Technical Memorandum

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Prepared for: Santa Clara Valley Water District (Valley Water)

Project Title: Water Supply Master Plan Benchmarking Study

Project No.: 157387.005

Technical Memorandum (TM) No. 1

Subject: Water Supply Master Plan Benchmarking Study TM

Date: August 17, 2022

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Limitations:

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Acknowledgements

The Water Supply Master Plan (WSMP) Benchmarking Study reflects valuable input from many contributors that helped make this work possible. The Brown and Caldwell (BC) project team acknowledges the valuable contributions of staff from Valley Water and five peer agencies.

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List of Abbreviations

AF	acre-feet
AFY	acre-feet per year
AMC	Asset Management Committee (SPU)
AWS	Alternative Water Supply (SFPUC)
Board	Board of Directors
CAP	Central Arizona Project
CIP	capital improvement program
CRA	Colorado River Aqueduct
EIR	Environmental Impact Report
FFMP	Flexible Flow Management Program (PWD)
GPCD	gallons per capita day
GM	general manager
IRP	Integrated Water Resources Plan (MWD)
IWSP	Integrated Water Supply Plan (TRWD)
LOS	level of service
LTVA	Long Term Vulnerability Assessment (SFPUC)
MAP	Monitoring and Assessment Program (Valley Water)
MGD	million gallons per day
MWD	Metropolitan Water District of Southern California
O&M	operations and maintenance
Project	Water Supply Master Plan Benchmarking Study
PWD	Philadelphia Water Department
RWS	Regional Water System (SFPUC)
SDCWA	San Diego County Water Authority
SFPUC	San Francisco Public Utilities Commission
SOP	standard operating procedure
SPU	Seattle Public Utilities
SRF	State Revolving Fund
State Board	California's State Water Resources Control Board
SWP	State Water Project
TAC	Technical Advisory Committee
TDS	total dissolved solids
TRWD	Tarrant Regional Water District
UWMP	Urban Water Management Plan
WAC	Washington Administrative Code
WIFIA	Water Infrastructure Finance and Innovation Act
WMP	Drinking Water Master Plan (PWD)
WSMP	Water Supply Master Plan (Valley Water)
WSP	Water System Plan (SPU)

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Executive Summary

In 2019, Valley Water completed its Water Supply Master Plan (WSMP) 2040, which is its long-range water supply plan that assesses the need for water supply projects and evaluates and recommends water supply and infrastructure projects to achieve its Level of Service goal (LOS) through 2040. To inform the next comprehensive WSMP update, Valley Water set out to study peer agencies' equivalent long-range water supply planning approaches, processes, and tools. The study included reviewing peer agencies' plans and interviewing staff from a subset of the agencies.

The review of seven peer water suppliers' long-range plans involved comparing and summarizing drivers, approaches, project evaluation/selection methods, and internal and external stakeholder engagement. Peer agencies involved in this study include three water suppliers in California and four from out of state, with the agencies interviewed in bold:

- Within California
  - **San Francisco Public Utilities Commission (SFPUC) in the San Francisco Bay Area**
  - **Metropolitan Water District of Southern California (MWD)**
  - **San Diego County Water Authority (SDCWA) in Southern California**
- Outside of California
  - **Tarrant Regional Water District (TRWD) in Texas**
  - **Tucson Water in Arizona**
  - Philadelphia Water Department (PWD) in Pennsylvania
  - Seattle Public Utilities (SPU) in Washington

After plan review, staff from five of the seven peer agencies were interviewed to answer follow up questions and provide further understanding of those agencies' water supply planning processes and efforts.

The seven peer agencies generally share similar drivers for water supply planning (e.g., resilience to climate change, supply portfolio diversification, drought planning, and water use efficiency/conservation). Like Valley Water, all the peer agencies also aim to develop a reliable, resilient water supply portfolio to meet future demands in the face of uncertainty surrounding water supply while also considering the increasing cost of service and water affordability concerns.

To address future uncertainties, peer agencies use water supply models, scenario planning, and adaptive planning approaches. While several peer agencies included in this study have adopted adaptive management (i.e., development of various future scenarios but no timeline for decisions or indicators to trigger action), several others use a more rigid decision tree method with a defined set of actions triggered by indicators and/or decision points along the way.

In seeking agreement and increased communication across the agency in the water supply planning process, most peer agencies considered in this study convene an internal work group or task force consisting of managers and technical experts from multiple departments/divisions. The work groups, led by their planning team/department, meet regularly to discuss project evaluation, analysis approaches, data

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inputs, and findings and recommendations. All seven peer agencies engage external stakeholders and the public throughout the process, some extensively.

From the plan review and staff interviews, several opportunities were identified for Valley Water to consider in future updates to the WSMP and summarized as follows.

1. **Develop a workplan to guide the comprehensive update.** Prior to the actual plan development, Valley Water could consider developing a workplan to clearly define planning objectives, establish evaluation guidelines (such as approach for project/portfolio selection and boundary conditions), and specify procedures for engaging external stakeholders, communicating updates to the Board, and convening an internal work group.
2. **Continue to convene an inter-departmental work group on WSMP update.** Like Valley Water, the water supply planning team/department at most agencies in this study leads a cross-disciplinary work group to seek input from internal subject matter experts. Several related principles, practices, and lessons gleaned from or inspired by peer agency interviews include:
   - Consistent work group participation—from the WSMP update's project definition phase through its complete development—yields dividends in internal efficiencies, coordinated communications, and aligned understanding.
   - Continued support from executives and upper management, including possibly an executive steering committee, leads to consistent engagement of department/unit managers and/or delegates from Valley Water's relevant business areas.
   - The workplan for the comprehensive update process could serve as a framework for the inter-disciplinary work group, defining its role, responsibility/expectations, and composition.
3. **Enhance Valley Water's planning approach.** Valley Water's current WSMP strategy is developed based on evaluation of various combinations of potential future demands, imported water contract deliveries, and new supply and storage projects. To explicitly account for uncertainty affecting many factors in water supply planning and provide further flexibility in decision-making, Valley Water could enhance its planning approach by developing alternative futures and decision trees and signposts, as was done by several peer agencies (scenario planning). This scenario planning approach provides a basis for adaptive management and may help Valley Water preemptively determine different courses of action and inform decisions regarding water supply investments in response to various potential future circumstances. A key component of this approach is to develop performance indicators (signposts) to gauge what future trajectory will be more likely to occur, and then adjust investment strategy accordingly.
4. **Use a planning horizon of 20-30 years.** Valley Water has been using a planning horizon of 20-25 years for its WSMP, which is consistent with what was used by most peer agencies including all three California agencies. For future WSMP updates, Valley Water could use a planning horizon of up to 30 years, which strikes a good balance between data availability and the uncertainty related to future conditions (i.e., forecasted demand and supply, project implementation). A longer planning period would bring more uncertainty into planning processes and outcomes. All three California agencies in this study update their plans every five years, a frequency that is consistent with Valley Water's practice and should be continued.

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5. **Develop a framework for project evaluation with additional criteria if feasible.** All agencies use multiple criteria to develop and evaluate new projects, some of them quantifiable, others not. Valley Water similarly uses a list of criteria for project evaluation. Valley Water could consider developing a framework to help better compare projects, with established goals, list of criteria, underlying assumptions, and performance matrix. Where feasible, Valley Water could consider adding some additional criteria that were used by other agencies, such as climate resilience, conveyance utilization, and water treatment plant utilization, to enhance its project evaluation approach and framework.
6. **Continue to evaluate drought resilient local supplies and diversify storage.** Consistent with all peer agencies, Valley Water has also developed a diverse water supply portfolio to meet its existing and future needs. Going forward, Valley Water could continue its current path of evaluating and developing locally controlled, drought resilient supplies to help reduce reliance on surface water supplies, both local and imported, as they are more vulnerable to droughts, natural disasters, and regulatory restrictions. Valley Water could also look to increase or diversify its storage to better capture more water during wet years to be used for dry years and provide flexibility to its operations.
7. **Increase coordination and alignment between WSMP, Capital Improvement Program (CIP), and rate setting process.** As with Valley Water, all peer agencies use their master plans as a guiding document to inform future investment. Peer agencies' CIPs are sometimes driven by factors beyond long-term planning goals; however, project and action evaluation is generally based on consistency with the long-term plan and long-term benefits. To promote increased consistency between CIP, rate setting process, and WSMP, Valley Water could better align those efforts. This could ensure Valley Water's different business areas concertedly move toward the same goals and the projects/programs best meeting Valley Water's short-term and long-term goals are prioritized within the overall context of Valley Water's missions.
8. **Continue to hold Board workshops and continued engagement with committees to communicate water supply project updates and seek input on the comprehensive WSMP update.** Based on interviews with peer agencies, holding workshops with elected boards with a dedicated focus on WSMP topics increases engagement, communication, and understanding during the comprehensive update process. In addition, continued engagement with Valley Water's various committees would support improved alignment among relevant staff and Board committee members assigned to projects/topics that are regularly addressed in those committees.
9. **Communicate updates publicly and post to a designated webpage with regular frequency using a consistent high-level format.** Based on best practices among peer agencies, Valley Water may consider issuing written updates as brief, standalone work products accessible to a broad public audience including decision-makers, ratepayers, and other stakeholders. Updates should be structured consistently and clearly identify changes or updates since the last report-out. Using a standard structure/format and posting updates on a designated webpage may improve stakeholder access to information and engagement in the update process.

While the review of peer agencies' plans identified similarities, there is no one-size-fits-all approach to water supply planning since it depends on agency size, constraints, and risks being mitigated. This benchmarking study gleaned best practices and valuable insights on the level of service goals and planning approaches and methods. As Valley Water prepares its next WSMP comprehensive update, staff may turn to these

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findings and continue to network with peer agencies to learn from each other to collectively improve long-term water supply planning.

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Section 1: Introduction

The Water Supply Master Plan 2040 (WSMP) is Valley Water's guiding document for long-term water supply investments to ensure water supply reliability for Santa Clara County through the year 2040. Adopted by Valley Water's Board of Directors (Board) in 2019, this long-range water supply plan assesses the future county-wide demands and evaluates and recommends water supply and infrastructure projects to meet those demands to achieve its level of service (LOS) goal through 2040.

Valley Water follows a roughly 5-year cycle for its WSMP update. To help inform the direction and framework of the next WSMP update, Valley Water and its Consulting team performed a benchmarking study to learn best practices in long range water supply planning from some of its peer water utilities.

1.1 Purpose of Benchmark Study

The purpose of this study is to assess industry examples of practices, approaches, and methodologies used by other water suppliers for long range water resources planning with the intent of informing Valley Water's planning approaches and process. The findings from this study will be used to:

- Strengthen Valley Water's overall approach for water supply master planning;
- Improve the rigor of project evaluation and analysis by learning from industry practices, approaches, and methodologies used by other water agencies;
- Improve board and stakeholder engagement during the plan development process; and
- Increase coordination between WSMP and CIP and rate setting

1.2 Benchmark Study Approach

The study involved four steps – selecting seven peer agencies (Figure 1), reviewing their long-range water resources plans, interviewing staff from a subset of the agencies, and summarizing findings and recommendations in a technical memorandum (TM). Each step is described further below.

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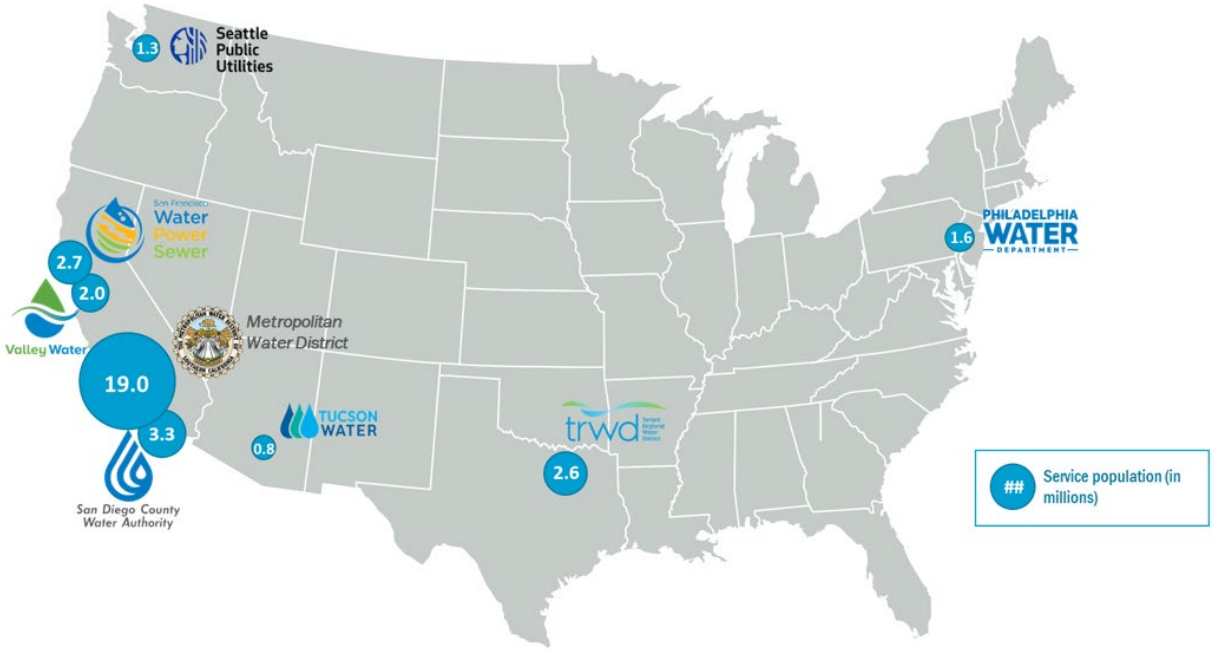

Figure 1. Utilities Selected for Benchmarking Study

STEP 1: Select peer agencies for benchmarking. Valley Water sought to identify seven agencies with a mix of geographic representation, including several agencies in California and several out-of-state agencies, that serve wholesale water supply and/or a similar number of customers, have a diverse set of water supply sources, and manage a comparable or larger annual budget. Based on these guidelines, Valley Water selected below seven peer agencies across the United States for this study:

1. San Francisco Public Utilities Commission (SFPUC), California
2. Metropolitan Water District of Southern California (MWD)
3. San Diego County Water Authority (SDCWA), California
4. Tarrant Regional Water District (TRWD), Texas
5. Tucson Water, Arizona
6. Philadelphia Water Department (PWD), Pennsylvania
7. Seattle Public Utilities (SPU), Washington

STEP 2: Review peer agencies' water supply planning documents. The objective of the plan reviews was to glean high-level understanding of each peer agency's planning efforts and identify approaches that may be of interest to Valley Water (i.e., similarities and differences). The project team reviewed the most up-to-date, publicly available long-range water supply planning documents from the seven peer agencies. To guide the review, the project team developed a standardized format to gather information related to Valley Water's areas of interest to compare and contrast across the seven agencies. The findings from the plan review provided grounds for further, targeted interview questions for Step 3.

STEP 3: Conduct interviews with five peer agencies. Based on the plan review from Step 2, five of the seven peer agencies were selected for staff interview because of their similar situations and interesting

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planning approaches. Valley Water staff developed interview questions and conducted virtual interviews. The focus of the interviews was to determine which best practices and approaches were effective for each agency. The desired outcomes of these interviews were to:

- Further discuss the agencies' planning approaches and methods
- Obtain information and lessons learned about the planning process that are not explicit in the planning document
- Discuss ongoing or upcoming improvements to the planning process
- Build relationships with peer agencies facing similar water supply challenges for mutual benefit and information sharing

STEP 4: Prepare TM to summarize findings and recommendations. This TM summarizes key findings from the plan reviews and agency interviews as well as recommendations for Valley Water's consideration in the forthcoming comprehensive update to the WSMP.

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Section 2: Plan Overview by Agency

The following sections present an overview of each agency and their water supply planning document(s). The overview includes key drivers of water supply planning, planning approaches, project evaluation, and communication and stakeholder engagement during the course of plan development. A summary of baseline characteristics for each utility is provided in Table 1. Valley Water's baseline characteristics are also included as a point of reference.

Table 1. Peer Agencies Considered for Benchmark Study

Agency	State (Region)	Organizational Structure	Population Served (millions)	Policy-level Decision Makers
Valley Water	California (SF Bay Area)	Wholesaler	2	7 Elected representatives on Board of Directors
SFPUC	California (SF Bay Area)	Wholesaler and Retailer	2.7	5 Commissioners appointed by Mayor
MWD	California (SoCal)	Wholesaler	19	38 Representatives from member agencies on Board of Directors
SDCWA	California (SoCal)	Wholesaler	3.3	36 Representatives from member agencies on Board of Directors
TRWD	Texas	Wholesaler	2.6	5 Elected representatives on Board of Directors
Tucson Water	Arizona	Retailer	0.8	8 Elected representatives, including Mayor, City Council, and City Manager
PWD	Pennsylvania	Wholesaler and Retailer	1.6	5 Commissioners appointed by Mayor
SPU	Washington	Wholesaler and Retailer	1.3	7 Commissioners appointed by Mayor and City Council

2.1 San Francisco Public Utilities Commission

SFPUC is a wholesale water provider serving a population of 2.7 million in the San Francisco Bay Area. SFPUC provides water to the city/county of San Francisco and 28 wholesale customers in three Bay Area counties. Existing water supply sources include surface water (primarily Hetch Hetchy; there is also a smaller contribution of local runoff into SFPUC's East Bay and Peninsula reservoirs), groundwater (Westside Basin, Livermore Valley Basin, and regional groundwater storage and recovery), and non-potable recycled water from Pacifica/North Coast County Water District (SFPUC, 2021a). Average annual water use for the SFPUC is around 218,000 acre-feet (AF).

In 2020, SFPUC initiated its Alternative Water Supply (AWS) Program to evaluate potential sources of future water supply through 2045, as well as plan for next steps for further development of feasible projects to expand its water supply portfolio to support reliability in the coming decades. Currently, SFPUC staff are developing a plan for the AWS Program that will be delivered to the Commission by July 2023 to set a

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confirmed path forward for next steps. The AWS and the associated planning efforts essentially function as SFPUC's long-range water supply master planning to support policy-level decision-making.

2.1.1 Key Drivers

The most significant driver of SFPUC's long-term water supply planning and alternative water supply projects is the new instream (environmental) flow requirements for the Tuolumne River, the primary watershed for SFPUC's supply, as established in amendments to the Sacramento-San Joaquin Delta Water Quality Control Plan (Bay-Delta Plan). The Bay-Delta Plan sets a requirement that 40 percent of unimpaired flow remains in the Tuolumne River in all types of water years. Based on current water demands, SFPUC would need additional supply in drought years to meet its current water obligations to its 26 Wholesale Customers and its retail customers. For a design drought of 8.5 years, SFPUC's analysis indicates the annual shortfall could be up to 93 million gallons per day (MGD), resulting in systemwide rationing of up to 50 percent in drought years. SFPUC is developing its plan for the AWS Program based on the current Bay-Delta Plan amendment while concurrently working with the State of California on a Voluntary Settlement Agreement to protect the Bay-Delta ecosystem.

In addition to the new instream flow requirements, SFPUC must also determine whether it may make the Cities of Santa Clara and San Jose permanent customers, without compromising its delivery obligations to current wholesale customers. Guaranteeing permanent status to these two cities would require an additional 9 MGD of new, year-round supplies to meet historic demand levels and up to 15.5 MGD to meet planned demand through 2045. Through the AWS Program's planning efforts, the SFPUC intends to identify supplies to meet anticipated dry year needs of existing Wholesale Customers and help inform the policy decision on permanent status for San Jose and Santa Clara by 2028.

2.1.2 Planning Approach

SPFUC's forecasted demand is 272,590 AF by 2045. Through the AWS Program, SFPUC is taking a programmatic approach to planning for future water supply options to meet demands. The AWS plan takes supply and storage projects and analyzes how they fill the supply gap and evaluates them based on a number of criteria to create a water supply portfolio. With this approach, every project identified in the plan has its own benefits, timelines, decision points, and environmental process. There are cumulative benefits of implementing all projects in the portfolio, but no individual project depends on another to progress into subsequent planning or implementation phases. Each project milestone is an opportunity to revisit project activities in the context of evolving long-term water supply needs and uncertainties. The AWS Plan provides recommendations for individual projects but is also transparent about the risks and limitations, or what would need to occur if an informed recommendation cannot yet be made. For example, pursuing exchanges with other agencies would not be recommended or deferred to a later date if service agreements that outline delivery methods and water supply sources are not yet in place with those agencies.

Currently, SFPUC's AWS Program is evaluating the feasibility of 14 projects, including eight regional projects in the Bay Area, three in the upcountry Sierra Nevada region that require partnerships, and three local projects in San Francisco. Of those are four storage projects, five recycled projects, one desalination project, three transfers, and one local supply project.

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2.1.3 Project Evaluation

The project evaluation for the AWS focuses on high-level evaluation of how each project helps to fill the gap for dry year supply with other considerations (cost, challenges, etc.) and meet delivery obligations, as well as their impacts on investment decisions. The list of criteria used for project evaluation includes:

- Cost/Funding
- Volume
- Timing and availability of supply
- Location
- Technical and institutional feasibility
- Water quality impacts
- Water treatment needs
- Operational needs/constraints
- Distribution

The evaluation criteria are not explicitly weighted. From the project evaluation, the AWS Plan defines what next investment and work is needed for each proposed project and the commission will make a decision on next steps on a project-by-project basis.

2.1.4 Communication and Stakeholder Engagement

The AWS Program Team, which is composed of five staff that meet weekly, convenes meetings with an internal cross-departmental Water Supply Task Force with management (or delegated staff) from various internal departments/divisions, including legal, operations, engineering, water quality/treatment, and communications. The task force meets every other week (biweekly) to share project updates and discuss technical details, risks, challenges, and milestones. Consistent representation and participation among task force members have made these meetings a uniquely valuable forum for delving into complex issues and gathering insights from managers and subject matter experts.

SFPUC issues executive summary-style quarterly update reports that are posted on its website and included in Commission meeting packets. The quarterly update reports present the latest progress and next steps to the Commission quarterly in public meetings. Staff have adopted a consistent structure for the high-level quarterly update reports as standalone documents with programmatic context. Through these quarterly updates, stakeholders and interested parties are routinely informed at a consistent cadence. Quarterly updates do not evaluate new or existing projects; rather they provide updates on the projects presented in the latest AWS Plan.

2.2 Metropolitan Water District of Southern California

MWD is a wholesale water provider serving a population of 19 million in the Southern California region. MWD provides wholesale water to 14 cities and 12 member agencies within its service area. Existing water supply sources include imports from the State Water Project (SWP) and Colorado River Aqueduct (CRA), as well as a diverse set of local sources including stormwater, groundwater, recycling, and desalination. MWD is currently evaluating

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a major regional recycling project (Pure Water Southern California) in partnership with the Los Angeles County Sanitary District. MWD also manages water storage facilities, transmission/conveyance systems, and conservation programs. Average annual water use for MWD is around 3,271,000 AF.

MWD's Integrated Water Resources Plan (IRP) is its long-term water supply plan that guides water supply policies, programs, and investments to provide the region with a reliable and affordable water supply. Initiated in 1996, MWD's IRP is updated on a five-year cycle with a 25-year planning horizon. In each comprehensive update, MWD considers lessons learned and improvements needed based on evolving conditions and experiences from past planning cycles and recalibrated to current conditions and incorporated the best information available to update its forecasts.

MWD has started its most recent comprehensive update in 2020 and the plan development is still underway. The 2020 IRP establishes reliability targets, evaluates imported and local supply reliability, and identifies strategies to mitigate supply shortage risks through 2045.

2.2.1 Key Drivers

MWD's 2020 IRP seeks to address a wide range of uncertainties that affecting its water supply reliability, including those associated with climate change, regulatory requirements, local supply production, population change, and cooperation amongst Basin states for renegotiation of Colorado River Supply. Among them, climate change and regulatory requirements are most significant as they bring most uncertainty into water supply reliability.

Main objectives of MWD's 2020 IRP include the following:

- Define and account for uncertainties affecting water reliability
- Develop a method to assess and communicate the impacts of those uncertainties
- Explain the uncertainties and their relevance in a clear and transparent way
- Allow integration with an adaptive management strategy that will provide ongoing decision support

2.2.2 Planning Approach

For the 2020 IRP, MWD split the effort into two phases:

- **Regional Needs Assessment**. As the first phase, the Regional Needs Assessment was completed in 2021 and involved identifying factors of uncertainty that could challenge or benefit Southern California's water supply, developing and analyzing scenarios to quantify supply gaps, and developing a mix of actions that address the outcomes of each scenario to promote reliability despite future uncertainties.
- **One Water Implementation**. Currently ongoing and anticipated to take up to two years, the second phase involves developing an adaptive management plan through identifying "signposts" (performance metrics), refining assumptions from Phase 1, and updating modeling tools to inform implementation of actions defined in the Regional Needs Assessment.

In contrast to MWD's previous planning efforts that were focused on a single set of assumptions, the 2020 IRP takes a scenario planning approach to address a wide range of uncertainties. The scenario planning approach provides a basis for adaptive management by considering factors of uncertainty that could challenge or benefit Southern California's water supply under various alternative futures. Key to this approach is assessing risks and uncertainties to imported supplies.

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MWD's scenario planning involves four steps, summarized as follows. The first three steps were completed in Phase 1, and step 4 is in Phase 2 and currently ongoing.

STEP 1: Determine what will impact the future. MWD identified factors impacting the future (e.g., climate change, economics, demographics, legislation and regulations, federal and state support, technological advances in water, aging infrastructure)

STEP 2: Build scenarios. MWD developed four scenarios (alternative futures) that reflect varying levels of impact of the uncertainty factors (e.g., climate change impacts, regulatory impacts, and economic growth) to promote greater understanding of the wider range of potential outcomes. This approach helps identify projects that are common across all scenarios vs. which are unique to some scenarios.

- **Scenario A (lower demand, greater imported supply stability):** Characterized as a combination of plentiful regional and local supplies, struggling economy, low population growth, and continuing water use ethic across the region. Of the four scenarios, Scenario A has the least challenging reliability outlook.
- **Scenario B (higher demand, greater imported supply stability):** Reflects increasing demands resulting from high population growth and strong economy. Climate change impacts are assumed to be manageable, and imported supplies remain stable.
- **Scenario C (lower demand, less imported supply stability):** Combines modest population growth with success efforts among local agencies to manage water use behavior. This scenario assumes a rapid onset of climate change impacts and regulatory constraints affecting imported and local supplies.
- **Scenario D (higher demand, less imported supply stability):** Characterized by higher demands, unstable imports, and diminishing local supplies. This scenario assumes strong economic and demographic growth, a rebound of water-use behaviors, and severe climate change and regulatory constraints. Of the four scenarios, Scenario D has the most challenging reliability outlook.

STEP 3: Conduct supply gap analysis. MWD evaluated the gap between expected water supplies and how much water the region will need in each scenario. MWD uses a resource analysis model called IRPSIM to inform its water supply planning. IRPSIM is a mass balance model that estimates future water supply reliability by integrating projected demands, conservation, imported supplies, future hydrologic conditions, and storage. The model uses a Monte-Carlo simulation to cycle through 96 years of historical hydrology and generates 96 reliability outcomes for each forecast year, based on ranges of impacts in historical hydrology. The model calculates the probability of shortage or surplus for forecasted years. Several other models feed into IRPSIM, including member agency demand and conservation projections, reliability of imported supplies (SWP and Colorado River), and climate effects on demands and supplies (local and imported).

STEP 4: Develop portfolios of actions. Based on the supply gap analysis, MWD identified a portfolio of actions (i.e., solutions, policies, projects that promote reliability) corresponding to each of the four scenarios. Each portfolio contains a unique distribution of projects within three supply categories:

- **Core supply**: A supply that is generally available and used every year to meet demands under normal conditions. High reliability and value if used often. Expensive otherwise.

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- **Flexible supply**: A supply that is implemented on an as-needed basis and may or may not be available for use each year. Expensive if used too much or too often. Better value if used occasionally.
- **Storage**: The capability to save water supply to meet future demands. Converts Core Supply into Flexible Supply. Evens out variability in supply and demand.

2.2.3 Project Evaluation

As MWD advances the 2020 IRP to its second phase (One Water Implementation), MWD is identifying projects that are common (and those that are unique) across scenarios as a basis for adaptive management. Projects and portfolios will be evaluated based on the following performance measures:

- **Affordability**: cost and rate impacts
- **Reliability**: water quantity, frequency of shortage, depth of storage, timing/ease of implementation, diversification, resiliency to climate change
- **Equity**: shortage shared across regions, water quality, system flexibility/redundancy in SWP exclusive areas, and disadvantaged communities
- **Water quality**: salinity and shocks to water quality
- **Environmental**: continued flows to ecosystems, habitat impacts, energy intensity

As part of this improved IRP approach, MWD will adaptively manage as informed by "signposts" (i.e., performance measures) that staff will monitor and report out each year. This approach affords MWD the flexibility to continually adapt to conditions that impact water supply and evaluate new opportunities as they arise. MWD is currently developing signposts and acknowledges that some will be more quantifiable than others.

Each scenario will have its own signposts (e.g., related to global temperatures, population, housing market, regulations, etc.) that would need to be observed before advancing the courses of action proposed in the scenarios. This approach provides the ultimate flexibility when conditions or scenarios change; for example, a high value project that moves forward in Scenario D could be paused or removed when conditions shift toward Scenario A. This approach promotes informed decision-making and does not confine MWD to any individual scenario or project.

2.2.4 Communication and Stakeholder Engagement

MWD's water supply planning team reported meeting regularly with engineering staff along with operations teams during their planning process, and formal interactions occur regularly during board committee meetings attended by other departments.

To support the development of the 2020 IRP, MWD formed two expert panels (one for demand forecasting and the other for climate change impacts) and invited several external subject matter experts to participate in each. These experts collaborated with MWD staff, board members, and member agencies to respond to questions. The panels each met several times over the course of developing the Regional Needs Assessment. The objective of these workshops was to define ranges and major drivers of uncertainty in each demand scenario rather than predictively forecast future water demand or climate change impacts on water supplies and demand.

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About once a month, MWD holds two types of meetings with member agencies to discuss water supply issues - a technical meeting with member agencies' staff and a policy-level discussion with member agencies' general managers. In addition, MWD staff present to the Board and a special board committee convened among 10-11 Board members to guide the IRP process, with updates on water supply planning. MWD staff also engage individually with board members outside of board meetings to answer questions and build rapport. MWD organizes content on its 2020 IRP webpage for transparent communication with stakeholders and the public and posts a wealth of informational resources. After board meetings, MWD staff update the webpage content with resulting outcomes and decisions.

2.3 San Diego County Water Authority

SDCWA is a wholesale water provider with 24 member agencies that serve a population of 3.3 million in the San Diego region. As an MWD member agency, SDCWA's existing imported supply sources include the Colorado River (66 percent) and SWP (10 percent). The remaining balance of SDCWA's water supply portfolio (24 percent) is local supply from surface runoff, seawater desalination, recycled water, and groundwater. The average annual water use is about 494,000 AF.

In 2013, SDCWA completed its Regional Water Facilities Optimization and Master Plan Update (2013 Master Plan) as a roadmap for new infrastructure development through 2035. The Master Plan assesses future supply and demand, reliability of the existing and planned system infrastructure, and options for supply and conveyance if local water supplies are not developed as planned. The plan aims to quantify the range of uncertainties in factors such as conservation, local supply, hydrology, and climate change for consideration when designing the size of supply facilities.

SDCWA is currently developing an update, referred to as the 2023 Master Plan, through a 2045 planning horizon. Consistent with its 2020 Urban Water Management Plan (UWMP), SDCWA does not anticipate a supply shortfall until 2045 in any future scenario. As a result, the 2023 Master Plan will focus on optimizing the existing system and asset management rather than addressing supply shortfall.

2.3.1 Key Drivers

Drought has been the primary challenge for water supply reliability in the SDCWA service area in the past. Located at the end of imported supply pipelines and with precipitation averaging 10 inches per year, San Diego had historically relied on imported water from MWD and lacked local supply. This shifted after SDCWA experienced a loss of 35 percent of its imported water during extreme drought between 1987 and 1992. With significant impacts to the local economy and quality of life, the shortfall prompted SDCWA's strategy to prioritize investments in supply diversification by developing local sources. As a result, SDCWA has reduced the proportion of imported supply (MWD purchases) in its water supply portfolio from 95% in 1991 to 30% in 2020. To maximize the previous 20-year investment in infrastructure, a primary focus of the 2013 Master Plan was to optimize existing systems while maintaining the flexibility to adjust to a range of future planning outcomes.

2.3.2 Planning Approach

Similar to MWD, SDCWA also employed a scenario planning approach to present alternative views of how the future might unfold, rather than providing one prediction or forecast of the future. Based on the major driving

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forces and critical uncertainties influencing SDCWA supplies, demands, and infrastructure needs, four well-constructed scenarios were developed to represents a range of plausible futures. The purpose of the scenarios was to evaluate the performance of SDCWA's system under a range of different supply and demand outcomes and to test the sensitivity of anticipated future infrastructure to these various outcomes. Those scenarios are not intended to establish goals or targets for local supply development or conservation savings.

- **Scenario A: UWMP Projection.** This scenario essentially reflects the 2010 UWMP estimate of demographic projections, growth patterns, local supply development, and conservation achievement.
- **Scenario B: Reduced Conservation, Lower Local Supply Development.** This scenario represents an important upper bracketing scenario by assuming no new conservation or member agency supply projects, plus an increased level of imported water uncertainty and demand uncertainty associated with climate change.
- **Scenario C: Enhanced Local Resource Management.** This scenario assumed more active local agency resource development and management, and less implementation of regional solutions. Demands on the Water Authority would be less than in the 2010 UWMP.
- **Scenario D: Adjusted Local Supply Development.** This scenario considered both adjusted local supply development (50 percent of 2010 UWMP "verifiable" projects) and adjusted conservation (5 percent of SBX7-7 targets) to assess higher demand on the Water Authority.

Following the scenario development, options were developed by analyzing the existing system response under each scenario, identifying potential service gaps, and identifying potential specific project options, alternatives or strategies that can be employed to alleviate the predicted gaps.

2.3.3 Project Evaluation

A key objective of the 2013 Master Plan is the evaluation and assessment of the capability of the region's Baseline System of conveyance, storage, and treatment facilities to satisfy current and projected member agency demands over the 20-year planning horizon (2015 through 2035). Individual projects (both new projects and those included in the current CIP) are evaluated based on how well they address water shortage according to the water supply model and how well they perform across the following weighted criteria:

- **Delivery reliability**: System's ability to meet annual, monthly, and peak water demands as measured by projected future supply shortages
- **Conveyance utilization**: Extent and frequency of system conveyance capacity use
- **Supply diversification**: current and future regional supply mixes to compare over
- time the percentage of total annual deliveries from local sources compared to imported supplies
- **Water treatment plant utilization**: Extent and frequency of water treatment plant capacity use at regional and local treatment facilities
- **Storage utilization**: Use of SDCWA-owned seasonal and carryover storage pools
- **Power usage and generation**: Power use and generation, system-wide and by facility

Projects are then packaged into four portfolios, with each providing a singular approach to address projected untreated water conveyance constraints and supply shortages. Under each of four future scenarios and

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through modeling analysis, the effectiveness of these portfolios in mitigating water shortage was evaluated. For each of the portfolios, there is a specific project implementation sequence that reflects a "right sizing" and "right timing" strategy by implementing improvements only when needed and to address specific supply or conveyance risks. The resulting performance metrics for selected project options and their implementation timing allowed for comparison between projects and among portfolios.

2.3.4 Communication and Stakeholder Engagement

SDCWA formed a work group with directors from other internal departments. The work group held three workshops prior to project kickoff and continued to meet monthly to discuss progress throughout plan development.

Informing and engaging board members and member agencies has been a key component of SDCWA's planning process. During the 2013 master plan development, SDCWA member agencies were kept informed through General Managers' meetings, Board meetings, and meetings with the Master Plan team. Staff from several departments were actively involved in the master planning process through regularly held meetings as well as focused workshops, which provided opportunities for identification and discussion of key issues, clarification of assumptions, and decision making.

The development of SDCWA's 2023 master plan will also involve extensive coordination and communication with the member agencies and outreach to the general public. There are seven meetings scheduled with the board, including one kickoff meeting with general managers and technical staff from member agencies, and two or three half-day workshops. There will be four workshops with general managers of the member agencies to discuss supply, storage, recommended projects, and the final report. More than 80 meetings are scheduled for the project overall.

2.4 Tarrant Regional Water District

TRWD is a wholesale water supplier in the Dallas-Fort Worth region that provides raw water to 30 wholesale customers in 11 counties for nearly 2.6 million residents. Serving one of the fastest growing regions in the nation, TRWD is tasked with developing supplies to meet increasing demands on pace with development. TRWD's existing water system includes four supply reservoirs, three terminal storage reservoirs, and indirect potable reuse. Along with the indirect potable reuse project planned at a surface water reservoir, TRWD is currently conducting an aquifer storage and recovery (ASR) pilot study to test the use of subsurface storage. Average annual water uses for TRWD is around 400,000 AF.

TRWD's 2013 Integrated Water Supply Plan (IWSP) is an integration of its discrete planning efforts over many years that identify the new water supplies with the greatest potential benefit for water supply reliability. A major goal of the 2013 IWSP is to develop a 50-year implementation plan that is adaptive and maximizes reliability through 2060.The IWSP is not an endpoint but rather a *platform* that will be constantly built upon by integrating new opportunities (e.g., local sources, reuse of treated wastewater effluent), technologies (e.g., aquifer storage and recovery, advanced conservation), and strategies (e.g., pursuing groundwater). The 2013 IWSP provides a detailed analysis of TRWD's water supply needs, options, and associated costs through 2060. TRWD is currently working to update the IWSP through phased studies, rather than a comprehensive update under a single scoped effort.

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The 2013 IWSP obtained average demand projections, project capital costs, and cost methodologies from the Texas Water Development Board's Region C Water Plan, which is updated every five years. Region C represents 16 counties in and around the Dallas-Fort Worth region. Though aligned with the Region C master planning, TRWD's IWSP is a more detailed analysis of TRWD's water supply needs, options, and associated costs. In 2019, TRWD conducted its own water demand study to refine projected use as a basis for the updated IWSP.

2.4.1 Key Drivers

Because TRWD's water supply fully originates from surface water including runoff capture and pumped diversions, TRWD's primary challenges relate to year-to-year hydrologic differences and disparity across its service area. TRWD's LOS goal is to meet 100 percent of water demands during normal years and 80 percent in drought (no more than a 20 percent reduction in supply). TRWD's primary focus areas for integrated water supply planning include:

- Diversifying water supply portfolio
- Strengthening water conservation and reducing demands
- Maintaining existing infrastructure

2.4.2 Planning Approach

Recognizing inherent uncertainty about future water availability, population and demand trends, and economic conditions, TRWD used a scenario planning approach for its IWSP, similar to what was used by MWD and SDCWA. Its intent is to analyze several possible future scenarios that bookend the future water supply possibilities. With this approach, three scenarios that represent different combinations of future demand and supply conditions were developed and analyzed:

- **Accepted Projections Scenario:** a possible future in which demand grows as projected by the 2011 Region C based demand projections, historic climate and streamflow is an accurate prediction of the future, and power costs grow as predicted by the raw water generation and transmission cost study.
- **Stressed System Scenario:** a possible future in which demand grows as projected by the 2011 Region C based demand projections, future flows are 15% lower and future evaporation is 15% higher than historic values, and power costs grow at a rate 25% greater than predicted.
- **Optimistic Projections Scenario:** a possible future in which demand grows as projected based on extrapolation of recent trends, historic climate and streamflow is an accurate prediction of the future, and power costs grow at a rate 25% less than predicted.

Under each scenario, three water supply portfolios, which are a combination of water management strategies based on the themes of Low Cost, Low Risk, Regional Partnerships/High Yield, were developed and evaluated. As the building blocks for TRWD's planning process, water management "strategies" are defined by source (e.g., stored surface supply, groundwater, reuse, or conservation) along with associated conveyance and partnerships. Each strategy is characterized by annual yield estimates, capital cost, annual operations and maintenance (O&M) cost, risk profile, and implementation schedule.

A final adaptive management plan, referred as a decision tree, was then built for each portfolio/scenario combination to guide decision making. The decision tree is developed based on major triggers that result in actions on selection and sequencing of strategies. Two primary decision triggers were used:

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1) Yes/No decision to prioritize the timing of a major regional water management strategy over the recommended TRWD implementation plan.
2) Project Viability – the decision tree recommends alternate strategies should any recommended implementation path become unfeasible.

The 2013 IWSP recommended that TRWD implement water supply strategies based on the decision tree built for the Accepted Projections Scenario (Figure 2). The detailed decision tree not only specifies several other possible paths TRWD could take to developing water management strategies, but it also specifies the year by which decisions must be made to change paths should individual strategies become unviable. Using the decision trees will allow TRWD adapt to changing conditions and make investment decisions accordingly.

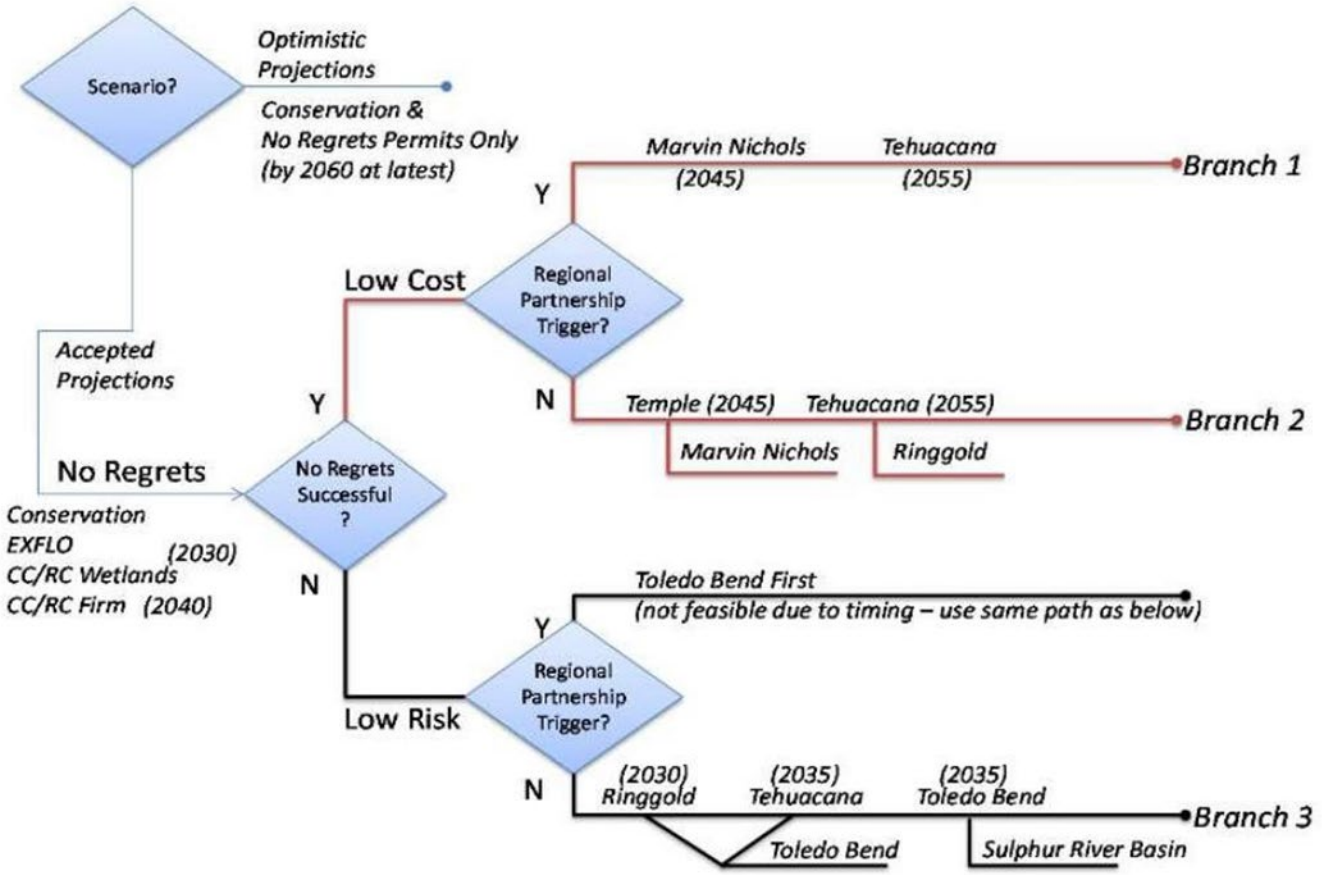

Figure 2. TRWD's decision tree as recommended in the 2013 IWSP

(Source: TRWD, 2014)

The decision tree is based on projections of possible future conditions, but it must be adapted as conditions change. As part of the implementation of the plan, The IWSP recommends tracking hydrologic, socio-economic, and institutional trends periodically, and the decision tree or other portions of the plan adjusted as needed. It is recommended that this update occur at least every five years and would involve updating the analyses as needed and revising the decision tree according to the new results.

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2.4.3 Project Evaluation

TRWD selected a group of projects for this TWSP, focusing primarily on surface water projects that have already been part of their long-range planning. Each project was independently assessed based on the following factors:

- Implementation risk,
- Capital and annual cost
- Impact on supply reliability,
- Project development (planning, design, construction) schedule
- Project yield

These assessments were used as the basis to develop water supply portfolios/Scenario combinations. In addition, each water supply project has factors that affect the probability it can be successfully developed, which defines as risks that influence uncertainty in project performance or viability. The ISWP considered two types of risks:

- **System-wide Risks:** defined as Population/Demand Growth Rate, Climate Variability, and Power Costs. These risks impact water supply reliability and cost for the entire TRWD system.
- **Strategy-specific Risks:** defined as Institutional/Legal Risks, Regulatory/Environmental Risks, and Capital Cost Variability/Water Quality Risks. These risks impact project viability and schedule of individual projects.

Risks for each water management strategy were scored using the professional judgment of the entire IWSP Team. The risk scores were then used to quantify the potential impact on each strategy's implementation schedule. Supply reliability performance measures (frequency and magnitude of simulated shortages) determine when each new strategy should be connected, and these performance measures were calculated using the IWSP System Simulation Model.

As part of the evaluation process, the IWSP also considers the financial impact of each implementation plan in the recommended decision tree on TRWD customers, using the metrics of capital cost, annual cost, and the resulting impact on water rates. TRWD used a model to project rate impacts of implementing various strategies and portfolios for high-level planning purposes only. This rate projection does not optimize the timing of future expenditures and debt repayment. The comparison of different impact on costs and rates under each implementation plan provides useful information for master planning and strategy development.

2.4.4 Communication and Stakeholder Engagement

TRWD's planning team works regularly with various departments on water supply planning, including engineering and environmental departments. The planning team collaborated with other departments closely in developing proposals and recommendations to the board. There are usually many rounds of internal communication to ensure buy-in before information is presented to the board.

Throughout the plan development, general updates and specific water supply planning items were brought to board meetings. Engagement with the public occurred through informal stakeholder groups.

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2.5 Tucson Water

Tucson Water is a retail water provider serving a population of 760,000 in southern Arizona in its active management area. Existing sources of water supply include local groundwater, Colorado River imports from the Central Arizona Project (CAP), and recycled water. Average annual water use is around 99,000 AF.

Water Plan 2000-2050 is Tucson Water's long-term water supply plan that was developed in 2004 and last updated in 2012. The plan assesses current available supplies and potential future supplies to ensure adequate supply over the 50-year planning horizon. The plan identifies critical decisions that must be made by the community and decision makers at key points to ensure the timely implementation of desired projects and programs to guarantee long-term water resources sustainability.

Tucson Water is currently developing its One Water 2100 Master Plan, a new comprehensive long-range plan that will adopt the "One Water" water resource management framework. One Water visioning and stakeholder scenario planning efforts are complete. Broader public outreach efforts began in early 2022.

2.5.1 Key Drivers

Tucson Water does not anticipate a shortfall in supply until around 2100. The utility is currently using approximately two-thirds of its allocation from the Colorado River for its customers and is saving or "banking" one-third of the supply. Until 2100, Tucson Water's objective is to continue banking water and living within the existing water supplies without tapping into groundwater for as long as possible.

Regulatory requirements through Tucson Water's Assured Water Supply program are a key driver of the plan. The Assured Water Supply program limits the amount of groundwater the City of Tucson can legally withdraw. The goal of the program is to eliminate reliance on "mined" groundwater and shift toward renewable water supplies. To support this goal, the program requires that all new developments must demonstrate that their existing, committed, and reasonably foreseeable future water demands can be met using renewable water supplies over a 100-year period.

In addition to complying with the Assured Water Supply program, resource management goals for the Water Plan 2000-2050 include meeting projected total demand, using renewable resources, meeting water quality targets, achieving sustainable pumping, and managing costs and rate impacts. Key goals of the One Water 2100 Master Plan also include reducing overall demand, diversifying the supply portfolio, and public engagement and education.

2.5.2 Planning Approach

In Water Plan 2000-2050, Tucson Water used scenario planning to allow flexibility in water resources management over an extended planning horizon and to guide decision-making with major milestones in the near-, mid-, and long-term. The scenario planning focuses on guiding actions related to potential future strategies and projects for groundwater recharge/banking through the Clearwater Program and reuse. The approach includes four steps:

1. Identify driving forces and uncertainties
2. Rank driving forces and uncertainties by degree of uncertainty and importance
3. Develop "futures" (alternative outcomes used for planning) based on critical uncertainties

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4. Group futures by common elements (programs and projects) and critical decision points

Possible futures were developed through separate assessments related to the Clearwater Program and reuse strategies, with four futures for Clearwater Program and eight for reuse strategies. Together they resulted in a total of 32 "combined futures" that "collectively constitute a wide range of planning possibilities through which to utilize both Colorado River water and effluent." Of the 32 combined futures, four were considered highly unlikely to occur and thus removed. The remaining 28 were packaged as 14 sets of "paired planning pathways." Each paired planning pathway reflects two different scenarios for mineral content of blended supply from the Clearwater Program. The combined futures and 14 planning pathways are categorized into four "families of futures" for potable supply options, including:

- No effluent reuse for potable purposes
- Total recharge of all Colorado River supply and effluent
- Combined technology for direct treatment and/or recharge and recovery of Colorado River supply; all effluent would be recharged
- Treatment flexibility for direct treatment and/or recharge and recovery of all Colorado River supply and all effluent

These pathways consist of the project and program that were specified to realize each of the four futures. An analysis was done to identify common elements that are applicable under the broadest range of possible futures. Once initiated, the common projects and programs would provide the direction and flexibility needed to contribute toward meeting the planning goals. The Recommended Plan resulted from the scenario planning process consists of common projects and programs and a series of key decision points specified through time, which will be implemented by following the route of common elements with the key decision points providing choices and direction along the way.

2.5.3 Pathway Evaluation

To evaluate the 14 pathways and identify those most likely to achieve specific planning goals, Tucson Water assessed each pathway using nine criteria related to source water, operations, and environmental considerations:

- Colorado River water sources acceptance
- Effluent water source acceptance
- Renewable supply utilization
- Meeting projected water demand
- Source reliability
- Impacts to recharge neighbors
- Riparian issues
- Salinity control
- Subsidence prevention

Each criterion is assigned a rating between 1 and 10. The sum score across all nine criteria determined how well a pathway met the overall planning goals and ranks relative to other alternatives. the most highly rated pathways and their associated futures serve as indicators of the programs and

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projects that could best achieve the stated planning goals. Two pathways under the "total recharge" family received the highest score among the options evaluated. These total scores are not intended to be definitive. The goal of this scoring process is to identify the most highly rated pathways that could best achieve the planning goals—not to limit flexibility when future conditions and planning goals change.

2.5.4 Communication and Stakeholder Engagement

Tucson Water engages staff from all departments within the organization in its Water Plan 2050 and its One Water 2100 Master Plan currently under development. Internal engagement of fellow staff occurs through recurring meetings, and water supply planning staff are currently making efforts to engage and inform other departments about the One Water Plan.

Tucson Water engaged with stakeholders early in the visioning process; they hosted three virtual workshops with 23 to 30 community members in attendance to discuss potential supply and demand futures, ideal and worst-case scenarios for local resources, reclaimed and harvested water, and potential pathways. Ranked pathways were included in the Master Plan. Tucson Water also gained feedback and support from the City Council, the Mayor of Tucson, and the Citizens' Water Authority Council during the initial visioning process, to identify key concerns and factors driving water supply planning. Tucson Water staff meets with the mayor and council monthly to discuss planning updates.

2.6 Philadelphia Water Department

PWD is a retail and wholesale water provider serving a population of 1.6 million in Philadelphia. Existing water supply sources include surface water from the Delaware and Schuylkill rivers. Average annual water use is about 235,000 AF.

PWD's Drinking Water Master Plan (WMP) is currently under development, and functions as a roadmap for PWD to provide reliable drinking water and cost-effective operations for the next 25 years from 2020 to 2045. Although the latest update is not yet available to the public, the plan will include a historic and existing conditions survey, drivers, asset evaluation and condition assessment, hydraulic modeling, LOS goal and CIP development, demand projections, and alternatives evaluations. Information presented here about the plan is based on publicly available information included in PWD's WMP executive summary, released in 2019.

2.6.1 Key Drivers

PWD's water system assets are aging and many of these assets have already reached or will soon reach their design life. The draft WMP is focused heavily on asset management, including operations, reliability, and repair/replacement. In the face of large investment requirements to keep the system operational and serving safe, clean water, water rates and affordability are top priorities for elected officials and the community.

In addition to the urgent need for water system investments, the WMP executive summary specifies three major drivers for PWD's water supply planning: addressing changing climate, water quality, and policies/regulations. To address climate drivers, PWD is committed to meeting the City of Philadelphia's Energy Plan of net-zero greenhouse gas emissions by 2050 by mitigating, or lessening, PWD's contribution to

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climate change by reducing energy use and shifting to renewable energy sources. Further, PWD is adopting an official policy requiring the use of PWD's Climate-Resilient Planning & Design Guidance in the planning, design, and construction of all PWD projects.

2.6.2 Planning Approach

PWD followed a comprehensive planning process to develop the final recommendations in the WMP. PWD's planning approach follows the methodical process outlined in Figure 3.

Figure 3. WMP planning approach
(Source: PWD, 2019)

2.6.3 Project Evaluation

Six goals and criteria were established to evaluate each project or program included in the WMP and to identify potential risks:

- Water quality - Achieve present and future regulatory requirements
- Water quantity - Provide long-term water supply to the service area
- Operability - Provide the appropriate system redundancy for a wide range of emergency conditions
- Service pressure - Provide adequate water pressure for system operation

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- Capital availability - Manage financial resources to make necessary investments in the water system while keeping rates affordable
- Public perception - Seek public engagement to meet service goals

The WMP executive summary presents 10 key projects including 3 water treatment plant projects, 3 pumping station projects, and 4 transmission main projects.

2.6.4 Communication and Stakeholder Engagement

PWD's engagement process (both internal and external) centered on reaching agreement on service goals and building trust at all levels, which was critical for getting City Council and public buy-in. A steering committee of staff with hands-on experience operating PWD facilities oversees the plan development. The steering committee established service goals through a series of workshops, and operations staff played a key role in defining these goals. PWD's planning and research department developed the WMP with support from a consultant and an internal review committee of technical experts in source water protection, water treatment, water conveyance, engineering planning, engineering design, construction, and laboratory services. PWD is currently developing an outreach strategy to effectively engage with the public prior to releasing the plan.

2.7 Seattle Public Utilities

Seattle Public Utilities

SPU is a retail and wholesale water provider serving a population of 1.3 million in the Puget Sound region of Washington state. Existing water supply sources include the Cedar River (60 to 70 percent) and the South Fork Tolt River (30 to 40 percent). In addition, SPU operates two small well fields in the City of SeaTac as needed, under a temporary water right permit, for drought response and emergency supply. Average annual water use is about 175,000 AF

SPU is required to prepare a Water System Plan (WSP) to comply with requirements for community water systems in the Washington Administrative Code. Most recently updated in 2019, the WSP is structured around SPU's major business areas of Water Resources, Water Quality and Treatment (including watershed programs to protect drinking water quality), and Water Transmission and Distribution. The WSP outlines future investments needed for these separate business areas in a single, cohesive planning document. The plan focuses on the next 10 years (through 2030) while also discussing longer-term outlooks (2040 and beyond).

2.7.1 Key Drivers

SPU's WSP is developed to plan for long term needs and to meet regulatory requirements. Washington State requires water service providers to submit a WSP every 10 years and provides a checklist of specific information required in each WSP. Aside from the regulatory requirement, other main drivers include long-term supply/system reliability, and water quality.

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2.7.2 Planning Approach

SPU's demand forecast and current firm yield estimate for existing supply show no new sources of supply are needed before 2060 to meet SPU's objectives and service level targets (Table 2). In the absence of need, SPU did not evaluate new water supply projects in the WSP. Implementation or action plans in the Water Resources business area focus on continued conservation, climate change adaptation, and improvements to water supply facilities.

Table 2. SPU's Service Levels for Managing Water Resources

Service Level Objective	Service Level Target
Meet the environmental requirements of our water rights and water supply operations.	Meet instream flow requirements and performance commitments in tribal, regional, state, and federal agreements and permits.
Meet water use efficiency goals to ensure wise use and demonstrate good stewardship of limited resource.	Reduce per capita water use from current levels so that total average annual retail water use of members of the Saving Water Partnership is less than 105 MGD from 2013 through 2018 despite forecasted population.

2.7.3 Project Evaluation

Six goals and criteria were used to evaluate project or program included in the WSP:

- Cost
- Water quality
- Average annual supply
- Long term supply/system reliability
- Environmental requirements
- Equity

2.7.4 Communication and Stakeholder Engagement

Communication and stakeholder engagement for WSP was primarily through Seattle Water Supply Operating Board and the Water System Advisory Committee. The Seattle Water Supply Operating Board is a board of representatives made up of SPU's member agencies, which have some authority over policy and operations. The Water System Advisory Committee is "customer-based" and provided input and feedback on conservation programs.

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Section 3: Key Findings

This section provides a summary of key findings from reviewing of peer agencies' long-range planning documents and interviewing their staff. The summary includes a number of key aspects of seven peer agencies' plans and their planning processes. The comparison of findings across agencies practices, along with Valle Water's, helps illuminate good practices and potential opportunities for Valley Water to improve its long-range planning approach when preparing future WSMP updates.

3.1 Common Planning Steps

While each agency involved in this study uses a somewhat unique water supply planning process, a few key planning steps are common across the agencies as summarized below. Valley Water's WSMP planning process also includes these steps.

- Define goals, guiding principles, drivers and/or risks
- Identify project alternatives and water supply strategies
- Reach consensus on evaluation metrics, prepare evaluation tools, models, and feasibility studies
- Develop portfolios and implementation steps

3.2 Planning Goals and Key Drivers

Due to unique circumstances and characteristics, different agencies have different drivers and planning goals, but all of them approach water resources planning with a common goal of providing water supply reliability over a long-term horizon (Table 3). Every agency has planned for multiple goals.

Table 3. Goals and Drivers of Peer Agencies' Plans

Agency	Goals and Drivers				
	Supply reliability	Diversified portfolio	Regional storage optimization	Flexibility in responding to future uncertainty	Water quality
Valley Water	●	●	●	●	●
SFPUC	●	●	●	●	
MWD	●	●	●	●	
SDCWA	●	●	●	●	
TRWD	●	●	●	●	
Tucson Water	●	●	●	●	●
PWD	●				●
SPU	●				●

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3.3 Planning Horizon and Update Frequency

With the exception of TRWD and Tucson Water, all other agencies use planning horizons of 20 or 25 years, consistent with Valley Water's planning timeframe (Table 4). The frequency of comprehensive updates varies by agency, and the three California agencies issue comprehensive updates every 5 years, a frequency driven by several factors including:

- State requirements for urban water suppliers to prepare an UWMP to assess the reliability of existing supplies to meet anticipated demands over a 20-year planning timeframe
- Data availability
- Uncertainty related to future conditions

Valley Water's cycle for issuing comprehensive updates to the WSMP (i.e., every five years) aligns with the most frequent update frequency among the peer agencies.

In addition to comprehensive plan update, three peer agencies report interim updates for their water supply plans at varying frequencies. Valley Water provides interim update to its board on an annual basis.

Table 4. Planning Horizon and Frequency of Comprehensive Updates

Agency	Planning Horizon (years)	Comprehensive Update Cycle (years)	Interim Update Frequency
Valley Water	**20**	**5**	**Annual**
SFPUC	**20**	**5**	Quarterly
MWD	**25**	**5**	Annual
SDCWA	**20**	**5**	
TRWD	**50**	**10**	
Tucson Water	**50-80**	**20**	Quadrennial (4 year)
PWD	**25**	**10**	
SPU	**20**	**6**	

3.4 Planning Approach

Recognizing inherent uncertainty about future water availability, population and demand trends, and economic conditions, four of the five agencies that have a comprehensive plan employed a scenario planning approach to present alternative views of how the future might unfold, rather than providing one prediction or forecast of the future. The approach involves analyzing several possible future scenarios that bookend the future water supply and demand possibilities, which then provides a basis for adaptive management. With this approach, various scenarios that represent different combinations of future demand and supply conditions were developed and analyzed, providing the basis for evaluating the various projects and programs that should be implemented to realize those futures. As conditions change and new challenges and opportunities arise, decisions can be made according to the future that is considered most likely to occur. Scenario planning provides organizational flexibility by planning for multiple possible futures (scenarios) and promotes informed decision-making. Key to this approach is identifying and assessing risks

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and uncertainties that could have a major impact on the future and hence on the success of any planning effort.

In the case of TRWD, after the scenario evaluation, a detailed decision tree was built for each portfolio/scenario combination to serve as a final adaptive management plan to guide decision making. The decision tree is developed based on major triggers that result in actions on selection and sequencing of strategies. The detailed decision tree not only specifies several possible paths TRWD could take to developing water management strategies, but it also specifies the year by which decisions must be made to change paths should individual strategies become unviable. Using the decision trees will allow TRWD adapt to changing conditions and make investment decisions accordingly.

3.5 Demand Projection

Based on readily available water use data collected for peer agencies, most have reduced water demands over the past 10 to 20 years despite population growth (Table 5). Further, while all the agencies anticipate continued population increases, most project that water use in 20 or more years will be lower compared to demands in 2000 (Figure 4). Demand management through water use efficiency/conservation programs has been key to reduce water demand and an integral strategy to each agency's water supply reliability.

Table 5. Past and Projected Water Demand and Population Trends Among Peer Agencies

Agency	% Change, Historical to Existing			% Change, Existing to Future Projections		
	Years	Water use	Population	Years	Water use	Population
Valley Water	2000-2020	-20%	18%	2020-2045	13%	36%
SFPUC	2000-2020	-23%	15%	2020-2045	21%	34%
MWD	2000-2020	-16%	13%	2020-2045	9%	16%
SDCWA	2000-2020	-33%	14%	2020-2045	36%	16%
TRWD	2000-2020	25%	39%	2020-2060	114%	79%
Tucson Water	2000-2020	-23%	16%	2020-2050	61%	47%
PWD	Data not found					
SPU	2000-2020	-20%	22%	2020-2040	15%	14%

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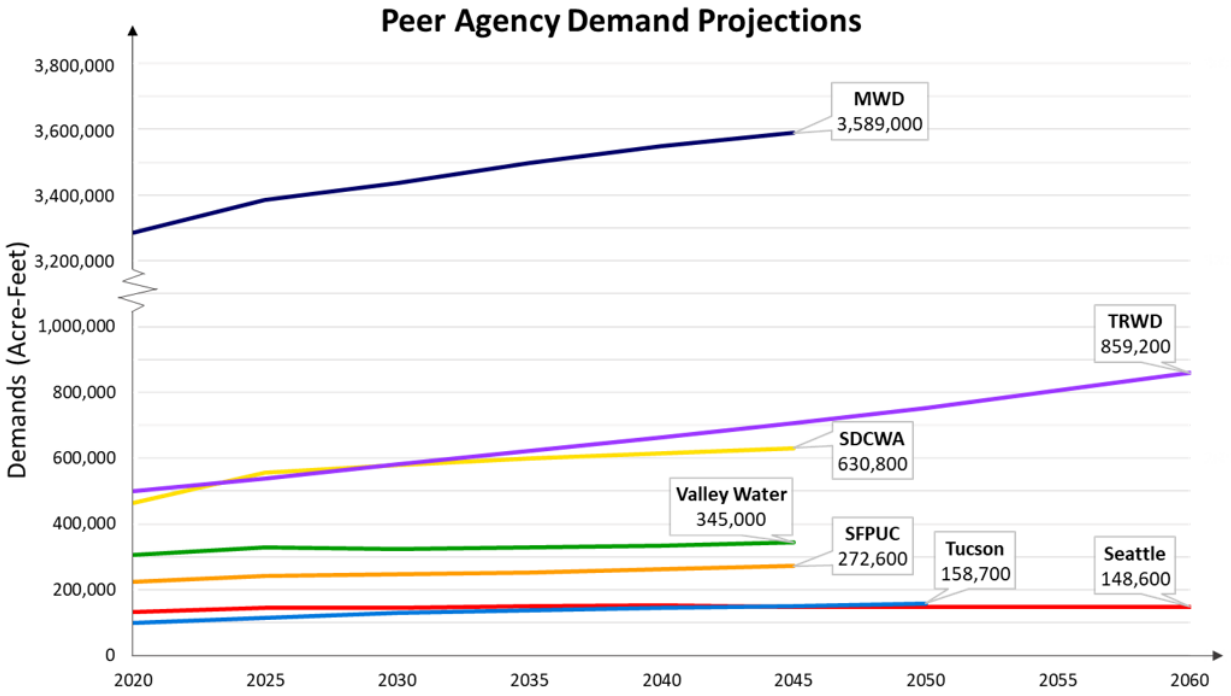

Figure 4. Water use trends and future projections

3.6 Project/Portfolio Evaluation

While each agency interviewed has a unique approach to evaluating water supply projects (or portfolios of projects), most use multiple evaluation criteria and risk-based assessments. Table 6 presents criteria used by each agency to evaluate and ultimately select projects, and some highlights include:

- SDCWA uses measurable performance criteria that are weighted to evaluate/screen and ultimately rank projects.
- SFPUC, MWD, and TRWD apply evaluation criteria to study project feasibility but do not use their planning documents to score, rank, or select projects. Once feasibility is established, TRWD and SFPUC consider unit costs and qualitative project benefits to prioritize projects.
- Tucson Water uses scenario planning to develop future mitigation scenarios for drought or supply shortages at a high level.

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Table 6. Evaluation Criteria Used in Peer Agencies' Water Supply Project Portfolio Evaluations

Agency	Generalized Evaluation Criteria											
	Average Annual Supply	Supply Reliability/ Availability	Diverse Supply Portfolio	Cost	Rate Impacts	Environmental	Water Quality	Equity	Institutional Complexity	Schedule	Utilization [a]	Power Use and Generation
Valley Water	●	●	●	●	●	●	●	●	●	●	●	
SFPUC	●	●	●	●					●	●		
MWD	●	●	●	●	●	●	●	●				
SDCWA	●	●	●	●							●	●
TRWD	●			●		●	●		●	●		●
Tucson Water	●	●	●			●	●	●				
PWD	●	●		●		●	●	●			●	
SPU	●	●		●		●		●				

a. Operational use in terms of available capacity for conveyance, storage, and/or treatment facilities

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3.7 Diverse Water Supply Portfolio

Similar to Valley Water's practices, all agencies developed diverse water supply portfolios to meet their future needs, which typically includes surface water supply, storage, groundwater, recycled water, and water conservation. As imported water has become increasingly uncertain due to environmental regulations and recurring droughts, four agencies that heavily rely on imported water supply (SFPUC, MWD, SDCWA, Tucson) focused their strategies on developing local, drought resilient supplies, along with adding additional storage, to reduce their reliance on imported supply delivery. For instance, SFPUC is currently looking at four storage projects, five recycled water projects, and one desalination project. MWD is currently evaluating a major regional recycling project (Pure Water Southern California) in partnership with the Los Angeles County Sanitary District which would produce up to 150 million gallons of water daily. MWD is also evaluating expansion of water storage, stormwater capture, and seawater desalination. SDCWA added desalinated seawater to its supply portfolio in 2015 as a new, drought-proof supply to reduce the region's dependence on local and imported surface supplies, and as a result, they do not anticipate shortages through 2045. Tucson Water's strategy is to continue groundwater banking, developing recycled water, and reducing per capital water use through water conservation.

In addition, all agencies have conservation as an integral part of their water supply portfolios, with a range of programs in place to permanently reduce water use. Peer agencies' GPCD is shown in Table 7.

Table 7. Peer Agency GPCD

Peer Agency	GPCD	Reference Year
Valley Water	121	2020
MWD	127	2020
SDCWA	134	2021
SFPUC	76	2020
Tucson	119	2020
Tarrant	161	2018
SPU	85	2019
Philadelphia	187.5	2020

3.8 Role in Informing Water Supply Investment Decisions

The role of long-range water resources plans in informing supply system investments was identified for several peer agencies through reviewing their plans and/or conducting staff interviews. SFPUC uses their AWS Plan to define the next investment step for each proposed project and the commission will make a decision on a project-by-project basis. For MWD, the IRP is an umbrella framework that envelopes a range of potential water supply and storage projects that they may implement as needed based on future conditions, and projects consistent with the IRP are more likely to receive support from management and the Board. SDCWA's project decisions (short- and long-term) are considered within the context of their Master Plan, and they use their bi-annual budget process to reassess need and timing of Master Plan projects and help make

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the decision to progress, delay, or defer specific projects. TRWD's IWSP acts as a guidebook and basis of comparison for any new water projects.

Overall, agencies all use their master plans as a roadmap for future investment. Projects identified in the plans are generally prioritized and used as the basis of comparison for any new water projects. Project evaluations take place within the context of the WSMP, and primary factor evaluated for all projects is their ability to meet dry year demands.

3.9 Internal/External Coordination and Collaboration

Like Valley Water, the seven peer agencies engage key internal staff to inform long-range water supply plans, mostly through structured inter-departmental work groups with planning team as lead (Table 8). The work groups meet every two weeks or every month while preparing comprehensive updates. Operations, water quality/treatment, and engineering departments typically participate in these inter-departmental work groups. Some agencies also involve finance, public affairs/communications, environmental, and other departments in plan development. Consistent representation and participation among task force members have made these meetings a uniquely valuable forum for delving into complex issues and gathering insights from managers and subject matter experts.

Table 8. Internal Departments Participating in Water Supply Planning

Agency	Internal Departments (Divisions or Units)								
	Water Resources Planning	Operations	Water Quality/ Treatment	Engineering / Design	Asset Management	Environmental	Finance	Public Affairs/ Outreach	Other
Valley Water	●	●	●	●	●	●	●		
SFPUC	●	●	●			●	●		
MWD [b]	●	●		●					
SDCWA	●	●		●					Real Estate [c]
TRWD [b]	●								
Tucson Water [b]	●	●	●	●			●	●	Conservation
PWD	●		●	●					Lab Services
SPU	●	●		●	●	●	●	●	Admin

a. Including: Water Supply and Conservation Planning, Imported Water, Groundwater Management, and Recycled and Purified Water Units.

b. Complete lists of internal departments involved in supply planning coordination not obtained from these agencies.

c. Real Estate involvement pertains to right-of-way issues.

The peer agencies engage decision-makers (board or city council members) through public meetings that occur at various frequencies and as often as monthly, based on each agency's specific needs and unique governance structure. As well, some agencies convene expert panels composed of external subject matter experts to inform specific technical aspects, which tends to focus on factors that introduce risk and uncertainty in future supply planning, such as demand projections and climate. Several agencies have developed dedicated pages on their websites where long-range supply plans and updates are posted in a centralized repository that is publicly accessible.

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Section 4: Opportunities

The findings from the peer agency plan review and interviews are informative, and they confirm that Valley Water's planning efforts and practices are in line with many good practices adopted by other agencies. From demand projection, project evaluation, water supply portfolio development, to communication and internal/external stakeholder engagement, Valley Water employed the same or similar approaches as most of peer agencies.

While this is the case, insights and lessons learned from this study provide opportunities for Valley Water to consider enhancing its next comprehensive update to the WSMP, in the areas of planning process, planning approach, and stakeholder engagement.

1. **Develop a workplan to guide the comprehensive update.** Prior to the actual plan development, Valley Water could consider developing a workplan to clearly define planning objectives, establish evaluation guidelines (such as approach for project/portfolio selection and boundary conditions), and specify procedures for engaging external stakeholders, communicating updates to the Board, and convening an internal work group.
2. **Continue to convene an inter-departmental work group on WSMP update.** Like Valley Water, the water supply planning team/department at most agencies in this study leads a cross-disciplinary work group to seek input from internal subject matter experts. Several related principles, practices, and lessons gleaned from or inspired by peer agency interviews include:
   - Consistent work group participation—from the WSMP update's project definition phase through its complete development—yields dividends in internal efficiencies, coordinated communications, and aligned understanding.
   - Continued support from executives and upper management, including possibly an executive steering committee, leads to consistent engagement of department/unit managers and/or delegates from Valley Water's relevant business areas.
   - The workplan for the comprehensive update process could serve as a framework for the inter-disciplinary work group, defining its role, responsibility/expectations, and composition.
3. **Enhance Valley Water's planning approach.** Valley Water's current WSMP strategy is developed based on evaluation of various combinations of potential future demands, imported water contract deliveries, and new supply and storage projects. To explicitly account for uncertainty affecting many factors in water supply planning and provide further flexibility in decision-making, Valley Water could enhance its planning approach by developing alternative futures and decision trees and signposts, as was done by several peer agencies (scenario planning). This scenario planning approach provides a basis for adaptive management and may help Valley Water preemptively determine different courses of action and inform decisions regarding water supply investments in response to various potential future circumstances. A key component of this approach is to develop performance indicators (signposts) to gauge what future trajectory will be more likely to occur, and then adjust investment strategy accordingly.
4. **Use a planning horizon of 20-30 years.** Valley Water has been using a planning horizon of 20-25 years for its WSMP, which is consistent with what was used by most peer agencies including all three California agencies. For future WSMP updates, Valley Water could use a planning horizon of up to 30 years, which strikes a good balance between data availability and the uncertainty related to

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future conditions (i.e., forecasted demand and supply, project implementation). A longer planning period would bring more uncertainty into planning processes and outcomes. All three California agencies in this study update their plans every five years, a frequency that is consistent with Valley Water's practice and should be continued.

5. **Develop a framework for project evaluation with additional criteria if feasible.** All agencies use multiple criteria to develop and evaluate new projects, some of them quantifiable, others not. Valley Water similarly uses a list of criteria for project evaluation. Valley Water could consider developing a framework to help better compare projects, with established goals, list of criteria, underlying assumptions, and performance matrix. Where feasible, Valley Water could consider adding some additional criteria that were used by other agencies, such as climate resilience, conveyance utilization, and water treatment plant utilization, to enhance its project evaluation approach and framework.
6. **Continue to evaluate drought resilient local supplies and diversify storage.** Consistent with all peer agencies, Valley Water has also developed a diverse water supply portfolio to meet its existing and future needs. Going forward, Valley Water could continue its current path of evaluating and developing locally controlled, drought resilient supplies to help reduce reliance on surface water supplies, both local and imported, as they are more vulnerable to droughts, natural disasters, and regulatory restrictions. Valley Water could also look to increase or diversify its storage to better capture more water during wet years to be used for dry years and provide flexibility to its operations.
7. **Increase coordination and alignment between WSMP, Capital Improvement Program (CIP), and rate setting process.** As with Valley Water, all peer agencies use their master plans as a guiding document to inform future investment. Peer agencies' CIPs are sometimes driven by factors beyond long-term planning goals; however, project and action evaluation is generally based on consistency with the long-term plan and long-term benefits. To promote increased consistency between CIP, rate setting process, and WSMP, Valley Water could better align those efforts. This could ensure Valley Water's different business areas concertedly move toward the same goals and the projects/programs best meeting Valley Water's short-term and long-term goals are prioritized within the overall context of Valley Water's missions.
8. **Continue to hold Board workshops and continued engagement with committees to communicate water supply project updates and seek input on the comprehensive WSMP update.** Based on interviews with peer agencies, holding workshops with elected boards with a dedicated focus on WSMP topics increases engagement, communication, and understanding during the comprehensive update process. In addition, continued engagement with Valley Water's various committees would support improved alignment among relevant staff and Board committee members assigned to projects/topics that are regularly addressed in those committees.
9. **Communicate updates publicly and post to a designated webpage with regular frequency using a consistent high-level format.** Based on best practices among peer agencies, Valley Water may consider issuing written updates as brief, standalone work products accessible to a broad public audience including decision-makers, ratepayers, and other stakeholders. Updates should be structured consistently and clearly identify changes or updates since the last report-out. Using a standard structure/format and posting updates on a designated webpage may improve stakeholder access to information and engagement in the update process.

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