X

X

X

X

Groundwater

Yuima Municipal Water District

UWMP Verifiable ‐
Groundwater

Verifiable

Yes

Included ‐ Approved

Input Demands Spreadsheet

2015

None

MWD Allocation

X

X

X

X

X

X

Drought Restriction/Allocation

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

See model documentation

MWD Imported Water

X

X

X

X

X

X

Imported Water Purchases

SDCWA

National City Well Field

X

X

X

X

X

X

Groundwater

Baseline
UWMP Verifiable ‐
Groundwater

Murray Urban Runoff Diversion
System Capture
Mutual Water Company wells within
district

X

Watershed and Ecosystem Management Sweetwater Authority

Input Spreadsheet

2,000

23

Nestor Creek Channel Restoration

New Local Supply Rincon del Diablo ‐
Hale Avenue RRF/ City of
Escondido/WRFs
North Ave and Grove Green Street

X

X

Watershed and Ecosystem Management City of San Diego

Potable Reuse

X

Sweetwater Authority

Rincon del Diablo Municipal Water
District

Watershed and Ecosystem Management Sweetwater Authority

UWMP/City Staff Mann

Reservoir Capacity

City Staff

Water Supply Volume (AF/yr)

UWMP

Water Supply Volume (AF/yr)

‐

‐

‐
‐

840

‐

1,680

1,680

1,680

1,680

‐

‐

‐

‐

‐

‐

‐

‐

6

‐
‐

‐

6

‐
‐

200

6

‐
‐

200

6

‐
‐

200

‐
200

200

7,000

7,000

7,000

7,000

7,000

7,000

7,000

‐

‐

‐

‐

‐

‐

‐

Existing

Yes

Included ‐ Approved

Model Logic

2015

See model documentation

UWMP

Available Water Volume

‐

‐

‐

‐

‐

‐

‐

Verifiable

Yes

Included ‐ Approved

Input Demands Spreadsheet

2015

Groundwater supply for Sweetwater

UWMP

Water Supply Volume (AF/yr)

2,100

2,100

2,100

2,100

2,100

2,100

2,100

SWRP ‐ Listed

Planned

No

Not Able to Model

N/A

UWMP

N/A

‐

‐

‐

UWMP Additional Planned ‐
Potable Reuse

Planned

Yes

Included ‐ Approved

Addition to Rincon's recycled/potable reuse
supply

UWMP

Water Supply Volume (AF/yr)

‐

‐

‐

SWRP ‐ Listed

Planned

No

Not Able to Model

N/A

UWMP

N/A

‐

‐

‐

N/A

Input Demands Spreadsheet

N/A

Page 4 of 10

2050

‐

‐

200

‐

‐

1,000

‐

‐

1,000

‐

1,000

‐


<table>
<thead>
<tr>
<th>Project Name</th>
<th>Baseline</th>
<th>Water Source</th>
<th>Delivery</th>
<th>CIP</th>
<th>Source</th>
<th>CWASim</th>
<th>SDCWA</th>
<th>DEMAND</th>
<th>Scenario</th>
<th>Note/Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>North City WWP - Project 1</td>
<td>X</td>
<td>Recycled Water</td>
<td>City of Poway</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demands Spreadsheet</td>
<td>2015</td>
<td>Addition to Poway's recycled supply</td>
<td>UNKN Water Supply Volume [AF/yr]</td>
</tr>
<tr>
<td>North City WWP - Project 2</td>
<td>X</td>
<td>Recycled Water</td>
<td>City of Poway</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demands Spreadsheet</td>
<td>2015</td>
<td>Addition to Poway's recycled supply</td>
<td>UNKN Water Supply Volume [AF/yr]</td>
</tr>
<tr>
<td>North County Public Services District (Second Supply)</td>
<td>X</td>
<td>Recycled Water</td>
<td>City of Poway</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demands Spreadsheet</td>
<td>2015</td>
<td>Addition to Poway's recycled supply</td>
<td>UNKN Water Supply Volume [AF/yr]</td>
</tr>
<tr>
<td>North County Program Projects</td>
<td>X</td>
<td>Recycled Water</td>
<td>City of Poway</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demands Spreadsheet</td>
<td>2020</td>
<td>Addition to Poway's recycled supply</td>
<td>UNKN Water Supply Volume [AF/yr]</td>
</tr>
<tr>
<td>North County Program Projects</td>
<td>X</td>
<td>Recycled Water</td>
<td>City of Poway</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demands Spreadsheet</td>
<td>2025</td>
<td>Addition to Poway's recycled supply</td>
<td>UNKN Water Supply Volume [AF/yr]</td>
</tr>
<tr>
<td>North County Program Projects</td>
<td>X</td>
<td>Recycled Water</td>
<td>City of Poway</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demands Spreadsheet</td>
<td>2030</td>
<td>Addition to Poway's recycled supply</td>
<td>UNKN Water Supply Volume [AF/yr]</td>
</tr>
<tr>
<td>North County Program Projects</td>
<td>X</td>
<td>Recycled Water</td>
<td>City of Poway</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demands Spreadsheet</td>
<td>2035</td>
<td>Addition to Poway's recycled supply</td>
<td>UNKN Water Supply Volume [AF/yr]</td>
</tr>
<tr>
<td>North County Program Projects</td>
<td>X</td>
<td>Recycled Water</td>
<td>City of Poway</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demands Spreadsheet</td>
<td>2040</td>
<td>Addition to Poway's recycled supply</td>
<td>UNKN Water Supply Volume [AF/yr]</td>
</tr>
</tbody>
</table>

**Note:**
- "X" indicates the project is included in the model.
- "Yes" indicates the project is approved.
- "CS" indicates the project is conceptual.
- "End of Project" indicates the end of the project.
- "UNKN" indicates unknown.
- "N/A" indicates not applicable.
- "Pipeline Capacity" indicates the pipeline capacity.
Optimize Existing Facilities

Watershed Health & Ecosystem Resetoration

Increase Supplies

Enhanced Conservation

Baseline

Project Name

Projects Spreadsheet

Baseline+

Projects_082318

Concept

CWASim SDCWA Member Agency

Project Source Document

Status

To be Modeled?

CWASim Model Status

Conveyance Improvement

SDCWA

CWA Facilities Master Plan

Conceptual

Yes

10/31/2018

Model Implementation

Demand Scenario

Included ‐ Approved

Model Logic

2050

Modeling Notes/Questions

Confirmed by

Scenario Model Input

2015

2020

2025

2030

2035

2040

2050
(assumed
equivalen
t to 2040
unless a
2050
value is
known)

‐

‐

‐

‐

‐

‐

‐

Timeline is beyond 2040, so turn on at 2050
Pipeline 3/Pipeline 4 Conversion

X

Including Option 1 from 2013 Master Plan
only, not option 2.

Treated or Untreated. Treated flow of 450 cfs
downstream of TOV. Minimum flow 40 cfs.
Minimum demands South of TOV to keep P4
flowing North to South 232 cfs.

Water Authority

Model Logic

SDCWA

Pipeline Capacity

Pipeline 4 (Second Aqueduct)

X

X

X

X

X

X

Conveyance Improvement

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

Pipeline 4 (Second Aqueduct) Relining

X

X

X

X

X

X

Conveyance Improvement

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

Expected to reduce capacity at Delivery Point
to 395 cfs.

SDCWA

Pipeline Capacity

Pipeline 5 (Second Aqueduct)

X

X

X

X

X

X

Conveyance Improvement

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

Untreated. P5 + P3 = 780 cfs before 7/1/2024,
and 720 cfs after. Downstream of TOV
conveyance capacity of 636 cfs.

SDCWA

Pipeline Capacity

‐

‐

‐

‐

‐

‐

‐

Pipeline 5 (Second Aqueduct) Relining

X

X

X

X

X

X

Conveyance Improvement

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

Untreated. P5 + P3 = 780 cfs before 7/1/2024,
and 720 cfs after.

SDCWA

Pipeline Capacity

‐

‐

‐

‐

‐

‐

‐

Pomerado Pipeline

X

X

X

X

X

X

Conveyance Improvement

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

Untreated. Capacity 220 cfs.

SDCWA

Pipeline Capacity

‐

‐

‐

‐

‐

‐

‐

Potable Reuse

City of Escondido

UWMP Project Concept ‐
Potable Reuse

Conceptual

Yes

Included ‐ Approved

Input Demands Spreadsheet

2050

Addition to Escondido's recycled/potable reuse
supply

UWMP

Water Supply Volume (AF/yr)

‐

‐

‐

5,000

5,000

5,000

X

Stormwater BMPs

City of San Diego

SWRP ‐ Listed

Planned

No

Not Able to Model

N/A

UWMP

N/A

‐

‐

‐

‐

‐

‐

‐

X

Potable Reuse

City of San Diego

UWMP Additional Planned ‐
Potable Reuse

Planned

Yes

Included ‐ Approved

Model Logic

2025

See write up. North City to Miramar, 30 mgd
by 2021

Jeff Pasek

Water Supply Volume (AF/yr)

‐

‐

‐

‐

‐

‐

‐

Potable Reuse

City of San Diego

UWMP Additional Planned ‐
Potable Reuse

Planned

Yes

Included ‐ Approved

Model Logic

2050

See write up. Central Facility to San V at 53
mgd.

Jeff Pasek

Facility Production Capacity (AF/yr)

‐

‐

‐

‐

‐

‐

‐

SDCWA

Baseline

Existing

Yes

Included ‐ Approved

Model logic

2015

See model documentation

UWMP

Water Supply Volume (AF/yr)

‐

‐

‐

‐

‐

‐

‐

Otay Water District

UWMP Verifiable ‐ Recycled
Water

Verifiable

Yes

Included ‐ Approved

Input Demands Spreadsheet

2015

Recycled supply for Otay

UWMP

Water Supply Volume (AF/yr)

1100

1100

1100

1100

1100

1100

1,100

City of San Diego

City of San Diego UWMP

Conceptual

Yes

Included ‐ Approved

Input Demands Spreadsheet

2050

Add to conservation for City of San Diego

UWMP

Water Supply Volume (AF/yr)

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

Treated. Capacity 104 cfs.

SDCWA

Pipeline Capacity

Olivenhain Municipal Water District

UWMP Project Concept ‐
Recycled Water

Conceptual

Yes

Included ‐ Approved

Input Demands Spreadsheet

2050

Addition to Olivenhain's recycled supply

UWMP

Water Supply Volume (AF/yr)

‐

‐

‐

100

100

100

100

Otay Water District

UWMP Additional Planned ‐
Groundwater

Planned

Yes

Included ‐ Approved

Input Demands Spreadsheet

2050

Added to Otay's groundwater supply

UWMP

Water Supply Volume (AF/yr)

‐

‐

‐

500

500

500

500

SDCWA

N/A

Existing

Yes

Included ‐ Approved

Model Logic

2015

Capacity 600 cfs of Untreated conveyance
downstream of Rancho

SDCWA

Pipeline Capacity

Recycled Water

Padre Dam Municipal Water District

UWMP Additional Planned ‐
Recycled Water

Planned

Yes

Included ‐ Approved

Input Demands Spreadsheet

2025

Addition to Padre Dam's recycled supply

UWMP

Water Supply Volume (AF/yr)

‐

‐

1,008

1,008

1,008

1,008

Recycled supply for Padre Dam

UWMP

Water Supply Volume (AF/yr)

896

896

896

896

896

896

896

1120

1120

1120

1120

1120

1120

1,120

Potable Reuse/Hale Avenue Resource
Recovery Facility (HARRF)

X

Pure Water ‐ Los Penasquitos Creek
Urban Dry‐Weather Water Harvesting

Pure Water San Diego Phase 1 ‐ North
City

X

X

Pure Water San Diego Phase 2 ‐
Central

X

X

X

Quantification Settlement Agreement

X

X

X

X

X

X

Firm Water Supply Agreements

R. W. Chapman WRF/Otay WD

X

X

X

X

X

X

Recycled Water

X

Stormwater Capture

X

Conveyance Improvement

Rainwater harvesting

Ramona Pipeline

X

X

X

Rancho Cielo

X

X

Rancho del Rey Groundwater Well
Development (capacity)
Rancho Pipeline

X

X

Recycled Water

X

X

X

X

X

Groundwater

X

X

X

X

X

Conveyance Improvement

Ray Stoyer WRF ‐ Landscape,
Irrigation, Dust Control

X

N/A

‐

‐

‐

‐

‐

‐

‐

X

X

X

X

Recycled Water

Padre Dam Municipal Water District

UWMP Verifiable ‐ Recycled
Water

Verifiable

Yes

Included ‐ Approved

Input Demands Spreadsheet

2015

Ray Stoyer WRF (Existing)/Padre Dam
MWD

X

X

X

X

X

X

Recycled Water

Padre Dam Municipal Water District

UWMP Verifiable ‐ Recycled
Water

Verifiable

Yes

Included ‐ Approved

Input Demands Spreadsheet

2015

Recycled supply for Padre Dam

UWMP

Water Supply Volume (AF/yr)

N/A

‐

Based upon IRWM Prop 84‐3 grant agreement,
include in Baseline + portfolio without any
associated water volumes

UWMP

Conservation Volume (AF/yr)

‐

‐

‐

‐

‐

‐

X

X

X

X

Urban and Agricultural Water Use
Efficiency

SDCWA

IRWM ‐ Prop 84.3

Planned

No

Not Able to Model

Regional Drought Resilience Program

X

X

X

X

X

Urban and Agricultural Water Use
Efficiency

SDCWA

IRWM ‐ Prop 84.4

Planned

yes

Included ‐ Approved

Input Demands Spreadsheet

2050

Allocate conservation savings evenly amongst
all member agencies.

UWMP

Conservation Volume (AF/yr)

Carlsbad Municipal Water District

N/A

Conceptual

Yes

Included ‐ Approved

Model Logic

2025

Increase rated capacity from 50MGD to
53MGD per Eric Rubalcava.

UWMP

Facility Production Capacity (AF/yr)

City of San Diego

UWMP Verifiable ‐
Groundwater

Verifiable

Yes

Included ‐ Approved

Input Demands Spreadsheet

2025

Groundwater supply for City of San Diego

UWMP

Water Supply Volume (AF/yr)

Re‐rating of Carlsbad Desalination for
higher flow
Richard A. Reynolds Desalination
Facility

X

X

X

X

X

Seawater Desalination

X

X

Groundwater

Page 6 of 10

‐

‐

416

‐

1,008

X

‐

‐

‐

X

X

‐

4,000

‐

Ray Stoyer WRF (Existing)/Padre Dam
MWD

Regional Demand Management
Program Expansion

‐

416

‐

‐

‐

‐

1,809

416

‐

‐

‐

1,809

1,809

1,809

‐

‐

‐

‐

‐

‐

2,600

2,600

2,600

2,600

2,600

2,600


<table>
<thead>
<tr>
<th>Project Name</th>
<th>Concept CWASim</th>
<th>Stewardship Authority</th>
<th>Conceptual</th>
<th>To be Modeled?</th>
<th>Model Implementation</th>
<th>Demand Scenario</th>
<th>Modeling Notes/Questions</th>
<th>Scenarios to Model</th>
<th>Year</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2050</th>
<th>Baseline Value</th>
<th>2025 Increase (Yearly average)</th>
<th>2050 Increase (Yearly average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Name</td>
<td>2015</td>
<td>2020</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Diego CSO Outfall Water Reclamation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City of San Diego</td>
<td>No</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Diego Water Reclamation MWD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SD12 Pipeline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Bay WRP/City of SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Bay WRP/City of San Diego</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South WWTPs/USMC Beam Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Yes</td>
<td>Included</td>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Name</td>
<td>Subcategory</td>
<td>Funding Source Document</td>
<td>Source To Be Modeled</td>
<td>Status</td>
<td>Source Model Status</td>
<td>Model Implementation</td>
<td>Scenario Scenario</td>
<td>Modelling Notes/Scenarios</td>
<td>UWMP Source</td>
<td>2015</td>
<td>2020</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2050</td>
<td>Source to Model Impact</td>
<td>2015</td>
<td>2025</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------------------------------</td>
<td>-------------------------</td>
<td>---------------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>-------------------</td>
<td>------------------------</td>
<td>------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>---------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>SCDWA San Vicente Canal</td>
<td>3 Conventional Improvement</td>
<td>SCDWA</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Model Logic</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River Street</td>
<td>3 Stormwater SDCWA</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Model Logic</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Local Surface Water Reamissions</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Local Surface Water Reamissions</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Diego River</td>
<td>3 Watershed and Ecosystem Management</td>
<td>Stormwater Authority</td>
<td>SDCWA</td>
<td>Included</td>
<td>Approved</td>
<td>Input Spreadsheet</td>
<td>2035.5</td>
<td>strombroted. Capacity: 0.0</td>
<td>UNANP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Project Name</td>
<td>To be Modeled?</td>
<td>Model Source Document</td>
<td>Scenario</td>
<td>Model Implementation Status</td>
<td>Demand Scenario</td>
<td>Modelling Notes/Questions</td>
<td>Source to Model Input</td>
<td>2015</td>
<td>2020</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2050</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>----------------</td>
<td>-----------------------</td>
<td>----------</td>
<td>----------------------------</td>
<td>----------------</td>
<td>--------------------------</td>
<td>----------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weese Water Treatment Plant</td>
<td>Yes</td>
<td>Existing</td>
<td>Existing</td>
<td>Included</td>
<td>Approved</td>
<td>Model Logic</td>
<td>To be Modelled</td>
<td>2025</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welk WRF</td>
<td>None</td>
<td>Conceptual</td>
<td>Existing</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demand Spreadsheet</td>
<td>To be Modelled</td>
<td>2025</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woods Valley Ranch WRF (Phase 2)</td>
<td>None</td>
<td>Conceptual</td>
<td>Existing</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demand Spreadsheet</td>
<td>To be Modelled</td>
<td>2025</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woods Valley Ranch WRF/VC</td>
<td>None</td>
<td>Conceptual</td>
<td>Existing</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demand Spreadsheet</td>
<td>To be Modelled</td>
<td>2025</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woodside Avenue Complete Green Street</td>
<td>Planned</td>
<td>Existing</td>
<td>Existing</td>
<td>Included</td>
<td>Approved</td>
<td>Input Demand Spreadsheet</td>
<td>To be Modelled</td>
<td>2025</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The 2050 row is assumed equivalent to 2040 unless a 2050 value is known.
Appendix B – Model Implementation Details for Selected Projects

- Camp Pendleton Desalination Plant
- Dulzura Conduit Replacement
- Enhanced Conservation
- Hodges Water Quality Improvement Program
- Pure Water San Diego
- Rosarito Beach Desalination Plant
- San Diego Reservoir Intertie
Camp Pendleton Desalination Plant

Project Overview
The Camp Pendleton Desalination Plant (CPDP) is proposed as a new seawater desalination supply to the San Diego region’s supply portfolio beyond the 2025 timeframe. Future decisions regarding this project’s development will be based on analysis of water supply reliability factors including changes in anticipated demands, failure to implement planned local supply projects, as well as significant future changes in imported water supply reliability.

Marine Corps Base Camp Pendleton is one of a handful of locations on the Southern California coast that are potentially available to support a large-scale, regional desalination project. A 2009 feasibility study conducted by the Water Authority found that Camp Pendleton’s location in North San Diego County provides the advantage of efficient integration of a new water supply into the existing Water Authority aqueduct delivery system for distribution throughout the county (RBF Consulting, 2009). The proposed CPDP project involves the development of an initial 50 million gallons per day (mgd) or 56,000 acre-feet per year (AF/y) seawater desalination plant, with subsequent expansions at 50 mgd increments up to a maximum capacity of 150 mgd or 168,000 AF/y. The Water Authority completed planning and technical studies in 2013 which included detailed facility siting and pipeline alignment studies, as well as on-shore and off-shore field investigations near the proposed project sites to determine the viability, costs and impacts to marine life of seawater intake and discharge systems.

Currently, CPDP is undergoing further evaluations for subsurface intake options and a $4.05 million contract has been authorized for building, operating and reporting on a pilot-scale seawater intake testing program. Major project components include new intake and discharge facilities, tunnels that will connect offshore facilities to the plant, the seawater desalination plant, commercial power delivery facilities, and the desalinated water conveyance (San Diego County Water Authority, 2016).

Table B-1. Member Agencies Supplied by Camp Pendleton Desalination Plant

<table>
<thead>
<tr>
<th>Member Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceanside</td>
</tr>
<tr>
<td>Carlsbad</td>
</tr>
<tr>
<td>Vista</td>
</tr>
<tr>
<td>Valley Center</td>
</tr>
<tr>
<td>Fallbrook</td>
</tr>
<tr>
<td>Rainbow</td>
</tr>
<tr>
<td>San Diego Rincon</td>
</tr>
<tr>
<td>San Diego Vallecitos</td>
</tr>
<tr>
<td>San Diego Olivenhain</td>
</tr>
<tr>
<td>San Diego Ramona</td>
</tr>
<tr>
<td>San Diego San Diego North</td>
</tr>
<tr>
<td>Padre Dam</td>
</tr>
</tbody>
</table>

The CPDP plans to use seawater desalination to supply the member agencies listed in Table B-1 via Pipeline 4. Additional components of the project include providing North County member agencies access to CPDP supplies, and idling CPDP supplies to San Vicente reservoir. The CWASim model has incorporated many of the CPDP components, which are the focus of this document.
**Modeling Methodology**

The CPDP is modeled similar to other water treatment plants in CWASim. The user can choose to include the CPDP in a scenario by turning it on and indicating the implementation year on the Desalination dashboard. The default maximum plant capacity is 150 mgd (168,000 AF/y) but this can be adjusted by the user on the Water Treatment Plant dashboard. Its supply priority can be defined by the user on the *Water Treatment Plant Capacities and Other Supply Operations* dashboard. Currently, the agencies listed in Table B-1 receive CPDP supply from March through October if additional water supply is needed after using available resources from local surface water, San Vicente carryover/seasonal storage, MWD untreated, Carlsbad Desalination, and Twin Oaks Valley WTP (but before using available resources from MWD Treated). Outside this period, the San Vicente carryover/seasonal storage is moved to the lowest priority water delivery. The CPDP supply prioritization and operation start date can be changed through the *Water Treatment Plant Capacities and Other Supply Operations* dashboard. The model will only supply water to those member agencies beginning on and after the user-indicated CPDP implementation date. If the CPCP is turned on, it is assumed that CPDP supplies the member agencies via Pipeline 4 except for Ramona and Rincon which are supplied by the Ramona pipeline, and San Diego Alvarado and San Diego Miramar, which are supplied by Pipeline 4B if necessary.

The CPDP modeling implementation also includes two conveyance alternatives switches in the Desalination dashboard: conveyance of CPDP supply to North County, and idle excess of CPDP supply to San Vicente Reservoir. The CPDP to North County reverses Pipeline 4 operations to allow the plant to supply Fallbrook, Oceanside, Rainbow, and Rincon member agencies. To be able to reverse Pipeline 4 operations for this conveyance scenario, the “Reverse North County Flow” switch must also be checked on through the *Pipe and Pump Capacities* dashboard. The idle CPDP supply to San Vicente Reservoir switch will convey excess CPDP production not fulfilling member agency demands to fill San Vicente reservoir during the San Vicente filling period.

**Energy Consumption Methodology**

The CWASim model also produces energy consumption estimates associated for the Camp Pendleton Desalination Plant. Energy consumption is estimated daily using a power versus flow linear relationship. This relationship is retained from the 2013 Master Plan analysis and indicates 296,088 MWh are consumed for every 77 cubic feet per second.
Dulzura Conduit Replacement

Project Overview
In 1922 the City of San Diego completed the construction of the Dulzura Conduit, which is an 11-mile concrete channel that conveys water from Barrett Reservoir to Cottonwood Creek, which ultimately leads to Lower Otay Reservoir. Since its completion in 1922, various portions of the structure have been replaced or repaired to address material failures and damage by natural events, including earthquakes, wildfires, and mudslides. The current conditions of the conduit have consequently limited the operational usage of this asset and the amount of water that is currently able to be conveyed.

The proposed project would renovate and replace the 11 miles of the channel, which will help to improve the reliability and yield of the local water supply from two local reservoirs with a combined storage capacity of 90,000 AF. The project and the Conduit are essential components of the City’s regional water supply: it is a significant component of the three-reservoir system between Morena, Barrett, and Otay Reservoirs; there are planned ongoing and future capital improvement projects that are taking place upstream of the Conduit; the City of San Diego has water rights for the diversion of this water, and it plays a role in local flood control which helps to protect both life and property. It should also be noted that no water can be moved through the Conduit during periods of refurbishment or replacement.

Modeling Methodology
The deteriorated conditions have left this asset vulnerable to failure, and in most instances, nonoperational. Although the current condition of the Conduit makes it mostly inoperable, the baseline capacity in the model was adjusted to 21,300 AF/y (19 mgd) with 10% water loss. This represents the minimum operational management of the Conduit as well as the capacity identified in the City of San Diego’s 2015 Raw Water Master Plan. Due to the deteriorated conditions, as well as rock slides and conduit failures being a somewhat regular occurrence, there are only brief periods when this functionality is able to be realized. The proposed project, the Dulzura Conduit Replacement, will replace any deteriorated conditions at the Conduit and enable the full volume of water to be transferred. The proposed project would be completed by 2050 and is estimated to increase the overall capacity of the conduit to 60 mgd with 0% loss. A conservative modeling approach was taken for the Basin Study and the total capacity for the completed project was modeled at 44,800 AF/y (40 mgd).
Enhanced Conservation

Introduction
The San Diego Basin Study examines options to improve delivery reliability in the future under climate and demand uncertainty. One of the options that Study stakeholders were interested in exploring was water conservation resulting in demand reductions beyond currently planned levels. The Enhanced Conservation Portfolio explores these potential demand reductions. The demand reductions included in the Portfolio are assumed to be achieved by long-term or permanent restrictions in water use. 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 Enhanced Conservation Portfolio does not specify or assume any particular projects or strategies to reduce demand. The Portfolio is a high-level analysis of simulated demand reduction at the regional scale, which may be achieved by a broad range of demand reduction strategies or projects implemented by either the public or private sectors. This Portfolio represents and includes a single project and Concept, Enhanced Conservation.

Model Demands
To simulate water system operations, the CWASim model requires that the user input gross demand volume (before conservation) and any conservation that should be subtracted to obtain modeled demands on the system.

Gross demand (before any conservation) is represented as follows:

- **2025**: Demands calculated from 2015 SDCWA UWMP Baseline Demand Forecast (Table B-2) as Total Baseline Demand Forecast minus Accelerated Forecasted Growth (Table B-2) minus Camp Pendleton demands (10,960 AF/y).
- **2050**: Linear regression extension of calculated demands for 2020-2040 without accelerated growth and Camp Pendleton.

<table>
<thead>
<tr>
<th>Gross Demand (Normal Years, no climate change)</th>
<th>2015 (AF/y)</th>
<th>2025 (AF/y)</th>
<th>2050 (AF/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>619,739</td>
<td>722,507</td>
<td>845,488</td>
<td></td>
</tr>
</tbody>
</table>

Conservation Values for Baseline and Baseline Plus Portfolios
Conservation values in the Baseline and Baseline Plus Portfolios are applied as demand reductions to the gross demands prior to implementing the Enhanced Conservation demand reductions.
Conservation in the Baseline Portfolio is represented as follows:


- 2025: Projected conservation as documented in the SDCWA 2015 UWMP (which used the Alliance for Water Efficiency Water Conservation Tracking Tool to develop conservation projections).

- 2050: Projected conservation calculated as a straight-line projection based on the value for 2035 and 2040 reported in the 2015 SDCWA UWMP.

Conservation in the Baseline Plus Portfolio is represented as follows:

- 2015: No additional conservation beyond Baseline.

- 2025: Two additional Urban and Agricultural Water Use Efficiency Projects beyond Baseline.

- 2050: Five additional Urban and Agricultural Water Use Efficiency Projects beyond Baseline.

Conservation Values for Enhanced Conservation Portfolio

The demand reductions defined by the Enhanced Conservation Portfolio represent additional conservation beyond the conservation volumes in the Baseline and Baseline Plus Portfolios.

Enhanced Conservation is defined as a 1% reduction in water demand (gallons per capita per day, GPCD) per year, starting in 2020 when it is assumed that the 20x20 targets outlined in SBX7-7 are reached. The additional regional conservation required to achieve Enhanced Conservation was calculated in a three-step process:

1) Calculate total regional demands for 2025 and 2050 assuming a 1% reduction in GPCD. To accomplish this, the 20x20 target (584,949 AF/y) was converted to GPCD and a 1% reduction in GPCD per year for future demand scenarios was calculated for 2025 and 2050. GPCD values for 2025 and 2050 were calculated using population projections provided by the 2015 UWMP and the CWA staff. These GPCD values were then converted to AF/y. Enhanced Conservation projected regional demands are reported in Table B-3.

<table>
<thead>
<tr>
<th>Table B-3. Enhanced Conservation Portfolio projected regional demands.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Projected Demand</strong></td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>GPCD (total)</td>
</tr>
<tr>
<td>AF/y</td>
</tr>
</tbody>
</table>
2) Calculate total regional conservation volume required to achieve Enhanced Conservation projected demands values

3) Calculate regional conservation volume required in addition to Baseline and Baseline Plus conservation volumes to achieve total regional Enhanced Conservation volume (Table B-4)

Table B-4. Conservation volumes for Baseline, Baseline Plus, and Enhanced Conservation Portfolios.

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Projected Demand Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2015 (AF/y)</td>
</tr>
<tr>
<td>Baseline Conservation Volume</td>
<td>50,000</td>
</tr>
<tr>
<td>Baseline Plus Conservation Volume (in addition to Baseline)</td>
<td>0</td>
</tr>
<tr>
<td>Enhanced Conservation Portfolio volume demand reduction (in addition to Baseline and Baseline Plus)</td>
<td>0</td>
</tr>
<tr>
<td>Total Enhanced Conservation Portfolio conservation volume</td>
<td>50,000</td>
</tr>
</tbody>
</table>

**Model Implementation**

The total regional Enhanced Conservation amount was then split between member agency demand nodes for use in the CWASim model. The Enhanced Conservation Portfolio conservation volumes are incorporated in the model as demand reductions (AF/y) for each time period of the Basin Study analysis: 2015, 2025, and 2050. The Gross regional demand values, total regional Enhanced Conservation Portfolio conservation volumes, and the difference between gross demand and conservation is shown in Table B-5.

Table B-5. Gross Demands minus Enhanced Conservation Portfolio volume

<table>
<thead>
<tr>
<th></th>
<th>2015 (AF/y)</th>
<th>2025 (AF/y)</th>
<th>2050 (AF/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Demand (Normal Years, no climate change)</td>
<td>619,739</td>
<td>722,507</td>
<td>845,488</td>
</tr>
<tr>
<td>Total Enhanced Conservation Portfolio conservation volume</td>
<td>50,000</td>
<td>142,156</td>
<td>337,924</td>
</tr>
<tr>
<td>Gross Demand minus Total Enhanced Conservation Portfolio conservation volume</td>
<td>569,736</td>
<td>580,351</td>
<td>507,564</td>
</tr>
</tbody>
</table>
Hodges Water Quality Improvement Program

Project Overview

This project allows for increased use of Hodges Reservoir for water supply by improving its water quality, which is currently not meeting the requirements to be conveyed into the aqueduct and regional system. This project allows higher releases of water from Hodges Reservoir to other parts of the regional water system, such as Emergency Storage Project storage or seasonal pool storage in Olivenhain Reservoir, which can then be conveyed into the Second Aqueduct system and be stored in San Vicente Reservoir downstream where it can then be used to meet demands. During wet weather events Hodges Reservoir often overfills, and without the ability to move water from Hodges Reservoir to the regional water system, water spills from Hodges Dam and is thus underutilized.

The Hodges Water Quality Improvement Program is a combination of projects being implemented by the City of San Diego Public Utilities Department to improve the water quality within Hodges Reservoir, which is currently 303(d) listed by the Clean Water Act as impaired for color, manganese, mercury, nitrogen, phosphorus, turbidity, and pH. Through the San Diego Integrated Regional Water Management Program, the City of San Diego and its partners have been able to secure $5,440,972 to design and construct the Hodges Hypolimnetic Oxygenation System and the Hodges Natural Treatment System.

Hodges Oxygenation System Project

(Total Cost: $3,468,735 | Grant Award: $2,554,500)

The Hodges Hypolimnetic Oxygenation System project is designed to reduce and control excessive algal productivity, reduce methylmercury concentrations, increase oxygen concentration of the hypolimnion, and reduce nutrient flux from sediments and bottom waters. Improved water quality will be achieved through construction and operation of a speece cone in the reservoir to oxygenate the deep portions of the reservoir and improve water quality.

Hodges Natural Treatment System

(Total Cost: $3,850,880 | Grant Award: $2,886,472)

In support of ongoing efforts to reduce pollutant loading to Hodges Reservoir, the Hodges Natural Treatment System project will design and construct a natural treatment system that includes a constructed wetland at Green Valley Creek and Hodges Reservoir. The Natural Treatment System will be designed to reduce nutrient concentrations from two water sources: 1) the Green Valley Creek tributary, and 2) reservoir water that will be pumped from the reservoir into the treatment wetland for nutrient removal. The project will improve the water quality of Hodges Reservoir, and reduce downstream treatment costs and challenges.

Modeling Methodology

With the current limitations from water quality impairments, the reservoir is not able to properly convey water into the regional supply in a timely manner before wet weather events, which increases the vulnerability to potential spills. Because of these limitations or restrictions on water quality and reservoir operations, the Baseline Portfolio limited the maximum reservoir release to 7,000 AF/y (6.245 mgd) in scenarios in which the project is not implemented in the CWASim.
model. In scenarios with the project implemented the maximum release is increased to 168,133 AF/y (150 mgd). The project is included in the Baseline Plus Portfolio and is implemented in the 2050 scenarios based on the projected timeline for reservoir water quality improvements.
Pure Water San Diego

Program Overview
The Pure Water Program (Pure Water San Diego) is the City of San Diego Public Utilities Department’s proposed program to provide an additional safe, secure, and sustainable local drinking water supply for San Diego. The program plans to use advanced water purification technology to supply the San Diego regions of North City, Central Area and the South Bay with potable recycled water. Pure Water San Diego includes construction of new advanced water purification facilities and a water reclamation plant, upgrades to existing water reclamation and wastewater treatment facilities, and construction of new pump stations and pipelines. The program is expected to produce a cumulative total of 93,000 AF/y (83 mgd) of potable recycled water for the City of San Diego’s supply portfolio by completion in 2035. It is also expected that this will decrease the region’s imported water demand and associated energy usage. The CWASim model has incorporated many of the Pure Water Program’s components as described below.

Pure Water is considering four reservoir options to store the new supply after it is treated at the advanced water treatment plants. These include:

1. Phase 1: 33,600 AF/y (30 mgd) from North City Advanced Water Reclamation Plant to Miramar Reservoir by the year 2021.

2. Phase 2: Option 1: 59,400 AF/y (53 mgd) from Central Area Advanced Water Reclamation Plant to Murray Reservoir or San Vicente by 2035. Option 2: 15 mgd from South Bay Advanced Water Reclamation Plant to Lower Otay Reservoir by the year 2035. The production rate of Phase 2 would be reduced to 42,400 AF/y (38 mgd) if Lower Otay option is implemented (total production rate of 76,200 AF/y [68 mgd] for both Phase 1 and Phase 2).

Modeling Methodology
The CWASim model includes user options to implement the Pure Water program for each of the reservoirs mentioned (Miramar, Murray, San Vicente, Lower Otay) separately. The user can perform a model simulation with any combination of the four reservoirs. A production rate and implementation date are also included as a user input control for each of the reservoirs.

If the user implements the Miramar, Murray, or Otay reservoir options, the model logic will utilize the user-defined production rate to those reservoirs as long as there is available capacity in their seasonal pools (refer to CWASim model documentation for description of reservoir pools). The CWASim model will utilize the Pure Water San Diego supply at first priority, reducing other supplies to fill the reservoir if needed. The model will only supply water to those reservoirs beginning on and after the user indicated implementation date.

The CWASim model applies the user-defined production rate associated with San Vicente reservoir to that reservoir element after the specified implementation date. There is currently no limit for Pure Water San Diego deliveries to San Vicente reservoir. Preliminary results indicate San Vicente will always have capacity available to handle Pure Water inflows.
Rosarito Beach Desalination Plant

Project Overview
The Rosarito Beach Desalination Plant is a component of the Otay District’s supply
diversification efforts and could meet up to one-third of district’s water demand by 2025. A new
desalination plant in Playas de Rosarito, Baja California, Mexico has been awarded to Aguas de
Rosarito (AdR), a private consortium that signed a 40-year definitive public-private partnership
agreement with the Baja California government on August 25, 2016 to build the plant and
operate it for 37 years. The companies that make up AdR are NuWater of Singapore, Suez
Environment of France, and Mexico-based N.S.C. Agua (NSCA), a subsidiary of Cayman-
Islands based Consolidated Water (CWCO).

When the Plant is complete, the additional water supply would be delivered to the San Diego
region directly using a cross-border pipeline that was approved by the Department of State on
May 16, 2017 (U.S. Department of State, 2017). The proposed Rosarito project features an initial
phase with the construction of a seawater desalination plant with a production of 50 mgd or
56,000 AF/y, and a subsequent expansion phase increasing production up to a maximum
capacity of 100 mgd or 112,000 AF/y. The first phase is expected to be operational by 2021.
Otay Water District will receive supply after implementation of the second phase, which includes
construction of the pipeline to the United States-Mexico border, and is planned to be completed
by 2030. The supply amount will vary depending on the demand in Mexico and available
remaining supply, but is estimated to remain around 30% of the 50 mgd production rate, on
average.

Modeling Methodology
The additional water supply provided by the Rosarito plant is simply modeled as a demand
reduction on Otay Water District. In the Desalination dashboard, the user can turn on the
Rosarito Desalination Plant, indicate the implementation year and the supply amount. The
implementation year is currently set to 2030. The baseline supply values are pulled from the
2015 UWMP Table F-6 and are listed in Table B-6.

<table>
<thead>
<tr>
<th>Year</th>
<th>Supply (AF/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>-</td>
</tr>
<tr>
<td>2020</td>
<td>-</td>
</tr>
<tr>
<td>2025</td>
<td>-</td>
</tr>
<tr>
<td>2030</td>
<td>15,600</td>
</tr>
<tr>
<td>2035</td>
<td>16,100</td>
</tr>
<tr>
<td>2040</td>
<td>16,800</td>
</tr>
</tbody>
</table>
San Diego Reservoir Intertie

Reservoir Intertie Overview
The goal of the San Diego Reservoir Intertie project is to improve water storage operations, supply reliability, and water yield through more effective interconnections between various water storage reservoirs. The project was originally conceived to be developed in cooperation with the City of San Diego and the Sweetwater Authority to intertie San Vicente, El Capitan, Murray and Loveland Reservoirs. However, it has evolved to be only include City of San Diego storage facilities, and currently does not include Sweetwater Authority facilities. Based on discussions with the City of San Diego water planning and operations staff, the following reservoir intertie concept (Figure B-1) has been developed:

Storage Facilities
- El Capitan Reservoir
- San Vicente Reservoir
- Santee-El Monte Groundwater Basin
- Lake Murray

Hydraulic/Conveyance Facilities
- New pump station to convey water from El Capitan pipeline to San Vicente Reservoir (reverse flow in San Vicente pipeline)
- Upgraded flow control facility to permit simultaneous draw of water from El Capitan and San Vicente reservoirs, and to allow reverse flow on the El Capitan pipeline when imported water storage in El Capitan is desired
- Reconfigured inlet/outlet works at El Capitan to allow for imported water storage
- Recharge/extraction wells to permit recharge of San Diego River water via El Capitan releases, and extraction of stored groundwater in the El Monte portion of the groundwater basin

The integration of these storage facilities and new/upgraded conveyance facilities would allow storage operations in San Vicente Reservoir, El Capitan Reservoir, and the El Monte Groundwater Basin to be optimized as a “reservoir system” for the benefit of water supply reliability. Local supply and imported supply could be stored and moved between any of these storage facilities to reduce spills and maximize imported water storage opportunities. Water from all three storage facilities could be released through existing pipelines to Lake Murray and Alvarado Water Treatment Plant for distribution into the existing treated water system.
Prior to modifications for the San Diego Reservoir Intertie, the existing CWASim model included storage operations for San Vicente Reservoir, El Capitan Reservoir, and Lake Murray. The model also included capacity limitations for the El Capitan Pipeline, San Vicente Pipeline, and El Monte Pipeline that limit the rate at which water can be released or exchanged between reservoirs. The model also limited the El Capitan operable pool to an elevation of 700 feet due to Division of Safety of Dams (DSOD) restrictions.

The following modifications to the CWASim model were made to enable simulation of the San Diego Reservoir Intertie project:

- Removal of DSOD restrictions on the operable pool at El Capitan. This modification reflects the achievement of meeting dam safety criteria through future dam improvements. These improvements may be identified through ongoing investigations and addressed by potential future dam improvement projects.
- Enabling simultaneous draw of water from El Capitan and San Vicente reservoirs.
- Enabling reverse flow in the El Capitan Pipeline during periods when imported water is being stored in El Capitan Reservoir.
- Addition of a new pump station to convey water from El Capitan pipeline to San Vicente Reservoir (reverse flow in the San Vicente pipeline). The capacity of the pump station was set at 55,100 AF/y (76 cfs), based on model calibration tests.
- Enabling imported water storage in El Capitan Reservoir using existing conveyance (CWA aqueduct).
- Simulation of approximately 7,000 AF of groundwater storage in the El Monte Groundwater Basin.
- Enabling release of water from El Capitan and San Vicente reservoirs to the El Monte Groundwater Basin through either river channel or recharge wells. Release was limited to 3,500 acre-feet per year (AF/y).

When the project is activated in the model, model logic will transfer water from one reservoir to the other based on available capacity in their seasonal pools for each time step. Simulated operations are modified in the model to prioritize the storage in San Vicente Reservoir first, followed by El Capitan Reservoir, and finally followed by El Monte Groundwater Basin storage. Releases from the storage reservoirs generally follow a reversal of the fill priority. The groundwater storage is treated as a “last in – first out” operation, meaning that it is the last storage to fill and the first storage to be withdrawn. Exploratory model simulations were first developed to determine the most “optimal” operations using the three interconnected reservoirs. A generalized rule was then applied to perform long-term simulations for use in a variety of scenarios being considered in the Basin Study. This project will be implemented in the 2050 scenarios for the San Diego Basin Study.

**Appendix B References**


Appendix C - Energy Consumption and Generation Model Implementation

Energy Consumption and Generation Overview
This document describes the CWASim model’s representation of energy use and generation at major water supply facilities throughout the San Diego region. To calculate energy consumption and generation, facilities have been separated into five categories: supply sources, conveyance, treatment, pumped storage and offices. The energy consumption and/or generation values are either linked to facility flows calculated in CWASim or are a function of elapsed time based on historical average annual values documented in the San Diego County Water Authority Regional Facilities Master Plan (SDCWA, 2013). These are described for each facility in Table C-1. The model metrics that tabulate energy generation and consumption are described in Tables C-2 and C-3. The energy consumption metrics represent total consumption and do not distinguish among energy supply sources. The metrics also do not include calculation of greenhouse gas (GHG) emissions, which is outside of the scope of the Basin Study.

Energy Consumption and Generation Calculations

Supply Sources
This category includes energy consumption associated with obtaining each supply by source. Energy consumption rates described in Table C-1 are linked to total annual delivery by supply source calculated in CWASim. Supply source categories include: Energy generation and consumption are only calculated for Potable Reuse (Pure Water), Recycled, Groundwater, Imported Water, and Desalination; other supply source categories included in the Basin Study are not included in the energy generation and consumption metrics.

Potable Reuse
Energy consumption associated with Potable Reuse is calculated only for the Pure Water project. Energy consumption is a function of the volume of Pure Water supply that is conveyed to reservoirs. Table 5.15-9 in the Pure Water Environmental Impact Report (EIR) indicates a total energy consumption of 11,100 kWh/MG is expected (Figure C-1). This includes supply and conveyance (0 kWh/MG), program treatment beyond secondary (3,600 kWh/MG), program conveyance (3,700 kWh/MG), water treatment (100 kWh/MG), distribution (1,200 kWh/MG), and collection system and wastewater treatment (2,500 kWh/MG). The CWASim model energy calculations only include supply and conveyance, program treatment beyond secondary, and program conveyance, totaling 7,300 kWh/MG.
No energy generation metrics are included in the CWASim model for Pure Water. However, the City of San Diego plans to pursue a renewable energy supply mix for the Pure Water project (Phases 1 and 2). The North City Renewable Energy Facility is anticipated to produce power for the expanded North City Water Reclamation Plant, the Pure Water Facility, and the Pure Water Pump Station. The renewable energy facility would reduce the GHG emissions of the Pure Water Program. In addition, within the City of San Diego jurisdiction, GHG emissions are expected to decline as the City gets closer to its Climate Action Plan (CAP) goal of 100% renewable energy supply by 2035. Maintaining a diverse portfolio of renewable energy sources will decrease the total amount of GHG emissions in the region.

Recycled Water and Groundwater
Recycled and groundwater consumption rates are a function of total deliveries input by the user, using values from the California Energy Commission (California Energy Commission, 2005; California Energy Commission, 2006), as shown in Table C-1.

Imported Water
Imported supply energy consumption is linked to total imported supplies coming from Metropolitan Water District of Southern California and QSA deliveries as calculated by the model using the value of imported water consumption documented in the Pure Water EIR, as shown in Table C-1.

Desalination
Each desalination plant’s energy consumption is linked to total production from each plant. References for each consumption rate are shown in Table C-1.

Conveyance
Conveyance energy consumption and generation metrics are limited to main supply system pump stations and hydroelectric facilities. Facilities included in CWASim are the North County Pump Station, San Vicente Pump Station, Valley Center Pump Station, Olivenhain Pump Station, Escondido Pump Station, and Rancho Peñasquitos hydroelectric facility. All energy consumption
and generation values for conveyance are retained from the 2013 Master Plan, as shown in Table C-1.

**Treatment**

Every water treatment plant included in CWASim has an associated energy consumption rate linked to its production rate. These values are shown in Table C-1. Energy consumption rates for Miramar, Alvarado, and Otay water treatment plants were developed from measured electricity usage and production rates. Estimates were developed for the smaller treatment plants based on regional data. These values were developed as part of the 2013 Master Plan and retained in the CWASim model for the Basin Study.

Miramar and Alvarado also include energy generation values associated with their hydroelectric facilities. Twin Oaks Valley WTP includes energy generation values associated with the solar panels located at the plant. These values are also a function of the water treatment plant production and are retained from the 2013 Master Plan.

**Pumped Storage**

The pumped storage category only includes Hodges Pumped Storage Hydroelectric Facility. The model includes both a consumption and generation algorithm for this facility. The connection of Hodges Reservoir to Olivenhain Reservoir provides the ability to transfer water downhill from Olivenhain to Hodges Reservoir. As developed for the 2013 Master Plan, the CWASim model assumes that this facility consumes 100,000 MWh/year and generates 74,000 MWh/year of energy, regardless of the storage algorithms for Hodges and Olivenhain reservoirs.

**Offices**

The offices included in the CWASim model are the SDCWA Administrative Office and Operations Center. Energy consumption and generation values were retained from SDCWA’s 2013 Master Plan. Generation values are associated with solar energy located at each office.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Energy Consumption Value</th>
<th>Energy Generation Value</th>
<th>Reference</th>
<th>Model Element(s) Containing Value(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply Sources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure Water</td>
<td>7,300 kWh/MG</td>
<td>NA</td>
<td>Pure Water EIR (City of San Diego, 2016)</td>
<td>Pure_Supply_Pcons</td>
</tr>
<tr>
<td>Recycled water</td>
<td>1,228 kWh/MG</td>
<td>NA</td>
<td>California Energy Commission (2005)</td>
<td>RCY_Supply_Pcons</td>
</tr>
<tr>
<td>Groundwater</td>
<td>2,915 kWh/MG</td>
<td>NA</td>
<td>California Energy Commission (2005)</td>
<td>GW_Supply_Pcons</td>
</tr>
<tr>
<td>Imported Water</td>
<td>10,000 kWh/MG</td>
<td>NA</td>
<td>Pure Water EIR (City of San Diego, 2016)</td>
<td>Import_Supply_Pcons</td>
</tr>
<tr>
<td>Rosarito Desalination Plant</td>
<td>12,889 kWh/MG</td>
<td>NA</td>
<td>Rosarito Desalination Plant Feasibility Study (2005)</td>
<td>Rosarito_Pcons</td>
</tr>
<tr>
<td>Facility</td>
<td>Energy Consumption Value</td>
<td>Energy Generation Value</td>
<td>Reference</td>
<td>Model Element(s) Containing Value(s)</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------------------</td>
<td>-------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conveyance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North County Pump Station</td>
<td>140 kWh/MG</td>
<td>NA</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>NCPS_Pcons_1</td>
</tr>
<tr>
<td>San Vicente Pump Station</td>
<td>1,310 kWh/MG or 12 MWh/yr when idle</td>
<td>NA</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>SVPS_Pcons_1</td>
</tr>
<tr>
<td>Valley Center Pump Station</td>
<td>346 kWh/MG or 690 MWh/yr when idle</td>
<td>NA</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>VCPS_Pcons</td>
</tr>
<tr>
<td>Olivenhain Pump Station</td>
<td>663 kWh/MG</td>
<td>NA</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>OlivPS_Pcons</td>
</tr>
<tr>
<td>Rancho Peñasquitos Hydroelectric Facility</td>
<td>21 MWh/yr</td>
<td>337 kWh/MG</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>RPEN_Pcons, Rancho_Pgen</td>
</tr>
<tr>
<td>Escondido Pump Station</td>
<td>31 MWh/yr</td>
<td>NA</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>ESCPS_Pcons</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Badger WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
<td>CEC 2006</td>
<td>BADG_Pcons</td>
</tr>
<tr>
<td>Escondido WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
<td>CEC 2006</td>
<td>ESC_Pcons</td>
</tr>
<tr>
<td>Levy WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
<td>CEC 2006</td>
<td>LEVY_Pcons</td>
</tr>
<tr>
<td>Poway WTP</td>
<td>111 kWh/MG</td>
<td>NA</td>
<td>California Energy Commission (2006)</td>
<td>POW_Pcons</td>
</tr>
<tr>
<td>Facility</td>
<td>Energy Consumption Value</td>
<td>Energy Generation Value</td>
<td>Reference</td>
<td>Model Element(s) Containing Value(s)</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------------------</td>
<td>------------------------</td>
<td>------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td><strong>Pumped Storage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hodges Pump Storage Hydroelectric Facility</td>
<td>100,000 MWh/yr</td>
<td>74,000 MWh/yr</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>HodgesPSHydro_Pcons, HodgesPSHydro_Pgen</td>
</tr>
<tr>
<td><strong>Offices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Authority San Diego Office</td>
<td>1094 MWh/yr</td>
<td>676 MWh/yr</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>SDOOfficePower_Pcons, SDOOffice_Solar_Pgen</td>
</tr>
<tr>
<td>Water Authority Escondido Office</td>
<td>683 MWh/yr</td>
<td>252 MWh/yr</td>
<td>2013 SDCWA Master Plan (2013)</td>
<td>ESCOffice_SolarPowerCons, ESCOffice_Solar_Pgen</td>
</tr>
</tbody>
</table>

### Table C-2. Annual Metrics

<table>
<thead>
<tr>
<th>Metric Name</th>
<th>Metric Description</th>
<th>Calculation</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWANN_1</td>
<td>Annual Energy Generation TOTAL (Supply Source + Conveyance + Treatment + Pumped Storage + WA Offices)</td>
<td>ALV_Pgen + MIR_Pgen + SDOOffice_Solar_Pgen + ESCOffice_Solar_Pgen + HodgesPSHydro_Pgen + RPEN_Pgen</td>
<td>MWh/yr</td>
<td>Generation</td>
</tr>
<tr>
<td>POWANN_3</td>
<td>Annual Net Energy - Consumption minus Generation: TOTAL (Supply Source + Conveyance + Treatment + Pumped Storage + WA Offices)</td>
<td>POWANN_2 - POWANN_1</td>
<td>MWh/yr</td>
<td>Net (Consumption-Generation)</td>
</tr>
<tr>
<td>POWANN_ Supply</td>
<td>Annual Net Energy Consumption minus Generation: Supply Source</td>
<td>GW_Supply_Pcons + RCY_Supply_Pcons + Import_Supply_Pcons + Desal_Supply_Pcons + Pure_Supply_Pcons + Rosarito_Pcons</td>
<td>MWh/yr</td>
<td>Net (Consumption-Generation)</td>
</tr>
<tr>
<td>POWANN_ Conveyance</td>
<td>Annual Net Energy Consumption minus Generation Conveyance</td>
<td>(NCPS_Pcons_1 + VPS_Pcons_1 + VCPS_Pcons + OlivPS_Pcons + RPEN_Pcons + ESCPS_Pcons) - (Rancho_Pgen)</td>
<td>MWh/yr</td>
<td>Net (Consumption-Generation)</td>
</tr>
<tr>
<td>Metric Name</td>
<td>Metric Description</td>
<td>Calculation</td>
<td>Units</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>POWANN_PS</td>
<td>Annual Net Energy Consumption minus Generation Pumped Storage</td>
<td>HodgesPSHydro_Pcons</td>
<td>MWh/yr</td>
<td>Net (Consumption-Generation)</td>
</tr>
<tr>
<td>POWANN_Offices</td>
<td>Annual Net Energy Consumption minus Generation WA Offices</td>
<td>(SDOfficePower_Pcons + ESCOffice_SolarPowerCons) - (SDOffice_Solar_Pgen + ESCOffice_Solar_Pgen)</td>
<td>MWh/yr</td>
<td>Net (Consumption-Generation)</td>
</tr>
<tr>
<td>GW_POWANN</td>
<td>Annual Energy Consumption of groundwater supply source</td>
<td>GW_Supply_Pcons</td>
<td>MWh/yr</td>
<td>Consumption</td>
</tr>
<tr>
<td>RCY_POWANN</td>
<td>Annual Energy Consumption of recycled water supply source</td>
<td>RCY_Supply_Pcons</td>
<td>MWh/yr</td>
<td>Consumption</td>
</tr>
<tr>
<td>IMPORTED_POWANN</td>
<td>Annual Energy Consumption of imported water supply source</td>
<td>Import_Supply_Pcons</td>
<td>MWh/yr</td>
<td>Consumption</td>
</tr>
<tr>
<td>DESAL_POWANN</td>
<td>Annual Energy Consumption of sea-desalinated water supply source</td>
<td>Desal_Supply_Pcons + Rosarito_Pcons</td>
<td>MWh/yr</td>
<td>Consumption</td>
</tr>
<tr>
<td>PURE_POWANN</td>
<td>Annual Energy Consumption of Pure water supply source</td>
<td>Pure_Supply_Pcons</td>
<td>MWh/yr</td>
<td>Consumption</td>
</tr>
</tbody>
</table>

**Table C-3. Monthly Metrics**

<table>
<thead>
<tr>
<th>Metric Name</th>
<th>Metric Description</th>
<th>Calculation</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCY_Monthly</td>
<td>Recycled Water Energy Consumed</td>
<td>RCY_Supply_Pcons</td>
<td>MWh/ month</td>
<td>Consumption</td>
</tr>
<tr>
<td>Metric Name</td>
<td>Metric Description</td>
<td>Calculation</td>
<td>Units</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------</td>
<td>---------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>GW_Monthly</td>
<td>Groundwater Energy Consumed</td>
<td>GW_Supply_Pcons</td>
<td>MWh/ month</td>
<td>Consumption</td>
</tr>
<tr>
<td>Imported_</td>
<td>Imported Water Energy Consumed</td>
<td>Import_Supply_Pcons</td>
<td>MWh/ month</td>
<td>Consumption</td>
</tr>
<tr>
<td>Monthly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desal_Monthly</td>
<td>Desal Water Energy Consumed</td>
<td>Desal_Supply_Pcons</td>
<td>MWh/ month</td>
<td>Consumption</td>
</tr>
<tr>
<td>Pure_Monthly</td>
<td>Pure Water Energy Consumed</td>
<td>Pure_Supply_Pcons</td>
<td>MWh/ month</td>
<td>Consumption</td>
</tr>
</tbody>
</table>

**Appendix C References**


Appendix D – Detailed Model Results

Appendix D contains figures and results summaries for each metric analyzed in the San Diego Basin Study.
Appendix D – Detailed Model Results

Appendix D contains figures and results summaries for each metric analyzed in the San Diego Basin Study.

Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Delivery</td>
<td>3</td>
</tr>
<tr>
<td>Water Delivery – Demands</td>
<td>3</td>
</tr>
<tr>
<td>Gross Demand Volume</td>
<td>3</td>
</tr>
<tr>
<td>Average Annual Gross Demand Volume: Current and Future Climate Within Portfolio Comparisons</td>
<td>3</td>
</tr>
<tr>
<td>Average Annual Gross Demand Volume: Across Portfolio Comparisons</td>
<td>6</td>
</tr>
<tr>
<td>Water Delivery – Deliveries</td>
<td>8</td>
</tr>
<tr>
<td>Delivery and Conservation Volume</td>
<td>8</td>
</tr>
<tr>
<td>Average Annual Delivery and Conservation Volume: Across Portfolio Comparisons</td>
<td>8</td>
</tr>
<tr>
<td>Average Annual Delivery and Conservation Volume by Supply Source: Current Climate Within Portfolio Comparisons</td>
<td>10</td>
</tr>
<tr>
<td>Average Annual Delivery and Conservation Volume: 2025 Demands Current and Future Climate Within Portfolio Comparisons</td>
<td>23</td>
</tr>
<tr>
<td>Average Annual Delivery and Conservation Volume: 2050 Demands Current and Future Climate Within Portfolio Comparisons</td>
<td>36</td>
</tr>
<tr>
<td>Average Annual Delivery and Conservation Volume by Concept: Across Portfolio Comparisons</td>
<td>49</td>
</tr>
<tr>
<td>Average Annual Delivery and Conservation Percentage of Supply by Supply Source: Current Climate Within Portfolio Comparisons</td>
<td>64</td>
</tr>
<tr>
<td>Water Delivery – Shortage</td>
<td>71</td>
</tr>
<tr>
<td>Shortage Volume</td>
<td>71</td>
</tr>
<tr>
<td>Average Annual Shortage Volume: Across Portfolio Comparisons</td>
<td>71</td>
</tr>
<tr>
<td>Average Annual Shortage Volume: Current and Future Climate Within Portfolio Comparisons</td>
<td>74</td>
</tr>
<tr>
<td>Percent of Shortages Above Threshold: Across Portfolio Comparisons</td>
<td>81</td>
</tr>
<tr>
<td>Percent of Shortages Above Threshold: Within and Across Portfolio Comparisons for 2025 and 2050 Demand Scenarios</td>
<td>83</td>
</tr>
<tr>
<td>Water Delivery – Conveyance</td>
<td>86</td>
</tr>
<tr>
<td>Pipeline Flow Volume</td>
<td>86</td>
</tr>
<tr>
<td>Average Monthly Pipeline Flow Volume: Current Climate Within Portfolio Comparisons</td>
<td>86</td>
</tr>
<tr>
<td>Average Monthly Pipeline Flow Volume: Future Climate Within Portfolio Comparisons</td>
<td>93</td>
</tr>
<tr>
<td>High Pipeline Utilization Summer Count</td>
<td>106</td>
</tr>
<tr>
<td>Average High Pipeline Utilization Summer Count: Current Climate Within Portfolio Comparisons</td>
<td>106</td>
</tr>
<tr>
<td>Average High Pipeline Utilization Summer Count: Future Climate Within Portfolio Comparisons</td>
<td>113</td>
</tr>
<tr>
<td>Average High Pipeline Utilization Summer Count: Across Portfolio Comparisons</td>
<td>126</td>
</tr>
</tbody>
</table>
High Pump Station Utilization ................................................................................................................ 135
Average Annual High Pump Station Utilization: Across Portfolio Comparisons .................................. 135
Treatment Plant Utilization .......................................................................................................................... 138
Average Annual Treatment Plant Utilization by Treatment Plant: Current Climate Within Portfolio
Comparisons .................................................................................................................................................. 138
System Wide Average Annual Treatment Plant Utilization: Current Climate Within Portfolio
Comparisons .................................................................................................................................................. 145
Average Annual Treatment Plant Utilization by Treatment Plant: Future Climate Within Portfolio
Comparisons .................................................................................................................................................. 152
System Wide Average Annual Treatment Plant Utilization: Future Climate Within Portfolio
Comparisons .................................................................................................................................................. 177
Average Annual Treatment Plant Utilization by Treatment Plant: Across Portfolio Comparisons .... 190
Water Delivery - Reservoir Operations ........................................................................................................ 211
Reservoir Storage .......................................................................................................................................... 211
Average Monthly Reservoir Storage: Within and Across Portfolio Comparisons for Future and Current Climate ........................................................................................................................................ 211
Reservoir Releases ....................................................................................................................................... 269
Average Monthly Reservoir Releases: Within and Across Portfolio Comparisons for Future and
Current Climate ............................................................................................................................................... 269
End of September Reservoir Storage .......................................................................................................... 330
Average End of September Reservoir Storage: Current Climate Within Portfolio Comparisons .......... 330
Average End of September Reservoir Storage: Future Climate Within Portfolio Comparisons .......... 337
Average End of September Reservoir Storage: Across Portfolio Comparisons ........................................ 350
Energy ......................................................................................................................................................... 359
Energy Generation and Consumption ........................................................................................................ 359
Average Annual Energy Generation and Consumption: Current Climate and Future Climate Within
Portfolio Comparisons ................................................................................................................................. 359
Average Annual Energy Generation and Consumption: Across Portfolio Comparisons ...................... 372
Recreation ..................................................................................................................................................... 377
End of September Reservoir Elevation: Current Climate Within Portfolio Comparisons ..................... 377
End of September Reservoir Elevation: Future Climate Within Portfolio Comparisons ..................... 384
Percent of Realizations Below the Boat Ramp Elevation: Across Portfolio Comparisons ..................... 397
End of September Reservoir Elevation: Across Portfolio Comparisons .................................................. 406
Flood Control - Average Number of Flood Outflows & Flood Outflow Volume ..................................... 413
Average Annual Number of Days with Flood Outflows & Flood Outflow Volume: Current Climate
Within Portfolio Comparisons ......................................................................................................................... 413
Average Annual Number of Days with Flood Outflows & Flood Outflow Volume: Future Climate
Within Portfolio Comparisons ......................................................................................................................... 420
Average Annual Flood Outflow Volume: Across Portfolio Comparisons .................................................. 433
Average Annual Number of Days With Flood Outflows: Across Portfolio Comparisons ....................... 439
Water Delivery—Demands—Gross Demand Volume

Average Annual Gross Demand Volume

Current and Future Climate Within Portfolio Comparison
Within Portfolio - All Portfolios - Current Climate
• There is evidence that Gross Demands Projections are higher in 2025 than in 2015 (p<0.01) and higher in 2050 than in 2025 (p<0.01).
Within Portfolio - All Portfolios - Current and Future Climate Scenarios

- There is evidence that Gross Demands Projections are lower for current climate than for central tendency climate (p<0.01) for both 2025 and 2050 demands. There is no evidence of a difference in Gross Demands Projections between central tendency climate scenario and other climate scenarios (p>0.1) in either 2025 or 2050 demands.
Water Delivery—Demands—Gross Demand Volume

Average Annual Gross Demand Volume

Across Portfolio Comparison
Across Portfolio - Baseline Compared to Other Portfolios - Demands

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Demands between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.
- **2025 Demands**: There is no evidence of a difference (p>0.1) in Demands between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.
- **2050 Demands**: There is no evidence of a difference (p>0.1) in Demands between the Baseline Portfolio and any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Demands

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Demands between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.
- **2025 Demands**: There is no evidence of a difference (p>0.1) in Demands between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.
- **2050 Demands**: There is no evidence of a difference (p>0.1) in Demands between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Water Delivery—Deliveries—Delivery and Conservation Volume

Average Annual Delivery and Conservation Volume

Across Portfolio Comparison
Across Portfolio - Baseline Compared to Other Portfolios - Total Deliveries and Conservation

**2015 Demands:** Total deliveries (including conservation) are 631,418 AF in all Portfolios for 2015 demands and current climate.

**2025 Demands:** Total deliveries (including conservation) are lower in the Baseline Portfolio than all other Portfolios for 2025 demands and current, central tendency, and hot-dry climates.

**2050 Demands:** Total deliveries (including conservation) are lower in the Baseline Portfolio than all other Portfolios for 2025 demands and current, central tendency, and hot-dry climates.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Total Deliveries and Conservation

**2015 Demands:** Total deliveries (including conservation) are 631,418 AF in all Portfolios for 2015 demands and current climate.

**2025 Demands:** Total deliveries (including conservation) are lower in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios, and similar in the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for current, central tendency, and hot-dry climates.

**2050 Demands:** Total deliveries (including conservation) are lower in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios, some higher in the Baseline Plus Portfolio than in the Optimize Existing Facilities Portfolio, and similar in the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios for current, central tendency, and hot-dry climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Water Delivery—Deliveries—Delivery and Conservation Volume

Average Annual Delivery and Conservation Volume by Supply Source

Current Climate Within Portfolio Comparisons
Within Portfolios - Baseline - Current Climate Comparisons Across Demand Scenarios

- **Enhanced Conservation:** There is no Enhanced Conservation in the Baseline Portfolio.

- **Urban and Agricultural Water Use Efficiency:** Urban and Agricultural Water Use Efficiency conservation is larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.

- **Firm Water Supply Agreements (QSA):** Delivery of water from Firm Water Supply Agreements does not change between the 2015, 2025, and 2050 demand scenarios.

- **Groundwater:** Deliveries of Groundwater are larger for the 2025 demand scenario than for the 2015 demand scenario and similar for the 2025 and 2050 demand scenarios.

- **Imported Water Purchases:** There is evidence that Imported Water deliveries are larger ($p<0.01$) in 2025 than in 2015 and larger ($p<0.01$) in 2050 than in 2025.

- **Surface Water:** There is no evidence of a difference ($p>0.1$) in Surface Water deliveries between the 2015, 2025, and 2050 demand scenarios.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline - Current Climate Comparisons Across Demand Scenarios

- **Recycled Water**: Deliveries of Recycled Water are larger for the 2025 demand scenario than for the 2015 demand scenario and slightly larger for the 2050 demand scenario than for the 2025 demand scenario.
- **Desalination**: There is evidence that deliveries of Desalinated Water are larger ($p<0.01$) for the 2025 demand scenario than for the 2015 demand scenario and larger ($p<0.01$) for the 2050 demand scenario than for the 2025 demand scenario.
- **Potable Reuse**: There is evidence that Potable Reuse deliveries are larger ($p<0.01$) for 2025 demands than for 2015 demands (there are no Potable Reuse deliveries in 2015 demands), but no evidence of a difference ($p>0.1$) in Potable Reuse deliveries between 2025 and 2050 demands.
- **Stormwater BMPs**: There are no Stormwater BMP projects in the Baseline Portfolio.
- **Gray Water Use**: There are no Gray Water use projects in the Baseline Portfolio.
- **Stormwater Capture**: There are no Stormwater Capture projects in the Baseline Portfolio.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline Plus - Current Climate Comparisons Across Demand Scenarios

- **Enhanced Conservation:** There is no Enhanced Conservation in the Baseline Plus Portfolio.
- **Urban and Agricultural Water Use Efficiency:** Urban and Agricultural Water Use Efficiency conservation is larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.
- **Firm Water Supply Agreements (QSA):** Delivery of water from Firm Water Supply Agreements does not change between the 2015, 2025, and 2050 demand scenarios.
- **Groundwater:** Deliveries of Groundwater are larger for the 2025 demand scenario than for the 2015 demand scenario and slightly larger for the 2050 demand scenario than for the 2025 demand scenario.
- **Imported Water Purchases:** There is no evidence of a difference (p>0.1) in Imported Water deliveries between the 2015 and 2025 demand scenarios, but there is evidence that imported water deliveries are larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.
- **Surface Water:** There is no evidence of a difference (p>0.1) in Surface Water Deliveries between 2015 and 2025 demand scenarios, but there is evidence that Surface Water deliveries are larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline Plus - Current Climate Comparisons Across Demand Scenarios

- **Recycled Water**: Deliveries of Recycled Water are larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.

- **Desalination**: There is evidence that deliveries of Desalinated Water are larger (p<0.01) for the 2025 demand scenario than for the 2015 demand scenario and larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Potable Reuse**: There is evidence that deliveries of Potable Reuse water are larger (p<0.01) for the 2025 demand scenario than the 2015 demand scenario (there are no Potable Reuse deliveries in 2015 demands) and smaller (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Stormwater BMPs**: There are no Stormwater BMP projects in the Baseline Plus Portfolio.

- **Gray Water Use**: There are no Gray Water projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, but no evidence of a difference between 2025 and 2050 demands.

- **Stormwater Capture**: There are no Stormwater Capture projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, but no evidence of a difference between 2025 and 2050 demands.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Enhanced Conservation - Current Climate Comparisons Across Demand Scenarios

- **Enhanced Conservation:** There is no enhanced conservation for the 2015 demand scenario, but it is included in the 2025 demand scenario, with a larger volume for 2050 the demand scenario than the 2025 demand scenario.

- **Urban and Agricultural Water Use Efficiency:** Urban and Agricultural Water Use Efficiency conservation is larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.

- **Firm Water Supply Agreements (QSA):** Delivery of water from Firm Water Supply Agreements does not change between the 2015, 2025, and 2050 demand scenarios.

- **Groundwater:** Deliveries of Groundwater are larger for the 2025 demand scenario than for the 2015 demand scenario and slightly larger for the 2050 demand scenario than for the 2025 demand scenario.

- **Imported Water Purchases:** There is evidence that Imported Water Purchase deliveries are smaller (p<0.01) for the 2025 demand scenario than for the 2015 demand scenario and smaller (p<0.01) for the 2050 scenario than for the 2025 demand scenario.

- **Surface Water:** There is no evidence of a difference (p>0.1) in Surface Water Deliveries between 2015 and 2025 demand scenarios. There is evidence that Surface Water deliveries are larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Enhanced Conservation - Current Climate Comparisons Across Demand Scenarios

- **Recycled Water**: Deliveries of Recycled Water are larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.

- **Desalination**: There is evidence that deliveries of Desalinated Water are larger (p<0.01) for the 2025 demand scenario than for the 2015 demand scenario but smaller (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Potable Reuse**: There is evidence that deliveries of Potable Reuse water are larger (p<0.01) for the 2025 demand scenario than the 2015 demand scenario (there are no Potable Reuse deliveries in 2015 demands) but smaller (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Stormwater BMPs**: There are no Stormwater BMP projects in the Enhanced Conservation Portfolio.

- **Gray Water Use**: There are no Gray Water projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, but no evidence of a difference between 2025 and 2050 demands.

- **Stormwater Capture**: There are no Stormwater Capture projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, but no evidence of a difference between 2025 and 2050 demands.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Increase Supplies - Current Climate Comparisons Across Demand Scenarios

- Enhanced Conservation: There is no Enhanced Conservation in the Increase Supplies Portfolio.

- Urban and Agricultural Water Use Efficiency: Urban and Agricultural Water Use Efficiency conservation is larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.

- Firm Water Supply Agreements (QSA): Delivery of water from Firm Water Supply Agreements does not change between the 2015, 2025, and 2050 demand scenarios.

- Groundwater: Deliveries of Groundwater are larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.

- Imported Water Purchases: There is evidence that Imported Water Purchase deliveries are smaller (p<0.01) for the 2025 demand scenario than for the 2015 demand scenario and smaller (p<0.01) for the 2050 scenario than for the 2025 demand scenario.

- Surface Water: There is no evidence of a difference in Surface Water Deliveries between 2015 and 2025 (p>0.1). There is some evidence (p=0.076) that Surface Water Deliveries are higher for the 2050 demand scenario than for the 2025 demand scenario.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Continued from page 17.

Within Portfolios - Increase Supplies - Current Climate Comparisons Across Demand Scenarios

- **Recycled Water**: Deliveries of Recycled Water are larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.

- **Desalination**: There is evidence that deliveries of Desalinated water are larger (p<0.01) for the 2025 demand scenario than for the 2015 demand scenario and larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Potable Reuse**: There is evidence that deliveries of Potable Reuse water are larger (p<0.01) for the 2025 demand scenario than the 2015 demand scenario (there are no Potable Reuse deliveries in 2015 demands) and larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Stormwater BMPs**: There are no Stormwater BMP projects in the Increase Supplies Portfolio.

- **Gray Water Use**: There are no Gray Water projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, and higher for 2050 demands than for 2025 demands.

- **Stormwater Capture**: There are no Stormwater Capture projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, but no evidence of a difference between 2025 and 2050 demands.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Optimize Existing Facilities- Current Climate Comparisons Across Demand Scenarios

- **Enhanced Conservation:** There is no Enhanced Conservation in Optimize Existing Facilities.
- **Urban and Agricultural Water Use Efficiency:** Urban and Agricultural Water Use Efficiency conservation is larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.
- **Firm Water Supply Agreements (QSA):** Delivery of water from Firm Water Supply Agreements does not change between the 2015, 2025, and 2050 demand scenarios.
- **Groundwater:** Deliveries of Groundwater are larger for the 2025 demand scenario than for the 2015 demand scenario and slightly larger for the 2050 demand scenario than for the 2025 demand scenario.
- **Imported Water Purchases:** There is no evidence of a difference (p>0.1) in Imported Water deliveries between the 2015 and 2025 demand scenarios, but there is evidence that imported water deliveries are larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.
- **Surface Water:** There is no evidence of a difference (p>0.1) in Surface Water Deliveries between 2015 and 2025 demand scenarios. There is evidence that Surface Water deliveries are larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Continued from page 19.

Within Portfolios - Optimize Existing Facilities- Current Climate Comparisons Across Demand Scenarios

- **Recycled Water**: Deliveries of Recycled Water are larger for the 2025 demand scenario than the 2015 demand scenario and larger for the 2050 demand scenario than the 2025 demand scenario.

- **Desalination**: There is evidence that deliveries of Desalinated water are larger (p<0.01) for the 2025 demand scenario than for the 2015 demand scenario and larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Potable Reuse**: There is evidence that deliveries of Potable Reuse water are larger (p<0.01) for the 2025 demand scenario than the 2015 demand scenario (there are no Potable Reuse deliveries in 2015 demands) and smaller (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Stormwater BMPs**: There are no Stormwater BMPs in the Optimize Existing Facilities Portfolio.

- **Gray Water Use**: There are no Gray Water projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, but no evidence of a difference between 2025 and 2050 demands.

- **Stormwater Capture**: There are no Stormwater Capture projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, but no evidence of a difference between 2025 and 2050 demands.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Watershed Health and Ecosystem Restoration - Current Climate Comparisons Across Demand Scenarios

- **Enhanced Conservation:** There is no Enhanced Conservation in the Watershed Health and Ecosystem Restoration Portfolio.

- **Urban and Agricultural Water Use Efficiency:** Urban and Agricultural Water Use Efficiency conservation is larger for the 2025 demand scenario than for the 2015 demand scenario and larger for the 2050 demand scenario than for the 2025 demand scenario.

- **Firm Water Supply Agreements (QSA):** Delivery of water from Firm Water Supply Agreements does not change between the 2015, 2025, and 2050 demand scenarios.

- **Groundwater:** Deliveries of Groundwater are larger for the 2025 demand scenario than for the 2015 demand scenario and slightly larger for the 2050 demand scenario than for the 2025 demand scenario.

- **Imported Water Purchases:** There is no evidence of a difference (p>0.1) in Imported Water deliveries between the 2015 and 2025 demand scenarios, but there is evidence that imported water deliveries are larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

- **Surface Water:** There is no evidence of a difference (p>0.1) in Surface Water Deliveries between 2015 and 2025 demand scenarios. There is evidence that Surface Water deliveries are larger (p<0.01) for the 2050 demand scenario than for the 2025 demand scenario.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Watershed Health and Ecosystem Restoration - Current Climate Comparisons Across Demand Scenarios

- **Recycled Water**: Deliveries of Recycled Water are larger for the 2025 demand scenario than the 2015 demand scenario and larger for the 2050 demand scenario than the 2025 demand scenario.

- **Desalination**: There is evidence that deliveries of Desalinated water are larger ($p<0.01$) for the 2025 demand scenario than for the 2015 demand scenario and larger ($p<0.01$) for the 2050 demand scenario than for the 2025 demand scenario.

- **Potable Reuse**: There is evidence that deliveries of Potable Reuse water are larger ($p<0.01$) for the 2025 demand scenario than the 2015 demand scenario (there are no Potable Reuse deliveries in 2015 demands) and smaller ($p<0.01$) for the 2050 demand scenario than for the 2025 demand scenario.

- **Stormwater BMPs**: Stormwater BMP deliveries are higher for 2050 demands than for 2025 demands (there are no Stormwater BMP deliveries in 2015 or 2025 demand scenarios).

- **Gray Water Use**: There are no Gray Water projects in the 2015 demand scenario, but a small amount is delivered in the 2025 and 2050 demand scenarios. There is evidence that delivery is higher for 2025 demands than for 2015 demands, but no evidence of a difference between 2025 and 2050 demands.

- **Stormwater Capture**: There are no Stormwater Capture projects in the 2015 demand scenario, but a small amount is delivered in the 2025 demand scenario and a larger amount is delivered in the 2050 demand scenario. There is evidence that delivery is higher for 2025 demands than for 2015 demands, and higher for 2050 demands than for 2025 demands.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Water Delivery—Deliveries—Delivery and Conservation Volume

Average Annual Delivery and Conservation Volume

2025 Demands Current and Future Climate Within Portfolio Comparisons
Within Portfolios - Baseline - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Baseline Portfolio.
- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower (p=0.052) for current climate than central tendency climate but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Surface Water:** There is no evidence of a difference (p>0.1) in Surface Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water:** There is no evidence of a difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Desalination:** There is evidence that Desalination delivery volume is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Potable Reuse:** There is no evidence of a difference (p>0.1) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater BMPs:** There is zero Stormwater BMP delivery in the Baseline Portfolio.

- **Gray Water Use:** There is zero Gray Water Use delivery in the Baseline Portfolio.

- **Stormwater Capture:** There is zero Stormwater Capture delivery in the Baseline Portfolio.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline Plus - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water:** There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Desalination:** There is evidence that Desalination delivery volume is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Potable Reuse:** There is no evidence of a difference (p>0.1) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater BMPs:** There is zero Stormwater BMP delivery in the Baseline Plus Portfolio.

- **Gray Water Use:** There is no evidence of a difference in Gray Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater Capture:** There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline Plus - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water**: There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Desalination**: There is evidence that Desalination delivery volume is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Potable Reuse**: There is no evidence of a difference ($p>0.1$) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Stormwater BMPs**: There is zero Stormwater BMP delivery in the Baseline Plus Portfolio.
- **Gray Water Use**: There is no evidence of a difference in Gray Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Stormwater Capture**: There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Enhanced Conservation - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is no difference in enhanced conservation in the Enhanced Conservation Portfolio between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower (p=0.039) for current climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Surface Water:** There is no evidence of a difference (p>0.1) in Surface Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Continued from page 28.

Within Portfolios - Enhanced Conservation - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water**: There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Desalination**: There is evidence that Desalination delivery volume is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Potable Reuse**: There is evidence that in Potable Reuse delivery volume is slightly lower (p<0.01) for current climate than for central tendency climate but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater BMPs**: There is zero Stormwater BMP delivery in the Enhanced Conservation Portfolio.

- **Gray Water Use**: There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater Capture**: There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Increase Supplies - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Increase Supplies Portfolio.
- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower (p=0.043) for current climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Surface Water:** There is no evidence of a difference (p>0.1) in Surface Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Increase Supplies - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water:** There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Desalination:** There is evidence that Desalination delivery volume is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Potable Reuse:** There is no evidence of a difference (p<0.01) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater BMPs:** There is zero Stormwater BMP delivery in the Increase Supplies Portfolio.

- **Gray Water Use:** There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater Capture:** There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Optimize Existing Facilities - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Optimize Existing Facilities Portfolio.
- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower (p=0.046) for current climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Surface Water:** There is no evidence of a difference in Surface Water delivery volume between current climate and central tendency climate (p>0.1). There is some evidence (p=0.096) that deliveries are lower for hot-dry climate than central tendency climate, but no evidence of differences between central tendency climate and hot-wet, warm-dry, or warm-wet climates (p>0.1).

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Continued from page 32.

Within Portfolios - Optimize Existing Facilities - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water**: There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Desalination**: There is evidence that Desalination delivery volume is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Potable Reuse**: There is no evidence of a difference (p>0.1) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater BMPs**: There is zero Stormwater BMP delivery in the Optimize Existing Facilities Portfolio.

- **Gray Water Use**: There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater Capture**: There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Watershed Health and Ecosystem Restoration - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Watershed Health and Ecosystem Restoration Portfolio.

- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower (p=0.046) for current climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Surface Water:** There is no evidence of a difference in Surface Water delivery volume between current climate and central tendency climate (p>0.1). There is some evidence (p=0.096) that deliveries are lower for hot-dry climate than central tendency climate, but no evidence of differences (p>0.1) between central tendency climate and hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Watershed Health and Ecosystem Restoration - 2025 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water:** There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Desalination:** There is evidence that Desalination delivery volume is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Potable Reuse:** There is no evidence of a difference ($p>0.1$) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Stormwater BMPs:** There is zero Stormwater BMP delivery in the Watershed Health and Ecosystem Restoration Portfolio for 2025 demands.
- **Gray Water Use:** There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Stormwater Capture:** There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Water Delivery—Deliveries—Delivery and Conservation Volume

Average Annual Delivery and Conservation Volume

2050 Demands Current and Future Climate Within Portfolio Comparisons
Within Portfolios - Baseline - 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Baseline Portfolio.

- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Imported Water Purchases:** There is some evidence that Imported Water delivery volume is slightly lower (p=0.067) for current climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Surface Water:** There is no evidence of a difference in Surface Water delivery volume between current climate and central tendency climate (p>0.1) or between central tendency climate and hot-wet (p>0.1) or warm-dry (p>0.1) climates. There is some evidence that Surface Water deliveries are lower (p=0.079) for hot-dry climate and higher (p=0.098) for warm-wet climate.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Continued from page 37.

Within Portfolios - Baseline - 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water:** There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Desalination:** There is evidence that Desalination delivery volume is lower \( (p=0.014) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Potable Reuse:** There is no evidence of a difference \( (p>0.1) \) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Stormwater BMPs:** There is zero Stormwater BMP delivery in the Baseline Portfolio.
- **Gray Water Use:** There is zero Gray Water Use delivery in the Baseline Portfolio.
- **Stormwater Capture:** There is zero Stormwater Capture delivery in the Baseline Portfolio.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline Plus - 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Baseline Plus Portfolio.
- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower (p=0.053) for current climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Surface Water:** There is no evidence of a difference in Surface Water delivery volume between current climate and central tendency climate (p>0.1), but some evidence that deliveries are higher for hot-wet climate (p=0.097) and lower for warm-dry climate (p=0.090) than central tendency climate. There is evidence that deliveries are lower (p=0.037) for hot-dry climate than central tendency climate and higher (p=0.032) for warm-wet climate than central tendency climate.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline Plus - 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water**: There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Desalination**: There is evidence that Desalination delivery volume is lower (p=0.018) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Potable Reuse**: There is no evidence of a difference (p>0.1) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry climates. There is evidence that potable reuse delivery is lower (p<0.01) with warm-wet climate than with central tendency climate.
- **Stormwater BMPs**: There is zero Stormwater BMP delivery in the Baseline Plus Portfolio.
- **Gray Water Use**: There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Stormwater Capture**: There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Enhanced Conservation- 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is no difference in enhanced conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower \((p=0.027)\) for current climate than for central tendency climate, but no evidence of a difference \((p>0.1)\) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Surface Water:** There is no evidence of a difference in Surface Water delivery volume between current climate and central tendency climate \((p>0.1)\), but some evidence that deliveries are higher for hot-wet \((p=0.072)\) and lower for warm-dry \((p=0.076)\) climates than central tendency. There is evidence that deliveries are lower for hot-dry \((p=0.039)\) and higher \((p=0.033)\) for warm-wet climates than central tendency climate.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Enhanced Conservation- 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water:** There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Desalination:** There is evidence that Desalination delivery volume is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Potable Reuse:** There is no evidence of a difference (p>0.1) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, or warm-dry climates. There is evidence that potable reuse delivery is lower (p<0.01) with warm-wet climate than with central tendency climate.

- **Stormwater BMPs:** There is zero Stormwater BMP delivery in Enhanced Conservation.

- **Gray Water Use:** There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, or warm-wet climates.

- **Stormwater Capture:** There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Increase Supplies- 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Increase Supplies Portfolio.

- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower (p=0.017) for current climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Surface Water:** There is no evidence of a difference in Surface Water delivery volume between current climate and central tendency climate (p>0.1), but some evidence that deliveries are higher for hot-wet climate (p=0.094) and lower for warm-dry climate (p=0.092) than for central tendency climate. There is some evidence that deliveries are lower (p=0.059) for hot-dry climate than central tendency climate and evidence that deliveries are higher (p=0.032) for warm-wet climate than central tendency climate.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Increase Supplies- 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water:** There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Desalination:** There is evidence that Desalination delivery volume is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Potable Reuse:** There is no evidence of a difference (p>0.1) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry climates. There is evidence that potable reuse delivery is lower (p<0.01) with warm-wet climate than with central tendency climate.

- **Stormwater BMPs:** There is zero Stormwater BMP delivery in the Increase Supplies Portfolio.

- **Gray Water Use:** There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater Capture:** There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Optimize Existing Facilities - 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Optimize Existing Facilities Portfolio.
- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Imported Water Purchases:** There is some evidence that Imported Water deliveries are lower (p=0.073) for current climate than central tendency climate and no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Surface Water:** There is no evidence of a difference (p>0.1) in Surface Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-wet or warm-dry climates. There is evidence that deliveries are lower (p=0.042) for hot-dry climate than central tendency climate and higher (p=0.031) for warm-wet climate than central tendency climate.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Optimize Existing Facilities - 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water**: There is no difference in Recycled Water delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Desalination**: There is evidence that Desalination delivery volume is lower (p=0.018) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Potable Reuse**: There is no evidence of a difference in Potable Reuse delivery volume between current climate and central tendency climate (p>0.1) or between central tendency climate and hot-wet climate (p>0.1). There is evidence that potable reuse delivery is lower (p<0.01) with warm-wet climate than with central tendency climate. There is some evidence that potable reuse delivery is higher with hot-dry climate (p=0.055) and warm-dry climate (p=0.086) than with central tendency climate.

- **Stormwater BMPs**: There is zero Stormwater BMP delivery in Optimize Existing Facilities.

- **Gray Water Use**: There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Stormwater Capture**: There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Watershed Health and Ecosystem Restoration - 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Enhanced Conservation:** There is zero enhanced conservation in the Watershed Health and Ecosystem Restoration Portfolio.

- **Urban and Agricultural Water Use Efficiency:** There is no difference in conservation volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Firm Water Supply Agreements (QSA):** There is no difference in QSA delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Groundwater:** There is no difference in Groundwater deliveries between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Imported Water Purchases:** There is evidence that Imported Water delivery volume is slightly lower (p=0.051) for current climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

- **Surface Water:** There is no evidence of a difference in Surface Water delivery volume between current climate and central tendency climate (p>0.1), but some evidence that deliveries are higher for hot-wet climate (p=0.097) and lower for warm-dry (p=0.088) climates. There is evidence that deliveries are lower (p=0.036) for hot-dry climate and higher (p=0.032) for warm-wet climate than central tendency climate.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Watershed Health and Ecosystem Restoration - 2050 Demand Scenario Comparisons Across Climate Scenarios

- **Recycled Water**: There is no difference in Recycled Water volume between current climate and central tendency climate or between central tendency and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Desalination**: There is evidence that Desalination delivery volume is lower (p=0.018) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Potable Reuse**: There is no evidence of a difference (p>0.1) in Potable Reuse delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, or warm-dry climates. There is evidence that potable reuse delivery is lower (p<0.01) with warm-wet climate than with central tendency climate.
- **Stormwater BMPs**: There is no evidence of a difference in Stormwater BMP delivery between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, or warm-dry climates.
- **Gray Water Use**: There is no evidence of a difference in Gray Water Use delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.
- **Stormwater Capture**: There is no evidence of a difference in Stormwater Capture delivery volume between current climate and central tendency climate or between central tendency climate and hot-dry, hot-wet, warm-dry, or warm-wet climates.

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Water Delivery—Deliveries—Delivery and Conservation Volume

Average Annual Delivery and Conservation Volume by Concept

Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios - Enhanced Conservation

- **2015 Demands**: Enhanced Conservation is zero in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Enhanced Conservation is zero except for in the Enhanced Conservation Portfolio for current, central tendency, and hot-dry climates, therefore Enhanced Conservation volume is higher in the Enhanced Conservation Portfolio than all other Portfolios.
- **2050 Demands**: Enhanced Conservation is zero except for in the Enhanced Conservation Portfolio for current, central tendency, and hot-dry climates, therefore Enhanced Conservation volume is higher in the Enhanced Conservation Portfolio than all other Portfolios.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Enhanced Conservation

- **2015 Demands**: Enhanced Conservation is zero in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Enhanced Conservation is zero except for in the Enhanced Conservation Portfolio for current, central tendency, and hot-dry climates, therefore Enhanced Conservation volume is higher in the Enhanced Conservation Portfolio than all other Portfolios.
- **2050 Demands**: Enhanced Conservation is zero except for in the Enhanced Conservation Portfolio for current, central tendency, and hot-dry climates, therefore Enhanced Conservation volume is higher in the Enhanced Conservation Portfolio than all other Portfolios.
Across Portfolio - Baseline Compared to Other Portfolios - Urban and Agricultural Water Use Efficiency

- **2015 Demands**: Urban and Agricultural Water Use Efficiency conservation is the same in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Although it is not supported by p-values, Urban and Agricultural Water Use Efficiency conservation is slightly larger in the Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed and Ecosystem Restoration Portfolios than in the Baseline Portfolio for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Although it is not supported by p-values, Urban and Agricultural Water Use Efficiency conservation is slightly larger in the Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed and Ecosystem Restoration Portfolios than in the Baseline Portfolios for 2050 demands for current, central tendency, and hot-dry climates.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Urban and Agricultural Water Use Efficiency

- **2015 Demands**: Urban and Agricultural Water Use Efficiency conservation is the same in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Urban and Agricultural Water Use Efficiency conservation is the same in all portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Urban and Agricultural Water Use Efficiency conservation is slightly larger in the Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed and Ecosystem Restoration Portfolios than in the Baseline Portfolios for 2050 demands for current, central tendency, and hot-dry climates based on observations, although p-values indicate that this difference is not significant.
Across Portfolio - Baseline Compared to Other Portfolios - Firm Water Supply Agreements

- **2015 Demands**: Deliveries of Firm Water Supply Agreement water are the same in all portfolios for 2015 demand for current climates.
- **2025 Demands**: Deliveries of Firm Water Supply Agreement water are the same in all portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Deliveries of Firm Water Supply Agreement water are the same in all portfolios for 2050 demands for current, central tendency, and hot-dry climates.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Firm Water Supply Agreements

- **2015 Demands**: Deliveries of Firm Water Supply Agreement water are the same in all portfolios for 2015 demand for current climate.
- **2025 Demands**: Deliveries of Firm Water Supply Agreement water are the same in all portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Deliveries of Firm Water Supply Agreement water are the same in all portfolios for 2050 demands for current, central tendency, and hot-dry climates.
Across Portfolio - Baseline Compared to Other Portfolios - Groundwater

- **2015 Demands:** Deliveries of Groundwater are the same in all portfolios for 2015 demands for current climate.

- **2025 Demands:** Deliveries of Groundwater are smaller in the Baseline Portfolio than in all other Portfolios for 2025 demands for current, central tendency, and hot-dry climates. Deliveries are equal in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. Deliveries are highest in the Increase Supplies Portfolio.

- **2050 Demands:** Deliveries of Groundwater are smaller in the Baseline Portfolio than in all other Portfolios for 2050 demands for current, central tendency, and hot-dry climates. Deliveries are equal in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios. Deliveries are highest in the Increase Supplies Portfolio.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Groundwater

- **2015 Demands:** Deliveries of Groundwater are the same in all portfolios for 2015 demands for current climate.

- **2025 Demands:** Deliveries of Groundwater are equal in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands for current, central tendency, and hot-dry climates. Deliveries are higher in the Increase Supplies Portfolio.

- **2050 Demands:** Deliveries of Groundwater are equal in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands for current, central tendency, and hot-dry climates. Deliveries are highest in the Increase Supplies Portfolio.
Across Portfolio - Baseline Compared to Other Portfolios - Imported Water

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Imported Water deliveries between any portfolios for 2015 demands for current climate.

- **2025 Demands:** There is evidence that Imported Water deliveries are smaller (p<0.01) in the Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios than the Baseline Portfolio for 2025 demands for current, central tendency, and hot-dry climates.

- **2050 Demands:** There is evidence that Imported Water deliveries are smaller (p<0.01) in the Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios than the Baseline Portfolio for 2050 demands for current, central tendency, and hot-dry climates.

Note that Imported Water Deliveries are slightly overstated due to a water accounting inconsistency in the CWASim model and that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Imported Water

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Imported Water deliveries between any portfolios for 2015 demands for current climate.

- **2025 Demands:** There is evidence that Imported Water deliveries are smaller in the Enhanced Conservation and Increase Supplies Portfolios than in the Baseline Plus Portfolio for 2025 demands for current climate, central tendency, and hot-dry climates (p<0.01 for all comparisons other than comparison for central tendency climate between Baseline Plus and Increase Supplies, where p=0.01). There is no evidence of a difference (p>0.1) in Imported Water deliveries between the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios and the Baseline Portfolio for 2025 demands for current, central tendency, and hot-dry climates.

- **2050 Demands:** There is evidence that Imported Water deliveries are smaller (p<0.01) in the Enhanced Conservation and Increase Supplies Portfolios than in the Baseline Plus Portfolio for 2050 demands for current climate, central tendency, and hot-dry climates. There is no evidence of a difference (p>0.1) in Imported Water deliveries between the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios and the Baseline Portfolio for 2050 demands for current, central tendency, and hot-dry climates.

Note that Imported Water Deliveries are slightly overstated due to a water accounting inconsistency in the CWASim model and that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
### Across Portfolio - Baseline Compared to Other Portfolios - Surface Water

- **2015 Demands:** There is no evidence of a difference \((p>0.1)\) in Surface Water deliveries between any portfolios for 2015 demands for current climate.

- **2025 Demands:** There is no evidence of a difference \((p>0.1)\) in Surface Water deliveries between any portfolios for 2025 demands for current climate, central tendency, and hot-dry climates.

- **2050 Demands:** There is evidence that Surface Water deliveries are larger in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios than the Baseline Portfolio for 2050 demands for current climate \((p<0.01, p=0.024, p<0.01, \text{ and } p<0.01, \text{ respectively})\) central tendency climate \((p<0.01, p=0.018, p<0.01, \text{ and } p<0.01, \text{ respectively})\), and hot-dry climate \((p=0.049, p=0.068, p=0.029, \text{ and } p=0.050, \text{ respectively})\), although there is only some evidence of this difference under hot-dry climate \((p=0.068)\) with the Enhanced Conservation Portfolio. There is no evidence of a difference \((p>0.1)\) in Surface Water Deliveries between the Baseline and Increase Supplies Portfolios with current climate, central tendency climate, and hot-dry climate.

Note that Surface Water Deliveries are slightly overstated due to a water accounting inconsistency in the CWASim model and that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Surface Water

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Surface Water deliveries between any portfolios for 2015 demands for current climate.

- **2025 Demands:** There is no evidence of a difference (p>0.1) in Surface Water deliveries between the Baseline Plus Portfolio and the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands for current climate, central tendency, and hot-dry climates.

- **2050 Demands:** There is no evidence of a difference in Surface Water deliveries between the Baseline Plus Portfolio and the Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands for central tendency and hot-dry climates (p>0.1), and only some evidence of a difference (p=0.099) for current climate.

Note that Surface Water Deliveries are slightly overstated due to a water accounting inconsistency in the CWASim model and that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Across Portfolio - Baseline Compared to Other Portfolios - Recycled Water

- **2015 Demands**: Deliveries of Recycled Water are the same in all portfolios for 2015 demands for current climate.

- **2025 Demands**: Deliveries of Recycled Water are slightly larger in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios than in the Baseline Portfolio for 2025 demands for current, central tendency, and hot-dry climates. Deliveries are much larger in the Increase Supplies Portfolio than in the Baseline or other Portfolios for 2025 demands for current, central tendency, and hot-dry climates.

- **2050 Demands**: Deliveries of Recycled Water are slightly larger in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios than in the Baseline Portfolio for 2050 demands for current, central tendency, and hot-dry climates. Deliveries are much larger in the Increase Supplies Portfolio than in the Baseline or other Portfolios for 2050 demands for current, central tendency, and hot-dry climates.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Recycled Water

- **2015 Demands**: Deliveries of Recycled Water are the same in all portfolios for 2015 demands for current climate.

- **2025 Demands**: Deliveries of Recycled Water are equal in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands for current, central tendency, and hot-dry climates. Deliveries are higher in the Increase Supplies Portfolio for 2025 demands for current, central tendency, and hot-dry climates.

- **2050 Demands**: Deliveries of Recycled Water are equal in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands for current, central tendency, and hot-dry climates. Deliveries are higher in the Increase Supplies Portfolio for 2050 demands for current, central tendency, and hot-dry climates.
Across Portfolio - Baseline Compared to Other Portfolios - Desalinated Water

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Desalinated water deliveries between any portfolios for 2015 demands for current climate.
- **2025 Demands**: There is evidence that Desalinated water deliveries are larger (p<0.01) in the Baseline Portfolio than all other Portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: There is evidence that Desalinated water deliveries are larger (p<0.01) in the Baseline Portfolio than in the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios and that deliveries are smaller (p<0.01) in the Baseline Portfolio than in the Increase Supplies Portfolio for 2025 demands for current, central tendency, and hot-dry climates.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Desalinated Water

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Desalinated water deliveries between any portfolios for 2015 demands for current climate.
- **2025 Demands**: There is evidence that Desalinated water deliveries are smaller (p<0.01) in the Enhanced Conservation Portfolio compared to the Baseline Plus Portfolio for 2025 demands for current, central tendency, and hot-dry climates. There is no evidence of a difference (p>0.1) in Desalinated water deliveries between the Baseline Plus, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: There is evidence that Desalinated water deliveries are smaller (p<0.01) in the Enhanced Conservation Portfolio and larger (p<0.01) in the Increase Supplies Portfolio compared to the Baseline Plus Portfolio for 2050 demands for current, central tendency, and hot-dry climates. There is no evidence of a difference (p>0.1) in Desalinated water deliveries between the Baseline Plus, Optimize Existing Facilities and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands for current, central tendency, and hot-dry climates.
Across Portfolio - Baseline Compared to Other Portfolios - Potable Reuse

- **2015 Demands:** Potable Reuse delivery is zero (p=NA) in all Portfolios for 2015 demands and current, central tendency, and hot-dry climate scenarios.

- **2025 Demands:** There is evidence that Potable Reuse deliveries are lower (p<0.01) in the Baseline Portfolio than all other Portfolios for 2025 demands under current, central tendency, and hot-dry climate scenarios.

- **2050 Demands:** There is evidence that Potable Reuse deliveries are lower (p<0.01) in the Baseline Portfolio than all other Portfolios for 2050 demands under current, central tendency, and hot-dry climate scenarios.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Potable Reuse

- **2015 Demands:** Potable Reuse is zero (p=NA) in all Portfolios and climate scenarios for 2015 demands.

- **2025 Demands:** There is no evidence of a difference (p>0.1) in Potable Reuse deliveries between the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands and current, central tendency, and hot-dry climate scenarios. There is evidence that Potable Reuse deliveries are smaller (p<0.01) in the Enhanced Conservation Portfolio only under current climate, however this difference is minimal based on observations, and there is no evidence of a difference (p>0.1) between Baseline Plus and Enhanced Conservation with central tendency climate or hot-dry climate. There is evidence that Potable Reuse deliveries are larger (p<0.01) in the Increase Supplies Portfolio than the Baseline Plus Portfolio for 2025 demands and current, central tendency, and hot-dry climate scenarios.

- **2050 Demands:** There is evidence that Potable Reuse deliveries are smaller (p<0.01) in the Enhanced Conservation Portfolio and larger (p<0.01) in the Increase Supplies Portfolio compared to Baseline Plus for 2050 demands for current, central tendency, and hot-dry climates. There is no evidence of a difference in Potable Reuse deliveries between the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands for current, central tendency, and hot-dry climates (p>0.1). There is some evidence that deliveries are smaller for the Optimize Existing Facilities Portfolio only for hot-dry climate (p=0.076) with no evidence of a difference (p>0.1) for current or central tendency climate.
Across Portfolio - Baseline Compared to Other Portfolios - Stormwater BMPs
- **2015 Demands**: Stormwater BMP deliveries are zero in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Stormwater BMP deliveries are zero in all portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Stormwater BMP deliveries are zero except for in the Watershed Health and Ecosystem Restoration Portfolio for 2050 demands for current, central tendency, and hot-dry climates, therefore deliveries are higher in the Watershed Health and Ecosystem Restoration Portfolio.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Stormwater BMPs
- **2015 Demands**: Stormwater BMP deliveries are zero in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Stormwater BMP deliveries are zero in all portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Stormwater BMP deliveries are zero except for in the Watershed Health and Ecosystem Restoration Portfolio for 2050 demands for current, central tendency, and hot-dry climates, therefore deliveries are higher in the Watershed Health and Ecosystem Restoration Portfolio.
### Across Portfolio - Baseline Compared to Other Portfolios - Gray Water

- **2015 Demands**: Gray Water deliveries are zero in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Gray Water deliveries are smaller in the Baseline Portfolio (zero in Baseline) than in all other portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Gray Water deliveries are smaller in the Baseline Portfolio (zero in Baseline) than in all other portfolios, with the largest deliveries in the Increase Supplies Portfolio for 2050 demands for current, central tendency, and hot-dry climates.

### Across Portfolio - Baseline Plus Compared to Other Portfolios - Gray Water

- **2015 Demands**: Gray Water deliveries are zero in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Gray Water deliveries are the same between the Baseline Plus and subsequent portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Gray Water deliveries are the same between the Baseline Plus and Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios, but are larger in the Increase Supplies Portfolio for 2050 demands and current, central tendency, and hot-dry climates.
Across Portfolio - Baseline Compared to Other Portfolios - Stormwater Capture

- **2015 Demands**: Stormwater Capture deliveries are zero in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Stormwater Capture deliveries are smaller in the Baseline Portfolio (zero in Baseline) than in all other portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Stormwater Capture deliveries are smaller in the Baseline Portfolio (zero in Baseline) than in all other portfolios, with the largest deliveries in the Watershed Health and Ecosystem Restoration Portfolio for 2050 demands for current, central tendency, and hot-dry climates.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Stormwater Capture

- **2015 Demands**: Stormwater Capture deliveries are zero in all portfolios for 2015 demands for current climate.
- **2025 Demands**: Stormwater Capture deliveries are equal in the Baseline Plus, Enhanced Conservation, Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands for current, central tendency, and hot-dry climates.
- **2050 Demands**: Stormwater Capture deliveries are larger in the Watershed Health and Ecosystem Restoration Portfolio than in the Baseline Plus Portfolio and equal in the Baseline Plus, Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios for 2050 demands for current, central tendency, and hot-dry climates.
Water Delivery—Deliveries—Delivery and Conservation Volume

Average Annual Delivery and Conservation Percentage of Supply by Supply Source

Current Climate Within Portfolio Comparisons
Within Portfolios - Baseline - Current Climate Comparisons Across Demand Scenarios

- **2015 Demands:** Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (44.4%), followed by Imported Water (24.2%). Groundwater represents the smallest supply source (2.8%), followed by Recycled Water (4.4%).

- **2025 Demands:** Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (37.8%), followed by Imported Water (26.4%). Potable Reuse represents the smallest supply source (0.4%), followed by Groundwater (3.1%), then Recycled Water (5.8%).

- **2050 Demands:** Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (32.4%), followed by Imported Water (28.6%). Potable Reuse represents the smallest supply source (0.4%), followed by Groundwater (2.6%), then Recycled Water (5.3%).

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Baseline Plus - Current Climate Comparisons Across Demand Scenarios

- **2015 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (44.4%), followed by Imported Water (24.2%). Groundwater represents the smallest supply source (2.8%), followed by Recycled Water (4.4%).

- **2025 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (37.6%), followed by Imported Water (20.8%). Stormwater Capture and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (3.5%), then Recycled Water (5.8%).

- **2050 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (31.6%), followed by Imported Water (22.5%). Stormwater Capture and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (3.0%), then Potable Reuse (4.8%).

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Enhanced Conservation - Current Climate Comparisons Across Demand Scenarios

- **2015 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (44.4%), followed by Imported Water (24.2%). Groundwater represents the smallest supply source (2.8%), followed by Recycled Water (4.4%).

- **2025 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (37.3%), followed by Imported Water (14.9%). Stormwater Capture and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (3.5%), then Recycled Water (5.7%).

- **2050 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (30.5%), followed by Surface Water (7.8%) which was utilized more than Imported Water (7.4%). Stormwater Capture and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (2.9%), then Potable Reuse (4.2%).

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Increase Supplies - Current Climate Comparisons Across Demand Scenarios

- **2015 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (44.4%), followed by Imported Water (24.2%). Groundwater represents the smallest supply source (2.8%), followed by Recycled Water (4.4%).

- **2025 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (37.5%), followed by Imported Water (17.4%). Stormwater Capture and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (5.0%), then Potable Reuse (6.3%).

- **2050 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (31.1%), followed by Potable Reuse (14.3%) which was utilized more than Imported Water (9.5%). Stormwater Capture (less than 0.1%) and Gray Water (0.3%) represent the smallest supply sources, followed by Groundwater (4.6%), then Surface Water (7.3%).

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Optimize Existing Facilities - Current Climate Comparisons Across Demand Scenarios

- **2015 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (44.4%), followed by Imported Water (24.2%). Groundwater represents the smallest supply source (2.8%), followed by Recycled Water (4.4%).

- **2025 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (37.6%), followed by Imported Water (20.8%). Stormwater Capture and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (3.5%), then Recycled Water (5.8%).

- **2050 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (31.6%), followed by Imported Water (22.5%). Stormwater Capture and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (3.0%), then Potable Reuse (4.6%).

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Within Portfolios - Watershed Health and Ecosystem Restoration - Current Climate Comparisons Across Demand Scenarios

- **2015 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (44.4%), followed by Imported Water (24.2%). Groundwater represents the smallest supply source (2.8%), followed by Recycled Water (4.4%).

- **2025 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (37.6%), followed by Imported Water (20.8%). Stormwater Capture and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (3.5%), then Recycled Water (5.8%).

- **2050 Demands**: Firm Water Supply Agreements (QSA) represents the largest percentage of Annual Deliveries (31.6%), followed by Imported Water (22.4%). Stormwater Capture, Stormwater BMPs, and Gray Water represent the smallest supply sources (each are less than 0.1%), followed by Groundwater (3.0%), then Potable Reuse (4.8%).

Note that Average Total Annual Delivery Volume does not equal the Average Annual Demand Volume due to supply shortages that occur in some years of the model simulations and due to complexities in water delivery accounting. See Section 7.1.2 for further details.
Water Delivery—Shortage—Shortage Volume

Average Annual Shortage Volume

Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios - Shortage Volume

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Shortage Volume (which is zero) between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is no evidence of a difference (p>0.1) in Shortage Volume between Baseline and Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration for 2025 demands with current climate or central tendency climate, but there is evidence that Shortage Volume is lower in Enhanced Conservation (p<0.01) and Increase Supplies (p=0.026) than in Baseline with current climate. There is some evidence of a statistical difference between Baseline and Enhanced Conservation (p=0.073), and Increase Supplies (p=0.087) under central tendency climate. There is evidence that Shortage Volume is lower in all other Portfolios than in the Baseline Portfolio under hot-dry climate (p<0.01 for all Portfolios compared to Baseline).

- **2050 Demands:** There is evidence that Shortage Volume is lower for Baseline Plus, Enhanced Conservation, Increase Supplies, and Watershed Health and Ecosystem Restoration Portfolios than the Baseline Portfolio for current climate (p=0.028, p<0.1, p<0.1, and p=0.024, respectively), central tendency climate (p=0.045, p<0.1, p<0.1, and p=0.042, respectively), and hot-dry climate (p<0.1 for all four comparisons). There is no evidence of a difference between Baseline and Optimize Existing Facilities for central tendency climate (p>0.1), however there is evidence that Shortage Volume is lower in Optimize Existing Facilities than Baseline under hot-dry climate (p=0.027), and higher in Optimize Existing Facilities than Baseline under current climate (p=0.051).
Across Portfolio - Baseline Plus Compared to Other Portfolios - Shortage Volume

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Shortage Volume between the Baseline Plus Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in Shortage Volume between Baseline Plus and Optimize Existing Facilities or Watershed Health and Ecosystem Restoration for 2025 demands with current climate, central tendency climate, or hot-dry climate. There is evidence that Shortage Volume is higher in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate (p=0.012 and p=0.039, respectively) and central tendency climate (p<0.01), but no evidence of a difference (p>0.1) with hot-dry climate according to p-values.

- **2050 Demands**: There is no evidence of a difference in Shortage Volume between Baseline Plus and Watershed Health and Ecosystem Restoration for current climate, central tendency climate, or hot-dry climate (p>0.1). There is evidence that Shortage Volume is lower in Enhanced Conservation and Increase Supplies than in Baseline Plus for current climate, central tendency climate, and hot-dry climate (p<0.01). Although there is no evidence of a difference between Baseline Plus and Optimize Existing Facilities for hot-dry climate (p>0.1), there is evidence that Shortage Volume is higher in Optimize Existing Facilities than in Baseline Plus for current climate and central tendency climate (p<0.01).
Water Delivery—Shortage—Shortage Volume

Average Annual Shortage Volume

Current and Future Climate Within Portfolio Comparisons
Within Portfolios - Baseline - Current Climate Comparisons

- There is evidence that current climate Shortage Volume is higher for 2025 demands than for 2015 demands (p<0.01) and higher for 2050 demands than for 2025 demands (p<0.01). Although it appears that there is little difference between 2015 and 2025 demands based on observations, there is evidence of a statistical difference that is not observed due to the large scale on the y-axis.

Within Portfolios - Baseline - 2025 Demands

- There is some evidence of a difference in Shortage Volume between current climate and central tendency climate (p=0.085). There is evidence that Shortage Volume is higher for hot-dry climate (p<0.01) and warm-dry climate (p=0.014) than for central tendency climate, but no evidence of a difference between hot-wet climate (p>0.1) or warm-wet climate (p>0.1) and central tendency climate.

Within Portfolios - Baseline - 2050 Demands

- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p=0.023). There is evidence that Shortage Volume is higher for hot-dry climate (p<0.01) and warm-dry climate (p<0.01) than for central tendency climate, and lower for hot-wet climate (p=0.045) and warm-wet climate (p=0.041) than for central tendency climate.
Within Portfolios - Baseline Plus - Current Climate Comparisons

- There is evidence that current climate Shortage Volume is higher for 2025 demands than for 2015 demands (p=0.01) and higher for 2050 demands than for 2025 demands (p<0.01). Although it appears that there is little difference between 2015 and 2025 demands based on observations, there is evidence of a statistical difference that is not observed due to the large scale on the y-axis.

Within Portfolios - Baseline Plus - 2025 Demands

- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01), even though it cannot be observed due to the large y-axis scale in this figure. There is no evidence of a difference in Shortage Volume between central tendency climate scenario and warm-wet climate (p>0.1), hot-dry climate (p>0.1), or warm-dry climate (p>0.1), but some evidence of a difference between central tendency and hot-wet climate (p=0.077).

Within Portfolios - Baseline Plus - 2050 Demands

- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01). There is evidence that Shortage Volume is higher for hot-dry climate (p<0.01) and slightly with warm-dry climate (p=0.054) than for central tendency climate, but no evidence of a difference (p>0.1) between hot-wet climate or warm-wet climate and central tendency climate.
Within Portfolios - Enhanced Conservation - Current Climate Comparisons
- Although p-values indicate a difference between 2015 and 2025 demands (p<0.01) and 2025 and 2050 demands (p<0.01), the average Shortage Volume under current climate is zero for 2015, 2025, and 2050 demands in the Enhanced Conservation Portfolio.

Within Portfolios - Enhanced Conservation - 2025 Demands
- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p=0.041), even though it cannot be observed due to the large y-axis scale in this figure. There is some evidence (p=0.093) of a difference between hot-wet climate and central tendency climate, but no evidence of a difference (p>0.1) in Shortage Volume between central tendency climate scenario and other climate scenarios.

Within Portfolios - Enhanced Conservation - 2050 Demands
- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01), even though it cannot be observed due to the large y-axis scale in this figure. There is no evidence of a difference in Shortage Volume between central tendency climate scenario and other climate scenarios (p>0.1).
Within Portfolios - Increase Supplies - Current Climate Comparisons
- There is evidence that current climate Shortage Volume is higher for 2025 demands than for 2015 demands (p<0.01) and higher for 2050 demands than for 2025 demands (p<0.01). Although it appears that there is no difference between 2015 and 2025 demands based on observations, there is evidence of a statistical difference that is not observed due to the large scale on the y-axis.

Within Portfolios - Increase Supplies - 2025 Demands
- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01), even though it cannot be observed due to the large y-axis scale in this figure. There is no evidence of a difference in Shortage Volume between central tendency climate scenario and other climate scenarios (p>0.1). Based on observations, however, there is one realization close to the Shortage Threshold in the hot-dry climate scenarios, while there are no realizations close to the shortage threshold for other climate scenarios. This outlier was not sufficient to generate a p-value indicating significant differences because p-values examine differences between complete datasets rather than individual data points.

Within Portfolios - Increase Supplies - 2050 Demands
- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01). There is no evidence of a difference in Shortage Volume between central tendency climate scenario and other climate scenarios (p>0.1).
Within Portfolios - Optimize Existing Facilities - Current Climate Comparisons
- There is evidence that current climate Shortage Volume is higher for 2025 demands than for 2015 demands (p=0.010) and higher for 2050 demands than for 2025 demands (p<0.01). Although it appears that there is no difference between 2015 and 2025 demands based on observations, there is evidence of a statistical difference that is not observed due to the large scale on the y-axis.

Within Portfolios - Optimize Existing Facilities - 2025 Demands
- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01), even though it cannot be observed due to the large y-axis scale in this figure. There is no evidence of a difference in Shortage Volume between central tendency climate scenario and warm-wet climate (p>0.1), hot-dry climate (p>0.1), or warm-dry climate (p>0.1), but some evidence of a difference between central tendency climate and hot-wet climate (p=0.078).

Within Portfolios - Optimize Existing Facilities - 2050 Demands
- There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01). There is evidence that Shortage Volume is higher for hot-dry climate (p<0.01) than for central tendency climate, but no evidence of a difference (p>0.1) between warm-dry, hot-wet climate, or warm-wet climate and central tendency climate.
Within Portfolios - Watershed Health and Ecosystem Restoration - Current Climate Comparisons
• There is evidence that current climate Shortage Volume is higher for 2025 demands than for 2015 demands (p=0.010) and higher for 2050 demands than for 2025 demands (p<0.01). Although it appears that there is no difference between 2015 and 2025 demands based on observations, there is evidence of a statistical difference that is not observed due to the large scale on the y-axis.

Within Portfolios - Watershed Health and Ecosystem Restoration - 2025 Demands
• There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01). There is no evidence of a difference in Shortage Volume between central tendency climate scenario and warm-wet climate (p>0.1), hot-dry climate (p>0.1), or warm-dry climate (p>0.1), but some evidence of a difference between central tendency climate and hot-wet climate (p=0.078).

Within Portfolios - Watershed Health and Ecosystem Restoration - 2050 Demands
• There is evidence that Shortage Volume is lower for current climate than central tendency climate (p<0.01). There is evidence that Shortage Volume is higher (p<0.01) for hot-dry climate and warm-dry climate (p=0.054) than for central tendency climate, but no evidence of a difference (p>0.1) between hot-wet climate or warm-wet climate and central tendency climate.
Water Delivery—Shortage—Shortage Volume

Percent of Shortages Above Threshold

Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios

- **2015 Demands**: There are no realizations above the Shortage Threshold for 2015 demands in Baseline and all other Portfolios.
- **2025 Demands**: While 5% of realizations are above the Shortage Threshold for hot-dry climate in Baseline, there are no realizations above the Shortage Threshold for all other Portfolios and scenarios.
- **2050 Demands**: The percentage of realizations above the Shortage Threshold is higher in Baseline than in all other Portfolios.

Across Portfolio - Baseline Plus Compared to Other Portfolios

- **2015 Demands**: There are no realizations above the Shortage Threshold for 2015 demands in Baseline Plus and all Portfolios.
- **2025 Demands**: There are no realizations above the Shortage Threshold for 2025 demands in Baseline Plus and the subsequent Portfolios.
- **2050 Demands**: The percentage of realizations above the Shortage Threshold is similar for Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration. There are no realizations above the Shortage Threshold for Enhanced Conservation and Increase Supplies.
Water Delivery—Shortage—Shortage Volume

Percent of Shortages Above Threshold

Within and Across Portfolio Comparisons for 2025 and 2050 Demand Scenarios
Percent of Realizations above the 20,000 AF Shortage Threshold - 2025 Demands

- **Baseline**: The percentage of realizations above the 20,000AF Shortage Threshold is highest in the hot-dry climate (5.9%) followed by warm-dry climate (2.4%) for 2025 demands. The percentage of realizations above the 20,000AF Shortage Threshold is 0% for current climate, central tendency climate, hot-wet climate, and warm-wet climate for 2025 demands.
- **Baseline Plus**: The percentage of realizations above the 20,000AF Shortage Threshold is 0% for all climate scenarios in 2025 demands.
- **Enhanced Conservation**: The percentage of realizations above the 20,000AF Shortage Threshold is 0% for all climate scenarios in 2025 demands.
- **Increase Supplies**: The percentage of realizations above the 20,000AF Shortage Threshold is 0% for all climate scenarios in 2025 demands.
- **Optimize Existing Facilities**: The percentage of realizations above the 20,000AF Shortage Threshold is 0% for all climate scenarios in 2025 demands.
- **Watershed Health and Ecosystem Restoration**: The percentage of realizations above the 20,000AF Shortage Threshold is 0% for all climate scenarios in 2025 demands.
Percent of Realizations above the 20,000 AF Shortage Threshold - 2050 Demands

- **Baseline:** The percentage of realizations above the 20,000AF Shortage Threshold is highest in the hot-dry climate (28.2%) followed by warm-dry climate (20.0%) then central tendency climate (2.4%) and current climate (1.2%) for 2050 demands. The percentage of realizations above the 20,000 AF Shortage Threshold is 0% for hot-wet climate and warm-wet climate in 2050 demands.

- **Baseline Plus:** The percentage of realizations above the 20,000AF Shortage Threshold is highest in the hot-dry climate (16.5%) followed by warm-dry climate (4.7%) then central tendency climate (2.4%) for 2050 demands. The percentage of realizations above the 20,000 AF Shortage Threshold is 0% for current climate, hot-wet climate and warm-wet climate in 2050 demands.

- **Enhanced Conservation:** The percentage of realizations above the 20,000AF Shortage Threshold is 0% for all climate scenarios in 2050 demands.

- **Increase Supplies:** The percentage of realizations above the 20,000AF Shortage Threshold is 0% for all climate scenarios in 2050 demands.

- **Optimize Existing Facilities:** The percentage of realizations above the 20,000AF Shortage Threshold is highest in the hot-dry climate (16.5%) followed by warm-dry climate (7.1%) then central tendency climate (1.2%) for 2050 demands. The percentage of realizations above the 20,000 AF Shortage Threshold is 0% for current climate, hot-wet climate and warm-wet climate in 2050 demands.

- **Watershed Health and Ecosystem Restoration:** The percentage of realizations above the 20,000AF Shortage Threshold is highest in the hot-dry climate (15.3%) followed by warm-dry climate (4.7%) then central tendency climate (2.4%) for 2050 demands. The percentage of realizations above the 20,000 AF Shortage Threshold is 0% for current climate, hot-wet climate and warm-wet climate in 2050 demands.
Water Delivery—Conveyance—Pipeline Flow Volume

Average Monthly Pipeline Flow Volume

Current Climate Within Portfolio Comparisons
Within Portfolio - Baseline Portfolio - Current Climate

- **MWD Treated**: Pipeline Flow Volume peaks during summer months from June to September. During these summer months flow volume appears larger for 2025 demands than for 2015 demands and larger for 2050 demands than for 2025 demands.

- **Crossover**: Pipeline Flow Volume is higher in June and September than in March and December. Flow volume appears to be similar between 2015, 2025, and 2050 demands.

- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears larger for 2025 demands than for 2015 demands and larger for 2050 demands than for 2025 demands.

- **30 Inch**: Pipeline Flow Volume peaks in May then declines to June, followed by a steady incline and second peak in September. Pipeline flow volume appears smaller for 2025 demands than for 2015 demands but larger for 2050 demands than both 2025 and 2015 demands.

- **Untreated**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears larger for 2025 demands than for 2015 demands and larger for 2050 demands than for 2025 demands.
Within Portfolio - Baseline Plus Portfolio - Current Climate

- **MWD Treated**: Pipeline Flow Volume peaks during summer months from June to September. During these summer months flow volume appears larger for 2050 demands than for 2025 and 2015 demands. Flow Volume appears similar between 2015 and 2025 demands.
- **Crossover**: Pipeline Flow Volume appears higher in June and September than in March and December. Flow Volume appears similar between 2015, 2025, and 2050 demands.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears larger for 2025 demands than for 2015 demands and larger for 2050 demands than for 2025 demands.
- **30 Inch**: Pipeline Flow Volume peaks in May then declines to June, followed by a steady incline and second peak in September. Pipeline flow volume appears to be typically smaller for 2025 demands than for 2015 demands but typically larger for 2050 demands than both 2025 and 2015 demands.
- **Untreated**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears slightly larger for 2050 demands than for 2025 and 2015 demands.
Within Portfolio - Enhanced Conservation Portfolio - Current Climate

- **MWD Treated**: Pipeline Flow Volume peaks during summer months from June to September. During these summer months flow volume appears smaller for 2025 demands than for 2015 demands and smaller for 2050 demands than for 2025 demands.

- **Crossover**: Pipeline Flow Volume appears higher in June and September than in March and December. Pipeline flow volume appears smaller for 2025 demands than for 2015 demands and smaller for 2050 demands than for 2025 demands.

- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears larger for 2025 demands than for 2015 demands and smaller for 2050 demands than for 2025 demands.

- **30 Inch**: Pipeline Flow Volume peaks in May then declines to June, followed by a steady incline and second peak in September. Pipeline flow volume appears to be typically smaller for 2025 and 2050 demands than for 2015 demands.

- **Untreated**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears smaller for 2025 demands than for 2015 demands and smaller for 2050 demands than for 2025 demands.
Within Portfolio - Increase Supplies Portfolio - Current Climate

- **MWD Treated**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears slightly smaller for 2025 and 2050 demands than for 2015 demands.

- **Crossover**: Pipeline Flow Volume is higher in June and September than in March and December. Pipeline flow volume appears slightly smaller for 2025 and 2050 demands than for 2015 demands.

- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears larger for 2025 demands than for 2015 demands and smaller for 2050 demands than for 2025 demands.

- **30 Inch**: Pipeline Flow Volume peaks in May then declines to June, followed by a steady incline and second peak in September. Pipeline flow volume appears smaller for 2025 demands than for 2015 demands but larger for 2050 demands than both 2025 and 2015 demands.

- **Untreated**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears smaller for 2050 demands than for 2025 and 2015 demands.
Within Portfolio - Optimize Existing Facilities Portfolio - Current Climate

- **MWD Treated**: Pipeline Flow Volume peaks during summer months from June to September. During these summer months flow volume appears slightly larger for 2050 demands than for 2025 and 2015 demands. Flow Volume appears similar between 2015 and 2025 demands.

- **Crossover**: Pipeline Flow Volume appears higher in June and September than in March and December. Flow Volume appears similar between 2015, 2025, and 2050 demands.

- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears larger for 2025 demands than for 2015 demands and larger for 2050 demands than for 2025 demands.

- **30 Inch**: Pipeline Flow Volume peaks in May then declines to June, followed by a steady incline and second peak in September. Pipeline flow volume appears to be typically smaller for 2025 demands than for 2015 demands but typically larger for 2050 demands than both 2025 and 2015 demands.

- **Untreated**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears slightly larger for 2050 demands than for 2025 and 2015 demands.
### Within Portfolio - Watershed Health and Ecosystem Restoration Portfolio - Current Climate

- **MWD Treated**: Pipeline Flow Volume peaks during summer months from June to September. During these summer months flow volume appears larger for 2050 demands than for 2025 and 2015 demands. Flow Volume appears similar between 2015 and 2025 demands.
- **Crossover**: Pipeline Flow Volume appears higher in June and September than in March and December. Flow Volume appears similar between 2015, 2025, and 2050 demands.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears larger for 2025 demands than for 2015 demands and larger for 2050 demands than for 2025 demands.
- **30 Inch**: Pipeline Flow Volume peaks in May then declines to June, followed by a steady incline and second peak in September. Pipeline flow volume appears to be typically smaller for 2025 demands than for 2015 demands but typically larger for 2050 demands than both 2025 and 2015 demands.
- **Untreated**: Pipeline Flow Volume peaks during summer months from June to September. Pipeline flow volume appears slightly larger for 2050 demands than for 2025 and 2015 demands.
Water Delivery—Conveyance—Pipeline Flow Volume

Average Monthly Pipeline Flow Volume

Future Climate Within Portfolio Comparisons
Within Portfolio - Baseline Portfolio - 2025 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climates than for central tendency climate.
- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Within Portfolio - Baseline Portfolio - 2050 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **30 Inch**: Pipeline Flow Volume appears slightly smaller for current climate, hot-wet climate, and warm-wet climate than for central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.
- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
**Within Portfolio - Baseline Plus Portfolio - 2025 Demands**

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume is slightly larger for hot-dry and warm-dry climate than for central tendency climate.
- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
San Diego Basin Study Appendix D — Detailed Model Results

**Within Portfolio - Baseline Plus Portfolio - 2050 Demands**

- **MWD Treated:** During the summer months of June to September pipeline flow volume appears slightly smaller in current climate than central tendency climate and the other climate scenarios.
- **Crossover:** Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Pipeline 4 (Just South of TOV):** Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **30 Inch:** Pipeline Flow Volume appears slightly smaller for current climate, hot-wet climate, and warm-wet climate than for central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.
- **Untreated:** Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Within Portfolio - Enhanced Conservation Portfolio - 2025 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.

- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Within Portfolio - Enhanced Conservation Portfolio - 2050 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.
- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
**Within Portfolio - Increase Supplies Portfolio - 2025 Demands**

- **MWD Treated:** Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **Crossover:** Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **Pipeline 4 (Just South of TOV):** Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **30 Inch:** Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.

- **Untreated:** Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Within Portfolio - Increase Supplies Portfolio - 2050 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.
- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Within Portfolio - Optimize Existing Facilities Portfolio - 2025 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.
- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Within Portfolio - Optimize Existing Facilities Portfolio - 2050 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.

- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration Portfolio - 2025 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.

- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.

- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration Portfolio - 2050 Demands

- **MWD Treated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Crossover**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **Pipeline 4 (Just South of TOV)**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
- **30 Inch**: Pipeline Flow Volume appears similar between current climate and central tendency climate. Pipeline Flow Volume appears slightly larger for hot-dry and warm-dry climate than for central tendency climate.
- **Untreated**: Pipeline Flow Volume appears similar between current climate and central tendency climate and similar between central tendency climate and other climate scenarios.
Water Delivery—Conveyance—High Pipeline Utilization Summer Count

Average High Pipeline Utilization Summer Count

Current Climate Within Portfolio Comparisons
Within Portfolio - Baseline - Current Climate

- **Untreated**: There is evidence that current climate Pipeline Utilization is higher (p<0.01) for 2025 demands than for 2015 demands. There is some evidence that current climate Pipeline Utilization is higher (p=0.061) for 2050 demands than for 2025 demands.
- **Crossover**: There is evidence that current climate Pipeline Utilization is higher (p<0.01) for 2025 demands than for 2015 demands. There are no days when Pipeline Utilization exceeds 95% of capacity during summer for 2015 demands. There is no evidence of a statistical difference (p>0.1) in Pipeline Utilization between current climate scenarios for 2025 and 2050 demands.
- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer for 2015 and 2025 demands (p=NA). There is evidence that current climate Pipeline Utilization is higher for 2050 demands than for 2025 demands (p<0.01), but the number of days averages less than one per realization.
- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA for 2015 and 2025 comparison and p>0.1 for 2025 and 2050 comparison).
- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).
Within Portfolio - Baseline Plus - Current Climate

- **Untreated:** There is some evidence \( (p=0.092) \) that Pipeline Utilization is higher for 2025 demands than for 2015 demands and there is evidence \( (p<0.01) \) that Pipeline Utilization is higher for 2050 demands than for 2025 demands.

- **Crossover:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer for 2015 demands. There is evidence of a difference in Pipeline Utilization between current climate scenarios for 2015 and 2025 demands \( (p=0.029) \) and between 2025 and 2050 demands \( (p<0.01) \), but the number of days of exceedance is less than one on average.

- **30-inch:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands \( (p=NA) \).

- **Just South of TOV:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands \( (p=NA) \).

- **Treated:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands \( (p=NA) \).
Within Portfolio - Enhanced Conservation - Current Climate

- **Untreated**: Although it appears that there is a difference between 2015 and 2025 demands, there is no evidence of a statistical difference (p>0.1) in Pipeline Utilization between current climate scenarios for 2015 and 2025 demands. There is evidence that current climate Pipeline Utilization is lower (p<0.01) for 2050 demands than for 2025 demands.

- **Crossover**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).
Within Portfolio - Increase Supplies - Current Climate

- **Untreated**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate scenarios for 2015 and 2025 demands. There is evidence that current climate Pipeline Utilization is lower (p<0.01) for 2050 demands than for 2025 demands.

- **Crossover**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).
Within Portfolio - Optimize Existing Facilities - Current Climate

- **Untreated**: There is some evidence ($p=0.092$) that Pipeline Utilization is higher for 2025 demands than for 2015 demands. There is evidence that current climate Pipeline Utilization is lower ($p<0.01$) for 2050 demands than for 2025 demands.

- **Crossover**: There is evidence that current climate Pipeline Utilization is higher ($p=0.029$) for 2025 demands than for 2015 demands, and lower ($p=0.029$) for 2050 demands than for 2025 demands. There are no days when Pipeline Utilization exceeds 95% of capacity during summer for 2015 and 2050 demands, and the average number of days with exceedances is less than one for 2025 demands.

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands ($p=NA$).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands ($p=NA$).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands ($p=NA$).
Within Portfolio - Watershed Health and Ecosystem Restoration - Current Climate

- **Untreated**: There is some evidence (p=0.092) that Pipeline Utilization is higher for 2025 demands than for 2015 demands. There is evidence that current climate Pipeline Utilization is higher (p<0.01) for 2050 demands than for 2025 demands.

- **Crossover**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer for 2015 demands. There is evidence that current climate Pipeline Utilization is higher (p=0.029) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands, but the magnitude is less than one day on average.

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate scenarios for 2015, 2025, and 2050 demands (p=NA).
Water Delivery—Conveyance—High Pipeline Utilization Summer Count

Average High Pipeline Utilization Summer Count

Future Climate Within Portfolio Comparisons
**Within Portfolio - Baseline - 2025 Demands**

- **Untreated:** There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover:** There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is evidence that Pipeline Utilization is higher (p=0.043) for hot-wet climate than for central tendency climate, and some evidence that it is higher for warm-wet climate (p=0.095) and lower for hot-dry climate (p=0.079), but no evidence of a difference in Pipeline Utilization between warm-dry climate (p>0.1) and central tendency climate.

- **30-inch:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Just South of TOV:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Treated:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
Within Portfolio - Baseline - 2050 Demands

- **Untreated**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is evidence that Pipeline Utilization is lower (p<0.01) for hot-dry climate than for central tendency climate, but no evidence of a difference (p>0.1) in Pipeline Utilization between hot-wet, warm-dry, or warm-wet climates and central tendency climate.

- **30-inch**: There is evidence that Pipeline Utilization is lower for current climate than for central tendency climate (p<0.01). There is no evidence of a difference in Pipeline Utilization between central tendency climate scenario and other climate scenarios (p>0.1).

- **Just South of TOV**: There is evidence that Pipeline Utilization is lower for current climate than for central tendency climate (p<0.01). There is no evidence of a difference in Pipeline Utilization between central tendency climate scenario and other climate scenarios (p>0.1).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
Within Portfolio - Baseline Plus - 2025 Demands

- **Untreated**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
Within Portfolio - Baseline Plus - 2050 Demands

- **Untreated:** There is no evidence of a difference \((p>0.1)\) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference \((p>0.1)\) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover:** There is no evidence of a difference \((p>0.1)\) in Pipeline Utilization between current climate and central tendency climate. There is evidence that Pipeline Utilization is lower \((p=0.021)\) for hot-dry climate than for central tendency climate, and some evidence that it is higher for hot-wet climate \((p=0.078)\) and warm-wet climate \((p=0.085)\), but no evidence of a difference between warm-dry climate \((p>0.1)\) and central tendency climate.

- **30-inch:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios \((p=\text{NA})\).

- **Just South of TOV:** There is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate \((p=\text{NA})\). There is no evidence of a difference in Pipeline Utilization between central tendency climate scenario and other climate scenarios \((p=\text{NA} \text{ for comparison to hot-wet climate and } p>0.1 \text{ for comparison to other climate scenarios})\).

- **Treated:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios \((p=\text{NA})\).
Within Portfolio - Enhanced Conservation - 2025 Demands

- **Untreated**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
Within Portfolio - Enhanced Conservation - 2050 Demands

- **Untreated**: There is evidence that Pipeline Utilization is lower (p=0.030) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.
- **Crossover**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
Within Portfolio - Increase Supplies - 2025 Demands

- **Untreated**: There is no evidence of a difference ($p>0.1$) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover**: There is some evidence that Pipeline Utilization is lower ($p=0.058$) for current climate than for central tendency climate. There is no evidence of a difference in Pipeline Utilization between central tendency climate scenario and other climate scenarios ($p>0.1$).

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios ($p=NA$).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios ($p=NA$).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios ($p=NA$).
Within Portfolio - Increase Supplies - 2050 Demands

- **Untreated**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
**Within Portfolio - Optimize Existing Facilities - 2025 Demands**

- **Untreated:** There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover:** There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **30-inch:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Just South of TOV:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Treated:** There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
Within Portfolio - Optimize Existing Facilities - 2050 Demands

- **Untreated**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
Within Portfolio - Watershed Health and Ecosystem Restoration - 2025 Demands

- **Untreated**: There is no evidence of a difference ($p>0.1$) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover**: There is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate ($p>0.1$). There is no evidence of a difference in Pipeline Utilization between central tendency climate scenario and other climate scenarios ($p>0.1$).

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios ($p=NA$).

- **Just South of TOV**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios ($p=NA$).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios ($p=NA$).
Within Portfolio - Watershed Health and Ecosystem Restoration - 2050 Demands

- **Untreated**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in Pipeline Utilization between central tendency climate scenario and other climate scenarios.

- **Crossover**: There is no evidence of a difference (p>0.1) in Pipeline Utilization between current climate and central tendency climate. There is evidence that Pipeline Utilization is lower (p=0.017) for hot-dry climate than for central tendency climate, but no evidence of a difference (p>0.1) in Pipeline Utilization between hot-wet, warm-dry, or warm-wet climates and central tendency climate.

- **30-inch**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).

- **Just South of TOV**: There is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate (p=NA). There is no evidence of a difference in Pipeline Utilization between central tendency climate scenario and other climate scenarios (p>0.1 for comparison to hot-dry and warm-dry scenarios and p=NA for comparison to hot-wet and warm-wet scenarios).

- **Treated**: There are no days when Pipeline Utilization exceeds 95% of capacity during summer, therefore there is no evidence of a difference in Pipeline Utilization between current climate and central tendency climate, and no evidence of a difference between central tendency climate and any other climate scenarios (p=NA).
Water Delivery—Conveyance—High Pipeline Utilization Summer Count

Average High Pipeline Utilization Summer Count

Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios - Untreated Pipeline

- **2015 Demands:** There is no evidence of a difference (p>0.1) in High Summer Pipeline Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that High Summer Pipeline Utilization is higher in the Baseline Portfolio than all other portfolios for 2025 demands with current climate (p=0.015 when compared to Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration, and p<0.01 when compared to Enhanced Conservation and Increase Supplies) and central tendency climate (p=0.040 when compared to Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration, and p<0.01 when compared to Enhanced Conservation and Increase Supplies); for hot-dry climate Pipeline Utilization was higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios, but there was no evidence of a difference (p>0.1) between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios.

- **2050 Demands:** There is evidence that High Summer Pipeline Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) between the Baseline Portfolio and the Baseline Plus or Watershed Health and Ecosystem Restoration Portfolios with current climate, central tendency climate, and hot-dry climate.
### Across Portfolio - Baseline Plus Compared to Other Portfolios - Untreated Pipeline

- **2015 Demands:** There is no evidence of a difference (p>0.1) in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that High Summer Pipeline Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is some evidence that utilization is higher for the Baseline Plus Portfolio than the Increase Supplies Portfolio for hot-dry climate (p=0.067) and current climate (p=0.077), but no evidence of a difference with central tendency climate (p>0.1). There is no evidence of a difference (p>0.1) between the Baseline Plus Portfolio and Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios.

- **2050 Demands:** There is evidence that High Summer Pipeline Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) between the Baseline Plus Portfolio and the Watershed Health and Ecosystem Restoration Portfolio.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Crossover Pipeline

- **2015 Demands**: There is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands**: There is evidence that High Summer Pipeline Utilization is higher in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for current climate (p=0.029 for both) and central tendency climate (p<0.01 for Enhanced Conservation comparison and p=0.024 for Increase Supplies comparison), and some evidence (p=0.059) that utilization is higher in Baseline Plus than in Enhanced Conservation for hot-dry climate. There is no evidence of a difference (p>0.1) in High Summer Pipeline Utilization between the Baseline Plus Portfolio and the Increase Supplies Portfolio under hot-dry climate, and no evidence of a difference (p>0.1) for the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios under current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that High Summer Pipeline Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios, but no evidence of a difference (p>0.1) between Baseline Plus and Watershed Health and Ecosystem Restoration for 2025 demands with current climate, central tendency climate, and hot-dry climate.
There is no evidence of a difference in High Summer Pipeline Utilization between the Base-
Across Portfolio - Baseline Compared to Other Portfolios - 30-Inch Pipeline

- **2015 Demands**: There is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate (p=NA).
- **2025 Demands**: There is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Portfolio and any portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate (p=NA).
- **2050 Demands**: There is evidence that High Summer Pipeline Utilization is higher (p<0.01) in the Baseline Portfolio than in all other portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - 30-Inch Pipeline

- **2015 Demands**: There is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate (p=NA).
- **2025 Demands**: There is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
- **2050 Demands**: There is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
Across Portfolio - Baseline Compared to Other Portfolios - Pipeline 4 South of TOV

- **2015 Demands**: There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands**: There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Portfolio and any portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate (p=NA).

- **2050 Demands**: There is evidence that High Summer Pipeline Utilization is higher in the Baseline Portfolio than in all other portfolios for 2050 demands with central tendency and hot-dry climates (p=0.042 for Baseline/Baseline Plus and p=0.024 for Baseline/Watershed Health and Ecosystem Restoration, otherwise p<0.01), but no evidence of a difference with current climate (p>0.1).
### Across Portfolio - Baseline Plus Compared to Other Portfolios - Pipeline 4 South of TOV

- **2015 Demands:** There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands:** There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

- **2050 Demands:** There is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent portfolios for 2050 demands with current climate (p=NA) and central tendency climate (p=0.081), and no difference between Baseline Plus and Watershed Health and Ecosystem Restoration with hot-dry climate (p>0.1), but there is some evidence of a difference with hot-dry climate (p=0.081) for Baseline Plus compared to Enhanced Conservation, Increase Supplies, and Optimize Existing facilities.

<table>
<thead>
<tr>
<th>Climate Group</th>
<th>Current Climate</th>
<th>Central Tendency</th>
<th>Hot-Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days Pipeline Exceeds 95% Capacity During Summer</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Average High Pipeline Utilization Summer Count - Pipeline 4 South of TOV

**2015 Demands**

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>B+</th>
<th>EC</th>
<th>IS</th>
<th>OEF</th>
<th>WE</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**2025 Demands**

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>B+</th>
<th>EC</th>
<th>IS</th>
<th>OEF</th>
<th>WE</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**2050 Demands**

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>B+</th>
<th>EC</th>
<th>IS</th>
<th>OEF</th>
<th>WE</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Across Portfolio - Baseline Compared to Other Portfolios - Treated Pipeline

- **2015 Demands**: There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate (p=NA).
- **2025 Demands**: There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Portfolio and any portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate (p=NA).
- **2050 Demands**: There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Portfolio and any other portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climates (p=NA).

Across Portfolio - Baseline Plus Compared to Other Portfolios - Treated Pipeline

- **2015 Demands**: There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate (p=NA).
- **2025 Demands**: There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
- **2050 Demands**: There are no days when Pipeline Utilization exceeds 95% capacity during the summer, therefore there is no evidence of a difference in High Summer Pipeline Utilization between the Baseline Plus Portfolio and any other subsequent portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
Water Delivery—Conveyance—High Pump Station Utilization

Average Annual High Pump Station Utilization

Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios - San Vicente Pump Station

- **2015 Demands**: There were no days where flow in the San Vicente Pump Station exceeded 95% capacity in all Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands**: There were no days where flow in the San Vicente Pump Station exceeded 95% capacity in all Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

- **2050 Demands**: There were no days where flow in the San Vicente Pump Station exceeded 95% capacity in all Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

Across Portfolio - Baseline Plus Compared to Other Portfolios - San Vicente Pump Station

- **2015 Demands**: There were no days where flow in the San Vicente Pump Station exceeded 95% capacity in all Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands**: There were no days where flow in the San Vicente Pump Station exceeded 95% capacity in all Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

- **2050 Demands**: There were no days where flow in the San Vicente Pump Station exceeded 95% capacity in all Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
Across Portfolio - Baseline Compared to Other Portfolios - P2A Pump Station

- **2015 Demands**: There were no days where flow in the P2A Pump Station exceeded 95% capacity in all Portfolios for 2015 demands with current climate \((p=\text{NA})\).
- **2025 Demands**: There were no days where flow in the P2A Pump Station exceeded 95% capacity in all Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate \((p=\text{NA})\).
- **2050 Demands**: There were no days where flow in the P2A Pump Station exceeded 95% capacity in all Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate \((p=\text{NA})\).

Across Portfolio - Baseline Plus Compared to Other Portfolios - P2A Pump Station

- **2015 Demands**: There were no days where flow in the P2A Pump Station exceeded 95% capacity in all Portfolios for 2015 demands with current climate \((p=\text{NA})\).
- **2025 Demands**: There were no days where flow in the P2A Pump Station exceeded 95% capacity in all Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate \((p=\text{NA})\).
- **2050 Demands**: There were no days where flow in the P2A Pump Station exceeded 95% capacity in all Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate \((p=\text{NA})\).
Water Delivery—Conveyance—Treatment Plant Utilization

Average Annual Treatment Plant Utilization by Treatment Plant

Current Climate Within Portfolio Comparisons
Within Portfolio - Baseline - Current Climate

- **Alvarado**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Badger**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Escondido**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p=0.032) for 2050 demands and 2025 demands.
- **Levy**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Miramar**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Olivenhain**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2050 demands.
- **Otay**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Poway**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Perdue**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Twin Oaks Valley**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Weese**: There is evidence that current climate Treatment Plant Utilization is higher (p=0.026) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
Within Portfolio - Baseline Plus - Current Climate

- **Alvarado**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Badger**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Escondido**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p=0.019) for 2050 demands and 2025 demands.
- **Levy**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Miramar**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Olivenhain**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands, but lower (p<0.01) for 2050 demands than for 2025 demands.
- **Otay**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Poway**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Perdue**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Twin Oaks Valley**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Weese**: There is some evidence (p=0.082) that current climate Treatment Plant Utilization is higher for 2025 demands than for 2015 demands. There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2050 demands than for 2025 demands.
Within Portfolio - Enhanced Conservation - Current Climate

- **Alvarado**: There is evidence that Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands, and lower (p<0.01) for 2025 demands than for 2050 demands.
- **Badger**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Escondido**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Levy**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Miramar**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands but lower (p<0.01) for 2050 demands than for 2025 demands.
- **Olivenhain**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Otay**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Perdue**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands but higher (p<0.01) for 2050 demands than for 2025 demands.
- **Twin Oaks Valley**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands but lower (p<0.01) for 2050 demands than for 2025 demands.
- **Weese**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
Within Portfolio - Increase Supplies - Current Climate

- **Alvarado**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.

- **Badger**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.

- **Escondido**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.

- **Levy**: There is evidence that Treatment Plant Utilization is higher (p=0.017) for 2025 demands than for 2015 demands, but no there is no evidence of a difference (p>0.1) between 2025 demands and 2050 demands.

- **Miramar**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.

- **Olivenhain**: There is evidence that current climate Treatment Plant Utilization is lower (p=0.031) for 2015 demands than for 2025 demands and lower (p<0.01) for 2050 demands than for 2025 demands.

- **Otay**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.

- **Poway**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.

- **Perdue**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.

- **Twin Oaks Valley**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands but lower (p<0.01) for 2050 demands than for 2025 demands.

- **Weese**: There is no evidence of a difference (p>0.1) in current climate Treatment Plant Utilization between 2015 and 2025 demands, but there is evidence that utilization is lower (p<0.01) for 2050 demands than for 2025 demands.
Within Portfolio - Optimize Existing Facilities - Current Climate

- **Alvarado**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Badger**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Escondido**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p=0.020) for 2050 demands and 2025 demands.
- **Levy**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Miramar**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Olivenhain**: There is evidence that current climate Treatment Plant Utilization is similar (p>0.1) for 2015 and 2025 demands, but lower (p<0.01) for 2050 demands than for 2025 demands.
- **Otay**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Poway**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and similar (p>0.1) for 2050 demands and 2025 demands.
- **Perdue**: There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Twin Oaks Valley**: There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Weese**: There is some evidence (p=0.082) that current climate Treatment Plant Utilization is higher for 2025 demands than for 2015 demands. There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2050 demands than for 2025 demands.
**Within Portfolio - Watershed Health and Ecosystem Restoration - Current Climate**

- **Alvarado:** There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Badger:** There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **Escondido:** There is evidence that current climate Treatment Plant Utilization is lower (p=0.019) for 2050 demands and 2025 demands.
- **Levy:** There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Miramar:** There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Olivenhain:** There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands, but lower (p<0.01) for 2050 demands than for 2025 demands.
- **Otay:** There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Poway:** There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Perdue:** There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Twin Oaks Valley:** There is evidence that current climate Treatment Plant Utilization is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.
- **Weese:** There is some evidence (p=0.082) that current climate Treatment Plant Utilization is higher for 2025 demands than for 2015 demands. There is evidence that current climate Treatment Plant Utilization is lower (p<0.01) for 2050 demands than for 2025 demands.
Water Delivery—Conveyance—Treatment Plant Utilization

System Wide Average Treatment Plant Utilization

Current Climate Within Portfolio Comparisons
Within Portfolio - Baseline - Current Climate

- The largest increase in the system wide average for treatment plant utilization between 2015, 2025, and 2050 occurs in the Baseline Portfolio (54% in 2015 demands, 55% in 2025 demands, and 58% in 2050 demands).
Within Portfolio - Baseline Plus - Current Climate

- The system wide average for treatment plant utilization is similar between demand scenarios for the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios (54% in 2015 demands, 54% in 2025 demands, and 56% in 2050 demands). There are minimal differences in treatment plant utilization between these three Portfolios.
Within Portfolio - Enhanced Conservation - Current Climate

- The largest decrease in the system wide average for treatment plant utilization between 2015, 2025, and 2050 occurs in the Enhanced Conservation Portfolio (54% in 2015 demands, 49% in 2025 demands, and 37% in 2050 demands).
Within Portfolio - Increase Supplies - Current Climate
- There is a decrease in the system wide average for treatment plant utilization between 2015, 2025, and 2050 in the Increase Supplies Portfolio (54% in 2015 demands, 52% in 2025 demands, and 50% in 2050 demands).
Within Portfolio - Optimize Existing Facilities - Current Climate

- The system wide average for treatment plant utilization remains similar between demand scenarios for the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios (54% in 2015 demands, 54% in 2025 demands, and 56% in 2050 demands). There are minimal differences in treatment plant utilization between these three Portfolios.
Within Portfolio - Watershed Health and Ecosystem Restoration - Current Climate

- The system wide average for treatment plant utilization remains similar between demand scenarios for the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios (54% in 2015 demands, 54% in 2025 demands, and 56% in 2050 demands). There are minimal differences in treatment plant utilization between these three Portfolios.
Water Delivery—Conveyance—Treatment Plant Utilization

Average Annual Treatment Plant Utilization by Treatment Plant

Future Climate Within Portfolio Comparisons
Within Portfolio - Baseline - 2025 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Continued from page 153.

**Within Portfolio - Baseline - 2025 Demands**

- **Otay**: There is evidence that Treatment Plant Utilization is lower \((p<0.01)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower \((p<0.01)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower \((p<0.01)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower \((p<0.01)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is evidence that Treatment Plant Utilization is lower \((p=0.037)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline - 2050 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower (p=0.024) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is some evidence that Treatment Plant Utilization is lower (p=0.065) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower (p=0.015) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower (p=0.023) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower for current climate (p<0.01) and hot-dry climate (p<0.01) than for central tendency climate, and some evidence that it is lower (p=0.075) for warm-dry climate. There is no evidence of a difference in Treatment Plant Utilization between central tendency climate scenario and hot-wet or warm-wet climate scenarios (p>0.1).

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline - 2050 Demands

- **Otay**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower (p=0.036) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower for current climate (p=0.017), hot-dry climate (p<0.01) and warm-dry climate (p=0.034) than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is some evidence (p=0.077) that Treatment Plant Utilization is lower for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline Plus - 2025 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Badger**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Escondido**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Levy**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Miramar**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline Plus - 2025 Demands

- **Otay:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese:** There is evidence that Treatment Plant Utilization is lower (p=0.035) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline Plus - 2050 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower ($p=0.018$) for current climate than central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is some evidence that Treatment Plant Utilization is lower ($p=0.065$) for current climate than central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower ($p=0.015$) for current climate than central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower ($p=0.021$) for current climate than central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline Plus - 2050 Demands

- **Otay**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower (p=0.036) for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than central tendency climate and lower (p=0.049) for hot-dry climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is some evidence (p=0.092) that Treatment Plant Utilization is lower for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Enhanced Conservation - 2025 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Badger**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Escondido**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Levy**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Miramar**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Enhanced Conservation - 2025 Demands

- **Otay**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is evidence that Treatment Plant Utilization is lower ($p=0.026$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Enhanced Conservation - 2050 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower ($p=0.017$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is some evidence that Treatment Plant Utilization is lower ($p=0.061$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower ($p=0.019$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Enhanced Conservation - 2050 Demands

- **Otay**: There is evidence that Treatment Plant Utilization is lower \((p<0.01)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower \((p<0.01)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower \((p=0.036)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower \((p<0.01)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is some evidence that Treatment Plant Utilization is lower \((p=0.063)\) for current climate than for central tendency climate. There is no evidence of a difference \((p>0.1)\) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Increase Supplies - 2025 Demands

- **Alvarado:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Increase Supplies - 2025 Demands

- **Otay:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese:** There is evidence that Treatment Plant Utilization is lower (p=0.034) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Increase Supplies - 2050 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower (p=0.017) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is some evidence that Treatment Plant Utilization is lower (p=0.065) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower (p=0.023) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower (p=0.027) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Increase Supplies - 2050 Demands

- **Otay**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower (p=0.036) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is some evidence (p=0.092) that Treatment Plant Utilization is lower for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Optimize Existing Facilities - 2025 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower ($p<0.01$) for current climate than for central tendency climate. There is no evidence of a difference ($p>0.1$) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Continued from page 169.

**Within Portfolio - Optimize Existing Facilities - 2025 Demands**

- **Otay**: There is evidence that Treatment Plant Utilization is lower \( (p<0.01) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower \( (p<0.01) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower \( (p<0.01) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower \( (p<0.01) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is evidence that Treatment Plant Utilization is lower \( (p=0.035) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Optimize Existing Facilities - 2050 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower (p=0.017) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is some evidence that Treatment Plant Utilization is lower (p=0.065) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower (p=0.016) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower (p=0.021) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Optimize Existing Facilities - 2050 Demands

- **Otay**: There is evidence that Treatment Plant Utilization is lower \( (p<0.01) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower \( (p<0.01) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower \( (p=0.036) \) for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower for current climate \( (p<0.01) \) and hot-dry climate \( (p=0.046) \) than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is some evidence \( (p=0.091) \) that Treatment Plant Utilization is lower for current climate than for central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration - 2025 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration - 2025 Demands

- **Otay:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley:** There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese:** There is evidence that Treatment Plant Utilization is lower (p=0.035) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration - 2050 Demands

- **Alvarado**: There is evidence that Treatment Plant Utilization is lower \( (p=0.018) \) for current climate than central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Badger**: There is some evidence that Treatment Plant Utilization is lower \( (p=0.065) \) for current climate than central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Escondido**: There is evidence that Treatment Plant Utilization is lower \( (p=0.015) \) for current climate than central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Levy**: There is evidence that Treatment Plant Utilization is lower \( (p=0.021) \) for current climate than central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Miramar**: There is evidence that Treatment Plant Utilization is lower \( (p<0.01) \) for current climate than central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that Treatment Plant Utilization is lower \( (p<0.01) \) for current climate than central tendency climate. There is no evidence of a difference \( (p>0.1) \) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration - 2050 Demands

- **Otay**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Poway**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Perdue**: There is evidence that Treatment Plant Utilization is lower (p=0.036) for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Twin Oaks Valley**: There is evidence that Treatment Plant Utilization is lower (p<0.01) for current climate than central tendency climate and lower (p=0.052) for hot-dry climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.

- **Weese**: There is some evidence (p=0.092) that Treatment Plant Utilization is lower for current climate than central tendency climate. There is no evidence of a difference (p>0.1) in Treatment Plant Utilization between central tendency climate scenario and other climate scenarios.
Water Delivery—Conveyance—Treatment Plant Utilization

System Wide Average Annual Treatment Plant Utilization

Future Climate Within Portfolio Comparisons
Within Portfolio - Baseline - 2025 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline - 2050 Demands
- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline Plus - 2025 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline Plus - 2050 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Enhanced Conservation - 2025 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Enhanced Conservation - 2050 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Increase Supplies - 2025 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Increase Supplies - 2050 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Optimize Existing Facilities - 2025 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Optimize Existing Facilities - 2050 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration - 2025 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration - 2050 Demands

- There is a 2% difference in the system wide average for treatment plant utilization between current climate and central tendency climate. There are minimal differences in the system wide average for treatment plant utilization between central tendency climate scenario and other climate scenarios.
Water Delivery—Conveyance—Treatment Plant Utilization

Average Annual Treatment Plant Utilization by Treatment Plant

Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios - Weese

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Weese

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Twin Oaks Valley

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate and central tendency climate, but only some evidence of a difference (p=0.077) for hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate and central tendency climate, but no evidence of a difference (p>0.1) for hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Twin Oaks Valley

- **2015 Demands**: There is no evidence of a difference ($p>0.1$) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher ($p<0.01$) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference ($p>0.1$) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher ($p<0.01$) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference ($p>0.1$) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Olivenhain

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current, central tendency, and hot-dry climates.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in Baseline than in all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Olivenhain

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) between the Baseline Plus Portfolio and any other Portfolios for 2025 demands with current climate, central tendency, and hot-dry climates.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Badger

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate (p<0.01 for both comparisons), central tendency climate (p<0.01 and p=0.01, respectively), and hot-dry climate (p<0.01 and p=0.01, respectively). There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Badger

**2015 Demands:** There is no evidence of a difference ($p>0.1$) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

**2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher ($p<0.01$) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference ($p>0.1$) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

**2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate ($p<0.01$ and $p=0.015$, respectively), central tendency climate ($p<0.01$ and $p=0.018$, respectively), and hot-dry climate ($p<0.01$ and $p=0.018$, respectively). There is no evidence of a difference ($p>0.1$) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Escondido

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Escondido

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Levy

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.
- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in any other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in any other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Levy

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.
- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.
- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Miramar

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate and higher (p<0.01) in the Baseline Portfolio than in the Increase Supplies Portfolios for 2050 demands with current climate and central tendency climate, but not with hot-dry climate (p>0.1). There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate and central tendency climate, but there is evidence that utilization is lower in the Baseline Portfolio than in the Baseline Plus (p<0.01), Optimize Existing Facilities (p<0.01), and Watershed Health and Ecosystem Restoration (p=0.011) Portfolios with hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Miramar

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate (p<0.01 for all comparisons except Increase Supplies hot-dry, where p=0.059). There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Alvarado

**2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

**2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

**2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate (p<0.01 except for comparison to Increase Supplies hot-dry climate, where p=0.048). There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Alvarado

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate (p<0.01 for both), central tendency climate (p<0.01 for both), and hot-dry climate (p<0.01 and p=0.011, respectively). There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Perdue

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Perdue

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.

Continued from page 205.
Across Portfolio - Baseline Compared to Other Portfolios - Lower Otay

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Lower Otay

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Poway

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Poway

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Water Treatment Plant Utilization is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in Water Treatment Plant Utilization between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

Barrett Reservoir
Barrett - Current Climate

- **Baseline:** Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears to be lower for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Baseline Plus:** Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears to be lower for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Enhanced Conservation:** Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Increase Supplies:** Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears to be lower for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Optimize Existing Facilities:** Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Watershed Health and Ecosystem Restoration:** Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears to be lower for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
Barrett - 2025 Demands

- **Baseline:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Increase Supplies:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
Barrett - 2050 Demands

- **Baseline:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Baseline Plus:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Enhanced Conservation:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Increase Supplies:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
### Across Portfolio - Baseline Compared to Other Portfolios - Barrett

- **2015 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios, with slightly higher storage in the Enhanced Conservation Portfolio with current climate, central tendency climate, and current climate.
- **2050 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and the Baseline Plus, Increase Supplies, and Watershed Health and Ecosystem Restoration Portfolios, but higher in the Enhanced Conservation and Optimize Existing Facilities Portfolios.

### Across Portfolio - Baseline Plus Compared to Other Portfolios - Barrett

- **2015 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios, with slightly higher storage in the Enhanced Conservation Portfolio with current climate, central tendency climate, and current climate.
- **2050 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus and Increase Supplies and Watershed Health and Ecosystem Restoration Portfolios, but higher in the Enhanced Conservation and Optimize Existing Facilities Portfolios.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

El Capitan Reservoir
El Capitan - Current Climate

- **Baseline**: Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Baseline Plus**: Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Enhanced Conservation**: Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Increase Supplies**: Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears higher for 2050 demands than for 2025 and 2015 demands and similar between 2015 and 2025 for every month of the year.
- **Optimize Existing Facilities**: Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears higher for 2050 demands than for 2025 and 2015 demands and similar between 2015 and 2025 for every month of the year.
- **Watershed Health and Ecosystem Restoration**: Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
El Capitan - 2025 Demands

- **Baseline**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Baseline Plus**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Enhanced Conservation**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Increase Supplies**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
El Capitan - 2050 Demands

- **Baseline**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Baseline Plus**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Enhanced Conservation**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Increase Supplies**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate and similar for central tendency climate scenario and other climate scenarios.
Across Portfolio - Baseline Compared to Other Portfolios - El Capitan

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Storage appears slightly higher in the Enhanced Conservation Portfolio, higher in the Increase Supplies Portfolio, and significantly higher in the Optimize Existing Facilities Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - El Capitan

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and the Watershed Health and Ecosystem Restoration Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Storage appears slightly higher in the Enhanced Conservation Portfolio, higher in the Increase Supplies Portfolio, and significantly higher in the Optimize Existing Facilities Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

Hodges Reservoir
Hodges - Current Climate

- **Baseline**: Reservoir storage starts to peak in March but starts to decline through May, then peaks in June and declines through December. Monthly Average Reservoir Storage appears similar between current climate scenarios for 2015, 2025, and 2050 demands for every month of the year.
- **Baseline Plus**: Reservoir storage starts to peak in March but starts to decline through May, then peaks in June and declines through December. Monthly Average Reservoir Storage appears lower for 2050 demands than for 2025 and 2015 demands.
- **Enhanced Conservation**: Reservoir storage starts to peak in March but starts to decline through May, then peaks in June and declines through December. Monthly Average Reservoir Storage appears lower for 2050 demands than for 2025 and 2015 demands.
- **Increase Supplies**: Reservoir storage starts to peak in March but starts to decline through May, then peaks in June and declines through December. Monthly Average Reservoir Storage appears lower for 2050 demands than for 2025 and 2015 demands.
- **Optimize Existing Facilities**: Reservoir storage starts to peak in March but starts to decline through May, then peaks in June and declines through December. Monthly Average Reservoir Storage appears lower for 2050 demands than for 2025 and 2015 demands.
- **Watershed Health and Ecosystem Restoration**: Reservoir storage starts to peak in March but starts to decline through May, then peaks in June and declines through December. Monthly Average Reservoir Storage appears lower for 2050 demands than for 2025 and 2015 demands.
Hodges - 2025 Demands

- **Baseline:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet and central tendency climates.

- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Increase Supplies:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate and central tendency climate.
Hodges - 2050 Demands

- **Baseline:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate from December through April. Central tendency climate appears similar to hot-wet climate the entire year, and similar to other climate scenarios from May to November.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate from January through April. Central tendency climate appears similar to hot-wet climate the entire year, and similar to other climate scenarios from May to December.
Continued from page 225.

**Hodges - 2050 Demands**

- **Increase Supplies:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate from December through May. Central tendency climate appears similar to hot-wet climate the entire year, and similar to other climate scenarios from May to December.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate from December through April. Central tendency climate appears similar to hot-wet climate the entire year, and similar to other climate scenarios from May to November.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate from December through April. Central tendency climate appears similar to hot-wet climate the entire year, and similar to other climate scenarios from May to November.
Across Portfolio - Baseline Compared to Other Portfolios - Hodges

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears lower in the Baseline Portfolio than in all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Hodges

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and subsequent Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and subsequent Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

Loveland Reservoir
Loveland - Current Climate

- **Baseline:** Reservoir storage at Loveland increases from January to March, then decreases from December to January. Monthly Average Reservoir Storage appears to be higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Baseline Plus:** Reservoir storage at Loveland increases from January to March, then decreases from December to January. Monthly Average Reservoir Storage appears to be higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Enhanced Conservation:** Reservoir storage at Loveland increases from January to March, then decreases from December to January. Monthly Average Reservoir Storage appears higher for 2050 and 2025 demands than for 2015 demands.
- **Increase Supplies:** Reservoir storage at Loveland increases from January to March, then decreases from December to January. Monthly Average Reservoir Storage appears to be higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Optimize Existing Facilities:** Reservoir storage at Loveland increases from January to March, then decreases from December to January. Monthly Average Reservoir Storage appears to be higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Watershed Health and Ecosystem Restoration:** Reservoir storage at Loveland increases from January to March, then decreases from December to January. Monthly Average Reservoir Storage appears to be higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
Loveland - 2025 Demands

- **Baseline**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Baseline Plus**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Enhanced Conservation**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Increase Supplies**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate, but similar for hot-wet climate and central tendency climate.
Loveland - 2050 Demands

- **Baseline:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from April to December. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Baseline Plus:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from April to December. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from April to December. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Increase Supplies:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from April to December. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from April to December. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from April to December. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
Across Portfolio - Baseline Compared to Other Portfolios - Loveland

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios, with slightly higher storage in the Enhanced Conservation Portfolio, for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Loveland

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and subsequent Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and subsequent Portfolios, with slightly higher storage in the Enhanced Conservation Portfolio, for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

Lower Otay Reservoir
Lower Otay - Current Climate

- **Baseline**: Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears to be lower for 2050 demands than for 2025 and 2015 demands.
- **Baseline Plus**: Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands for every month of the year.
- **Enhanced Conservation**: Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025.
- **Increase Supplies**: Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands for every month of the year.
- **Optimize Existing Facilities**: Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands.
- **Watershed Health and Ecosystem Restoration**: Reservoir storage peaks in March and April and declines through December. Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands for every month of the year.
**Lower Otay - 2025 Demands**

- **Baseline:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate but similar between central tendency climate and hot-wet and warm-wet climates.

- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate scenario and other climate scenarios.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate scenario and other climate scenarios.

- **Increase Supplies:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate scenario and other climate scenarios.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate scenario and other climate scenarios.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate scenario and other climate scenarios.
Lower Otay - 2050 Demands

- **Baseline:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate and higher for hot-wet and warm-wet climates than for central tendency climate.

- **Baseline Plus:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears similar for hot-dry, warm-dry, hot-wet, and warm-wet climates and central tendency climate.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than central tendency climate, but similar for hot-dry, warm-dry and central tendency climates.

- **Increase Supplies:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate and higher for hot-wet and warm-wet climates than for central tendency climate.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears higher for current climate and central tendency climate. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate but similar for central tendency climate and hot-wet and warm-wet climates.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears similar for hot-dry, warm-dry, hot-wet, and warm-wet climates and central tendency climate.
Across Portfolio - Baseline Compared to Other Portfolios - Lower Otay

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears lower in the Baseline Portfolio than in all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears lower in the Baseline Portfolio than in all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Lower Otay

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and subsequent Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and the Increase Supplies and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Storage appears higher in the Enhanced Conservation and Optimize Existing Facilities Portfolios than in the Baseline Plus Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

Miramar Reservoir
San Diego Basin Study Appendix D — Detailed Model Results

Figure WD_RS_CC_MM

Monthly Average Reservoir Storage - Miramar
Current Climate

- **Baseline:** Reservoir storage remains constant from January to July then peaks between August and November. Monthly Average Reservoir Storage appears to be lower for 2025 demands than 2015 demands for August and September, and lower for 2050 demands than for 2025 demands for August to October.

- **Baseline Plus:** In 2015 Reservoir Storage remains constant from January to July then peaks between August and November, while in 2025 and 2050 Reservoir Storage peaks from May to September then slowly declines through January. Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands.

- **Enhanced Conservation:** In 2015 Reservoir Storage remains constant from January to July then peaks between August and November, while in 2025 and 2050 Reservoir Storage peaks from May to September then slowly declines through January. Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands.

- **Increase Supplies:** In 2015 Reservoir Storage remains constant from January to July then peaks between August and November, while in 2025 and 2050 Reservoir Storage peaks from May to September then slowly declines through January. Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands.

- **Optimize Existing Facilities:** In 2015 Reservoir Storage remains constant from January to July then peaks between August and November, while in 2025 and 2050 Reservoir Storage peaks from May to September then slowly declines through January. Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands.

- **Watershed Health and Ecosystem Restoration:** In 2015 Reservoir Storage remains constant from January to July then peaks between August and November, while in 2025 and 2050 Reservoir Storage peaks from May to September then slowly declines through January. Monthly Average Reservoir Storage appears higher for 2025 and 2050 demands than for 2015 demands.
Miramar - 2025 Demands

- **Baseline:** Monthly Average Reservoir Storage appears higher for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for hot-wet and warm-wet climates and central tendency climate, but lower for central tendency climate than for hot-dry and warm-dry climates.
- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
- **Enhanced Conservation:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
- **Increase Supplies:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
Miramar - 2050 Demands

- **Baseline**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears lower for hot-wet and warm-wet climates than for central tendency climate, but similar for central tendency climate and hot-dry and warm-dry climates.
- **Baseline Plus**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
- **Enhanced Conservation**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
- **Increase Supplies**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears similar for central tendency climate and other climate scenarios.
### Across Portfolio - Baseline Compared to Other Portfolios - Miramar

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Storage appears lower in the Baseline Plus Portfolio than in all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Storage appears lower in the Baseline Plus Portfolio than in all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

### Across Portfolio - Baseline Plus Compared to Other Portfolios - Miramar

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

Morena Reservoir
Morena - Current Climate

- **Baseline**: Reservoir Storage peaks in April and May then declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Baseline Plus**: Reservoir Storage peaks in April and May then declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Enhanced Conservation**: Reservoir Storage peaks in April and May then declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Increase Supplies**: Reservoir Storage peaks in April and May then declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Optimize Existing Facilities**: Reservoir Storage peaks in April and May then declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Watershed Health and Ecosystem Restoration**: Reservoir Storage peaks in April and May then declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
Morena - 2025 Demands

- **Baseline:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Increase Supplies:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
Morena - 2050 Demands

- **Baseline:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Baseline Plus:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Enhanced Conservation:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Increase Supplies:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
Across Portfolio - Baseline Compared to Other Portfolios - Morena

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios, except for the Enhanced Conservation Portfolio where storage is higher, for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios, except for the Enhanced Conservation Portfolio where storage is higher, for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Morena

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios, except for the Enhanced Conservation Portfolio where storage is higher, for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios, except for the Enhanced Conservation Portfolio where storage is higher, for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

Olivenhain Reservoir
Olivenhain - Current Climate

- **Baseline**: Reservoir Storage is constant for a majority of the year, then declines in May. Monthly Average Reservoir Storage appears lower for 2025 demands than for 2015 demands from June to October and lower for 2050 demands than for 2025 demands from June to November.

- **Baseline Plus**: Reservoir Storage is constant for a majority of the year, then declines in May. Monthly Average Reservoir Storage appears lower for 2025 demands than for 2015 demands from June to October and lower for 2050 demands than for 2025 demands from June to November.

- **Enhanced Conservation**: Reservoir Storage is constant for a majority of the year, then declines in May for 2015 and 2025 demands. Monthly Average Reservoir Storage appears similar between 2015, 2025, and 2050 demands from September to May, and higher for 2050 demands than for 2025 and 2015 demands from June to August.

- **Increase Supplies**: Reservoir Storage is constant for a majority of the year, then declines in May for 2015 and 2025 demands. Monthly Average Reservoir Storage appears similar between 2015, 2025, and 2050 demands from September to May, and higher for 2050 demands than for 2025 and 2015 demands from June to August.

- **Optimize Existing Facilities**: Reservoir Storage is constant for a majority of the year, then declines in May for 2015 and 2025 demands. Monthly Average Reservoir Storage appears similar between 2015, 2025, and 2050 demands from October to May, and the Monthly Average Reservoir Storage appears lower for 2025 demands than for 2015 demands from June to September, and higher for 2050 demands than for 2025 demands from June to August.

- **Watershed Health and Ecosystem Restoration**: Reservoir Storage is constant for a majority of the year, then declines in May. Monthly Average Reservoir Storage appears lower for 2025 demands than for 2015 demands from June to October and lower for 2050 demands than for 2025 demands from June to November.
Olivenhain - 2025 Demands

- **Baseline:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate from June to November, but similar for hot-wet and warm-wet climates.

- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate from June to October, but similar for hot-wet and warm-wet climates.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from July to August. Monthly Average Reservoir Storage appears similar for hot-dry, warm-dry, hot-wet, warm-wet and central tendency climates.

- **Increase Supplies:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from July to September. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate from June to November, but similar for hot-wet, warm-wet and central tendency climates.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from July to September. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate from June to November, but similar for hot-wet, warm-wet, and central tendency climates.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears lower for hot-dry and warm-dry climates than for central tendency climate from June to October, but similar for hot-wet and warm-wet climates.
Olivenhain - 2050 Demands

- **Baseline**: Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from June to December. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate from June to December and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Baseline Plus**: Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from June to December. Monthly Average Reservoir Storage appears lower for hot-wet climate than for central tendency climate from June to July and October to November, lower for warm-wet climate than for central tendency climate from May to November, lower for warm-dry climate than for central tendency climate from October to December, and lower for hot-dry climate than for central tendency climate throughout the year.

- **Enhanced Conservation**: Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from June to August. Monthly Average Reservoir Storage appears similar for hot-dry, warm-dry, hot-wet, warm-wet and central tendency climates.
Olivenhain - 2050 Demands

- **Increase Supplies**: Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from June to November. Monthly Average Reservoir Storage appears lower for hot-dry climate than for central tendency climate throughout the year, and lower for warm-dry climate than central tendency climate from September to December, but similar for hot-wet, warm-wet and central tendency climates.

- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears lower for hot-dry climate than for central tendency climate throughout the year and lower for warm-dry climate than for central tendency climate from September to December, but similar for hot-wet, warm-wet, and central tendency climates.

- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate from June to December. Monthly Average Reservoir Storage appears lower for hot-wet climate than for central tendency climate from June to July and October to November, lower for warm-wet climate than for central tendency climate from May to November, lower for warm-dry climate than for central tendency climate from October to December, and lower for hot-dry climate than for central tendency climate throughout the year.
Across Portfolio - Baseline Compared to Other Portfolios - Olivenhain

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2025 demands for current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Storage appears slightly higher in the Enhanced Conservation and Increase Supplies Portfolio for current climate, central tendency climate, and hot-dry climate, and slightly higher in the Optimize Existing Facilities Portfolio for current climate and central tendency climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Olivenhain

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands for current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and the Watershed Health and Ecosystem Restoration Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Storage appears slightly higher in the Enhanced Conservation and Increase Supplies Portfolio for current climate, central tendency climate, and hot-dry climate, and slightly higher in the Optimize Existing Facilities Portfolio for current climate and central tendency climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

San Vicente Reservoir
San Vicente - Current Climate

- **Baseline:** Reservoir Storage peaks in March and April and declines through November. Monthly Average Reservoir Storage appears slightly lower for 2025 demands than for 2015 demands and slightly lower for 2050 demands than for 2025 demands.
- **Baseline Plus:** Reservoir storage peaks in March and April and declines through November. Monthly Average Reservoir Storage appears slightly lower for 2050 demands than for 2025 and 2015 demands.
- **Enhanced Conservation:** Reservoir storage peaks in March and April and declines through November. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands.
- **Increase Supplies:** Reservoir storage peaks in March and April and declines through November. Monthly Average Reservoir Storage appears higher for 2050 demands than for 2025 and 2015 demands.
- **Optimize Existing Facilities:** Reservoir storage peaks in March and April and declines through November. Monthly Average Reservoir Storage appears lower for 2050 demands from January to April and similar for 2015, 2025, and 2050 demands from May to December.
- **Watershed Health and Ecosystem Restoration:** Reservoir storage peaks in March and April and declines through November. Monthly Average Reservoir Storage appears slightly lower for 2050 demands than for 2025 and 2015 demands.
San Vicente - 2025 Demands

- **Baseline**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate.

- **Baseline Plus**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate.

- **Enhanced Conservation**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Increase Supplies**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate.

- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate.
San Vicente - 2050 Demands

- **Baseline**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Baseline Plus**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Enhanced Conservation**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Increase Supplies**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.
Across Portfolio - Baseline Compared to Other Portfolios - San Vicente

- **2015 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands:** Monthly Average Reservoir Storage appears lower in the Baseline Portfolio than in all other Portfolios for 2025 demands for current climate, central tendency climate, and hot-dry climate.
- **2050 Demands:** Monthly Average Reservoir Storage appears lower in the Baseline Portfolio than in all other Portfolios for 2050 demands for current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - San Vicente

- **2015 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and the Increase Supplies, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Storage appears higher in the Enhanced Conservation Portfolio than in the Baseline Plus Portfolio with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and the Optimize Existing Facilities and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands for current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Storage appears higher in the Enhanced Conservation and Increase Supplies Portfolios (it appears highest in the Increase Supplies Portfolio) than in the Baseline Plus Portfolio with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

*Sweetwater Reservoir*
San Diego Basin Study Appendix D — Detailed Model Results

Sweetwater - Current Climate

- **Baseline**: Reservoir Storage peaks from February to May then declines through December. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Baseline Plus**: Reservoir Storage peaks from February to May then declines through December. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Enhanced Conservation**: Reservoir Storage peaks from February to May then declines through December. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and slightly lower for 2050 demands than for 2025 demands.
- **Increase Supplies**: Reservoir Storage peaks from February to May then declines through December. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Optimize Existing Facilities**: Reservoir Storage peaks from February to May then declines through December. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
- **Watershed Health and Ecosystem Restoration**: Reservoir Storage peaks from February to May then declines through December. Monthly Average Reservoir Storage appears higher for 2025 demands than for 2015 demands and lower for 2050 demands than for 2025 demands.
Sweetwater - 2025 Demands

- **Baseline:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but similar for hot-wet climate and central tendency climate.

- **Increase Supplies:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.
Sweetwater - 2050 Demands

- **Baseline**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Baseline Plus**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Enhanced Conservation**: Monthly Average Reservoir Storage appears higher for current climate than for central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate.

- **Increase Supplies**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.

- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm wet climates than for central tendency climate from January to June and lower for hot-dry and warm-dry climates than for central tendency climate throughout the year.
Across Portfolio - Baseline Compared to Other Portfolios - Sweetwater

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Storage appears higher in the Baseline Plus and subsequent Portfolios than in the Baseline Portfolio for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Storage appears higher in the Baseline Plus and subsequent Portfolios than in the Baseline Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Sweetwater

- **2015 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and subsequent Portfolios, except for the Enhanced Conservation Portfolio with has more storage, for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and subsequent Portfolios, except for the Enhanced Conservation Portfolio with has more storage, for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Storage

Average Monthly Reservoir Storage

Within and Across Portfolio Comparisons for Current and Future Climate

Wohlford Reservoir
San Diego Basin Study Appendix D — Detailed Model Results

Wohlford - Current Climate

- **Baseline:** Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Baseline Plus:** Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Enhanced Conservation:** Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Increase Supplies:** Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears higher for 2050 demands than for 2025 and 2015 demands from January through July and similar for 2015, 2025, and 2050 demands from August to December.
- **Optimize Existing Facilities:** Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.
- **Watershed Health and Ecosystem Restoration:** Reservoir storage peaks in April and declines through December. Monthly Average Reservoir Storage appears similar for 2015, 2025, and 2050 demands.


**Wohlford - 2025 Demands**

- **Baseline:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet climate than for central tendency climate from March to May and lower for hot-dry and warm-dry climate than for central tendency climate from February to July, but similar between warm-wet climate and central tendency climate.

- **Baseline Plus:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet climate than for central tendency climate from March to May and lower for hot-dry and warm-dry climate than for central tendency climate from February to July, but similar between warm-wet climate and central tendency climate.

- **Enhanced Conservation:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet climate than for central tendency climate from March to May and lower for hot-dry and warm-dry climate than for central tendency climate from February to July, but similar between warm-wet climate and central tendency climate.

- **Increase Supplies:** There is no evidence of a difference in Monthly Average Reservoir Storage between current climate and central tendency climate. There is no evidence of a difference in Monthly Average Reservoir Storage between central tendency climate scenario and other climate scenarios.

- **Optimize Existing Facilities:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet climate than for central tendency climate from March to May and lower for hot-dry and warm-dry climate than for central tendency climate from February to July, but similar between warm-wet climate and central tendency climate.

- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet climate than for central tendency climate from March to May and lower for hot-dry and warm-dry climate than for central tendency climate from February to July, but similar between warm-wet climate and central tendency climate.
Wohlford - 2050 Demands

- **Baseline**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climate than for central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to August.

- **Baseline Plus**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climate than for central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to August.

- **Enhanced Conservation**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climate than for central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to August.

- **Increase Supplies**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climate than for central tendency climate from February to April and similar for hot-dry, warm-dry climate and central tendency climate.

- **Optimize Existing Facilities**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climate than for central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to August.

- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Storage appears similar for current climate and central tendency climate. Monthly Average Reservoir Storage appears higher for hot-wet and warm-wet climate than for central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to August.
**Across Portfolio - Baseline Compared to Other Portfolios - Wohlford**

- **2015 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

**Across Portfolio - Baseline Plus Compared to Other Portfolios - Wohlford**

- **2015 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands:** Monthly Average Reservoir Storage appears similar between the Baseline Plus Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

Barrett Reservoir
Barrett - Current Climate

- **Baseline:** Monthly Average Reservoir Releases appear larger for 2025 demands than for 2015 demands from November to January and larger for 2050 demands than for 2025 demands from November to May.
- **Baseline Plus:** Monthly Average Reservoir Releases appear larger for 2025 demands than for 2015 demands from November to December and larger for 2050 demands than for 2025 demands from November to May.
- **Enhanced Conservation:** Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 demands from January to March and similar for 2015, 2025, and 2050 April to December.
- **Increase Supplies:** Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 demands from January to March and similar for 2015, 2025, and 2050 April to December.
- **Optimize Existing Facilities:** Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Releases appear larger for 2025 demands than for 2015 demands from November to December and larger for 2050 demands than for 2025 demands from November to May.
Barrett - 2025 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, with exception of hot-dry and warm-dry climate that appear to be lower than central tendency climate from June to December.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, with exception of hot-dry and warm-dry climate that appear to be lower than central tendency climate from June to December.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, with exception of hot-dry and warm-dry climate that appear to be lower than central tendency climate from June to December.

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, with exception of hot-dry and warm-dry climate that appear to be lower than central tendency climate from June to December.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, with exception of hot-dry and warm-dry climate that appear to be lower than central tendency climate from June to December.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, with exception of hot-dry and warm-dry climate that appear to be lower than central tendency climate from June to December.
Barrett - 2050 Demands

- **Baseline:** Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from June to December, and higher for hot-wet climate and warm-wet climate than for central tendency climate from June to December.
- **Baseline Plus:** Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate from June to December, and higher for hot-wet climate and warm-wet climate than for central tendency climate from June to December.
- **Enhanced Conservation:** Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate from June to December, and higher for hot-wet climate and warm-wet climate than for central tendency climate from June to October.
- **Increase Supplies:** Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate from June to December, and higher for hot-wet climate and warm-wet climate than for central tendency climate from June to December.
- **Optimize Existing Facilities:** Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate from June to December, and higher for hot-wet climate and warm-wet climate than for central tendency climate from June to December.
- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate from June to December, and higher for hot-wet climate and warm-wet climate than for central tendency climate from June to December.
Across Portfolio - Baseline Compared to Other Portfolios - Barrett

- **2015 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Barrett

- **2015 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

El Capitan Reservoir
El Capitan - Current Climate

- **Baseline**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Baseline Plus**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Increase Supplies**: Monthly Average Reservoir Releases appear lower 2050 demands than for 2025 and 2015 demands in May and larger for 2050 demands than for 2025 and 2015 demands from July to September.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear lower 2050 demands than for 2025 and 2015 demands from February to April and larger for 2050 demands than for 2025 and 2015 demands from October to December.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
El Capitan - 2025 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Increase Supplies**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Optimize Existing Facilities**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Watershed Health and Ecosystem Restoration**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
El Capitan - 2050 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Increase Supplies**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Optimize Existing Facilities**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Watershed Health and Ecosystem Restoration**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
Across Portfolio - Baseline Compared to Other Portfolios - El Capitan

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - El Capitan

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

Hodges Reservoir
Hodges - Current Climate

- **Baseline**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Baseline Plus**: Monthly Average Reservoir Releases appear larger for 2050 demands than for 2025 and 2015 demands.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear larger for 2050 demands than for 2025 and 2015 demands.
- **Increase Supplies**: Monthly Average Reservoir Releases appear larger for 2050 demands than for 2025 and 2015 demands.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear larger for 2050 demands than for 2025 and 2015 demands.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear larger for 2050 demands than for 2025 and 2015 demands.
Hodges - 2025 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Increase Supplies**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Optimize Existing Facilities**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Watershed Health and Ecosystem Restoration**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
San Diego Basin Study Appendix D — Detailed Model Results

Hodges - 2050 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Baseline Plus**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate and higher for hot-wet climate and warm-wet climate than for central tendency climate. Releases appear similar for central tendency climate and current climate.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate and higher for hot-wet climate and warm-wet climate than for central tendency climate. Releases appear similar for central tendency climate and current climate.
- **Increase Supplies**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate and higher for hot-wet climate and warm-wet climate than for central tendency climate. Releases appear similar for central tendency climate and current climate.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate and higher for hot-wet climate and warm-wet climate than for central tendency climate. Releases appear similar for central tendency climate and current climate.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than central tendency climate and higher for hot-wet climate and warm-wet climate than for central tendency climate. Releases appear similar for central tendency climate and current climate.
### Across Portfolio - Baseline Compared to Other Portfolios - Hodges

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Releases appear lower in the Baseline Portfolio than in all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

### Across Portfolio - Baseline Plus Compared to Other Portfolios - Hodges

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

Loveland Reservoir
Loveland - Current Climate

- **Baseline**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Baseline Plus**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Increase Supplies**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
Loveland- 2025 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for warm-wet climate than for central tendency climate with minimal differences between hot-wet climate and central tendency climate, and lower for hot-dry and warm-dry climates than for central tendency climate. From February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for warm-wet climate than for central tendency climate with minimal differences between hot-wet climate and central tendency climate, and lower for hot-dry and warm-dry climates than for central tendency climate. From February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for warm-wet climate than for central tendency climate with minimal differences between hot-wet climate and central tendency climate, and lower for hot-dry and warm-dry climates than for central tendency climate. From February to December there appear to be minimal differences between central tendency climate and other climate scenarios.
Loveland - 2025 Demands

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for warm-wet climate than for central tendency climate with minimal differences between hot-wet climate and central tendency climate, and lower for hot-dry and warm-dry climates than for central tendency climate. From February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for warm-wet climate than for central tendency climate with minimal differences between hot-wet climate and central tendency climate, and lower for hot-dry and warm-dry climates than for central tendency climate. From February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for warm-wet climate than for central tendency climate with minimal differences between hot-wet climate and central tendency climate, and lower for hot-dry and warm-dry climates than for central tendency climate. From February to December there appear to be minimal differences between central tendency climate and other climate scenarios.
Loveland- 2050 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but from February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but from February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but from February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

*Figure description continued on page 290.*
Loveland- 2050 Demands

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but from February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but from February to December there appear to be minimal differences between central tendency climate and other climate scenarios.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. In January releases appear to be higher for hot-wet and warm-wet climates than for central tendency climate and lower for hot-dry and warm-dry climates than for central tendency climate, but from February to December there appear to be minimal differences between central tendency climate and other climate scenarios.
Across Portfolio - Baseline Compared to Other Portfolios - Loveland

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Loveland

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

Lower Otay Reservoir
Lower Otay - Current Climate

- **Baseline**: Monthly Average Reservoir Releases appear larger for 2025 demands than 2015 demands and larger for 2050 demands than for 2025 demands.
- **Baseline Plus**: Monthly Average Reservoir Releases appear larger for 2025 demands than 2015 demands and larger for 2050 demands than for 2025 demands.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear larger for 2025 demands than 2015 demands and larger for 2050 demands than for 2025 demands.
- **Increase Supplies**: Monthly Average Reservoir Releases appear larger for 2025 demands than 2015 demands and larger for 2050 demands than for 2025 demands.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear larger for 2025 demands than 2015 demands and larger for 2050 demands than for 2025 demands.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear larger for 2025 demands than 2015 demands and larger for 2050 demands than for 2025 demands.
Lower Otay - 2025 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Increase Supplies**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Optimize Existing Facilities**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Watershed Health and Ecosystem Restoration**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
Lower Otay - 2050 Demands

- **Baseline**: Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climate than for central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate.
- **Baseline Plus**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from May to October.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from May to October.
- **Increase Supplies**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate and higher for hot-wet and warm-wet climate than for central tendency climate.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear to be lower for hot-dry climate than for central tendency climate from May to October and lower for warm-dry climate than for central tendency climate from May to July.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from May to October.
Across Portfolio - Baseline Compared to Other Portfolios - Lower Otay

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear lower in the Baseline Portfolio than all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear lower in the Baseline Portfolio than all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Lower Otay

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and the Increase Supplies and Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Releases appear slightly lower in the Enhanced Conservation Portfolio and higher in the Optimize Existing Facilities Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

*Miramar Reservoir*
**Miramar - Current Climate**

- **Baseline:** Monthly Average Reservoir Releases appear lower for 2025 demands than for 2015 demands from August to October and lower for 2050 demands than for 2025 demands from August to November.
- **Baseline Plus:** Monthly Average Reservoir Releases appear larger for 2025 and 2050 demands than for 2015 demands.
- **Enhanced Conservation:** Monthly Average Reservoir Releases appear larger for 2025 and 2050 demands than for 2015 demands.
- **Increase Supplies:** Monthly Average Reservoir Releases appear larger for 2025 and 2050 demands than for 2015 demands.
- **Optimize Existing Facilities:** Monthly Average Reservoir Releases appear larger for 2025 and 2050 demands than for 2015 demands.
- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Releases appear larger for 2025 and 2050 demands than for 2015 demands.
Miramar - 2025 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.
Miramar - 2050 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and hot-dry and warm-dry climate scenarios. Releases appear to be lower for hot-wet and warm-wet climate scenarios than all other climate scenarios from September to November.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, except for in November and December where releases appear lower for warm-wet climate scenario than all other climate scenarios.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, except for in November and December where releases appear lower for warm-wet climate scenario than all other climate scenarios.

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, except for in November and December where releases appear lower for warm-wet climate scenario than all other climate scenarios.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, except for in November and December where releases appear lower for warm-wet climate scenario than all other climate scenarios.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, except for in November and December where releases appear lower for warm-wet climate scenario than all other climate scenarios.
Across Portfolio - Baseline Compared to Other Portfolios - Miramar

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Releases appear lower in the Baseline Portfolio than in all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Releases appear lower in the Baseline Portfolio than in all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Miramar

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

Morena Reservoir
Morena - Current Climate

- **Baseline**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Baseline Plus**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Increase Supplies**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
San Diego Basin Study Appendix D — Detailed Model Results

Morena - 2025 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Increase Supplies**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Optimize Existing Facilities**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Watershed Health and Ecosystem Restoration**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.
Morena - 2050 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases from May to March and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases May to March and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases May to March and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.
Morena - 2050 Demands

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases May to March and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases May to March and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios, although hot-dry and warm-dry climates appear to have slightly fewer releases May to March and hot-wet and warm-wet climates appear to have slightly higher releases from June to December.
### Across Portfolio - Baseline Compared to Other Portfolios - Morena

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

### Across Portfolio - Baseline Plus Compared to Other Portfolios - Morena

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

Olivenhain Reservoir
Olivenhain - Current Climate

- **Baseline**: Monthly Average Reservoir Releases appear lower for 2025 demands then for 2015 demands from May to October and lower for 2050 demands than for 2025 demands from April to November.
- **Baseline Plus**: Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 and 2015 demands.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 and 2015 demands.
- **Increase Supplies**: Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 and 2015 demands from September to June.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 and 2015 demands from October to May.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 and 2015 demands.
Olivenhain - 2025 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from April to December.

- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from May to October.

- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Increase Supplies**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Optimize Existing Facilities**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from May to October.

- **Watershed Health and Ecosystem Restoration**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from May to October.
Olivenhain - 2050 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from April to November.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry climate than for central tendency climate from April to November.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from April to November.
Across Portfolio - Baseline Compared to Other Portfolios - Olivenhain

- **2015 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands:** Monthly Average Reservoir Releases appear higher for the Baseline Portfolio than for the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios with current climate, but not with central tendency climate or hot-dry climate, and higher for Baseline than for the Enhanced Conservation Portfolio with current climate and central tendency climate, but not with hot-dry climate for 2050 demands. Monthly Average Reservoir Releases appear lower in the Baseline Portfolio than in the Increase Supplies and Optimize Existing Facilities Portfolios with hot-dry climate, but not with current climate or with central tendency climate for 2050 demands.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Olivenhain

- **2015 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands:** Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

San Vicente Reservoir
San Vicente - Current Climate

- **Baseline**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Baseline Plus**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands except for in May, when releases appear lower for 2025 and 2050 demands than for 2015 demands.
- **Enhanced Conservation**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands except for in May, when releases appear lower for 2025 and 2050 demands than for 2015 demands.
- **Increase Supplies**: Monthly Average Reservoir Releases appear significantly higher for 2050 demands than for 2025 and 2015 demands throughout the entire year.
- **Optimize Existing Facilities**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands except for in May, when releases appear lower for 2025 and 2050 demands than for 2015 demands.
- **Watershed Health and Ecosystem Restoration**: Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands except for in May, when releases appear lower for 2025 and 2050 demands than for 2015 demands.
San Vicente - 2025 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to September and higher for hot-dry and warm-dry climate in October. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from April to September.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to August. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to August.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from November to August. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from November to August.
San Vicente - 2025 Demands

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to August. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to August.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to August. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to August.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to August. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to August.
San Vicente - 2050 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to September and higher for hot-dry climate than central tendency climate from October to December. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to September.

- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to September and higher for hot-dry and warm-dry climate in October. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to September.

- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to August. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to August.
Continued from page 317.

San Vicente - 2050 Demands

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from May to September. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from May to September.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to September and higher for hot-dry and warm-dry climates than central tendency climate in October. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to September.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be lower for hot-dry and warm-dry climate than for central tendency climate from January to September and higher for hot-dry and warm-dry climate in October. Monthly Average Reservoir Releases appear to be higher for hot-wet and warm-wet climates than for central tendency climates from January to September.
Across Portfolio - Baseline Compared to Other Portfolios - San Vicente

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and the Baseline Plus, Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Releases appear higher in the Increase Supplies Portfolio than in all other Portfolios with current climate, central tendency climate, and hot-dry climate for 2050 demands.

Across Portfolio - Baseline Plus Compared to Other Portfolios - San Vicente

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.

- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and the Enhanced Conservation, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. Monthly Average Reservoir Releases appear higher in the Increase Supplies Portfolio than in all other Portfolios with current climate, central tendency climate, and hot-dry climate for 2050 demands.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

Sweetwater Reservoir
Sweetwater - Current Climate

- **Baseline:** Monthly Average Reservoir Releases appear lower for 2025 demands than for 2015 demands from June to August and in January but similar for 2015, 2025, and 2050 demands from September to December and from January to May.
- **Baseline Plus:** Monthly Average Reservoir Releases appear lower for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands from June to August, and lower for 2025 and 2050 demands than for 2015 demands in January. Releases appear similar for 2015, 2025, and 2050 demands from September to December and February to May.
- **Enhanced Conservation:** Monthly Average Reservoir Releases appear lower for 2025 and 2050 demands than for 2015 demands from June to August and in January, but similar for 2015, 2025, and 2050 demands from September to December and February to May.
- **Increase Supplies:** Monthly Average Reservoir Releases appear lower for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands from June to August, and lower for 2025 and 2050 demands than for 2015 demands in January. Releases appear similar for 2015, 2025, and 2050 demands from September to December and February to May.
- **Optimize Existing Facilities:** Monthly Average Reservoir Releases appear lower for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands from June to August, and lower for 2025 and 2050 demands than for 2015 demands in January. Releases appear similar for 2015, 2025, and 2050 demands from September to December and February to May.
- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Releases appear lower for 2025 demands than for 2015 demands and higher for 2050 demands than for 2025 demands from June to August, and lower for 2025 and 2050 demands than for 2015 demands in January. Releases appear similar for 2015, 2025, and 2050 demands from September to December and February to May.
Sweetwater - 2025 Demands

- **Baseline**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios from January to August. From September to December releases appear lower for hot-dry and warm-dry climates.

- **Baseline Plus**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios from January to August. From September to December releases appear lower for hot-dry and warm-dry climates.

- **Enhanced Conservation**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios.

- **Increase Supplies**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios from January to August. From September to December releases appear lower for hot-dry and warm-dry climates.

- **Optimize Existing Facilities**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios from January to August. From September to December releases appear lower for hot-dry and warm-dry climates.

- **Watershed Health and Ecosystem Restoration**: There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate and between central tendency climate and other climate scenarios from January to August. From September to December releases appear lower for hot-dry and warm-dry climates.
Sweetwater - 2050 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate.

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate and lower for hot-dry and warm-dry climate than for central tendency climate.
Across Portfolio - Baseline Compared to Other Portfolios - Sweetwater

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios except for the Enhanced Conservation Portfolio which has slightly less releases for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Sweetwater

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios except for the Enhanced Conservation Portfolio which has slightly less releases for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—Reservoir Releases

Average Monthly Reservoir Releases

Within and Across Portfolio Comparisons for Current and Future Climate

Wohlford Reservoir
San Diego Basin Study Appendix D — Detailed Model Results

Wohlford - Current Climate

- **Baseline:** Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Baseline Plus:** Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Enhanced Conservation:** Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 and 2015 demands from January to March and higher for 2050 demands than for 2025 and 2015 demands from April to May.
- **Increase Supplies:** Monthly Average Reservoir Releases appear lower for 2050 demands than for 2025 and 2015 demands from January to March and higher for 2050 demands than for 2025 and 2015 demands from April to September.
- **Optimize Existing Facilities:** Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
- **Watershed Health and Ecosystem Restoration:** Monthly Average Reservoir Releases appear similar for 2015, 2025, and 2050 demands.
Wohlford - 2025 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to July and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.
Wohlford - 2050 Demands

- **Baseline:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.

- **Baseline Plus:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.

- **Enhanced Conservation:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to July and lower for hot-dry and warm-dry climate than for central tendency climate from January to June.

- **Increase Supplies:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to October and lower for hot-dry and warm-dry climate than for central tendency climate from January to October.

- **Optimize Existing Facilities:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.

- **Watershed Health and Ecosystem Restoration:** There appear to be minimal differences in Monthly Average Reservoir Releases between current climate and central tendency climate. Monthly Average Reservoir Releases appear to be larger for hot-wet and warm-wet climates than central tendency climate from January to May and lower for hot-dry and warm-dry climate than for central tendency climate from January to May.
Across Portfolio - Baseline Compared to Other Portfolios - Wohlford

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Wohlford

- **2015 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2015 demands with current climate.
- **2025 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands**: Monthly Average Reservoir Releases appear similar between the Baseline Plus Portfolio and all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Water Delivery—Reservoir Operations—End of September Reservoir Storage

Average End of September Storage

Current Climate Within Portfolio Comparisons
Within Portfolio - Baseline - Current Climate

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate scenarios for 2015, 2025, and 2050 demands.
- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate scenarios for 2015, 2025, and 2050 demands.
- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate scenarios for 2015, 2025, and 2050 demands.
- **Olivenhain:** There is evidence that End of September Storage is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.
- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate scenarios for 2015, 2025, and 2050 demands.
Within Portfolio - Baseline Plus - Current Climate

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between 2015 and 2025, but there is evidence that End of September Storage is lower (p<0.01) for 2050 demands than for 2025 demands.

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate scenarios for 2015, 2025, and 2050 demands.

- **Lower Otay:** There is evidence that End of September Storage is higher (p<0.01) for 2025 demands than for 2015 demands but no evidence of a difference (p>0.1) between 2050 demands and 2025 demands.

- **Olivenhain:** There is evidence that End of September Storage is lower (p<0.01) for 2025 demands than for 2015 demands and lower (p<0.01) for 2050 demands than for 2025 demands.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate scenarios for 2015, 2025, and 2050 demands.
Within Portfolio - Enhanced Conservation - Current Climate

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between 2015 demands and 2025 demands, but there is evidence that End of September Storage is lower (p<0.01) for 2050 demands than for 2025 demands.
- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate scenarios for 2015, 2025, and 2050 demands.
- **Lower Otay:** There is evidence that End of September storage is higher (p<0.01) for 2025 demands than for 2015 demands, and that End of September Storage is higher (p<0.01) for 2050 demands than 2025 demands.
- **Olivenhain:** There is no evidence of a difference (p>0.1) between End of September Storage for 2015 demands and 2025 demands. There is evidence of a statistical difference (p<0.01) between 2025 demands and 2050 demands, although this difference is in hundreds of AF while the order of magnitude of the End of September Storage is in the tens of thousands of AF.
- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Storage between 2015 demands and 2025 demands, but there is evidence that End of September Storage is higher (p=0.016) for 2050 demands than for 2025 demands.
Within Portfolio - Increase Supplies - Current Climate

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between 2015 demands and 2025 demands, but there is evidence that End of September Storage is lower (p<0.01) for 2050 demands than for 2025 demands.

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between 2015 demands and 2025 demands, but there is evidence that End of September Storage is higher (p=0.011) for 2050 demands than for 2025 demands.

- **Lower Otay:** There is evidence that End of September Storage is higher (p<0.01) for 2025 demands than for 2015 demands, but there is no evidence of a difference (p>0.1) between 2025 demands and 2050 demands.

- **Olivenhain:** There is no evidence of a difference (p>0.1) between End of September Storage for 2015 demands and 2025 demands, but there is evidence of a statistical difference (p<0.01) between 2025 demands and 2050 demands, although this difference is within one-hundred AF while the order of magnitude of the End of September Storage is in the tens of thousands of AF.

- **San Vicente:** There is no evidence of a difference (p>0.1) between End of September Storage for 2015 demands and 2025 demands, but there is evidence that End of September Storage is higher (p<0.01) for 2050 demands than for 2025 demands.
Within Portfolio - Optimize Existing Facilities - Current Climate

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between 2015 and 2025 demands, but there is evidence that end of September Storage is lower (p<0.01) for 2050 demands than for 2025 demands.
- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between 2015 and 2025 demands, but there is evidence that End of September Storage is higher (p<0.01) for 2050 demands than for 2025 demands.
- **Lower Otay:** There is evidence that End of September Storage is higher (p<0.01) for 2025 demands than for 2050 demands and that End of September Storage is higher (p<0.01) for 2050 demands than for 2025 demands.
- **Olivenhain:** There is statistical evidence that End of September Storage is lower (p<0.01) for 2025 demands than for 2015 demands, and higher (p<0.01) for 2025 demands than for 2050 demands, although these differences are in hundreds of AF while the order of magnitude of the End of September Storage is in the tens of thousands of AF.
- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Storage for 2015, 2025, or 2050 demands.
Within Portfolio - Watershed Health and Ecosystem Restoration - Current Climate

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between 2015 and 2025 demands, but there is evidence that end of September Storage is lower (p<0.01) for 2050 demands than for 2025 demands.

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between 2015, 2025, and 2050 demands.

- **Lower Otay**: There is evidence that End of September Storage is higher (p<0.01) for 2025 demands than for 2015 demands, but there is no evidence of a difference (p>0.1) between End of September Storage for 2025 and 2050 demands.

- **Olivenhain**: There is evidence that End of September Storage is lower (p<0.01) for 2025 demands than for 2015 demands and that End of September Storage is lower (p<0.01) for 2050 demands than 2025 demands.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between 2015, 2025, and 2050 demands.
Water Delivery—Reservoir Operations—End of September Reservoir Storage

Average End of September Storage

Future Climate Within Portfolio Comparisons
Within Portfolio - Baseline - 2025 Demands

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There some evidence that storage is lower for hot-dry climate than central tendency climate (p=0.077), but no evidence of differences in End of September Storage between central tendency climate scenario and other climate scenarios (p>0.1).

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry (p=0.038) and warm-dry (p=0.040) climate than central tendency climate and higher for warm-wet (p=0.014) climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage between central tendency climate and hot-wet climate.
Within Portfolio - Baseline - 2050 Demands

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower (p<0.01) for hot-dry climate than for central tendency climate and some evidence that it is higher for warm-wet climate than central tendency climate (p=0.078), but there is no evidence of a difference (p>0.1) in End of September Storage between hot-wet and central tendency climates.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry (p<0.01) and warm-dry (p=0.043) climates than central tendency climate and higher for warm-wet (p=0.048) climate than central tendency climate, but there is no evidence of a difference (p>0.1) in End of September Storage between hot-wet and central tendency climates.
Within Portfolio - Baseline Plus - 2025 Demands

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is some evidence of a difference (p=0.073) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry (p=0.029) and warm-dry (p=0.028) climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage between central tendency climate and hot-wet or warm-wet climate.
**Within Portfolio - Baseline Plus - 2050 Demands**

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry climate (p=0.034) than central tendency climate and higher for hot-wet (p=0.027) and warm-wet (p=0.014) climates than central tendency climate, but only some evidence (p=0.086) that End of September Storage is lower for warm-dry climate than central tendency climate.
Within Portfolio - Enhanced Conservation - 2025 Demands

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence of a difference (p=0.037) between End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry (p=0.011) and warm-dry (p<0.01) climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage between central tendency climate and hot-wet or warm-wet climate.
**Within Portfolio - Enhanced Conservation - 2050 Demands**

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is evidence that End of September Storage is lower (p<0.01) for central tendency climate than for current climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is some evidence that End of September Storage is higher for warm-dry climate than central tendency climate (p=0.070), but no evidence of differences between central tendency climate scenario and other climate scenarios (p>0.1).

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower (p<0.01) for hot-dry and warm-dry climates than for central tendency climate and higher (p=0.031) for hot-wet climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage between warm-wet climate and central tendency climate.
Within Portfolio - Increase Supplies - 2025 Demands

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is evidence that End of September Storage is higher (p<0.01) for current climate than for central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry (p=0.026) and warm-dry (p=0.024) climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage for hot-wet or warm-wet climate.
Within Portfolio - Increase Supplies - 2050 Demands

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is higher for hot-wet climate (p=0.033) and warm-wet climate (p=0.031) than central tendency climate and slightly lower (p=0.050) for hot-dry climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage between central tendency climate scenario and warm-dry climate.

- **Olivenhain:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry (p=0.016) and warm-dry (p<0.01) climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage between hot-wet or warm-wet climate and central tendency climate.
Within Portfolio - Optimize Existing Facilities - 2025 Demands

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain**: There is some evidence (p=0.073) that End of September Storage is higher for current climate than for central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry (p=0.029) and warm-dry (p=0.028) climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage between central tendency climate and hot-wet or warm-wet climate.
Within Portfolio - Optimize Existing Facilities - 2050 Demands

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is some evidence that End of September Storage is higher for warm-wet climate than central tendency climate (p=0.075), but no evidence of differences between central tendency climate scenario and hot-wet, hot-dry, or warm-dry climate scenarios (p>0.1).

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is evidence that End of September Storage is higher (p<0.01) with current climate than with central tendency climate. There is evidence that End of September Storage is lower (p<0.01) for hot-dry climate than central tendency climate, and some evidence that End of September Storage is higher for warm-wet climate (p=0.063) and lower for warm-dry climate (p=0.076) than central tendency climate, but no evidence of differences in End of September Storage between central tendency climate scenario and hot-wet climate (p>0.1).

- **Olivenhain**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry climate (p<0.01) and warm-dry climate (p=0.018) than central tendency climate, but no evidence of differences (p>0.1) in End of September Storage between central tendency climate and hot-wet climate or warm-wet climate.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry climate (p=0.035) than central tendency climate and higher for hot-wet (p=0.030) and warm-wet (p=0.017) climates than central tendency climate, and some evidence (p=0.072) that End of September Storage is lower for warm-dry climate than for central tendency climate.
Within Portfolio - Watershed and Ecosystem Restoration - 2025 Demands

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain:** There is some evidence of a difference (p=0.073) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry (p=0.028) and warm-dry (p=0.026) climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Storage between hot-wet or warm-wet climate and central tendency climate.
**Within Portfolio - Watershed and Ecosystem Restoration - 2050 Demands**

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **Olivenhain:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is no evidence of differences (p>0.1) in End of September Storage between central tendency climate scenario and other climate scenarios.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Storage between current climate and central tendency climate. There is evidence that End of September Storage is lower for hot-dry climate (p=0.033) than central tendency climate and higher for hot-wet (p=0.026) and warm-wet (p=0.012) climates than central tendency climate, but only some evidence of a difference (p=0.077) in End of September Storage between warm-dry and central tendency climate.

---

**Figure WD_EOS_50_WE**

**WE Average End of September Reservoir Storage - 2050 Demands**

<table>
<thead>
<tr>
<th>Climate Group</th>
<th>Hodges</th>
<th>El Capitan</th>
<th>Lower Otay</th>
<th>Olivenhain</th>
<th>San Vicente</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Climate</td>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
<td><img src="image4.png" alt="Graph" /></td>
<td><img src="image5.png" alt="Graph" /></td>
</tr>
<tr>
<td>Central Tendency</td>
<td><img src="image6.png" alt="Graph" /></td>
<td><img src="image7.png" alt="Graph" /></td>
<td><img src="image8.png" alt="Graph" /></td>
<td><img src="image9.png" alt="Graph" /></td>
<td><img src="image10.png" alt="Graph" /></td>
</tr>
<tr>
<td>Hot-Dry</td>
<td><img src="image11.png" alt="Graph" /></td>
<td><img src="image12.png" alt="Graph" /></td>
<td><img src="image13.png" alt="Graph" /></td>
<td><img src="image14.png" alt="Graph" /></td>
<td><img src="image15.png" alt="Graph" /></td>
</tr>
<tr>
<td>Hot-Wet</td>
<td><img src="image16.png" alt="Graph" /></td>
<td><img src="image17.png" alt="Graph" /></td>
<td><img src="image18.png" alt="Graph" /></td>
<td><img src="image19.png" alt="Graph" /></td>
<td><img src="image20.png" alt="Graph" /></td>
</tr>
<tr>
<td>Warm-Dry</td>
<td><img src="image21.png" alt="Graph" /></td>
<td><img src="image22.png" alt="Graph" /></td>
<td><img src="image23.png" alt="Graph" /></td>
<td><img src="image24.png" alt="Graph" /></td>
<td><img src="image25.png" alt="Graph" /></td>
</tr>
<tr>
<td>Warm-Wet</td>
<td><img src="image26.png" alt="Graph" /></td>
<td><img src="image27.png" alt="Graph" /></td>
<td><img src="image28.png" alt="Graph" /></td>
<td><img src="image29.png" alt="Graph" /></td>
<td><img src="image30.png" alt="Graph" /></td>
</tr>
</tbody>
</table>

**Seasonal Pool**

- Hodges: 50,773 AF
- El Capitan: 45,237 AF
- Lower Otay: 20,288 AF

**Carryover Pool**

- Hodges: 10,385 AF
- San Vicente: 202,165 AF (Not Shown)
Water Delivery—Reservoir Operations—End of September Reservoir Storage

Average End of September Storage

Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios - El Capitan

- **2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.
- **2025 Demands:** There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.
- **2050 Demands:** There is evidence that End of September Storage is lower in the Baseline Portfolio than in the Increase Supplies and Optimize Existing Facilities Portfolios for 2050 demands with current climate (p<0.01), central tendency climate (p<0.01), and hot-dry climate (p=0.038 for comparison to Increase Supplies and p<0.01 for comparison to Optimize Existing Facilities). There is evidence that storage is lower in the Baseline Portfolio than in the Enhanced Conservation Portfolio with current climate (p=0.031) and central tendency climate (p=0.045), but no evidence of a difference with hot-dry climate (p>0.1). There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and the Baseline Plus or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - El Capitan

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: There is evidence that End of September Storage is lower in the Baseline Plus Portfolio than in the Increase Supplies and Optimize Existing Facilities Portfolios for 2050 demands with current climate (p=0.014 for comparison to Increase Supplies and p<0.01 for comparison to Optimize Existing Facilities), central tendency climate (p=0.015 for comparison to Increase Supplies and p<0.01 for comparison to Optimize Existing Facilities), and hot-dry climate (p=0.038 for comparison to Increase Supplies and p<0.01 for comparison to Optimize Existing Facilities). There is no evidence of a difference (p>0.1) in storage between the Baseline Plus Portfolio and the Enhanced Conservation or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Hodges

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: There is evidence that End of September Storage is lower (p<0.01) in the Baseline Portfolio than in all other Portfolios for 2050 demands with current climate, central tendency, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Hodges

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios with current climate, however there is evidence that storage is lower in Baseline Plus than in Enhanced Conservation (p<0.01), Increase Supplies (p=0.013), and Optimize Existing Facilities (p=0.012) Portfolios under central tendency climate, and evidence that storage is lower (p<0.01) in Baseline Plus than in Enhanced Conservation and Increase Supplies with hot-dry climate, but no evidence of a difference (p>0.1) between Baseline Plus and Optimize Existing Facilities with hot-dry climate. There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and the Watershed Health and Ecosystem Restoration Portfolio for 2050 demands with current, central tendency, and hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Lower Otay

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that End of September Storage is lower (p<0.01) in the Baseline Portfolio than all other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: There is evidence that End of September Storage is lower (p<0.01) in the Baseline Portfolio than all other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Lower Otay

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: There is evidence that End of September Storage is lower (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Optimize Existing Facilities Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is evidence that End of September Storage is lower (p<0.01) in the Baseline Plus Portfolio than in the Increase Supplies Portfolio with central tendency climate, but no evidence of a difference (p>0.1) with current climate or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Olivenhain

- **2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that End of September Storage is lower in the Baseline Portfolio than all other Portfolios with current climate, central tendency climate, and hot-dry climate (p=0.017 for central tendency comparison between the Baseline and Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration, and p<0.01 for the other comparisons).

- **2050 Demands:** There is evidence that End of September Storage is lower (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is some evidence that End of September Storage is lower in the Baseline Portfolio than in the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios with hot-dry climate (p=0.079 and p=0.074, respectively), but there is no evidence of a difference (p>0.1) with current climate or central tendency climate, and hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - Olivenhain

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that End of September Storage is lower in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios with current climate (p<0.01), central tendency climate (p<0.01 for comparison to Enhanced Conservation and p=0.022 for comparison to Increase Supplies), and hot-dry climate (p<0.01 for comparison to Enhanced Conservation and p=0.045 for comparison to Increase Supplies).

- **2050 Demands**: There is evidence that End of September Storage is lower (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation, Increase Supplies, and Optimize Existing Facilities Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus and Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - San Vicente

- **2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that End of September Storage is lower in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2025 demands with current climate (p=0.021), central tendency climate (p=0.037) and very some evidence of the difference with hot-dry climate (p=0.067). There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Restoration Portfolios with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands:** There is evidence that End of September Storage is lower (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios with current climate, central tendency climate, and hot-dry climate. There is evidence that End of September Storage is lower in the Baseline Portfolio than in the Optimize Existing Facilities Portfolio with hot-dry climate (p=0.018) and slightly with current climate (p=0.057), but there is no evidence of a difference with central tendency climate (p>0.1). There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Portfolio and the Baseline Plus or Watershed Health and Ecosystem Restoration Portfolios with current climate, central tendency climate, and hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - San Vicente

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and subsequent Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

- **2050 Demands**: There is evidence that End of September Storage is lower (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios with current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in End of September Storage between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios with current climate, central tendency climate, and hot-dry climate.
Energy—Generation and Consumption

Average Annual Energy Generation and Consumption

Current Climate and Future Climate Within Portfolio Comparisons
Within Portfolio - Baseline - Demand Scenario Comparison Under Current Climate

- **Generation:** Although there is no difference in average Energy Generation for 2015, 2025, and 2050 demands based on observations, there is evidence of that Energy Generation is higher (p<0.01) for 2025 demands than for 2015 demands, and higher (p<0.01) for 2050 demands than for 2025 demands, although these differences are in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh.

- **Consumption:** There is evidence that Energy Consumption is greater (p<0.01) for 2025 demands than for 2015 demands and that Energy Consumption is greater (p<0.01) for 2050 demands than for 2025 demands.
Continued from page 360.

**Within Portfolio - Baseline - Climate Scenario Comparison Under 2025 Demands**
- **Generation:** There is no evidence of a difference (p>0.1) in Energy Generation between climate scenarios under 2025 demands.
- **Consumption:** There is evidence that Energy Consumption is lower (p=0.040) in current climate than in central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

**Within Portfolio - Baseline - Climate Scenario Comparison Under 2050 Demands**
- **Generation:** There is some evidence that Energy Generation is lower (p=0.051) in current climate than in central tendency climate, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference (p>0.1) in Energy Generation between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.
- **Consumption:** There is some evidence that Energy Consumption is lower (p=0.058) in current climate than in central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2050 demands.
Within Portfolio - Baseline Plus - Demand Scenario Comparison Under Current Climate

- **Generation:** Although there is no difference in average Energy Generation for 2015, 2025, and 2050 demands based on observations, there is evidence of that Energy Generation is higher (p<0.01) for 2025 demands than for 2015 demands, and higher (p<0.01) for 2050 demands than for 2025 demands, although these differences are in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh.

- **Consumption:** There is evidence that Energy Consumption is greater (p<0.01) for 2025 demands than for 2015 demands and that Energy Consumption is greater (p<0.01) for 2050 demands than for 2025 demands.
Within Portfolio - Baseline Plus - Climate Scenario Comparison Under 2025 Demands

- **Generation:** There is evidence that Energy Generation is lower (p=0.018) in current climate than in central tendency climate, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference (p>0.1) in Energy Generation between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

- **Consumption:** There is evidence that Energy Consumption is lower (p=0.035) in current climate than in central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

Within Portfolio - Baseline Plus - Climate Scenario Comparison Under 2050 Demands

- **Generation:** There is no evidence of a difference (p>0.1) in Energy Generation between current climate and central tendency climate or between central tendency climate and other climate scenarios for 2050 demands.

- **Consumption:** There is some evidence that Energy Consumption is lower (p=0.051) in current climate than in central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2050 demands.
Within Portfolio - Enhanced Conservation - Demand Scenario Comparison Under Current Climate

- **Generation:** There is no evidence of a difference (p>0.1) in Energy Generation for 2015 and 2025 demands. There is evidence that Energy Generation is lower (p<0.01) in 2050 demands than in 2025 demands, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh.

- **Consumption:** There is no evidence of a difference (p>0.1) in Energy Consumption between 2015 demands than for 2025 demands, but there is evidence (p<0.01) that Energy Consumption is lower for 2050 demands than for 2025 demands.
Within Portfolio - Enhanced Conservation - Climate Scenario Comparison Under 2025 Demands

- **Generation:** There is some evidence that Energy Generation is lower (p=0.053) in current climate than in central tendency climate, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference (p>0.1) in Energy Generation between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

- **Consumption:** There is evidence that Energy Consumption is lower (p=0.027) in current climate than in central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

Within Portfolio - Enhanced Conservation - Climate Scenario Comparison Under 2050 Demands

- **Generation:** There is evidence that Energy Generation is lower (p<0.01) in current climate than in central tendency climate, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference (p>0.1) in Energy Generation between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2020 demands.

- **Consumption:** There is evidence that Energy Consumption is lower (p=0.024) in current climate than in central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2050 demands.
Within Portfolio - Increase Supplies - Demand Scenario Comparison Under Current Climate

- **Generation:** There is no evidence of a difference (p>0.1) in Energy Generation for 2015 and 2025 demands. There is evidence that Energy Generation is higher (p<0.01) in 2050 demands than in 2025 demands, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh.

- **Consumption:** There is evidence that Energy Consumption is higher (p=0.032) for 2025 demands than for 2050 demands. There is only some evidence (p=0.099) that Energy Consumption is higher for 2050 demands than for 2025 demands.
Within Portfolio - Increase Supplies - Climate Scenario Comparison Under 2025 Demands

- **Generation:** There is evidence that Energy Generation is lower ($p=0.012$) in current climate than in central tendency climate, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference ($p>0.1$) in Energy Generation between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

- **Consumption:** There is evidence that Energy Consumption is lower ($p=0.031$) in current climate than in central tendency climate. There is no evidence of a difference ($p>0.1$) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

Within Portfolio - Increase Supplies - Climate Scenario Comparison Under 2050 Demands

- **Generation:** There is no evidence of a difference ($p>0.1$) in Energy Generation between current climate and central tendency climate or between central tendency climate and other climate scenarios for 2050 demands.

- **Consumption:** There is evidence that Energy Consumption is lower ($p=0.015$) in current climate than in central tendency climate. There is no evidence of a difference ($p>0.1$) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2050 demands.
Within Portfolio - Optimize Existing Facilities - Demand Scenario Comparison Under Current Climate

- **Generation**: Although there is no difference in average Energy Generation for 2015, 2025, and 2050 demands based on observations, there is evidence that Energy Generation is higher (p<0.01) for 2025 demands than for 2015 demands, and higher (p<0.01) for 2050 demands than for 2025 demands, although these differences are in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh.

- **Consumption**: There is evidence that Energy Consumption is greater (p<0.01) for 2025 demands than for 2015 demands and that Energy Consumption is greater (p<0.01) for 2050 demands than for 2025 demands.
Continued from page 368.

Within Portfolio - Optimize Existing Facilities - Climate Scenario Comparison Under 2025 Demands
- **Generation:** There is evidence that Energy Generation is lower (p=0.018) in current climate than in central tendency climate, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference (p>0.1) in Energy Generation between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.
- **Consumption:** There is evidence that Energy Consumption is lower (p=0.035) in current climate than in central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

Within Portfolio - Optimize Existing Facilities - Climate Scenario Comparison Under 2050 Demands
- **Generation:** There is no evidence of a difference (p>0.1) in Energy Generation between current climate and central tendency climate or between central tendency climate and other climate scenarios for 2050 demands.
- **Consumption:** There is some evidence that Energy Consumption is lower (p=0.067) in current climate than in central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2050 demands.
Within Portfolio - Watershed Health and Ecosystem Restoration - Demand Scenario Comparison Under Current Climate

- **Generation:** Although there is no difference in average Energy Generation for 2015, 2025, and 2050 demands based on observations, there is evidence of that Energy Generation is higher (p<0.01) for 2025 demands than for 2015 demands, and higher (p<0.01) for 2050 demands than for 2025 demands, although these differences are in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh.

- **Consumption:** There is evidence that Energy Consumption is greater (p<0.01) for 2025 demands than for 2015 demands and that Energy Consumption is greater (p<0.01) for 2050 demands than for 2025 demands.
Within Portfolio - Watershed Health and Ecosystem Restoration - Climate Scenario Comparison Under 2025 Demands

- **Generation:** There is evidence that Energy Generation is lower ($p=0.018$) in current climate than in central tendency climate, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference ($p>0.1$) in Energy Generation between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

- **Consumption:** There is evidence that Energy Consumption is lower ($p=0.035$) in current climate than in central tendency climate. There is no evidence of a difference ($p>0.1$) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2025 demands.

Within Portfolio - Watershed Health and Ecosystem Restoration - Climate Scenario Comparison Under 2050 Demands

- **Generation:** There is some evidence that Energy Generation is lower ($p=0.064$) in central tendency climate than in hot-dry climate, although this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference ($p>0.1$) in Energy Generation between climate scenarios under 2050 demands.

- **Consumption:** There is some evidence that Energy Consumption is lower ($p=0.050$) in current climate than in central tendency climate. There is no evidence of a difference ($p>0.1$) in Energy Consumption between central tendency climate and hot-wet, warm-wet, hot-dry, or warm-dry climate scenarios under 2050 demands.
Energy—Generation and Consumption

Average Annual Energy Generation and Consumption

Across Portfolio Comparisons
### Across Portfolio - Baseline Compared to Other Portfolios

**2015 Demands:** There is no evidence of a difference (p>0.1) in Energy Generation between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

**2025 Demands:** There is evidence that Energy Generation is higher (p<0.01) in the Baseline Portfolio than any other Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate however based on observations this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh.

**2050 Demands:** There is evidence that Energy Generation is higher (p<0.01) in the Baseline Portfolio than any other Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate however based on observations this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh.
### Across Portfolio - Baseline Plus Compared to Other Portfolios

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Energy Generation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Energy Generation is higher in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate (p<0.01), central tendency climate (p<0.01 and p=0.011, respectively), and hot-dry climate (p<0.01 and p=0.011, respectively) however based on observations this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference (p>0.1) in Energy Generation between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Energy Generation is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate, and hot-dry climate however based on observations this difference is in tens of mWh while the order of magnitude of the energy generation is in the tens of thousands of mWh. There is no evidence of a difference (p>0.1) in Energy Generation between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Energy Consumption between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is evidence that Energy Consumption is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolio for 2025 demands with current climate, central tendency climate, and hot dry climate. There is some evidence of a difference in Energy Consumption between the Baseline Portfolio and the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Services Portfolios for 2025 demands with current climate (p=0.074) and central tendency climate (p=0.084), but no evidence of a difference with hot-dry climate (p>0.1).

- **2050 Demands**: There is evidence that Energy Consumption is higher (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolio for 2050 demands with current climate, central tendency climate, and hot dry climate. There is evidence that Energy Consumption is higher in the Baseline Portfolio than in the Baseline Plus, Optimize Existing Facilities, and Watershed Health and Ecosystem Services Portfolios for 2025 demands with current climate (p=0.038, p=0.032, and p=0.034, respectively) and central tendency climate (p=0.056, p=0.034, and p=0.052, respectively), but no evidence of a difference (p>0.1) with hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Energy Consumption between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that Energy Consumption is higher in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2025 demands with current climate (p<0.01 and 0.041, respectively), central tendency climate (p<0.01 and 0.049, respectively), and hot-dry climate (p<0.01 and 0.042, respectively). There is no evidence of a difference (p>0.1) in Energy Consumption between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that Energy Consumption is higher (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for 2050 demands with current climate, central tendency climate. There is no evidence of a difference (p>0.1) in Energy Consumption between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Recreation

End of September Reservoir Elevation

Current Climate Within Portfolio Comparisons
Within Portfolio - Baseline - Current Climate

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.
- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.
- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.
- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.
Within Portfolio - Baseline Plus - Current Climate

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.

- **Hodges**: There is evidence that current climate End of September Elevation is lower (p<0.01) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.

- **Lower Otay**: There is evidence that current climate End of September Elevation is higher (p<0.01) for 2025 demands than for 2015 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2050 demands.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.
Within Portfolio - Enhanced Conservation - Current Climate

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.

- **Hodges**: There is evidence that current climate End of September Elevation is lower (p<0.01) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.

- **Lower Otay**: There is evidence that current climate End of September Elevation is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.

- **San Vicente**: There is evidence that current climate End of September Elevation is higher (p=0.016) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.
Within Portfolio - Increase Supplies - Current Climate

- **El Capitan**: There is evidence that current climate End of September Elevation is slightly higher (p=0.013) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.

- **Hodges**: There is evidence that current climate End of September Elevation is lower (p<0.01) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.

- **Lower Otay**: There is evidence that current climate End of September Elevation is higher (p<0.01) for 2025 demands than for 2015 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2050 demands.

- **San Vicente**: There is evidence that current climate End of September Elevation is higher (p<0.01) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.
Within Portfolio - Optimize Existing Facilities - Current Climate

- **El Capitan**: There is evidence that current climate End of September Elevation is higher (p<0.01) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.

- **Hodges**: There is evidence that current climate End of September Elevation is lower (p<0.01) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.

- **Lower Otay**: There is evidence that current climate End of September Elevation is higher (p<0.01) for 2025 demands than for 2015 demands and higher (p<0.01) for 2050 demands than for 2025 demands.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.
Within Portfolio - Watershed Health and Ecosystem Restoration - Current Climate

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.

- **Hodges**: There is evidence that current climate End of September Elevation is lower (p<0.01) for 2050 demands than for 2025 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2015 demands.

- **Lower Otay**: There is evidence that current climate End of September Elevation is higher (p<0.01) for 2025 demands than for 2015 demands, but no evidence of a difference (p>0.1) between 2025 demands and 2050 demands.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate scenarios for 2015, 2025, and 2050 demands.
Recreation

End of September Reservoir Elevation

Future Climate Within Portfolio Comparisons
Within Portfolio - Baseline - 2025 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate (p=0.036) and warm-dry climate (p=0.039) than central tendency climate, and higher for warm-wet climate (p=0.014) than central tendency climate, but no evidence of a difference in End of September Elevation between central tendency climate scenario and hot-wet climate (p>0.1).
Within Portfolio - Baseline - 2050 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate (p=0.01) and warm-dry climate (p=0.040) than central tendency climate, and higher for warm-wet climate (p=0.046) than central tendency climate, but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and hot-wet climate.
Within Portfolio - Baseline Plus - 2025 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate (p=0.028) and warm-dry climate (p=0.026) than central tendency climate, but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and hot-wet climate or warm-wet climate.
Within Portfolio - Baseline Plus - 2050 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate than central tendency climate (p=0.031), and higher for hot-wet climate (p=0.025) and warm-wet climate (p=0.013) than central tendency climate, but only some evidence (p=0.085) that End of September Elevation is higher for central tendency climate than warm-dry climate.
Within Portfolio - Enhanced Conservation - 2025 Demands

- **El Capitan**: There is no evidence of a difference ($p>0.1$) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference ($p>0.1$) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference ($p>0.1$) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference ($p>0.1$) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate ($p=0.011$) and warm-dry climate ($p<0.01$) than central tendency climate, but no evidence of a difference ($p>0.1$) in End of September Elevation between central tendency climate scenario and hot-wet climate or warm-wet climate.
Within Portfolio - Enhanced Conservation - 2050 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is evidence that End of September Elevation is higher (p<0.01) for current climate than for central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower (p<0.01) for hot-dry climate and warm-dry climate than central tendency climate, and higher (p=0.033) for hot-wet climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and warm-wet climate.
Within Portfolio - Increase Supplies - 2025 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate (p=0.025) and warm-dry climate (p=0.022) than central tendency climate, but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and hot-wet climate or warm-wet climate.
Within Portfolio - Increase Supplies - 2050 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is some evidence (p=0.081) that End of September Elevation is higher for warm-wet climate than central tendency climate, but no evidence of a difference in End of September Elevation between central tendency climate scenario and other climate scenarios (p>0.1).

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower (p=0.033) for hot-dry climate than central tendency climate, but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios and warm-dry climate.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate (p=0.016) and warm-dry climate (p<0.01) than central tendency climate, but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and hot-wet climate or warm-wet climate.
Within Portfolio - Optimize Existing Facilities - 2025 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate (p=0.028) and warm-dry climate (p=0.026) than central tendency climate, but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and hot-wet climate or warm-wet climate.
Within Portfolio - Optimize Existing Facilities - 2050 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is some evidence that End of September Elevation is higher for warm-wet climate than central tendency climate (p=0.075), but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is evidence that End of September Elevation is higher (p<0.01) for current climate than for central tendency climate. There is evidence that End of September Elevation is lower (p<0.01) for hot-dry climate than central tendency climate, but no evidence of a difference in End of September Elevation between central tendency climate scenario and hot-wet climate (p>0.1), and only some evidence that End of September Elevation is higher (p=0.061) for warm-wet climate and lower for warm-dry climate (p=0.079) than central tendency climate.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower (p=0.033) for hot-dry climate than central tendency climate, and higher for hot-wet climate (p=0.029) and warm-wet climate (p=0.017) than central tendency climate, but only some evidence (p=0.073) that End of September Elevation is higher for central tendency climate scenario than warm-dry climate.
Within Portfolio - Watershed Health and Ecosystem Restoration - 2025 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente**: There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate (p=0.028) and warm-dry climate (p=0.026) than central tendency climate, but no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and hot-wet climate or warm-wet climate.
Within Portfolio - Watershed Health and Ecosystem Restoration - 2050 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in End of September Elevation between central tendency climate scenario and other climate scenarios.

- **San Vicente:** There is no evidence of a difference (p>0.1) in End of September Elevation between current climate and central tendency climate. There is evidence that End of September Elevation is lower for hot-dry climate (p=0.030) than central tendency climate, and higher for hot-wet climate (p=0.026) and warm-wet climate (p=0.012) than central tendency climate, but only some evidence (p=0.077) that End of September Elevation is higher for central tendency climate than warm-dry climate.
Recreation

Percent of Realizations Below the Boat Ramp Elevation

Across Portfolio Comparisons
Percent of Realizations below the El Capitan Boat Ramp - 2025 Demands

- **Baseline**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet and warm-wet climates (86%) followed by central tendency climate (85%), current climate (84%), hot-dry climate (81%), and warm-dry climate (80%) for 2025 demands.
- **Baseline Plus**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet climate (85%) followed by warm-wet climate (82%), central tendency climate (82%), and current climate (82%), then hot-dry climate (79%) and warm-dry climate (76%) for 2025 demands.
- **Enhanced Conservation**: The percentage of realizations below the El Capitan boat ramp is highest in the warm-wet climate (84%) followed by hot-wet climate (82%) and central tendency climate (82%), current climate (80%), hot-dry climate (78%), and warm-dry climate (78%) for 2025 demands.
- **Increase Supplies**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet climate (85%) followed by warm-wet climate (84%), current climate (82%), central tendency climate (81%), hot-dry climate (76%), and warm-dry climate (76%) for 2025 demands.
- **Optimize Existing Facilities**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet climate (85%) followed by warm-wet climate (82%), central tendency climate (82%), and current climate (82%), then hot-dry climate (79%) and warm-dry climate (76%) for 2025 demands.
- **Watershed Health and Ecosystem Restoration**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet climate (85%) followed by warm-wet climate (82%), central tendency climate (82%), and current climate (82%), then hot-dry climate (79%) and warm-dry climate (76%) for 2025 demands.
Percent of Realizations below the El Capitan Boat Ramp - 2050 Demands

- **Baseline**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet and warm-wet climates (88%) followed by central tendency climate (85%), current climate (85%), hot-dry climate (84%), and warm-dry climate (80%) for 2050 demands.
- **Baseline Plus**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet climate (85%) followed by warm-wet climate (84%), central tendency climate (82%), current climate (82%), hot-dry climate (81%), and warm-dry climate (79%) for 2050 demands.
- **Enhanced Conservation**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-dry climate (79%) followed by central tendency climate (78%), warm-dry climate (75%), current climate (72%), hot-wet climate (72%), and warm-wet climate (72%) for 2050 demands.
- **Increase Supplies**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet climate (72%) followed by central tendency climate (67%) and current climate (67%), then warm-dry climate (66%), warm-wet climate (64%), and hot-dry climate (61%) for 2050 demands.
- **Optimize Existing Facilities**: The percentage of realizations below the El Capitan boat ramp is 0% for all climate scenarios in 2050 demands.
- **Watershed Health and Ecosystem Restoration**: The percentage of realizations below the El Capitan boat ramp is highest in the hot-wet climate (86%) followed by central tendency climate (84%) and warm-wet climate (84%), then current climate (82%), hot-dry climate (81%), and warm-dry climate (79%) for 2050 demands.
Percent of Realizations below the Hodges Boat Ramp - 2025 Demands

- **Baseline**: The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2025 demands.
- **Baseline Plus**: The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2025 demands.
- **Enhanced Conservation**: The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2025 demands.
- **Increase Supplies**: The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2025 demands.
- **Optimize Existing Facilities**: The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2025 demands.
- **Watershed Health and Ecosystem Restoration**: The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2025 demands.
Percent of Realizations below the Hodges Boat Ramp - 2050 Demands

- **Baseline:** The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2050 demands.
- **Baseline Plus:** The percentage of realizations below the Hodges boat ramp is 1% for current climate, central tendency climate, hot-dry climate, and warm-dry climate, and 0% for hot-wet and warm-wet climates in 2050 demands.
- **Enhanced Conservation:** The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2050 demands.
- **Increase Supplies:** The percentage of realizations below the Hodges boat ramp is 0% for all climate scenarios in 2050 demands.
- **Optimize Existing Facilities:** The percentage of realizations below the Hodges boat ramp is 1% for hot-dry and warm-dry climates, and 0% for central tendency climate, current climate, and hot-wet and warm-wet climates in 2050 demands.
- **Watershed Health and Ecosystem Restoration:** The percentage of realizations below the Hodges boat ramp is 1% for central tendency climate, hot-dry climate, and warm-dry climate, and 0% for central tendency, hot-wet and warm-wet climates in 2050 demands.
Percent of Realizations below the Lower Otay Boat Ramp - 2025 Demands

- **Baseline:** The percentage of realizations below the Lower Otay boat ramp is highest in the warm-dry climate (33%) followed by hot-dry climate (32%), current climate (29%), central tendency climate (28%), hot-wet climate (26%), and warm-wet climate (25%) for 2025 demands.
- **Baseline Plus:** The percentage of realizations below the Lower Otay boat ramp is 0% for all climate scenarios in 2025 demands.
- **Enhanced Conservation:** The percentage of realizations below the Lower Otay boat ramp is 0% for all climate scenarios in 2025 demands.
- **Increase Supplies:** The percentage of realizations below the Lower Otay boat ramp is 0% for all climate scenarios in 2025 demands.
- **Optimize Existing Facilities:** The percentage of realizations below the Lower Otay boat ramp is 0% for all climate scenarios in 2025 demands.
- **Watershed Health and Ecosystem Restoration:** The percentage of realizations below the Lower Otay boat ramp is 0% for all climate scenarios in 2025 demands.
Percent of Realizations below the Lower Otay Boat Ramp - 2050 Demands

- **Baseline:** The percentage of realizations below the Lower Otay boat ramp is highest in the hot-dry climate (45%) followed by warm-dry climate (44%), central tendency climate (33%), current climate (29%), hot-wet climate (29%), and warm-wet climate (26%) for 2050 demands.

- **Baseline Plus:** The percentage of realizations below the Lower Otay boat ramp is highest in the warm-dry climate (7%) followed by hot-dry climate (5%), central tendency climate (4%), current climate (2%), and hot-wet climate (1%), with 0% of realizations below the boat ramp in warm-wet climate for 2050 demands.

- **Enhanced Conservation:** The percentage of realizations below the Lower Otay boat ramp is 0% for all climate scenarios in 2050 demands.

- **Increase Supplies:** The percentage of realizations below the Lower Otay boat ramp is highest in the hot-dry climate (12%) followed by warm-dry climate (9%), central tendency climate (7%), current climate (7%), hot-wet climate (1%), and warm-wet climate (1%) for 2050 demands.

- **Optimize Existing Facilities:** The percentage of realizations below the Lower Otay boat ramp is highest in the hot-dry climate (4%) followed by warm-dry climate (1%), with 0% of realizations below the boat ramp in central tendency climate, current climate, hot-wet climate, and warm-wet climate for 2050 demands.

- **Watershed Health and Ecosystem Restoration:** The percentage of realizations below the Lower Otay boat ramp is highest in the warm-dry climate (8%) followed by hot-dry climate (7%), central tendency climate (4%), current climate (2%), and warm-wet climate (1%), with 0% of realizations below the boat ramp in hot-wet climate for 2050 demands.
Percent of Realizations below the San Vicente Boat Ramp - 2025 Demands

- **Baseline**: The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2025 demands.
- **Baseline Plus**: The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2025 demands.
- **Enhanced Conservation**: The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2025 demands.
- **Increase Supplies**: The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2025 demands.
- **Optimize Existing Facilities**: The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2025 demands.
- **Watershed Health and Ecosystem Restoration**: The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2025 demands.
Percent of Realizations below the San Vicente Boat Ramp - 2050 Demands

- **Baseline:** The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2050 demands.
- **Baseline Plus:** The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2050 demands.
- **Enhanced Conservation:** The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2050 demands.
- **Increase Supplies:** The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2050 demands.
- **Optimize Existing Facilities:** The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2050 demands.
- **Watershed Health and Ecosystem Restoration:** The percentage of realizations below the San Vicente boat ramp is 0% for all climate scenarios in 2050 demands.
Recreation

End of September Reservoir Elevation Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios - El Capitan

- **2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that End of September Elevation is higher in the Enhanced Conservation Portfolio than in the Baseline Portfolio for current climate (p=0.032) and central tendency climate (p=0.045), but no evidence of a difference for hot-dry climate (p>0.1). There is evidence that End of September Elevation is higher in the Increase Supplies and Optimize Existing Facilities Portfolios than in the Baseline Portfolio for current climate (p<0.01), central tendency climate (p<0.01), and hot-dry climate (p=0.013 for Increase Supplies Comparison and p<0.01 for Optimize Existing Facilities comparison). There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and the Baseline Plus or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Plus Compared to Other Portfolios - El Capitan

- **2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.
- **2025 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.
- **2050 Demands:** There is evidence that End of September Elevation is higher in the Increase Supplies and Optimize Existing Facilities Portfolios than in the Baseline Plus Portfolio for current climate (p=0.013 and p<0.01, respectively), central tendency climate (p=0.013 and p<0.01, respectively), and hot-dry climate (p=0.026 and p<0.01, respectively). There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and the Enhanced Conservation or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Hodges

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that End of September Elevation is higher (p<0.01) in the Baseline Portfolio than in any other Portfolios for 2050 demands with current climate, central tendency, or hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Hodges

- **2015 Demands**: There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that End of September Elevation is lower (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with central tendency climate and hot-dry climate, but no evidence of a difference (p>0.1) with current climate. There is evidence that End of September Elevation is lower in the Baseline Plus Portfolio than in the Increase Supplies with central tendency climate (p=0.013) and hot-dry climate (p<0.01), but no evidence of a difference (p>0.1) with current climate. There is evidence that End of September Elevation is lower in the Baseline Plus Portfolio than in the Optimize Existing Facilities Portfolios with central tendency climate (p=0.012), but no evidence of a difference (p>0.1) with hot-dry or current climate. There is no evidence of a difference (p>0.1) between the Baseline Plus Portfolio and Watershed Health and Ecosystem Restoration Portfolio with hot-dry, central tendency, or current climate for 2050 demands.
Across Portfolio - Baseline Compared to Other Portfolios - Lower Otay

- **2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that End of September Elevation is lower (p<0.01) in the Baseline Portfolio than in any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that End of September Elevation is lower (p<0.01) in the Baseline Portfolio than in any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Lower Otay

- **2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that End of September Elevation is higher (p<0.01) in the Enhanced Conservation and Optimize Existing Facilities Portfolios than in the Baseline Plus Portfolio for current climate, central tendency climate, and hot-dry climate. There is evidence that End of September Elevation is higher (p<0.01) in the Increase Supplies Portfolio than in the Baseline Plus Portfolio for central tendency climate, but no evidence of a difference (p>0.1) for current climate or hot-dry climate. There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and the Watershed Health and Ecosystem Restoration Portfolio for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - San Vicente

- **2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is evidence that End of September Elevation is lower in the Baseline Portfolio than in the Enhanced Conservation Portfolio for current climate (p=0.020) and central tendency climate (p=0.033), and some evidence for hot-dry climate (p=0.060) for 2025 demands. There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios with current climate, central tendency climate, and hot-dry climate for 2025 demands.

- **2050 Demands:** There is evidence that End of September Elevation is lower (p<0.01) in the Baseline Portfolio than in the Enhanced Conservation and Increase Supplies Portfolios for current climate, central tendency climate, and hot-dry climate for 2050 demands. There is evidence that End of September Elevation is lower in the Baseline Portfolio than in the Optimize Existing Facilities Portfolio for hot-dry climate (p=0.015), and slightly for current climate (p=0.056), but no evidence of a difference (p>0.1) with central tendency climate for 2050 demands. There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Portfolio and the Baseline Plus or Watershed Health and Ecosystem Restoration Portfolios with current climate, central tendency climate, and hot-dry climate for 2050 demands.
Across Portfolio - Baseline Plus Compared to Other Portfolios - San Vicente

**2015 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

**2025 Demands:** There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, and hot-dry climate.

**2050 Demands:** There is evidence that End of September Elevation is lower (p<0.01) in the Baseline Plus Portfolio than in the Enhanced Conservation and Increase Supplies Portfolio for current climate, central tendency climate, and hot-dry climate. There is no evidence of a difference (p>0.1) in End of September Elevation between the Baseline Plus Portfolio and the Optimize Existing Facilities or Watershed Health and Ecosystem Restoration Portfolios with current climate, central tendency climate, and hot-dry climate.
Flood Control—Number of Days with Flood Outflows and Flood Outflow Volume

Average Annual Number of Days with Flood Outflows and Average Annual Flood Outflow Volume

Current Climate Within Portfolio Comparisons
Within Portfolio - Baseline - Number of Flood Outflows - Current Climate
- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.
- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.

Within Portfolio - Baseline - Flood Outflow Volume - Current Climate
- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
**Within Portfolio - Baseline Plus - Number of Flood Outflows - Current Climate**

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.
- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015 and 2025 demands. There is evidence that the Average Number of Flood Outflows is lower (p<0.01) for 2050 demands than for 2025 demands.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.

**Within Portfolio - Baseline Plus - Flood Outflow Volume - Current Climate**

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
- **Hodges**: Although it appears that the Average Flood Outflow Volume decreases between 2025 and 2050, there is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
Within Portfolio - Enhanced Conservation - Number of Flood Outflows - Current Climate

- **El Capitan**: Although it appears that the Average Number of Flood Outflows increases between 2015, 2025, and 2050 demands based on observations, there is no evidence of a statistical difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.

- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015 and 2025 demands. There is evidence that the Average Number of Flood Outflows is lower (p<0.01) for 2050 demands than for 2025 demands.

- **Lower Otay**: Although it appears that the Average Number of Flood Outflows increases between 2015, 2025, and 2050 demands based on observations, there is no evidence of a statistical difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.

Within Portfolio - Enhanced Conservation - Flood Outflow Volume - Current Climate

- **El Capitan**: Although it appears that the Average Flood Outflow Volume increases between 2015, 2025, and 2050 demands based on observations, there is no evidence of a statistical difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.

- **Hodges**: Although it appears that the Average Flood Outflow Volume decreases between 2025 and 2050, there is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.

- **Lower Otay**: Although it appears that the Average Flood Outflow Volume is higher for 2050 demands than for 2025 demands based on observations, there is no evidence of a statistical difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
Within Portfolio - Increase Supplies - Number of Flood Outflows - Current Climate

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015 and 2025 demands. There is some evidence that the Average Flood Outflow Volume is higher (p=0.065) for 2050 demands than for 2025 demands.
- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015 and 2025 demands. There is evidence that the Average Number of Flood Outflows is lower (p<0.01) for 2050 demands than for 2025 demands.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.

Within Portfolio - Increase Supplies - Flood Outflow Volume - Current Climate

- **El Capitan**: Although it appears that the Average Flood Outflow Volume is higher for 2050 demands than for 2025 demands based on observations, there is no evidence of a statistical difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
- **Hodges**: Although it appears that the Average Flood Outflow Volume decreases between 2025 and 2050, there is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
Within Portfolio - Optimize Existing Facilities - Number of Flood Outflows - Current Climate

- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015 and 2025 demands. There is evidence that the Average Number of Flood Outflows is lower (p=0.021) for 2050 demands than for 2025 demands.

- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015 and 2025 demands. There is evidence that the Average Number of Flood Outflows is lower (p<0.01) for 2050 demands than for 2025 and 2015 demands.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.

Within Portfolio - Optimize Existing Facilities - Flood Outflow Volume - Current Climate

- **El Capitan:** Although it appears that the Average Flood Outflow Volume is higher for 2050 demands than for 2025 demands based on observations, there is no evidence of a statistical difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.

- **Hodges:** Although it appears that the Average Flood Outflow Volume decreases between 2025 and 2050, there is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
**Within Portfolio - Watershed Health and Ecosystem Restoration - Number of Flood Outflows - Current Climate**

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.

- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015 and 2025 demands. There is evidence that the Average Number of Flood Outflows is lower (p<0.01) for 2050 demands than for 2025 and 2015 demands.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate scenarios for 2015, 2025, and 2050 demands.

**Within Portfolio - Watershed Health and Ecosystem Restoration - Flood Outflow Volume - Current Climate**

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.

- **Hodges**: Although it appears that the Average Flood Outflow Volume decreases between 2025 and 2050, there is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate scenarios for 2015, 2025, and 2050 demands.
Flood Control—Number of Days with Flood Outflows and Flood Outflow Volume

Average Annual Number of Days with Flood Outflows and Average Annual Flood Outflow Volume

Future Climate Within Portfolio Comparisons
Within Portfolio - Baseline - Number of Flood Outflows - 2025 Demands

- **El Capitan:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence ($p>0.1$) of a difference in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Baseline - Flood Outflow Volume - 2025 Demands

- **El Capitan:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence ($p>0.1$) of a difference in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline - Number of Flood Outflows - 2050 Demands
- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.
- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.
- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Baseline - Flood Outflow Volume - 2050 Demands
- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline Plus - Number of Flood Outflows - 2025 Demands
- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.
- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Baseline Plus - Flood Outflow Volume - 2025 Demands
- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Baseline Plus - Number of Flood Outflows - 2050 Demands
- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.
- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is some evidence (p=0.067) that Average Number of Flood Outflows is higher for warm-wet climate than central tendency climate, but no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and hot-wet, hot-dry, or warm-dry climate scenarios.
- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Baseline Plus - Flood Outflow Volume - 2050 Demands
- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Enhanced Conservation - Number of Flood Outflows - 2025 Demands

- **El Capitan:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Enhanced Conservation - Flood Outflow Volume - 2025 Demands

- **El Capitan:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Enhanced Conservation - Number of Flood Outflows - 2050 Demands

- **El Capitan:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is evidence that Average Number of Flood Outflows between is higher ($p=0.053$) for warm-wet climate than for central tendency climate, but no evidence of a difference ($p>0.1$) between central tendency climate scenario and hot-wet, hot-dry, or warm-dry climate scenarios.

- **Lower Otay:** There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Enhanced Conservation - Flood Outflow Volume - 2050 Demands

- **El Capitan:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference ($p>0.1$) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Increase Supplies - Number of Flood Outflows - 2025 Demands
- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.
- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.
- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Increase Supplies - Flood Outflow Volume - 2025 Demands
- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Increase Supplies - Number of Flood Outflows - 2050 Demands
- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.
- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is some evidence that Average Number of Flood Outflows between is higher (p=0.062) for warm-wet climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate scenario and hot-wet, hot-dry, or warm-dry climate scenarios.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Increase Supplies - Flood Outflow Volume - 2050 Demands
- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Optimize Existing Facilities - Number of Flood Outflows - 2025 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Optimize Existing Facilities - Flood Outflow Volume - 2025 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Optimize Existing Facilities - Number of Flood Outflows - 2050 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is some evidence (p=0.068) that the Average Number of Flood Outflows is higher for warm-wet climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is some evidence (p=0.092) that the Average Number of Flood Outflows is higher for warm-wet climate than central tendency climate, but no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Optimize Existing Facilities - Flood Outflow Volume - 2050 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration - Number of Flood Outflows - 2025 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Watershed Health and Ecosystem Restoration - Flood Outflow Volume - 2025 Demands

- **El Capitan:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Hodges:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Lower Otay:** There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Within Portfolio - Watershed Health and Ecosystem Restoration - Number of Flood Outflows - 2050 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is some evidence of a difference (p=0.069) for warm-wet climate than for central tendency climate, but no evidence of a difference (p>0.1) between central tendency climate and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Number of Flood Outflows between central tendency climate scenario and other climate scenarios.

Within Portfolio - Watershed Health and Ecosystem Restoration - Flood Outflow Volume - 2050 Demands

- **El Capitan**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Hodges**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.

- **Lower Otay**: There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between current climate and central tendency climate. There is no evidence of a difference (p>0.1) in the Average Flood Outflow Volume between central tendency climate scenario and other climate scenarios.
Flood Control—Number of Days with Flood Outflows and Flood Outflow Volume

Average Annual Flood Outflow Volume

Across Portfolio Comparisons
### Across Portfolio - Baseline Compared to Other Portfolios - El Capitan

**2015 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

**2025 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

**2050 Demands:** There is no evidence of a difference (p>0.1) in Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.

### Across Portfolio - Baseline Plus Compared to Other Portfolios - El Capitan

**2015 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

**2025 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

**2050 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Hodges

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.
- **2025 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.
- **2050 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Hodges

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.
- **2025 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.
- **2050 Demands:** There is no evidence of a difference (p>0.1) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Lower Otay

- **2015 Demands**: There is no evidence of a difference ($p>0.1$) in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.
- **2025 Demands**: There is no evidence of a difference ($p>0.1$) in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.
- **2050 Demands**: There is no evidence of a difference ($p>0.1$) in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Lower Otay

- **2015 Demands**: There is no evidence of a difference ($p>0.1$) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.
- **2025 Demands**: There is no evidence of a difference ($p>0.1$) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.
- **2050 Demands**: There is no evidence of a difference ($p>0.1$) in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - San Vicente

- **2015 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

- **2050 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

Across Portfolio - Baseline Plus Compared to Other Portfolios - San Vicente

- **2015 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

- **2050 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
Across Portfolio - Baseline Compared to Other Portfolios - Olivenhain

- **2015 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

- **2050 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Portfolio and any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

Across Portfolio - Baseline Plus Compared to Other Portfolios - Olivenhain

- **2015 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate (p=NA).

- **2025 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

- **2050 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Flood Outflow Volume between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
Flood Control—Number of Days with Flood Outflows and Flood Outflow Volume

Average Number of Days with Flood Outflows

Across Portfolio Comparisons
Across Portfolio - Baseline Compared to Other Portfolios - El Capitan

**2015 Demands:** There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

**2025 Demands:** There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

**2050 Demands:** There is evidence that the Average Number of Days with Flood Outflows is lower in the Baseline Portfolio than in the Increase Supplies Portfolio with current climate (p=0.016), central tendency climate (p=0.012), and hot-dry climate (p=0.047). There is some evidence that the Average Number of Days with Flood Outflows is higher in the Baseline Portfolio than in the Optimize Existing Facilities Portfolio with current climate (p=0.062) and central tendency climate (p=0.058), but no evidence of a difference with hot-dry climate (p=0.1). There is some evidence (p=0.089) that the Average Number of Days with Flood Outflows is higher in Enhanced Conservation than Baseline, but no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Portfolio and the Baseline Plus or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p>0.1).
Across Portfolio - Baseline Plus Compared to Other Portfolios - El Capitan

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that the Average Number of Days with Flood Outflows is lower in the Baseline Plus Portfolio than in the Increase Supplies Portfolio with central tendency climate (p=0.036) and some evidence of this in current climate (p=0.066), but only some evidence with hot-dry climate (p=0.096). There is evidence that the Average Number of Days with Flood Outflows is higher in the Baseline Plus Portfolio than in the Optimize Existing Facilities Portfolio with current climate (p=0.025), central tendency climate (p=0.028), and hot-dry climate (p=0.048). There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and the Enhanced Conservation or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Hodges

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is evidence that the Average Number of Days with Flood Outflows is larger (p<0.01) in the Baseline Portfolio than in any other Portfolio for 2050 demands with current climate, central tendency climate, and hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Hodges

- **2015 Demands**: There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands**: There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands**: There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - Lower Otay

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is evidence that the Average Number of Days with Flood Outflows is higher in the Baseline Portfolio than in the Enhanced Conservation Portfolio for 2050 demands with current climate (p=0.024), central tendency climate (p=0.040), and hot-dry climate (p=0.039). There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Portfolio and the Baseline Plus, Increase Supplies, Optimize Existing Facilities, or Watershed Health and Ecosystem Restoration Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.

Across Portfolio - Baseline Plus Compared to Other Portfolios - Lower Otay

- **2015 Demands:** There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate.

- **2025 Demands:** There is no evidence of a difference (p>0.1) in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate.

- **2050 Demands:** There is some evidence (p=0.096) that the Average Number of Days with Flood Outflows is higher in Enhanced Conservation Portfolio than the Baseline Plus Portfolio, but no evidence of a difference (p>0.1) between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate.
Across Portfolio - Baseline Compared to Other Portfolios - San Vicente

- **2015 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate (p=NA).
- **2025 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
- **2050 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

Across Portfolio - Baseline Plus Compared to Other Portfolios - San Vicente

- **2015 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate (p=NA).
- **2025 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
- **2050 Demands**: There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
Across Portfolio - Baseline Compared to Other Portfolios - Olivenhain

- **2015 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2015 demands with current climate (p=NA).
- **2025 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
- **2050 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Portfolio and any other Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).

Across Portfolio - Baseline Plus Compared to Other Portfolios - Olivenhain

- **2015 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2015 demands with current climate (p=NA).
- **2025 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2025 demands with current climate, central tendency climate, or hot-dry climate (p=NA).
- **2050 Demands:** There are no Flood Outflows for any of the Portfolios, therefore there is no evidence of a difference in Average Number of Days with Flood Outflows between the Baseline Plus Portfolio and any other subsequent Portfolios for 2050 demands with current climate, central tendency climate, or hot-dry climate (p=NA).