Final
2013 Regional Water Facilities Optimization and Master Plan Update

MARCH 2014

PREPARED FOR:

San Diego County Water Authority

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PROFESSIONAL CERTIFICATION

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Contents

Tables

Figures

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Chapter 1.0 Introduction

1.1 Overview

For 70 years, the San Diego County Water Authority has met its mission to provide a safe and reliable supply of water to the San Diego region. Working together, the Water Authority and its 24 member agencies have developed and maintained the water systems that support the region's vibrant $191 billion economy and the quality of life of 3.1 million residents.

During the past decade, infrastructure development has largely followed the Water Authority's 2003 Regional Water Facilities Master Plan (2003 Master Plan) (Water Authority, 2002), which charted a course resulting in the implementation of new conveyance, water supply, surface water treatment, and storage facilities that have significantly improved the region's overall water reliability.

The 2003 Master Plan identified a need for additional water treatment for the region; the Twin Oaks Valley Water Treatment Plant was completed in 2008

The *2013 Regional Water Facilities Optimization and Master Plan Update* (2013 Master Plan) is intended to serve as the region's roadmap for new infrastructure development through the Water Authority's 2035 planning horizon. In developing this roadmap, there were important changes to consider from the period when the 2003 Master Plan was prepared that takes into account the evolving focus of the Water Authority from a strong emphasis on new infrastructure development to an organization that operates and maintains a robust water production and delivery system. With a substantial amount of new facilities built over the last two decades, the 2013 Master Plan also takes into account the latest supply and demand projections from the 2010 Urban Water Management Plan (2010 UWMP) (Water Authority, 2011a) and incorporates the "new normal" of reduced water sales volumes and a greater emphasis on local supply development and conservation. Additionally, the 2013 Master Plan evaluates the emergence of new energy management and renewable energy opportunities, and the need to safeguard the regional aqueduct system from potential vulnerabilities and natural hazards.

Optimization of existing facilities, like San Vicente Reservoir and Pump Station, to meet future demands will allow the Water Authority to provide improved reliability without additional capital investments.

To maximize the previous 20-year investment in infrastructure, a primary focus of the 2013 Master Plan is to optimize existing systems while maintaining the flexibility to adjust to a range of future planning outcomes. This planning approach is based on developing scenarios that represent a variety of reasonable future water supply and demand conditions. As the future unfolds, the Water Authority can readily adjust and fine-tune the likely planning scenarios and prioritize project implementation to react to known real-world conditions, such as availability of supply, population growth, conservation ethos, the cost of alternative water supplies, and the achievement of water supply diversification goals.

Based on this planning approach, the strategies adopted by the 2013 Master Plan for evaluating new infrastructure development focused on the following goals:

- Alleviating projected near- and long-term imported water conveyance constraints
- Addressing potential long-term supply shortages
- Assuring timely completion of the Emergency Storage Project (ESP)
- Assuring appropriate implementation of the remaining projects in the current Capital Improvement Program (CIP)

This chapter presents background information on the Water Authority and describes the environment within which the 2013 Master Plan was developed. Topics covered are summarized in Table 1-1 and discussed in more detail in the sections that follow.

TABLE 1-1
Summary of 2013 Master Plan

Analysis Component	Description
Purpose, Need, and Objectives of Master Plan	
Planning Basis	The 2013 Master Plan builds on the Water Authority's 2003 Master Plan, the 2010 UWMP, and other related planning documents.
Environmental Review	A Supplemental Program Environmental Impact Report (SPEIR) (Water Authority, 2013c) has been prepared to address in a comprehensive manner general environmental issues and cumulative impacts related to future facility development and operation.
Water Authority Background	Established in 1944, the Water Authority is the county's regional wholesaler and predominant source of water, supplying up to 95 percent of the region's water supply.
Stakeholder Review	Member agencies participated in the 2013 Master Plan process as it evolved and provided input on options to optimize the region's water system.
Planning Process and Methodologies	
General Approach	Supply and demand data from the 2010 UWMP was refined to capture recent lower demand trends for the region. The data was integrated into a logic-based computer model that analyzed alternative infrastructure solutions for ensuring a safe and reliability water supply into the future.
Approach to Determining Facility Requirements	The Water Authority's existing/baseline aqueduct system was tested against a range of potential future planning conditions. Operational and infrastructure modifications to alleviate supply and demand gaps were identified, and options were formulated and evaluated. An implementation strategy was devised to react to actual system demands that unfold over time.

TABLE 1-1
Summary of 2013 Master Plan

Analysis Component	Description
Sequence of 2013 Master Plan Development	The general sequence for development of the Master Plan included testing the reliability of the current/baseline system; developing options that would close predicted reliability gaps; evaluating options on the basis of cost, reliability, and qualitative criteria; determining timing/phasing of project implementation; and developing strategies for implementation of near- and long-term projects to address system and supply constraints.
Key Planning Issues	Planning issues addressed by the 2013 Master Plan include future uncertainty, facility risk factors, natural hazards, energy management, cost, and stakeholder acceptance.
Successes of 2003 Master Plan	The 2003 Master Plan charted a course that resulted in the implementation of many facilities that are currently in use and have significantly improved the overall water reliability, including the Twin Oaks Valley Water Treatment Plant (WTP), expansion of the San Vicente Reservoir, integration of the Carlsbad Desalination Project into the regional aqueduct system, ongoing high-priority pipeline relining projects, and ongoing system improvements to increase delivery capacity and improve operational efficiency.
Report Organization	
General Organization	The 2013 Master Plan is divided into 12 chapters supported by a series of technical appendices. For the convenience of the reader, each Master Plan chapter begins with an overview, summarizing the chapter's overall content.
Recommendations	Report conclusions and recommendations are summarized in Chapter 11.

1.2 Purpose, Need, and Objectives

The comprehensive analyses performed in the 2013 Master Plan are intended to support decisions on new infrastructure investments through a planning horizon that extends to year 2035. These analyses will allow the Water Authority to accomplish the following:

- Plan facilities to meet regional treated and untreated water demand and supply projections
- Optimize the use of existing regional infrastructure
- Protect the public's health, safety and welfare by maintaining a safe and reliable water supply
- Plan facilities that are cost-effective
- Develop facility plans adaptive to changes in future conditions

1.2.1 Planning Basis

The Water Authority has a long history in the planning and implementation of new infrastructure required to meet the region's need for a safe and reliable water supply. Many of the concepts developed in these prior efforts form the basis for new infrastructure planning in the 2013 Master Plan. In particular, the 2003 Master Plan and the 2010 UWMP have guided recent infrastructure accomplishments as the Water Authority and its member agencies continue to diversify the region's water supplies.

Updating the various planning studies allow the Water Authority to adjust their objectives and planning goals as the water supply and demand portfolios continue to evolve.

1.2.1.1 2003 Master Plan

The Water Authority's initial 2003 Master Plan document has served as the principal guide for new facilities implemented by the Water Authority under its ongoing CIP. Significant achievements from the initial master plan included the following:

- The Twin Oaks Valley WTP, capable of treating 100 million gallons per day (mgd), was completed in 2008.
- Expansion of the San Vicente Reservoir, now in construction and to be completed in early 2014, will provide 100,000 acre-feet of carryover storage. Total Water Authority storage at San Vicente will increase to 152,000 acre-feet.
- The Carlsbad Desalination Project—the largest desalination plant in the nation—is under construction and expected to come on line in 2016, integrating with the regional aqueduct system.
- High-priority pipeline relining projects are ongoing and increasing the reliability of the conveyance systems.
- System improvements to increase delivery capacity, eliminate capacity constraints, and improve operational efficiency are ongoing.

In addition, implementation of facilities related to the Water Authority's ESP, which had begun in 1998, was continued. The ESP is a system of reservoirs, interconnected pipelines, and pumping stations designed to make water available to the San Diego region in the event of an interruption in imported water deliveries. Key ESP facilities are the Olivenhain Reservoir pipeline and pump station; the Lake Hodges pipeline and pump station; and the San Vicente Reservoir dam raise, pipeline, and pump station. Construction of these facilities began in 2000. The timing for implementation of the remaining elements of the ESP was evaluated as part of the 2013 Master Plan.

1.2.1.2 2010 Urban Water Management Plan

The 2010 UWMP quantified the regional mix of existing and projected local and imported supplies necessary to meet future retail demands within the Water Authority's service area, thus providing the foundation for assessing water supply and demand as part of the 2013 Master Plan. A scenario planning approach was applied in the 2010 UWMP to assess the uncertainty of available supplies and project the occurrence and magnitude of supply shortfalls. The assessment of supplies and demands in the 2013 Master Plan, as described in *Chapter 4 – Scenario Planning*, is consistent with the approach used in the 2010 UWMP.

Further refinement of the supply and demand projections was performed to consider recent downward demand trends and the latest population and demographic estimates included in the San Diego Association of Governments Series 13 Regional Growth Forecast (SANDAG, 2013). The 2010 UWMP also included specific documentation regarding development of the Water Authority's supplies. Member agency projections of available supply and Metropolitan Water District of Southern California's Integrated Resources Plan (IRP) Update (MWD, 2010c) and Regional UWMP (MWD, 2010b) were reviewed for assessments of supply availability.

1.2.1.3 Capital Improvement Program

The Water Authority's CIP was initiated in 1989 with Board of Directors (Board) adoption of *The Water Distribution Plan, a Capital Improvement Program through the Year 2010* (Water Authority, 1989). The objectives from the Water Distribution Plan were narrowly focused on increasing the capacity, reliability, and flexibility of the aqueduct system; increasing the yield from existing water treatment plants; and obtaining additional supplies from MWD. Since that time, many new projects have been added to the CIP to address the growing needs of the Water Authority's service area and, more importantly, to assure supply reliability through a more diversified supply mix. Notable additions to the CIP include the ESP, which includes development of new surface water storage and new distribution improvements to address potential supply disruptions and, more recently, the transfer of conserved Colorado River supplies from the Imperial Irrigation District.

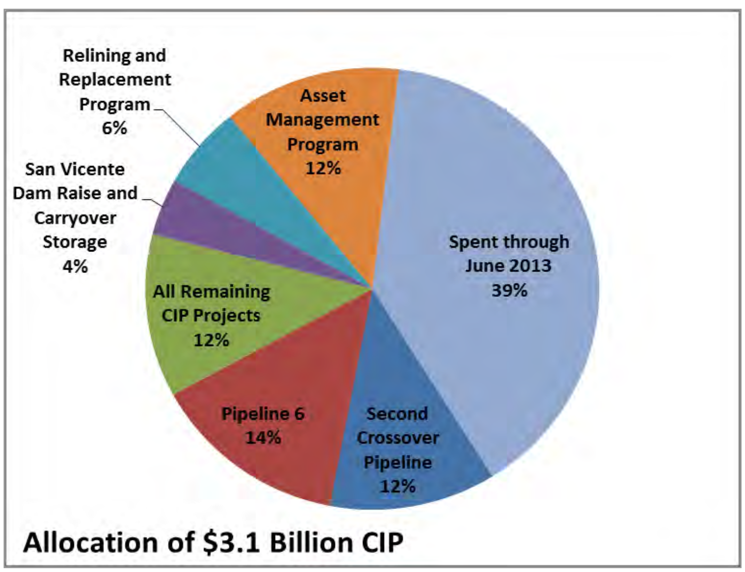


FIGURE 1-1
Water Authority Fiscal Year 2014/2015 CIP Budget Allocation

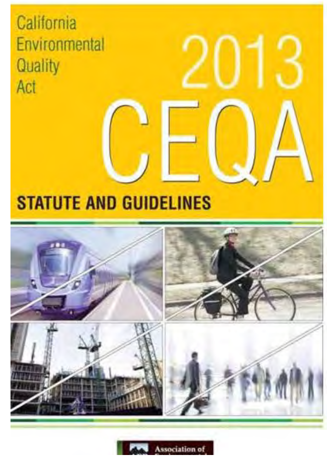
The current CIP, adopted with the fiscal year 2015 budget, includes 46 projects with a total life budget of $3.1 billion. Of this dollar amount, $1.2 billion or 39 percent of the life budget has been spent on active projects through the end of June 2013, leaving a remaining balance of $1.9 billion. The majority of this remaining balance is projected to be spent on five projects that include Pipeline 6, Second Crossover Pipeline, Asset Management Program, Pipeline Relining and Replacement Program, and the San Vicente Dam Raise and Carryover Storage project (Figure 1-1). Outcomes from this 2013 Master Plan will greatly influence the timing of expenditures for the remaining CIP budget.

1.2.1.4 Additional Planning Documents

In addition to the 2003 Master Plan and the 2010 UWMP, extensive reports, correspondence, and data were reviewed as part of the 2013 Master Plan. These documents covered a wide range of topics, including the Water Authority conveyance, storage, and treatment system; regional and local facility planning; water supply development; and both Water Authority and member agency reservoir storage operations. Specific data also was collected for system analysis and system model development for the 2013 Master Plan. Appendix A provides a list of reference documents (reports and correspondence) and a list of data collected and reviewed.

1.2.2 Environmental Review

The Water Authority is the Lead Agency under the California Environmental Quality Act (CEQA) for preparation of a SPEIR. The environmental review also includes preparation of a Climate Action Plan (CAP), which will provide an analysis on Water Authority green-house gas (GHG) emissions and identify program-wide mitigation measures. As a program-level document, the SPEIR will not focus on construction of a single project but, instead, presents reasonable assumptions about the type of activities the Water Authority could undertake to implement the 2013 Master Plan recommendations.



Environmental considerations are critical to the success of the project

1.3 Water Authority Background

1.3.1 History

Prior to 1947, the San Diego region relied on surface reservoirs and groundwater to meet the area's water demand. This system of local supplies provided sufficient water for the county until World War II, when a vastly expanded military presence practically doubled the population in six years. With a strong military presence, federal support from the U.S. Department of the Navy and the U.S. Bureau of Reclamation allowed for construction of the first two pipelines that linked San Diego County to the Colorado River Aqueduct. Water from the river first arrived to the new San Vicente Reservoir in November 1947. After the second pipeline was completed in 1952, the Water Authority constructed three additional pipelines, giving the region five large-diameter pipelines that extend north-south throughout the county. These pipes allow for the importation of supplemental water supplies from the Colorado River and from Northern California, via the State Water Project.

For the past two decades, the Water Authority, in coordination with its 24-member retail water agencies, has developed and executed a long-term plan to enhance the reliability of the region's water supply. That strategy includes diversifying the region's portfolio of water supply sources, making major improvements to the region's water infrastructure, and promoting greater water use efficiency. By 2020, local water supplies, including conservation, are projected to meet 36 percent of the region's water demands.

From its inception, the Water Authority has evolved from a wholesale water supplier and pipeline operator into the region's sophisticated full-service water supply, treatment, and planning organization of today. The Water Authority is now the county's predominant source of water, in some years supplying over 90 percent of the water used by residents and businesses within its service area.

1.3.1.1 Mission

The Water Authority's mission is to provide a safe and reliable supply of water to its member agencies serving the San Diego region. The 2013 Master Plan is consistent with this mission and is one of many initiatives being undertaken by the Water Authority to maintain and enhance the reliability of the region's water supply.

1.3.1.2 Legislative Mandate

The California Legislature, under the County Water Authority Act, Section 45, Chapter 2, has charged the Water Authority with responsibility to "provide each of its member agencies with adequate supplies of water to meet their expanding and increasing needs." Accordingly, the Legislature has authorized the Water Authority to acquire water and water rights within or outside the state; develop, store, and transport that water; reclaim and repurify sewage and wastewater; desalinate seawater; provide and deliver that water to its member agencies; and perform all other actions necessary or convenient to the full exercise of its statutory authorization.

1.3.2 Service Area

The Water Authority's boundaries extend from the border with Mexico in the south, to Orange and Riverside counties in the north, and from the Pacific Ocean to the foothills that terminate the coastal plain in the east. With a total of 951,000 acres (1,486 square miles), the Water Authority's service area encompasses the western one-third of San Diego County. Figure 1-2 shows the Water Authority's service area, its member agencies, and aqueducts (shown as blue lines).

When the Water Authority was established, the population within its service area was estimated at roughly 260,000 people. By 2010, the population had reached 3.1 million, or an approximate 12-fold increase. The city of San Diego represents the largest population of any member agency, with just under 1.4 million people. The Yuima Municipal Water District has the smallest population, at approximately 1,500 people. The average population density in 2010 was 3.0 per acre, with National City having the highest density (12.0 per acre) and Yuima Municipal Water District the lowest (0.1 per acre).

The population of San Diego County is projected to increase by 844,800 people between 2010 and 2035, for a total county population in excess of 4 million. This change represents an average annual increase of about 33,800 people, or roughly 1.1 percent annually. These regional growth projections, presented in the 2010 UWMP, are based on the SANDAG 2050 Regional Growth Forecast (also known as the Series 12: 2050 Growth Forecast) (SANDAG, 2011).

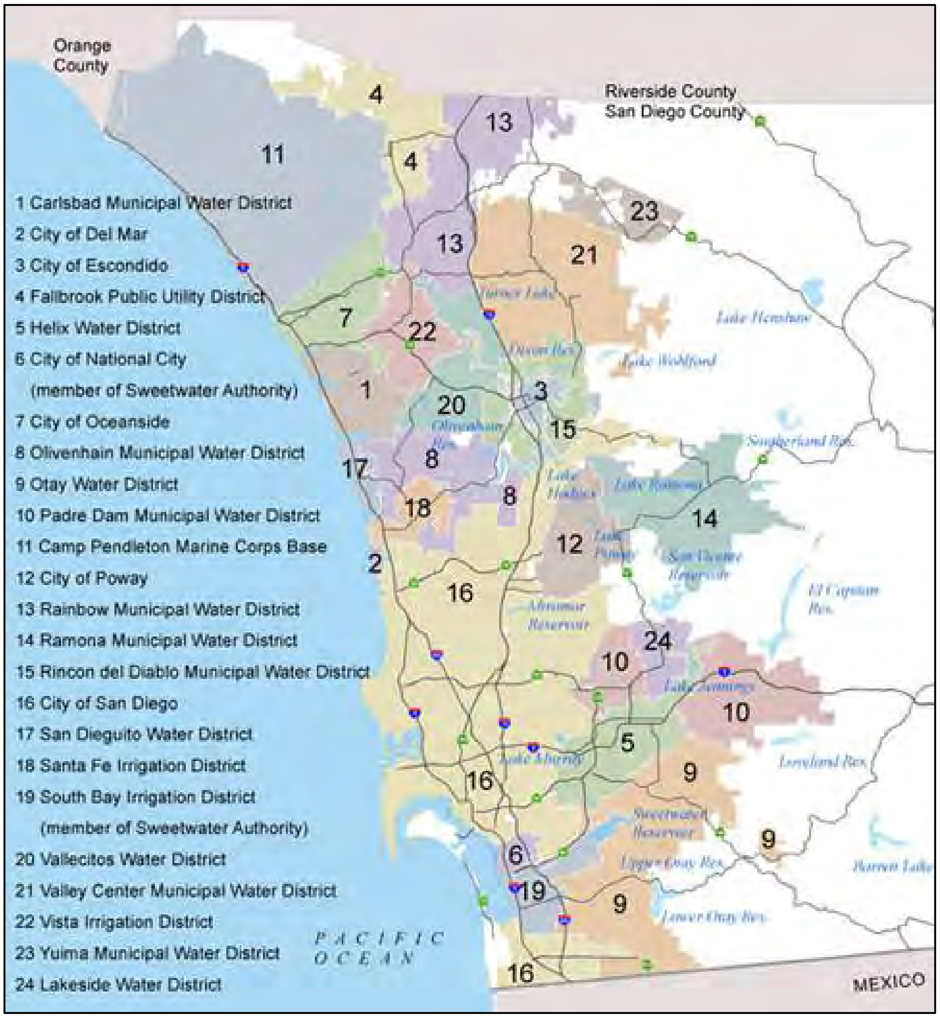


FIGURE 1-2
Water Authority Service Area and Member Agencies

1.3.3 Member Agencies

The Water Authority has 24 member agencies to which it sells water for retail distribution within its service territories. A 36-member Board comprised of member agency representatives governs the Water Authority. The member agencies' six cities, five water districts, eight municipal water districts, three irrigation districts, a public utility district, and a federal military agency have diverse and varying water needs. In terms of land area, the city of San Diego is the largest member agency with 210,726 acres. The smallest is the city of Del Mar, with 1,159 acres. Some member agencies, such as the cities of National City and Del Mar, use water almost entirely for municipal and industrial purposes. Others, including the Valley Center, Rainbow, and Yuima Municipal Water Districts, deliver water that is used mostly for agricultural production. In addition, the Sweetwater Authority, a water agency serving National City, Bonita, and the western and central portions of Chula Vista, is represented by the National City and South Bay Irrigation District on the Water Authority Board.

1.3.4 Water Delivery System

When the Water Authority was established, a primary objective was to provide a supplemental supply of water as the San Diego region's civilian and military population, which had expanded to meet wartime activities. Because of the strong military presence, the federal government arranged for supplemental supplies from the Colorado River in the 1940s. In 1947, water began to flow from the Colorado River via a single pipeline that connected to MWD's Colorado River Aqueduct (CRA), located in Riverside County. Imported water is delivered to the Water Authority by MWD through the CRA and State Water Project, shown in Figure 1-3.

FIGURE 1-3
Imported Water Delivery System

To meet the water demand for a growing population and economy, the Water Authority constructed four additional pipelines between the 1950s and early 1980s that are all connected to MWD's distribution system and deliver water to San Diego County. Over time, the Water Authority has developed an extensive aqueduct system consisting of pipelines, pump stations, storage reservoirs, treatment plants, and hydroelectric facilities. These facilities are described in detail in *Chapter 5 – Baseline System and CIP Projects Considered in the Master Plan.*

1.4 Planning Process and Methodologies

1.4.1 General Approach

The planning process developed for the 2013 Master Plan consists of a systematic and comprehensive approach that starts with a refinement of the 2010 UWMP demand and supply data for use in evaluating the Water Authority's delivery system. The data was integrated into a logic-based computer model that analyzed alternative infrastructure solutions for ensuring a safe and reliable water supply into the future. The 2013 Master Plan also assessed water supply uncertainty and scarcity to evaluate how adaptive water supply mixes identified in the 2010 UWMP would perform within the Water Authority's service area for the 2015 to 2035 planning horizon. The adaptive water supply mixes considered the proposed development of additional local supplies resulting from the city of San Diego's Indirect Potable Reuse/Direct Potable Reuse (IPR/DPR) program and the Otay Water District's Rosarito Seawater Desalination project.

The 2013 Master Plan provides: 1) an assessment of future supply and demand in the Water Authority service area, (2) an evaluation of the reliability of the existing and planned system infrastructure, 3) a facility mix that will optimize existing treated and untreated water conveyance, 4) an evaluation of renewable energy opportunities using available aqueduct pressure and other Water Authority assets, and 5) a plan for facility implementation, with supply and conveyance options in the event that local water supplies are not developed as planned.

Key activities are presented in Figure 1-4.

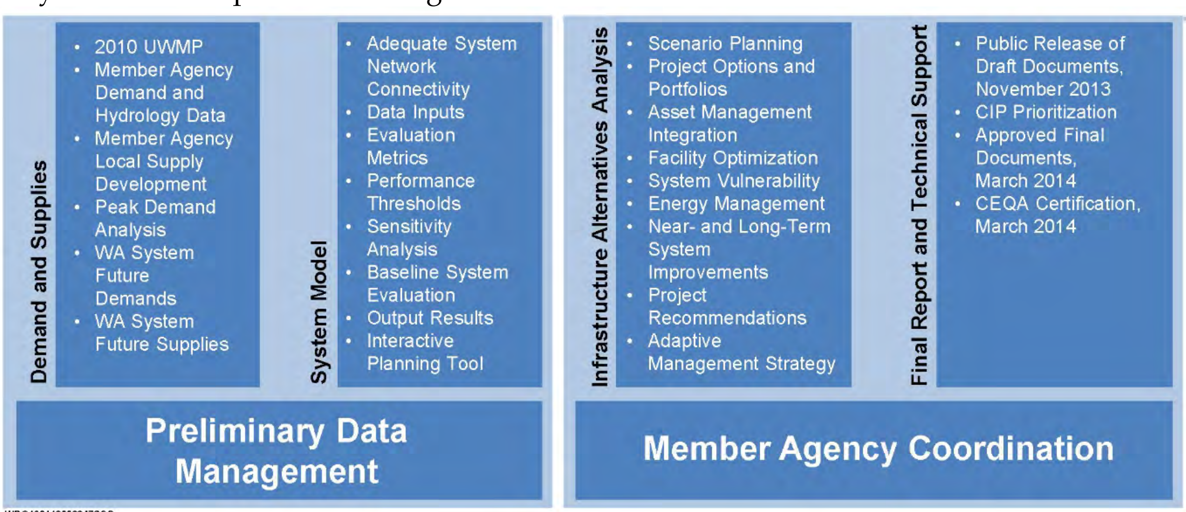


FIGURE 1-4
Overview of Planning Process

1.4.2 Importance of Member Agency Involvement

The Water Authority's aqueduct system serves a single purpose—to deliver water to the member agencies when they need it and where they need it. Because of the nature of the Water Authority's mission, involvement of the member agencies is crucial to the success and effectiveness of facility planning. To assure the needs of the member agencies are met, the 2013 Master Plan was prepared in collaboration with the Water Authority's member agencies. At every step in the development of the Master Plan, input from the member agencies was solicited through numerous presentations and focused workshops. Critical feedback provided a better understanding of member agency concerns and helped shape proposed options to optimize the region's water system. Member agencies also provided input into plans for coordinating regional reservoir operations.

1.4.3 Approach to Determining Facility Requirements

To identify future Water Authority system facility needs, a computer model capable of simulating the operation, use, and interaction of the regional system of aqueducts, treatment facilities, and surface storage reservoirs was used as an analytical tool for the 2013 Master Plan. The model was developed to evaluate both the existing aqueduct system and the several project options identified in this report. The model will also be available for future use by the Water Authority in its continuous planning efforts.

The Water Authority's existing aqueduct system was tested against a range of potential future planning conditions. Deficiencies in the system that resulted in projected reliability gaps occurred under certain supply and demand conditions. Operational or infrastructure modifications to alleviate these gaps were identified, and options that represented the combination of various modifications were formulated and evaluated with respect to various performance parameters. The options and combinations of various modifications were further categorized to meet either near- or long-term system needs, with near-term needs defined as improvements or modifications that may be needed prior to 2025 to address a current or projected conveyance constraint, and long-term needs defined as improvements that may be needed post-2025 to address a projected conveyance constraint or supply shortfall. This analysis process is described in *Chapter 6 – System Reliability Analysis*.

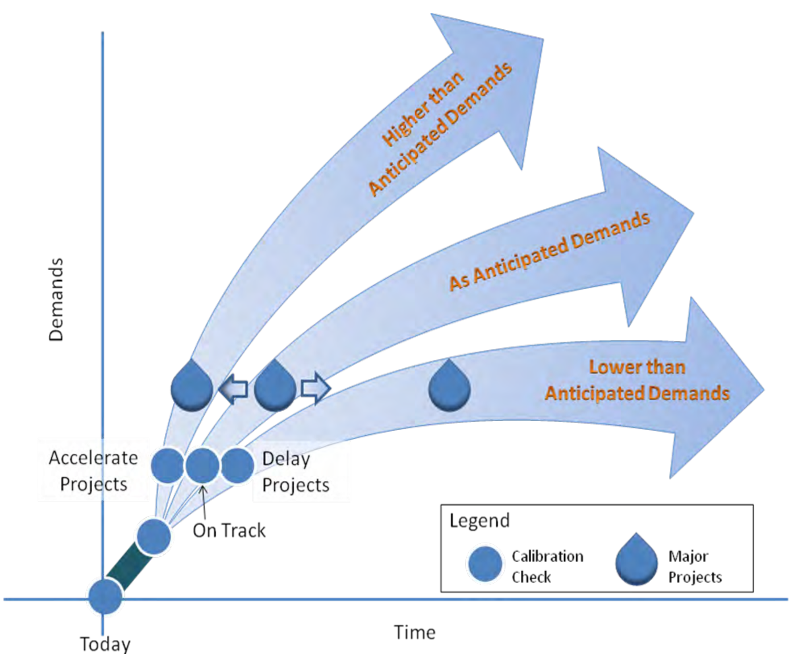


FIGURE 1-5
Project Implementation Strategy

The implementation of such modifications, in particular for the long-term improvements and modifications, will depend upon actual system demands that unfold over time. Modeling of the system response under various conditions allowed for the inclusion of specific system modifications at different points in time, depending upon the system needs driven by the varying planning conditions. As depicted in Figure 1-5, decisions to implement major projects identified in the 2013 Master Plan will need to be made at critical future points in time and will depend upon the actual realizations of the supply and demand conditions to which the Water Authority system must be able to respond.

In addition to system demands, a number of other factors, both internal and external to the Water Authority decision process, will influence the need for new facility improvements. These factors may include decisions on new local supply projects, the extent of reductions in per capita water use, or resolution of statewide resource decisions, such as the Bay Delta Conservation Plan. A prudent strategy of monitoring these key factors will afford Water Authority decision makers multiple opportunities to track, correlate, and adapt infrastructure needs to better match future outcomes.

1.4.4 Sequence of 2013 Master Plan Development

The general sequence of developing and analyzing alternatives for the 2013 Master Plan includes the following:

- Testing the reliability of the current/baseline Water Authority system against four potential planning scenarios representing future external conditions affecting projected demands and supplies and predicted reliability gaps
- Developing facility options that would close the predicted reliability gaps, based upon a source of future delivery of supply
- Evaluating options on the basis of reliability, system utilization, cost, energy use, and qualitative criteria
- Developing an implementation process that varies in response to changes in external conditions

1.5 Key Planning Issues

The evaluations and assessments conducted for the 2013 Master Plan, as well as the recommendations related to the timing and size for new infrastructure, have recognized the evolving nature of the Water Authority from an organization with a strong focus on new infrastructure development to an organization that operates and maintains a robust water production and delivery system. Further consideration has been given to the recent decline in per capita demand attributed to water use restrictions imposed from 2008 to 2011, conservation messaging, the Great Recession[1], and increasing water rates. As shown in the Water Authority's 2013 Annual Water Supply Report (Water Authority, 2013a), demands on the Water Authority system were reduced by 27 percent between 2007 and 2012. Accordingly, the focal points of the 2013 Master Plan have been to reevaluate the purpose, need, and timing of all newly proposed infrastructure, as well as optimizing the Water Authority's recent investments in new conveyance, treatment, and storage facilities. The objective is to identify and prioritize the need for new improvements within the context of a lower, yet dynamic, water demand and supply environment facing the San Diego region. The key planning issues addressed in support of this 2013 Master Plan objective are summarized in Table 1-2.

[1]Reference to the global economic downturn that began as a national recession in 2007.

TABLE 1-2
Summary of Key Planning Issues

Issue/Description	Description
Demand Uncertainty	A technically defensible, physically based, and weather-correlated approach was used to develop demand.
Future Uncertainty	A scenario planning approach was implemented to develop a range of plausible futures to assist in the assessment of future risks and development of mitigation strategies. To enable maximum flexibility, projects were developed to meet both near- and long-term system reliability needs.
Facility Risk Factors	Facility risk factors considered as part of the 2013 Master Plan included imported water reliability, conservation, regulations, water quality, operations, and natural disasters.
Natural Hazards	The *Emergency Storage Project SDCWA Aqueducts Repair Time Estimates Report* (Water Authority, 1993) was reevaluated. This report focused on earthquakes and assessed potential impacts of other natural hazard events such as fires, floods, and major electrical outages.
Energy Management	Energy use and energy generation was assessed at the Water Authority's existing facilities, as well as current renewable energy use and future opportunities. Specific projects were identified for in-conduit hydroelectric and re-powering of existing hydroelectric facilities.
Cost	A costing basis and costing protocols were developed to assist the Water Authority in the timing and prioritization of implementing project options.
Stakeholder Involvement	Board member and member agency participation was extensive throughout the master planning process, contributing to an understanding of the need and timing for new infrastructure and the role of regional storage to address peak demands.

The 2003 Master Plan initiated and implemented many successful projects, including the Twin Oaks Valley WTP, the San Vicente Dam Raise, the Carlsbad Desalination Project, and various relining projects.

1.6 Report Organization

1.6.1 General Organization

Table 1-3 presents the overall organization of the 2013 Master Plan. Supplemental information is provided in a series of technical appendices.

TABLE 1-3
Organization of the 2013 Master Plan

Master Plan Section	Description
Introduction (Chapter 1)	Describes purpose, need, and objectives of the 2013 Master Plan and provides an overall summary of its contents.
Regional Demand Analysis (Chapter 2)	Collects, compiles, and reviews demand data based on the 2010 UWMP and other planning documents; projects daily and peak demands; reviews conservation savings; develops an analysis of the potential impacts of climate change; and develops the refined water demand forecast.
Regional Supply Analysis (Chapter 3)	Assesses local water supplies and imported water supply, determines effect of local supplies on Water Authority demand, and reviews potential of working with member agencies to identify opportunities for long-term storage strategies.
Scenario Planning (Chapter 4)	Describes scenario planning approach and develops planning scenarios.
Baseline System and CIP Projects Considered in the Master Plan (Chapter 5)	Describes the Aqueduct System, identifies existing and Baseline System facilities that will be in place by 2015, and reviews the existing CIP.
Baseline System Reliability (Chapter 6)	Identifies the reliability of the Water Authority's system to meet member agency needs through 2035 and assesses options and strategies to mitigate future risks. Performs Baseline System Reliability analysis.
Facility Options (Chapter 7)	Summarizes the facility options that were considered in the 2013 Master Plan to address potential future needs to improve Water Authority system operations and reliability. Facility options were evaluated from an engineering and system integration perspective, approximate timelines for development of the options were described, and costs were provided.
System Reliability with Facility Options (Chapter 8)	The Baseline System was evaluated with various facility options to address specific supply or conveyance needs as they arose. Describes how the facility options were organized and evaluated for addressing future system needs. Evaluates how the system performance could be improved using the facility options.
Risk Factors and Mitigation (Chapter 9)	Identifies and assesses facility risk factors; reviews natural hazards such as earthquakes, fires, floods, and major electrical outages; assesses additional facilities and vulnerabilities since the 2003 Master Plan (Water Authority, 2002); reviews current vulnerability mitigation measures; and identifies system reliability projects.
Energy Management Analysis (Chapter 10)	Assesses Water Authority energy use and generation, both existing energy portfolio and future projections; discusses renewable energy alternatives including wind, solar, and hydroelectric; estimates energy costs and reviews funding options; identifies strategies for future energy management including the need for future studies; and summarizes future potential energy projections.
Summary, Conclusions and Recommendations (Chapter 11)	Summarizes the planning approach and conclusions drawn from the analyses and evaluations. Identifies recommendations to address near- and long-term infrastructure requirements. Presents preliminary schedules for project implementation.
Stakeholder Participation (Chapter 12)	Describes current and future stakeholder participation activities.

The relationships between the 2013 Master Plan chapters as they reflect the planning process are depicted in Figure 1-6. Highlighted in this figure are the elements described in *Chapter 1 - Introduction*.

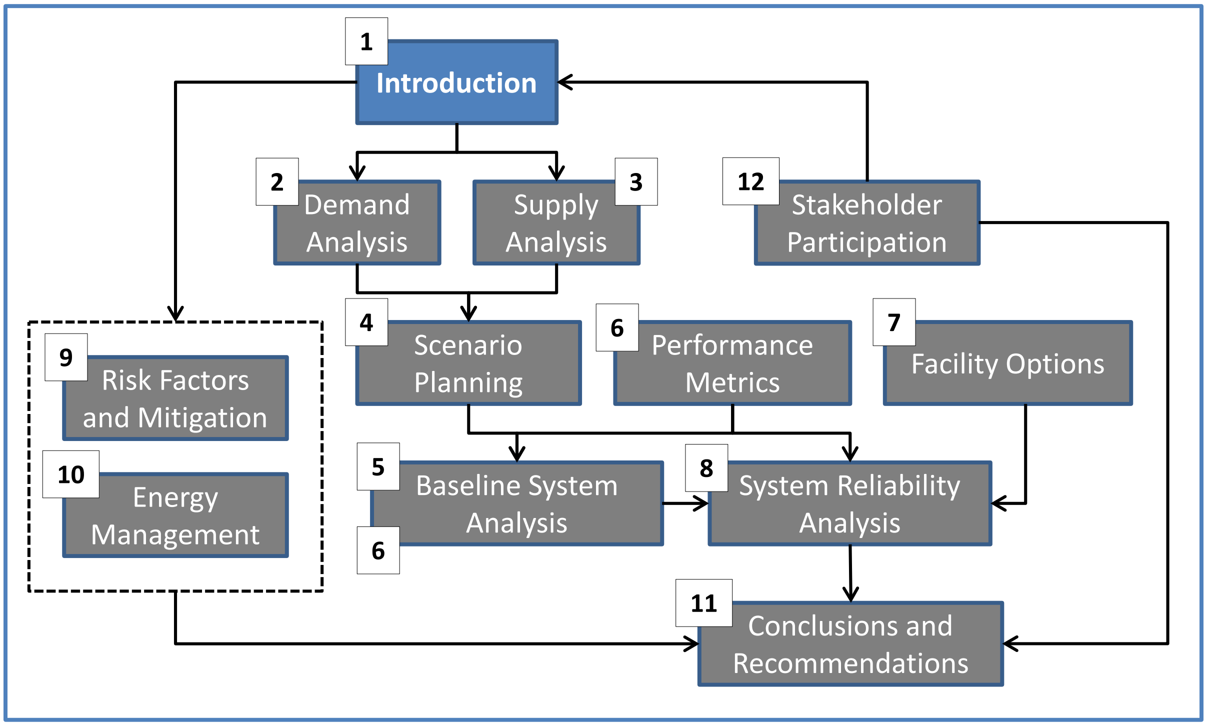


FIGURE 1-6
Relationships Between 2013 Master Plan Chapters and Planning Process

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Chapter 2.0 Regional Demand Analysis

2.1 Overview

The analysis of regional water demands conducted in the 2013 Master Plan is based on projections of both normal and dry-year annual demands from the 2010 UWMP. These demand projections have been significantly influenced by two key factors. First, results from the County Water Authority-Municipal and Industrial Needs (CWA-MAIN) forecasting model have incorporated recent economic and demographic conditions that will slow the pace of increasing water use as the region's population increases. Second, passage of California State water conservation legislation mandates a 20 percent reduction in per capita water use by 2020. These factors, combined with the water use restrictions imposed between 2008 and 2011, have essentially reset regional demand from the record high water sales achieved in 2007 (see Figure 2-1). As economic conditions improve, the Water Authority is experiencing a small rebound in water deliveries from the 2011 low sales year, with projections for future deliveries closely pegged to the recent lows.

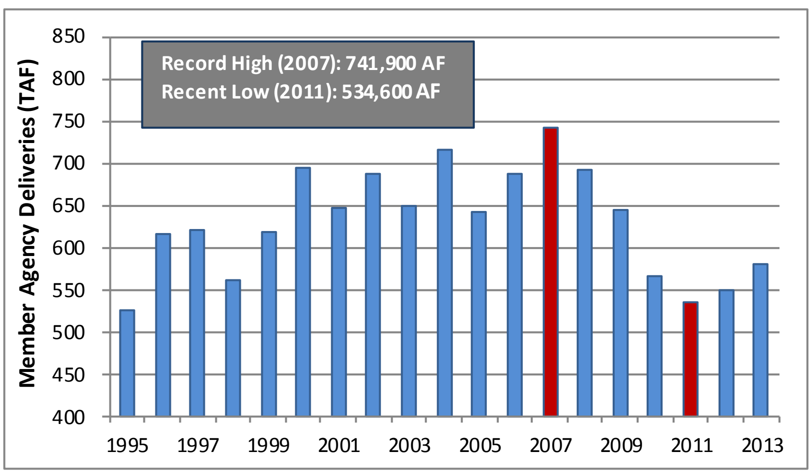


FIGURE 2-1
Historical Member Agency Deliveries, 1995 through 2013

To appropriately assess the impact of both normal and dry-year demands on the size and timing of new infrastructure needs, the annual demands from the 2010 UWMP are converted to reflect peak flow delivery regimes on the aqueduct system. The regional demand analysis for the 2013 Master Plan also attempts to simulate weather-related influences by correlating daily demands with historical climatic conditions. The flow regimes are further clarified to match member agency demands for treated and untreated water service. The demand analysis process is summarized in Table 2-1 and described in more detail in the sections that follow. A full description of how daily demands are determined is provided in *Appendix D – Development of Daily Demand Shapes*.

TABLE 2-1
Description of Regional Demand Analysis Process

Analysis Component	Description
Data Assessment	The primary sources of demand data were the 2010 UWMP and various sets of historical metered daily water delivery records. These data sources are listed in Appendix A.
Weather-Related Influences on Annual Water Demands	
Demand Variations	Gross demands were projected under normal year, single dry-year, and multiple dry-year conditions. Demands used in the 2013 Master Plan analyses were based on historical sequences of weather conditions.
Climate Change Impact on Demands	More than 100 climate projections were used to assess the range of warming and change in precipitation over each of the member agencies' services areas.
Demand Basis for 2013 Master Plan	
Demand Definition	The demand that must be met by the Water Authority is defined as the total water use by each member agency less the amount of member agency-produced local supplies, such as groundwater, recycled water, or surface water.
Demand Allocation to Member Agencies	The distribution of projected demand by member agencies was correlated with historical metered use records. Demand sensitivity to updated population and demographic forecasts was analyzed.
Daily Distribution of Demands	Daily demand was developed using historical records and technically defensible methods.

Figure 2-2 shows the overall Master Plan process and the associated chapters. Highlighted in this figure are the elements described in *Chapter 2 – Regional Demand Analysis*.

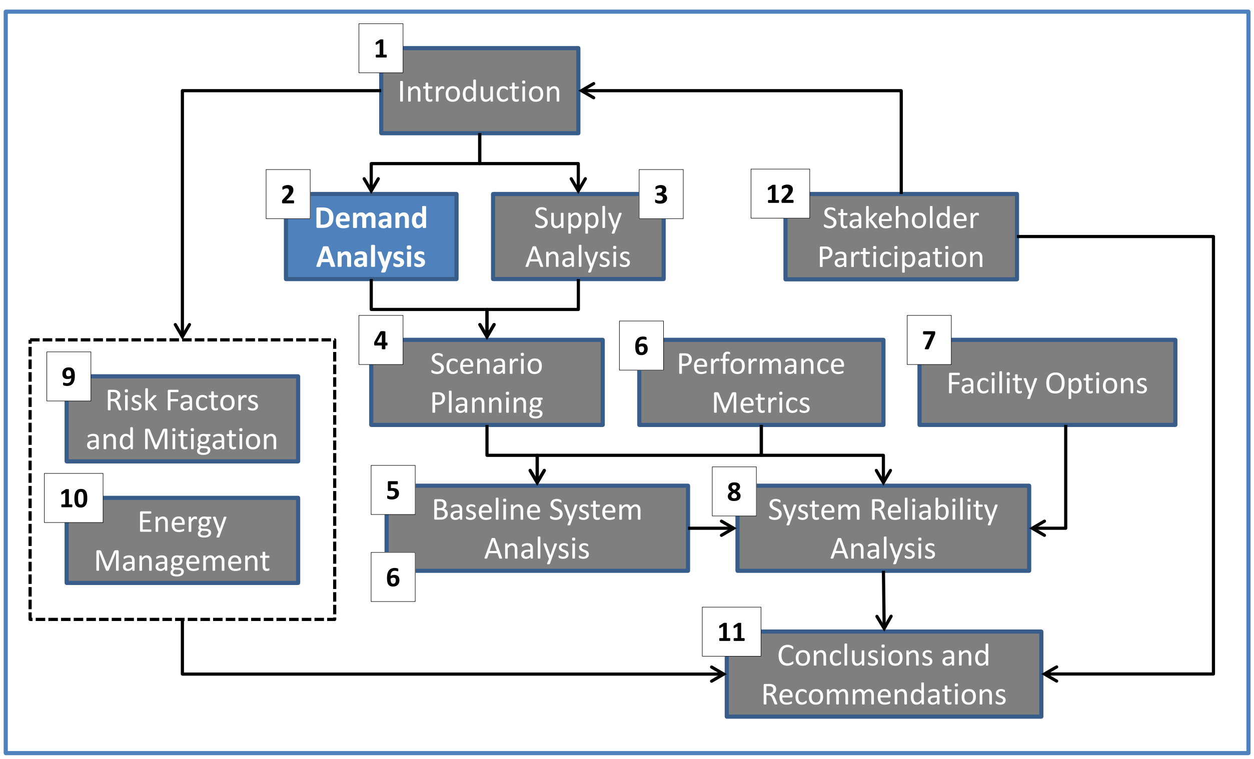


FIGURE 2-2
Relationships between 2013 Master Plan Chapters and Planning Process

2.2 Data Assessment

The primary sources of data regarding demands were: 1) the 2010 UWMP and 2) various sets of historical metered Water Authority daily water use records. These data sources are listed fully in *Appendix A –References*, and relevant excerpts from the 2010 UWMP are included as *Appendix C – Selected 2010 UWMP Tables*.

2.3 Weather-Related Influences on Annual Water Demands

2.3.1 Demand Variations

The demands on the Water Authority aqueduct system vary considerably based on the weather of a particular month, season, or year. As expected, the warmer and drier the year, the larger the demand for water becomes. To reflect the variability and influence of weather on annual demands, the 2010 UWMP describes projected demands for single and multiple dry-year conditions, in addition to the normal year conditions. The gross demand projections (without conservation) for normal year, single dry-year, and multiple dry-year conditions from the 2010 UWMP are shown in Figure 2-3. As shown in the figure, gross demands are projected to vary by almost 100 thousand acre-feet (TAF) in any given year depending on the local weather conditions.

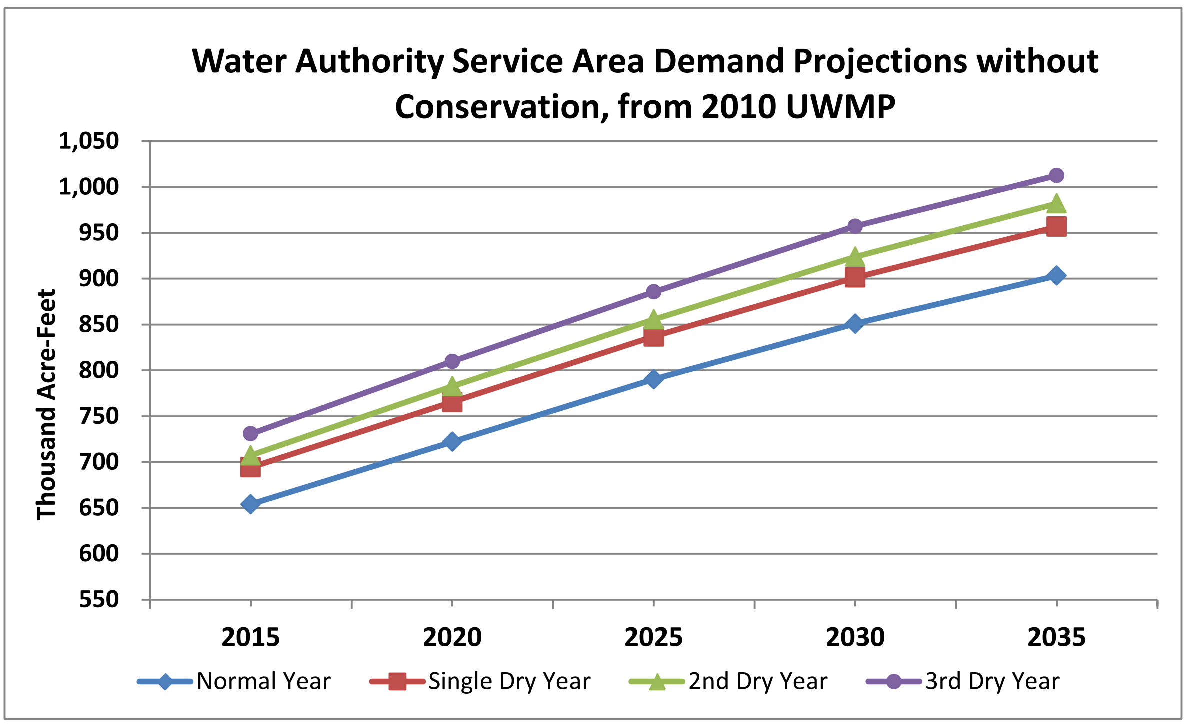


FIGURE 2-3
2013 Master Plan Projected Gross Demands under Normal Year, Single Dry-Year, and Multiple Dry-Year Conditions

When future demands .were simulated with realistic annual sequences of weather conditions, the appropriate demands were selected based on the corresponding year type (normal year, single dry-, second dry-, and third dry-year). Figure 2-4 demonstrates an example of this process using a hypothetical sequence (based on 1988–2008 weather sequence) of normal year, single dry-, and multiple dry-year demands. Demands used in the 2013 Master Plan analyses were based on historical sequences of weather conditions. This shows that the variability of actual weather patterns results in fluctuations of demand patterns that can vary significantly from the linear demand projections of the 2010 UWMP.

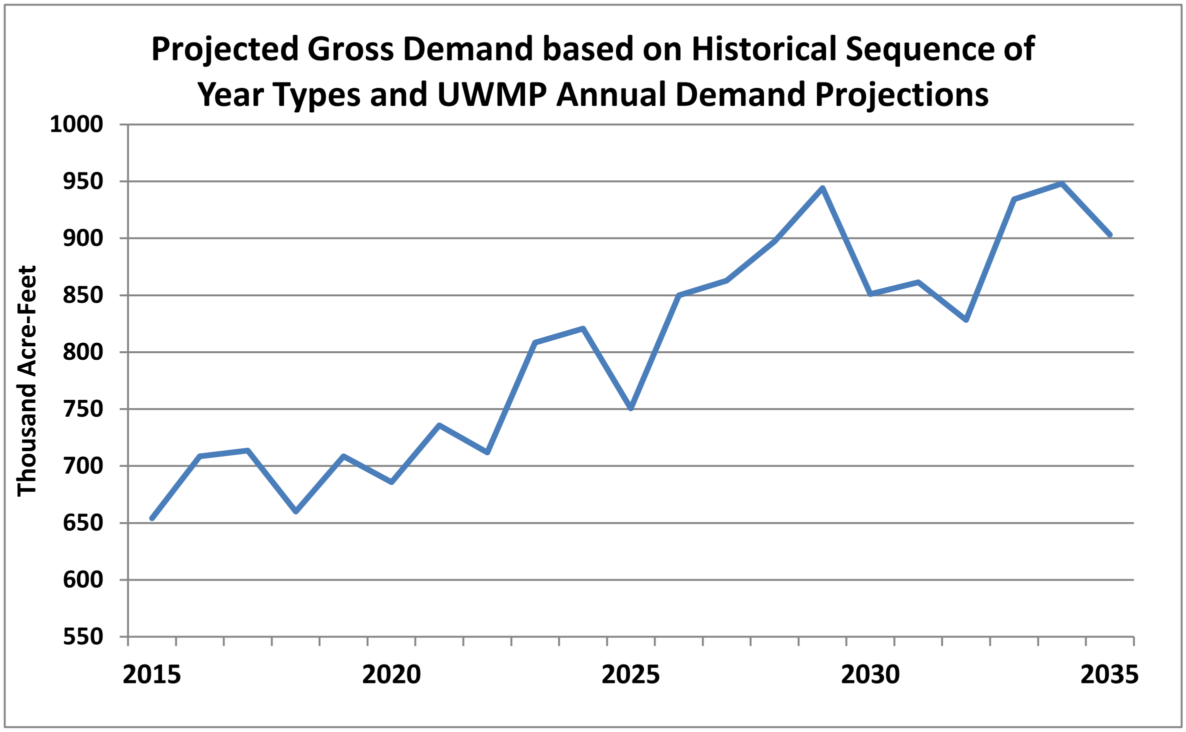


FIGURE 2-4
Hypothetical Sequence of Future Annual Demands based on Year Types and 2010 UWMP Demand Scenarios
Source: 2010 UWMP

2.3.2 Climate Change Impact on Demands

The 2010 UWMP discusses climate change and its potential impacts on supply and demand. The main conclusions were that: 1) climate change impacts are not likely to be significant during the current 25-year planning period (2010–2035), and 2) the primary effects of climate change will be experienced as shortages of imported water supply sources and not as significant increases in water demands. Climate impacts on Colorado River Basin water supply and demand were also projected in the *United States Bureau of Reclamation's Colorado River Basin Supply and Demand Study* (Reclamation, 2012). The potential impacts of imported water shortages are accounted for by the various scenarios that consider MWD imported supply reliability challenges in multiple dry years. The effects of changes in monthly and peak demands were not addressed in the 2010 UWMP.

Potential changes in demand due to climate change or other factors were addressed within the scenarios considered in the alternatives analysis for this 2013 Master Plan. More than 100 climate projections were utilized in this study to assess the range of warming and changes in precipitation over each of the member agencies' service areas. Changes in potential evapotranspiration associated with warming were then computed to estimate the change in outdoor demand under different future climates.

The annual average temperature is projected to increase by about 1°C (degree Celsius) by the end of 2035 in comparison to the simulated historical average over 1971 through 2000. By 2035, the ensemble climate model projections suggest more than 0.7°C warming in all months, with larger warming projections in summer and fall. The future projections of climate were then coupled with the Variable Infiltration Capacity (VIC) hydrologic model to estimate changes in potential evapotranspiration (PET). PET represents the primary physical process influencing outdoor demand. Projections suggest increases in agency annual demand of 0.7 to 2.7 percent over the study period 2011–2035 with respect to historical period 1971–2000. In general, larger increases in demand are projected for the member agencies that are located inland (2.2 percent) and smaller changes in coastal regions (1.4 percent). A strong seasonal pattern of demand change was also observed in the simulated results. Significant increases in demand associated with climate change are projected in spring (March through June), with smaller increases in summer and early fall. Decreases in demand are projected for late fall and winter. Projected changes in May demand range from approximately 4 percent to approximately 9 percent depending on the localized climate conditions of the member agencies (largely coastal vs. inland). Under some of the demand scenarios in the 2013 Master Plan, an increase in projected annual demands of 2 percent and seasonal shifts of up to 10 percent were included to reflect the potential effects of a changing climate.

The detailed climate analysis is presented in *Appendix E – Analysis of Potential Future Climate Effects on Water Authority Demands* and serves as the basis for characterizing future demand scenarios under climate change in the 2013 Master Plan.

2.4 Demand Basis for 2013 Master Plan

This section defines demand as used in the 2013 Master Plan, presents Water Authority service area demands in five-year increments, briefly discusses assignment of demand to member agencies, describes how demands were incorporated within the system model developed for the 2013 Master Plan, and discusses the daily distribution of demands.

2.4.1 Demand and Role of Groundwater, Recycled Water, and Conservation

An initial step in facility planning is to determine the amount of water the system will need to deliver to its customers. The 2010 UWMP provides the annual demand forecasts for each of its member agencies in five-year increments for 2015 through 2035. The 2010 UWMP presents the annual demand projections for each member agency as both the gross, or unmodified, demand and a water sales forecast (which is the demand on the Water Authority system) for each agency. A detailed discussion of the methods used to develop demand projections can be found in the 2010 UWMP.

The 2010 UWMP total demand projection for each member agency is a gross demand in that it represents member agency demand before considering the projected levels of conservation by the member agencies. Thus, the total amount of water actually used by the member agencies is the gross demand less conservation.

The amount of an individual agencies' total water use that must be met by the Water Authority system also depends on the extent to which each agency develops its local supplies such as groundwater, recycled water, and surface water. In this 2013 Master Plan, this net demand to be supplied by Water Authority facilities is referred to as the Net Demand on Water Authority Facilities (NeDWAF). Determining the net demand on the Water Authority is a key step in modeling how the Water Authority will meet those demands with available regional supplies as discussed in *Chapter 3 – Regional Supply Analysis*.

The estimates of groundwater and recycled water available to each member agency are also included in the 2010 UWMP. Figure 2-5 shows how the various demand and supply components relate to each other and to the demand used in the system model for the 2013 Master Plan analysis.

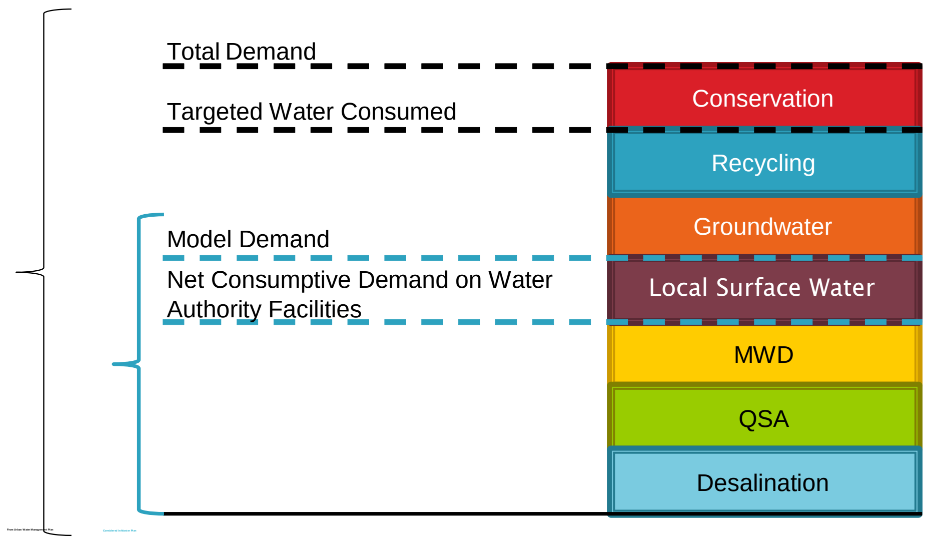


FIGURE 2-5
Relationship between 2013 Master Plan and 2010 UWMP Demands
Source: 2010 UWMP

Daily demands were then developed by applying a range of daily historical demand patterns (derived from 1996 through 2010 metered daily deliveries) to the projected annual demands. Figure 2-6 provides an example of the distribution of average annual demand for each member agency.

Once the daily demand patterns were established for each member agency, the daily demands were adjusted for daily production values for each member agency's local supplies. The result of this calculation is the net daily demand on the Water Authority, which will vary based on annual gross demand and the daily variability of local supplies.

The sum of all individual member agency NeDWAF demands equals the total Water Authority service area demand. Supplies available to the Water Authority to meet NeDWAF include water imported from the north (both Quantification Settlement Agreement [QSA] and MWD, as discussed in *Chapter 3 – Regional Supply Analysis*), water provided from carryover storage, and seawater desalination supplies. If the Water Authority is unable to meet the NeDWAF with these sources, regional shortage conditions could result.

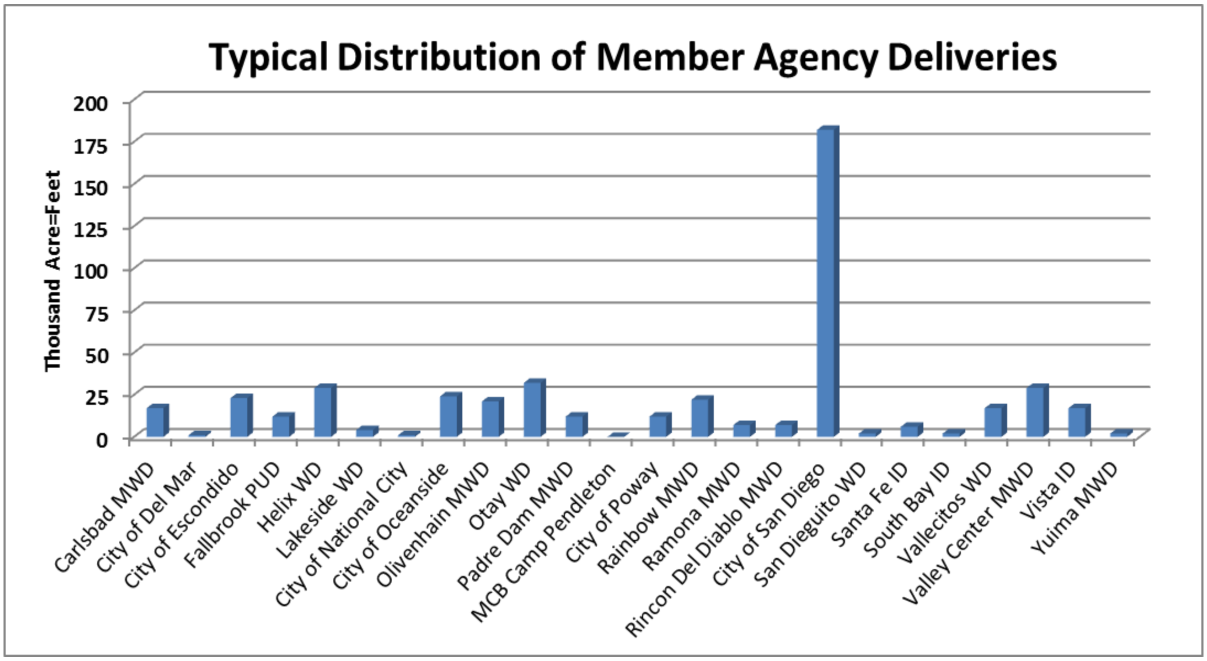


FIGURE 2-6
Member Agency Average Annual Demand

2.4.2 Water Authority Total Service Area Demand in Five-Year Increments

Table 2-2 shows the 2010 UWMP gross demands, along with the planned demand reductions due to conservation, recycled water, groundwater and surface supply, and the resulting normal year NeDWAF in five-year increments. *Appendix C – Selected 2010 UWMP Tables* provides selected demand information from the 2010 UWMP that was used in this 2013 Master Plan. Table 2-2 presents "normal year" demand and, thus, does not reflect the annual variability in demand that is associated with weather patterns, urban and agricultural water use characteristics, and water operational differences (such as refilling reservoirs). As reference, the highest historical annual Water Authority delivery was 666 TAF in 2007, and the most recent annual deliveries have been 417 TAF and 440 TAF in 2011 and 2012, respectively (Annual Report [Water Authority; 2007, 2011 b, and 2012]). Water Authority deliveries for 2013 are 482 TAF, showing further recovery from recent drought-related restrictions. For the 2013 Master Plan, the normal year annual demands were linearly interpolated between each of the five-year increments.

TABLE 2-2
Net Demand on Water Authority (in AF)

	Normal Year 2015	Normal Year 2020	Normal Year 2025	Normal Year 2030	Normal Year 2035
Total regional demand	**654,000**	**722,000**	**790,000**	**851,000**	**903,000**
Less "additional" conservation	6,700	47,000	72,200	97,300	117,500
Total demand less conservation	**647,300**	**675,000**	**717,500**	**753,700**	**785,500**
Less local supplies*	108,900	118,200	122,100	124,200	125,700
Net demand on Water Authority	**538,400**	**556,800**	**595,700**	**629,500**	**659,800**

*Local supplies are comprised of recycled water, groundwater, and surface water. The breakdown of these components is provided in *Chapter 3 – Regional Supply Analysis*.

2.4.3 Treated versus Untreated Demand Distribution

The Water Authority has satisfied the NeDWAF with a combination of treated and untreated water deliveries from MWD. The aqueduct system has developed over the years to meet the historic ratio in treated versus untreated demands. In years past, treated water deliveries were generally close to 60 percent of total deliveries. In the 2003 Master Plan, many of the adopted improvements to the aqueduct system were to address the need to reorient deliveries to predominantly untreated water. This shift in treated versus untreated deliveries was the result of the implementation of a regional strategy to emphasize surface water treatment within the county through the expansion of existing and construction of new treatment plants. This recent change is illustrated in Figure 2-7, where historical 2005 deliveries of treated water are on par with the untreated deliveries, while the UWMP projections for 2015 through 2035 reflect the recent drop in proportion to nearly one-fourth of the untreated deliveries. As a result, the region's treated water infrastructure is well prepared to meet future treated water demands, while the untreated water delivery system will be significantly more stressed during the Master Plan planning horizon.

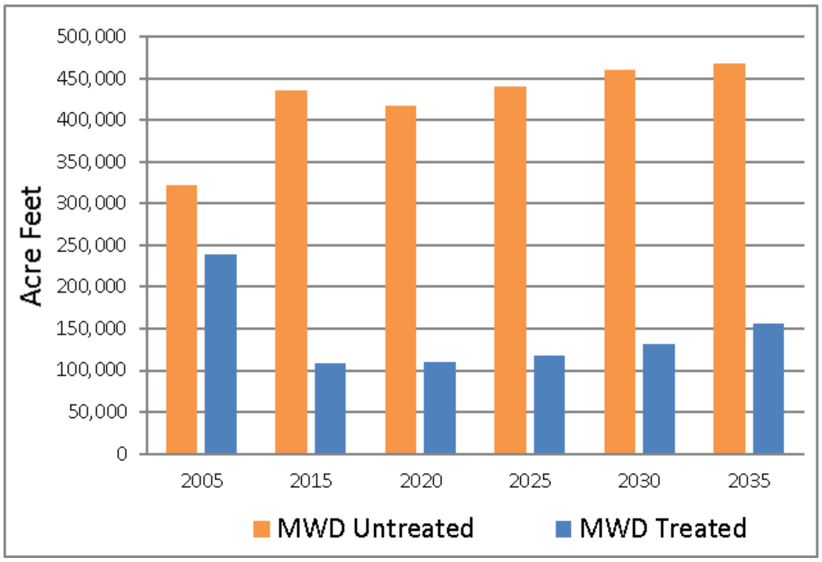


FIGURE 2-7
Historical and Projected MWD Untreated and Treated Water Deliveries

2.4.4 Allocation of Demand to Member Agencies

For normal year projections, the 2010 UWMP provides estimates of NeDWAF for each member agency (see Appendix C). As verification of this allocation, the proposed UWMP distribution of demands (percent of total) was checked against the historical actual metered use records. The 2010 UWMP projections were found to be consistent with historical trends.

2.4.5 Daily Distribution of Demands

For the 2013 Master Plan, an analysis of how these demands would be distributed on a daily basis was developed for use in evaluating the reliability of the Water Authority distribution system. Daily demand estimates were prepared for each member agency based on a review of historical daily variability in water deliveries. Normalized patterns of daily-to-annual demand were developed for five annual hydroclimatic conditions, and annual demand projections were then multiplied by a daily factor to reflect plausible future variability in daily demands.

The full details of how the daily demand patterns were established are presented in *Appendix D – Development of Daily Demand Shapes*. Briefly, the process for developing future daily demands was to multiply the member agency projected annual demand by a factor reflecting the historical variability in daily deliveries. Based on recorded historical daily deliveries, a year-long sequence of daily multiplier factors was determined for each year for the 1996–2010 period so that numerous sequences were obtained for each member agency. A weather-correlated method based on potential evapotranspiration was used to fill in any missing daily data so that complete sequences of member agency demands, and daily factors, could be generated. Each such annual sequence was then correlated with the historical weather for the year. Normalized daily patterns were prepared for five annual hydroclimatic conditions, represented as wet, above normal, below normal, dry, and critical year types. When applied to the future demand projections, the daily demand for any given year is selected based on the year type of the hydroclimate reference year used in the simulation to ensure correlation with local conditions.

These patterns of daily demand multipliers were developed and calibrated separately for each member agency demand node in the model. An example of the daily demand patterns for one Water Authority member agency is shown in Figure 2-8. The figure depicts the strong summer demand peaks and the considerable variability that occurs in the spring and fall due to specific weather conditions. The process, however, represents a technically defensible, physically based, and weather-correlated approach to developing daily demands.

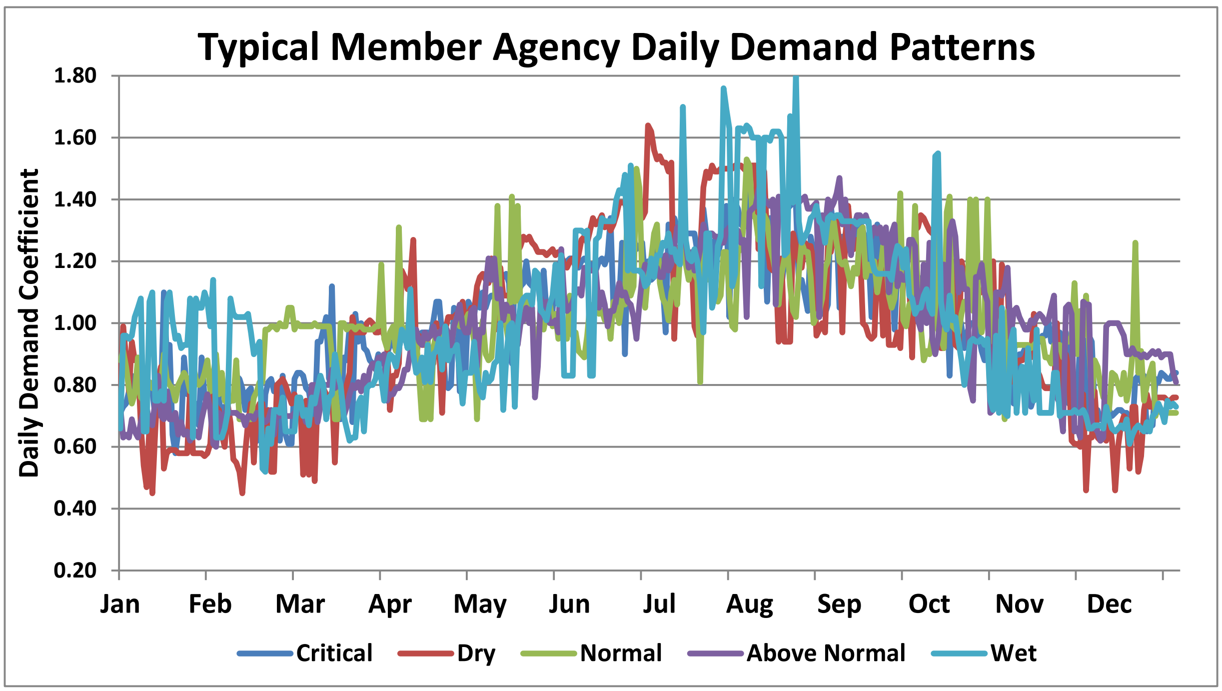


FIGURE 2-8
Example Daily Demand Patterns for a Member Agency Demand Point

2.5 Summary of Development of 2013 Master Plan Demands

In summary, the demands considered in the 2013 Master Plan are aligned with those assumptions included in the 2010 UWMP. However, the 2013 Master Plan must consider the effect of annual and daily variability on the Water Authority's infrastructure and the effect on the operations and delivery capability of the Water Authority system. In addition, the 2013 Master Plan considered the effects of climate change on annual and seasonal demands, which are factored into future demand scenarios. The 2013 Master Plan demand development process can be summarized by the following steps as described previously:

- Normal, dry, and multiple dry-year annual demands were consistent with those in the 2010 UWMP for each member agency.
- Annual and daily variability were evaluated based on historical delivery information and assigned to five different year-type categories reflecting San Diego region weather variability.
- Annual and daily variability were applied to the projected annual demands based on the simulated historical sequence.
- Under scenarios considering climate change, demands were adjusted for both annual and seasonal increases associated with projected changes due to future warming.

The demand methods described in this chapter form the basis for developing the scenarios described in *Chapter 4 – Scenario Planning*. The 2013 Master Plan has utilized a scenario planning approach toward considering future supply and demand conditions. The scenario planning approach is used to recognize that predicting future demand is not truly possible, but rather that a plausible range should be considered.

Chapter 3.0 Regional Supply Analysis

3.1 Overview

A cornerstone of the Water Authority's long-term strategy to ensure supply reliability is to diversify the region's water supply portfolio. Each component of the region's water supply—both imported and local supply—are described in this chapter. Also included in this chapter is the analysis of regional supplies, which captures projections of normal and dry-year annual supply from the 2010 UWMP and the variations in surface water runoff based on historical hydrology records. The supply analysis process is summarized in Table 3-1 and described in more detail in the sections that follow.

TABLE 3-1
Description of Regional Supply Analysis Process

Analysis Component	Description
Water Supply Sources	
Water Authority Supplies	Water Authority supplies considered in this analysis include conserved water made available through the Imperial Irrigation District (IID) transfer agreement and All-American Canal (AAC) and Coachella Canal (CC) lining projects, the Carlsbad Seawater Desalination Project, in-region storage, and out-of-region groundwater storage banking.
MWD Supplies	MWD water supplies considered in this analysis included imported water from the Colorado River and the State Water Project (SWP), and water made available from MWD Storage Programs.
Member Agency Supplies	Supplies from member agencies considered in this analysis include local surface water yield, groundwater development, water recycling both for non-potable or indirect potable purposes, and seawater desalination (consistent with the 2010 UWMP).
Water Conservation	Conservation savings are consistent with 2010 UWMP projections.
Regional Reservoir Coordination	This analysis considers coordination of existing local storage to address off-peak demand periods.
Local Supply Influences on Water Authority Demand	A scenario planning approach was applied to consider differing levels of conservation and local supply development and to investigate their effect on Water Authority delivery reliability.

Figure 3-1 shows the overall Master Plan process and the associated chapters. Highlighted in this figure are the elements described in this *Chapter 3 - Regional Supply Analysis*.

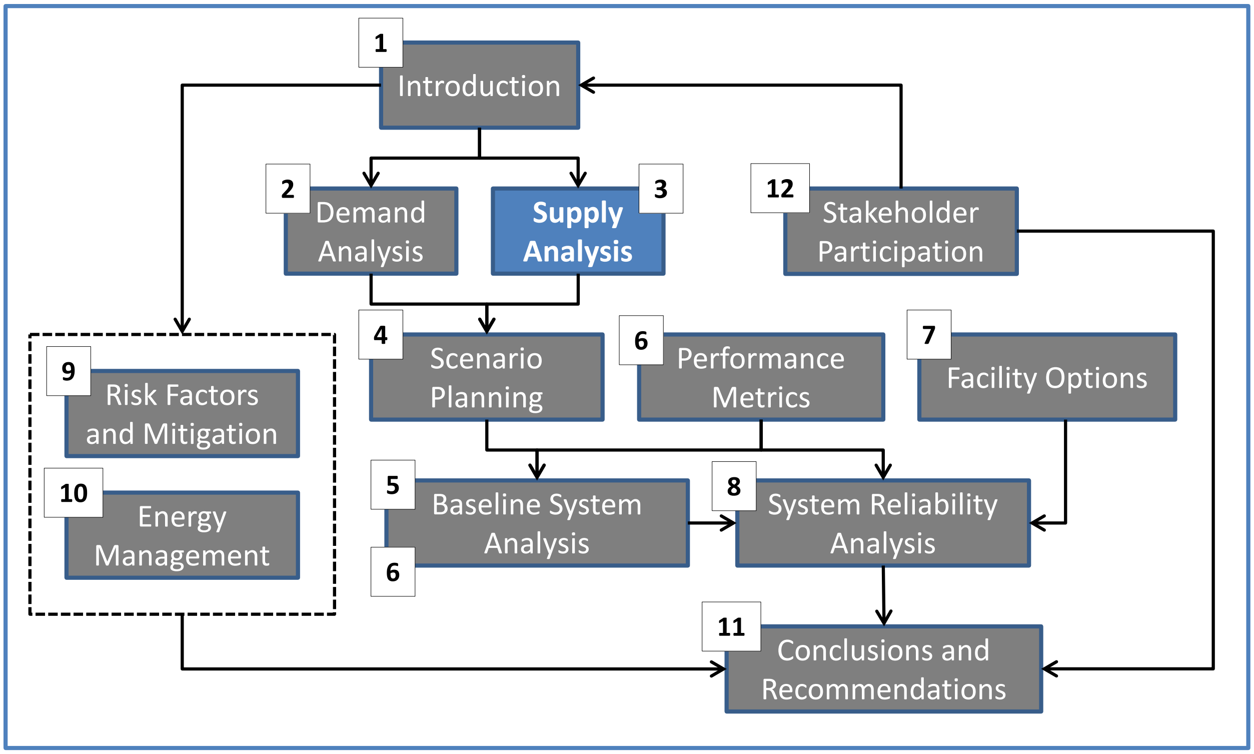


FIGURE 3-1
Relationships between 2013 Master Plan Chapters and Planning Process

3.2 Water Supply Sources

The primary source of supply for the Water Authority's service area has historically been water purchased from MWD for sale by the Water Authority to its member agencies. However, periodic drought conditions and continued population growth in the Water Authority's service area have emphasized the need for a more reliable and diversified water supply. Consistent with its mission statement, the Water Authority has actively pursued a strategy of supply diversification that includes the acquisition of highly reliable imported water supplies and the development of new local water supply projects. The supplies available to the Water Authority's member agencies originate from the following sources: (1) conserved water from the Imperial Irrigation District (IID) Transfer Agreement, (2) conserved water from the AAC and CC lining projects, (3) imported water supplied by MWD from the Sacramento-San Joaquin Bay-Delta and the Colorado River, and (4) local supplies such as surface water runoff, groundwater, reclamation, and beginning in 2016, seawater desalination.

Located at the terminus of the two major sources of imported water supplies, as seen in Figure 3-2, highlights the importance of developing new local supplies to ensure supply reliability and to meet increasing water demands. The Water Authority and its member agencies are implementing a long-term diversification strategy that will further reduce the region's dependence on variable imported supplies. Figure 3-3 illustrates the progress made in developing new local supplies, along with future goals through the 2035 planning horizon. This figure also shows the projected changes to the supply distribution in 2020 that reflects full implementation of the IID transfer and canal-lining deliveries, supply from the Carlsbad Seawater Desalination Project, and increased water recycling.

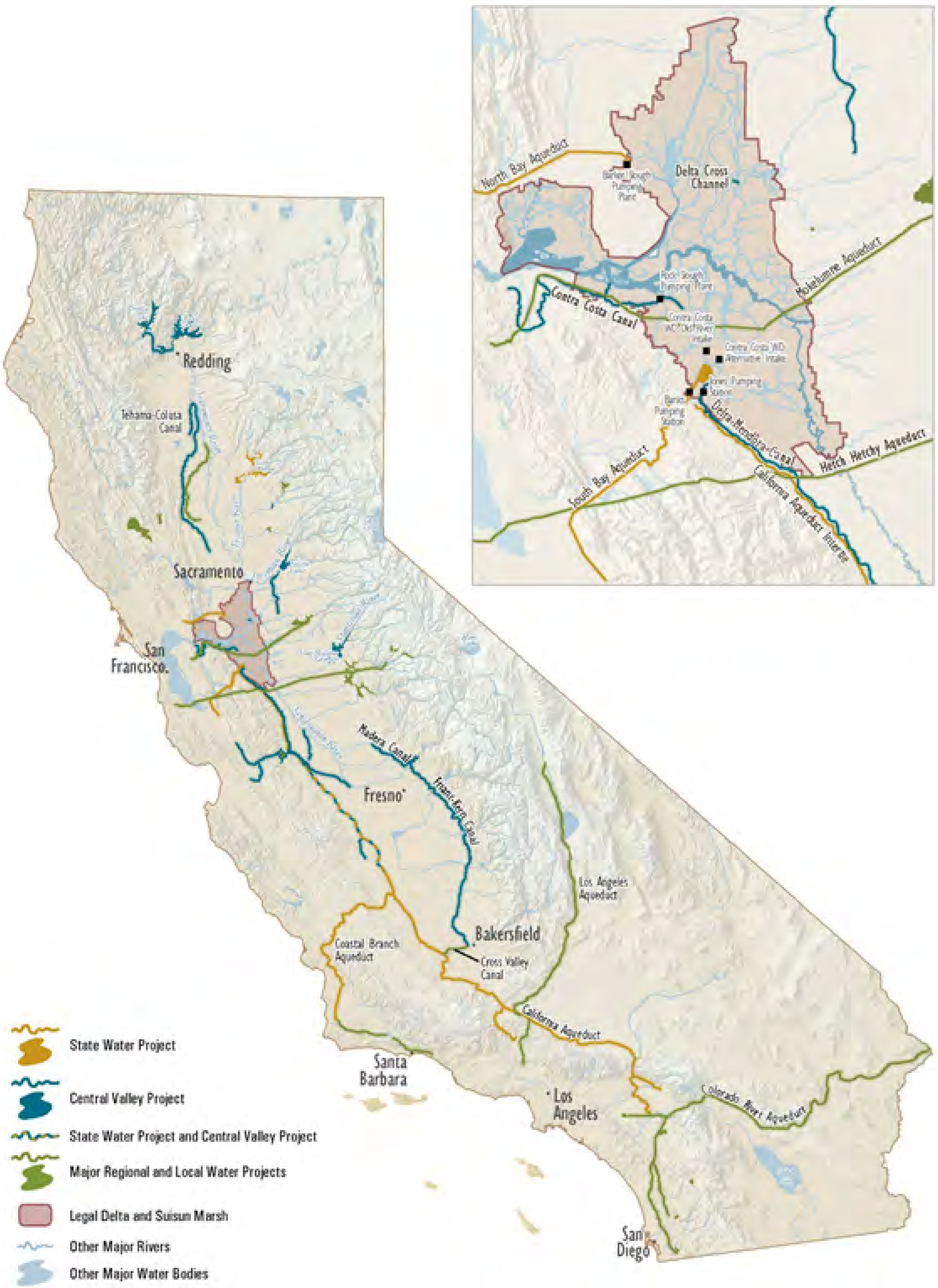


FIGURE 3-2
Major Conveyance Systems Serving California

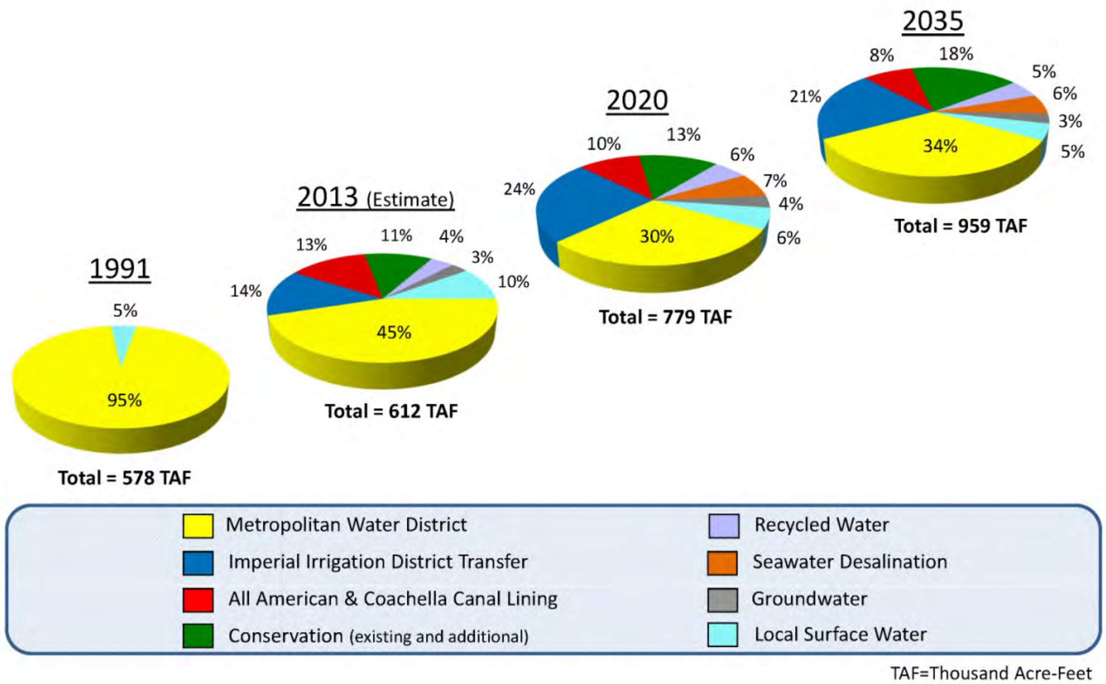


FIGURE 3-3
Water Authority Supply Mix, Actual 1991, Estimated 2013, and Planned 2020 and 2035

3.2.1 Water Authority Supplies

Water Authority sources, beyond the core imported sources, include conserved water supplies made available through a transfer agreement with IID and the canal-lining projects, surface water storage, the Carlsbad Seawater Desalination Project, and out-of-region groundwater banking.

3.2.1.1 Water Authority – Imperial Irrigation District Water Conservation and Transfer Agreement

In 1998, the Water Authority entered into an agreement with the IID for the long-term transfer of conserved Colorado River water to San Diego County. Water conserved by Imperial Valley farmers or through system efficiency improvements within the IID system can be transferred to the Water Authority for use in San Diego County. Deliveries into San Diego County from the Transfer Agreement began in 2003 with an initial delivery of 10,000 acre-feet (AF). The Water Authority is to receive increasing amounts of transfer water according to a water delivery schedule contained in the transfer agreement. In 2012, the Water Authority received 106,722 AF. The quantities will increase annually to 200,000 AF by 2021 and then remain fixed for the duration of the agreement. The initial term of the Transfer Agreement is 45 years, with a provision that either agency may extend the agreement for an additional 30-year period. Based on the terms and conditions in the Transfer Agreement, Figure 3-4 shows the anticipated delivery schedule of the conserved transfer water as it ramps up to full deliveries beginning in 2021.

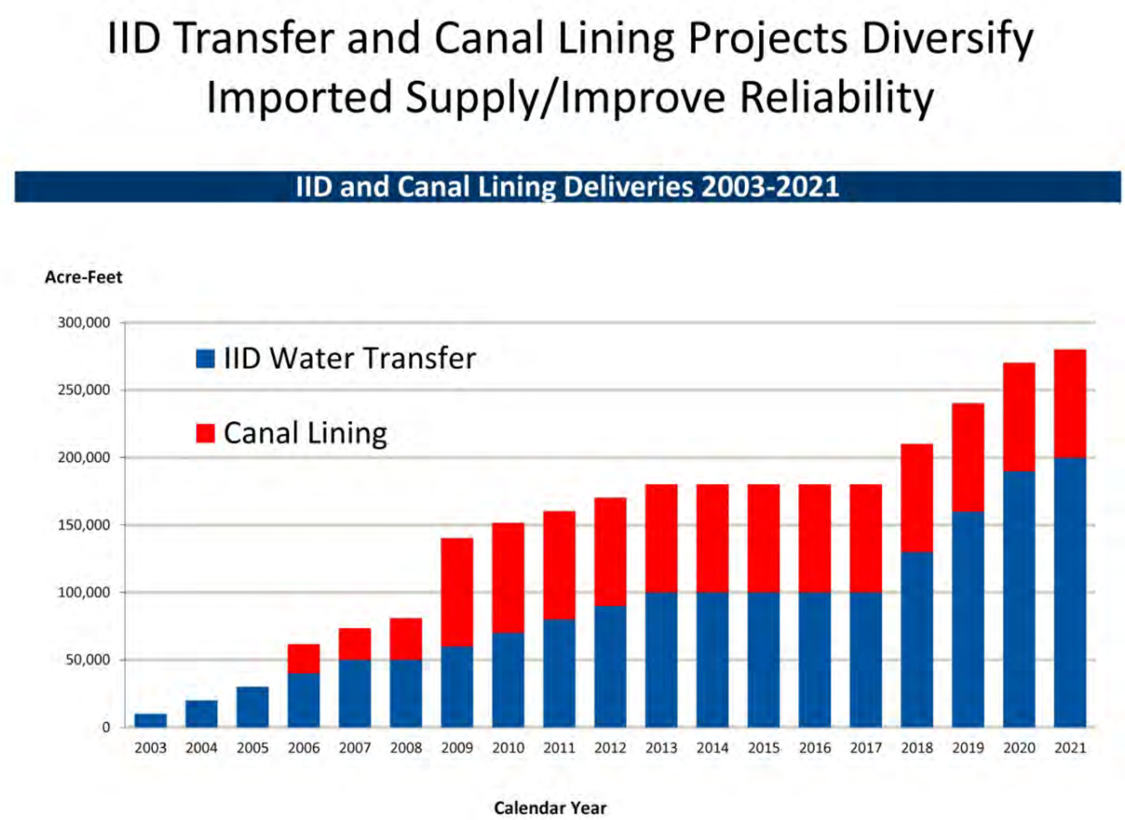


FIGURE 3-4
Existing and Projected Water Authority IID Transfer Supplies

In October 2003, the Water Authority, together with the Coachella Valley Water District, IID, and MWD, along with the United States Secretary of the Interior, ratified 34 agreements that collectively comprise the Colorado River Quantification Settlement Agreement (QSA). The QSA, which is in effect for 45 years (and up to 75 years), resolved long-standing disputes regarding Colorado River water use among the agencies, and established a baseline water use for IID, Coachella Valley Water District (CVWD), and MWD. This permitted the implementation of a variety of water conservation and transfer agreements, including the Water Authority's Transfer Agreement with IID.

Several legal challenges have been made regarding specific aspects of the Transfer Agreement and the QSA, but the current court rulings have upheld the QSA and Transfer Agreement, and delivery of the transfer water is continuing according to schedule.

The water available under the Transfer Agreement is considered highly reliable. During dry years, when Colorado River water availability is low, the conserved water will be transferred under IID's Colorado River rights, which are among the most senior in the Lower Colorado River Basin. Without the protection of these rights, the Water Authority could suffer delivery cutbacks. The water available under the Transfer Agreement is linked to the QSA.

3.2.1.2 All-American Canal and Coachella Canal Lining Projects

As part of the QSA and related contracts, the Water Authority contracted for 77,700 AF per year (AF/YR) of conserved water from projects that lined portions of the AAC and CC. The projects reduced the loss of water that occurred through seepage, and the conserved water is delivered to the Water Authority. The AAC lining project makes 67,700 AF of Colorado River water per year available for allocation to the Water Authority and San Luis Rey Indian water rights settlement parties. The CC lining project makes another 26,000 AF of Colorado River water each year available for allocation, bringing the total amount of conserved water to 93,700 AF. The 2003 Allocation Agreement[2] provides for 16,000 AF/YR of the total amount of conserved canal lining water to be allocated to the San Luis Rey Indian Water Rights Settlement Parties. The remaining amount of conserved water, or 77,700 AF/YR, is to be available to the Water Authority. An additional 4,850 AF/YR is also available to the Water Authority depending on environmental requirements from the CC lining project. For planning purposes, the Water Authority assumes that 2,500 AF of the 4,850 AF will be available each year for delivery, for a total of 80,200 AF/YR. The canal-lining contracts are in effect for a period of 110 years. Both canal-lining projects have been completed, and full deliveries of conserved water to the Water Authority are occurring.

3.2.1.3 In-Region Surface Storage

The Water Authority has invested heavily in the past decade in developing regional carryover and emergency storage capacity to provide increased reliability during droughts and improve the access to supply during emergencies. The most recently constructed surface storage facility is the Olivenhain Reservoir (Water Authority), which is part of the Water Authority's ESP. The ESP will add a combined total of 90,100 AF of storage capacity and is designed to protect the region from disruptions in the water delivery system. In addition, the 2003 Regional Water Facilities Master Plan (2003 Master Plan) identified an opportunity to augment the ESP with a carryover storage component at San Vicente. Construction of the ESP/Carryover Storage Project (CSP) is scheduled for completion in early 2014, with filling scheduled to occur within three to five years. The CSP will provide 100,000 AF of additional water storage capacity to buffer dry-year supply shortages. Total Water Authority in-region storage is shown in Table 3-2.

TABLE 3-2
Water Authority In-Region Storage Pools

Reservoir	Storage Capacity (AF)	
Hodges	20,000	Emergency Pool
San Vicente	52,000	Emergency Pool
San Vicente	100,00	Carryover Pool
Olivenhain	24,364	Emergency Pool
Total	196,364	

[2]The 2003 Allocation Agreement parties included the United States of America, MWD, CVWD, IID, the Water Authority, the La Jolla, Pala, Pauma, Rincon, and San Pasqual Bands of Mission Indians, the San Luis Rey River Indian Water Authority, the City of Escondido, and Vista Irrigation District.

3.2.1.4 Carlsbad Seawater Desalination Project

The Carlsbad Seawater Desalination Project (Carlsbad project) is a fully permitted seawater desalination plant and conveyance pipeline currently under construction by Poseidon Resources, a private investor–owned company that develops water and wastewater infrastructure. The Water Authority entered into a 30-year Water Purchase Agreement with Poseidon for delivery of the desalinated seawater supply. The Carlsbad project, located at the Encina Power Station in Carlsbad, will desalinate seawater and convey product water to the Water Authority's Twin Oaks Valley WTP, where it will be blended with treated imported water and subsequently distributed into the Water Authority's existing aqueduct system.

Development of seawater desalination in San Diego County will assist the region in diversifying its water resources, reduce dependence on imported supplies, and provide a new drought-proof, locally treated water supply. This supply is considered highly reliable and when completed, the Carlsbad project is expected to produce a consistent 56,000 AF of water each year.

3.2.1.5 Out-of-Region Groundwater Storage

In 2008, the Water Authority acquired a total of 70,000 AF of permanent storage allocation in the Semitropic-Rosamond Water Bank Authority and Semitropic Water Bank (40,000 and 30,000 AF, respectively) located in Kern County. Due to its location near the California Aqueduct, the Kern River, and the Friant-Kern Canal, the location was ideally suited for groundwater banking. The Water Authority's assigned rights also included a total Program Delivery or put capacity of 12,715 AF/YR and 10,865 AF/YR of Program Pumpback or take Capacity. Current charges for put and take are approximately $70 per AF. The annual storage charge is $25 per AF of capacity. Plans to take water require notification by April 1 prior to the year of the planned take. This program provides the Water Authority with the most cost-effective solution for storage outside of San Diego County.

The project will allow water to be delivered and stored during above-normal hydrology, and extracted from the basin for delivery to the Water Authority either by wheeling through various facilities, exchanges, or a reduction in demands on the Water Authority. Groundwater banking offers a convenient method of exchanging water with MWD for in-lieu deliveries. The current available supply from the Semitropic bank is 16,000 AF. This supply is considered reliable in a dry year and will generally be available in the year that the take is requested. The banked water will be conveyed through SWP and MWD facilities and delivered to the Water Authority without the need for new infrastructure.

3.2.2 Metropolitan Water District Supplies

The Water Authority purchases imported water from MWD to meet a large portion of its water supply portfolio. The Water Authority is the largest purchaser of the 26 MWD member agencies, purchasing 266,079 AF, or about 19 percent of all the water MWD delivered in fiscal year 2012. The imported sources consist of Colorado River supply delivered through the CRA and Sacramento-San Joaquin Bay Delta supplies delivered through the SWP; both supplies are blended at MWD's Skinner reservoir. Figure 3-5 shows the imported water supply sources available to MWD and the Water Authority. In order to meet emerging challenges from dry hydrologic conditions and regulatory restrictions that limit supplies from the SWP, MWD's water supply strategy consists of significant investments in dry-year water transfers and the use of storage programs to maximize available supplies in wet years for use in dry years.

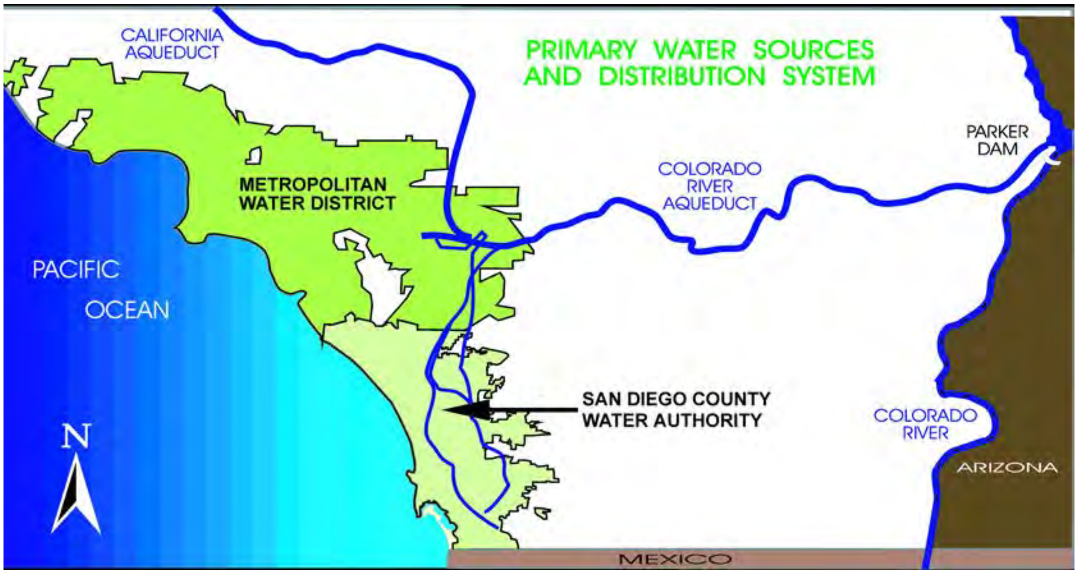


FIGURE 3-5
Imported Water Supplies Available to MWD and the Water Authority

Under Section 135 of the Metropolitan Water District Act, each member agency has a preferential right to MWD purchases. Under MWD's interpretation, preferential rights are determined by each agency's total historic payments to MWD from property taxes, readiness-to-serve charges, and other minor miscellaneous revenue; revenue resulting from the purchase of MWD water is excluded, even though more than 80 percent of MWD's revenues come from water sales.

MWD member agencies' ability to exercise preferential rights was confirmed in a lawsuit filed by the Water Authority in 2001. The court decisions made clear how much water the Water Authority may count on from MWD should a member agency invoke its preferential right. Under MWD's interpretation of preferential rights, the Water Authority had a preferential right to purchase 17.92 percent of MWD's water as of June 30, 2012; it purchased about 19 percent of MWD's available supply in fiscal year 2012.

In MWD's *2010 Regional Urban Water Management Plan* (Regional UWMP), Section 2.3, MWD presents its supply availability at the regional level, rather than at the member agency level. The report stated that the region can provide reliable water supplies under both the single driest year and the multiple dry-year hydrologies through 2035. The report listed MWD's forecasted imported water supply capabilities under normal, single driest year, and multiple dry-year hydrologies through 2035. These capabilities would provide the Water Authority with adequate imported supplies in normal years and a single dry year. In multiple dry years, under its projected preferential right formula, the Water Authority could experience shortages. For the 2013 Master Plan, it was assumed that MWD supplies in multiple dry years would be allocated according to the preferential right formula, assuming MWD is allocating between 1.5 and 1.8 million acre-feet (MAF) and that the Water Authority's preferential right percentage is 18.7 percent, as estimated for year 2030 in the

2010 UWMP, Section 10. The range of available MWD supplies during multiple dry years was considered through the water supply-demand scenarios developed as part of the 2013 Master Plan. The MWD supply available to the Water Authority would be 336,600 AF when assuming MWD is allocating 1.8 MAF and 280,500 AF when assuming MWD is allocating 1.5 MAF.

3.2.2.1 Colorado River

MWD was formed to import water from the Colorado River. During the 1930s, MWD built the CRA to convey Colorado River water from Lake Havasu on the Arizona/California border to Lake Mathews in Riverside County. The aqueduct has the capacity to deliver up to 1.25 MAF/YR. Before 1964, MWD had a firm annual allocation of 1.212 MAF of Colorado River water through contracts with the U.S. Department of the Interior, which was enough to keep MWD's aqueduct full. However, as a result of the U.S. Supreme Court decision in *Arizona vs. California*, MWD's firm supply fell to 550,000 AF/YR, its basic annual apportionment.

Water availability from the Colorado River is governed by a system of priorities and water rights collectively known as the "Law of the River." The Colorado River Lower Basin states (California, Arizona, and Nevada) have an annual apportionment of 7.5 million AF of water divided as follows: (1) California, 4.4 million AF; (2) Arizona, 2.8 million AF; and (3) Nevada, 300,000 AF. The 1931 Seven Party Agreement established California's priorities for water among California's contractors to use Colorado River water made available to California. The first four priorities total the 4.4 million AF/YR available to California. MWD has priorities 4, 5(a), and 5(b) water listed in the Seven Party Agreement, but only priorities 1–4 of the Seven Party Agreement are within California's basic annual apportionment. MWD's fourth priority of 550,000 AF is junior to that of the first three priorities, 3.85 million AF to California agricultural agencies. Water used to satisfy MWD's priorities 5(a) and 5(b) must come from unused allocations within California, Arizona, or Nevada, or from surpluses declared by the Secretary of the Interior.

MWD relied on its fifth priority for up to 662,000 AF/YR through several sources:

- Unused water from holders of priorities 1 through 3.
- Water saved by Palo Verde Irrigation District or when the U.S. Secretary of Interior declared surplus or unused water by Arizona and/or Nevada).
- Additional supplies when the Department of Interior declared surplus flows are available.

With the 2003 QSA and related agreements among the IID, CVWD, State of California, Department of Interior, MWD, and Water Authority, a plan was formalized on how California will implement water transfers and supply programs that allow California to live within the state's 4.4 million AF basic annual apportionment of Colorado River water. Since then, MWD has relied on cooperative transfer programs and storage programs to increase its Colorado River water deliveries beyond its basic priority 4 water.

In 2007, the Bureau of Reclamation released the Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead (Reclamation, 2007), which describes the process for improving operations of Lake Powell and Lake Mead during times of low storage conditions. A significant component of the Guidelines was the ability for Lower Basin states to store intentionally created surplus (ICS) water (conserved water) in Lake Mead for use in subsequent years. California has the ability to develop and store up to 400,000 AF per year or a maximum of 1.5 million AF in Lake Mead. MWD has been the largest user of the ICS mechanism to date.

The Colorado River Basin states and the Bureau of Reclamation recently prepared the long-range Colorado River Basin Supply and Demand Study to evaluate the reliability of the system over a range of future conditions. Climate change and growth in demand throughout the Basin are expected to further challenge long-term water management. Climate change itself may reduce the long-term Colorado River supply by more than 9 percent by 2060. The study included evaluations of the system reliability under baseline and alternative future portfolios of water management actions. The risk of Lower Basin shortages was found to be increasing through 2060 due to both decreasing projected supply and increasing consumptive uses. Specific risks to individual entitlement holders were not evaluated in the study.

During dry and multiple dry years, MWD, in its *2010 Regional Urban Water Master Plan*, continues to target a full CRA of 1.25 million AF. This figure includes MWD's basic apportionment deliveries, water management programs such as those described previously, and IID/Water Authority transfers and conserved canal-lining water conveyed through the CRA to the Water Authority.

3.2.2.2 State Water Project

The SWP is owned by the State of California and is operated by the Department of Water Resources. MWD has a take-or-pay supply contract with the State of California and is entitled to take about 48 percent of available SWP water through its Long-Term SWP Water Supply Contract (Table A allocation). The project stretches more than 600 miles, from Lake Oroville in the north to Lake Perris in the south. Water is stored at Lake Oroville and released when needed into the Feather River, which flows into the Sacramento River and through the Sacramento–San Joaquin River Delta (Delta). The combined flow into the Delta is allocated among state, federal, and local water delivery projects; flows needed to manage seawater intrusion and in-Delta water quality; and flows needed for fish and wildlife dependent on the Delta ecosystem. The SWP pumps water from the south Delta and delivers water along the 444-mile-long California Aqueduct. During winter and early spring, when demands are lower, water is stored at the San Luis Reservoir located south of the Delta, then released from San Luis Reservoir in late spring and summer to meet peak demands. SWP facilities provide drinking water to 25 million Californians and 750,000 acres of irrigated farmland (DWR, 2013).

MWD's currently contracted entitlement for SWP water (Table A) is 1,911,500 AF. In addition, during wet years when excess water is available and the San Luis Reservoir is full, SWP contractors may receive additional water deliveries (Article 21). However, the reliability of SWP supplies is dependent on both the hydrology of the Sacramento-San Joaquin watershed and pumping restrictions in the Delta due to state and federal environmental regulations. Since the 1970s, additional restrictions on SWP operations have been enacted under the State Water Resources Control Board (SWRCB) water rights decisions, federal biological opinions, and interim court decisions. The most significant of these restrictions began in 2007 when federal biological opinions for Delta smelt and salmon were invalidated in federal court. The interim measures and subsequent revised biological opinions have substantially reduced water deliveries for the SWP through limits on exports during months of critical fish concerns (December through June).

The State of California Department of Water Resources *2009 State Water Project Delivery Reliability Report* (DWR, 2009b) updated DWR's estimate of the current and future water delivery reliability of the SWP. The 2009 report showed that future deliveries will be further impacted by significant restrictions due to operational requirements contained in federal biological opinions and forecasted effects of climate change and sea level rise. Under the reliability report, long-term average (1922–2003 hydrology) SWP allocations are estimated to be approximately 60 percent of the Table A demands, while single dry-year (1977) deliveries could be as low as 7 percent. Under future conditions, single dry-year deliveries are estimated to be approximately 11 percent, while long-term average allocations are estimated to remain at 60 percent. The future allocations translate into long-term average SWP deliveries to MWD of approximately 1.15 million AF and approximately 134,000 AF under single dry-year conditions.

In 2006, a voluntary collaboration of state, federal, and local water agencies; state and federal fish agencies; environmental organizations; and other interested parties began development of the Bay Delta Conservation Plan (BDCP). The purpose of the BDCP is to restore and protect Delta water supply, water quality, and ecosystem health within a stable regulatory environment. The BDCP is designed to provide the basis for the issuance of endangered species permits for the operation of state and federal water projects, and would be implemented over the next 50 years. Draft documents outlining the BDCP strategy and assessments were released on December 13, 2013 for a 108-day public review period. A parallel effort, the Delta Habitat Conservation and Conveyance Program (DHCCP) provides the state government's mechanism for achieving the BDCP's goals. Under current BDCP alternatives, new Delta conveyance, water operations, habitat restoration, and other conservation measures are proposed to address the long-term issues in the Delta. In developing its projection of supply delivery capabilities, MWD assumed a new Delta conveyance as fully operational by 2022, which would return supply reliability similar to 2005 conditions, prior to supply regulatory restrictions imposed.

MWD's *2010 Regional Urban Water Master Plan* indicates that MWD's SWP target for a dry year (based on 1977 hydrology) is 522,000 AF in 2015, 601,000 AF in 2020, and 651,000 AF in 2025. These estimates include SWP Table A allocations, MWD carryover storage in the San Luis Reservoir and other Central Valley transfer and storage programs conveyed in the California Aqueduct. The 2010 Regional UWMP estimates that the supplies from the California Aqueduct (SWP deliveries, Central Valley transfers, and Central Valley storage programs) will be capable of serving between 1.55 million AF to MWD in 2015 and 1.73 million AF to MWD in 2035 in an average year.

3.2.2.3 Storage Management Programs

While dependent on the supply from the Colorado River and the Delta, MWD relies on water in storage to augment these supplies during times of supply limitations. It manages its storage portfolio by storing water during wet years to meet the region's needs during critical droughts caused by varied hydrologic conditions and SWP pumping restrictions imposed to protect endangered or threatened fish species. The ability of MWD to project reliable deliveries to member agencies under significant hydrologic and regulatory fluctuations is largely dependent on its storage management programs. Currently, MWD has about 30 storage programs in operation that provide flexibility to meet delivery requirements. The storage accounts include groundwater and surface storage programs and facilities, within and outside of MWD's service area. MWD's dry-year storage portfolio has the potential to store more than 5 million AF.

MWD's 2010 Regional UWMP indicates that the in-region storage and transfer program target for a dry year (based on 1977 hydrology) is 685,000 AF in 2015, 931,000 AF in 2020, and 1,076,000 AF in 2025. The 2010 Regional UWMP estimates that the in-region storage and transfer program will be capable of serving between 830,000 and 964,000 AF to MWD from 2015 through 2035 in an average year.

3.2.3 Member Agency Supplies

The Water Authority's member agencies have important local water supplies that support the water supply diversification goals of the San Diego region. These consist of surface water sources, groundwater sources, and water recycling programs as discussed in the following subsections.

3.2.3.1 Surface Water

The local surface water yield is derived from the 25 surface reservoirs in San Diego County (shown in Figure 3-6), with reservoir characteristics summarized in Table 3-3. The total capacity of these reservoirs is approximately 742,000 AF, providing significant seasonal and carryover storage for member agencies and the Water Authority. Of the total surface storage, nearly 70 percent is owned and operated by the City of San Diego, with Helix Water District, Ramona Municipal Water District, Sweetwater Authority, and the City of Escondido operating the majority of the remaining storage capacity. The estimated total average annual inflow to these reservoirs is roughly 100,000 AF, ranging from negligible inflow during an extremely dry year up to an historical high of 853,000 AF. In the 2010 UWMP, the projected average annual water supply available from these local reservoirs is approximately 48,000 AF. The average annual available surface water supply is lower than the average annual inflow due to reservoir evaporation, reservoir spills, and water uses and losses not directly accounted in the reservoir balance measurements.

The natural runoff into these reservoirs is primarily derived from watersheds that capture Pacific storm precipitation high in the Peninsular Range and drain to the Pacific Ocean. The largest of these reservoirs is El Capitan reservoir (City of San Diego) with a capacity of over 112,000 AF. The City of San Diego also has 90,230 AFY of storage capacity in the San Vicente Reservoir.

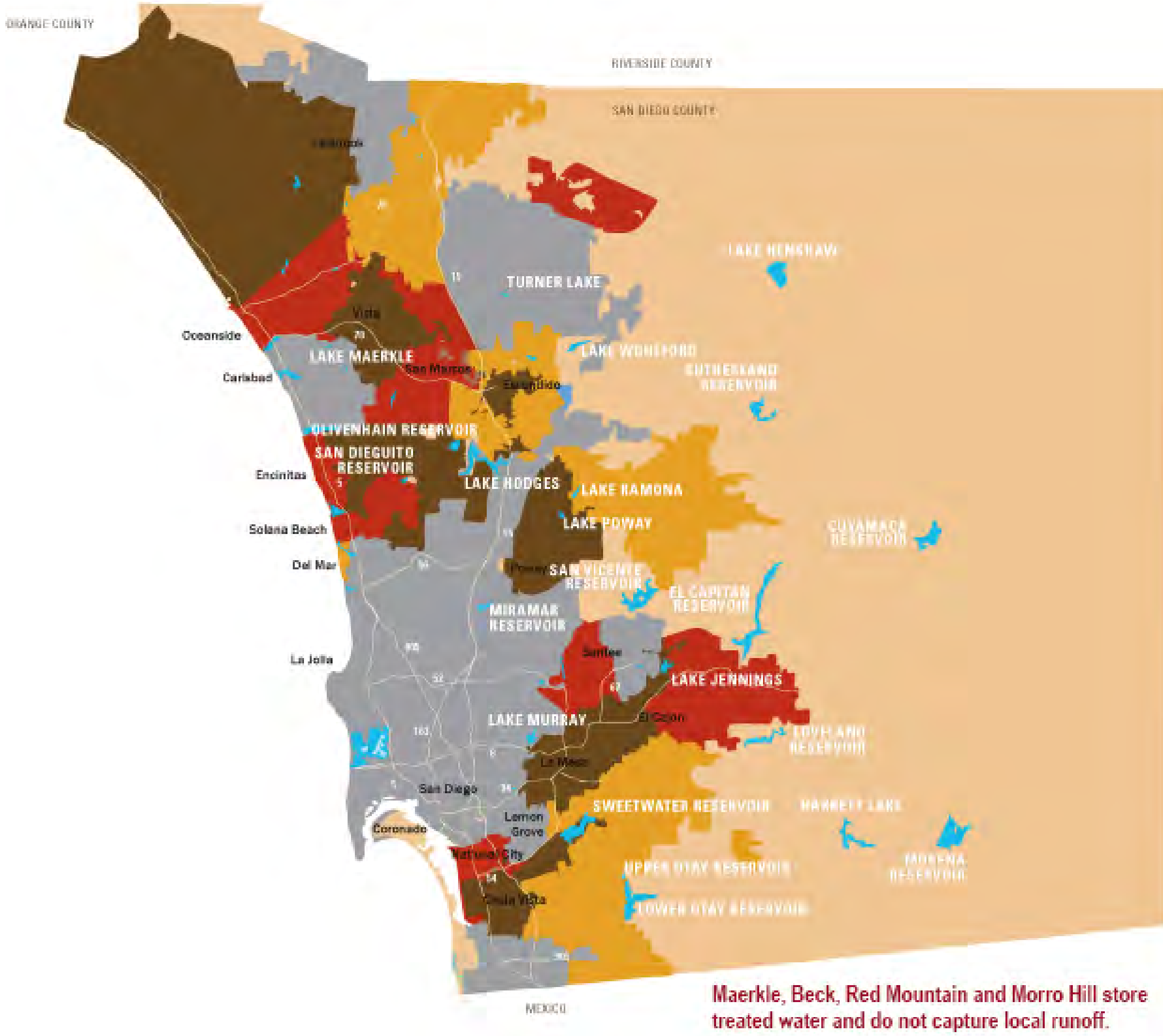


FIGURE 3-6
Location of San Diego County Surface Water Reservoirs

For the 2013 Master Plan, monthly local hydrology developed from 112 years of past records was simulated for each of the reservoirs indicated in Table 3-3.[3] Total annual inflows for all San Diego Region reservoirs are shown in Figure 3-7. Inflow varies significantly, and the actual variability of historical is captured in the 2013 Master Plan demand analysis through the use of historical hydrology data.

Within the 2013 Master Plan analysis, the reservoirs are operated based on operating criteria derived from previous studies, through review of past storage operations, or through consultation with Water Authority and member agency staff. These reservoirs provide direct water delivery to various member agencies or store water for future use by the same agency. When storage developed at San Vicente Reservoir is fully integrated into the

[3] Historic reservoir inflow data was compiled under previous planning efforts for the period of 1888 to 1989; surface water hydrology data set was extended to include the period from 1990 to 2011 using information from the Water Authority and member agencies. The methodology and results of this hydrology extension process for the San Diego Region is presented in Appendix F.

Water Authority delivery system, it will provide seasonal and carryover storage for distribution to the member agencies.

TABLE 3-3
Characteristics of Local Surface Water Reservoirs

Reservoir	Owner	Storage Capacity (AF)	Average Annual Inflow (AF)[1]
Maerkle	Carlsbad Municipal Water District (treated)	600	N/A
Dixon	City of Escondido	2,606	N/A
Wohlford	City of Escondido	6,506	1,613
Red Mountain	Fallbrook Public Utility District (PUD) (treated)	1,335	N/A
Cuyamaca	Helix Water District	8,195	N/A
Jennings	Helix Water District	9,790	N/A
Poway	City of Poway	3,330	N/A
Beck	Rainbow Municipal Water District (treated)	625	N/A
Morro Hill	Rainbow Municipal Water District (treated)	465	N/A
Ramona	Ramona Municipal Water District	12,000	N/A
Barrett	City of San Diego	37,947	11,656
El Capitan	City of San Diego	112,807	24,414
Hodges	City of San Diego	30,251	25,119
Lower Otay	City of San Diego	49,510	5,771
Miramar	City of San Diego	7,185	N/A
Morena	City of San Diego	50,207	9,672
Murray	City of San Diego	4,818	N/A
Sutherland	City of San Diego	29,685	7,768
San Vicente	City of San Diego	90,230	8,935
	Water Authority	152,000	
Olivenhain	Water Authority	24,364	0
San Dieguito	San Dieguito Water District/Santa Fe Irrigation District	883	N/A
Loveland	Sweetwater Authority	25,387	10,707
Sweetwater	Sweetwater Authority	28,079	4,534
Turner	Valley Center Municipal Water District (offline)	1,613	N/A
Henshaw	Vista Irrigation District	51,774	N/A
Total		742,192	110,189

[1]Average annual inflow estimated from reservoir inflows derived from the water years 1956 through 2010.

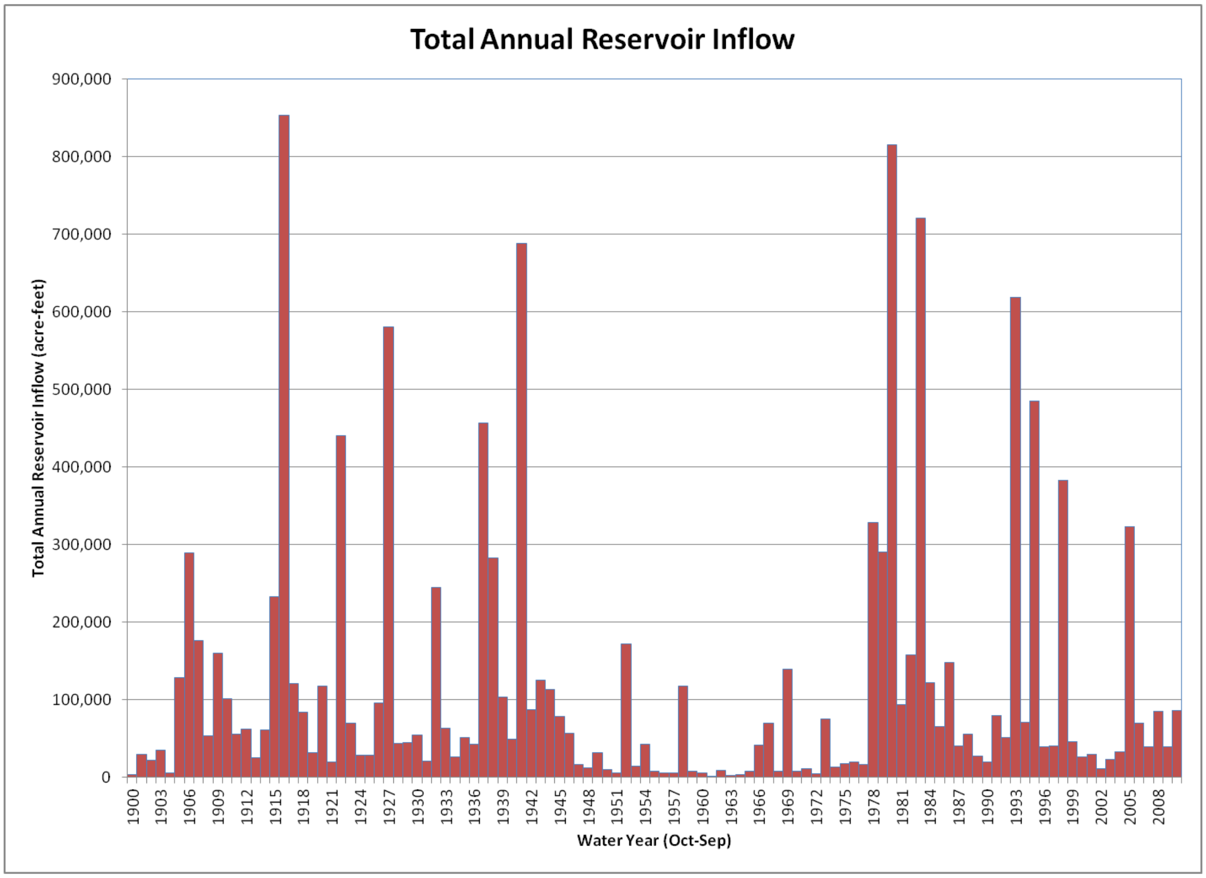


FIGURE 3-7
Total Annual Reservoir Inflow in San Diego Region, 1900–2010

3.2.3.2 Groundwater

Groundwater basins in San Diego County are limited due to the region's geology. Where the hydrogeology is favorable (usually small alluvial sand and gravel aquifers), much of the higher water quality supply has been developed through construction of relatively shallow wells. Outside these areas, groundwater has been developed in fractured bedrock formations, which generally yield only small quantities of water. The most developed areas for groundwater supply are within the Santa Margarita River watershed (Marine Corps Base [MCB] Camp Pendleton), Mission Basin (City of Oceanside), San Diego Formation (Sweetwater Authority), and Warner Basin (Vista Irrigation District). The total estimated groundwater supply produced within the Water Authority service area is estimated to be approximately 22,030 to 28,360 AF per year with dry-year supplies expected to be up to 22,238 AF per year.

The greatest potential for new groundwater development exists in the form of brackish groundwater recovery projects and groundwater recharge and recovery. Brackish groundwater recovery projects use membrane technology, principally reverse osmosis (RO), to treat groundwater high in total dissolved solids (TDS) to potable water standards. The city of Oceanside's 6.37 mgd capacity Mission Basin Desalter and the Sweetwater Authority's existing 4.0 mgd Richard A. Reynolds Groundwater Desalination Facility are the only currently operating brackish groundwater recovery and treatment facilities within the Water Authority's service area. Artificial recharge and recovery projects, also referred to as conjunctive-use projects, can increase groundwater basin yields by diverting excess surface water to recharge basins or injection wells to supplement natural rainfall recharge. Groundwater basins can be operated similarly to surface water reservoirs to supply stored water to the region if imported deliveries are limited due to high demand, or supply and facility constraints, or a combination thereof. The Fallbrook PUD and MCB Camp Pendleton, and Padre Dam Municipal Water District and Helix Water District are currently exploring the feasibility of such projects. Consistent with the 2010 UWMP assumptions, only "verifiable" supplies were included in most of the 2013 Master Plan analyses. For one Master Plan scenario (Scenario C, described in Chapter 4), "additional planned" supplies were also included. A summary of the groundwater supply volumes applied in the 2013 Master Plan analyses is provided in Table 3-4.

TABLE 3-4
Groundwater Supplies Applied in 2013 Master Plan Analyses

UWMP Supply Project Categories	Groundwater Supplies (AF)				
	2015	**2020**	**2025**	**2030**	**2035**
Local Verifiable	22,000	26,600	27,600	28,400	28,400
Additional Planned*	500	11,700	11,700	12,700	12,700

Source: 2010 UWMP
* Master Plan Scenario C only

3.2.3.3 Water Recycling

Water recycling has been identified as a growing part of the Water Authority's resource mix. Water may be recycled for non-potable or indirect potable purposes. Agencies in San Diego County use recycled water to fill lakes, ponds, and ornamental fountains; to irrigate parks, campgrounds, golf courses, freeway medians, community greenbelts, school athletic fields, food crops, and nursery stock; and to control dust at construction sites. Recycled water can also be used in certain industrial processes, in cooling towers, for flushing toilets and urinals in non-residential buildings, and potentially for street sweeping purposes. Currently, approximately 27,900 AF/YR of recycled water is used within the Water Authority's service area, and this number is projected to grow to nearly 50,000 AF per year by 2035.

Indirect potable reuse is a system of reusing wastewater through a multi-barrier treatment process, which may include treatment technologies such as RO and advanced oxidation, and a natural barrier, such as a groundwater basin or surface water reservoir then retreatment before delivery to the retail system. Several Water Authority member agencies are completing studies pertaining to potable reuse in San Diego County through groundwater recharge or reservoir augmentation. Consistent with the 2010 UWMP assumptions, only verifiable projects were included in most of the 2013 Master Plan analyses. For one Master Plan scenario (Scenario C, described in Chapter 4), "additional planned" supplies were also included. A summary of the recycled water supply volumes applied in the 2013 Master Plan analyses is provided in Table 3-5.

TABLE 3-5
Recycled Water Supplies Applied in Master Plan Analyses

UWMP Supply Project Categories	Recycled Water Supply (AF)				
	2015	2020	2025	2030	2035
Local Verifiable	38,700	43,700	46,600	48,300	50,000
Additional Planned*	2,500	21,500	25,400	25,500	25,500

Source: 2010 UWMP
* Master Plan Scenario C only

3.2.3.4 Water Conservation

Both sound water resource stewardship and state law require that water conservation be an important component of water supply planning. Urban and agricultural water conservation has proven to be an effective part of the water management toolbox during periods of drought, where reductions of 10 to 20 percent (more for some agencies) in per capita water use have been achieved. However, much of the reduction in per capita water use is short-lived, ultimately rebounding to pre-drought levels. With the passage of the Water Conservation Act of 2009 (Senate Bill 7 of the Seventh Extraordinary Session or SBX7-7), retail urban water agencies within the state are required to achieve a 20 percent reduction in urban per capita water use by December 31, 2020. While the Water Authority is a wholesale agency and not directly subject to these requirements, the law requires wholesale suppliers to support retail member agencies' efforts to comply with SBX7-7 through a combination of regionally and locally administered active and passive water conservation measures, programs, and policies, as well as the use of recycled water.

As part of the 2010 UWMP, member agencies provided their strategies for achieving the provisions of SBX7-7. The 2013 Master Plan baseline analysis is consistent with the 2010 UWMP treatment of conservation achievement. The conservation levels are increased over time as shown in Table 3-6, which represents 20 percent conservation by 2020. However, in the scenario planning approach considered in the 2013 Master Plan, some scenarios explored slower or more rapid achievement of the conservation goals as discussed in Chapter 4.

TABLE 3-6
Projected Member Agency Additional Water Conservation per SBX7-7

UWMP Supply Project Categories	Water Conservation (AF)				
	2015	2020	2025	2030	2035
Conservation Requirements	6,700	47,000	72,000	97,300	117,500
Additional Conservation*	700	4,700	7,200	9.700	11,800

Source: 2010 UWMP
* Master Plan Scenario C only

3.2.3.5 Regional Reservoir Coordination

The Water Authority has made strategic investments in both regional emergency and carryover reservoir storage to improve the reliability of the system to help meet the need for water during catastrophic outages or during dry hydrologic conditions. The ESP was augmented with the CSP specifically to improve reliability under dry hydrologic conditions.

The San Vicente dam raise project is scheduled for completion in early 2014, with filling of the Water Authority storage pools to occur within three to five years of the completion date. San Vicente will provide 100,000 AF of water storage resources to buffer dry-year supply shortages and 52,000 of ESP storage.

The San Vicente Dam Raise Project yields significant additional surface storage for the county.

The majority of surface storage in the county is owned and operated by the Water Authority member agencies to capture local runoff and serves to meet their local retail demands. The member agencies' local storage is used to meet normal demands and provide service during an emergency. Typical operations are to use locally impounded runoff first and then supplement with imported water. This type of operation financially benefits retail agencies because it minimizes costs of imported water purchases for the Water Authority and minimizes losses of the runoff water due to seepage and evaporation. Since average evaporation in the county is approximately 5 feet per year, significant amounts of this water can be lost. Some member agencies also have a reserve pool of water for emergencies in case of an interruption of other supplies. The city of San Diego has the largest emergency pool (in which they maintain six-tenths of a year of the forward-looking demand for emergencies per City Council policy 400-4).

The Water Authority will own or have rights to approximately 196,000 AF of in-region storage at the completion of the San Vicente Dam Raise project. In addition, the Water Authority has acquired 70,000 AF of out-of-region groundwater banking, bringing the total to 266,000 AF of storage available for Water Authority use. Of this total amount, up to 92,000 AF is allocated for emergency storage, and the remaining 174,000 AF (or more) will be available for carryover, operational, and seasonal storage use. Seasonal storage is defined as placing water into storage in the low-demand winter months for later use in the summer months to alleviate peak conveyance constraints. Carryover or dry-year storage is storage to make up for reduced deliveries of imported water during multiyear droughts. In analyzing system requirements, the 2013 Master Plan accounted for the seasonal and dry-year operation of Water Authority-owned storage (both in-region and out-of-region) and the operation of the aqueduct system to deliver water to and from available storage reservoirs to the member agencies.

A workshop was held with the member agencies for the Water Authority to understand and confirm current and anticipated future operation of their local storage reservoirs. The member agencies that own surface water reservoirs confirmed that they will continue to use local runoff water in storage until they reach the emergency pool level, and will then purchase imported water from the Water Authority to meet retail demands. The member agencies also confirmed that financial incentives would likely be needed to modify current reservoir operations and utilize a portion of available storage to address peak summer conveyance concerns.

3.3 Local Supply Influence on Water Authority Demand

As discussed in *Chapter 2 – Regional Demand Analysis*, the demand on Water Authority facilities is influenced by the amount of local supply available to member agencies and the priorities of that use. The Water Authority's 2010 UWMP provides the annual demand forecasts for each of its member agencies. This forecast represents the total or gross demand that the member agency is targeting to satisfy from all available supply sources.

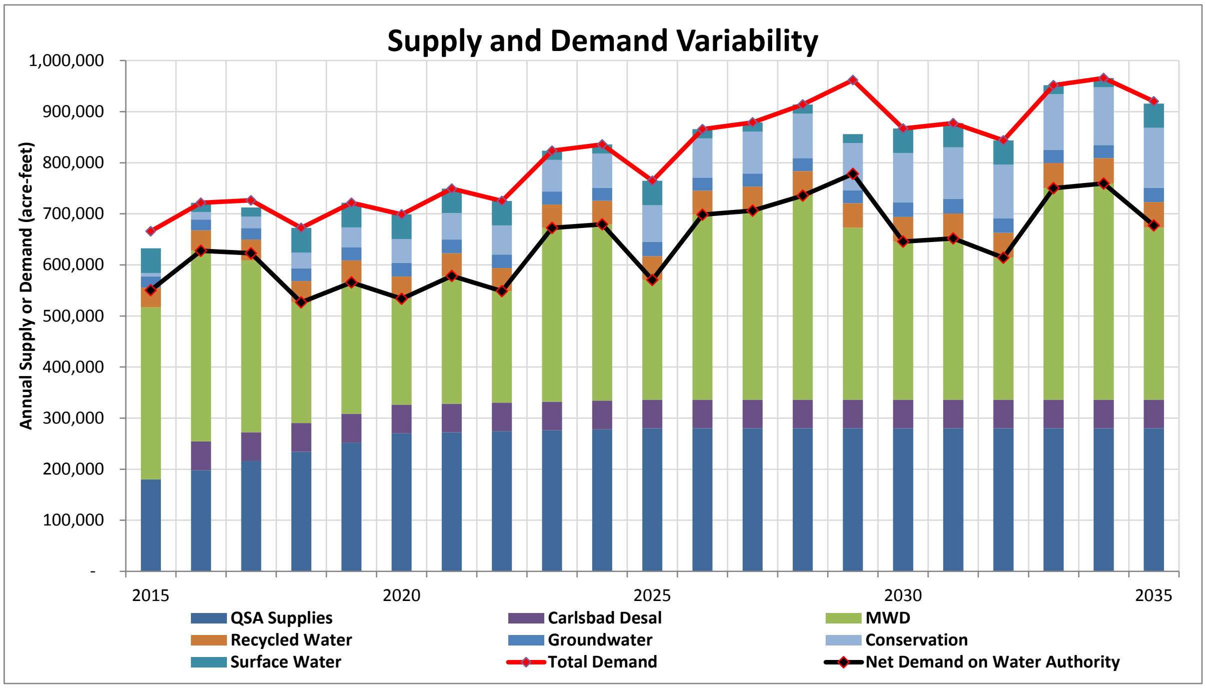
However, to account for the demand on the Water Authority facilities, the gross demand for each member agency must be reduced by the level of conservation and the quantities of projected recycled water, projected groundwater, and local surface water available to meet the demands. The net demand remaining after conservation and all local sources have been accounted for must be supplied by the Water Authority. A summary of these values is shown in Table 3-7.

The quantities for recycled water, groundwater, and conservation shown in Table 3-7 are relatively constant for any given weather pattern and corresponding hydrologic sequence. Surface water supplies, on the other hand, can vary considerably with weather patterns and have a greater influence on the net demand on the Water Authority. Figure 3-8 depicts an example of the influence of local member agency supplies on the Net Demand on the Water Authority and, in particular, illustrates the range in local surface water supplies and demands on the Water Authority when taking into account annual weather variability. Water conservation and member agency supplies are projected to reduce the gross demand by over 130,000 AF in the year 2035. However, supply/demand gaps, as shown in Figure 3-8 for years 2015 and 2029, may occur as a result of multiple dry-year conditions and the drawdown of local storage supplies.

In the analyses for the 2013 Master Plan, it was assumed that the verifiable local supplies would reduce the demands on the Water Authority. However, in the scenario planning approach considered in this study, differing levels of conservation and local supply development were explored to investigate their effect on Water Authority delivery reliability.

TABLE 3-7
Projected Net Demand on Water Authority – Normal Weather Year

		Member Agency Supplies				
Forecast Year	**Total Demand (AF)**	**Surface Water (AF)**	**Recycled Water (AF)**	**Groundwater (AF)**	**Conservation (AF)**	**Demand on Water Authority (AF)**
2015	654,000	48,200	38,700	22,000	6,700	538,400
2020	722,100	47,900	43,700	26,600	47,000	556,900
2025	790,200	47,900	46,600	27,600	72,200	595,900
2030	850,900	47,500	48,300	28,400	97,300	629,400
2035	903,200	47,300	50,000	28,400	117,500	660,000



* Applying 1986 hydroclimatic conditions

FIGURE 3-8
Example Annual Trace for 2015-2035* with a Future Supply Portfolio without Supplemental Supplies

Chapter 4.0 Scenario Planning

4.1 Overview

Water supply reliability for the San Diego region is very dependent on numerous federal, state, and local decisions that affect resource management and demographic makeup. For example, at the federal- and state-level decisions are related to management of the Bay-Delta and Colorado River supplies. At a more local level, issues are covering regional population estimates, land use, hydrologic variability, the effectiveness of conservation programs, and member agency local supply development. Given the many factors, each with the potential to affect water variability, the precise trajectory of supply and demand, and the resulting state of the physical system over time, are uncertain and cannot be represented by a single view of the future.

In light of this uncertainty, the 2013 Master Plan has utilized a scenario planning approach to consider and portray a range of plausible futures that are based on reasonable assumptions limiting the outcomes, or variability, of resource management issues. A scenario planning approach was also applied to assess water supply reliability in the 2010 UWMP (Water Authority, 2011a), allowing for the identification of potential water management strategies to address projected supply shortfalls. For the 2013 Master Plan, many of the resource decisions and demographics included in the 2010 UWMP were expanded to provide increased awareness of how each factor may affect the timing and need for new infrastructure improvements. The Master Plan Scenarios were not developed to establish local supply development goals or target conservation savings. Instead, the Master Plan scenarios were developed to assess infrastructure needs should any of the factors, or combination of factors, result in a demand trajectory on the Water Authority that differs significantly from the projections in the 2010 UWMP. The Master Plan scenarios also provide greater awareness of adaptive management decisions affecting long-term facility requirements. The most significant of the expanded factors considered in the Master Plan was the use and analysis of 112 years of historical hydrology to assess the variability of local surface water supplies. The scenario planning approach is summarized in Table 4-1.

TABLE 4-1
Summary of Scenario Planning

Analysis Component	Description
Scenario Planning Approach	Rather than providing one prediction or forecast of the future, scenarios present alternative views of how the future might unfold. A set of well-constructed scenarios represents a range of plausible futures that assists in the assessment of future risks and the development of mitigation and adaptation options and strategies.
Scenario Development for the 2013 Master Plan	
Scenario A: UWMP Projection	The 2013 Master Plan took two approaches to the UWMP Scenario (which was the 2013 Master Plan baseline assumption): Scenario A1, UWMP, and Scenario A2, UWMP with Demand Pattern Uncertainty, due to consideration of climate effect on outdoor demands.

TABLE 4-1
Summary of Scenario Planning

Analysis Component	Description
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 (Water Authority, 2011a).
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.
Comparison of Scenarios	Table 4-3 presents a comparison of the scenarios in terms of theme, purpose, gross demand assumptions, climate change, conservation, QSA supplies, member agency supplies, and MWD supplies. Each scenario assumed baseline projects that included Carlsbad Desalination Project online by 2016.

Figure 4-1 shows the overall 2013 Master Plan process and the associated chapters. Highlighted in this figure is the step in that establishes the scenarios considered for the planning process. The scenarios represent a range of possible future conditions that are presented in this *Scenario Planning* chapter (*Chapter 4*).

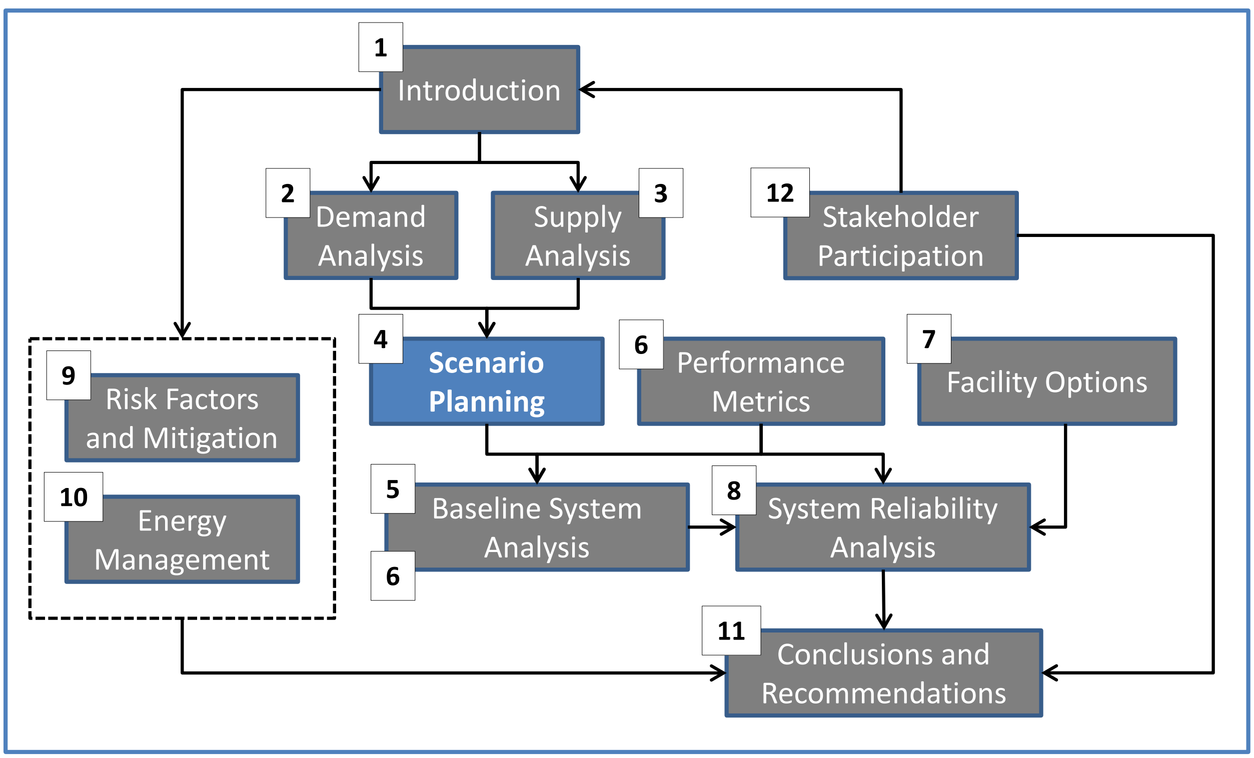


FIGURE 4-1
Elements and Associated Chapters Included in the Master Plan

4.2 Scenario Planning Process

As described in Section 4.1, scenarios were developed based on the major driving forces and critical uncertainties influencing the operation and reliability of the Water Authority system. The purpose of the scenarios was to evaluate the performance of the Water Authority's system under a range of different supply and demand outcomes and to test the sensitivity of anticipated future infrastructure to these various outcomes. The Master Plan scenarios are not intended to establish goals or targets for local supply development or conservation savings.

This chapter focuses on Scenario Development and describes the scenario planning approach, development of the specific scenarios, and how other Water Authority documents supported the development of a logical and defensible range of plausible futures.

4.2.1 Terminology

To establish a common understanding of the key project elements and processes specific to the scenario planning approach used for the 2013 Master Plan, the following project terminology is used:

Storylines – Narratives that describe the estimated trajectory for demand and supplies during the planning horizon. Narratives help in shaping and understanding the 2013 Master Plan Scenarios.

Scenarios – Combinations of demand and supply conditions that include a range of futures from forecasted to boundary conditions that aid in analyzing uncertainties beyond the control of the Water Authority.

System Configuration – Water Authority system configured in model runs, which includes elements such as pipelines, storage, treatment, and supply assumptions. System configuration also includes basic operational assumptions, such as reservoir rule curves and treatment plant utilization priorities.

Baseline System – Representation of the Water Authority's system that includes projects planned for implementation by the end of fiscal year 2014, the Carlsbad Desalination Project, and completion of the San Vicente Dam Raise Project. The Baseline Facilities Configuration is also considered the starting point for identifying future system improvements to be addressed by 2013 Master Plan options.

Options – Water Authority projects or programs within its control that can optimize the capacity, operation, and reliability of the supply, conveyance, treatment, and storage system.

4.2.2 Planning Scenarios

Planning for the future needs of the residents of San Diego County involves assumptions of how the future may unfold over time. However, the precise trajectory of how future supply and demand conditions may play out over time cannot be represented by a single view of the future. Scenario approaches have been widely applied in water planning and management, from global to regional scales, although specific methodologies can vary considerably.

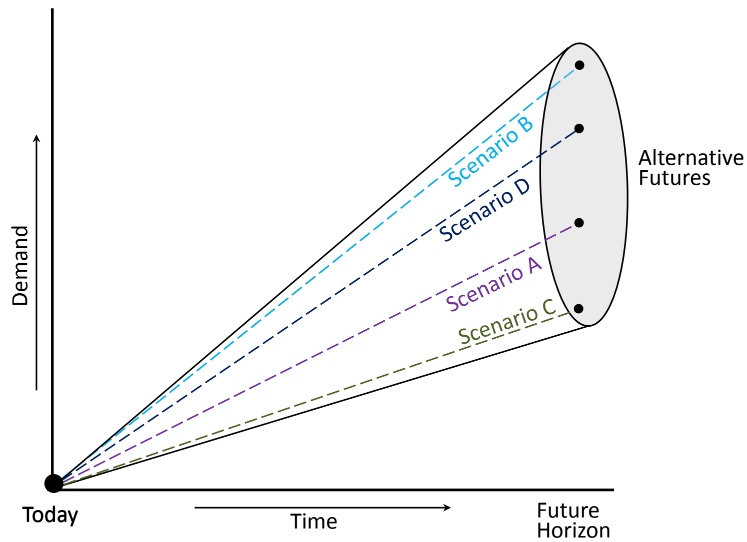


FIGURE 4-2
Conceptual Representation of the Uncertain Future of a System, also known as "The Scenario Funnel" (adapted from Timpe and Scheepers, 2003)

Scenarios are not predictions or forecasts of the future, but are alternative views of how the future might unfold. A set of well-constructed scenarios represents a range of plausible futures that assists in the assessment of future risks and the development of optimization and adaptation strategies. In scenario planning, a range of plausible futures, represented by the funnel shown in Figure 4-2, can be identified. The suite of scenarios used in the planning effort should be sufficiently broad to span the range of supply and demand conditions.

Scenario planning generally involves the steps outlined in Figure 4-3, with the objectives of the planning effort framed as a question or series of questions. Scenarios are then developed that account for the range of future conditions by considering the driving forces that must be responded to (such as water demands and supply availability) and uncertainties that are beyond the Water Authority's control (such as weather conditions and climate change). Narratives are then generated, describing the range of conditions that can be anticipated, and the pertinent parameters that can be measured and quantified are established for each scenario. Options development involves analyzing the existing system under each of the planning scenarios to identify the existing (Baseline) system's response, evaluating the results of this analysis to identify potential service gaps, and identifying potential solutions, that is, specific project options, alternatives or strategies that can be employed to alleviate the predicted gaps. The system is then analyzed with the implementation of the potential solutions to assess their effectiveness in mitigating the predicted gaps.

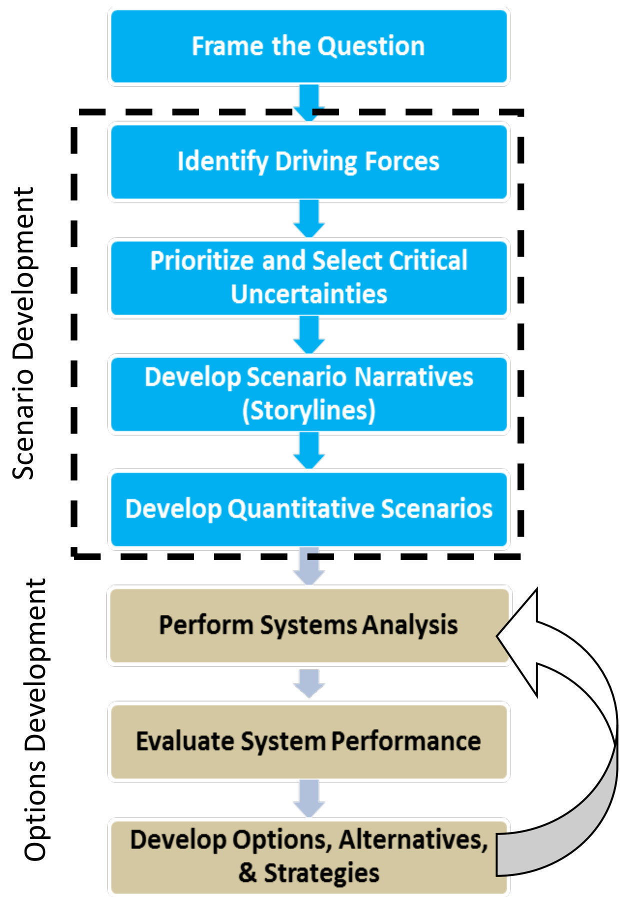


FIGURE 4-3
Steps Considered in the Scenario Development and Options and Alternatives Development Phases of the Study

4.3 Scenario Development for the 2013 Master Plan

Framing the question to be addressed is important in developing the scenarios that will be analyzed. The 2013 Master Plan advanced two fundamental questions: (1) "What is the reliability of the Water Authority system under projections of future supply and demand?" and (2) "What are the options that will ensure future system reliability for various resource mixes?" The first question directly relates to incorporating future uncertainty and was the focus of the scenario development process.

Many driving forces may contribute to future uncertainty in Water Authority supplies, demands, and infrastructure needs. Such uncertainties, which are largely external to the control of the Water Authority, are considered along with internal aspects affecting how the Water Authority manages, operates, or invests in infrastructure. Scenarios can be considered as multiple representations of future baseline conditions (external factors), from which each action to be considered in the 2013 Master Plan Update was tested. The supply and demand uncertainties that were considered are listed in Table 4-2.

TABLE 4-2
Supply and Demand Uncertainties

Supply Uncertainties Location, Magnitude, and Timing of Supplies	Demand Uncertainties Location, Magnitude, and Timing of Demands
• MWD imported supply reliability • Timing of local supply development programs (recycling, desalination, groundwater) outside of Water Authority control • Climate change affecting supply reliability • Regulatory changes influencing supply availability	• Demographics/population • Regional economy • Price elasticity of water • Water use efficiency (passive and mandated, SBX7-7) • Climate change influence on annual and peak demands • Seasonal and diurnal demand patterns • Regional integration • Annexation of new service areas

While all of the uncertainties in Table 4-2 were considered in the early scenario scoping, several uncertainties were combined in the development of actual supply and demand scenarios. For example, uncertainty surrounding the future of Bay-Delta exports, SWP supplies, and Colorado River supplies were incorporated by considering MWD imported supply reliability uncertainties. The following scenarios and storylines developed for the 2013 Master Plan are further described in the following sections.

Master Plan Supply-Demand Scenarios

Scenario	Description
A – Urban Water Management Plan	Assumptions for local supply development, conservation targets, imported supply reliability match 2010 UWMP
B – Reduced Local Supplies	Assumes lower local supply development, reduced conservation savings, reduced imported supply reliability, and climate change impacts
C – Enhanced Local Supplies	Assumes enhanced local supply development, increased conservation savings and imported supply reliability per 2010 UWMP
D – Adjusted Local Supplies	Assumes local supply and conservation savings adjusted to reach 50 percent of targets, imported supply reliability per 2010 UWMP

4.3.1 Scenario A – 2010 Urban Water Management Plan Projection

This scenario essentially reflects the 2010 UWMP estimate of demographic projections, growth patterns, local supply development, and conservation achievement. The Water Authority's supply diversification mix is largely achieved with a mix of reliable supplies from the QSA agreements, MWD supplies, local supply programs, and the Carlsbad Desalination Project. Conservation programs continue to reduce demand up to the SBX7-7 target of 167 gallons per capita per day (GPCD) by 2020, but no further reductions are considered. MWD supplies are based on the findings in the MWD *Regional Urban Water Master Plan*, indicating that supplies would be reliable for meeting Water Authority demands in normal and single dry years (MWD, 2010b). During multiple dry years, however, the 2010 UWMP assumed that MWD would allocate water to its member agencies, and the Water Authority's allocation would be based on its preferential right (18.7 percent), with MWD's total supply, assumed to be 1.8 MAF. Local recycling and brackish groundwater projects would continue to be developed, but at a modest ("verifiable") pace, and the Carlsbad Seawater Desalination Plant will commence deliveries in 2016.

Two scenario branches exist under this storyline to reflect future demand uncertainty. The first branch (A1) assumed annual demands based on SANDAG's population projections and seasonal/daily demand patterns based on historical water deliveries. The second branch (A2) considered modest increases in annual demands due to the effects of climate change (approximately 2 percent increase over the study period), with more pronounced seasonal/daily demand patterns (an increase of up to 3 to 10 percent during March through July) due to climate effects on outdoor demand behavior.

4.3.2 Scenario B – Reduced Imported Supplies, Climate Change, and Lower Local Supply Development

This storyline explores two main differences from the Scenario A – 2010 UWMP storyline. In this scenario, the regional economy would experience greater growth and consumer spending and lead to a reduced emphasis on conservation. Only passive conservation levels would be achieved, while the public focus would be on the benefits of regional economic growth. Regional agencies would lessen the messaging on conservation while seeking financial stability by reduced local supply development. Meanwhile, climate change would occur consistent with recent model projections and lead to a modest increase in annual and seasonal water demands, as described previously for Scenario A2.

Supplies from MWD would be further limited in dry conditions due to continued pressures on the SWP and Colorado River systems. During multiple dry years, it was assumed that MWD would allocate water to its members, and the Water Authority's allocation would be based on its preferential right (18.7 percent), with total supply assumed to be 1.5 MAF. The IID-Water Authority transfer program and Carlsbad Desalination Project would continue as planned. Net demand on the Water Authority would be greater than the projections under the 2010 UWMP. With the assumptions of lower local supply development, Scenario B represents the upper bracket for net demands on the Water Authority.

4.3.3 Scenario C – Enhanced Local Resource Management

Under Scenario C, the recent growing trend of local supply development and demand management would take hold and accelerate in a significant way. Local, verifiable water supply projects would be completed more rapidly than assumed in the 2010 UWMP, and several additional "planned" and "conceptual" projects identified in the 2010 UWMP would be implemented over the timeframe of the 2013 Master Plan. This scenario assumes there is less member agency need for a regional supply project. Water conservation continues at a more rapid rate than established in the SBX7-7 targets of 167 GPCD by 2020, and further reductions in demand would be achieved through 2035 (an additional 10 percent to 150 GPCD by 2035). More aggressive conservation targets would be established at either the local or state/federal level, creating the driver for these changes.

The Water Authority's QSA supplies would continue to ramp up to full implementation as soon as planned. The demand for MWD supplies would be reduced with the growing emphasis on local supply enhancement and demand management programs. However, MWD supplies would remain a significant and important part of the resource mix. During multiple dry years, it was assumed that MWD would allocate water to its members, and the Water Authority's allocation would be based on its preferential right (18.7 percent), with total supply assumed to be 1.8 MAF. Under this scenario, net demands on the Water Authority would be less than the 2010 UWMP projections. With the assumptions for a higher level of local supply development, Scenario C represents the lower bracket for net demand on the Water Authority.

4.3.4 Scenario D – Adjusted Local Supply Development

The Adjusted Local Supply Development Scenario reflects the 2010 UWMP estimate of demographic projections and growth patterns. Local supply development and conservation achievement is reduced to 50 percent of what was considered verifiable for the 2010 UWMP. The Water Authority's supply diversification mix is largely achieved with a mix of reliable supplies from the IID-Water Authority transfer programs, MWD supplies, local supply programs, and the Carlsbad Desalination project. Conservation programs would continue to reduce demand, but only up to 50 percent of the SBX7-7 target of 167 GPCD. The Water Authority's QSA supplies would be delivered in accordance with current agreements. MWD supplies would be based on findings in the MWD *Regional Urban Water Master Plan*, indicating that supplies would be reliable for meeting Water Authority demands in normal and single dry years (MWD, 2010b). During multiple dry years, however, it was assumed that MWD would allocate water to its members, and the Water Authority's allocation would be based on its preferential right (18.7 percent), with MWD's total supply assumed to be 1.8 MAF. Local recycling and brackish groundwater projects would continue to be developed, but at a reduced rate of 50 percent of the verifiable project yield stated in the 2010 UWMP. The Regional Carlsbad Seawater Desalination Facility will commence deliveries in 2016. Under Scenario D, net demands on the Water Authority would be greater than the 2010 UWMP projections, but less than Scenario B.

4.4 Comparison of Scenarios

Table 4-3 compares the 2013 Master Plan scenarios against nine criteria: theme, purpose, gross demand assumptions, climate change, conservation, QSA supplies, Carlsbad Desalination project, member agency supplies, and MWD supplies. The resulting net demands on the Water Authority demands (or NeDWAF, defined in *Chapter 2 – Regional Demand Analysis*) associated with the scenarios are shown in Figure 4-4. As shown in the figure, there is considerable uncertainty with respect to the range of future demands. By 2020, normal year demands are projected to range between 519 and 640 TAF, with 557 TAF considered in the UWMP scenarios. By 2035, the normal year demands range from 610 to 826 TAF, with 660 TAF considered in the UWMP scenarios. The results demonstrate the considerable range of forecasted Water Authority demands that were considered in evaluating future infrastructure needs and depict the influence of local supply development and conservation on Water Authority demands. Tables 4-4, 4-5, 4-6, and 4-7 provide summaries of the projected water resource mix to meet the demands anticipated under each of the four 2013 Master Plan scenarios.

TABLE 4-3
Scenarios for Use in the Master Plan

Name	Scenario A1 *2010 UWMP*	Scenario A2 *2010 UWMP with Demand Pattern Uncertainty*	Scenario B *Limited MWD Supplies under Regional Economic Focus and Climate Change*	Scenario C *Enhanced Local Resource Development*	Scenario D *Adjusted Local Supply Development*
Theme	Current estimates used in Water Authority planning and represents supply and demand consistent with 2010 UWMP assumptions.	Seasonal and daily demand patterns are important and uncertain with impacts to conveyance-related reliability measures.	Imported water uncertainty is significant, especially in dry years and, when coupled with factors that may slow the reduction in demands or the development of local project, presents an important bracketing scenario.	Local supply development and demand management are the focus with less willingness for regional solutions. Presents an important bracketing scenario.	Member agency local supply development and conservation savings reach 50 percent of planned amounts (allows for member agency uncertainty to meet established targets). Provides an intermediate scenario to compare project timing against the baseline.
Purpose	Assists in exploring the reliability of the Water Authority system under the current best available supply and demand projections.	Assists in evaluating the effect of demand pattern uncertainty associated with projected climate change, behavior shifts, and/or future agricultural demands	Emphasis of scenario is to explore the high-demand, low-import supply interactions. Allows exploration of the range and magnitude of widening supply-demand imbalances.	Emphasis of scenario is to consider a shift to more active member agency resource planning and management. Allows exploration of the lower demands on the Water Authority than considered in the 2010 UWMP.	Assists in exploring the reliability of the Water Authority system under the current best available demand projections dependent on 50 percent of local supply development.
Gross Demand Assumptions	Per 2010 UWMP projections, consistent with SANDAG population projections, accelerated growth forecast, and some annexations.	Per 2010 UWMP projections, consistent with SANDAG population projections, accelerated growth forecast, and some annexations.	Per 2010 UWMP projections, consistent with SANDAG population projections, accelerated growth forecast, and some annexations.	Per 2010 UWMP projections, consistent with SANDAG population projections, accelerated growth forecast, and some annexations.	Per 2010 UWMP projections, consistent with SANDAG population projections, accelerated growth forecast, and some annexations.
Climate Change	None	Climate effect on outdoor demands considered.	Climate effect on outdoor demands considered. Limited MWD supplies could stem from climate-related impacts on SWP and/or Colorado River systems.	None	None

TABLE 4-3
Scenarios for Use in the Master Plan

Name	**Scenario A1** ***2010 UWMP***	**Scenario A2** ***2010 UWMP with Demand Pattern Uncertainty***	**Scenario B** ***Limited MWD Supplies under Regional Economic Focus and Climate Change***	**Scenario C** ***Enhanced Local Resource Development***	**Scenario D** ***Adjusted Local Supply Development***
Conservation	Per SBX7-7 targets by 2020 as described in the 2010 UWMP; no further reductions considered.	Per SBX7-7 targets by 2020 as described in the 2010 UWMP; no further reductions considered.	Slow adoption of SBX7-7 targets. Agencies maintain current credits for recycled water supplies for SBX7-7 achievement, but no further reductions.	SBX7-7 targets are achieved more rapidly and are further reduced by 2035. Assumes GPCD is further reduced by 10 percent to 150 GPCD by 2035.	At an amount of 50 percent per SBX7-7 targets by 2020 as described in the UWMP; no further reductions considered.
QSA Supplies	Developed as planned.	Developed as planned.	Developed as planned.	Developed as planned.	Developed as planned.
Carlsbad Desalination Project	Developed as planned; online by 2016.	Developed as planned; online by 2016.	Developed as planned; online by 2016.	Developed as planned; online by 2016.	Developed as planned; online by 2016.
Member Agency Supplies	Projects that met the 2010 UWMP “verifiable” criteria included.	Projects that met the 2010 UWMP “verifiable” criteria included.	Member agency projects, even “verifiable” projects, are delayed or shelved such that implementation in the timeframe for the 2013 Master Plan Update is not included.	2010 UWMP “verifiable” projects are implemented at a faster rate, and some “planned” and “conceptual” projects are implemented by 2035.	At an amount of 50 percent of projects that met the 2010 UWMP “verifiable” criteria included.
MWD Supplies	Considered reliable in normal and single dry years. Allocated according to Preferential Right of 18.7 percent of 1.8 MAF in multiple dry years.	Considered reliable in normal and single dry years. Allocated according to Preferential Right of 18.7 percent of 1.8 MAF in multiple dry years.	Considered reliable in normal and single dry years. Allocated according to Preferential Right of 18.7 percent of 1.5 MAF in multiple dry years.	Considered reliable in normal and single dry years. Allocated according to Preferential Right of 18.7 percent of 1.8 MAF in multiple dry years.	Considered reliable in normal and single dry years. Allocated according to Preferential Right of 18.7 percent of 1.8 MAF in multiple dry years.

Source: 2010 UWMP (Water Authority, 2011a)

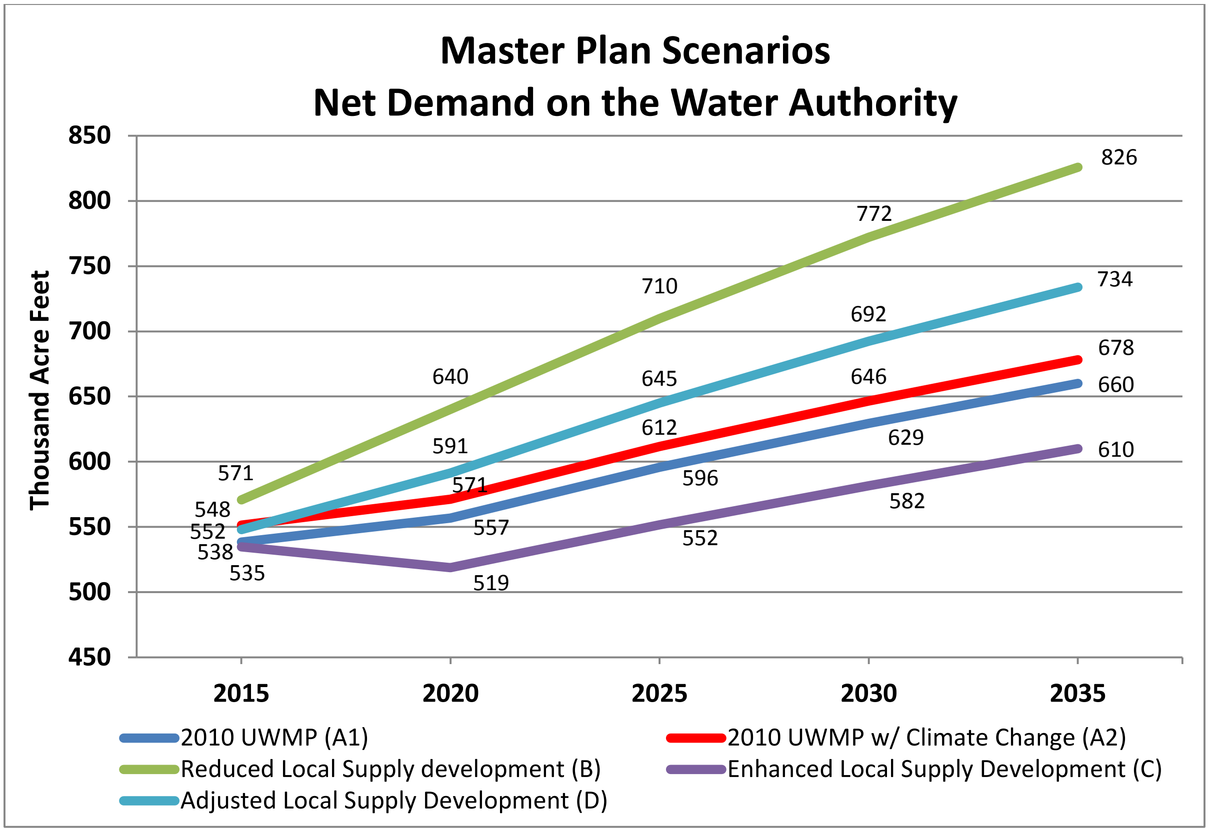


FIGURE 4-4
Comparison of Water Authority Demands Considered in Master Plan Scenarios

TABLE 4-4
Scenario A – 2010 UWMP Supplies/Demands

	Normal Water Year – Projected Resource Mix (AF/YR)				
	2015	**2020**	**2025**	**2030**	**2035**
Total Demand less Conservation	647,300	675,100	718,000	753,600	785,700
Member Agency Supplies	**108,900**	**118,200**	**122,100**	**124,100**	**125,600**
Surface Water	48,200	47,900	47,900	47,500	47,300
Groundwater	11,700	11,100	12,100	12,800	12,800
Brackish Water	10,300	15,500	15,500	15,500	15,500
Recycled Water	38,700	43,700	46,600	48,300	50,000
Water Authority Supplies	**180,200**	**326,200**	**336,200**	**336,200**	**336,200**
QSA Transfers	180,200	270,200	280,200	280,200	280,200
Carlsbad Desalination Project	-	56,000	56,000	56,000	56,000
MWD Supplies	**358,200**	**230,700**	**259,700**	**293,300**	**323,900**
Net Demand on Water Authority	**538,400**	**556,900**	**595,900**	**629,500**	**660,100**

Source: 2010 UWMP (Water Authority, 2011a)

TABLE 4-5
Scenario B – Lower Local Supply Development

	Normal Water Year – Projected Resource Mix (AF/YR)				
	2015	**2020**	**2025**	**2030**	**2035**
Total Demand less Conservation	667,100	736,400	806,000	867,900	921,300
Member Agency Supplies	**96,400**	**96,100**	**96,100**	**95,700**	**95,500**
Surface Water	48,200	47,900	47,900	47,500	47,300
Groundwater	10,000	10,000	10,000	10,000	10,000
Brackish Water	10,300	10,300	10,300	10,300	10,300
Recycled Water	27,900	27,900	27,900	27,900	27,900
Water Authority Supplies	**180,200**	**326,200**	**336,200**	**336,200**	**336,200**
QSA Transfers	180,200	270,200	280,200	280,200	280,200
Carlsbad Desalination Project	-	56,000	56,000	56,000	56,000
MWD Supplies	**390,500**	**314,100**	**373,700**	**435,900**	**489,600**
Net Demand on Water Authority	**570,700**	**640,300**	**709,800**	**772,100**	**825,800**

TABLE 4-6
Scenario C – Enhanced Local Resource Development

	Normal Water Year – Projected Resource Mix (AF/YR)				
	2015	**2020**	**2025**	**2030**	**2035**
Total Demand less Conservation	646,600	670,400	710,800	743,900	773,900
Member Agency Supplies	**111,900**	**151,400**	**159,200**	**162,200**	**163,600**
Surface Water	48,200	47,900	47,900	47,500	47,300
Groundwater	11,700	11,100	12,100	12,800	12,800
Brackish Water	10,800	27,200	27,200	28,200	28,200
Recycled Water	41,200	65,200	72,000	73,700	75,500
Water Authority Supplies	**180,200**	**326,200**	**336,200**	**336,200**	**336,200**
QSA Transfers	180,200	270,200	280,200	280,200	280,200
Carlsbad Desalination Project	-	56,000	56,000	56,000	56,000
MWD Supplies	**354,500**	**192,700**	**215,400**	**245,400**	**273,900**
Net Demand on Water Authority	**534,700**	**518,900**	**551,600**	**581,600**	**610,100**

TABLE 4-7
Scenario D – Adjusted Local Supply Development

	Normal Water Year – Projected Resource Mix (AF/YR)				
	2015	**2020**	**2025**	**2030**	**2035**
Total Demand less Conservation	650,700	698,600	754,100	802,300	844,400
Member Agency Supplies	**102,600**	**107,100**	**109,100**	**109,900**	**110,600**
Surface Water	48,200	47,900	47,900	47,500	47,300
Groundwater	10,800	10,500	11,000	11,400	11,400
Brackish Water	10,300	12,900	12,900	12,900	12,900
Recycled Water	33,300	35,800	37,300	38,100	39,000
Water Authority Supplies	**180,200**	**326,200**	**336,200**	**336,200**	**336,200**
QSA Transfers	180,200	270,200	280,200	280,200	280,200
Carlsbad Desalination Project	-	56,000	56,000	56,000	56,000
MWD Supplies	**367,800**	**265,100**	**308,800**	**356,000**	**397,600**
Net Demand on Water Authority	**548,000**	**591,300**	**645,000**	**692,300**	**733,900**

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Chapter 5.0 Description of Baseline System and CIP Projects Considered in the Master Plan

5.1 Overview

A thorough examination of the capabilities of the existing aqueduct system was performed to ensure 1) optimal use of the existing system of conveyance, treatment, and storage facilities; and 2) new infrastructure will be implemented at the appropriate timeframe to match the most recent projections of future supplies and demands.

This chapter describes the "Baseline System," which consists of the Water Authority's existing aqueduct system, all ongoing infrastructure improvements that will be completed and placed in service by 2015, and the Carlsbad Desalination Project. The Baseline System represents the components of the aqueduct system that will be in service at the beginning of the 2013 Master Plan planning horizon.

This chapter also describes a number of other existing CIP projects that were re-evaluated under the 2013 Master Plan but are not part of the Baseline System. These other existing CIP projects were re-evaluated to determine if there is still a need for these projects and, if so, to identify an appropriate scope and implementation timeframe. The re-evaluation of the existing projects is discussed in *Chapter 8 – System Reliability with Facility Options*, and the results are included in *Chapter 11 – Conclusions and Recommendations*.

This 2013 Master Plan primarily focused on evaluating existing CIP projects that would address supply shortfalls, conveyance constraints, and aqueduct system operational concerns. Other projects within the existing CIP, including projects that address environmental mitigation, building improvements, and the replacement and rehabilitation of existing infrastructure, have not been evaluated as part of this master planning process.

Topics covered by this chapter are summarized in Table 5-1 and described in more detail in the sections that follow.

TABLE 5-1
Overview of Baseline System and Current CIP Projects

Analysis Component	Description
Baseline System	Baseline System facilities include the existing aqueduct system, ongoing CIP construction projects, and the Carlsbad Desalination facility.
Evaluation of Existing CIP Projects	Existing CIP projects evaluated in the 2013 Master Plan include projects that would address supply shortages, increase conveyance capacity, and improve the physical operation of the aqueduct system.

Figure 5-1 shows the overall 2013 Master Plan process and the associated chapters. Highlighted in this figure is the step to assess the performance of the Water Authority's

Baseline System. The evaluation of the Baseline System is described in *Chapter 6 – Baseline System Reliability*.

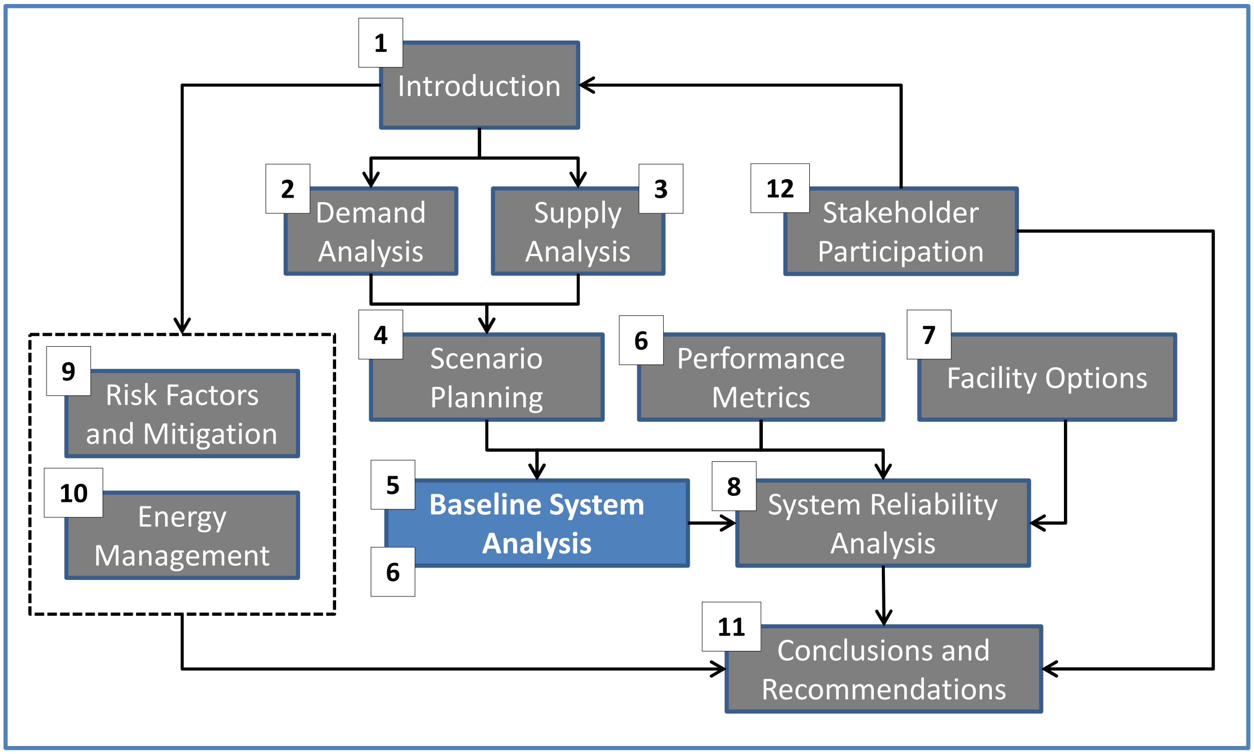

FIGURE 5-1
Relationships Between 2013 Master Plan Chapters and Planning Process

5.2 Existing Aqueduct System

The Water Authority's aqueduct system is a complex network of large-diameter pipelines, pumping stations, control and metering facilities, water treatment plants, and storage reservoirs that delivers both treated and untreated water service to the member agencies. The pipelines are divided into two aqueduct alignments, both of which originate at Lake Skinner in southern Riverside County and run in a north-to-south direction through the Water Authority service area. In addition to the north-south pipelines, several east-west pipelines extend service to multiple member agencies. A list of the major pipelines owned and operated by the Water Authority is provided in Table 5-2, with the pipeline locations shown in Figure 5-2.

TABLE 5-2
Water Authority Pipelines

Pipelines	Length (miles)	Diameter (inches)
First San Diego Aqueduct:		
Pipeline 1 and Pipeline 2	64.4	48
La Mesa-Sweetwater Extension	16.4	18–48
Moreno-Lakeside Pipeline	4.5	54–60
Second San Diego Aqueduct:		
Pipeline 3	57	66–75
Pipeline 4	75	69–108
Pipeline 5	33.3	96–108

TABLE 5-2
Water Authority Pipelines

Pipelines	Length (miles)	Diameter (inches)
East-West Pipelines:		
Crossover Pipeline	7.5	66
North County Distribution Pipeline	4.5	72
Tri-Agencies Branch Pipeline	6.4	21–42
Ramona Pipeline	7.2	36–57
Valley Center Pipeline	4.5	66
Olivenhain Pipeline	4.5	78
Olivenhain-Hodges Pipeline	1.5	120
San Vicente Pipeline	11	102

FIGURE 5-2
Water Authority Pipeline System
Source: 2010 UWMP

5.2.1 First Aqueduct

The First Aqueduct consists of Pipelines 1 and 2, which are located in a common right-of-way and are operated as a unit. North of the Crossover Pipeline, the First Aqueduct delivers treated water from MWD's Skinner WTP with a capacity of 180 cubic feet per second (cfs). The transition of ownership from MWD to the Water Authority is six miles south of the San Diego county boundary (the "MWD Delivery Point"). Treated water delivered through the First Aqueduct serves Fallbrook, Rainbow, Rincon, Vallecitos, Valley Center, Vista, and Yuima. Three Water Authority service connections on the First Aqueduct are north of the delivery point.

South of the Crossover Pipeline, the First Aqueduct is refilled with untreated water via a connection with the Crossover Pipeline. The capacity of the First Aqueduct below this connection is 190 cfs. The First Aqueduct terminates at the San Vicente Reservoir in Lakeside. Untreated water delivered through the Crossover-First Aqueduct system serves Escondido, Helix, Poway, Ramona, San Diego, and Vista. The capacity of the Crossover Pipeline is 200 cfs. Water delivered to Helix at its Levy WTP is also treated to supplement the demands of Padre Dam, Lakeside, and Otay through a contractual agreement between the Water Authority and Helix, whereby the Water Authority has a 36 mgd capacity right in the Levy WTP.

5.2.2 Second Aqueduct

Pipelines 3, 4, and 5 form the Second Aqueduct. Each of these pipelines is operated independently. All three pipelines run from the MWD Delivery Point, six miles south of the county boundary, to the Diversion Structure in Twin Oaks Valley, and continue south to a point where the Second Aqueduct crosses Interstate 15 in the Mira Mesa area. Pipeline 5 terminates just north of Interstate 15, while Pipelines 3 and 4 continue to the south end of the County, terminating at the City of San Diego's Lower Otay Reservoir. The Second Aqueduct pipelines deliver both treated and untreated water.

5.2.2.1 Reach from Metropolitan Delivery Point to Twin Oaks Valley Diversion Structure

The design capacity for Pipeline 3 is 280 cfs, Pipeline 4 is 470 cfs, and Pipeline 5 has a design capacity of 500 cfs at the delivery point from MWD. Within this reach, Pipelines 3 and 5 are used to deliver untreated water, and Pipeline 4 is used to deliver treated water. Untreated water is delivered to Oceanside's Weese WTP and the Water Authority's Twin Oaks Valley WTP. Pipeline 4, operating in conjunction with the First Aqueduct, provides a total treated-water delivery capacity of approximately 615 cfs to the Water Authority's service area from MWD. Treated water is delivered in this reach of Pipeline 4 to Fallbrook, Oceanside, Rainbow, Vallecitos, Valley Center, and Vista. The Valley Center Pipeline is a treated water pipeline running from west to east that interconnects Pipeline 4 with Pipelines 1 and 2. The Valley Center Pipeline can be used to supplement treated flows in either direction. The Water Authority also operates the North County Distribution Pipeline (NCDP) in this reach. This pipeline extends from Pipeline 4 to the west, and delivers treated water to Oceanside, Vista, Vallecitos, and Rainbow from both Pipeline 4 and Oceanside's Weese WTP.

5.2.2.2 Reach from Twin Oaks Valley Diversion Structure to Interstate 15

Pipelines 3, 4, and 5 continue in this reach. Currently, Pipeline 3 conveys treated water south of Twin Oaks. When the Carlsbad Desalination Plant comes online in 2016, a 5.5-mile portion of Pipeline 3 will be re-purposed north of the San Marcos vent to convey product water from the Carlsbad desalination plant to the clearwells at the Twin Oaks Valley WTP. South of the San Marcos Vents, Pipeline 3 will continue to operate as a treated-water gravity-flow pipeline. Pipeline 4, which has a capacity of 450 cfs, conveys treated water. Pipeline 4 will refill Pipeline 3 south of the San Marcos vent, where Pipeline 3 capacity is 200 cfs. Treated water is delivered to Vallecitos, Carlsbad, Vista, Oceanside, Olivenhain, San Dieguito, Santa Fe, City of San Diego, Del Mar, and Ramona in this reach. Pipeline 5 has a capacity of 636 cfs and is used to deliver untreated water to the Badger and David C. McCollom WTPs. The Water Authority operates two lateral lines in this reach, the Tri-Agency Pipeline (TAP) and the Ramona Pipeline. The TAP delivers treated water to Vista, Carlsbad, and Oceanside. The Ramona Pipeline is a treated-water line that runs from west to east and delivers water from the Second Aqueduct to Ramona and portions of Olivenhain and the City of San Diego.

5.2.2.3 San Vicente Pipeline (Connected to the Second Aqueduct)

The San Vicente Pipeline is a bi-directional east-west pipeline that delivers untreated water from Pipeline 5 to the San Vicente, El Capitan, and Jennings Reservoirs and the Levy WTP. Pipeline capacity is 444 cfs. The San Vicente Pipeline normally fills San Vicente reservoir for emergency, carryover, and operational storage. To meet peak untreated water demands and during emergency operations, the San Vicente Pump Station is used to pump backflows from San Vicente reservoir to Pipeline 5. The San Vicente Pump Station has a current capacity that varies between 240 and 296 cfs depending on the water surface elevation in San Vicente, with a planned capacity of 444 cfs.

5.2.2.4 Reach from Interstate 15 to Miramar WTP

Four pipelines span the reach from the Miramar Vents to the City of San Diego's Miramar WTP: Pipelines 3, 4, 4A, and 4BI. Pipelines 3, 4, and 4A are located in the same right-of-way, operate as a single pipeline, and deliver untreated water. Pipeline 3 is currently not in use. This pipeline was taken out of service as part of a sequential series of relining projects. Pipeline 3 will be returned to service between Interstate 15 and the Miramar WTP in 2017, following completion of the Nob Hill Modifications project. Pipeline 4BI is used to deliver treated water and is generally located in a separate alignment from the other three pipelines in this reach.

5.2.2.5 Reach from Miramar WTP to Alvarado WTP

Pipelines 3 and 4 are used to convey untreated water. These pipelines are operated independently, with Pipeline 4 terminating at the Alvarado WTP and Pipeline 3 extending to Lower Otay. Pipeline 3 is currently out of service within this reach. This pipeline was taken out of service as part of a sequential series of relining projects, and will remain out of service until untreated water demands increase above the capacity of Pipeline 4. Pipeline 4 has a capacity of 220 cfs and is used to deliver untreated water to the Alvarado WTP. Just north of the WTP, Pipeline 4 is connected to Pipeline 3 via a temporary 30-inch interconnection. The 30-inch interconnection is used to refill Pipeline 3 and has a capacity of

70 cfs. This interconnection is considered a temporary facility that was only intended to remain in operation until the original completion date for the Mission Trails suite of projects. With adoption of the fiscal year 2011 budget, the Mission Trails projects were delayed indefinitely.

Treated water in this reach is delivered through Pipelines 4BI and 4BII, which operate as a single pipeline and have a capacity of 410 cfs. Pipeline 4BII is connected to the Missions Trails Flow Regulatory Structure (FRS), and provides regulatory storage for the treated water pipeline south of Mission Trails Regional Park.

5.2.2.6 Reach from Alvarado WTP to Lower Otay Reservoir

South of Alvarado, two pipelines continue south to Lower Otay Reservoir. Pipeline 3 has a capacity of approximately 140 cfs and is used to deliver untreated water to Sweetwater Authority at the Perdue WTP and to San Diego at the Otay WTP. However, Pipeline 3 capacity is currently constrained by the 30-inch interconnection. Pipeline 4, also known as Pipelines 4EI and 4EII, delivers treated water and has a capacity of 370 cfs from Alvarado to Sweetwater Reservoir. South of Sweetwater, the capacity is 200 cfs to its termination at Lower Otay. Treated water service is provided to San Diego, Helix, Sweetwater, and Otay in this reach.

5.2.3 Pumping Stations

The Water Authority maintains seven pumping stations that enhance the operational flexibility of the pipeline system to meet daily, seasonal, and emergency needs. The Water Authority-owned pump stations are listed in Table 5-3. Capacities shown are either the current or planned operating capacity.

TABLE 5-3
Water Authority Pump Stations

Pump Stations	Capacity (cfs)	Service Type	Purpose
Escondido Pump Station	20	Untreated	Operational
Valley Center Pump Station	41[1]	Treated	Operational/ESP
Miramar Pump Station	60[2]	Treated	Operational/ESP
Olivenhain Pump Station	314	Untreated	Operational/ESP
San Vicente Pump Station	444	Untreated	Operational/ESP
Hodges Pump Station	590	Untreated	ESP/Operational/Power
Twin Oaks Valley ESP Pump Station	39	Untreated	ESP

Notes:

[1] Current capacity is 20 cfs. A planned expansion to 41 cfs was assumed in the 2013 Master Plan analysis.
[2] A planned operating capacity of 60 cfs was assumed in the 2013 Master Plan analysis following completion of the Miramar Pump Station Improvements project.

Three of the water pump stations are for untreated water and are sized to protect the region from potential disruptions of imported water supplies. If a supply disruption occurs, the untreated water pump stations will deliver emergency water supplies from newly expanded or existing local storage reservoirs.

At other times, except for the Miramar Pump Station and Twin Oaks Valley ESP Pump Station, all the Water Authority-owned pumping stations can be used to move water supplies into and out of storage reservoirs to meet seasonal delivery needs and to augment daily supplies to the member agencies. The Miramar Pump Station is mainly used to deliver treated water via the aqueduct system from the city's Miramar WTP to city of San Diego service connection SD11 south of the WTP. The Twin Oaks Valley ESP Pump Station is used to deliver untreated water supplies to the Twin Oaks Valley WTP when flow from the north is interrupted.

5.2.4 System Storage

As mentioned earlier, the aqueduct system is a large, complex network of pipelines, pump stations, treatment plants, control structures and service connections. The operators of this system are constantly making adjustments to these facilities to meet member agency daily orders for both treated and untreated water deliveries. These adjustments take into consideration the transit time between the supply sources and the points of delivery to each member agency to assure that the water reaches the member agency when expected. System regulatory storage improves these operations by providing storage reservoirs located at strategic points throughout the system that buffer the constant adjustments and enhance the ability to manage daily aqueduct operations.

System regulatory storage is also used to manage hydraulic transient impacts related to sudden (both expected and unexpected) flow changes related to operation of Water Authority owned pump stations. System regulatory storage allows for a constant delivery to the member agencies when pumps are stopped or started, and prevents spilling of water if a member agency suddenly rejects flow due to changes within the member agency system. As the Water Authority increases its use of pump stations, flow regulatory storage can benefit system reliability by reducing surge and cushioning deliveries after a pump trip. Existing Water Authority-owned system regulatory storage facilities are listed in Table 5-4.

TABLE 5-4
Water Authority System Storage

System Storage	Capacity (mg)	Service Type	Purpose
Twin Oaks Valley Diversion Structure	22	Untreated	Operational
Mission Trails Flow Regulatory Storage	18	Treated	Operational
North County Distribution Flow Regulatory Storage	1	Treated	Operational
San Vicente Surge Control Facility	3	Untreated	Operational/ESP

5.2.5 Water Treatment Plants

Water treatment for almost all retail water service is provided by either a member agency WTP, Twin Oaks Valley WTP, or by MWD's Skinner WTP. This regional treated-water capacity provides flexible and robust local water treatment options and supports member agencies' constructed facilities. The Skinner facility also provides treated water to other MWD member agencies in Riverside County, Eastern MWD, and Western MWD. A list of the local and regional treatment plants and their capacities is provided in Table 5-5.

TABLE 5-5
Existing Area Water Treatment Facilities and their Rated Capacities in 2013

Agency	Treatment Facility	Rated Capacity (mgd)
Escondido-Vista	Escondido-Vista	65
Helix	Levy	106
Olivenhain	Olivenhain	34
Oceanside	Weese	25
Poway	Berglund	24
San Diego	Alvarado	150*
	Miramar	140**
	Otay	35.5
San Dieguito-Santa Fe	Badger	40
Sweetwater Authority	Perdue	30
Water Authority	Twin Oaks Valley	100
	Total	750

* After CDPH approval the WTP will be certified for 200 mgd

** After CDPH approval the WTP will be certified for 215 mgd

5.2.6 Storage

The Water Authority's in-region storage includes the Olivenhain Reservoir, the San Vicente Reservoir, and Lake Hodges. In addition, the Water Authority has contracted for out-of-region groundwater storage at the Semitropic and Semitropic-Rosamond Water Banks. Olivenhain Reservoir is owned by the Water Authority and has roughly 24,700 AF of available storage, with 18,000 AF typically reserved for emergency purposes. The San Vicente Reservoir is owned by the City of San Diego. Following completion of the San Vicente Dam Raise, the Water Authority will own storage rights within the reservoir for carryover and emergency use. The Water Authority's carryover storage capacity is 100,000 AF, and the emergency storage capacity is 52,000 AF. The Water Authority also has 20,000 AF of storage capacity in the City of San Diego's Lake Hodges Reservoir. The Semitropic and Semitropic-Rosamond Water Banks are large programs that store water for many water agencies. The Water Authority owns rights to 16,000 AF but has capacity to store up to 70,000 AF. Table 5-6 summarizes the Water Authority's available storage.

TABLE 5-6
Water Authority Storage Facilities Summary

Storage Facility	Ownership	Water Authority Storage Capacity (AF)
Olivenhain Reservoir	Water Authority	24,364
San Vicente Reservoir	City of San Diego	152,000*
Lake Hodges	City of San Diego	20,000
Semitropic and Rosamond Water Banks	Semitropic Water Storage District	70,000
	Total	266,364

* ESP = 52,000 AF, Carryover = 100,000 AF

5.3 Existing CIP Projects Included in Baseline System

The following existing CIP projects are included in the Baseline System. Assumptions regarding these projects are described in Table 5-7.

TABLE 5-7
Water Authority CIP Projects Assumed in 2013 Master Plan Baseline Facilities System Configuration

Project Name	Project Description
Relining and Pipe Replacement Program	The program to assess, prioritize, and rehabilitate the 82 miles of prestressed concrete cylinder pipe (PCCP) within the Water Authority's aqueduct system was initiated in 1993. The approximate 34 miles of pipeline rehabilitated to date has been included in the 2013 Master Plan Assumptions. The Master Plan has assumed that the relining of Pipeline 3 between Lake Murray and Lower Otay will be complete by 2016, and that Pipeline 5 between the MWD Delivery Point and Twin Oaks will be relined by 2024. After relining, the capacity of Pipeline 5 will be reduced from 500 to 440 cfs. No capacity reduction was assumed following the relining of Pipeline 3.
Carlsbad Desalination Aqueduct Improvements	The Carlsbad Desalination Aqueduct Improvements include new connections to the Second Aqueduct pipelines in San Marcos and at the Twin Oaks WTP, and the rehabilitation and repurposing of a five-mile portion of Pipeline 3 between San Marcos and Twin Oaks Valley. The completion date assumed for these improvements, allowing for delivery of full plant capacity, is 2016.
Nob Hill Improvements	This project includes the lowering of an 800-foot segment of both Pipelines 3 and 4 at a high point elevation to avoid potentially damaging transient pressures resulting from a sudden flow interruption. The lowering of Pipelines 3 and 4 will have no impact on pipeline capacities assumed in the 2013 Master Plan.
Olivenhain 9 FCF	This project provides a new untreated water flow control facility (FCF) and connection to the Second Aqueduct as an option to serve Olivenhain's David C. McCollom WTP.
Olivenhain-Hodges Pumped Storage	The Lake Hodges Pumped Storage Project allows the transfer of water between Lake Hodges and the Olivenhain reservoir. Water and energy operations are considered in the 2013 Master Plan.
Twin Oaks Storage	This project will assess facility options to regulate unacceptable flow fluctuations that occur during peak delivery period to the Twin Oaks Valley WTP. This project will not affect 2013 Master Plan delivery assumptions for the Twin Oaks WTP.

TABLE 5-7
Water Authority CIP Projects Assumed in 2013 Master Plan Baseline Facilities System Configuration

Project Name	Project Description
Twin Oaks Valley WTP Expanded Service Area	This new project will expand to the north and northeast the geographic area that can reasonably be served by the Twin Oaks Valley WTP. Assumptions made in the 2013 Master Plan include a change in minimum meter capacity on Pipeline 4 at the Delivery Point from 45 to 40 cfs and an increase in capacity at the Pipeline 2A Pump Station from 20 to 41 cfs.
ESP – San Vicente Dam Raise and Carryover Storage	This project will increase storage volume owned by the Water Authority to 152,000 AF. The 2013 Master Plan assumes filling of the reservoir will occur beginning in 2016.

5.4 Evaluation of Existing CIP Projects

In addition to the Baseline System, several CIP projects have previously been identified to improve operations of the existing aqueduct system. Several of these existing projects have been referred to the 2013 Master Plan for a re-evaluation of the need, scope, and timing. This section discusses these previously identified projects as captured in the Water Authority's existing CIP. The existing CIP is described in the adopted budgets for fiscal years 2014 and 2015.[4]

5.4.1 Projects Considered in the 2013 Master Plan

The Water Authority's existing CIP includes a listing of projects that are at various stages of completion. The CIP Project Summary Table[5] provides both lifetime budgets that reflect the projects' estimated costs from design to construction, including post-construction, as well as the corresponding two-year appropriation for that respective budget period. The existing CIP includes 46 active projects with a total life budget of $3.1 billion. Many of these projects have either been substantially completed, or will be substantially completed before calendar year 2015, which represents the beginning of the 2013 Master Plan planning horizon. The majority of the remaining planned expenditures are on five projects that include Pipeline 6, Second Crossover Pipeline, Asset Management Program, Pipeline Relining and Replacement Program, and the San Vicente Dam Raise and Carryover Storage. Outcomes from this 2013 Master Plan will greatly influence the timing of expenditures for the remaining CIP budget.

The specific projects in the existing CIP that were evaluated in the 2013 Master Plan to determine whether they were needed to meet anticipated system demands, and to identify appropriate sizing, location, and timing for implementation, are shown in Table 5-8. Many projects in the current CIP were not evaluated in the 2013 Master Plan because they did not warrant the associated analysis with respect to the parameters considered for the 2013 Master Plan. The existing CIP projects evaluated in the 2013 Master Plan analyses are discussed in *Chapter 7 – Facility Options* and *Chapter 8 – System Reliability*.

[4] General Manager's Recommended Multi-Year Budget, Fiscal Years 2014 and 2015.
[5] General Manager's Recommended Multi-Year Budget, Fiscal Years 2014 and 2015,

TABLE 5-8
Water Authority Current CIP (Fiscal Years 2014/2015) Projects

Project No.	Asset Management	Baseline System	Evaluated in Master Plan	Not Evaluated in Master Plan
N0340	Additional Aqueduct Right-of-Way Width			X
R0100	Aqueduct Protection Program			X
G1900	ESP – Operations Center Upgrade			X
M0200	Fallbrook 7/Rainbow 14 FCFs			X
M0220	Fallbrook 8 FCF & DeLuz 1 Supervisory Control and Data Acquisition (SCADA)			X
P0610	Lake Hodges Quagga Mussel & Water Quality Mitigation			X
P0200	Line Structure and Access Improvements			X
N0330	Miramar Pump Station Rehabilitation			X
M0190	Miramar Pump Station Valve and Meter Vaults			X
R0200	Relining and Pipe Replacement Program	X		
M0290	San Diego 12 FCF Expansion		X	
M0280	San Diego 24 FCF		X	
P0550	Valve and Venturi Meter Replacement Program			X
P0800	Water System Security			X
Q0100	Asset Management Program			X
	Caltrans Highway 76 Realignment			X
	New Facilities			
K0400	Camp Pendleton Desalination Project		X	
K0300	Carlsbad Desalination Project	X		
I0400	Colorado River Canal Linings – Post-Construction Mitigation			X
P0720	Communications System Facilities			X
C0710	Lake Murray Control Valve		X	
C0600	Mission Trails FRS II		X	
C0720	Nob Hill Improvements	X		
M3550	Olivenhain 9 Flow Control Facility	X		
J0100	Olivenhain-Hodges Pumped Storage	X		
S0120	Twin Oaks Storage	X		
N0520	Twin Oaks Valley WTP Expanded Service Area	X		
	Emergency Storage Program			
G1300	ESP – Lake Hodges Pump Station and Inlet/Outlet	X		
G0200	ESP – Planning and Support Services			X
G2000	ESP – Post Construction Activities			X
G1400	ESP – San Vicente Dam Raise and Carryover Storage	X		
G0700	ESP – San Vicente Pipeline and Aqueduct Interconnect	X		
	Master Planning			
G1700	ESP – Pump Station at Pipeline 3 and Interconnect		X	
G1800	ESP – Pump Station at Pipeline 4		X	
G0610	ESP – San Vicente Third Pump Drive and Power		X	
F0100	Pipeline 6		X	
B0400	Evaluation of the La Mesa Sweetwater Extension (LMSE) to Sweetwater		X	
N0360	Second Crossover Pipeline		X	
N0500	System Storage		X	
H0120	Regional Facility Planning and Operational Assessment		X	
	Other Projects			
N0600	Capitalized Warranty			X
S0300	East County Regional Treated Water Improvements			X
P0710	Hydraulic Transient Model			X
H0200	Mitigation Program			X
H0500	Post-Construction Mitigation Monitoring Program			X

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Chapter 6.0 Baseline System Reliability

6.1 Introduction

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). The regional Baseline System consists of the Water Authority's existing aqueduct system, as well as member agency WTPs and surface storage reservoirs, as described in *Chapter 5 – Baseline System and CIP Projects Considered in the Master Plan*. The evaluations and assessments performed in this Master Plan are to confirm the level of reliability that can be achieved with the Baseline System, and determine when new infrastructure may be required to alleviate system constraints and supply shortages. This chapter describes the approach, assumptions, and results of the analysis conducted to evaluate the reliability of the Water Authority system.

Figure 6-1 shows the overall 2013 Master Plan process and associated chapters. Highlighted in this figure are the elements described in this *Chapter 6 - Baseline System Reliability*.

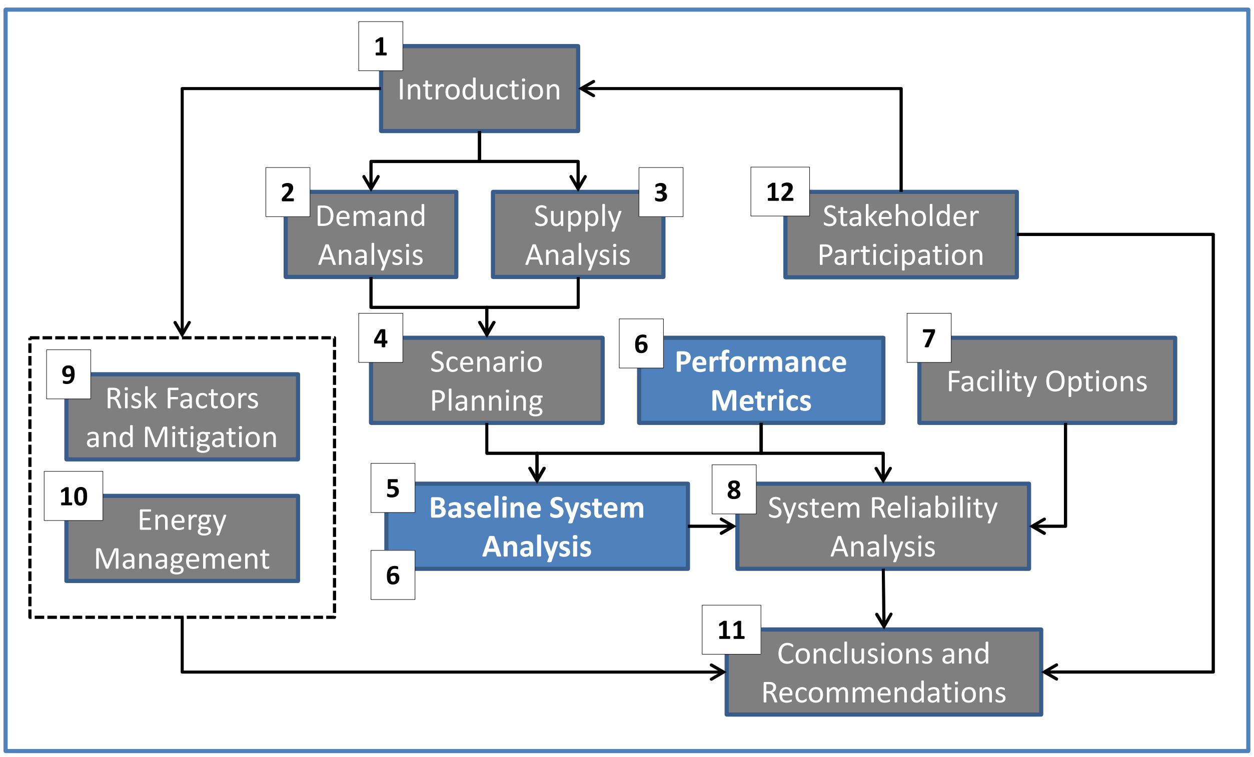

FIGURE 6-1
Relationships between 2013 Master Plan Chapters and Planning Process

The Baseline System reliability analysis is summarized in Table 6-1 and discussed in more detail in the sections that follow.

TABLE 6-1
Summary of Baseline System Reliability Analysis

Analysis Component	Description
Approach	Baseline System reliability was evaluated to understand current risk and to provide for a comparison of system reliability with the inclusion of possible facility options.
Methodologies for Analyzing New Infrastructure Needs	
Aqueduct System Model	A computer model (CWASim) of regional Water Authority and key member agency facilities was developed to analyze system reliability against a range of future supply and demand conditions.
Variability in Supply and Demand	2010 UWMP supply and demand projections were varied to include 112 years of historical data to simulate future sequences of hydrology over the planning horizon, increasing the complexity of the analysis while improving the portrayal of system reliability.
Evaluation Metrics	Six system evaluation metrics were established: delivery reliability (supply), conveyance utilization, supply diversification, WTP usage, storage utilization, and power usage and generation.
Performance Thresholds	Performance thresholds were developed specifically for the delivery reliability and conveyance utilization metrics to add perspective to frequency and magnitude of system risk and to expand the ability to compare the efficacy of infrastructure option implementation.
Evaluation of Baseline System Reliability	Using the six performance metrics, an analysis was conducted to determine how the Baseline System configuration would perform against the planning scenarios.

6.2 Approach

As described in *Chapter 4 – Scenario Planning,* four scenarios were used to consider a range of future water supply and demand conditions:

Master Plan Supply-Demand Scenarios

Scenario	Description
A – Urban Water Management Plan	Assumptions for local supply development, conservation targets, imported supply reliability match 2010 UWMP
B – Reduced Local Supplies	Assumes lower local supply development, reduced conservation savings, reduced imported supply reliability, and climate change impacts
C – Enhanced Local Supplies	Assumes enhanced local supply development, increased conservation savings and imported supply reliability per 2010 UWMP
D – Adjusted Local Supplies	Assumes local supply and conservation savings adjusted to reach 50 percent of targets, imported supply reliability per 2010 UWMP

These scenarios and the Baseline System facilities included in the Water Authority system collectively formed the basis for an evaluation of system reliability. The general approach for the analysis consisted of four steps:

1. Simulate the baseline system performance for each of the four water supply and water demand scenarios

2. Characterize system reliability, operational risk, and other measures of system performance
3. Run multiple computer simulations to understand which conditions and factors drive poor reliability performance or cause unacceptable operational risk
4. Identify and evaluate facility options that could improve the reliability of the system

The Baseline System reliability was evaluated to understand both current and future operational risks and to provide a basis for the comparison of system reliability with the implementation of new infrastructure options. The evaluation results were further compared to determine the magnitude of system improvements and the potential timing of need for new facilities. This analysis also provides the master planning process insight into the relative benefits of each facility option.

6.3 Methodology for Analyzing New Infrastructure Needs

An analytical framework was implemented that balanced the capability for evaluating numerous future scenarios with providing sufficient model resolution to represent the Water Authority's resources. This section presents the main components of such a framework: 1) an appropriate system-wide model, 2) a method to account for variability in supply and demand, and 3) a means to evaluate system performance. This section concludes with a discussion of the concept of vulnerability to aid in summarizing when the system's performance would fall below acceptable thresholds.

6.3.1 Water Authority System Model

A model of the Water Authority conveyance, treatment, and storage system was developed to confirm the viability of the existing system and to evaluate new facility options and suggested operational changes. The model was developed within a generalized system dynamics modeling platform called GoldSim. The Water Authority's customized system model was named CWASim.

The CWASim model serves as a tool that bridges the gap between a system hydraulic model and the Water Authority's need for a planning tool that evaluates system operations through the planning horizon. The philosophy carried through model development was to distill the complex aqueduct and reservoir system into primary conveyance elements, allowing for simulation of the system under a wide range of future water supply, water demand, hydrologies, and existing and evolving facility configurations. Operational considerations were also built into the model. The key requirements for the development of the CWASim model included the following:

1. Data collection
2. System and operational representation
3. Addition of future project options

In addition to facilitating the system analysis conducted for the 2013 Master Plan, CWASim was designed to allow for improved understanding of the system responses to supply, demand, and management changes and to explore system response to new facility options. Interactive capabilities were encouraged as much as possible in the development of CWASim to allow for improved ease of use. Figure 6-2 graphically depicts the model representation of the regional system.

6.3.2 Variability in Supply and Demand

The sequence of future wet and dry periods and the timing of weather-related peak demands are forecast based on historical weather and hydrology information collected for the past 112 years. The historical information is used to suggest patterns for sequences of future weather and hydrology over the 20-year planning horizon. The annual, monthly, and daily variability that existed in the historical records was assumed to be a reliable representation of possible future conditions, and distinct traces of supply and demand were developed. Under scenarios that considered climate change impacts on water demand, the annual demands were increased and the daily/monthly patterns were adjusted consistent with the detailed climate analysis that is described in *Chapter 2 – Regional Demand Analysis*. The result of this process is 112 traces of possible future outcomes for each scenario and system configuration included in the CWASim model. While the approach adds additional complexity to the analysis, the uncertainty in hydrology and climate are well represented, and the resulting portrayal of system reliability is significantly improved.

6.3.3 Evaluation Metrics

Performance measures are important for evaluating system reliability and facilitating the comparison of different strategies to improve future reliability. Collectively referenced as system evaluation metrics, these measures, which span six categories as shown in Table 6-2, are available within CWASim's model outputs to compare system response.

TABLE 6-2
Performance Metrics Considered in the Evaluation of the Master Plan

Evaluation Metric	Description
Delivery Reliability	Measures the system's ability to meet annual, monthly, and peak water demands, and provides a measure of potential supply shortages.
Conveyance Utilization	Measures the frequency and amount of conveyance capacity used in key aqueduct links.
Supply Diversification	Calculates the percent of supply used from imported and local sources.
WTP Usage	Calculates the frequency and percent of WTP capacity used at regional and local treatment facilities.
Storage Utilization	Calculates use of Water Authority-owned seasonal and carryover storage pools.
Power Usage and Generation	Calculates power use and generation by facility and system-wide.

The performance of the Water Authority system was assessed based on these evaluation metrics for each of the supply and demand scenarios, and the results of these analyses served as the basis for decision-making about future infrastructure projects.

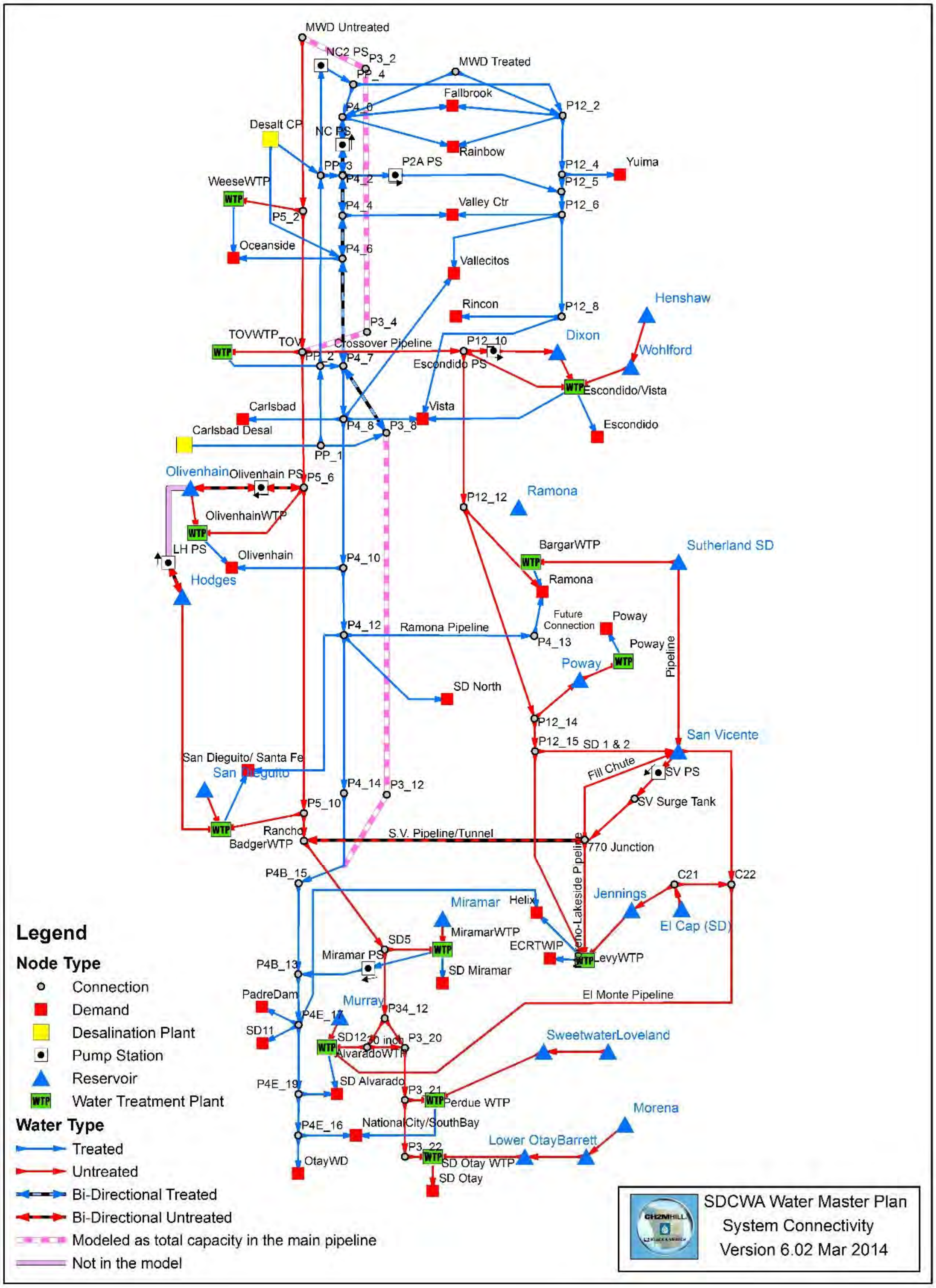

FIGURE 6-2
CWASim Model Schematic

6.3.4 Performance Thresholds

The approach taken to measure system reliability included quantifying system capabilities based on historical operations and establishing maximum exceedance levels that simultaneously stretch infrastructure utilization while maintaining a prudent and safe operating margin. Two of the evaluation metrics from Table 6-2 were determined to play a more significant role regarding when new facilities may be needed: delivery reliability and conveyance usage. The performance of the Water Authority's system, as measured by these two metrics, may vary considerably depending on the supply and demand scenarios. The process for establishing thresholds for these decision metrics involved detailed discussions with Water Authority planning, engineering, and operations staff to assure the performance limits reflected an appropriate risk tolerance. In addition, the thresholds were confirmed through member agency workshops, Board discussions, and a review of thresholds used by other similar water utilities.

By adding thresholds for these two decision metrics to the process, two benefits were realized. First, a perspective is provided in terms of the risk (frequency and magnitude) to the Water Authority system and operations. Second, the timing and magnitude of tracking the number and persistence of vulnerable events that are predicted to occur over time both with and without infrastructure option implementation provide a comparison of the efficacy of these options.

Performance thresholds are listed with their corresponding decision metrics in Table 6-3.

TABLE 6-3
Decision Metrics and Performance Thresholds

Decision Metric	Performance Threshold	Basis for Threshold
Delivery Reliability (Supply Shortage)	• Shortage >20 TAF • Two consecutive years	Annual shortages below 20 TAF can be mitigated by operational or management actions, and would not provide a basis for new infrastructure or supply development.
Conveyance Utilization	• 95 percent of conveyance capacity • 15 sequential days • 45 days during the peak season two consecutive years	Conveyance utilization near 95 percent is expected during peak season. If utilization exceeds threshold durations, the system may not meet peak demands or refill reservoirs. Water sales may be reduced.

6.4 Evaluation of Baseline System Reliability

The reliability analysis begins with an evaluation of system reliability without implementation of future infrastructure options, focusing on the performance of the Baseline System configuration. As mentioned earlier, the Baseline System configuration represents the physical status of the aqueduct system as it is expected to exist at the beginning of 2015, including implementation of the Carlsbad Desalination Project (online in 2016) and the continuation of the Water Authority's pipeline relining program in accordance with the Asset Management Program's recommended schedule. In addition, all of the modeling runs conducted with the Baseline System assumed optimized use of carryover storage in the San Vicente Reservoir to mitigate both seasonal and annual supply shortages.

Chapter 5 – Description of Baseline System and CIP Projects Considered in the Master Plan provides a more specific description of the Baseline System facilities. This section presents the results of how the Baseline System facility configuration performed against each of the possible planning scenarios.

6.4.1 Delivery Reliability

Delivery reliability was measured as the magnitude and frequency of supply shortages relative to member agency demands. Individual daily shortages for any given year were added at the end of the year and reported as the annual cumulative shortage. The performance threshold was established at 20 TAF because annual shortages of less than this amount were believed to be manageable through flexible aqueduct, storage, and member agency operations and were not considered to represent a critical system vulnerability that required a significant investment in capital expenditures for new infrastructure to alleviate the supply shortage. Furthermore, the criteria that the 20-TAF shortage must occur for two consecutive years considers the occurrence of a trending dry weather pattern instead of a single dry-year weather anomaly.

Figure 6-3 (top panel) shows the projected frequency of simulated annual shortages for each of the 2013 Master Plan scenarios for four 5-year periods through 2035. For Scenarios A and C (lower demand scenarios), shortages were projected to be less than the threshold for all years during the 2013 Master Plan planning horizon, suggesting a very low level of risk in the ability to meet all member agency demands. Under scenarios with higher member agency demands (Scenario D), shortages were projected to occur around 2025 and continue to grow through the planning horizon. Under the assumptions of Scenario B (highest demand scenario), which included lower local supply development, current conservation levels, climate change impacts, and reduced imported supplies during droughts, shortages were projected to grow rapidly from about 2022 onward. It was also noted that under the high-demand scenario (Scenario B), a supply shortage is projected to occur prior to 2020. This shortage is due to the ramp-up period for full development of the IID-SDCWA transfer supply.

A sensitivity analysis of the delivery reliability performance threshold was also conducted to determine system response to an increasing supply shortage level. The system was tested using an annual supply shortage of up to 50 TAF. The higher threshold was analyzed to reveal if an increase in the supply shortage risk would significantly delay the need for new supply development. The higher threshold, however, did not provide any meaningful effect on the timing for new supply development. In fact, timing shortages exceeding the threshold only differed by one to three years with the higher threshold, and the frequency of exceeding the thresholds were similar. The reason for this *nil effect* is that simulated shortages only occur during multiple dry years with limited imported supply availability and high future demands. Under these conditions, available MWD supplies are being allocated, and any supply shortages will tend to be large versus the relative low threshold value.

	PERIOD	SCENARIO A1	A2	B	C	D
Frequency of Annual Shortage Greater than Threshold (SS_1)	2016-2020	0%	0%	4%	0%	0%
	2021-2025	0%	0%	4%	0%	0%
	2026-2030	0%	0%	11%	0%	2%
	2031-2035	0%	1%	28%	0%	6%

	PERIOD	SCENARIO A1	A2	B	C	D
Frequency of Untreated Conveyance Greater than Threshold (PU_1)	2016-2020	2%	3%	9%	0%	9%
	2021-2025	13%	19%	47%	2%	39%
	2026-2030	47%	50%	71%	21%	64%
	2031-2035	57%	59%	73%	34%	72%

FIGURE 6-3
Projected frequency of annual shortage (top panel) and untreated water conveyance (bottom panel) exceeding thresholds for the 2013 Master Plan Scenarios.
Thresholds are annual shortage greater than 20 TAF for two consecutive years and untreated water conveyance greater than 95 percent of capacity for 15 consecutive days and 45 total days during peak season.

6.4.2 Conveyance Utilization

Conveyance utilization was measured as the number of days during the peak season (June through November) in which 95 percent or more of the conveyance capacity of a particular reach of the aqueduct system was used. A high number of days in which a pipeline reach is essentially operating at full capacity during this period would indicate a system with little operational flexibility and an increasing risk of member agency shortages.

Figure 6-3 (bottom panel) shows the projected frequency of simulated untreated water conveyance in Pipelines 3 and 5 at the MWD Delivery Point exceeding the threshold for each of the 2013 Master Plan scenarios in five-year increments through 2035. Under all 2013 Master Plan scenarios (including the lowest demand scenario), untreated water conveyance utilization was projected to be greater than the 45-day threshold. Roughly one-quarter of the hydrologic traces showed conveyance exceeding the threshold by 2023 in Scenario A. The year in which the threshold was exceeded, however, was not particularly sensitive to the demand scenario. For example, the year in which one-quarter (25 percent) of the traces exceeded the threshold ranged from approximately 2020 to 2029 for all scenarios. This relatively narrow range of results further supports the earlier conclusion that imported untreated water conveyance at the MWD Delivery Point will approach critical levels by the mid-2020s.

Figure 6-4 summarizes the percentage of traces in which the conveyance utilization threshold was exceeded for five reaches of the aqueduct system that have historically operated at or near full capacity for extended periods. The five reaches include Pipelines 3 and 5 at the MWD Delivery Point (untreated water), Pipeline 4 south of Twin Oaks (treated water), the Crossover Pipeline (untreated water), the Pipeline 3/Pipeline 4 Interconnection at Lake Murray (untreated water), and Pipeline 5 south of Twin Oaks (untreated water).

The results indicate that the conveyance constraints at the MWD Delivery Point and at the Pipeline 3/Pipeline 4 Interconnection will inhibit the ability to meet untreated water deliveries. As noted previously, the conveyance constraint at the MWD Delivery Point will reach a critical level by the mid-2020s, while the constraint at the Pipeline 3/Pipeline 4 Interconnect is already operating at a critical level and needs to be remedied as soon as possible.

The analysis further indicates that the treated water conveyance system has sufficient capacity with no critical conveyance areas identified. Similarly, the untreated water conveyance system south of Twin Oaks Valley WTP (Pipeline 5) was not projected to have conveyance-related challenges over the planning horizon. Only under the highest of the demand scenarios were vulnerabilities projected for the Crossover Pipeline. Under this high-demand scenario, operation of the Crossover Pipeline would approach critical levels between 2025 and 2030.

Similar to the delivery reliability threshold, a sensitivity analysis for conveyance utilization applying an increasing number of days exceeding the threshold was conducted to test the robustness of the conclusions. The purpose of the sensitivity analysis was to determine if an increase in conveyance risk would significantly delay the onset of new conveyance projects. The 45-day threshold was increased up to 60, 90, and 120 days, and the timing of threshold was evaluated. The 60-day threshold would indicate that half of the days during the peak summer period are exceeding 95 percent capacity, while the 120-day threshold would indicate that a pipeline reach is operating essentially the entire summer peak period at 95 percent or greater capacity. These higher thresholds reflect significant increases in operational risk for the Water Authority system, which could create peak season reliability concerns for member agencies and potential delivery shortages. The results of the sensitivity analysis show that the timing of conveyance vulnerability was delayed by roughly one to two years with a 60-day threshold, two to five years with a 90-day threshold, and six to eight years with a 120-day threshold.

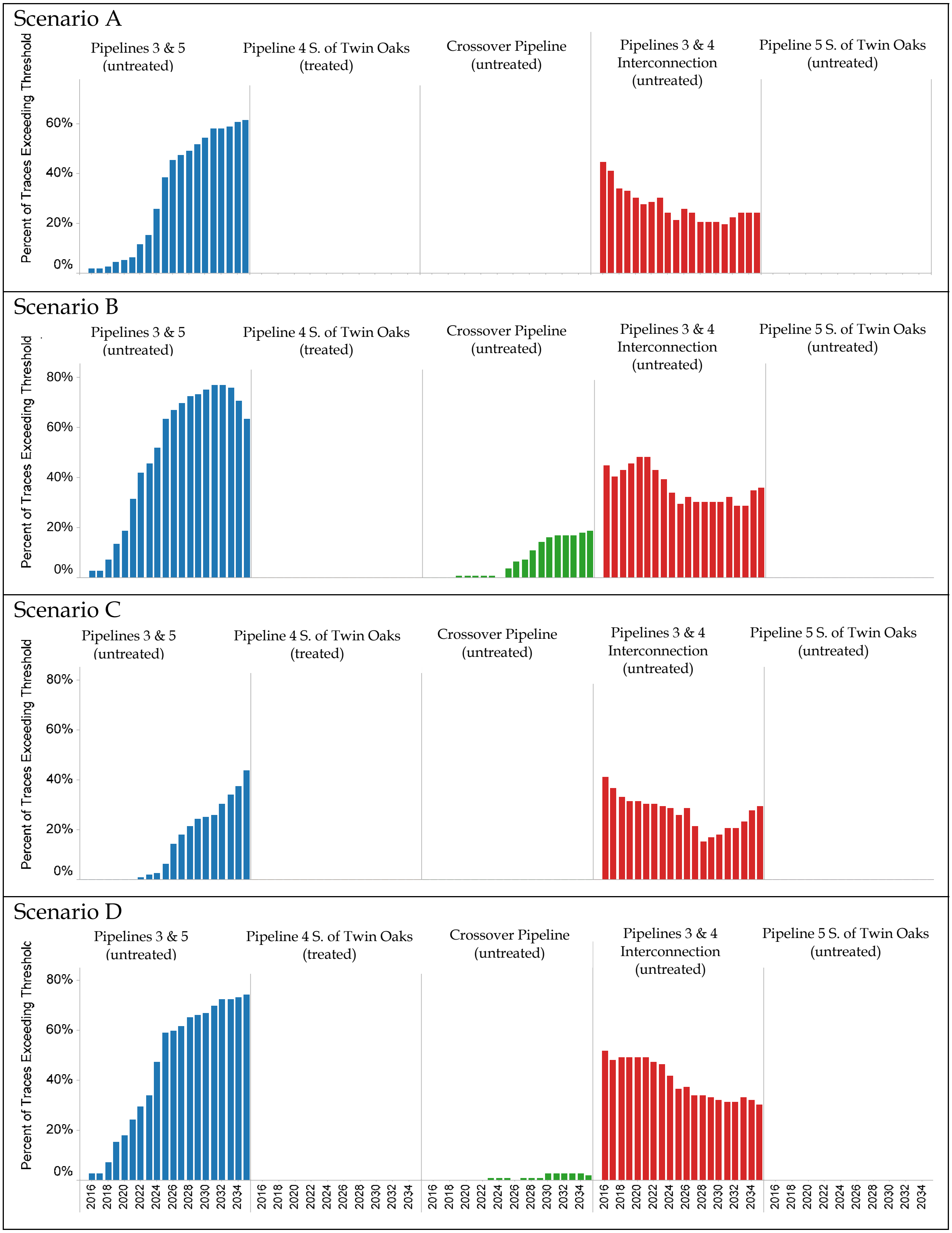

FIGURE 6-4

Conveyance Utilization Results (percent of traces exceeding threshold) for Five Critical Aqueduct System Areas (Untreated, Treated, Crossover, Pipelines 3 and 4 Intertie Pipeline, and South of Twin Oaks Valley WTP)

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6.4.3 Supply Diversification

Supply diversification has been a long-term objective of the Water Authority to meet the region's need for a more reliable water supply. For the Master Plan, the supply diversification metric is an indicator of current and future regional supply mixes. Supply sources include local surface water, recycled water, groundwater, imported supplies, and the Carlsbad desalination supply. This metric is used in the Master Plan to compare over time the percentage of total annual deliveries that are developed from imported water sources. These imported water sources generally include MWD and QSA supplies. Achievement of a lower percentage of MWD imported water deliveries can be an indicator of improved supply reliability.

Figure 6-5 shows the average distribution of total water deliveries for years 2015 and 2035 for the Baseline System. As can be seen from the chart, the addition of the Carlsbad Desalination supply and the ramp up of the QSA program significantly improve the Water Authority's water supply diversification. Between 2015 and 2035, reliance on MWD deliveries as a percentage of total deliveries are expected to drop from 55 percent to a little over 40 percent, indicating that the Baseline System provides a foundation for achievement of the Water Authority's long-term diversification goals.

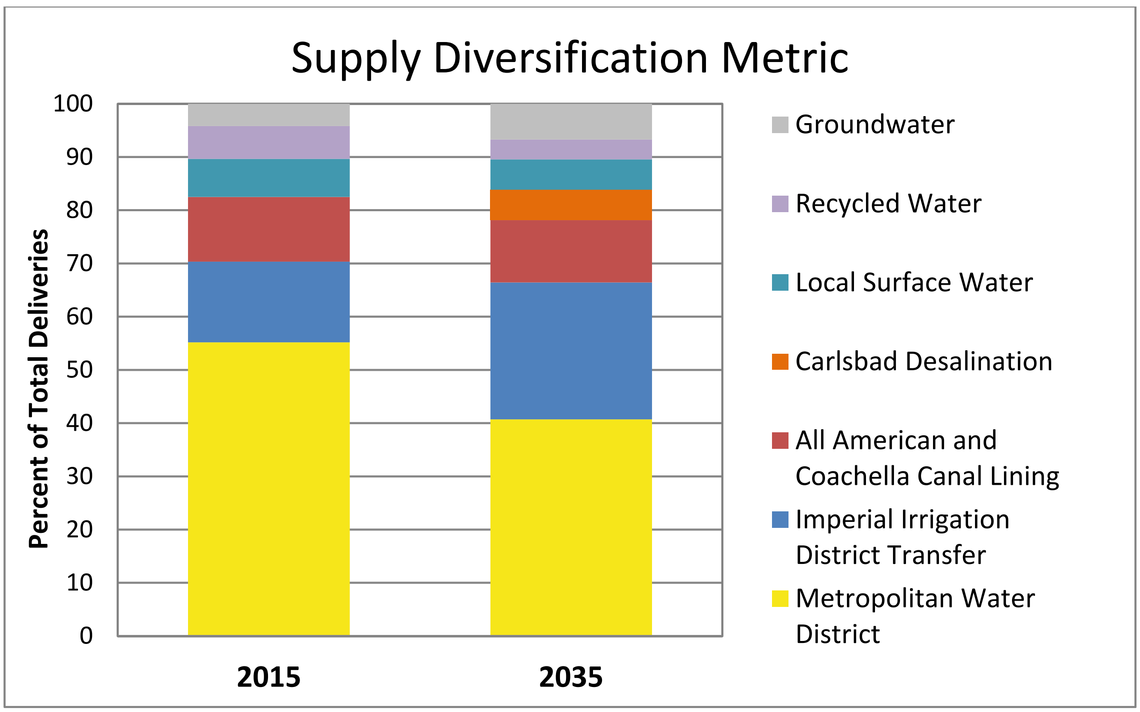

FIGURE 6-5
Average Distribution of Water Deliveries for 2015 and 2035

6.4.3 Water Treatment Plant Utilization

WTP utilization was measured as the average annual flow through each plant as a fraction of the total plant maximum capacity. The metric represents the utilization of the WTP asset and could indicate where additional treatment capacity might be needed or where an under-utilized WTP may present an opportunity to shift treatment load. Figure 6-6 shows the average annual utilization for the region's major WTPs for Scenario A and Scenario D. As shown in the figure, most of the region's plants are operating with an average use slightly greater than half of their plant capacities. This reflects that adequate treatment capacity is available throughout the planning horizon and well into the future.

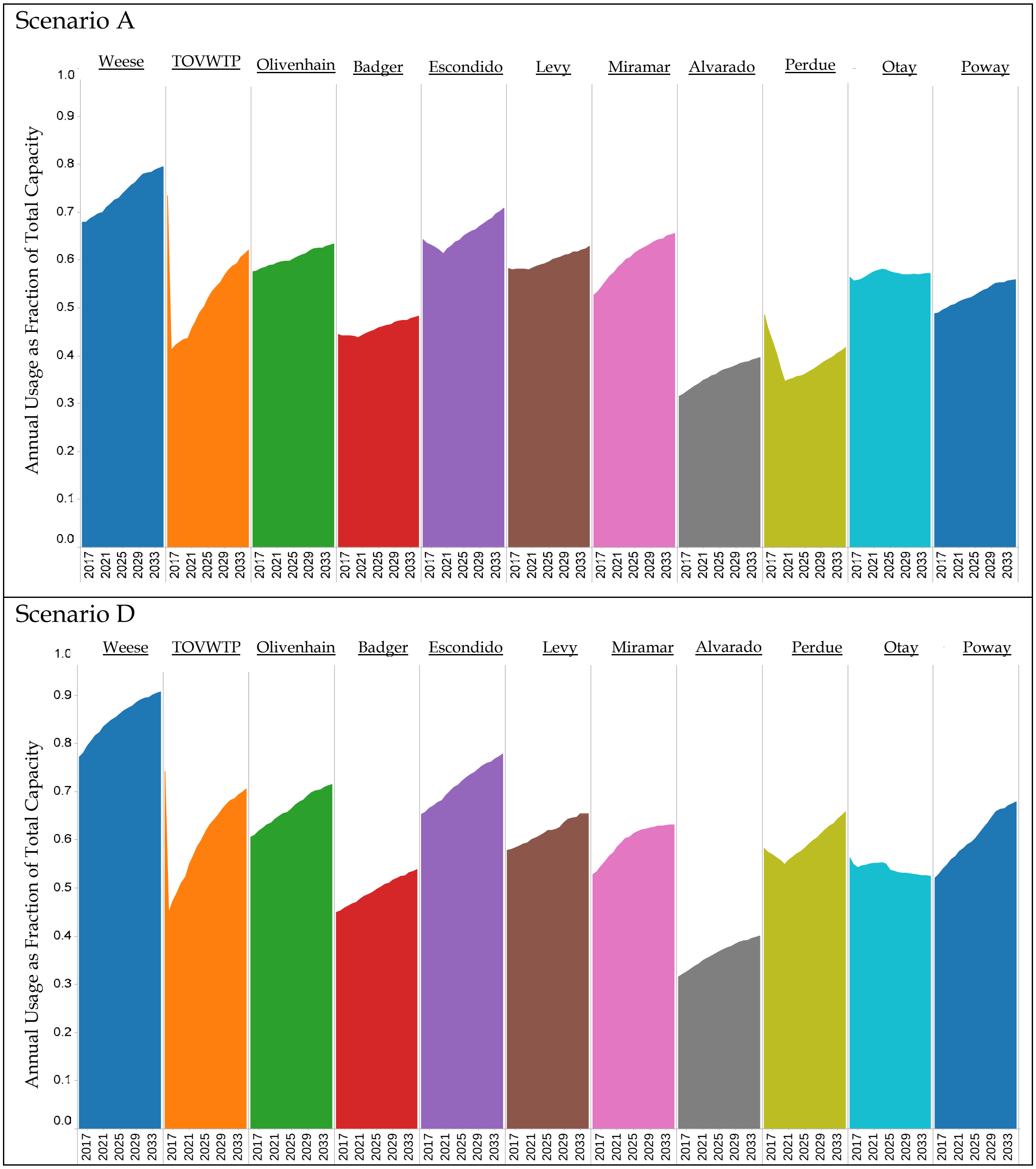

FIGURE 6-6
Regional Water Treatment Plant Utilization (average annual use as a fraction of plant capacity).

In the early part of the 2013 Master Plan planning horizon, the Twin Oaks Valley WTP usage was projected to drop as desalinated water from the Carlsbad Desalination Facility enters the Water Authority system. The drop in usage, however, will not fall below the contractual minimum production of 25 mgd. Towards the end of the planning horizon, it was projected that the Twin Oaks Valley WTP would be operated at levels similar to those prior to the inclusion of the desalinated water.

6.4.4 Storage Utilization

Surface runoff and storage in the San Diego region has always been a critical component of the region's water resources. As peak demands increase, management of storage is becoming more important to achieve dry-year delivery reliability. Once the San Vicente Dam raise is complete, there will be over 740,000 AF of surface storage in the region with about 525,000 AF of storage connected to the Water Authority's aqueduct system and capable of buffering imported water deliveries, providing forebay storage for water treatment plants, and helping to manage peak day deliveries. In the 2013 Master Plan model, operation of the System Baseline facilities configuration includes the Water Authority emergency, seasonal, and carryover storage pools in the San Vicente Reservoir. As an indicator of the storage utilization and for comparison to other alternative operations or facilities, this metric was defined as the average use of San Vicente storage during the peak summer period of May 1 through September 30. This period represents the timing of largest demand on the Water Authority system and generally reflects the period of release of water from storage to meet demands.

The average release of water from storage during this seasonal period was projected to be approximately 45 TAF, but could range from essentially zero up to approximately 55 TAF, depending on the quantity of water in storage and the dryness of the particular year. Figure 6-7 shows a typical trace of San Vicente storage operations. In most years, the seasonal operation of San Vicente would consist of filling the reservoir during the winter and releasing water during the summer peak season to meet demands and reduce the stress on the imported water conveyance system. However, during extended dry years, San Vicente storage would be used to augment the annual supply and reduce drought impacts, and would be drawn down considerably. Only after the drought periods have ended would there again be sufficient supply to refill the storage in San Vicente Reservoir. Figure 6-7 also shows the projected shortages that may occur with and without the San Vicente carryover storage pool. As shown in the bottom of the figure, shortages are substantially reduced during the first couple of years of extended dry periods. This storage operation provides considerable enhanced flexibility to support the region's drought reliability, but does not completely eliminate shortages during multi-year dry weather events.

Near-term potential exists for supply shortages in the region until the QSA deliveries are increased, the San Vicente dam raise is completed, and the reservoir is filled. The seasonal operation of local reservoirs could help mitigate the risk of these shortages by maintaining local water in storage during this period. The Water Authority and its member agencies recognize the need for the ability to deliver water to local storage during off-peak demand periods. The Water Authority's annual operating plan provides the tool to coordinate these reservoir deliveries. Analysis of the potential benefits of expanded operational use of available local reservoir capacity is discussed in *Chapter 8 – System Reliability with Facility Options* (Section 8.3.3).

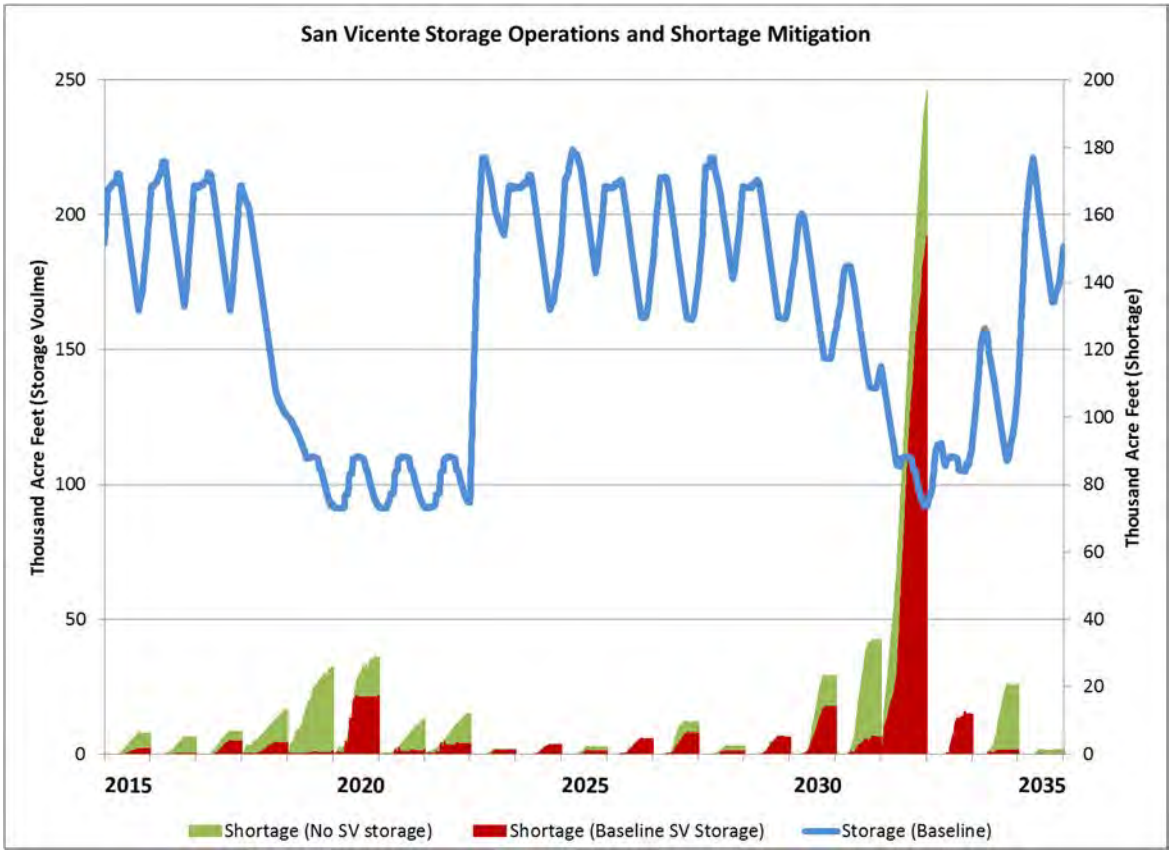

FIGURE 6-7
Projected San Vicente Storage Operations for One Future Hydrologic Sequence

6.4.5 Power Usage and Generation

The Water Authority manages a water system that has relatively low energy requirements for the amount of water delivered. The energy usage metric reflects gross energy consumption, energy generation, and the resulting net consumption in the Water Authority's aqueduct system. The largest energy user in the system is the Lake Hodges pumped-storage operation. This energy use coincides with pumping water when energy rates are inexpensive due to low demands on the electric grid. The water pumped from Lake Hodges to Olivenhain dam is then used to generate energy during periods of high energy demand. The net consumption is the difference between the energy needed to pump the water up to Olivenhain reservoir and the energy generated when water flows back down to Lake Hodges. The net consumption by this facility is relatively small due to the efficient equipment used.

The two facilities with the projected largest energy consumption are the San Vicente Pump Station and the Twin Oaks Valley WTP. The facility with the largest net energy generation is the existing Rancho Peñasquitos hydroelectric facility. The energy use by the Carlsbad Desalination Facility was not included in these estimates as the Water Authority does not own or operate this facility.

The total projected average annual energy consumption for the Water Authority is estimated to be approximately 129 GWh, while the projected average annual generation was estimated to be approximately 91 GWh. Thus the average annual net energy consumption was projected to be approximately 38 GWh. The net energy consumption is projected to decrease slightly with increasing demands due to increases in generation at the Rancho Peñasquitos hydroelectric facility.

6.4.6 Summary of Baseline System Reliability

Six performance metrics were applied to measure the reliability of the Water Authority's system or to measure other aspects of operational performance. Table 6-4 summarizes the performance metrics for each 2013 Master Plan scenario and for four 5-year periods spanning the planning horizon. While the metrics related to supply diversification, energy use, water treatment plant usage, and storage utilization are relatively insensitive to the variability represented by the 2013 Master Plan scenarios, metrics related to delivery reliability and conveyance usage are much more dependent on the scenario assumptions. The results suggest vulnerabilities related to delivery reliability for the higher-demand scenarios begin to occur after 2025, while lower-demand scenarios suggest a relatively low likelihood of problematic delivery conditions. Conveyance usage exceeds the threshold in all 2013 Master Plan scenarios, but is substantially more frequent in the higher demand scenarios, which suggest that conveyance system improvements will be needed by the mid-2020s.

TABLE 6-4
Performance Results for each of the Six Measures Considered in the 2013 Master Plan

Performance Measure	Time Period	Scenario A	Scenario B	Scenario C	Scenario D
Delivery Reliability	2016-2020	0%	4%	0%	0%
(frequency of annual shortage greater than 20 TAF for two consecutive years)	2021-2025	0%	4%	0%	0%
	2026-2030	0%	11%	0%	2%
	2031-2035	1%	28%	0%	6%
Conveyance Utilization	2016-2020	3%	19%	0%	9%
(frequency of untreated water conveyance greater than 95 percent of capacity for 15 consecutive days and 45 total days during peak season)	2021-2025	19%	47%	2%	39%
	2026-2030	50%	71%	21%	64%
	2031-2035	59%	73%	34%	72%
Supply Diversification	2016-2020	68%	70%	67%	69%
(percent of supply from imported water sources)	2021-2025	69%	73%	67%	71%
	2026-2030	72%	77%	69%	75%
	2031-2035	73%	80%	71%	77%
Water Treatment Plant Usage	2016-2020	43%	51%	36%	49%
(average annual percent of Twin Oaks Valley WTP capacity usage*)	2021-2025	49%	63%	38%	58%
	2026-2030	56%	69%	43%	65%
	2031-2035	60%	73%	48%	69%

TABLE 6-4
Performance Results for each of the Six Measures Considered in the 2013 Master Plan

Performance Measure	Time Period	Scenario A	Scenario B	Scenario C	Scenario D
Storage Utilization	2016-2020	46	46	47	47
(mean annual use of Water Authority's carryover pool in San Vicente Reservoir in TAF)	2021-2025	46	44	47	45
	2026-2030	44	37	46	42
	2031-2035	43	30	45	38
Energy Usage	2016-2020	40	41	40	40
(mean net annual energy use in GWh)	2021-2025	38	37	38	38
	2026-2030	35	29	36	32
	2031-2035	32	24	35	28

*Utilization of the Twin Oaks Valley WTP does not consider increased production resulting from expansion of the Pipeline 2A Pump Station. Expansion of this pump station may increase treatment plant production 15 – 20 percent.

6.5 Major Local Projects – Reliability Impacts Analysis

A separate analysis was conducted to assess the impacts of two potential supply options on water supply reliability: the City of San Diego's Direct/Indirect Potable Reuse (IPR) project and Otay Water District's Rosarito Desalination project. While the timing and eventual implementation of these projects is uncertain, they could have a considerable positive impact on the future water supply conditions in the San Diego region.

The City of San Diego is considering the implementation of a potable reuse project. This project likely will be implemented in phases over the next 20 years. The implementation schedule provided in the City's Recycled Water Study, dated July 2012, was used to evaluate the impact of potable reuse to the Water Authority's delivery requirements. The potable reuse project is scheduled for implementation as proposed below:

- North City IPR – 15 mgd on line in 2023
- South Bay IPR – 18 mgd on line in 2026
- Harbor Drive IPR – 52.8 mgd on line in 2032

If the City of San Diego's IPR is constructed as currently planned and results in a one-for-one reduction in demand on the Water Authority's system, the potential long-term shortages projected in the high-demand scenarios for the Baseline System would be largely eliminated. However, the largest increment of the planned IPR is not projected to be online until around 2032 and is not expected to impact potential supply shortfalls before then. In the Master Plan modeling analysis, this project served to reduce the City's demand on the Water Authority system in accordance with the implementation schedule summarized above.

The Rosarito Desalination Project has two different components – the desalination plant and conveyance system that is located in Mexico, and the conveyance and disinfection system that is located in the United States. The desalination plant and the conveyance system south of the border are being considered for development by NSC Agua S.A. de C.V. (NSC Agua), a Mexico Corporation with various investors and Consolidated Water Co. Ltd., a publicly traded company that operates desalination plants and water distribution systems in the Caribbean basin and in Southeast Asia and Mexico.

The project consists of a potential 100-million-gallon-per-day seawater reverse osmosis desalination plant, together with a pump station and pipeline to convey the water to Tijuana and excess production water to the United States border with Mexico. The primary purpose of the project is to provide potable water service to customers in Mexico and to provide a reliable supply of excess production water to Otay Water District in the United States. Supply to the Otay Water District from the Rosarito facility will vary depending on the demand in Mexico and available remaining supply. For this master planning evaluation, a range of 26,000 to 33,000 acre-feet per year was used to reduce Otay Water District's demand on the Water Authority, assuming an online date of 2021.

Both the City of San Diego's IPR/DPR program and the Otay Water District's Rosarito Desalination project further reduce potential future demand shortfalls. Because both of these projects have the ability to significantly delay or forgo future Water Authority investments in new infrastructure, the progress made by the City of San Diego and Otay Water District to implement each project should be closely monitored. Any decision on new regional supply development projects considered by the Water Authority should be weighed against the development potential of these two projects.

Chapter 7.0 Project Options and Portfolios

7.1 Introduction

This chapter summarizes the project options and portfolios that were considered in the 2013 Master Plan to address potential conveyance constraints and supply shortages indicated in the Baseline System reliability analysis (*Chapter 6 – System Reliability Analysis*). The project options described in this chapter include both new projects and projects included in the current CIP that were not part of the Baseline System. Project options were evaluated from an engineering and system integration perspective to assure that each project is implemented consistent with overall system timing and need. Approximate timelines for development of various options were described and cost estimates were prepared. Project options were also reviewed with member agency technical staff to address project timing and need against potential development of new local supplies.

Portfolios represent a discrete grouping of project options that explore a different strategy or emphasis in addressing regional supply shortfalls and conveyance constraints associated with the Baseline System. Four basic strategies were explored, including development of new supplies from a proposed Camp Pendleton Seawater Desalination Project, continued reliance on imported water supplies delivered through or from the MWD system, direct delivery of QSA supplies to the San Diego region from a new Colorado River conveyance system, and the optimization of both in-region and out-of-region storage to manage peak delivery requirements. The portfolios also include projects that address internal system needs.

Figure 7-1 shows the overall 2013 Master Plan process and the associated chapters. Highlighted in this figure is the step to improve system reliability through project options and portfolios as addressed in this chapter. The effectiveness of each project option and portfolio at improving system operations and reliability is described in *Chapter 8 – System Reliability with Facility Options*.

The Facility Options analysis is summarized in Table 7-1 and discussed in more detail in the sections that follow.

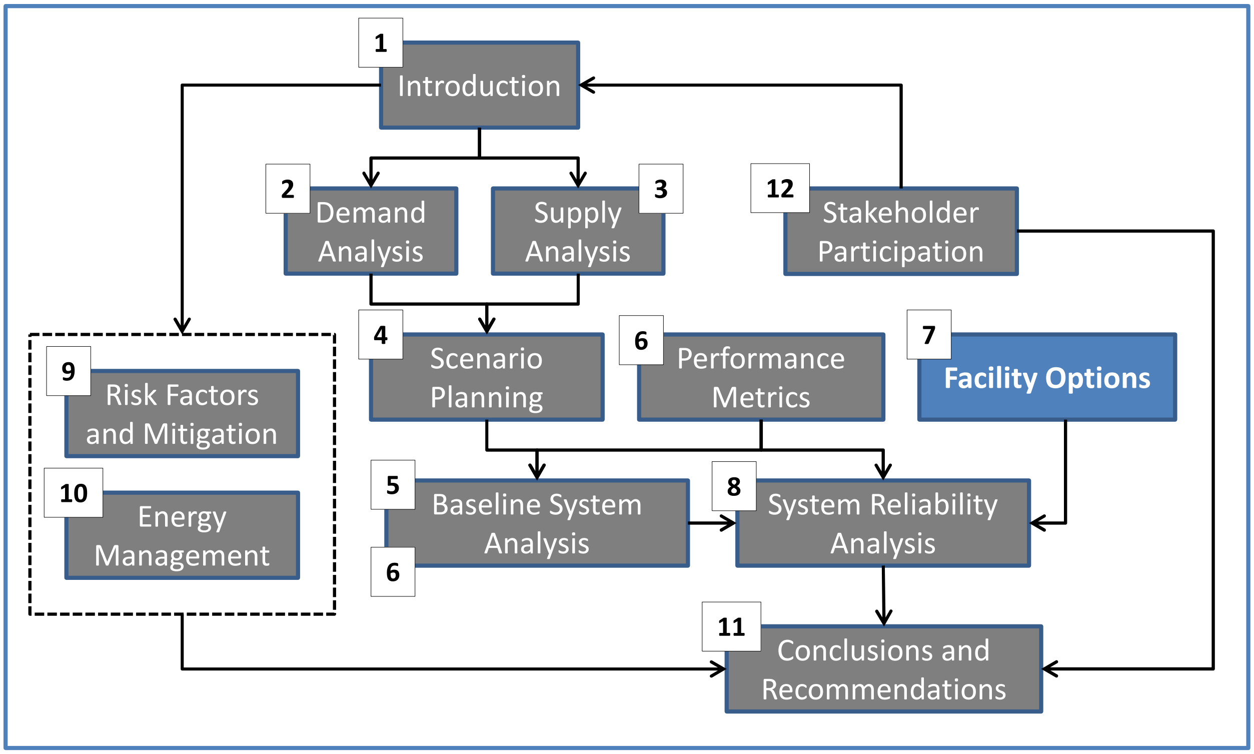

FIGURE 7-1
Relationships Between 2013 Master Plan Chapters and Planning Process

TABLE 7-1
Summary of Facility Options

Analysis Component	Description
Master Plan Portfolios	Portfolios represent the four different infrastructure strategies and associated project options evaluated in the 2013 Master Plan to address projected untreated water conveyance constraints and supply shortages.
Projects Common to Each Portfolio	Internal system improvements and planning initiatives will be needed to assure overall system reliability. These improvements are applicable to each of the 2013 Master Plan portfolios.
Implementation Duration	An estimated schedule for project duration and implementation is provided. Implementation will further depend on project prioritization and available budget.
Cost Basis	Capital and operating costs for each option were based on preliminary planning level data collected and developed as part of the 2013 Master Plan analysis. The capital costs are considered to be feasibility level costs with a range of +30 to -20 percent accuracy.

7.2 Master Plan Portfolios

The Baseline System analysis described in *Chapter 6 – System Reliability Analysis* reached two key conclusions regarding system reliability and the ability of the Water Authority and its member agencies to meet projected demands through the 2035 planning horizon. The first is that an increase in untreated water conveyance capacity will be required in the near term to alleviate a projected constraint at the MWD delivery point. The second is that new supply development will be required on a longer-term basis to address a projected shortfall during multi-year dry weather events. Four different infrastructure development strategies were devised to address both the untreated water conveyance constraint and the supply shortfall. These strategies, which are similar to the regional supply solutions included in the 2003 Master Plan document, are described in Table 7-2. The strategies are defined as a "portfolio" of projects that include one or more project options that provide a singular approach to addressing regional supply reliability. Each strategy also includes a series of other projects that are "common" to all the portfolios and address the need for system improvements internal to the Water Authority aqueduct system.

TABLE 7-2
Portfolios Explored in the Master Plan

Portfolio Name	Portfolio Description
Conveyance from the North (North)	Emphasizes continued reliance of imported supplies from MWD. New facilities include increasing conveyance capacity at the MWD delivery point.
Supply from the West (West)	Emphasizes developing new seawater desalination supplies from the proposed Camp Pendleton Seawater Desalination Project. This portfolio evaluates a new supply developed in 50 mgd increments from a proposed desalination plant sized from 50 to 150 mgd.
Conveyance from the East (East)	Emphasizes developing a new Colorado River conveyance system to import QSA supplies directly into the Water Authority aqueduct system at the San Vicente Reservoir.
Storage Optimization (Storage)	Emphasizes increased regional surface water storage beyond baseline operations and out of region groundwater storage banking to address peak demand constraints on the Baseline System.

7.3 Overview of Project Options

Strategies for helping to resolve future water supply and demand imbalances for the Water Authority system were provided from a range of member agency stakeholders. Through an iterative process, consensus was reached on the supply and demand scenarios, evaluation thresholds, and facility options that will be carried forward for further analysis. Project options were evaluated to meet one or more of three main objectives: 1) alleviate untreated water conveyance constraints, 2) increase water supplies, and 3) improve system operations and extend the service life of existing infrastructure.

The project options that define each portfolio are depicted in Figure 7-2 and are described in Table 7-3. Table 7-4 describes the projects that are common to each portfolio.

TABLE 7-3
Summary of Portfolio Project Options

Portfolio	Project Options	Purpose
Conveyance from the North	• Pipeline 6 • Pipeline 3/Pipeline 4 Conversion	Alleviate untreated water delivery constraint at MWD delivery point.
Supply from the West	• Camp Pendleton Desalination	Address regional supply shortages. Project also alleviates untreated water conveyance constraint.
Conveyance from the East	• Colorado River Conveyance	Convey QSA supplies through a Water Authority-owned facility. Project also alleviates untreated water conveyance constraint.
Storage Optimization	• Re-operation of existing regional storage	Utilize existing regional storage assets beyond the Baseline System to alleviate peak system constraints.

TABLE 7-4
Summary of Project Common to Each Portfolio

Project Options	Purpose
System Isolation Valves	Improve aqueduct operations and maintenance flexibility.
North County ESP Pump Station	Meet ESP delivery requirements.
ESP-San Vicente Pump Station 3rd Pump Drive and Power Supply	Meet ESP and carryover storage requirements.
Mission Trails Projects	Increase untreated water conveyance to serve south county WTPs.
System Storage	Provide regulatory storage for increased operation efficiencies and optimize conveyance capacity.
Second Crossover Pipeline	Address untreated water delivery constraint south of Twin Oaks.

San Diego County Water Authority
2013 Regional Water Facilities
Master Plan Update

Figure 7-2
Portfolio Project Options

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7.3.1 Conveyance from the North

There are two project options to alleviate the projected untreated water conveyance constraint at the MWD delivery point and increase imported water conveyance capacity from the MWD system. The first, Pipeline 6, is an existing CIP project that was initially proposed under the Water Authority's 1989 Water Distribution Plan. The second option is the Pipeline 3/Pipeline 4 Conversion, which is a newly proposed project that would increase untreated water conveyance to better match current projections.

7.3.1.1 Pipeline 6

Pipeline 6 is an existing CIP project that was originally conceived in the 1987 Water Distribution Plan to provide an increase in untreated water conveyance capacity from MWD. The project consists of a sixth pipeline connected to MWD's facilities at Lake Skinner and terminating at the Water Authority's Twin Oaks Valley Diversion Structure. The project would increase imported water capacity by approximately 500 cfs. Alignment studies and a certified environmental impact report (EIR) for a jointly developed project with MWD were completed in 1993 (Water Authority and MWD, 1993). Implementation of the project was subsequently delayed as a result of lower projected imported water sales and revised targets for developing a more diversified water portfolio for the San Diego region. In 2002, MWD initiated design and construction of an approximately 7-mile-long segment of Pipeline 6 based on the 1993 EIR, extending from Lake Skinner to the intersection of Anza and DePortola Roads in the Temecula area. This segment of Pipeline 6 was placed in service in 2006.

Also in 2006, and based on demand forecasts at that time, the Water Authority and MWD restarted planning efforts for Pipeline 6 with a new 2018 target date for project implementation. Both the Water Authority and MWD recognized this date could be pushed out to 2023 if 50 mgd of new seawater desalination supplies were developed for the San Diego area. The restarted planning efforts resulted in a revised preferred alignment for Pipeline 6. This preferred alignment extends westerly from the southern terminus of the existing segment of Pipeline 6 along De Portola Road to the intersection of the Pipeline 3 corridor, approximately 0.25 miles east of Jedediah Smith Road. The Pipeline 6 alignment turns south and runs parallel to the Pipeline 3 corridor southwest to the MWD Delivery Point. From the delivery point, Pipeline 6 would parallel the existing Second Aqueduct corridor to Twin Oaks.

The approximate length of the unconstructed portion of Pipeline 6 is 26 miles, with about 11 miles of this unconstructed portion being south of the MWD Delivery Point.[6] Following completion of the new alignment studies, the project was again placed on hold based on the recent reductions in water sales and focused efforts by the Water Authority to move forward with the Carlsbad Desalination Project. No action was taken by the Water Authority or MWD to conduct any further CEQA reviews to certify the new preferred alignment.

Figure 7-3 depicts the preferred Pipeline 6 alignment from the more recently completed planning studies.

[6] The Water Authority's CIP budget for Pipeline 6 includes funds to implement the 11-mile segment south of the MWD Delivery Point to Twin Oaks Valley.

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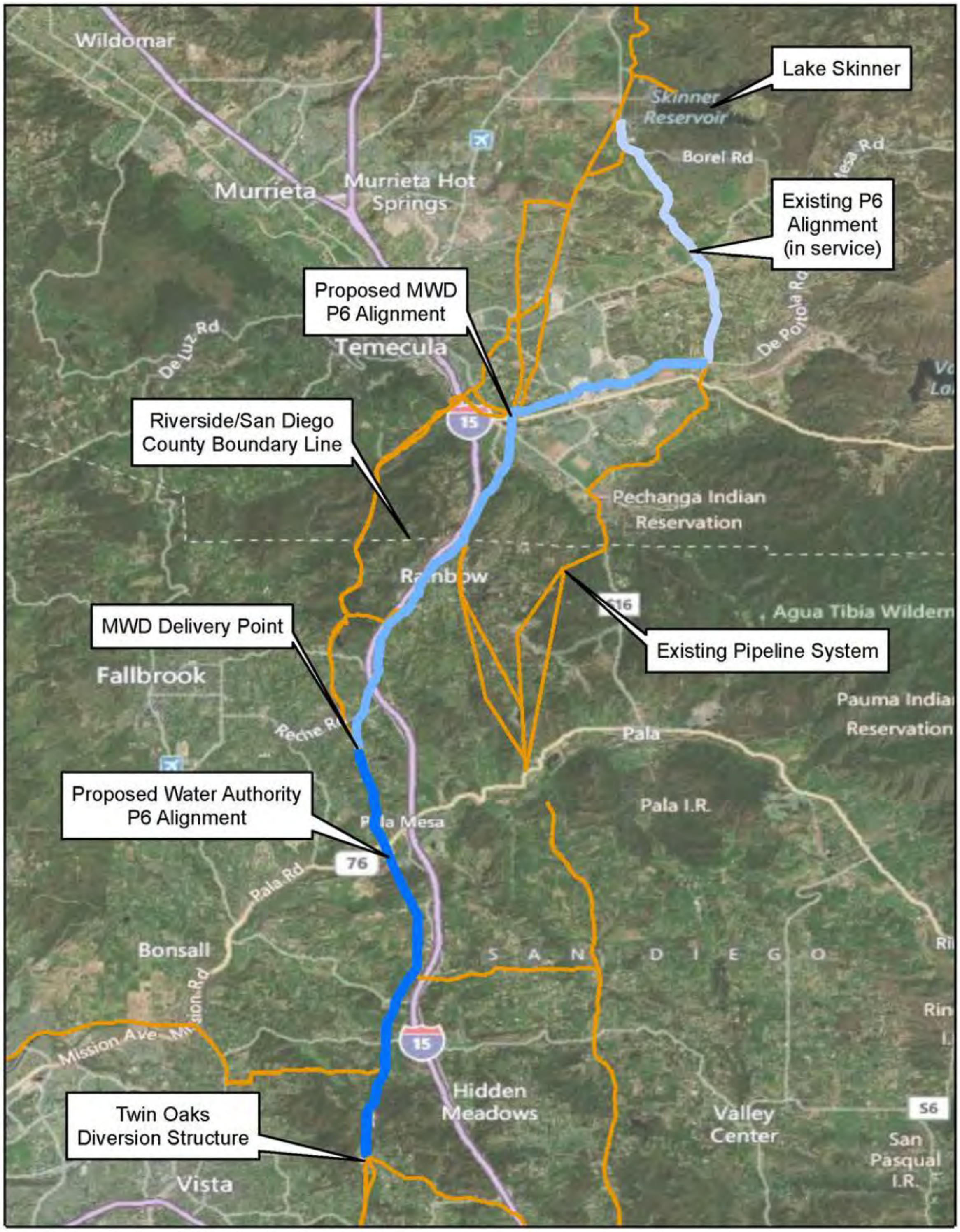

San Diego County Water Authority
2013 Regional Water Facilities
Master Plan Update

Figure 7-3
Pipeline 6 Project

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7.3.1.2 Pipeline 3/Pipeline 4 Conversion

The Pipeline 3/Pipeline 4 Conversion Project is intended to increase untreated water conveyance capacity in the Second Aqueduct north of Twin Oaks Valley by converting all or a portion of the existing Pipeline 4 (capacity 470 cfs) to untreated water service and converting a similar portion of the existing Pipeline 3 (capacity 280 cfs) to treated water service. Depending on which option is implemented, the project would increase the total untreated water delivery capacity by 190 to 970 cfs (the combined capacity of Pipeline 5 and Pipeline 4) and consequently reduce the total treated water delivery capacity to 460 cfs (the combined capacity of Pipeline 1, Pipeline 2 and Pipeline 3). The project would result in no net gain in conveyance capacity from MWD.

Two options for the Pipeline 3/Pipeline 4 Conversion have been evaluated, each requiring work on portions of the existing pipeline system both above and below the MWD Delivery Point. The work above the MWD Delivery Point will require further evaluation by MWD to define more precisely the modification that will be necessary to implement a conversion of the existing pipelines. The options described below for work above the MWD Delivery Point are conceptual only and provide a basis for further discussions with MWD.

Option 1

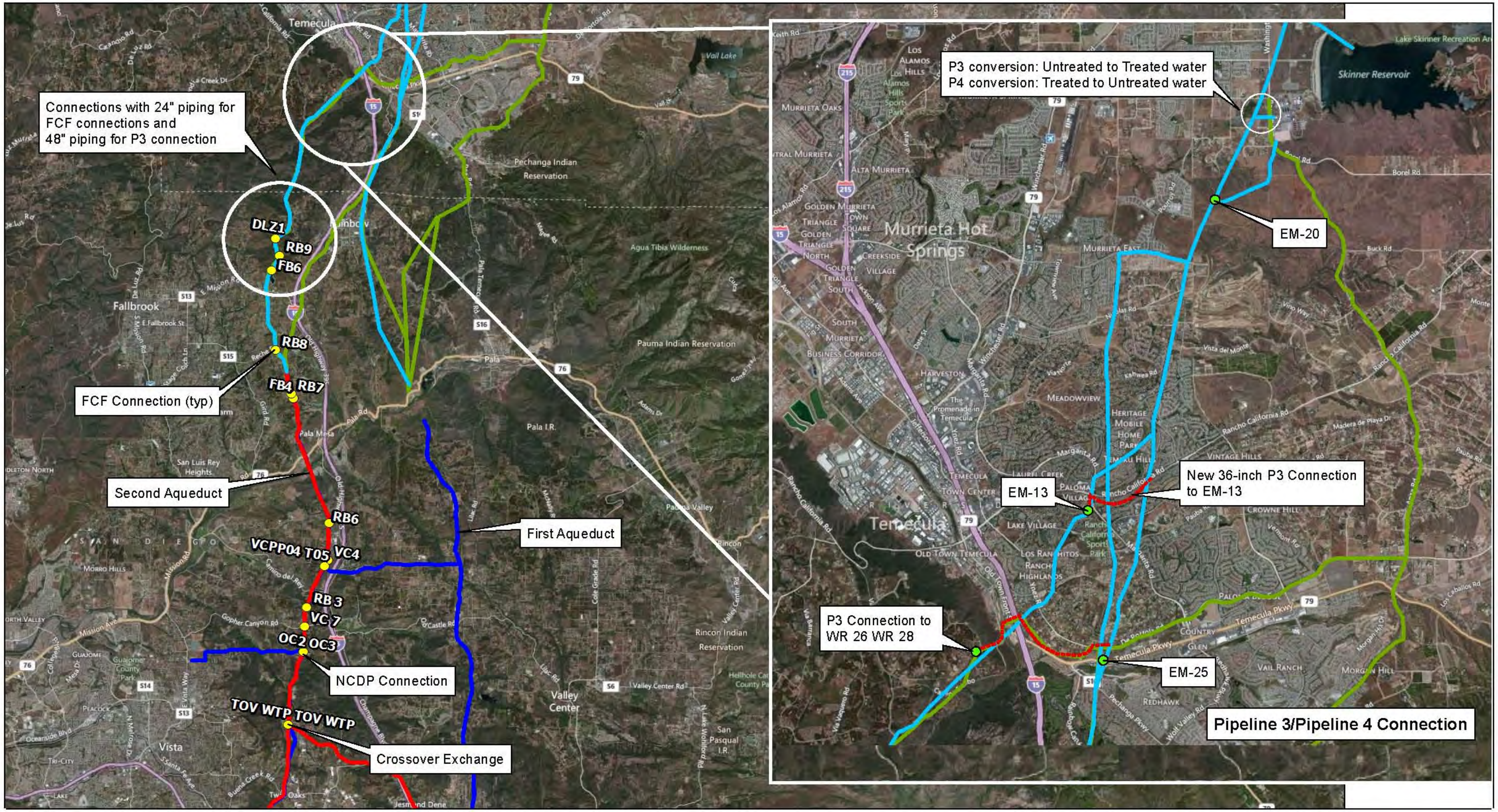
Option 1 is shown in Figure 7-4 and would convert the pipelines beginning at the Lake Skinner WTP. The conversion of Pipelines 3 and 4 would extend to just north of the Twin Oaks WTP at the existing Crossover Exchange Facility. South of this exchange facility, the pipelines would revert back to their current delivery regimes. This option would entail new pipe segments and connections at the Lake Skinner WTP and the conversion of all operational service connections from one pipeline to the other. Within the pipeline segments located outside of the Water Authority service area (i.e., within areas served by Eastern MWD and Western MWD of Riverside County), the following service connections would need to be reconnected: WR-26 (40 cfs), WR-28 (40 cfs), WR-25 (25 cfs), and EM-13 (40 cfs). The combined capacity of these four service connections is 145 cfs, which will affect the peak delivery capability of Pipeline 3. During peak demand periods, it is likely that all four service connections will be operated at or near rated capacity, thereby reducing treated water delivery capability at the MWD Delivery Point to 135 cfs.

More specifically, the first option includes the following:

- A new 75-inch-diameter connection from Lake Skinner to Pipeline 3 (approximately 1,000 feet) near Benton Road and Borel Road.
- A new 96-inch-diameter connection from Lake Skinner to Pipeline 4 (approximately 1,000 feet) near Benton Road and Borel Road.
- A new 36-inch-diameter pipeline from Pipeline 4 at the intersection of Zinfandel Avenue and Rancho California Road, 0.75 miles along Rancho California Road to Margarita Road, the 0.2 miles south on Margarita Road to EM-13.
- A new 48-inch-diameter pipeline from Pipeline 3 at the intersection of Temecula Parkway and Jedediah Smith Road, then 0.25 miles west along De Portola Road to East Vallejo Avenue, then approximately 0.3 miles west and north, then a tunnel west (approximately 0.3 miles) under Interstate 15 and the Santa Margarita River to Pujol

Street, then 0.2 miles south on Pujol Road, then 0.5 miles south and west on Camino Estribo Road, then 0.25 miles south on Via Novillo to WR-26 and WR-28.

- A new 48-inch-diameter pipeline segment extending in an eastern direction from Pipeline 3 to Pipeline 4 to provide treated water service to the existing Fallbrook (FB) 6, Rainbow (RB) 9, and De Luz (DLZ) 1 Service Connections along Pipeline 4, via a connection to a new 24-inch-diameter pipeline as described in the following bullet, with an approximate length of 1.5 miles.
- A new segment running in a north-south direction parallel to Pipeline 4 connecting the existing FB6, RB9, and DLZ1 Service Connections to the new 48-inch pipeline segment described previously, with a diameter of 24 inches and an approximate length of 1.2 miles.
- A new segment connecting the existing RB8 Service Connection along Pipeline 4 to Pipeline 3 with a diameter of 24 inches and approximate length of 0.4 miles.
- Where Pipelines 3 and 4 are parallel and share a common easement, new piping segments would be required to allow the existing treated water service connections on Pipeline 4 to receive treated water service from Pipeline 3. The Pipeline 4 connections to the Valley Center Pipeline and the North County Distribution Pipeline will also need to be removed and reconnected to Pipeline 3. The new pipe segments assume that a new turnout connection (new connection, isolation valve, and valve vault) will be required where each facility is reconnected to Pipeline 3. The following service connections would be disconnected from Pipeline 4 and reconnected to Pipeline 3: RB7 FCF, FB4 FCF, RB6 FCF, VC 4 FCF, RB3 FCF, VC7 FCF, and OC 3 FCF. The OC2 FCF untreated water service connection would need to be disconnected from Pipeline 3 and connected to Pipeline 4.



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2013 Regional Water Facilities
Master Plan Update

Figure 7-4
Pipeline 3/Pipeline 4 Conversion - Option 1

0 1.75 3.5 7 10.5 Miles

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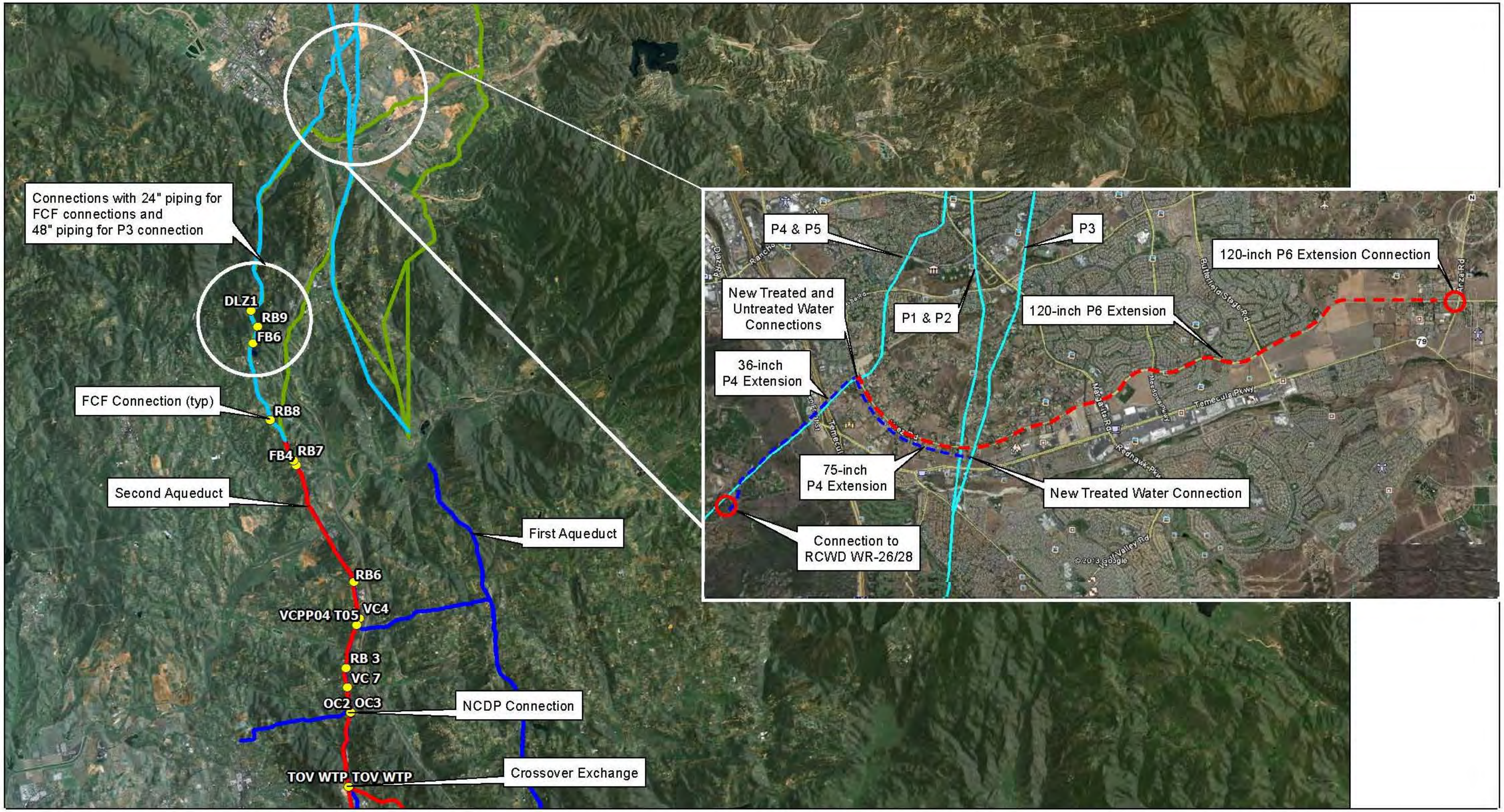
Option 2

Option 2 is shown in Figure 7-5 and would convert the pipelines closer to the Riverside/ San Diego County boundary, thereby allowing for essentially the full capacity of Pipeline 3 (280 cfs) to be available to convey treated water to the Water Authority's service area. In general, this option includes a new segment of Pipeline 6 in the Temecula area, connections to Pipelines 3 and 4 also in the Temecula area, and new connections and pipelines to transfer existing service connections in north San Diego County from one pipeline to another. Similar to Option 1, the Pipeline 3/Pipeline 4 conversion would revert back to the current treated and untreated water delivery regime at the existing Crossover Exchange Facility located just north of the Twin Oaks Valley WTP.

A new segment of Pipeline 6 will extend in a westerly direction in De Portola Road from the terminus of the existing MWD-owned Pipeline 6 to a connection point to Pipeline 4 located just east of where Pipeline 4 crosses Interstate 15. The diameter of the Pipeline 6 extension to Pipeline 3 will be 120 inches with an approximate length of 4.3 miles. The diameter of the Pipeline 6 extension between Pipeline 3 and Pipeline 4 will be 90 inches with an approximate length of 1.2 miles (this segment of Pipeline 6 corresponds with links 4 and 5 of the May 1993 Pipeline 6 EIR). Pipeline 4 south of the connection to Pipeline 6 will be converted to untreated water service. Pipeline 4 north of the connection to Pipeline 6 will remain as a treated water pipeline. Conceptual descriptions of the new pipelines and connections anticipated being required as part of the project are as follows:

- A new segment of Pipeline 6 that extends in a westerly direction in De Portola Road from the terminus of the existing MWD-owned Pipeline 6 to a connection point to Pipeline 4 located just east of where Pipeline 4 crosses Interstate 15. This new segment will be located generally parallel to the new segment of Pipeline 6. This new segment will convey treated water from Pipeline 4 to Pipeline 3. Pipeline 3 south of the connection to this new segment will be converted to treated water service. Pipeline 3 north of the connection to this segment will remain as an untreated water pipeline. The existing Pipeline 3 (conveying untreated water) may be terminated at this connection, or Pipeline 3 may be connected to the new segment of Pipeline 6.
- A new segment extending from the Pipeline 4 to Pipeline 6 connection, running south and parallel to Pipeline 4, to a connection to the existing Rancho California Water District (RCWD) WR-26/WR-27 service connection. This pipeline will provide treated water from the treated water segment of Pipeline 4 to WR-26/WR27 and will have a diameter of 36 inches and an approximate length of 1.5 miles.
- A new 48-inch pipeline segment extending in an eastern direction from Pipeline 3 to Pipeline 4 to provide treated water service to the existing FB6, RB9, and DLZ1 Service Connections along Pipeline 4, via a connection to a new 24-inch pipeline as described in the following bullet, with an approximate length of 1.5 miles.
- A new segment running in a north-south direction parallel to Pipeline 4 connecting the existing FB6, RB9, and DLZ1 Service Connections to the new 48-inch pipeline segment described previously, with a diameter of 24 inches and an approximate length of 1.2 miles.

- A new segment connecting the existing RB8 Service Connection along Pipeline 4 to Pipeline 3 with a diameter of 24 inches and approximate length of 0.4 miles.
- Where Pipelines 3 and 4 are parallel and share a common easement, new piping segments would be required to allow the existing treated water service connections on Pipeline 4 to receive treated water service from Pipeline 3. The Pipeline 4 connections to the Valley Center Pipeline and the North County Distribution Pipeline will also need to be removed and reconnected to Pipeline 3. The new pipe segments assume that a new turnout connection (new connection, isolation valve, and valve vault) will be required where each facility is reconnected to Pipeline 3. The following service connections would be disconnected from Pipeline 4 and reconnected to Pipeline 3: RB7 FCF, FB4 FCF, RB6 FCF, VC 4 FCF, RB3 FCF, VC7 FCF, and OC 3 FCF. The OC2 FCF untreated water service connection would need to be disconnected from Pipeline 3 and connected to Pipeline 4.



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2013 Regional Water Facilities
Master Plan Update

Figure 7-5
Pipeline 3/Pipeline 4 Conversion - Option 2

0 1.75 3.5 7 10.5 Miles

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7.3.2 Supply from the West

7.3.2.1 Camp Pendleton Desalination Project

The Water Authority has recently completed feasibility evaluations for a regional seawater desalination project on Marine Corps Base Camp Pendleton. 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 (Water Authority, 2009). The proposed project involves the development of an initial 50 mgd or 56,000 AF/YR seawater desalination plant, with subsequent expansions at 50 mgd increments up to a maximum capacity of 150 mgd or 168,000 AF/YR. Working in close coordination with representatives from Camp Pendleton, the 2009 study identified two potential desalination plant sites, both in the southwest corner of the base near the mouth of the Santa Margarita River (see Figure 7-6). Both sites have adequate acreage (23 to 30 acres) to accommodate treatment facilities sized up to the ultimate capacity of 150 mgd. 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 system.

With Camp Pendleton's authorization to continue to study the two plant sites, the Water Authority recently completed additional planning studies and field investigations to further evaluate the feasibility and cost of both subsurface and open ocean intake alternatives, the discharge facilities, plant layout and siting requirements, power requirements, alternative conveyance system alignments, facility operation, and facility impacts of integrating the water supply from the desalination project into the Water Authority aqueduct distribution system. Results from these studies validated the feasibility of building a desalination plant at each of the two sites, the viability of both screened open ocean intake and subsurface intake configurations, the viability of a diffuser type discharge system, and the preference of RO membrane technology for the desalination technology for the project. The studies also confirmed that desalinated water from the project could be efficiently conveyed and integrated into the Water Authority's aqueduct system through a 19-mile conveyance system consisting of 72-inch-diameter pipelines and two pumping stations. Two alignments were carried forward in the analysis, a northern corridor and a southern corridor, as shown in Figure 7-7. A location along each preferred alignment corridor was identified for the intermediate pump station, which is also shown in Figure 7-7.

As shown in Table 7-5, the total capital cost for the project ranges between $1.43 billion for the 50 mgd project and $3.26 billion for the 150 mgd project. Annual operations and maintenance cost ranges between $70 million and $200 million for the 50 and 150 mgd projects, respectively.

TABLE 7-5
Camp Pendleton Desalination Project – Capital and Operating Cost Summary

	Plant Production Capacity		
	50 mgd	100 mgd	150 mgd
Capital Costs – Desalination Plant [a, b]	$1.11 to $1.26 billion	$1.74 to $2.23 billion	$2.32 to $2.90 billion
Capital Costs – Conveyance [a]	$301 to $313 million	$324 to $336 million	$334 to $346 million
Annual Operating Costs	$70 million	$135 million	$200 million

Note: The costs estimates are considered planning-level estimates and rely on the information available at the time the study was conducted. All costs are expressed in 2012 dollars.

[a]Includes a 30 percent allowance for construction contingencies and a 25 percent allowance for permitting, legal, public outreach, investigations and surveys, engineering and design, construction management, administration, insurance, and right of way acquisitions.

[b]Desalination Plant costs include the seawater intake and brine discharge facilities.

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2013 Regional Water Facilities
Master Plan Update

Figure 7-6 Proposed Camp Pendleton Seawater Desalination Plant Locations

0 0.1 0.2 0.4 0.6 Miles

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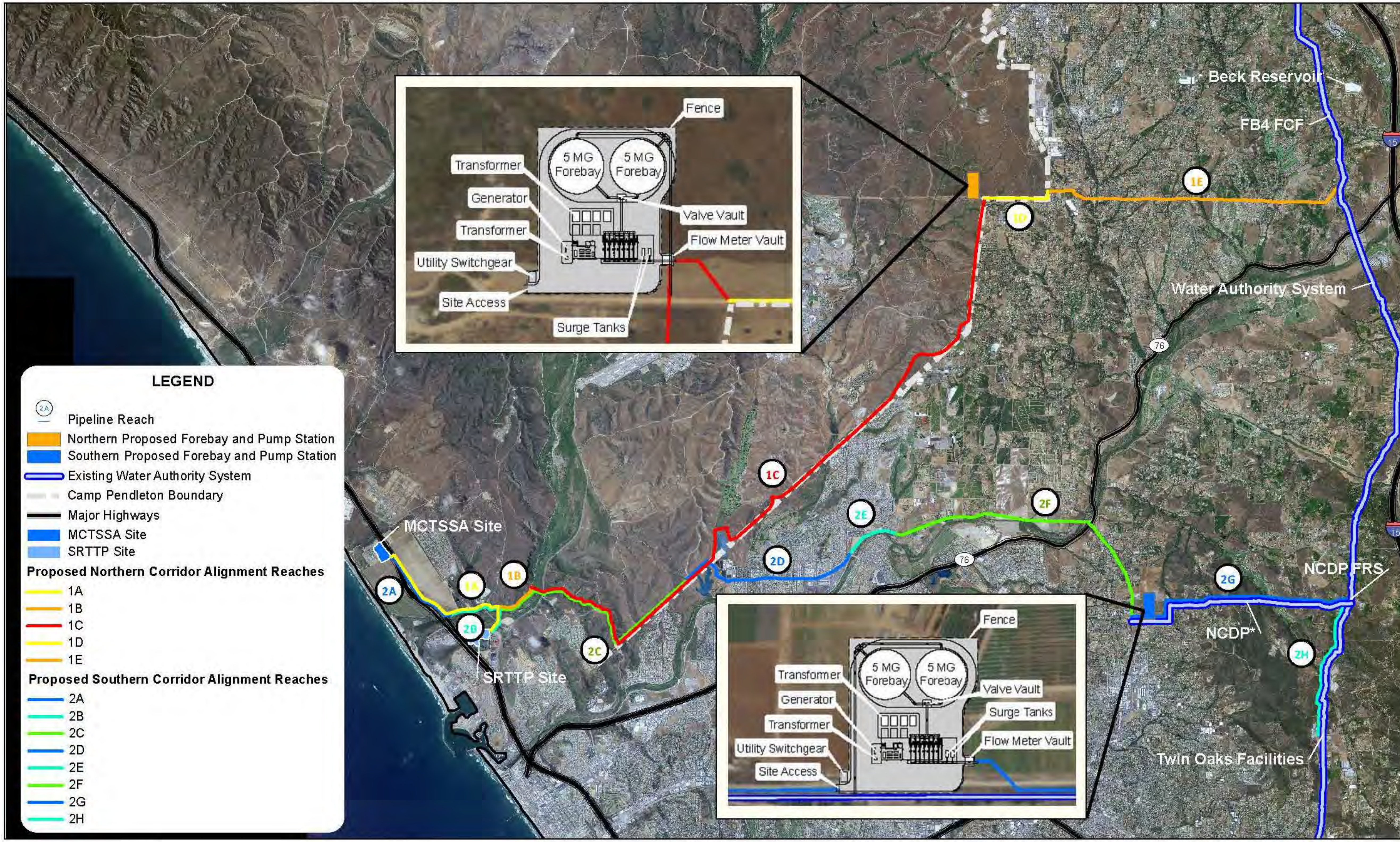

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2013 Regional Water Facilities
Master Plan Update

Figure 7-7
Camp Pendleton Conveyance Corridors

0 0.75 1.5 3 4.5 Miles

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7.3.3 Conveyance from the East

7.3.3.1 Colorado River Conveyance

Through the Water Conservation and Transfer Agreement with IID (IID Transfer) and the QSA for conserved water from canal lining projects, the Water Authority has contracted for delivery of 277,700 AF/YR of available water from the Colorado River. For supply planning purposes, the Water Authority also assumes that an additional 2,500 AF/YR of conserved water will be available from the Coachella Canal lining project, bringing the total supply to 280,200 AF/YR. This supply, which is considered a verifiable supply in the 2010 UWMP, is currently wheeled through MWD facilities and delivered to the Water Authority under terms of the Exchange Agreement with MWD. The Water Authority pays MWD's applicable wheeling rate for each acre-foot of water delivered.[7] The legality of this rate is the subject of pending litigation brought by the Water Authority in 2010 and 2012.

The proposed Colorado River Conveyance Facility would bypass MWD's facilities and provide direct conveyance of IID and QSA supplies from the Colorado River to the San Vicente Reservoir. Several potential routes for the Colorado River Conveyance Facility were previously analyzed by the Water Authority, beginning in 1996. Subsequent studies narrowed the potential routes to two preferred alternative alignments. These two preferred alternatives were further analyzed in the 2013 Master Plan.

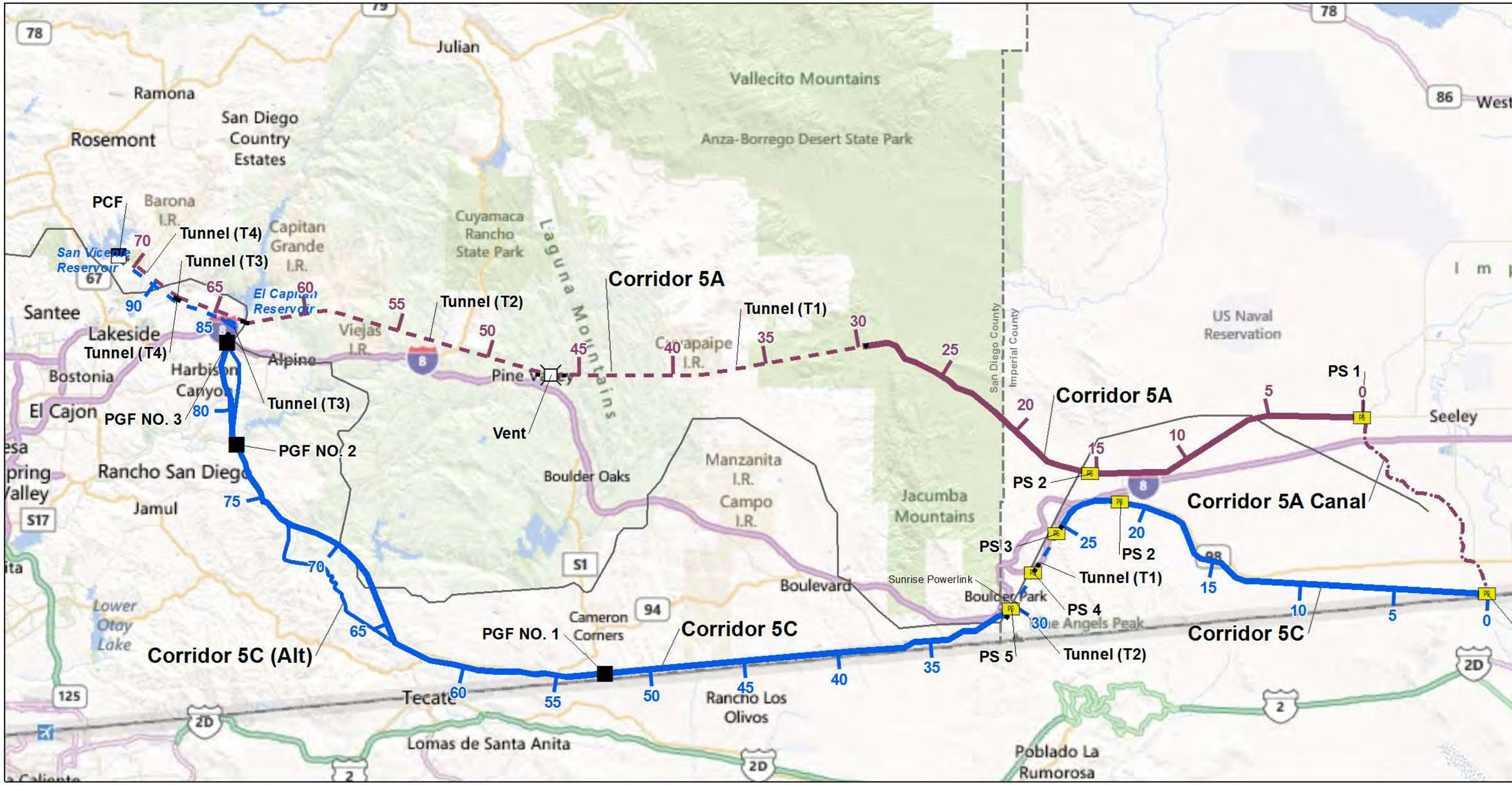
The 2013 Master Plan evaluation has included re-examining the assumptions and findings from the previous studies, most recently conducted in 2001, and determining any potential changes or fatal flaws in the alignments using current conditions. The evaluation also included cost and schedule refinements that considers current land use along the alignments; implementation of the San Vicente Dam Raise, Pipeline, and Pump Station; increase in the number of local water treatment plants that may now be served by San Vicente Reservoir; completion of the AAC relining project; completion of the Sunrise Powerlink Project, and energy management strategies to optimize power costs.

The two preferred alternatives include the "Tunnel Alignment," also known as Corridor 5A, that follows a more northerly route and contains 41 miles of tunnel, 12 miles of open channel canals, and 30 miles of pipeline; and the "Pipeline Alignment," also known as Corridor 5C, that follows a southerly alignment mostly along the international border and requires 81 miles of pipeline and 11 miles of tunnel. Both alternatives begin at the westerly terminus of the AAC at its junction with the Westside Canal and end at the San Vicente Reservoir. Each Colorado River Conveyance Facility alternative contains a mix of new pipelines, tunnels, open channel canals, pump stations, power generating facilities, pressure control facilities, new electrical transmission lines, and electrical substations. Water treatment facilities were also considered to address potential TDS concerns. A brief description and general location of the two alignment corridors are provided in Table 7-6 and shown in Figure 7-8.

[7] The 2013 wheeling rate is $453 per acre-foot and includes Metropolitan's rates for system access, water stewardship, and system power. The wheeling rate will increase to $465 per acre-foot in 2014.

TABLE 7-6
Description of Alignment Corridors 5A and 5C

Feature	Corridor 5A	Corridor 5C
Total Length	83.7 miles	91.8 miles
Canals	12 miles	-----
Pipelines	39.3 miles	81.2 miles
Tunnels	41.4 miles	10.6 miles
Pump Stations/Forebays	2/2	5/5
Power Generating Facilities/ Afterbays	-----	3/3



Legend

- Pressure Control Facility
- Power Generating Facility
- Pump Station
- Vent
- Milepost 5A
- Milepost 5C
- Tunnel Portal
- Corridor 5A
- Corridor 5A Tunnel
- Corridor 5A Canal
- Corridor 5C
- Corridor 5C Tunnel
- Corridor 5C (Alt)

CH2MHILL / BLACK & VEATCH

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Master Plan Update

Figure 7-8
Colorado River Conveyance Corridors

0 2.5 5 10 15 Miles

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7.3.4 Storage Optimization

Storage optimization relies on increased in-region surface water storage and out-of-region groundwater banking to alleviate peak demand constraints on the Baseline System.
The Water Authority will store water in four storage facilities: the Olivenhain Reservoir, the San Vicente Reservoir, Lake Hodges, and the Semitropic-Rosamond Water Bank. The 2013 Master Plan looked at ways to take advantage of storage opportunities and optimize available storage. With the upcoming completion of the San Vicente Dam Raise Project, the Water Authority will own significant storage capacity within the reservoir for carryover and emergency use. As further discussed in Section 8.2.4, the Storage Portfolio assumed that carryover capacity from in-region surface storage could increase by 90 TAF from the City of San Diego's San Vicente Reservoir. In order to use the San Vicente Reservoir carryover storage, it may be useful to operate the San Vicente Pump Station at its full capacity of 444 cfs, depending on the demand patterns. This requires improvements to the pump station, which currently only utilizes two pumps, to allow operation of the third pump, as further discussed in Section 7.4.1.3. The actual reoperation of storage within San Diego County may include multiple reservoirs that are connected to the aqueduct system. For the purpose of the analysis performed in *Chapter 8– System Reliability with Facility Options*, the 90 TAF of additional storage was modeled for San Vicente Reservoir as a surrogate for the actual reoperation strategy that could be implemented in the future.

7.4 Projects Common to Each Portfolio

The projects described in the following sections include both new and existing improvements that are required to assure reliable operation of the aqueduct system.

7.4.1 System Isolation Valves

The System Isolation Valves Project is a proposed new project that is needed to 1) isolate the aqueduct system from high-risk areas that have the potential to remove significant segments of the system for extended outages, 2) allow for more efficient isolation of segments of the aqueduct system to perform required inspections, maintenance, and repair work, and 3) isolate segments of the aqueduct system during low-flow periods to address potential water quality concerns. High-risk areas include river and lake crossings. Isolation valves are anticipated to be butterfly valves and would be installed on existing pipelines in new below-grade or partially below-grade concrete structures sized approximately 15 by 15 feet. The valve structures would be located within existing Water Authority pipeline easements and may require grading of new access roads for maintenance access. As shown in Figure 7-9 and described as follows, a total of four isolation valves are proposed for this project.

1. Pipeline 5 South of the San Luis Rey River Crossing – This valve would be constructed on Pipeline 5 north of the City of Oceanside Weese WTP. This valve would allow untreated water deliveries as far north as the Weese WTP should a failure of the untreated water pipelines occur at the San Luis Rey River Crossing.
2. Pipeline 4 South of the San Luis Rey River Crossing - This valve would be constructed on Pipeline 4 between the San Luis Rey River Crossing and the Vallecitos 10 Service Connection near the Twin Oaks Valley WTP. This valve would allow treated water

deliveries south of Twin Oaks should any portion of Pipeline 4 north of the valve be taken out of service for extended periods for maintenance and repair. Depending on the final location selected, this valve could allow treated water deliveries along Pipeline 4 as far north as the San Luis Rey River should a failure of Pipeline 4 occur at the San Luis Rey River Crossing. Implementation of the Pipeline 3/ Pipeline 4 Conversion Project may impact the location of this isolation valve.

3. Pipeline 3 at Mission Trails – This valve would be located on Pipeline 3 adjacent to the existing flow balancing structure. This valve would allow untreated water deliveries to the City of San Diego Alvarado WTP should any portion of Pipeline 3 between Mission Trails and Lower Otay be taken out of service for extended periods for maintenance and repair.
4. Pipeline 4 at State Route (SR)-125 – This valve would be constructed on Pipeline 4 in the vicinity of SR-125. This valve would allow isolation of treated water deliveries to address potential water quality concerns due to the presence of nitrification precursors.

7.4.2 North County ESP Pump Station

The North County ESP Pump Station is an existing CIP project. The project was referred to the 2013 Master Plan to determine implementation requirements consistent with the options to increase untreated water conveyance capacity. As part of the ESP, the North County Pump Station would be utilized to deliver water to portions of the North County service area during an emergency condition and when imported supplies are interrupted during planned outages of the aqueduct system. The pump station would send treated water north from the Twin Oaks Valley WTP to member agencies. The anticipated required footprint for the pump station is one to two acres, includes an above-grade pump station structure, and interconnects to the aqueduct system. The pump station would be sized for approximately 30 cfs and would be located in Fallbrook, with the site of the pump station to be determined consistent with the proposed new regional conveyance projects analyzed in the 2013 Master Plan. If the Pipeline 3/Pipeline 4 Conversion project is not implemented, then this new pump station would likely be located in the vicinity of the Red Mountain Reservoir and would require new tee connections to Pipeline 4 for the pump station influent and effluent, as well as an isolation valve and vault in between the connection points. However, if the Pipeline 3/Pipeline 4 Conversion project is implemented, the pump station would likely be located to the east of the I-15 freeway, near the intersection of Victoria Lane and East Mission Road, and would require new tee connections to Pipeline 3 for the pump station influent and effluent, as well as an isolation valve and vault in between the connection points. A third location where the Pipelines 3 and 4 alignments converge south of RB-8 off Dos Ninos Road was also identified to facilitate ease in implementation regardless of whether or not the Pipeline 3/Pipeline 4 Conversion project is implemented. This pump station would need to be sized slightly larger at approximately 50 cfs to accommodate additional flows from RB8. Figure 7-10 shows the general locations of the proposed pump stations.

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Master Plan Update

Figure 7-9
System Isolation Valves

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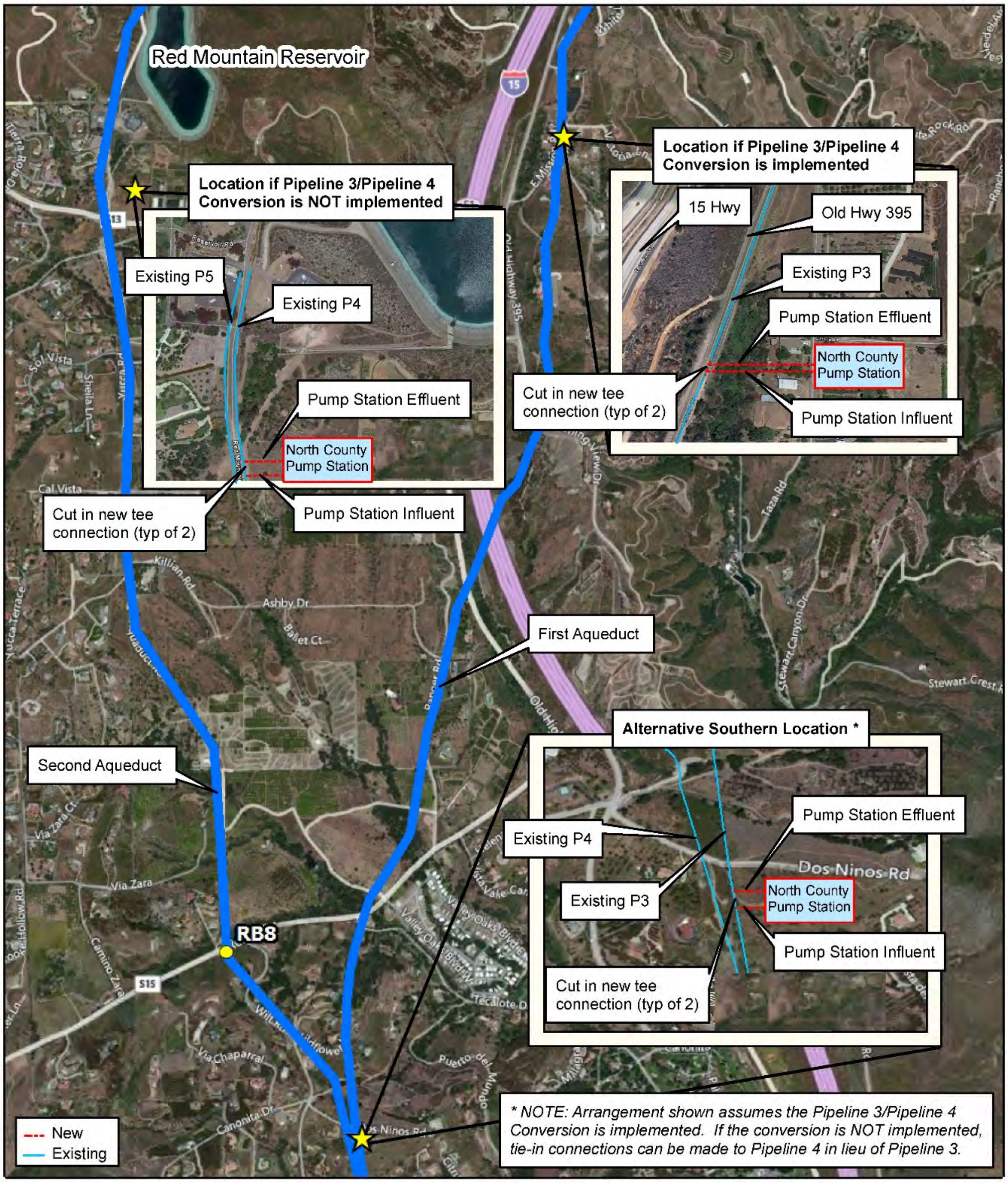

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Master Plan Update

Figure 7-10
North County ESP Pump Station

0 0.1 0.2 0.4 0.6 Miles

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7.4.3 San Vicente 3rd Pump Drive and Power Supply

This is an existing CIP project. The original purpose of the San Vicente Pump Station, as part of the ESP, was to deliver "75 percent of normal demand during the period of a major aqueduct outage due to earthquake or similar disaster." This required delivery quantity increases proportionately over the years as normal demand increase. When the pump station was constructed and placed in service, it was realized that the ultimate emergency demand that San Vicente Pump Station was intended to serve did not exist, allowing the pump station to be put into service with a power capability to run only two of the three pumps simultaneously. The current capacity with two pumps in service will vary with reservoir level, but for purposes of the 2013 Master Plan, is estimated at approximately 300 cfs. Pumping capacity with all three pumps in service will be 444 cfs. This project was referred to the 2013 Master Plan to confirm implementation timeframe based on based projected ESP demands as well as normal operating demands.

The San Vicente 3rd Pump Drive and Power Supply Project will provide station upgrades and a new power supply to allow the existing San Vicente Pump Station to be operated at full design capacity. Even though peak untreated water demands through the planning horizon of the 2013 Master Plan are not expected to exceed the current capacity of the San Vicente Pump Station, the project will also provide operational flexibility to deliver additional water from San Vicente Reservoir to meet unanticipated peak seasonal demands on the untreated water system. The location of San Vicente Pump Station is shown in Figure 7-11.

This project would upgrade the existing San Vicente Pump Station to add a third pump drive and an electrical transformer within the existing pump station structure. No structure modifications to the existing pump station are required to add the third pump drive and transformer. The new power supply options to operate the third pump may include a new 12 kilovolt (kV) overhead power line (to be implemented by South Diego Gas and Electric [SDG&E]) or onsite power generation using diesel or natural gas-powered generator sets. For onsite power generation, the existing fence line would need to be demolished, and new fencing would be provided to expand the site limits an approximate two to three acres for new onsite generators. The onsite generators would be sized to operate one pump, requiring a rated load capacity equal to about 6 megawatts (MW). The rated load capacity would typically be met by installing either three 2 MW diesel generators or one 6 MW natural gas generator. Additional yard switchgear and ancillary equipment would also be required for the onsite generation options. A general layout for the generator option is shown in Figure 7-12.

In addition, for the natural gas generator, a new natural gas feed line (to be implemented by SDG&E) would need to be constructed from the nearest gas service to the project site. For the diesel generators, a large onsite fuel storage tank would be required. The fuel storage tank would be sized to provide sufficient fuel to conduct periodic monthly maintenance testing of the generators. The monthly maintenance testing would require the generators to operate at approximately 30 percent of rated load for a minimum duration of 30 minutes. For continuous operation during an emergency event, each generator would require approximately 175 gallons per hour of fuel. Assuming storage for 24 hours, the three units would require 12,600 gallons of fuel. Thus, a 15,000-gallon fuel storage tank could be provided with a need for diesel fuel to be delivered to the site on a daily basis.

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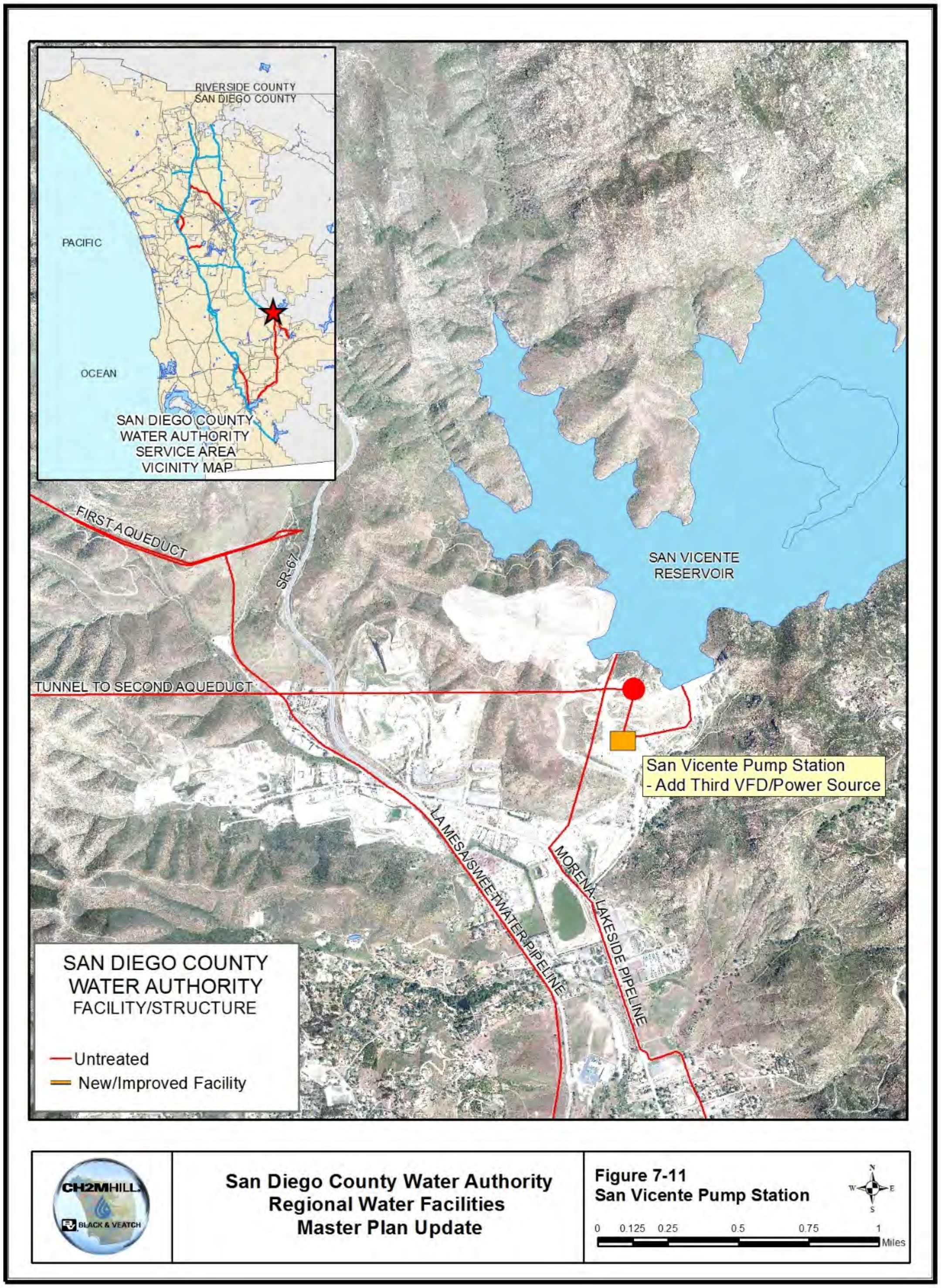
RIVERSIDE COUNTY
SAN DIEGO COUNTY
PACIFIC
OCEAN
SAN DIEGO COUNTY
WATER AUTHORITY
SERVICE AREA
VICINITY MAP
FIRST AQUEDUCT
SR-67
SAN VICENTE
RESERVOIR
TUNNEL TO SECOND AQUEDUCT
San Vicente Pump Station
- Add Third VFD/Power Source
LA MESA/SWEETWATER PIPELINE
MORENA-LAKESIDE PIPELINE
SAN DIEGO COUNTY
WATER AUTHORITY
FACILITY/STRUCTURE
Untreated
New/Improved Facility
CH2MHILL
BLACK & VEATCH
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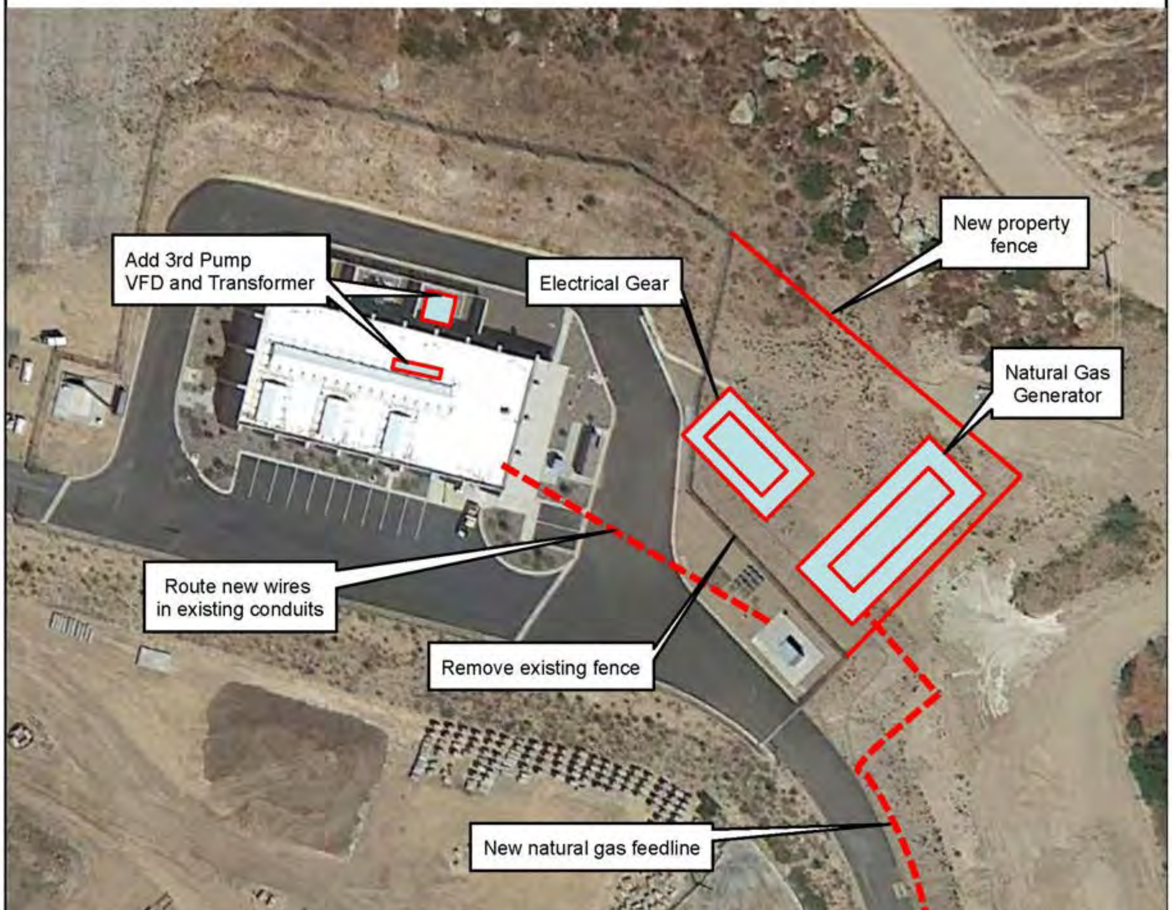
Figure 7-11
San Vicente Pump Station
0 0.125 0.25 0.5 0.75 1
Miles



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2013 Regional Water Facilities
Master Plan Update

Figure 7-12
San Vicente Pump Station Arrangement

0 0.005 0.01 0.02 0.03 Miles

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7.4.4 Mission Trails Projects

The Mission Trails suite of projects includes several existing CIP projects that were originally envisioned to meet expected untreated water demand increases resulting from improvements to expand the capacity at several central and south county WTPs. The projects will also relieve an existing hydraulic capacity constraint at the 30-inch interconnection between Pipelines 3 and 4 located in the Lake Murray area. The full suite of projects includes the Mission Trails Flow Regulatory Structure II (MTFRSII), the Mission Trails Tunnel, and the Lake Murray Control Valve. A separately funded project would also be required for the relining of Pipeline 3 between the Miramar WTP and State Route 52. These projects would increase untreated water conveyance capacity south of the Miramar WTP from 220 to 370 cfs. The tunnel project was constructed in 2009, but with the recent reduction in demands, implementation of the remaining projects has been delayed. The Mission Trails Projects were referred to the 2013 Master Plan to confirm sizing requirements and to determine an appropriate implementation time considering future demand increases and the operational benefits of an increase in regulatory storage.

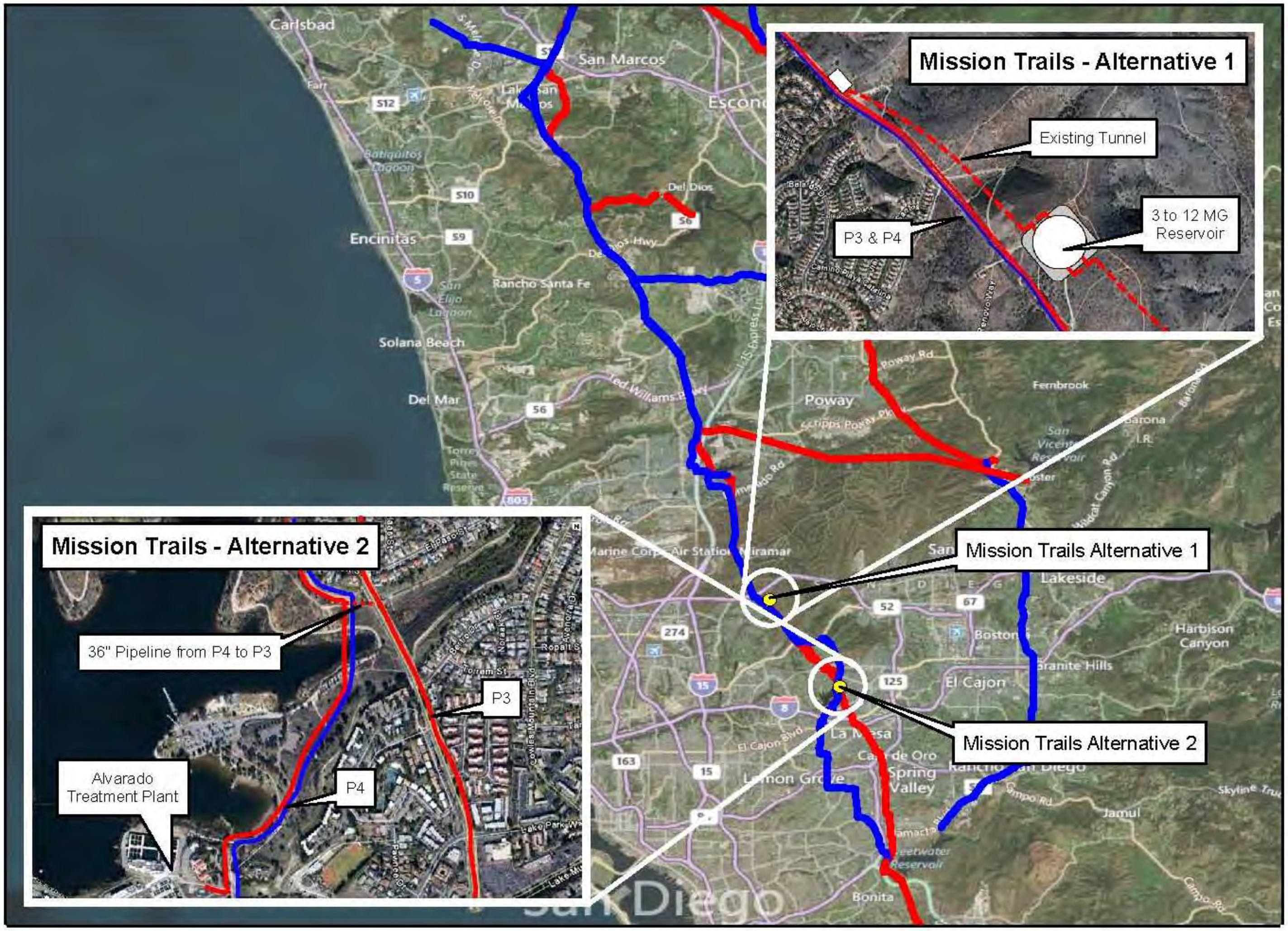
Two alternatives for the Mission Trails projects were considered as part of the 2013 Master Plan, as shown in Figure 7-13. Alternative 1 would implement the full suite of projects essentially as they are currently planned, with the schedule for all projects based on relieving the conveyance constraint at the 30-inch Interconnection at Lake Murray. Alternative 2 would further delay implementation of the full suite of projects until peak untreated water demands south of the Miramar WTP increased above 220 cfs, and instead propose a new facility that would be implemented to relieve the conveyance constraint at the 30-inch Interconnection at Lake Murray.

7.4.4.1 Alternative 1

Alternative 1 involves implementation of the project components as originally envisioned, and would increase untreated water conveyance capacity south of the Miramar WTP from 220 to 370 cfs. This alternative would also increase untreated water conveyance capacity south of the Alvarado WTP from 70 to 140 cfs. The project includes a 12 million-gallon underground concrete storage reservoir, appurtenant valve facilities, connections at both the north and south ends of the Mission Trails Tunnel to Pipelines 3 and 4, and a bypass around the Navajo vent. The regulatory storage component of the project is located in Mission Trails Regional Park with an anticipated footprint of approximately four to six acres. The storage reservoir would be connected to and operated in combination with the completed Mission Trails Tunnel. The project also includes the Lake Murray Control Valve, constructed along Pipeline 3 near the intersection of Lake Murray Boulevard and Baltimore Drive. The size of the storage reservoir may be reduced pending review of design and operational criteria for regulatory storage.

7.4.4.2 Alternative 2

Alternative 2 of the Mission Trails Project would further delay the MTFRSII and the Lake Murray Control Valve projects. In lieu of these two projects, Alternative 2 would construct a new interconnection between Pipelines 3 and 4, and increase the capacity south of Alvarado WTP to 140 cfs. Two options have been considered for the new interconnection. The first option is located on the east side of Lake Murray, south of the intersection of Laport Street and Baltimore Drive. This alternative would require approximately 500 feet of 36-inch-diameter piping in a 100-foot-wide right-of-way. Two isolation valves and a vault will be provided for operational flexibility. The second option would restore an existing interconnection between Pipelines 3 and 4 that is located in Mission Trails Park south of the site for the MTFRSII. This existing interconnection, also known as the Flow Balancing Structure, was removed from service during repair work on Pipeline 3 that required a reconfiguration of the untreated water pipelines south of the Miramar WTP. Restoring the Flow Balancing Structure requires installation of new pipe spools and valves in an existing below grade structure.



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2013 Regional Water Facilities
Master Plan Update

Figure 7-13
Mission Trails Project

0 1 2 4 6 Miles

7.4.5 System Storage

The System Storage Project is an existing CIP project that would provide new regulatory storage for improved operation of the aqueduct system. Regulatory storage is needed to manage daily flow changes, provide storage for unanticipated flow interruptions that otherwise may cause pipelines to drain or vent structures to spill, provide hydraulic control for segments of the aqueduct system, dampen hydraulic transient pressures, and serve as a pump station afterbay. The project includes two possible locations for new regulatory storage facilities: at the Twin Oaks Diversion Structure and at the First Aqueduct and Valley Center Pipeline connection. This project was referred to the 2013 Master Plan to confirm potential storage locations and system integration requirements.

7.4.5.1 Twin Oaks Diversion Structure

A new facility at the Twin Oaks Diversion structure site would provide regulatory storage for deliveries associated with increased imported water conveyance capacity resulting from the Pipeline 3/Pipeline 4 Conversion Project. A new facility at Twin Oaks would also allow for replacement of the existing Rejection Tower and Pressure Control Structure, improving flow control stability for deliveries to the Twin Oaks Valley WTP and the Crossover Pipeline.

As shown in Figure 7-14, the project would consist of a new 10- to 20-million-gallon, above-grade to a partially below-grade reinforced concrete regulatory structure, approximately 2,500 feet of new 96-inch-diameter pipeline, to connect the new storage structure to Pipeline 5 and Pipeline 3 (or to Pipeline 4 instead of Pipeline 3 if the Pipeline 3/Pipeline 4 Conversion Project is implemented), and a new pressure control facility. The new regulatory structure would be located on a site north and west of the existing Twin Oaks Valley WTP, with site selection based on providing a minimum reservoir floor elevation of approximately 1,130 feet. The project would have an anticipated footprint of approximately 10 acres. The size of the storage structure would be based on operating and design criteria for regulatory storage needs, although it is anticipated that two 5 to 10 million-gallon storage structures and appurtenant connection facilities would be required. The total storage requirement could be implemented in a phased approach.

7.4.5.2 First Aqueduct

As described in the 2003 Master Plan, a new regulatory storage structure is proposed along the First Aqueduct to reduce occurrence of treated water spilling into the untreated system south of Hubbard Hill. If located north of Hubbard Hill and closer to the point where Pipeline 2A connects to the First Aqueduct, this new storage structure would also operate as an afterbay for an expanded Pipeline 2A Pump Station. As an afterbay, the project would provide operational storage and prevent a draindown of the First Aqueduct pipelines during an unanticipated interruption of flows from the Pipeline 2A Pump Station. The storage structure would be sized to provide approximately one to three million gallons of storage. The project footprint would be approximately three to five acres. The project would also include up to 2,000 feet of new 60-inch-diameter pipeline to connect the storage structure to the First Aqueduct and appurtenant control structures to regulate flow.

7.4.6 Second Crossover Pipeline

The Second Crossover Pipeline is an existing CIP project that is intended to increase untreated water delivery capacity from Twin Oaks to the First Aqueduct. The project was referred to the 2013 Master Plan to confirm implementation timeframe. The existing Crossover Pipeline was constructed in the 1970s as a part of the aqueduct system reconfiguration that helped implement the new surface water treatment water quality regulations of the time. Although the northernmost part of the First Aqueduct is supplied with treated water directly from MWD, essentially all of the available flow is consumed at peak times of year before reaching Escondido, leaving an empty aqueduct at that point. Meanwhile, Escondido, Poway, the city of San Diego, and other customers along the more southerly part of this aqueduct have their own treatment plants and can safely treat untreated water. The Crossover Pipeline moves untreated flow from the Second Aqueduct to the First Aqueduct, to serve these untreated water customers. In order to boost the capacity of the pipeline, a facility known as the rejection tower was constructed to allow the Crossover Pipeline to be supplied at the higher hydraulic grade of Pipeline 5. Without the rejection tower, the capacity of the pipeline is 130 cfs; when "boosted" by the rejection tower, the capacity of the pipeline is 200 cfs.

The 2000 UWMP projections indicated that demand served by this pipeline would significantly increase (Water Authority, 2000). As a result of the projected flow increase and poor condition of the existing Crossover Pipeline, the 2003 Master Plan recommended that a new parallel Second Crossover Pipeline be constructed at significantly larger capacity, with the ultimate disposition of the existing pipeline to be determined after flows had been switched into the new pipe . Constructing a new Second Crossover Pipeline, parallel to the existing one, as contemplated in the 2003 Master Plan, would increase delivery capacity of this pipeline link to about 330 cfs. As a result of flows being lower than projected and recent condition assessment of the existing Crossover Pipeline, it appears that the pipeline only has isolated concerns and could continue to be utilized in lieu of replacement once repairs are made. The Crossover Pipeline corridor is shown in Figure 7-15.

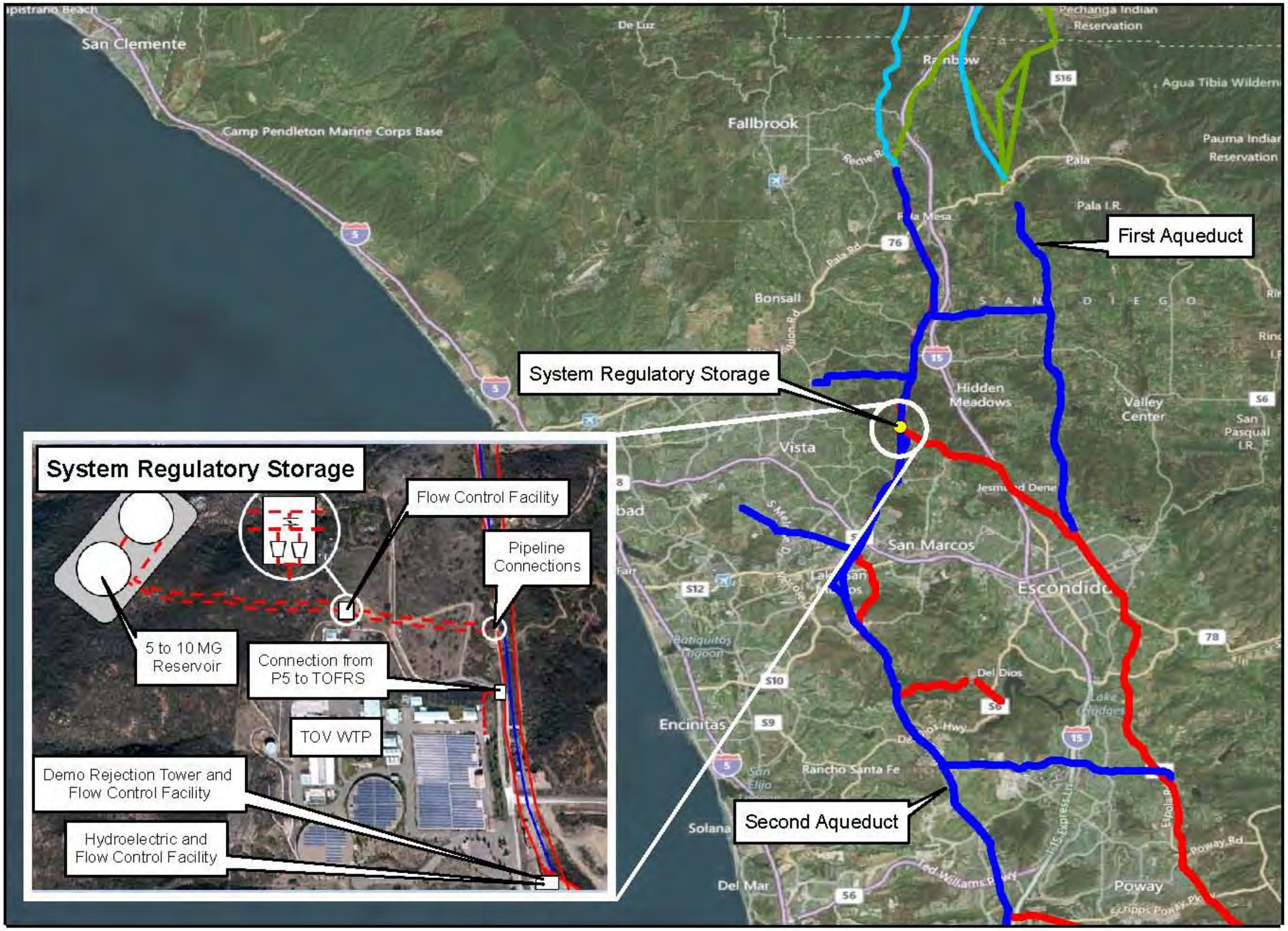

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Figure 7-14
System Storage

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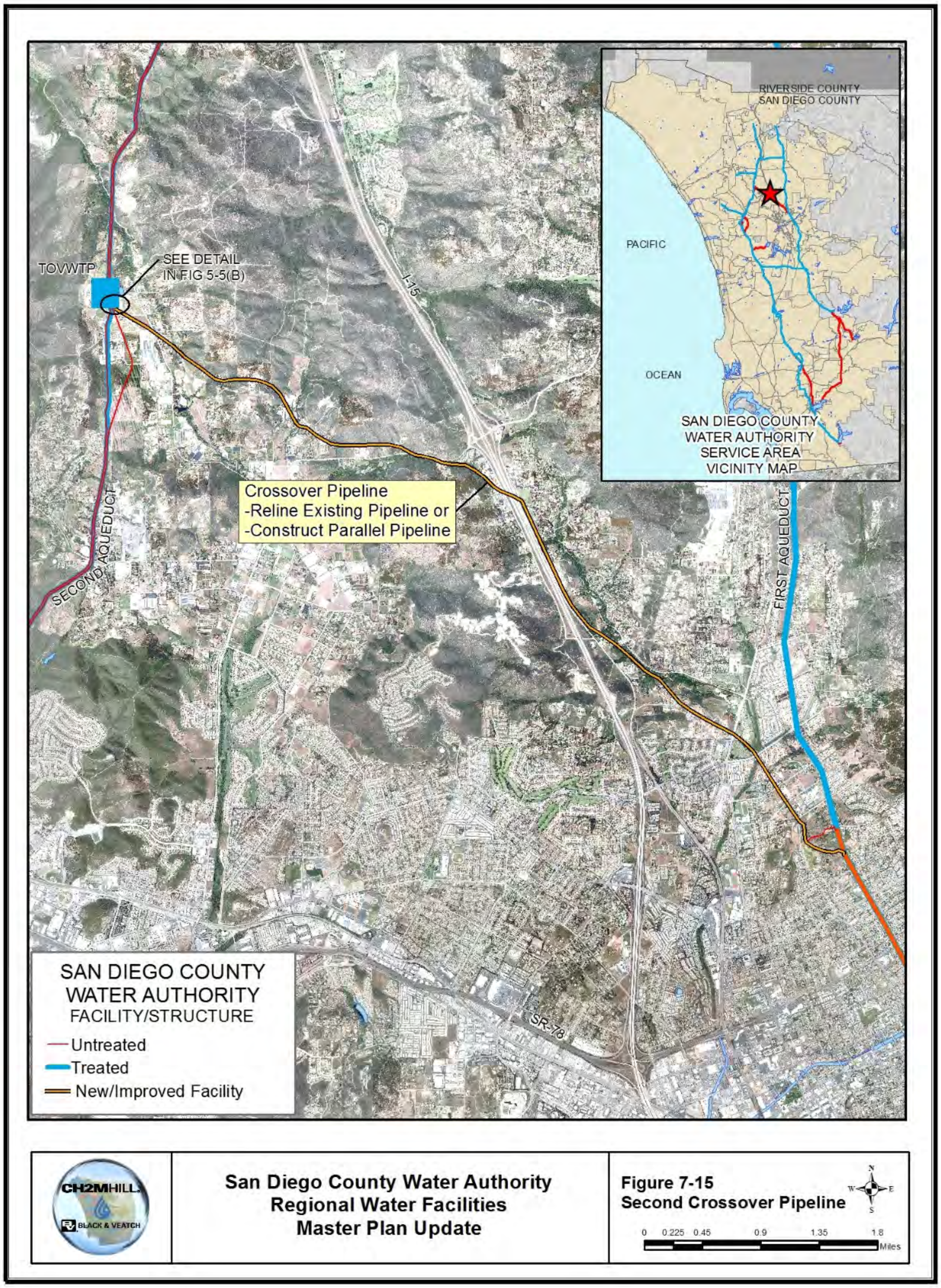

Figure 7-15
Second Crossover Pipeline

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7.5 Cost

To aid the Water Authority in the timing and prioritization of implementing project options and near-term projects, the 2013 Master Plan developed a costing basis and utilized costing protocols as defined in this section. Project options were then compared against costs and other criteria. Costs for the near-term projects were also identified.

7.5.1 Cost Basis

Cost estimates for each project option were assembled based on preliminary planning level data collected and developed as part of this analysis. Due to the preliminary status of the projects, the current unpredictable bidding climate, and unknown project schedules, opinions of probable costs should be updated regularly as the projects are better defined. To account for the preliminary nature of the analysis, allowances for construction contingency and soft costs were applied to the project costs. The allowance assigned for construction contingency varied from 30 to 50 percent for the projects, depending upon how far along they were in the planning stage. An allowance of 50 percent was applied for soft costs that include permitting, legal, public outreach, investigations and surveys, engineering and design, construction management, administration, and insurance. An exception is for the several projects for which the Water Authority had previously developed cost estimates; when these estimates were utilized, the contingency and soft costs applied varied from those indicated above.

Based on the current understanding of each project's key design criteria and general assumptions made regarding facility locations and configuration alternatives, this opinion is intended to provide a range of costs to bracket any alternatives within a project option. Costs were developed from a variety of sources, including Water Authority cost data, previous reports, historical data from similar projects, and input from cost estimators. When required, costs were adjusted for inflation by applying a direct ratio of the Engineering News Record (ENR) – Construction Cost Index (CCI) (ENR, 2012). At the time of the estimate, the Los Angeles ENR-CCI was 10,283 (October 2012). Therefore, the costs can be updated once the schedule has been further defined. The costs are considered to be feasibility level costs equivalent to a Class 4 Estimate using the Water Authority's Cost Estimating Guidelines (Water Authority, 2008). As such, the cost estimates have a range of +30 to -20 percent accuracy. Detailed cost information is provided in *Appendix H – Cost Estimates*. Table 7-7 provides a summary of the project costs, along with estimated project durations. No projects were identified for the Storage Optimization portfolio; thus no costs are included.

TABLE 7-7
Capital Costs for Project Options

Portfolio Projects	Capital Cost ($ millions)	Estimated Duration[a]
Conveyance from the North		
Pipeline 6 Project	$440	6 years
Pipeline 3/Pipeline 4 Conversion	$269[b]	5 years
Supply from the West Camp Pendleton Desalination Project		
50 mgd	$1,420 to $1,530	6 years
100 mgd	$2,070 to $2,370	7 years
150 mgd	$2,660 to $3,110	8 years
Conveyance from the East Colorado River Conveyance Project	$2,090 to $2,430	8 years
Projects Common to Each Portfolio		
System Isolation Valves	$11.0	3 years
North County Pump Station	$23.5 to $37.4	4 years
San Vicente 3rd Pump Drive and Power	$16.1 to $32.0	3 years
Mission Trails Projects	-	
Alternative 1	$43.9 to $53.1	4 years
Alternative 2	$3.1	2 years
System Storage	$56.2 to $97.5	4 years
Second Crossover Pipeline	$371	3 years

[a]Estimated Duration refers to the anticipated planning, design, construction, and startup duration for the project.
[b]Option 2 Costs, includes the MWD and Water Authority portions of the Pipeline 3/Pipeline 4 Conversion Project (i.e., extension of Pipeline 6 from the existing Pipeline 6 to Twin Oaks WTP). Option 1 will be less expensive.

Chapter 8.0 System Reliability with Facility Options

8.1 Introduction

The evaluation presented in *Chapter 6 – Baseline System Reliability* revealed a number of specific limitations related to conveyance capacity constraints and overall water supply reliability. The Baseline System evaluation further indicated that the future reliability of the system would be strongly dependent on demand trends, conservation savings, and member agency local supply development. As expected, conveyance constraints were more prevalent under the high-demand scenarios, with the constraints consistently exceeding performance thresholds beginning in 2020. Under the lower-demand scenarios, the same conveyance constraints were delayed three to five years out. On the supply side, system shortages only begin to occur with the high-demand scenarios around the 2025 timeframe, allowing for clarity of several local and statewide water resource issues to occur before any significant actions on new supply development by the Water Authority are needed.

With this understanding of the Baseline System, each of the four infrastructure portfolios were evaluated to address specific supply or conveyance needs through the 2035 planning horizon.

The System Reliability with Facility Options analysis is summarized in Table 8-1 and discussed in more detail in the sections that follow.

Figure 8-1 shows the overall 2013 Master Plan process and the associated chapters. Highlighted in Figure 8-1 are the elements described in this *System Reliability with Facility Options* chapter (Chapter 8). This chapter describes how the facility options (discussed in *Chapter 7 – Project Options and Portfolios*) were organized and evaluated for addressing future system needs (identified in Chapter 6). The chapter also evaluates how and when system performance could be improved using the facility options.

TABLE 8-1
Summary of System Reliability with Facility Options

Analysis Component	Description
Master Plan Portfolios	Four Master Plan Portfolios were developed that considered implementation of the projects or project options described in *Chapter 7 – Project Options and Portfolios* in varying order to explore different strategies to alleviate reliability constraints projected for the Baseline System: Supply from the West (West), Storage Optimization (Storage), Conveyance from the North (North), and Conveyance from the East (East).
Master Plan Portfolio Evaluation	Model simulations of each portfolio relative to the Baseline System configuration were conducted under the four supply and demand scenarios described in *Chapter 4 – Scenario Planning*. Results for six performance metrics were reported: Delivery Reliability, Conveyance Utilization, Supply Diversification, WTP Utilization, Storage Utilization, and Energy Usage.
Project Implementation	The results presented in this section can be analyzed to identify which projects need to be implemented in the near to mid-term, and which projects may be necessary only if triggered by future conditions. The projected timeframe for implementation of each project evaluated in the portfolios under each supply and demand scenario is summarized in Table 8-6.
Summary	Water supply and demand scenarios considered in the 2013 Master Plan spanned a broad range of plausible future conditions and provided invaluable information related to the performance of the system under these conditions. System modeling results demonstrated that all portfolios can reduce reliability constraints.

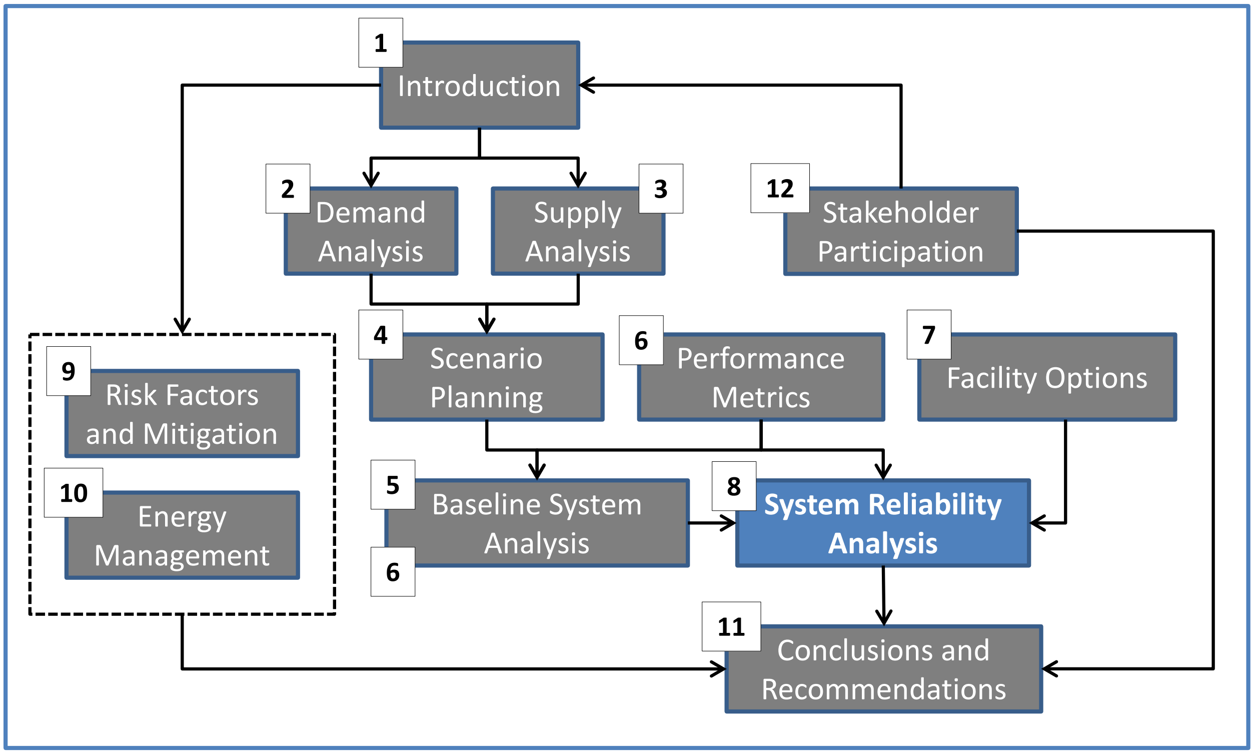

FIGURE 8-1
Elements and Associated Chapters Included in the Master Plan

8.1.1 Model Implementation

The 2013 Master Plan recognizes that both aqueduct system improvements and new supply development needs will depend upon future conditions that have varying levels of uncertainty. Therefore, successful strategies for addressing system needs must be adaptive to these uncertainties. Ideally, new improvements would be implemented under future conditions in which they are most likely needed, and are most effective for minimizing or preventing the risk of reoccurring conveyance constraints and supply shortfalls through the planning horizon. The modeling approach developed for the 2013 Master Plan applies this same "right sizing" and "right timing" strategy by implementing improvements only when needed and to address specific supply or conveyance risks. In the modeling analysis, this means that there is a specific project implementation sequence for each unique hydrologic trace.

The CWASim model was configured to monitor specific supply shortages and conveyance constraints and to implement various project options within each portfolio when certain performance thresholds were projected to be exceeded. For example, under a specific supply-demand scenario and hydrologic sequence, the conveyance threshold may not have been exceeded until 2028. In this case, a pipeline improvement project was implemented within the model in that year to address the conveyance deficiency. In another hydrologic sequence or supply-demand scenario, the threshold may have been only exceeded in 2030, and the implementation of the improvement project in the model would occur two years later.

For each of the portfolios, the model is also directed to implement projects in a defined sequence, or if a phasing opportunity is available, in a defined order of increasing capacity. This sequencing, or priority order of project implementation, is shown in Table 8-2.

TABLE 8-2
Priority Order for Project Options Considered in the 2013 Master Plan

Project Option	Baseline System	Supply from the West	Storage Optimization	Supply from the North	Supply from the East
Delivery Reliability Options					
Camp Pendleton Desalination – 50 mgd		1			
Camp Pendleton Desalination – 100 mgd		2			
Camp Pendleton Desalination – 150 mgd		3			
Storage Optimization – 90 TAF			1		
Groundwater Banking – 20 TAF annual take			2		
Conveyance Utilization Options					
Pipeline 3 and Pipeline 4 Conversion				1	
Pipeline 6				2	
Colorado River Conveyance					1
Second Crossover Pipeline		1	1	1	1
South County Intertie		1	1	1	1
Capacity Utilization Options					
San Vicente Pump Station, usage to 240 cfs	1	1	1	1	1
San Vicente Pump Station, usage to 444 cfs		2	2	2	2

At the conclusion of each model run/simulation, a summary of the selected project options and their implementation timing was included in the results output. In addition, the resulting performance metrics were output for each year and hydrologic traces of the simulation. These outputs allowed analysis of both the frequency and timing of option implementation and the resulting improvements in system performance of each portfolio. Figure 8-2 shows an example plot of option implementation for the "Supply from the West" portfolio under the high-demand Scenario B. The figure represents the simulated timing at which more than 90 percent of the hydrologic traces resulted in option implementation. Under this high-demand scenario, and as shown in Figure 8-2, the frequency of exceeding performance thresholds for both delivery reliability and conveyance constraints results in a model output displaying the need for new supply development beginning in 2025 and new conveyance needed by 2017. Because of the high demands placed on the Water Authority system under this scenario, additional supply development and added conveyance capacity is needed in succeeding years.

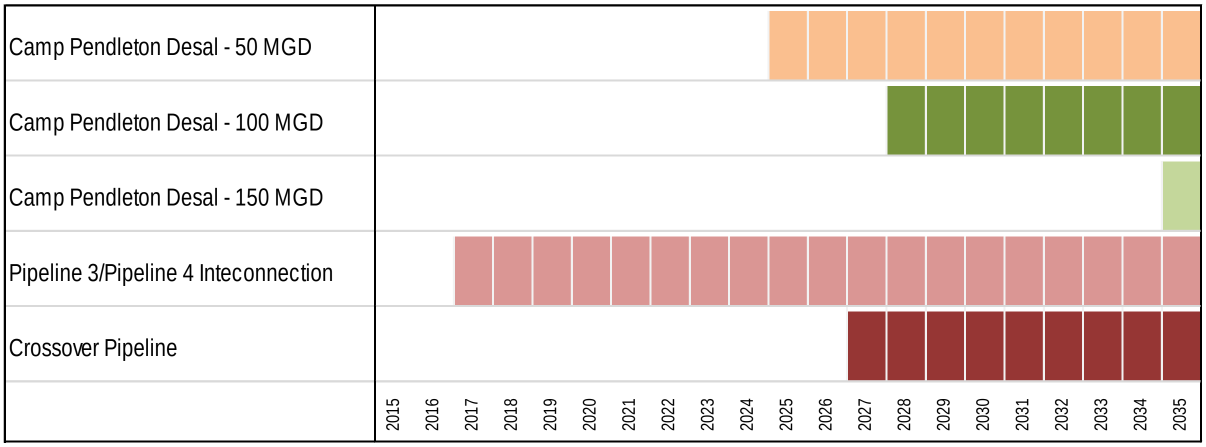

FIGURE 8-2
Example Model Output showing Frequency of Option Implementation for “Supply from the West” Portfolio for High-Demand Scenario B. A phased implementation approach is displayed to match the point in time when system capacity exceeds performance thresholds.

8.2 Master Plan Portfolio Evaluation

The effects of the portfolios were simulated in CWASim for each of the four supply and demand scenarios. The results are presented as a percentage of the traces that exceed the performance threshold for each decision metric for the Baseline System facilities configuration and each of the portfolios over four distinct 5-year time periods spanning the 2013 Master Plan planning horizon: 2015–2020, 2021–2025, 2026–2030, and 2031–2035. For ease of understanding, these values can be viewed as the percent likelihood of being exceeded in any year during these periods. The results are also grouped according to scenario (A, B, C, and D) (see Table 8-3) and portfolio (Baseline System performance vs. West, Storage, North, and East portfolios).

TABLE 8-3
Master Plan Supply-Demand Scenarios

Master Plan Supply-Demand Scenarios

Scenario	Description
A – Urban Water Management Plan	Assumptions for local supply development, conservation targets, imported supply reliability match 2010 UWMP
B – Reduced Local Supplies	Assumes lower local supply development, reduced conservation savings, reduced imported supply reliability, and climate change impacts
C – Enhanced Local Supplies	Assumes enhanced local supply development, increased conservation savings and imported supply reliability per 2010 UWMP
D – Adjusted Local Supplies	Assumes local supply and conservation savings adjusted to reach 50 percent of targets, imported supply reliability per 2010 UWMP

The specific results related to the water delivery reliability, conveyance utilization, and the role of storage are presented in the following subsections.

8.2.1 Water Delivery Reliability (Supply Shortages)

Simulation results from the evaluation of portfolios were used to estimate to what degree new facility investments could improve delivery reliability by alleviating projected supply shortages to the member agencies. Figure 8-4 (top panel) shows the frequency of exceedance for the water delivery metrics with portfolios in place compared with the Baseline System for each 2013 Master Plan scenario.

In general, the vulnerability to exceeding the water delivery reliability threshold for the Baseline System was very low (1 percent of the time or less) under the lower-demand scenarios (Scenarios A and C), and implementation of any portfolio had no effect on delivery reliability vulnerability. Under a higher-demand scenario (Scenario D), delivery vulnerabilities would also remain very low through the 2026–2030 time period (2 percent of the time), and only grow slightly to 6 percent of the time under the Baseline System at the later years of the planning horizon. The West, North, and East portfolios would reduce the vulnerabilities under Scenario D to less than 3 percent during the last time period, while the Storage portfolio would essentially not improve upon the Baseline System condition.

Only under the highest-demand scenario (Scenario B) did water delivery vulnerabilities approach a level that warranted attention. Under Scenario B, water delivery vulnerabilities could exceed 25 percent of the time under Baseline System conditions. The West and East portfolios would reduce these vulnerabilities to less than 5 percent, while the North portfolio would reduce these vulnerabilities to 10 percent of the time. Similar to the Scenario D condition, the Storage portfolio provides essentially no improvement compared to the Baseline System.

Based on these results, the Baseline System presents a very low level of risk to delivery reliability through the 2035 planning horizon. This risk level is acceptable when future supplies and demands are on a trajectory that closely matches or slightly exceeds the projections included in the 2010 UWMP (Water Authority, 2011a). The risk level, however, begins to notably exceed performance thresholds under the highest-demand scenario after the year 2025 and continues upward through the end of the planning horizon. As depicted in Figure 8-3, at some time after the year 2025, and possibly before the end of the planning horizon, the supply reliability risk may reach a point that warrants implementation of a portfolio option to lower the risk of a regional supply shortage.

Additionally, modeling results for delivery reliability indicate that under an extended dry weather event, imported supply could be insufficient due to an MWD shortage under preferential rights allocation and demands sufficiently high that no one facility option, or combinations of facility options, could fully mitigate all possible supply-demand imbalances. During such an event, it is likely that flexible Water Authority and member agency operations or drought management measures will need to be implemented to resolve these critical issues.

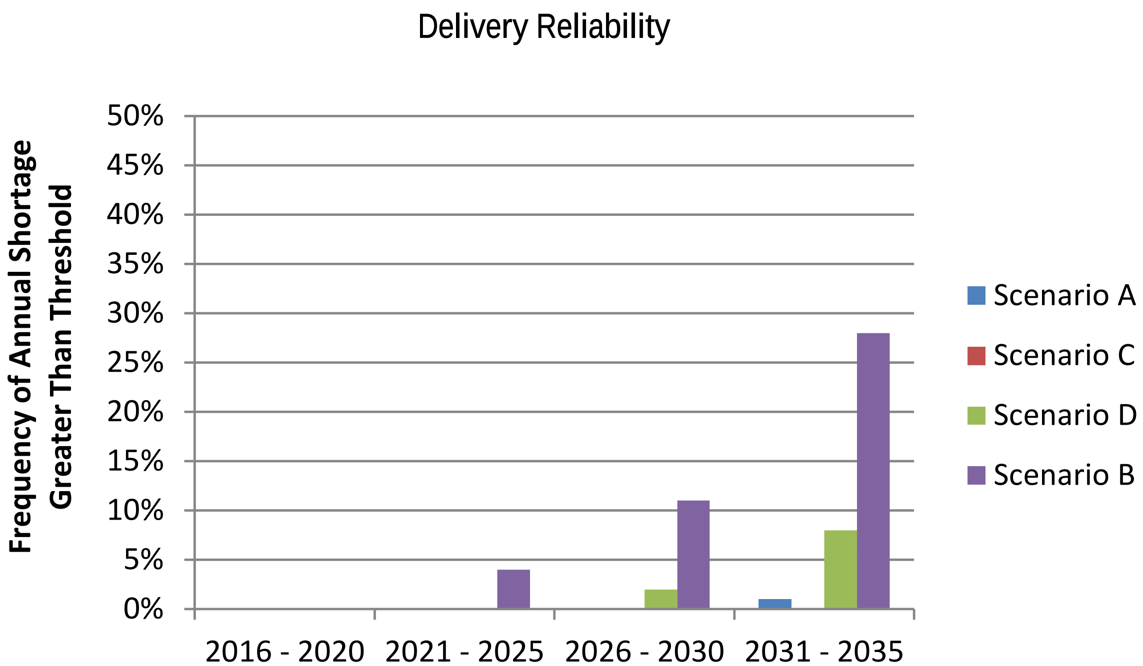

FIGURE 8-3
Delivery Reliability Risk of Baseline System

8.2.2 Conveyance Utilization

Simulation results from the evaluation of portfolios were also used to estimate to what degree new facility investments could alleviate conveyance constraints at critical locations in the aqueduct system. From the analysis of the Baseline System, we learned that the treated water conveyance system has sufficient capacity to meet projected demands through the 2035 planning horizon. We also learned that there are several potential constraints on the untreated water conveyance system, notably at the MWD Delivery Point and at the 30-inch interconnection near Lake Murray. Figure 8-4 (bottom panel) shows the expected frequency at which the conveyance utilization threshold will be exceeded for the untreated system at the MWD Delivery Point with portfolios in place compared with the Baseline System for each Master Plan scenario.

For all supply-demand scenarios, significant conveyance constraints at the MWD Delivery Point are projected starting in the 2021–2025 period. The frequency of exceeding the conveyance utilization threshold (45 days above 95 percent capacity) during the 2021–2025 period would range from 5 percent under the lowest-demand scenario, to approximately 20 percent under the 2010 UWMP assumptions scenario, and could exceed 40 percent of the time under the higher-demand scenarios. By the end of the planning horizon (2031–2035), conveyance vulnerabilities would be experienced more than 40 percent of the time under all scenarios for the Baseline System.

		Scenario A					Scenario B					Scenario C					Scenario D				
	PERIOD	Baseline	West	Storage	North	East	Baseline	West	Storage	North	East	Baseline	West	Storage	North	East	Baseline	West	Storage	North	East
Frequency of Annual Shortage Greater than Threshold (SS_1)	2016-2020	0%	0%	0%	0%	0%	4%	4%	3%	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	2021-2025	0%	0%	0%	0%	0%	4%	3%	3%	5%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	2026-2030	0%	0%	0%	0%	0%	11%	4%	11%	9%	3%	0%	0%	0%	0%	0%	2%	1%	2%	1%	0%
	2031-2035	1%	1%	1%	1%	0%	28%	3%	26%	10%	1%	0%	0%	0%	0%	0%	6%	1%	5%	3%	1%
Frequency of Untreated Conveyance Greater than Threshold (PU_1)	2016-2020	3%	3%	3%	3%	3%	9%	3%	4%	3%	3%	0%	1%	1%	1%	1%	9%	6%	5%	6%	6%
	2021-2025	19%	11%	13%	8%	13%	47%	26%	26%	16%	27%	2%	4%	5%	4%	5%	39%	21%	21%	15%	22%
	2026-2030	50%	21%	35%	11%	12%	71%	36%	52%	14%	16%	21%	10%	19%	9%	8%	64%	30%	48%	13%	15%
	2031-2035	59%	17%	41%	4%	5%	73%	29%	51%	8%	3%	34%	14%	29%	6%	7%	72%	25%	61%	5%	5%

FIGURE 8-4
Delivery Reliability (top panel) and Untreated Conveyance (bottom panel) Results for Baseline System and Four Portfolios.

Notes:
Scenarios: A2=Urban Water Management Plan, B=Reduced Imported Supply, Climate Change, and Lower Local Supply Development, C=Enhanced Local Resource Management, D=Adjusted Local Supply Development;
Portfolios: Baseline=Baseline Facilities Configuration, West=Supply from the West, Storage=Storage Optimization, North=Supply from the North, East=Supply from the East;

Color-shading indicates increasing risk from green to red.

All portfolios will reduce the frequency of conveyance constraints. The North and East portfolios would be especially effective at reducing these vulnerabilities by expanding the imported water conveyance capacity (North portfolio) or adding new conveyance into the system (East portfolio). While not specifically a conveyance project, the new supply developed by the Camp Pendleton Desalination Plant under the West portfolio would provide significant improvements in the conveyance vulnerabilities by creating a new supply downstream of the most significant constriction points in the system. The Storage portfolio, on the other hand, would provide some improvement to the conveyance vulnerability by exercising greater releases from existing storage during peak demand periods. The Storage portfolio, however, would be limited by conveyance constraints in the existing San Vicente Reservoir system and would not be able to achieve results comparable to the other portfolios.

Based on the analysis, the Baseline System presents a low to acceptable level of risk to conveyance reliability through the year 2020. The risk level, however, begins to exceed performance thresholds after the year 2020 and continues rapidly upward through 2025, as depicted in Figure 8-5. Sometime between 2020 and 2025, the conveyance utilization risk will reach a point that warrants implementation of a portfolio option to lower the anticipated risk.

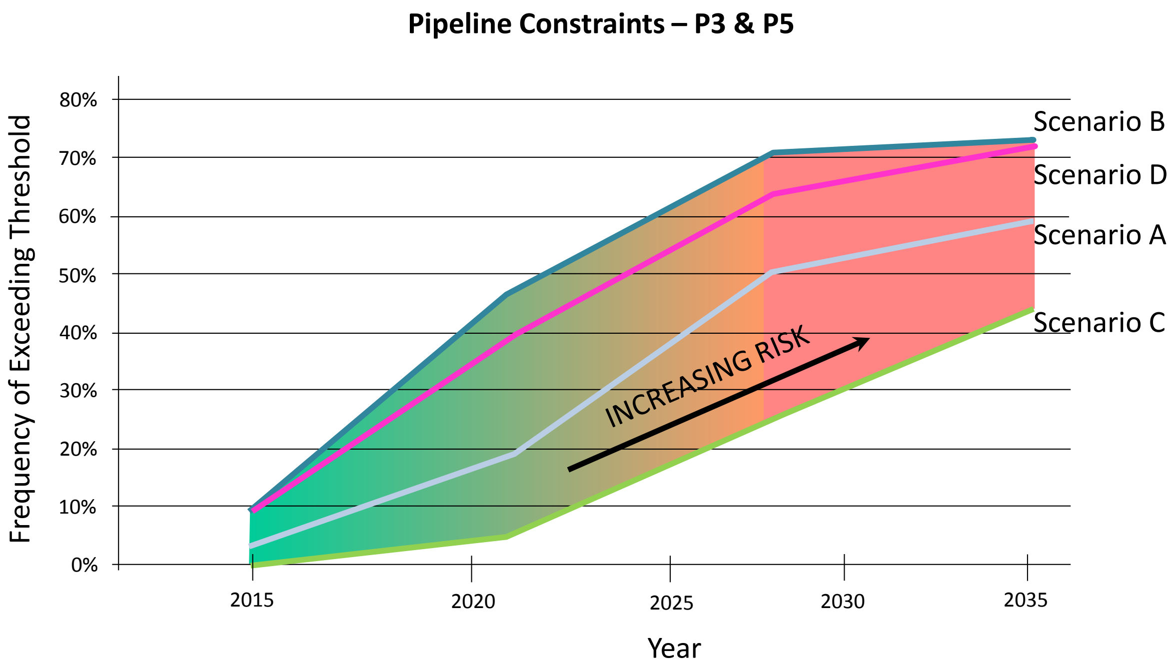

FIGURE 8-5
Conveyance Utilization Risk of Baseline System

8.2.3 Evaluation of Other Existing CIP Projects

The majority of existing CIP projects evaluated in this 2013 Master Plan were either part of the Baseline System described in Chapter 5 – *Description of Baseline System and CIP Projects Considered in the Master Plan* or were considered a facility option as described in *Chapter 7 – Project Options and Portfolios*. In addition to these existing projects, the CIP includes three other projects that have been evaluated in the 2013 Master Plan—SD12 FCF Expansion, SD24 FCF, and Evaluation of the LMSE Pipeline. The evaluation results for these three projects are summarized in this section.

8.2.3.1 SD12 FCF Expansion

This project was proposed by the city of San Diego to expand untreated water delivery capacity to the city of San Diego Alvarado WTP. The planned expansion was from 96 to 150 mgd and was intended to meet capacity requirements for the recently expanded WTP. Modeling results based on current operations and service area limits for the Alvarado WTP indicate that the capacity of the existing SD12 FCF, along with the City's El Monte conveyance system, is sufficient to meet projected demands at the Alvarado WTP through the planning horizon. Any request to expand service connection capacity to the Alvarado WTP should be at the discretion of the city of San Diego.

8.2.3.2 SD24 FCF

This project was proposed to expand untreated water delivery capacity to the city of San Diego Miramar WTP. The project was also intended to rehabilitate or replace the existing service connections service this WTP. The planned expansion was from 155 mgd up to 215 mgd to meet capacity requirements for the recently expanded WTP. Modeling results based on current operations and service area limits for the Miramar WTP indicate that additional delivery capacity to the Miramar WTP may be needed by the end of the planning horizon. The city of San Diego, however, has indicated that existing service connection capacity is sufficient to meet foreseeable WTP delivery requirements, and any request to expand service connection capacity should be at the discretion of the city of San Diego.

8.2.3.3 Evaluation of the LMSE Pipeline

With the recent completion of the East County Regional Treated Water Improvements project, the LMSE pipeline has recently been removed from service. This project was added to the CIP to determine the final disposition of the LMSE pipeline. Based on modeling results, the LMSE is not required to meet any existing or projected delivery requirements. Project options include abandoning the pipeline or transferring ownership to another agency that may have a need for this pipeline.

8.2.4 Role of Storage to Optimize Management of Supplies

In-region storage serves a unique purpose in providing reliable deliveries during short-term imbalances between supply and demand. On a seasonal basis, storage provides the ability to mitigate against weekly or monthly imbalances and reduces the stress on the overall conveyance system that may not be able to deliver peak demands. For years in which the total supply is insufficient to satisfy the demand, carryover storage is relied upon to ensure short-term dry-year reliability or to lessen the impact of shortages.

The Storage portfolio assumes an increase to in-region surface storage (beyond what is currently planned) and out-of-region groundwater storage to specifically test dry-year reliability. For purposes of this analysis, a surrogate to increase in-region surface storage was simulated as an ability to increase use of carryover capacity (90 TAF) in San Vicente Reservoir. Figure 8-6 shows an example trace of San Vicente storage under the Baseline System and Storage operations. The figure shows simulated storage volumes with currently constructed San Vicente storage (red) and with a 90 TAF increase in connected, in-region storage (blue).

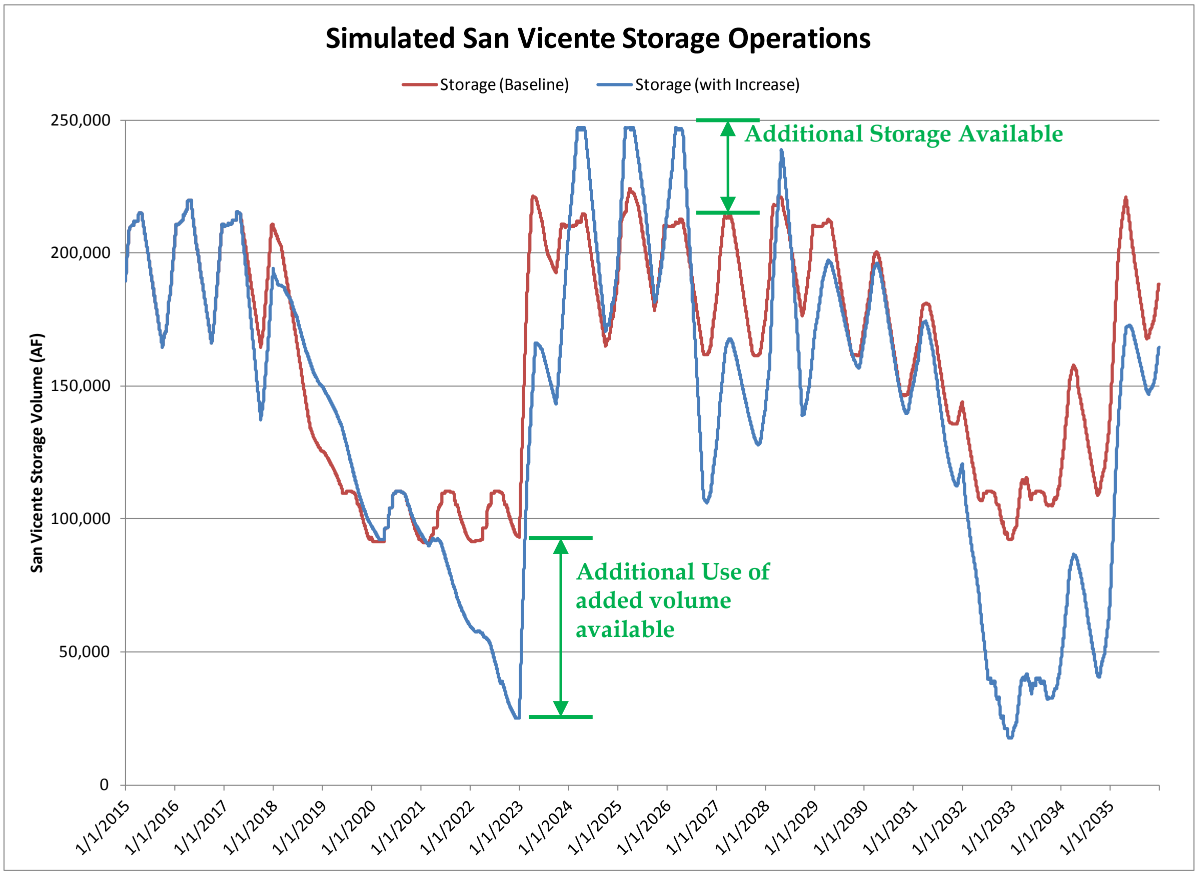

FIGURE 8-6
Simulated San Vicente Storage Operations with and without Enlargement

Typical operations are to exercise a portion of the storage pool for seasonal operations. During dry years, however, the operation may evolve into use of the carryover storage pool. Water is subsequently withdrawn from the carryover storage pool to alleviate the annual imbalances between supply and demand. The model simulates the use of carryover storage by relying on the roughly 100 TAF of storage in San Vicente Reservoir, drawing about 30 to 35 TAF per year for up to three years. Increased storage could resolve some of the smaller shortages by withdrawing a greater quantity of water from storage.

The benefit of additional carryover storage was evaluated, beyond the carryover storage that will be used in the San Vicente Reservoir following completion of the dam raising project. The additional carryover storage was increased in the model to add another 90 TAF of storage, all of which could be used in any year with the additional demand. Based on the modeling results, the additional 90 TAF of storage significantly increases the untreated water pipelines utilization (Pipeline 3, Pipeline 5, and the Crossover Pipeline) needed to refill the additional storage during wet years. It appears that the additional 90 TAF is near the maximum amount of additional storage that could be utilized without adding additional conveyance capacity.

The ability to increase use of carryover storage provides marginal benefit for dry periods lasting one to three years by drawing additional water from storage, and also for slightly longer dry periods by extending the duration of draw of water from storage. However, for periods of prolonged drought (greater than four years), in-region storage would provide limited benefits because the imbalances would be significantly large and the carryover storage pool would require intervening periods of excess supply in order to refill the storage pools. In summary, additional in-region storage provides benefit during multiple dry years, but during prolonged droughts, the storage is insufficient to resolve all delivery reliability concerns. Use of additional storage for seasonal operations helps reduce conveyance usage concerns during peak demand periods but results in significantly higher conveyance utilization during refill periods (fall and winter, and in years following prolonged dry periods).

8.2.5 Summary of System Reliability with Facility Options

Six performance metrics were applied to measure the reliability of the Water Authority's system or to measure other operational performance measures with the implementation of facility options. Tables 8-4 through 8-7 summarize the performance metric results for the Baseline System and each portfolio under the four supply and demand scenarios.

As noted in Section 8.2.1, **delivery reliability** vulnerabilities are a concern only under the high supply-demand scenario. The West, North, and East portfolios are able to reduce the frequency of potential shortages by half or more. While these portfolios differ in terms of strategies and facility options, they are similar in delivery reliability performance. The West and East reduce shortage frequencies to less than 1 percent, while the North portfolios reduce frequencies to less than 3 percent. The Storage portfolio provided limited delivery reliability improvements.

Conveyance utilization vulnerabilities are a concern under all supply-demand scenarios. While none of the portfolios fully mitigate the delivery reliability vulnerability, the risks are significantly reduced to acceptable levels with implementation of the East, West, and North portfolios. The North portfolio, which emphasizes north imported water conveyance and system conveyance fixes, and the East portfolio, which re-routes Colorado River supplies to San Vicente Reservoir, show the largest reductions. Even the West portfolio, which emphasizes Camp Pendleton desalination supply, reduces conveyance vulnerabilities by integrating the new supply and offsetting the need for additional imported water. The Storage portfolio, however, provides marginal improvement for conveyance vulnerabilities.

The **supply diversification** metric measures the percentage of imported water supplies compared to total annual supply. Imported supplies include MWD and QSA sources. Only the West portfolio, which adds new local supply with the proposed Camp Pendleton Desalination project, provides a significant reduction on the reliance of imported water toward the supply diversification metric. This metric indicates the West portfolio provides an improved level of supply reliability compared to the other portfolios and the Baseline System.

The **water treatment plant usage** measures the percentage of annual plant utilization compared to maximum plant capacity. This metric appears relatively insensitive to the choice of portfolio and shows an increasing use of treatment plant capacity as demand increases over time. Results are shown in Tables 8-4 through 8-7 for the Twin Oaks WTP, with similar results projected for all local WTPs. No local WTP is expected to exceed its maximum capacity on an annual basis through the planning horizon.

The San Vicente Reservoir **storage utilization** increases were applied to the East, West, and North portfolios. For the East portfolio, water is conveyed directly to the San Vicente Reservoir area from the AAC, freeing up capacity in Pipelines 3 and 5. This additional capacity in Pipelines 3 and 5 allows peak demands to be met from those pipelines and creates opportunities to store water conveyed from the east in San Vicente. For the North portfolio, the additional conveyance in Pipelines 3 and 5 provides opportunities to both meet peak demands and refill the reservoirs more efficiently. Therefore, more water is stored and used in San Vicente. The West portfolio provides a base-loaded raw water supply that will utilize San Vicente for storage during lower-demand periods. Here again, the storage in San Vicente is optimized to take advantage of this asset. Lastly, results for the Storage portfolio suggest that more than 75 TAF of additional carryover storage was used during dry periods in these portfolios. This expanded use of carryover storage allowed for improved protection during multiple dry years, but the magnitude of this use was not sufficient to eliminate reliability concerns for more than one to two years beyond the current storage capability.

Finally, **energy usage** is projected to increase under all portfolios. Under the West portfolio, a significant increase (more than 10 times) in the net energy use is projected with the addition of Camp Pendleton desalination project as a Water Authority energy responsibility. Similarly, the addition of the pumping needs (less energy recovery) for the dedicated Colorado River conveyance in the East portfolio increases the net energy use by the Water Authority by approximately six times the net use in the Baseline System.

TABLE 8-4
Performance Metric Results for Each of the Six Measures Considered in the 2013 Master Plan (Scenario A – 2010 UWMP)

Performance Measure	Time Period	Baseline	West	Storage	North	East
Delivery Reliability (frequency of annual shortage greater than 20 TAF for two consecutive years)	2016-2020	**0%**	0%	0%	0%	0%
	2021-2025	**0%**	0%	0%	0%	0%
	2026-2030	**0%**	0%	0%	0%	0%
	2031-2035	**1%**	1%	1%	1%	0%
Conveyance Utilization (frequency of untreated water conveyance greater than 95 percent of capacity for 45 days during peak season)	2016-2020	**3%**	3%	3%	3%	3%
	2021-2025	**19%**	11%	13%	8%	13%
	2026-2030	**50%**	21%	35%	11%	12%
	2031-2035	**59%**	17%	41%	4%	5%
Supply Diversification (percent of supply from imported water sources)	2016-2020	**68%**	66%	66%	66%	66%
	2021-2025	**69%**	67%	68%	68%	68%
	2026-2030	**72%**	65%	72%	69%	69%
	2031-2035	**73%**	60%	74%	70%	70%
Water Treatment Plant Usage (percent of Twin Oaks Valley WTP capacity usage)	2016-2020	**43%**	42%	42%	42%	42%
	2021-2025	**49%**	48%	48%	48%	48%
	2026-2030	**56%**	55%	55%	55%	54%
	2031-2035	**60%**	60%	60%	59%	60%
Storage Utilization (mean use of Water Authority's carryover pool in San Vicente Reservoir in TAF)	2016-2020	**46**	68	68	68	68
	2021-2025	**46**	79	78	79	78
	2026-2030	**44**	72	63	77	52
	2031-2035	**43**	78	59	82	43
Energy Usage (mean net annual energy use in GWh)	2016-2020	**40**	50	50	50	50
	2021-2025	**38**	68	49	50	49
	2026-2030	**35**	283	39	47	164
	2031-2035	**32**	548	37	49	249

TABLE 8-5
Performance Metric Results for Each of the Six Measures Considered in the Master Plan (Scenario D – Adjusted Local Demand)

Performance Measure	Time Period	Baseline	West	Storage	North	East
Delivery Reliability (frequency of annual shortage greater than 20 TAF for two consecutive years)	2016-2020	**0%**	0%	0%	0%	0%
	2021-2025	**0%**	0%	0%	0%	0%
	2026-2030	**2%**	1%	2%	1%	0%
	2031-2035	**6%**	1%	5%	3%	1%
Conveyance Utilization (frequency of untreated water conveyance greater than 95 percent of capacity for 45 days during peak season)	2016-2020	**9%**	6%	5%	6%	6%
	2021-2025	**39%**	21%	21%	15%	22%
	2026-2030	**64%**	30%	48%	13%	15%
	2031-2035	**72%**	25%	61%	5%	5%
Supply Diversification (percent of supply from imported water sources)	2016-2020	**69%**	67%	67%	67%	67%
	2021-2025	**71%**	69%	70%	70%	70%
	2026-2030	**75%**	65%	75%	71%	71%
	2031-2035	**77%**	59%	77%	72%	72%
Water Treatment Plant Usage (percent of Twin Oaks Valley WTP capacity usage)	2016-2020	**49%**	48%	48%	48%	48%
	2021-2025	**58%**	58%	58%	58%	58%
	2026-2030	**65%**	65%	65%	64%	65%
	2031-2035	**69%**	70%	69%	68%	70%
Storage Utilization (mean use of Water Authority's carryover pool in San Vicente Reservoir in TAF)	2016-2020	**47**	66	66	66	66
	2021-2025	**45**	72	71	74	71
	2026-2030	**42**	67	54	75	45
	2031-2035	**38**	73	47	76	39
Energy Usage (mean net annual energy use in GWh)	2016-2020	**40**	50	50	50	50
	2021-2025	**38**	83	46	47	46
	2026-2030	**32**	428	36	47	195
	2031-2035	**28**	733	33	47	259

TABLE 8-6
Performance Metric Results for Each of the Six Measures Considered in the Master Plan (Scenario B – Reduced Imported Supplies, Climate Change and Lower Local Supply Development)

Performance Measure	Time Period	Baseline	West	Storage	North	East
Delivery Reliability (frequency of annual shortage greater than 20 TAF for two consecutive years)	2016-2020	**4%**	4%	3%	4%	4%
	2021-2025	**4%**	3%	3%	5%	5%
	2026-2030	**11%**	4%	11%	9%	3%
	2031-2035	**28%**	3%	26%	10%	1%
Conveyance Utilization (frequency of untreated water conveyance greater than 95 percent of capacity for 45 days during peak season)	2016-2020	**9%**	3%	4%	3%	3%
	2021-2025	**47%**	26%	26%	16%	27%
	2026-2030	**71%**	36%	52%	14%	16%
	2031-2035	**73%**	29%	51%	8%	3%
Supply Diversification (percent of supply from imported water sources)	2016-2020	**70%**	68%	68%	68%	68%
	2021-2025	**73%**	71%	72%	72%	72%
	2026-2030	**77%**	65%	77%	74%	74%
	2031-2035	**80%**	60%	79%	74%	74%
Water Treatment Plant Usage (percent of Twin Oaks Valley WTP capacity usage)	2016-2020	**51%**	50%	51%	50%	50%
	2021-2025	**63%**	62%	62%	62%	62%
	2026-2030	**69%**	70%	69%	68%	70%
	2031-2035	**73%**	76%	74%	73%	76%
Storage Utilization (mean use of Water Authority's carryover pool in San Vicente Reservoir in TAF)	2016-2020	**46**	64	65	64	64
	2021-2025	**44**	66	65	68	65
	2026-2030	**37**	61	44	67	39
	2031-2035	**30**	67	34	69	40
Energy Usage (mean net annual energy use in GWh)	2016-2020	**41**	49	50	49	49
	2021-2025	**37**	96	44	45	43
	2026-2030	**29**	520	34	44	129
	2031-2035	**24**	836	34	44	172

TABLE 8-7
Performance Metric Results for Each of the Six Measures Considered in the Master Plan (Scenario C – Enhanced Local Resource Management)

Performance Measure	Time Period	Baseline	West	Storage	North	East
Delivery Reliability (frequency of annual shortage greater than 20 TAF for two consecutive years)	2016-2020	**0%**	0%	0%	0%	0%
	2021-2025	**0%**	0%	0%	0%	0%
	2026-2030	**0%**	0%	0%	0%	0%
	2031-2035	**0%**	0%	0%	0%	0%
Conveyance Utilization (frequency of untreated water conveyance greater than 95 percent of capacity for 45 days during peak season)	2016-2020	**0%**	1%	1%	1%	1%
	2021-2025	**2%**	4%	5%	4%	5%
	2026-2030	**21%**	10%	19%	9%	8%
	2031-2035	**34%**	14%	29%	6%	7%
Supply Diversification (percent of supply from imported water sources)	2016-2020	**67%**	65%	65%	65%	65%
	2021-2025	**67%**	65%	66%	65%	63%
	2026-2030	**69%**	65%	68%	67%	67%
	2031-2035	**71%**	62%	70%	68%	68%
Water Treatment Plant Usage (percent of Twin Oaks Valley WTP capacity usage)	2016-2020	**37%**	36%	36%	36%	36%
	2021-2025	**39%**	39%	39%	39%	39%
	2026-2030	**45%**	45%	45%	45%	44%
	2031-2035	**51%**	50%	50%	50%	50%
Storage Utilization (mean use of Water Authority's carryover pool in San Vicente Reservoir in TAF)	2016-2020	**47**	68	68	68	68
	2021-2025	**47**	83	83	84	83
	2026-2030	**46**	77	73	79	62
	2031-2035	**45**	78	68	82	45
Energy Usage (mean net annual energy use in GWh)	2016-2020	**40**	51	51	51	51
	2021-2025	**39**	59	53	53	53
	2026-2030	**37**	157	46	49	82
	2031-2035	**35**	324	42	49	118

The East, Storage, North, and West portfolios by themselves cannot fully achieve a performance level below threshold limits for all supply and demands scenarios. Combining portfolios would likely achieve superior results, but the cost impacts for a reduced risk level would likely be prohibitive. The goal of the 2013 Master Plan is not to achieve zero risk tolerance. Instead, the 2013 Master Plan is intended to evaluate the performance of each portfolio and develop a balanced approach to new infrastructure implementation and risk of operation.

8.3 Option Implementation for Different Portfolios

The four portfolios evaluated in the 2013 Master Plan represent different approaches for addressing the projected water delivery reliability and conveyance utilization vulnerabilities. These portfolios were developed as potential strategies, but the analysis described herein was targeted at learning about the facility needs and effectiveness under the changing-demand environment the region is experiencing. Analysis of the frequency and timing of project implementation provided insight toward development of both near- and long-term strategies for the Water Authority's infrastructure needs.

Risk-based planning involves the use of evidence of risks (such as projected delivery reliability concerns) to inform choices about which courses of action to adopt in the future. The results presented in this chapter identify projects that should be implemented in the near term, as well as projects that may be necessary over a longer term, but only if certain conditions external to the Water Authority warrant such project implementation. The long-term demand trajectories, as presented in this report, can provide a starting point for developing a monitoring approach to inform future infrastructure investment needs.

Some projects have sufficiently long implementation timelines such that decisions on project implementation would need to be taken well in advance of the certainty of conditions that warrant the investment. In such cases, the initiation or continuation of project feasibility studies would hedge against the possible vulnerable conditions. In reality, the actions taken to proceed with early planning and design activities would be needed well in advance of gaining certainty of the conditions that require the action. This is the reality of risk-based planning, and the information provided in this 2013 Master Plan can assist in making informed decisions about the Water Authority's infrastructure needs.

The CWASim model implements options according to the order defined by the portfolio preference and in response to performance thresholds. Since each portfolio was implemented in a step-wise fashion (options only implemented when needed), the timing of each facility option could be ascertained from the simulation results for each scenario. Table 8-8 provides a recommended timeframe for implementation of the facility options according to each supply-demand scenario and is based on the year in which the facility option was triggered in at least 10 percent of the traces under a given scenario.

TABLE 8-8
Simulated Timing of Facility Options Included in Master Plan Portfolios for Each Scenario
(shading: green for prior to 2026, orange for 2026-2030, brown for post-2030, and grey for not trigged)

West Portfolio					
Facility Options	First Year Available*	Scenario			
		A	B	C	D
Camp Pendleton Desal (50 mgd)	2023	N/A	2025	N/A	2033
Camp Pendleton Desal (100 mgd)	2023	N/A	2028	N/A	N/A
Camp Pendleton Desal (150 mgd)	2023	N/A	2035	N/A	N/A
Second Crossover Pipeline	2023	N/A	2027	N/A	2033
Pipelines 3 and 4 Intertie Pipeline	2015	2017	2017	2017	2017
San Vicente Pump Station – 3rd Pump	2015	N/A	2025	NA	2033
Storage Portfolio					
Facility Options	First Year Available*	Scenario			
		A	B	C	D
Enhanced In-Region Storage	2015	2031	2019	N/A	2026
Out-of-Region Groundwater Storage	2015	N/A	2024	N/A	2034
Second Crossover Pipeline	2023	N/A	2027	N/A	N/A
Pipelines 3 and 4 Intertie Pipeline	2015	2017	2017	2017	2017
San Vicente Pump Station – 3rd Pump	2015	2031	2019	N/A	2026
North Portfolio					
Facility Options	First Year Available*	Scenario			
		A	B	C	D
Pipelines 3 and 4 Conversion	2019	2022	2022	2025	2021
Pipeline 6**	2023	2035	2035	2035	2035
Second Crossover Pipeline	2023	N/A	2028	N/A	2035
Pipelines 3 and 4 Intertie Pipeline	2015	2017	2017	2017	2017
San Vicente Pump Station – 3rd Pump	2015	2022	2022	2025	2021
East Portfolio					
Facility Options	First Year Available*	Scenario			
		A	B	C	D
Colorado River Conveyance	2025	2026***	2026***	2026***	2026***
Second Crossover Pipeline	2023	N/A	2027	N/A	N/A
Pipelines 3 and 4 Intertie Pipeline	2015	2017	2017	2017	2017
San Vicente Pump Station – 3rd Pump	2015	2026	2026	2026	2026

* Represents the first year this facility option could be made available based on an estimate to complete environmental, permitting, design, and construction.

** Pipeline 6 implementation dates are reflective of a higher threshold for implementation than the Pipeline 3/Pipeline 4 Conversion Project

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*** Triggering of this option was fixed in the simulation.

As shown in the table, the lower-demand scenarios (Scenarios A and C) only triggered conveyance-related options. Supply-related options are not required for the lower-demand scenarios. For the higher-demand scenarios, water supply options begin to be needed under

Scenario D near 2030 and under Scenario B near 2025. Several other findings can be highlighted from the analysis of the results:

- The Pipelines 3 and 4 Intertie Pipeline addresses an immediate constraint near the Alvarado WTP.
- The San Vicente Pump Station options can currently operate two pumps simultaneously. The two-pump operation is sufficient to convey seasonal and carryover storage for the Baseline system. In the future, when a new portfolio is brought on-line, San Vicente Reservoir will need to store more water, which will trigger the need for a three-pump operation.
- The Pipeline 3/ Pipeline 4 Conversion was consistently triggered in the 2020–2025 time period, reflecting the need to resolve imported water conveyance as demand recovers to pre-2010 levels.
- Pipeline 6 was permitted to be triggered if conveyance utilization concerns continued to arise after the Pipeline 3/ Pipeline 4 Conversion in the North portfolio. Additional imported water conveyance (Pipeline 6) was needed in the high-demand scenarios, but these conditions generally did not trigger until after the 2030 timeframe.
- The Second Crossover Pipeline was needed only in the highest two demand scenarios.
- Under higher-demand scenarios, the Camp Pendleton Desalination Plant option was triggered (2033), but only expansive demand growth triggered more than 50 mgd of capacity.
- Enhanced In-Region Storage (included in the Storage portfolio) was triggered in three of the four scenarios in the 2020–2030 timeframe and delayed the need for Out-of-Region Groundwater Storage in this Portfolio. However, the enhanced storage provided little overall benefit at resolving the delivery reliability metrics over the planning horizon, and this portfolio also did not provide significant relief to untreated water conveyance constraints.
- Colorado River Conveyance was not simulated dynamically (that is, it always triggered in the East portfolio), but would resolve many vulnerabilities if it could realistically be developed by the assumed timeframes.

Facility options that are implemented in a wide range of future scenarios can be considered common or "low regret" options, in that implementation is likely to prove beneficial regardless of the external uncertainties. Conversely, options that are only implemented in some scenarios and only under certain conditions may be beneficial for outlier events (i.e., very high-demand growth), but are not likely to be effectively utilized under other conditions (i.e., low-demand growth). Options consistently triggered very near the first year available also suggest that planning for this option should commence immediately. These early action options, under *Scenario A – Urban Water Management Pl*an, include Pipeline 3/ Pipeline 4 Conversion, the Pipelines 3 and 4 Intertie Pipeline, and the San Vicente pump station upgrades.

The results suggest that new supplies or large-scale new conveyance are not likely to be needed except under the highest-demand scenarios. Options that were triggered but with a significant gap between the first year available suggest that monitoring of conditions should occur and planning could accelerate if conditions were to change. These longer-term action options include Camp Pendleton Desalination project, enhanced in-region storage, out-of-region groundwater storage, and the Crossover Pipeline. These options were only implemented under specific demand scenarios or had long delays between the first year available and simulated implementation.

Similar to the sensitivity analyses discussed in *Chapter 6 – Baseline System Reliability*, implementation of any of the options is only expected to shift by two to three years based on selection of different thresholds for delivery reliability and conveyance utilization metrics.

8.4 Summary

Water supply and water demand scenarios considered in the 2013 Master Plan spanned a broad range of plausible future conditions and provided critical information related to the evaluation of system performance under these conditions. Through the development and application of a new Water Authority system model, CWASim, the simulation of the aqueduct system was possible at the level needed for water and infrastructure planning. A suite of decision metrics were developed and quantified, then used as the indicators of system performance such that model simulations of the system under future conditions could be adequately evaluated. Performance thresholds were developed for the water delivery reliability and conveyance utilization metrics, and used in the assessment and eventual trigger for implementation of potential infrastructure projects.

Based on an analysis of modeling results with the Baseline System configuration, it was found that water delivery shortfalls are projected to occur only under the two higher-demand scenarios and would be minimal under the lower-demand scenarios. These results suggest that supply-based project options can be categorized as a long-term infrastructure need that requires monitoring of certain local and statewide water supply development actions before decisions are reached on a specific implementation date. Conversely, conveyance vulnerabilities were consistent across all scenarios in the 2020–2025 timeframe and suggest the need to proceed with near-term actions related to these improvement projects.

System modeling with the different portfolios demonstrated that all portfolios can reduce both the frequency and magnitude of supply shortages and conveyance constraints. The 2013 Master Plan confirms that the current Water Authority system as envisioned in the 2003 Master Plan (Water Authority, 2002) is relatively robust.

Finally, the reliability analysis suggests that the elimination of all vulnerabilities is not possible due to the nature of the prolonged dry-year conditions. These types of extreme conditions can significantly influence the measurement of reliability but are also very low-probability events. The Water Authority and its member agencies are continually balancing the tradeoffs between improved reliability and the cost and appropriateness of achieving the highest possible level of reliability. Concerted efforts by the Water Authority and its member agencies on water supply improvements, effective demand management measures, and optimizing regional infrastructure will contribute to improving reliability within and beyond the 2013 Master Plan planning horizon.

Chapter 9.0 Risk Factors and Mitigation

9.1 Overview

The ability of the Water Authority to deliver water to its member agencies can be affected by a number of uncontrollable events, including prolonged drought, natural disasters, shutdowns, or other unforeseen occurrences. These factors are generally outside the normal long-range infrastructure modeling scenarios described in previous chapters of this 2013 Master Plan. Although there are a variety of risks that could impact the Water Authority, this chapter focuses on risks to the physical condition of the aqueduct system from events such as earthquakes, floods, fires, and power outages, and provides a qualitative discussion related to the severity and likelihood of the risks occurring. The risks presented in this chapter were not specifically modeled as part of the 2013 Master Plan. These risks are summarized in Table 9-1 and discussed in more detail in the sections that follow.

TABLE 9-1
Summary of Risk Factors and Mitigation

Consideration	Description
1993 Vulnerability Report	This 2013 Master Plan builds upon the *Emergency Storage Project SDCWA Aqueducts Repair Time Estimates, June 1993* (Black & Veatch/Ebasco/EQE, 1993), which estimated pipeline damage and the amount of time required to restore service after a natural hazard event, with a focus on earthquakes. Report conclusions are still relevant to the current Water Authority system.
Additional Facilities and Vulnerabilities Since the 1993 Vulnerability Report	Vulnerabilities associated with major new facilities were included in the 2013 Master Plan in order to determine the most effective emergency mitigation plan.
ESP Facilities	Key natural hazard response factors associated with the ESP facilities considered in this 2013 Master Plan included conveyance system reliability, availability of backup power supply, and access to various system facilities.
Twin Oaks Valley WTP	The 2013 Master Plan considered the ability of the Twin Oaks Valley WTP to respond after a natural hazard event with respect to untreated water supply (intake), treated water delivery pipeline, power, access, and the structural integrity of connected older structures.
Additional Relevant Natural Hazards	Over the last decade, the system has endured significant impacts due to other natural hazard events, such as the 2003 Cedar Fire, the 2007 Southern California Wildfires, the Flood Event of 2005, and the 2011 regional electrical blackout in San Diego. These events were considered as part of the risk and reliability planning.
Risk Mitigation	The 2013 Master Plan considered Water Authority plans and procedures in place to respond to emergency events, including a proactive Asset Management Program and a comprehensive ESP.

Figure 9-1 shows the overall 2013 Master Plan process and the associated chapters. Highlighted in this figure are the elements described in this *Chapter 9 - Risk Factors and Mitigation*.

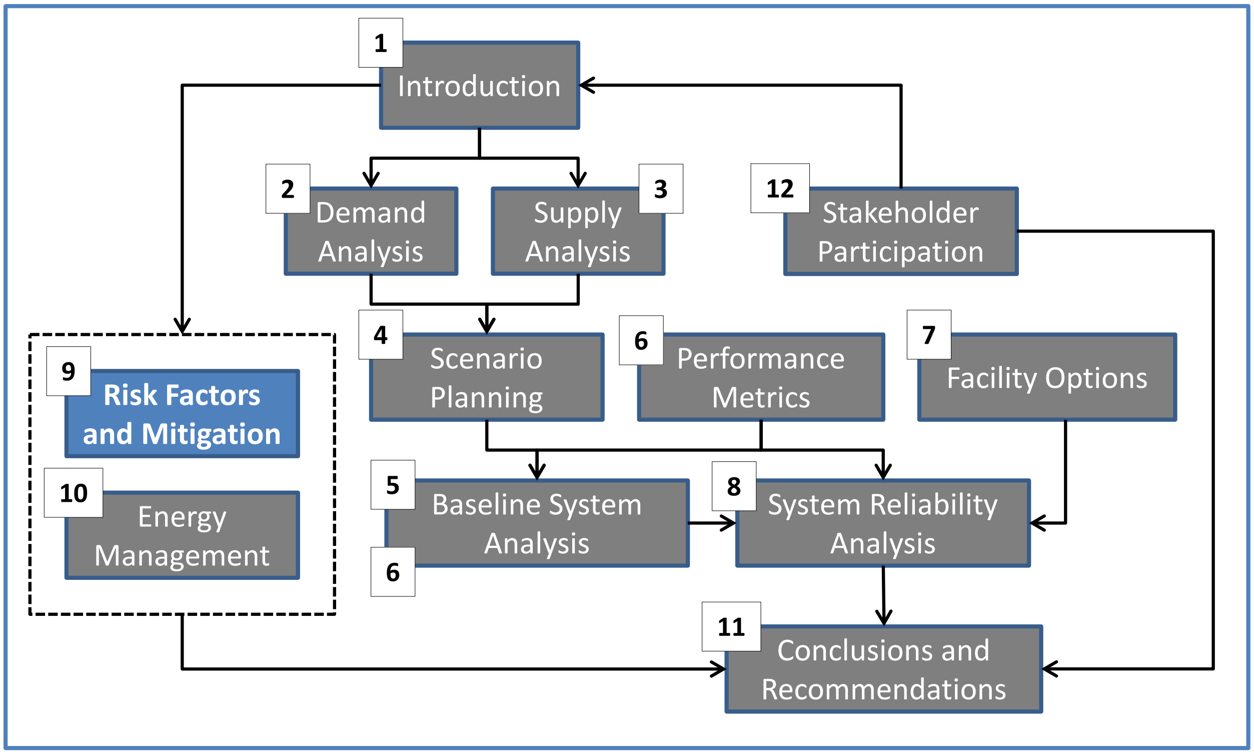

FIGURE 9-1
Relationships Between 2013 Master Plan Chapters and Planning Process

9.2 1993 Vulnerability Report

The report entitled, *Emergency Storage Project SDCWA Aqueducts Repair Time Estimates, June 1993* (1993 Vulnerability Report) provided a comprehensive review of seismic risk on the Water Authority system. This document supported decisions related to the need and sizing of facilities in the Water Authority's ESP. The document was reviewed as part of the 2013 Master Plan to confirm or update the report findings.

The 1993 Vulnerability Report considered the potential for damage to the five existing aqueduct pipelines, as well as the potential for damage to Pipeline 6 if it were constructed as planned at that time. The report focused on identifying the potential natural hazards that could impact the Water Authority's ability to deliver water along its existing and proposed conveyance system, as well as estimating the degree of damage to the pipelines and the amount of time required to restore service after a natural hazard event. Earthquakes of various magnitudes were analyzed. Other pertinent information, such as geologic conditions, pipeline size and material, ground shaking effects, and liquefaction potential, was also considered in determining the number and location of outages as well as the estimated repair time. Figure 9-2 shows the faults and key infrastructure related to this vulnerability assessment.

San Diego County Water Authority
2013 Regional Water Facilities
Master Plan Update

Figure 9-2
Faults and Key Infrastructure Related to the Vulnerability Assessment

0 2 4 8 12 Miles

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The report concluded that with all five pipelines crossing the Elsinore Fault Zone, this location was the most critical and would experience the most disruptive scenario after a large earthquake. The 1993 Vulnerability Report found that under a worst-case scenario, restoration to full-service capacity for all five pipelines was estimated to take as long as 86 days. Based on the evaluation performed as part of this 2013 Master Plan, the conclusions made in the 1993 Vulnerability Report are still valid.

9.2.1 Identification and Quantification of Natural Hazards

Earthquake scenarios were considered for the Elsinore, San Jacinto, San Andreas, La Nacion, and Rose Canyon faults. In addition to the direct damage caused by permanent ground displacement at fault crossings, secondary damage is also likely to occur as a result of transient pressures generated in pipelines and ground shaking and associated events. Intense ground shaking associated with large earthquakes on the Elsinore, San Andreas, San Jacinto, or other major faults is commonly accompanied by landslides, liquefaction, ground settlement, and rockfalls, which can cause damage to buried pipelines and ancillary structures.

For each fault or fault system, maximum probable events (MPEs) and maximum credible events (MCEs) were considered in estimating the potential damage to the Water Authority pipeline system. MPEs were defined as the largest events with a 10 percent chance of occurrence over the next 50 years, or having a 475-year return period. These events were based on long-term ground deformation rates and were positioned to have the maximum impact on the Water Authority pipeline system. MCEs were based on geologic criteria such as relationships between fault length, fault displacement, slip rate, and magnitude, based on past studies of the region.

During development of the 1993 Vulnerability Report, two types of models were created in an effort to estimate system breaks and expected repairs due to a natural disaster event. Pipeline performance modeling integrated the effects of the selected earthquake scenarios with geological information along the pipeline routes and the physical properties of the pipelines, including material and size. This data combination allowed the model to estimate the likely number and location of repairs required.

Furthermore, a transient pressure analysis was performed to evaluate the secondary damage due to the uncontrolled release of water caused by pipeline ruptures. If a break occurs, positive and negative transient pressure surges would be created. The transient models took into account the topographic profile along each pipeline, steady-state hydraulic gradient, pipeline material and size, standpipes, and air valves. One model was created to simulate ruptures in Pipelines 1 and 2; a separate model was created to simulate ruptures in Pipelines 3, 4, and 5.

9.2.2 Relative Estimate of Susceptibility of System to Damage

The pipeline performance and transient pressure models were used to determine the number, extent, and location of breaks to be expected in each pipeline as a result of a disruptive event. Repair time estimates were then developed using the failure data and the availability of material and labor required to complete repairs. The most impactful events overall were the Elsinore Fault scenarios. These scenarios had a majority of pipeline breaks occurring at the fault and in Temecula Valley – effectively cutting off supplies from MWD. The most impactful scenario for causing damage from a fault within San Diego County was from the Rose Canyon Fault. The 1993 Vulnerability Report repair time estimates are summarized in Table 9-2. The predicted failure totals and impacts are summarized in Table 9-3.

TABLE 9-2
Summary of Repair Time Estimates

	Total Repair Time (Days)	
Pipeline	**Elsinore MCE**	**Elsinore MPE**
4	40	38
3	54	50
1 and 2	69	63
5	86	78

Source: 1993 Vulnerability Report

TABLE 9-3
Summary of Impacts Expected from Specified Earthquake Events

Fault/Fault System	Scenario	Magnitude	Predicted Repairs	Impacts
Elsinore	MCE	7.5	119	• Damage within MWD system, no access to Lake Skinner and Diamond Valley Lake • No water delivery from MWD facilities to the north • Water Authority system failures due to fault rupture and liquefaction at river and creek crossings
	MPE	7.0	97	• Similar to MCE scenario • Less extensive damage in Elsinore Fault Zone • No access to MWD facilities to the north
San Andreas	MCE	8.25	63	• Catastrophic damage to MWD system in Riverside and San Bernardino • Water Authority system damage in areas that experience liquefaction-induced ground failures
	MPE	7.75	37	• Similar to San Andreas MCE scenario but less extensive/intense damage
San Jacinto	MCE/MPE	7.75	57	• Disruption is limited to Pipelines 1, 2, and 3 • Significant damage in liquefaction-prone areas of Temecula Valley • Minimal damage in remainder of Water Authority system

TABLE 9-3
Summary of Impacts Expected from Specified Earthquake Events

Fault/Fault System	Scenario	Magnitude	Predicted Repairs	Impacts
La Nacion	MCE	6.5	16	• Minimal impacts to Water Authority system • Predicted repair locations likely in central and southern portion of system • Unlikely to affect MWD facilities to north
Rose Canyon	MCE	7.0	51	• Most repairs required on Pipelines 1 to 4 in central and southern portion of Water Authority system • Disruption should be limited to isolated pipeline segments
	MPE	6.5	15	• Minimal impacts to Water Authority system • Repairs concentrated in central and southern portions of system

Source: 1993 Vulnerability Report

9.2.3 Mitigation Measures in the 1993 Vulnerability Report

The 1993 Vulnerability Report identified estimated repair times and a general schedule in the event that Water Authority water supply service is disrupted. The emergency event requiring the largest number of repairs (the Elsinore fault zone scenarios) was used to estimate the time required to repair the predicted pipeline ruptures.

The repair time estimation took into account site access, fabrication time for replacement of pipeline segments, availability of equipment and personnel to accomplish repairs, installation and testing of new pipeline segments, and other related items. It was estimated that the Elsinore Fault MCE could produce 119 breaks at 117 locations. The resulting repair estimate was 86 days for restoration of full service on all pipelines for this critical scenario.

The 1993 Vulnerability Report prioritized the restoration of potable water pipelines as extremely high, second only to lifesaving activities. As such, the 1993 Vulnerability Report prioritized repairing and restoring Pipeline 4 since it was then and still is the largest-diameter treated water pipeline into the San Diego area. While all pipelines were considered important, the availability of certified welders was considered a critical limiting factor. The estimated repair times were based on having 20 working welders at the beginning of repairs, increasing to 56 two weeks later, and remaining at 56 until completion. This number was chosen because it corresponded to the number of welders who could be used concurrently for repairs on Pipeline 4 and represented approximately 10 percent of certified welders located in Los Angeles, Orange, Riverside, San Diego, and Imperial counties.

The 1993 Vulnerability Report recommendations remain valid and provide sound planning guidance for a seismic event. The one gap in the 1993 Vulnerability Report was an evaluation of Water Authority structures such as the Twin Oaks Diversion structure or similar structures that were not evaluated for seismic stability. The 2013 Master Plan recommends further evaluation of these types of facilities.

During a natural disaster, the Water Authority will coordinate with regional agencies as part of the Regional Mutual Aid agreements with other local agencies. These agreements facilitate coordination and resource sharing to expedite service restoration as quickly and efficiently as possible.

9.3 Additional Facilities and Vulnerabilities since the 1993 Vulnerability Report

Since 1993, there have been important upgrades and improvements to the Water Authority system. This section discusses vulnerability considerations associated with the ESP facilities including the San Vicente Dam, Pipeline, and Pump Station; Rancho Peñasquitos Pressure Control and Hydroelectric Facility; Lake Hodges Pumped Storage Project; Olivenhain Dam; and Twin Oaks Valley WTP. These newly added facilities have increased the reliability of the system and will reduce impacts from natural hazard events. An understanding of the vulnerability considerations associated with these facilities is essential in determining the most effective emergency mitigation plan.

9.3.1 Emergency Storage Project

A significant improvement in the Water Authority's operation since 1993 is the implementation of the ESP, summarized in Figure 9-3. The ESP is a system of reservoirs, interconnected pipelines, and pumping stations designed to make water available to the San Diego region in the event of an interruption in imported water deliveries. Key facilities include Olivenhain Reservoir, Pipeline, and Pump Station; Lake Hodges Pipeline and Pump Station; and the San Vicente Dam Raise, Pipeline, and Pump Station. Overall, the ESP provides up to six months of emergency water storage in the San Diego region, expands the pipeline system to allow region-wide emergency water distribution, and adds approximately 90,100 acre-feet of water storage for emergency use.

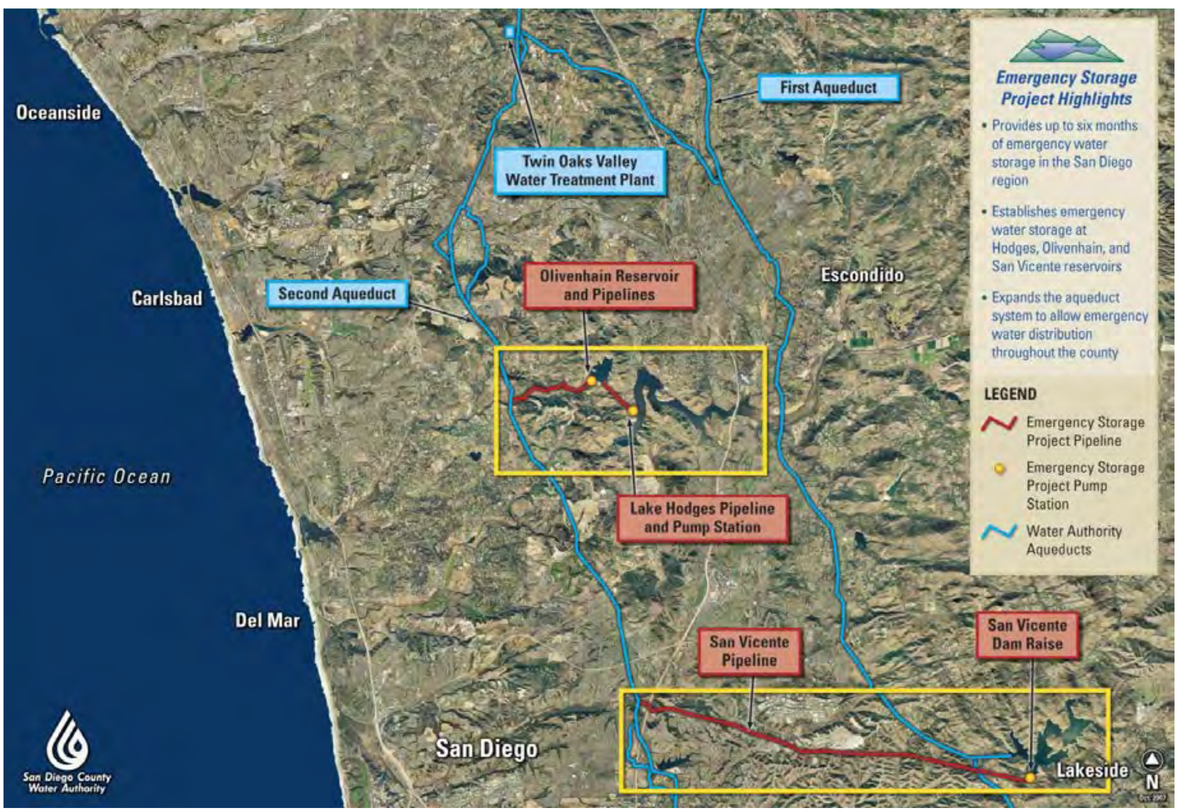


FIGURE 9-3
Emergency Storage Program

The ESP was developed by the Water Authority to provide needed water storage and distribution in the event a major natural disaster disrupts imported supplies from reaching San Diego County. The existing ESP facilities are described in the following section along with related risk concerns.

9.3.2 Facilities Related to Delivering San Vicente Water as Part of ESP

The expanded San Vicente Reservoir is a major resource for supplying untreated water during emergency events. A number of new facilities allow the delivery of water from San Vicente Reservoir to Pipeline 5 of the Second Aqueduct, and then both north to Del Dios Valve Vault and south to the Lower Otay Reservoir. Figure 9-4 summarizes the flow of water in these facilities during an emergency event.

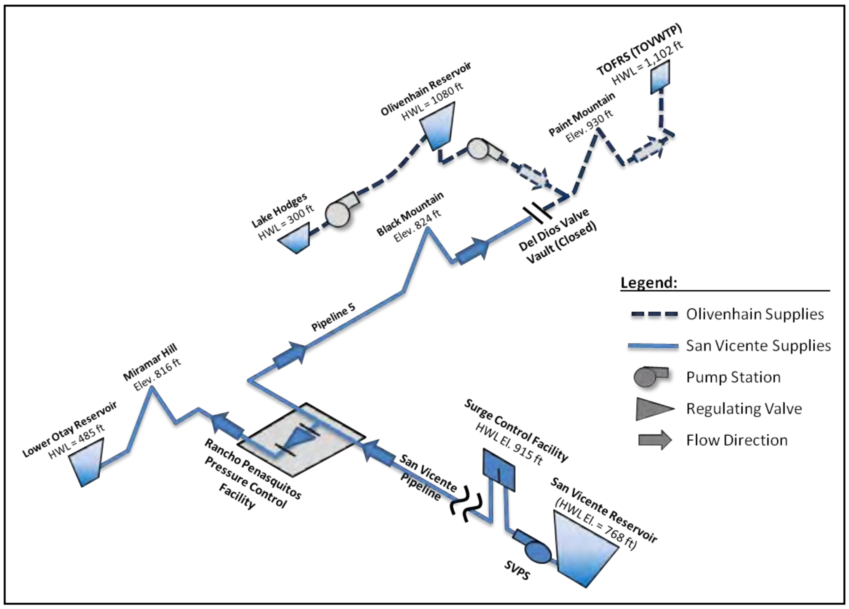


FIGURE 9-4
San Vicente and Olivenhain Emergency Operation Summary
Source: Operating Descriptions for San Vicente Pump Station (Black & Veatch, 2011)

9.3.2.1 San Vicente Reservoir

When the dam raise project is complete, San Vicente Reservoir will be able to store over 242,000 acre-feet. The reservoir capacity will be shared between the Water Authority (152,000 acre-feet) and the City of San Diego (90,000 acre-feet). The reservoir will be key in the Water Authority's plans for the ESP and regional carryover storage. The reservoir was designed to meet current seismic requirements and is expected to be functional following an earthquake.

San Vicente Dam Raise. The San Vicente Reservoir expansion will provide regional storage for emergency conditions.

9.3.2.2 San Vicente Pipeline

The San Vicente Pipeline and Tunnel connects Pipeline 5 of the Second Aqueduct to the surge control facility at the San Vicente Reservoir. Water can be delivered from Pipeline 5 to fill San Vicente Reservoir. With the San Vicente Pump Station, the flow is reversed to deliver San Vicente Reservoir supplies westward to Pipeline 5. This pipeline was designed to meet current design standards and is expected to be functional following an earthquake.

9.3.2.3 San Vicente Pump Station

The San Vicente Pump Station is located at the San Vicente Reservoir and pumps reservoir water to the adjacent surge control facility, allowing flow westward in the San Vicente Pipeline to Pipeline 5. Currently, there is power available to operate two of the three pumps, allowing a pump flow range between 100 to 296 cfs, depending on reservoir elevations. The pump station has an ultimate design capacity of 444 cfs, which is to be achieved with implementation of the San Vicente Pump Station 3rd Pump Drive and Power Supply project. The pump station was designed to meet current seismic standards and is expected to be functional following an earthquake.

The San Vicente Pump Station will be utilized to supply untreated water during emergency events.

9.3.2.4 Vulnerability Considerations Related to San Vicente Delivery Systems during Natural Hazards

The key to the San Vicente system's ability to respond after a natural hazard event includes the following key considerations:

- **Earthquakes.** Each of the San Vicente delivery system facilities were designed to meet current seismic requirements. Therefore, all these facilities are expected to be operational following an earthquake.
- **Conveyance System.** Maintaining the ability to move water to and from San Vicente Reservoir in an emergency event is crucial. While no deficient links were directly identified, maintaining these assets is critical hub for delivering untreated water during emergency conditions in which northern supplies are interrupted.
- **San Vicente Pump Station Power.** Pump Station power is currently delivered via two 12 kV circuits from the SDG&E grid. Both circuits are mounted on the same transmission poles. A power outage due to a natural hazard event could limit the pump station's effectiveness until one or both circuits are restored. The pump station currently has a 250 kW backup diesel generator that can provide limited power for lights and other building support systems. Several options should be considered to power the third pump, including onsite generation that would provide backup power for one pump in the event the commercial power is unavailable.
- **Access.** Access to the San Vicente Reservoir, Pump Station, and Surge Control Facility is provided via Highway 67, which is generally considered accessible.

9.3.2.5 Rancho Peñasquitos Pressure Control and Hydro Facility and Del Dios Valve Vault

The Rancho Peñasquitos Pressure Control and Hydro Facility regulates flow to and from the San Vicente Reservoir.

The Rancho Peñasquitos Pressure Control and Hydro Facility (RPPC) and the Del Dios Valve Vault are also considered part of the San Vicente Reservoir delivery system. In an emergency event, flow from the reservoir is pumped via the San Vicente Pump Station to a surge control reservoir. The RPPC is used to control the flow out of the surge reservoir and can bifurcate the flow both northward and southward in Pipeline 5. Flows to the south are regulated via pressure control valves and serve the city of San Diego's Miramar, Alvarado, and Otay WTPs and the Sweetwater Authority's R.A. Perdue WTP. The pressure control operation at the RPPC also allows flows to be diverted northward in Pipeline 5. By isolating Pipeline 5 at the Del Dios Valve Vault, water from San Vicente Reservoir can reach the San Dieguito/Santa Fe Badger WTP. In addition, with the Del Dios Valve Vault closed, Olivenhain Reservoir water can be conveyed north in Pipeline 5 to the Twin Oaks Diversion Structure.

9.3.2.6 Vulnerability Considerations Related to RPPC and Del Dios Valve Vault during Natural Hazards

- **Earthquakes.** These facilities were designed to meet current seismic requirements. Therefore, all these facilities are expected to be operational following an earthquake.
- **Conveyance System.** No deficient links were directly identified. Maintaining these assets is important for this location since it serves as a hub for delivering untreated water during emergency conditions in which northern supplies are interrupted.
- **RPPC Power Supply.** Commercial power is supplied to the RCCP. The facility also has a 135 kW backup diesel generator that can provide power for lighting and limited operation of the control valves.

9.3.2.7 Lake Hodges Pumped Storage Project

The Lake Hodges Pumped Storage Project is part of the ESP. This facility enables conveyance of water from Lake Hodges to the Olivenhain Reservoir.

9.3.2.8 Vulnerability Considerations Related to Lake Hodges Pumped Storage Project during Natural Hazards

- **Earthquakes.** These facilities were designed to meet current seismic requirements. Therefore, all these facilities are expected to be operational following an earthquake.
- **Conveyance System.** No deficient links were directly identified. Maintaining these assets is important for this location since it serves as a hub for delivering untreated water during emergency conditions in which northern supplies are interrupted.
- **Power Supply.** Commercial power is supplied to the Lake Hodges Pump Station. The facility also has a 200-kW backup diesel generator that can provide power for lighting

and limited operation of the control valves. It will be important to maintain power supply to the facility.

9.3.2.9 Olivenhain Reservoir

The Olivenhain Reservoir is part of the ESP. The reservoir supplies water to the northern area of the county and can provide untreated water to the Twin Oaks Valley WTP.

9.3.2.10 Vulnerability Considerations Related to Olivenhain Reservoir during Natural Hazards

- **Earthquakes.** The Olivenhain Dam was designed to meet current seismic requirements. Therefore, the reservoir is expected to be operational following an earthquake.
- **Conveyance System.** No deficient links were directly identified. Maintaining these assets is important for this location since it serves as a hub for delivering untreated water during emergency conditions in which northern supplies are interrupted.
- **Power Supply Olivenhain Dam Outlet Works.** Commercial power is supplied to the to the reservoir outlet works and will need to remain in service in order to readily control flows out of the reservoir.

9.3.3 Twin Oaks Valley Water Treatment Plant

The 100 mgd Twin Oaks Valley WTP was completed in 2008. This facility, along with its two 7.5-million-gallon treated-water clearwells and the 22-million-gallon Twin Oaks FRS (untreated water), provide major benefits and service enhancements related to system vulnerability. The Twin Oaks Valley WTP serves as a regional treatment plant capable of delivering potable water to multiple agencies through the Water Authority's system. Key considerations to the WTP's ability to respond after a natural hazard event include the following:

The Twin Oaks Valley WTP is a critical piece of infrastructure in the Water Authority's system, responsible for providing potable water deliveries to member agencies throughout the region.

- **Untreated Water Supply (Intake).** In an ESP event, untreated water can be pumped from Olivenhain Reservoir via the Olivenhain Pipeline and Pipeline 5 to the Twin Oaks Valley WTP.
- **Treated Water Delivery Pipelines.** Pipeline 4 will need to be operational to deliver water from the Twin Oaks Valley WTP after a natural hazard event. The use of Pipeline 4 to deliver treated water from the Twin Oaks Valley WTP was not considered in the 1993 Vulnerability Report. The 1993 Vulnerability Report predicted significantly fewer pipeline breaks south of Temecula Valley, which indicates that shorter repair times should be required for these pipelines (depending on the location and severity of any of these failures).
- **Power.** The Twin Oaks Valley WTP currently has three 1.5 MW diesel generators as backup power sources. These generators provide power to operate at full capacity the

WTP and the Twin Oaks Valley FRS Pump Station, which is used to deliver untreated water stored in the Twin Oaks FRS to the WTP.

- **Access.** The Twin Oaks Valley WTP is accessible in normal conditions, but it is possible that access could be limited during a natural hazard event due to its rural location. In emergency conditions, Water Authority personnel can access the plant via North Twin Oaks Valley Road and through aqueduct alignment easements.

Any damage to the plant in an emergency event would be restored following the Water Authority's Integrated Contingency Plan, which complies with the National Incident Management System (NIMS) protocol.

9.4 Additional Relevant Natural Hazards

The most likely critical natural hazard events for the Water Authority operation are earthquakes. The conclusions from the 1993 Vulnerability Report, which focused mainly on the primary and secondary effects of earthquakes, are still considered to be relevant to the current Water Authority system. Over the last decade, the region has endured other natural hazard events that highlight key considerations for vulnerability system planning. These other events include the 2003 Cedar Fire, the 2007 Southern California Wildfires, the Flood Event of 2005, and the 2011 electrical outage in San Diego County.

9.4.1 Southern California Wildfires

From October 25, 2003, to when it was contained on November 5, 2003, the Cedar Fire significantly impacted portions of San Diego and was the largest fire ever recorded in California. While southern California wildfires are not uncommon during Santa Ana weather conditions, the impact and duration of the Cedar Fire was unusual due to certain conditions. When the Cedar Fire started, 11 wildfires already were burning in southern California. These fires diverted some of San Diego County's resources before the Cedar Fire began and limited the amount of assistance that could be provided from neighboring counties. The fire impacted traffic across the region and thus limited the ability to access facilities. The Water Authority experienced some challenges in assisting member agencies with issues they faced. One Water Authority vehicle was damaged during the Cedar Fire; however, the fire ultimately did not impact the Water Authority's ability to deliver water.

Vulnerability system planning considered other natural events experienced over the last decade, such as fire, floods, and the massive 2011 electrical outage in San Diego County.

A series of 14 wildfires began burning across southern California on October 20, 2007, and continued for 19 days until finally being contained on November 9, 2007. Major contributing factors included the extreme drought condition in southern California, hot weather, and again strong Santa Ana winds gusting to 70 miles per hour (mph). The two biggest fires were located in San Diego County. Some member agencies experienced issues during the fires (for example, Ramona MWD had trouble getting water due to impacts from the fire to its distribution system power supply).

Other fire impacts included impacts to flow control facilities. The roof of the San Dieguito/ Santa Fe 3, 4, 5 Service Connection Facility burned down. Additionally, falling ash created various water quality issues in reservoirs. High levels of ash in the El Capitan Reservoir negatively impacted the water treatment process. Overall system flexibility that provides multiple options for water supply during periods of water quality challenges following large fires will help mitigate the impact of ash runoff.

Southern California wildfires are not uncommon and create unique challenges. The fires noted previously did not have a direct impact on the Water Authority but did impact member agencies that the Water Authority supported through mutual aid agreements.

9.4.1.1 Impacts to Power

Power lines in remote areas are subject to damage in large fires and pose a significant risk. Evaluation of backup power options is recommended as part of follow-up studies.

9.4.2 Flood Events

Flood events can jeopardize pipelines by eroding soil and exposing the pipelines to harsh conditions. This is especially concerning where the aqueduct intersects with creek crossings. Various sections of the aqueduct system have previously been subject to scour resulting in exposed pipeline segments. In some cases, sheet piles were installed to mitigate some scour problems on the Second Aqueduct.

The last significant flood event was in 2005, when a prolonged period of heavy precipitation occurred in southern California beginning Friday, January 7, and continuing almost constantly through Tuesday, January 11. All major river basins in southern California were impacted to some degree by the volume of precipitation that fell during the storm period. The greatest impact was experienced along the San Luis Rey River near Oceanside. Flooding from these storms took out the Valley Center 1A and 1B facilities. The storm also exposed a number of pipes.

The Water Authority’s existing Asset Management Program equips the Water Authority to identify and correct scour problems before damage progresses. An additional CIP project is suggested to evaluate older pipelines that could be subject to scour. The study would also include surveying the locations where the aqueduct crosses creeks and provide repair recommendations at locations that are determined to be damaged or in jeopardy of being damaged.

9.4.3 2011 San Diego County Electrical Outage

On September 8, 2011, a substantial power outage occurred throughout southern California and Baja, Mexico, that affected approximately 5 million people, lasting up to 12 hours in some portions of the county. While this event appeared to be caused by human error, some key observations are worth considering since the impacts could be similar if electrical service were severely affected during an earthquake or wildfire event. These include the following:

Transportation Impacts – The lack of power throughout the county caused substantial traffic delays as a majority of traffic signals were inoperable. A lack of power also limited commercial airline operations at local airports.

Impacted Communications – Cell phone carrier capacity was taxed and was not dependable during portions of the event.

Water Supply Issues – Within approximately four to five hours of the outage, four Water Authority member agencies announced mandatory rationing of water supplies—Valley Center Municipal Water District, Fallbrook Public Utility District, Helix Water District, and Ramona Municipal Water District. The city of San Diego also announced mandatory boil alerts in certain pumped pressure zones due to low pressures.

Lack of Commercial Fuel – The lack of backup power at gas stations throughout San Diego restricted the availability of fuel at these commercial sources. During this event, the Water Authority was allowed to utilize the county of San Diego's fueling stations, which are located throughout San Diego County and have adequate backup power. As a result of this experience, the Water Authority is currently pursuing an agreement with the county of San Diego to be able to use the fueling stations during unusual circumstances in the future.

During this event, the Water Authority initiated its Emergency Operation Center; the radio system was operable and worked effectively.

9.5 Vulnerability Mitigation

Preparing for a natural hazard event is as important as maintaining the existing infrastructure. The Water Authority has plans and procedures in place to respond to emergency events. Investments in an Asset Management Program and the implementation of the ESP have also contributed to system reliability and decreased vulnerability.

9.5.1 Asset Management Program

Over the last decade, there has been a growing focus on sustainability. While sustainability covers many aspects of the Water Authority's operation, its application to the long-term maintenance and protection of the Water Authority's existing assets relates directly to reducing vulnerability risks. Asset management is therefore one of the key elements in ensuring that risks are managed and service levels are maintained. Natural hazard events will test the system and will expose weak links in the system at a very critical time.
An active asset management program is one of the best means to continuously renew the system and limit risks and liability during natural hazard events.

The Water Authority established an Integrated Asset Management Program in June 2009, which united asset management efforts throughout the organization. The goals of the Asset Management Program are to (1) maximize the value of assets over their entire service life, and (2) enhance and maintain the condition of assets under the lowest possible cost while continuing to provide a safe and reliable water supply. The Asset Management Program will significantly reduce the risk of infrastructure failures during natural hazard events since these extreme conditions stress older, more vulnerable facilities.

The Asset Management Program implements several asset management industry best practices, such as an asset registry, condition assessment, determination of remaining life, and business risk. A comprehensive inventory, known as an Asset Registry, includes asset information such as location, condition, performance, and useful life. The Asset Registry also works with other enterprise software systems such as geological information system (GIS) and the Computerized Maintenance Management System (Maximo). Ongoing condition assessment efforts include visual inspections, internal inspections, steel thickness measurements, remote field eddy current data (prestressed pipe wire break information), real-time acoustic fiber optic data (prestressed pipe wire break information), and real-time cathodic protection data.

Assets are classified into three main groups:

- **Pipelines Class:** Includes the various type of pipelines used to transport water to the member agencies, with the exception of the facilities that meter, pump, or treat the water. It includes a complex network of over 300 miles of pipelines ranging in diameter from 20 to 108 inches and constructed with a variety of materials (for example, steel or PCCP).
- **Facilities Class:** Includes all water delivery facilities in the system. Currently, more than 120 facilities are used to meter, pump, treat, generate electricity, and control the flow of water.
- **Equipment Class:** Includes construction equipment, SCADA system hardware, Peoplesoft, technical equipment, and specialty tools required to operate and maintain the water delivery system. Through this class, the Water Authority strives to track and replace capital equipment when the capital equipment has reached the end of its useful life.

The Asset Management Program generates recommendations for constructing, operating, repairing, or replacing assets. The recommendations are based on two main factors: the remaining asset life and the business risk. A custom computer program systematically applies condition information (such as pipe decay index and the facility condition score metrics) to obtain the remaining asset life. The Water Authority can then assess the consequence and probability of failure to determine the business risk metric for assets.

9.5.2 Pipeline Repair Material

The Water Authority stores a limited supply of repair material specifically related to fixing pipeline breaks throughout the aqueduct system. Currently, supplies and materials are available to repair approximately 30 sections of pipe. These materials are not intended for massive emergency response preparedness, but rather for typical system repairs after an unexpected disruption. The 1993 Vulnerability Report, Tables 9-1 and 9-3, includes inventories of anticipated materials required to support the greatest number of repairs expected after an emergency event.

9.5.3 Strategic System Isolation

Having strategic isolation points within the system is essential to being able to repair damaged portions while they still remain in service. The 2013 Master Plan evaluations have recognized this important system aspect and have determined select locations where isolation valves would be beneficial.

9.5.4 Integrated Contingency Plan

The Water Authority has an Integrated Contingency Plan (ICP), which is a compilation of emergency plans that are related to the Water Authority operations. The ICP includes an Emergency Operations Plan (EOP), Functional and Facility annexes, and hazard-specific Emergency Action Plans. The ICP is an important tool used to coordinate the initial response in any emergency.

9.6 CIP Projects to Mitigate Vulnerability

This section summarizes project recommendations based on the vulnerability assessments performed under the 2013 Master Plan.

9.6.1 System Vulnerability Assessment

The Water Authority's system includes several aging structures that render it susceptible to damage from a seismic event. A more detailed study is recommended to evaluate the condition of existing structures and identify structural upgrades necessary to maintain system reliability. An example of facilities that should be evaluated in the System Vulnerability Assessment include the rejection tower, pressure control facility, and weir structure at the Twin Oaks Diversion Structure site to determine if seismic-related upgrades and improvements are needed to reduce the risk of a critical structure failure. With the knowledge gained in recent years related to the response of structures to earthquakes, existing facilities that are at risk can be made more reliable through seismic retrofitting.

9.6.2 System Isolation Valves

New isolation valves are recommended at targeted locations, including high-risk river and stream crossings that have a greater potential to incur failures due to scour or liquefaction. The isolation valves would minimize service disruptions while repairs are performed on the damaged pipeline segments. The addition of isolation valves would need to carefully consider aqueduct system hydraulics since sudden valve operation can cause pressure increases exceeding pipeline design tolerances, affect hydraulic transient conditions, or create overflows at vents or other regulating facilities. Section 7-4 includes a list of recommended valve locations. In addition, a broader look at isolation valves is warranted, including the potential for isolation valves at delivery points to agencies and other areas deemed useful, but not currently considered critical.

9.6.3 Comprehensive Energy Management Strategy

Due to the challenges that the Water Authority experienced during the 2011 electrical outage in San Diego County, and the fires of 2003 and 2007, it is recommended that the Water Authority further evaluate emergency power requirements for critical facilities. This

2013 Master Plan identified the need to develop sustainable strategies to operate facilities through a range of power challenges such as general power outages, fires, and natural disasters. Typical industry standards, such as backup power capacity, generator run-time, fuel storage, and available materials for repairs, should be compiled and guidelines developed to adequately equip facilities and ensure reliability in an emergency event. The Water Authority has already initiated some activities in this regard, including coordinating the ability to obtain vehicle fuel from County of San Diego facilities in emergency scenarios. This project would be a component of an energy management plan further discussed in *Chapter 10 – Energy Management Analysis*.

Chapter 10.0 Energy Management Analysis

10.1 Overview

The Water Authority's consumption of energy is relatively small compared to the substantial quantities of water that are conveyed through the aqueduct system and delivered to its member agencies. Much of the aqueduct system operates under gravity flow by taking advantage of the imported water supply elevation gradient at the MWD Delivery Point. While energy use is a small component of aqueduct operations, controlling energy consumption and understanding the important water-energy nexus is critical to meeting the region's need for an efficient and reliable delivery system.

Currently, total annual energy consumption for Water Authority-owned facilities is approximately 115,000 MWh. To help offset this demand, the Water Authority has implemented various energy conservation measures and developed renewable energy generation that can provide up to 92,000 MWh annually. With the recent addition of new facilities to augment and manage the region's water supplies, energy consumption is projected to increase, and the management of both energy use and energy generation will become even more important.

This chapter presents an energy management analysis of the Water Authority's existing system and proposed improvements. Major components of the energy management analysis are summarized in Table 10-1 and discussed in more detail in the sections that follow. Figure 10-1 shows the overall 2013 Master Plan process and the associated chapters. Highlighted in Figure 10-1 are the elements described in this *Chapter 10 - Energy Management Analysis*. Existing energy use and generation are shown in Figure 10-2.

TABLE 10-1
Summary of Energy Management Analysis

Analysis Component	Description
Existing Energy Portfolio	Energy use at existing Water Authority facilities was identified for five major categories of use: treatment, offices, pump stations, small facilities, and generation facilities. Energy generation was assessed for hydroelectric power generation facilities and solar facilities.
Renewable Energy Alternatives	Potential renewable energy includes hydroelectric, solar, and wind. New energy opportunities such as in-conduit hydroelectric facilities and repowering of existing facilities were identified.
New Energy Development Opportunities	
In-conduit Hydroelectric	An initial analysis of potential for in-conduit hydroelectric facilities within the Water Authority's system was followed by a more detailed review of key facilities. A preliminary energy generation analysis and a financial analysis were performed.
Repowering of Existing Hydroelectric Facilities	Two existing hydroelectric facilities owned by the Water Authority are currently out of service: Miramar Hydroelectric Facility and Alvarado Hydroelectric Facilities. A feasibility review was performed of the repowering of one or both of these facilities.

TABLE 10-1
Summary of Energy Management Analysis

Analysis Component	Description
Pumped Storage	An evaluation of potential pumped storage opportunities at the San Vicente Reservoir is being considered.
Solar	Operation of the photovoltaic solar panels at the Water Authority's Administration Office, Escondido Operations Center, and Twin Oaks Valley WTP, as well as potential new projects, has been reviewed.
Wind	The feasibility of new wind projects, as well as indirect purchase of wind energy from other entities to offset GHG emissions, has been reviewed.
Funding Options	Funding options available through local, state, and federal government programs including low interest loans, grants, incentives, and rebates have been reviewed.
Energy Management	Existing Water Authority energy management strategies, including partially or fully offsetting energy use and mitigating GHG emissions, have been incorporated. Additional strategies for energy management are suggested, and specific feasibility studies are recommended.
Future Potential Energy Projections	Energy use and costs were projected for operation of baseline facilities and potential future infrastructure.

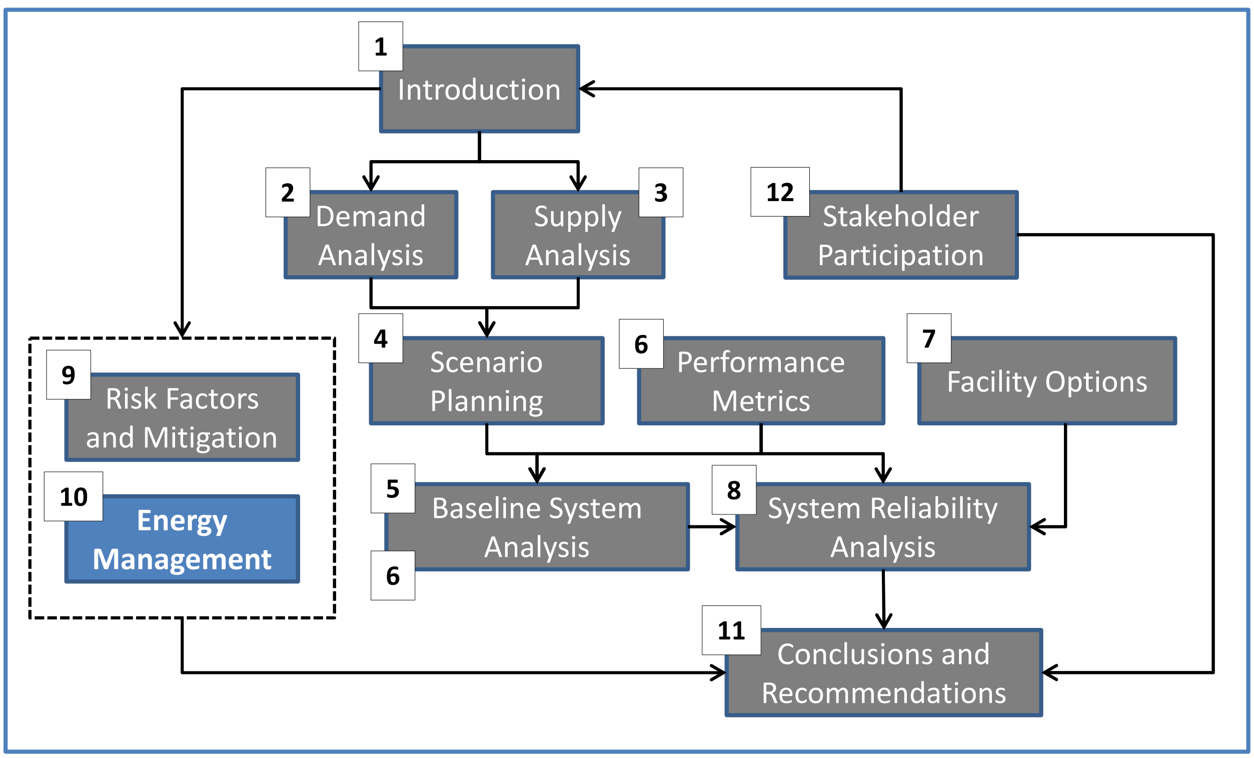
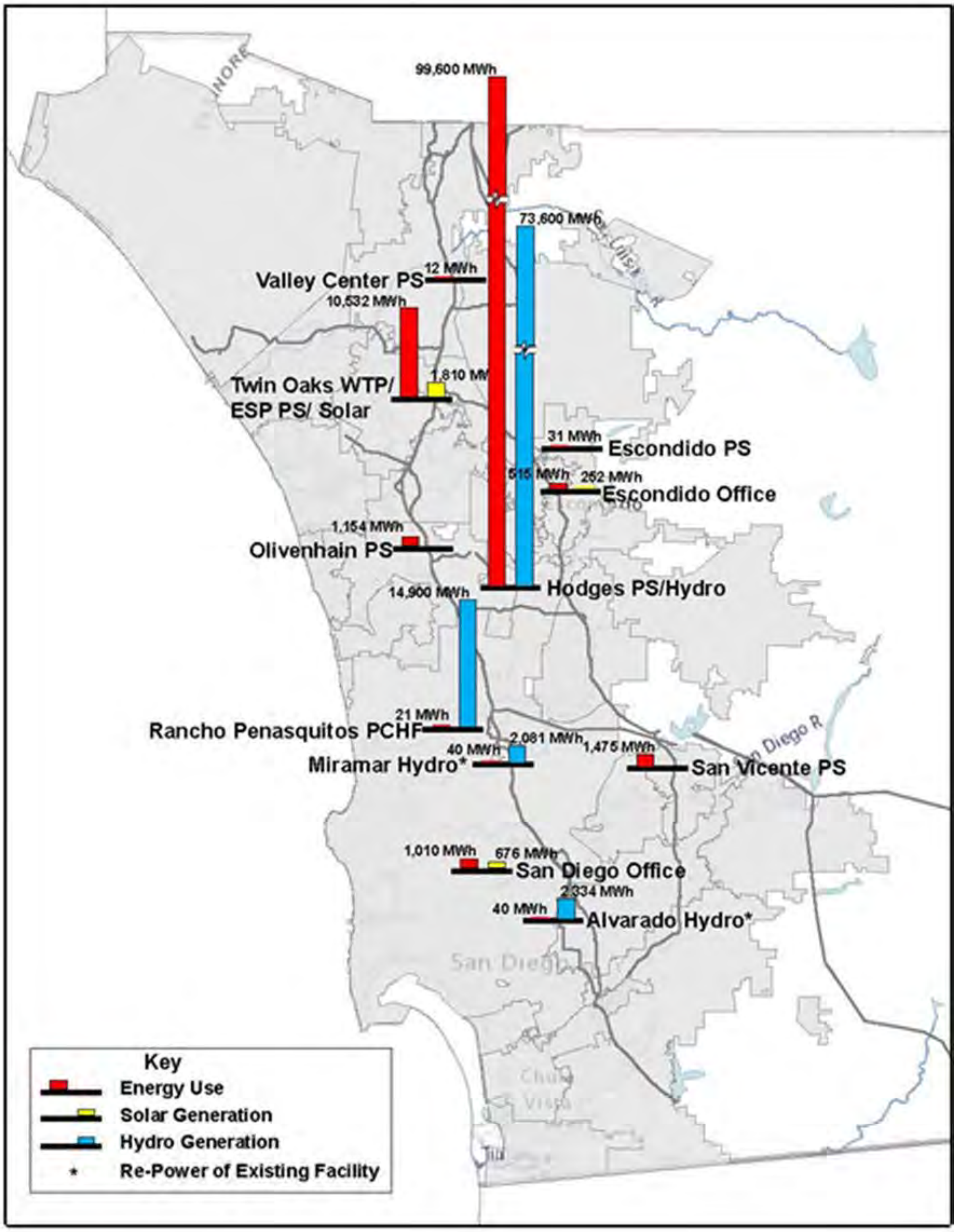


FIGURE 10-1
Relationships between 2013 Master Plan Chapters and Planning Process



San Diego County Water Authority
2013 Regional Water Facilities
Master Plan Update

Figure 10-2
2013 Major Energy Demand
and Power Generation

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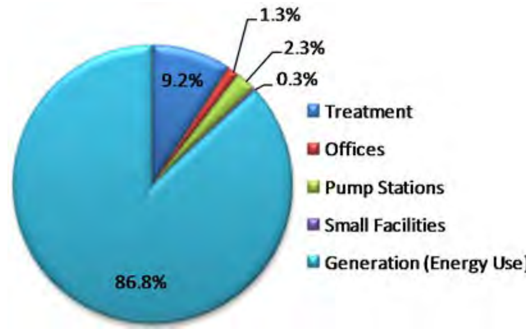
10.2 Existing Energy Portfolio

This section presents current energy use at the facilities throughout the Water Authority's system and describes energy generation at the Water Authority's hydroelectric power generation facilities and solar facilities.

10.2.1 Existing Energy Use

Energy use at existing Water Authority facilities was separated into five major categories: treatment, offices, pump stations, small facilities, and generation facilities. The energy use and cost for fiscal year 2013 is shown in Table 10-2. The table also shows total energy use, and the graphic indicates the percentage of average energy use attributed to each of the major categories.



Existing energy use is categorized by five key types of facilities.

TABLE 10-2
Summary of Annual Energy Use and Generation Projections (Existing Facilities)

Facility	Energy Use (MWh) Fiscal Year 2013	Comment
Energy Use		
Treatment		
Twin Oaks Valley WTP	10,532	
Treatment Subtotal	**10,532**	
Offices		
Administration Office	1,010	
Operations Center	515	
Offices Subtotal	**1,525**	
Pump Stations		
Escondido Pump Station	31	7-month operation
Valley Center Pump Station	12	No pumping (cycle only)
Olivenhain Pump Station	1,154	4-month operation
San Vicente Pump Station	1,475	No pumping (cycle only)
Pump Stations Subtotal	**2,672**	
Small Facilities		
SCs	228	
Flow Regulatory	98	
Aqueduct Protection Program	37	Trending up
Small Facilities Subtotal	**363**	
Generation (Energy Use)		
Lake Hodges Pumped Storage	99,600	Start Full Year Operation (25% Time)
Rancho Peñasquitos Hydroelectric Facility	21	
Generation (Energy Use) Subtotal	**99,621**	
TOTAL ENERGY USE (MWh)	**114,713**	
TOTAL COST	**$14,200,000**	

10.2.1.1 Treatment

The Twin Oaks Valley WTP, which began operation in 2008, is the Water Authority's largest energy use facility. This facility has a current annual energy use of approximately 10,500 MWh. Energy use includes all treatment, control, and pumping facilities. Energy use is dependent on the treatment plant utilization, which is based on the Water Authority's water supply demands during any given year.

10.2.1.2 Offices

The Water Authority's Administration Office constitutes a sizable amount of their overall energy use.

The Water Authority has two main offices: the Administration Office in Kearny Mesa and the Operations Center in Escondido. These facilities combined have an annual energy use of approximately 1,500 MWh. Energy use is dependent on lighting, equipment, and use hours for each office. Energy efficiency measures have reduced annual energy uses for fiscal years 2009 to 2011.

10.2.1.3 Pump Stations

The Water Authority has five major pump stations, which have a combined annual energy use of approximately 2,700 MWh. Energy use is dependent on frequency of operation and use of each facility. The San Vicente Pump Station was operated during startup and testing; however, this energy use is not a typical annual use so it was not considered in the existing average annual use. During dry periods, the San Vicente Pump Station will be used to transfer water stored in San Vicente Reservoir to the aqueduct system.

The Valley Center/P2A Pump Station is one of the Water Authority's five major pump stations.

10.2.1.4 Small Facilities

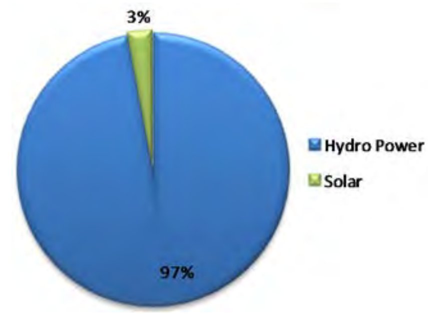
The Water Authority has multiple smaller facilities that contribute to its overall power use. These smaller facilities include service connections (SCs), flow regulatory structures, the Aqueduct Protection Program, and other miscellaneous facilities. The smaller facilities have a combined annual energy use of approximately 370 MWh. Energy use is dependent on lighting, equipment, and cathodic protection needs.

10.2.1.5 Generation Facilities

The Water Authority's hydroelectric facilities also consume electrical energy, accounting for approximately 99,600 MWh. For the existing hydroelectric facility at Rancho Peñasquitos, power use is minimal and is dependent on lighting and equipment uses. The Alvarado Hydroelectric Facility and Miramar Hydroelectric Facility are currently not in use and have no power use. For the Lake Hodges Pumped Storage Facility, which recently came online, the significant energy uses include operation of pump turbines, lighting, and equipment.

10.2.2 Existing Energy Generation

Energy generation at existing Water Authority facilities was separated into two major categories: hydroelectric power generation facilities and solar facilities. The energy generation for fiscal years 2012 and 2013 is shown in Table 10-3, while the graphic shows the relative average percentages for these two categories.



Existing energy generation is categorized by two key types of facilities.

TABLE 10-3
Summary of Annual Energy Use and Generation Projections (Existing Facilities)

Facility	Energy Generation (MWh) Fiscal Year 2013	Comment
Hydroelectric Power Generation Facilities		
Rancho Peñasquitos Hydroelectric Facility	14,900	
Lake Hodges Pumped Storage	73,584	Start Full Year Operation (20% Time)
Hydroelectric Power Generation Facilities Subtotal	**88,484**	
Solar Power Facilities		
Twin Oaks WTP	1,810	
Administration Office	676	
Operations Center	252	
Solar Power Facilities Subtotal	**2,738**	
TOTAL ENERGY GENERATION (MWh)	**91,222**	
TOTAL REVENUE	**$5,985,000**	

10.2.2.1 Hydroelectric Power Generation Facilities

Since December 2006, the Rancho Peñasquitos Pressure Control Hydroelectric Facility has been generating more than 20,000 MWh annually; however, there has been a downward trend of energy generation due to lower flows from reduced member agency demands. The 4.5 MW Francis Turbine is designed to operate year-round providing energy to the local grid, where it is sold at a fixed rate to SDG&E under a 10-year Power Purchase Agreement. The Power Purchase Agreement is set to expire in 2017.

To date, the Rancho Peñasquitos Pressure Control and Hydroelectric Facility is the primary source of energy generation for the Water Authority. The facility has seen a downward trend of energy generation due to lower flows from reduced member agency demands.

The Alvarado Hydroelectric Facility was constructed in 1984 and houses two 995-kilowatt (kW) generators, a 26 kW standby diesel generator, associated switchgear, transfer switches, mechanical piping, control valves, electrical panels, and instrumentation and control devices. In March 2007, the facility flooded and completely submerged the generators, shorted the switchgear, and damaged electrical and mechanical equipment and devices. The facility is currently out of service.

The Miramar Hydroelectric Facility was constructed in 1984 and houses two 400 kW generators. Due to higher flows and lower differential pressure than the design conditions, the facility is out of service. The lower differential pressure is due to changed downstream hydraulic conditions at the Miramar WTP.

The Lake Hodges Pump Storage Project, completed in 2012, consists of upper and lower reservoirs, interconnected pipelines, and a pump house designed to make water available to the San Diego region in the event of an interruption in imported water deliveries. The connection of the City's Hodges Reservoir to the Water Authority's Olivenhain Reservoir provides the ability to store 20,000 acre-feet of water in Hodges Reservoir for emergency use. When water is transferred downhill from Olivenhain Reservoir into Hodges Reservoir, it has the capacity to generate up to 100,000 MWh of hydroelectric energy per year.

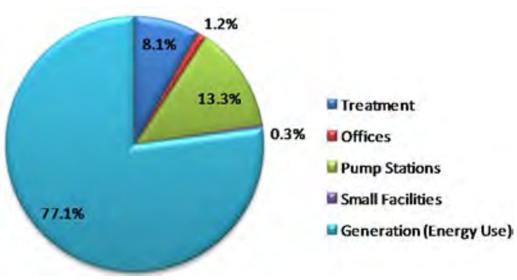
10.2.2.2 Solar Facilities

The Water Authority currently holds a Power Purchase Agreement (PPA) for photovoltaic solar power generated at the Administrative Office, Operations Center, and Twin Oaks Valley WTP. The PPA is a 20-year contract with Borrego Solar Systems, a San Diego-based energy service provider. The Water Authority purchases solar power under a preset reduced price structure, and the energy service provider is responsible for design, construction, and operation and maintenance of the systems. The Water Authority expects to save $1.7 million in energy costs over the 20-year life of the PPA.

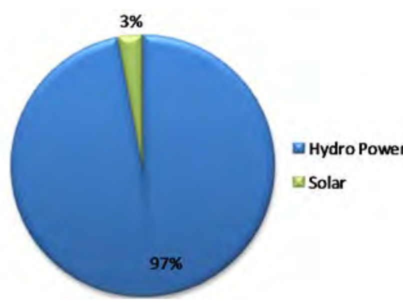
Solar facilities, like these shown at the Water Authority's Administrative Office, help to generate energy and offset energy use.

10.2.3 Existing Infrastructure Energy Projections

When evaluating the Water Authority's total energy demand, the existing facility energy use and generation must be included. Since the existing energy portfolio described in



Future energy use projections show a significant increase in usage from generation facilities.



Future projections also show a significant increase in potential energy generation.

Section 10.2.2 did not include operation of the San Vicente Pump Station (besides cycle only), Valley Center Pump Station (besides cycle only), or the proposed North County Pump Station projections were necessary to estimate future conditions. Energy generation projections are anticipated to be similar to existing use for the near future. Energy use and generation projections for existing facilities and the proposed North County Pump Station are shown in Table 10-4 and in Figure 10-3.

TABLE 10-4
Summary of Annual Energy Use and Generation Projections (Existing Facilities)

Energy Use		
Facility	**Projected Future Energy Use[1] (MWh)**	**Comment**
Treatment		
Twin Oaks Valley WTP	10,532	
Treatment Subtotal	**10,532**	
Offices		
Administration Office	1,010	
Operations Center	515	
Offices Subtotal	**1,525**	
Pump Stations		
Escondido Pump Station	31	7-month operation
North County Pump Station	218	4-month operation
Valley Center Pump Station	2,000	19,000 AF of average annual pumping
Olivenhain Pump Station	1,154	4-month operation
San Vicente Pump Station	20,000	45,000 AF of average annual pumping
Pump Stations Subtotal	**23,403**	
Small Facilities		
SCs	228	
Flow Regulatory	98	
Aqueduct Protection Program	37	Trending up
Small Facilities Subtotal	**363**	
Generation (Energy Use)		
Lake Hodges Pumped Storage	99,600	Start Full Year Operation (25% Time)
Rancho Peñasquitos Hydroelectric Facility	21	
Generation (Energy Use) Subtotal	**99,621**	
TOTAL ENERGY USE (MWh)	**135,444**	
TOTAL COST	**$16,766,000**	

Energy Generation		
Facility	**Projected Future Energy Generation[1] (MWh)**	**Comment**
Hydroelectric Power Generation Facilities		
Rancho Peñasquitos Hydroelectric Facility	14,900	
Lake Hodges Pumped Storage	73,584	Start Full Year Operation (20% Time)
Hydroelectric Power Generation Facilities Subtotal	**88,484**	
Solar Power Facilities		
Twin Oaks WTP	1,810	
Admin. Office	676	
Operations Center	252	
Solar Power Facilities Subtotal	**2,738**	
TOTAL ENERGY GENERATION (MWh)	**91,222**	
TOTAL REVENUE	**$5,985,000**	

[1] Energy use and generation will vary from year to year based on actual demands.

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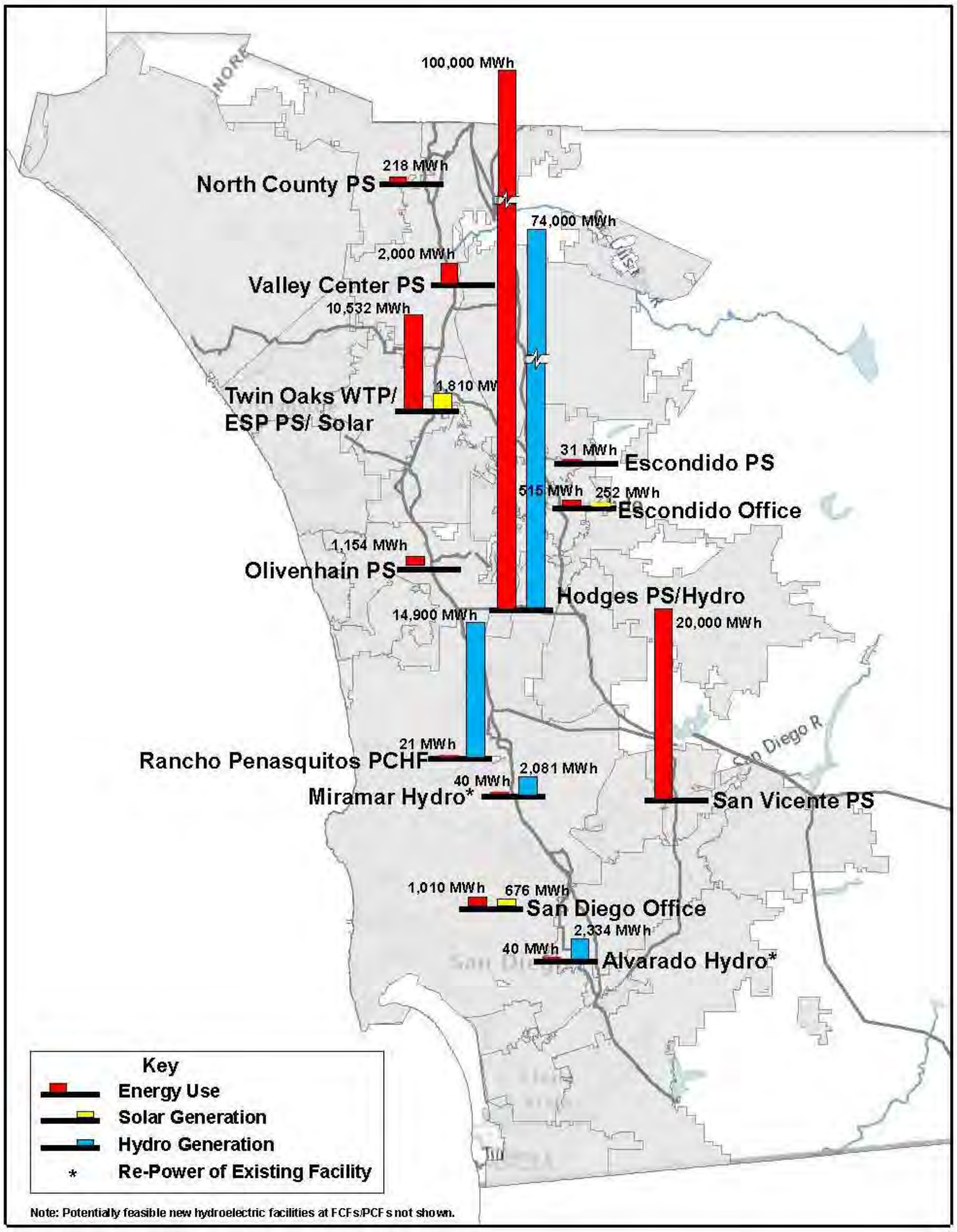

San Diego County Water Authority
2013 Regional Water Facilities
Master Plan Update

Figure 10-3
Projected Major Energy Demand and Power Generation for a Year Using Carry Over Storage From San Vicente Reservoir

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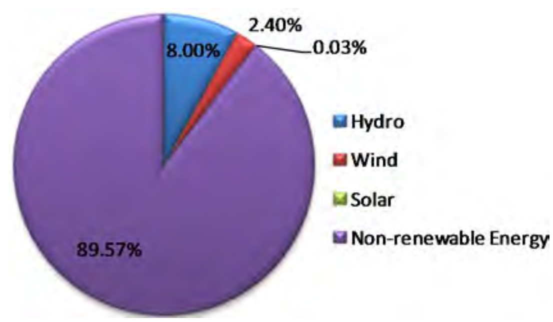
10.3 Renewable Energy Alternatives

This section presents potential new renewable energy generation options that are available to offset future energy use and provide an added revenue source. A brief synopsis of the overall renewable energy marketplace, as well as specific opportunities for new hydroelectric, solar, and wind alternatives, is provided. Other renewable alternatives are also discussed. The Water Authority currently has hydroelectric and solar power generation in operation.

10.3.1 Renewable Energy Market Place

The development of renewable energy is one of the fastest-growing areas in the global energy market today, based on concern related to climate change, the desire to decrease dependence on oil, and the creation of government incentive programs to promote renewable energy. Economics are still a major driving factor. However, as supply and incentives increase, project costs are dropping. It has been estimated that the cost to install a behind-the-meter solar photovoltaic system (connected on the customer side of the meter under a net metering agreement) has dropped by 17 percent within the United States from 2009 to 2010, and by another 16 percent from 2010 to 2011.[5] The costs of solar photovoltaic panels are rapidly dropping, but the installation costs are sufficient to keep the installed cost per megawatt of solar photovoltaic power significantly higher than fossil fuel generation at the present time. The electricity portfolio in the United States includes 8 percent hydroelectric, 2.4 percent wind (an increase of 28 percent over the prior year), and 0.03 percent solar (45 percent growth over prior year) according to the United States Energy Information Administration.



While renewable energy sources currently make up less than 10.5 percent of the nation's electricity portfolio, the opportunities and incentives available show promising growth for renewable energy projects.

California's Renewables Portfolio Standard (RPS) requires investor-owned utilities and energy service providers to increase their procurement of eligible renewable energy resources to 33 percent of retail energy sales by 2020, with interim targets of 20 percent by 2013 and 25 percent by 2016. This RPS requirement has driven demand for renewable energy by major California utilities.

10.3.2 Hydroelectric

Various types of hydroelectric power generation exist, including impoundment (dam), diversion (altering the run of the river), pumped storage (flow between two reservoirs), and in-conduit (within an existing piping system). In-conduit hydroelectric power generation is built within the existing water distribution or transmission system harnessing unrealized

[5] G. Barbose et al. 2011. Tracking the Sun IV, An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010, Lawrence Berkeley National Laboratory. September.

hydraulic energy with minimal environmental impacts and small-scale construction, such as the Water Authority's Rancho Peñasquitos Pressure Control and Hydroelectric Facility.

Within the Water Authority system, in-conduit hydroelectric power generation opportunities exist where differential elevation or pressure change occurs in the system. These locations are most often between pressure zones or at member agency service connections and are dependent on flow rate and downstream pressure requirements.

10.3.3 Solar

Solar power is a viable renewable energy source, particularly with the funding incentives described in Section 10.4. Solar power is typically obtained using photovoltaic panels. Solar energy is either used onsite to offset energy uses or can be sold to other entities. Solar power requires a significant amount of land to install the photovoltaic panels, ranging from 4 to 8 acres per megawatt depending on the panels and mounting systems, or panels can be incorporated into existing structures to minimize the system's footprint. The amount of solar power generated depends on the conditions of a particular site (global horizontal irradiance levels, site shading, soiling, cloud cover, and rainfall frequency) and the layout of the system (the efficiency of the panel itself, mounting system type, and panel orientation). Large solar projects near electric transmission infrastructure are typically more cost effective than small rooftop systems. Most very large solar power units are solar-thermal and have a much greater efficiency than solar photo-voltaic units. However, this solar thermal technology is restricted to very large units and is not practical for single-building uses.

10.3.4 Wind

Wind power is generally less attractive in the San Diego region compared to surrounding areas due to lower wind velocities and durations in the vicinity. Extensive permitting would be required. The visual impacts of wind generation projects can become challenging to overcome. Wind farms do not require intensive land use due to the large spacing between turbines; therefore, such land can often serve dual purposes (that is, wind power and agricultural use). Wind farms are typically more effective in large-scale systems and at locations near electric transmission infrastructure. The power generation from wind is dependent on the wind resource (velocity and duration), turbine size and mounting height, and number of turbines.

10.3.5 Other Renewable Energy Alternatives

Other commercialized renewable energy alternatives include solid biomass, biogas, and geothermal energy. Solid biomass utilizes biomass fuels such as waste wood and agricultural residue to burn as fuels to generate power. Biogas, often derived from landfill gas or anaerobic digestion of animal manure, sewage, or food waste, can be combusted or reformed in a fuel cell to produce electrical power. Geothermal energy is generated from high-temperature hot springs or through geothermal systems in which water is injected into the ground where high temperatures are present, and the steam generated is used to operate a turbine.

Fuel cells are not strictly considered to be renewable energy (unless operating on biogas) but are a low-emission, high-efficiency way to convert hydrogen-rich fuel sources directly to electricity through an electrochemical reaction. Fuel cells can sustain a high efficiency, are modular in nature, and can be easily sized according to power requirements.

None of these other renewable energy alternatives appear to be appropriate for the Water Authority to directly pursue except possibly fuel cells. However, indirect purchase of energy from these sources could be an option to offset GHG emissions.

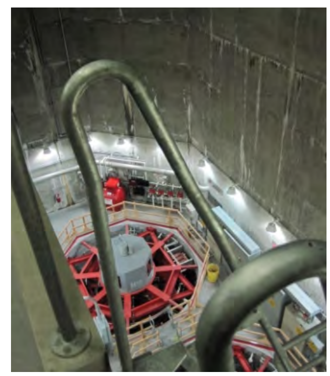
10.4 New Energy Development Opportunities

New energy development opportunities evaluated in this section are pumped storage, in-conduit hydroelectric, repowering of existing hydroelectric facilities, solar, wind, and other.

10.4.1 Pumped Storage

10.4.1.1 Overview

Pumped storage utilizes the elevation differential between two reservoirs to generate energy during peak energy pricing periods by releasing water from the upper reservoir through a turbine and into the lower reservoir, and then pumping the water back uphill to the upper reservoir during off-peak energy-pricing hours. Pumped storage projects are also used to generate energy to meet emergency conditions when other generation plants in the system fail to operate, thereby providing increased reliability to the power grid. For electric operators, pumped storage is considered a preferred resource for meeting reserve needs because of its fast-start capability and reliability. Pumped storage projects are new energy development opportunities but are considered net users of energy. However, pumped storage projects can be used to optimize renewable energy projects such as wind and solar to store energy during off-peak time periods for use during on-peak time periods.



The Lake Hodges Pumped Storage Facility is part of the ESP and has the ability to generate energy.

10.4.1.2 San Vicente Pumped Storage Project

The Water Authority is currently evaluating pumped storage opportunities at the San Vicente Reservoir. The Water Authority is the current preliminary permit holder for a proposed project (FERC Project No. 12747) that consists of the San Vicente Reservoir, a new upper reservoir, conveyance tunnels/shafts, powerhouse and pump station, access facilities, and electric transmission lines. The preliminary permit will allow for continued feasibility reviews to refine project size, economics, conduct additional environmental and engineering studies related to the upper reservoir, and secure and maintain priority of an application for an operating license. Four potential sites for the upper reservoir have been identified, providing up to 500 MW of energy generation.

10.4.2 In-Conduit Hydroelectric

10.4.2.1 Overview

The potential for in-conduit hydroelectric facilities within the Water Authority's system was evaluated at key locations including service connections and pressure control facilities. Service connections are located at member agency flow delivery points. Pressure head may or may not be dissipated at the member agency flow delivery points to provide the desired pressure downstream. Pressure control facilities are located at strategic points on the aqueducts to ensure upstream and downstream pressures are maintained. In-conduit hydroelectric energy generation was classified by size, as shown in Table 10-5.

TABLE 10-5
In-Conduit Hydroelectric Size Classification

Size	Generation Range	Average Capital Cost ($/kW)
Micro	5 to 100 kW	$2,300
Small	100 to 500 kW	$2,100
Large	500 kW and higher	$1,800

An initial analysis was conducted to identify locations with sufficient flow and head for feasible in-conduit hydroelectric installation. Candidate locations were initially screened based on having a potential energy generation exceeding 100 kW.

A typical schematic of an in-conduit small hydroelectric facility addition to an existing SC is shown in Figure 10-4.

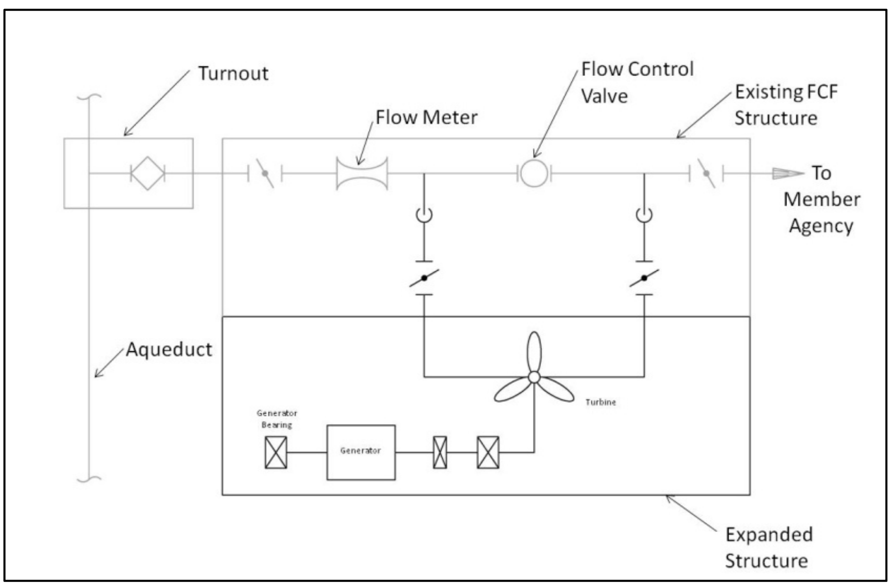


FIGURE 10-4
In-Conduit Small Hydroelectric Facility Schematic

Micro-hydroelectric power generation facilities generate less than 100 kW and are typically installed in small remote systems to provide a remote power source, and only a few manufacturers exist. The overall efficiency of a micro-hydroelectric system ranges between 40 and 70 percent, but a well-designed system will typically only be able to achieve an average efficiency of 55 percent. This drop in efficiency is due to the inability of the less expensive small hydroelectric equipment to adjust to variations in flow and head conditions.

10.4.2.2 Potential Energy Generation

Daily pressure and flow data for a two-year period was provided by the Water Authority for all service connections within the aqueduct system. The data was assumed to be representative of future operating conditions with conservatively lower flows due to water conservation. An analysis was performed to identify system-wide potential for in-conduit hydroelectric facility generation. The analysis assumed no change to current delivery regimes or to the pressure gradient currently provided downstream of the service connection. Table 10-6 presents the system-wide generation potential, candidate sites, and associated head, flow, and generation potential.

Opportunities for small hydroelectric facilities should continue to be studied, as they appear to have favorable generation potential.

TABLE 10-6
Summary of Potential In-Conduit Hydroelectric Energy Generation

Facility	Average Flow (cfs)	Average Head (feet)	Average Power Generation (kW)	Hydroelectric Size
Facilities with Near-Term Potential				
Oceanside 5 FCF	22	82	116	Small
Oceanside 6 FCF	20	158	197	Small
Vallecitos 2 FCF	21	124	169	Small
Carlsbad 5	4	300	79	Small
Crossover Pipeline (Terminal Structure)	35	220	494	Small
Escondido 3 FCF	20	104	130	Small
San Diego 14 FCF	24	77	119	Small
San Diego 5C FCF	24	57	88	Micro
San Diego 5B FCF[1]	49	57	176	Small
San Diego 5A FCF*	41	57	146	Small
National City/South Bay 1 FCF	23	288	419	Small
Otay 11 FCF	11	143	102	Small
National City/South Bay 4 FCF	18	489	564	Large
Otay 12 FCF	24	146	227	Small
Facilities as Part of Future Potential Work				
Twin Oaks Valley WTP (Pipeline 6)	370	197	4,625	Large
Twin Oaks Valley WTP (Flow Regulatory Storage)	500	62	1,967	Large

* The existing Miramar Hydroelectric Facility combines flow from the SD5A and SD5B FCFs.

The flow and pressure data was averaged to obtain one representative flow and differential head data point. Data entries with zero flow were eliminated from the data set based on the assumption that flow would be unavailable and that the turbine would not operate.
The historical data provided insight into the typical operations of each service connection. At times, a service connection would not receive flow; therefore, it was assumed that the facility would not always operate in the future. To ensure that the appropriate operations were captured for each facility, an availability factor was applied to the generation estimates based on the percentage of time that the service connection historically operated. The availability factor was reduced an additional 4 percent to account for annual maintenance of the turbine equipment.

Average energy generation was estimated for each service connection based on average flow, differential head, and an assumed turbine-generator efficiency of 75 percent. For the purpose of this evaluation, the net head was equated to the differential head at the service connection control valve. Net head at the turbine was determined as the upstream hydraulic grade line (HGL) at the turnout facility, minus the required HGL downstream of the turbine, minus piping head loss between the turnout and turbine.

10.4.2.3 Financial Analysis

A preliminary financial analysis was conducted to determine the best candidate sites. It was assumed that potential energy generation would be sold to the grid due to lack of energy demand onsite. SDG&E rates were obtained to determine the estimated annual revenue. Energy rates were based on California Public Utility Commission Resolution E-4298, adopting Market Price Referent Values for use in the 2009 RPS solicitations. The total generation output is purchased based on the Market-Price-Referent (MPR), Time of Use (TOU) Periods, and Energy Allocation Factors. The MPR defines the unit price ($/kWh) at which the energy is purchased. The TOU Periods are associated with periods of the day/night and seasons and are defined as On-Peak, Semi-Peak, and Off-Peak. Based on the TOU Period, the generation output is assigned an energy allocation factor. The energy allocation factors indicate the relative value of energy during the defined period and are multiplied by the MPR to obtain actual energy rates for the TOU Period. For purposes of this evaluation, the applicable energy rates were based on the TOU Periods and assumed a contract period of 20 years at the 2012 MPR of $0.10898/kWh.

The average energy generation for a representative year was estimated for each facility based on average discharge, net head, representative turbine efficiency, and the assumption that the facility would operate consistently throughout the day and year. The power output was applied to TOU Period Energy Allocation Factors (and resulting energy rates) and the corresponding number of days in the season within a representative year to determine the potential annual energy revenue.

Total project costs were developed based on recent project experience and literature review. Costs for turbines including installation are shown in Table 10-5. Remaining construction costs include electrical, instrumentation and control, connection to the grid and coordination with SDG&E, structure, piping modifications, and site work. A contingency of 50 percent was used based on the Water Authority's Cost Estimating Guidelines.

A net present worth analysis was completed for each facility to evaluate the present worth of the energy revenues and project capital costs, and determine the payback period for the project. To determine the net revenue, the annual operations and maintenance (O&M) costs were subtracted from the annual potential energy revenue. The estimated O&M cost for turbines was $0.006/kWh. A present worth discount factor of 2 percent and an annual escalation rate of 3 percent were used in the economic evaluation. Facilities with a payback period of greater than 25 years were considered to be not feasible based on a typical life cycle of a turbine of 25 years. The financial analysis results (arranged by payback period) are presented in Table 10-7.

TABLE 10-7
Financial Analysis Results

Facility	Capital Cost	Availability	Payback	Estimated Generation (MW/year)	Annual Revenue
Facilities with Near-Term Potential					
Crossover Pipeline (Terminal Structure)	$2,310,000	83%	6	3,600	$386,900
Otay 12 FCF	$1,370,000	90%	7	1,800	$190,900
Oceanside 6 FCF	$1,260,000	96%	7	1,700	$183,700
San Diego 5B FCF*	$1,190,000	78%	10	1,200	$131,900
Oceanside 5 FCF	$980,000	93%	11	900	$101,600
San Diego 14 FCF	$990,000	81%	13	800	$90,600
San Diego 5A FCF[1]	$1,080,000	67%	14	900	$94,800
Carlsbad 5	$915,000	96%	17	640	$69,800
National City/South Bay 4 FCF	$2,650,000	34%	19	1,700	$181,200
Otay 11 FCF	$930,000	57%	24	500	$54,300
Vallecitos 2 FCF	$1,160,000	41%	NF	NF	NF
San Diego 5C FCF	$880,000	49%	NF	NF	NF
Escondido 3 FCF	$1,030,000	24%	NF	NF	NF
National City/South Bay 1 FCF	$2,050,000	16%	NF	NF	NF
Facilities as Part of Future Potential Work					
Twin Oaks Valley WTP 1 (Pipeline 6)	$16,220,000	96%	3	38,900	$4,236,600
Twin Oaks Valley WTP 1 (Flow Regulatory Storage)	$6,440,000	96%	3	16,500	$1,800,000

NF = Not Feasible (payback period greater than 25 years)
*The existing Miramar Hydroelectric Facility combines flow from the SD5A and SD5B FCFs.

The preliminary financial analysis suggests there are several candidate sites that may provide a positive payback on the initial investment. Six of the candidate sites, with a potential total power output of 2,100 kW, are at existing service connections and control structures, and include the connections serving the Miramar and Alvarado WTPs, where hydroelectric generators were previously in operation but have since been removed from service due to changes in hydraulic parameters or equipment failure. Renovation of the existing generators or replacement with new higher-efficiency hydroelectric generating equipment is proposed at these two locations. The other candidate site, with a potential power output of 2,000 kW, is located at a future control structure associated with the proposed System Storage project at the Twin Oaks Diversion Structure.

It is recommended that additional studies for the more favorable candidate sites be completed to confirm feasibility and economic returns. The additional studies would include a more detailed hydraulic analysis based on available head and flow within the aqueduct system as well as downstream elevation requirements within the member agency distribution system. Desired operation schemes should be included in the analysis. Flow duration curves should be developed to determine the desired design flow for the turbine. Manufacturers should be contacted to obtain equipment quotes for more accurate economic analysis.

10.4.3 Solar

10.4.3.1 Overview

The Water Authority has photovoltaic solar panels at the Administration Office, Escondido Operations Center, and Twin Oaks Valley WTP. These solar facilities are owned and operated by Borrego Solar Systems through a 20-year PPA. The Water Authority has an option to purchase these facilities and continue to operate them at the end of the contract or have Borrego Solar remove the facilities. If the Water Authority elects to continue operation of the solar panels after the end of the contract, some routine maintenance and replacement of solar panels would be required. Also, the contract and price structure agreement with SDG&E would need to be renewed.

The Water Authority has identified various solar opportunities to supplement its renewable energy portfolio, similar to the solar panels installed at the Twin Oaks Valley WTP.

For new solar energy projects, the Water Authority is limited in the amount of land available to install photovoltaic solar panels. The Water Authority owns land at the Olivenhain Reservoir that may be suitable for a solar facility. In this case, the solar panels would be floated on the reservoir surface with connection back to land for electrical power transmission. This approach has not been demonstrated commercially on a scale suitable to assess project viability and, therefore, carries a high risk factor. Some concerns with this approach include operational interference with water management, O&M of the solar facilities, water quality, and visual impacts. One example of small-scale floating solar panel is at the Far Niente winery in Napa Valley, California. Large-scale floating solar panels on water reservoirs have been planned for a Singapore project, but not implemented.

10.4.3.2 Feasibility

Continuing use of photovoltaic solar panels at the Administration Office, Escondido Operations Center, and Twin Oaks Valley WTP is a feasible option for the Water Authority. Ultimate ownership and operation of the solar panels at the end of the PPA is also feasible depending on the market conditions and whether SDG&E implements grid connection fees for net metering. The current rate structure may not be available or economically attractive in the future if SDG&E eliminates net energy metering. Due to the limited land available, new large solar projects for the Water Authority do not appear to be feasible. However, indirect purchase of solar energy from other entities could be an option to implement new solar generation.

10.4.4 Wind

10.4.4.1 Overview

The Water Authority does not have any existing wind power facilities. For new wind power projects, the Water Authority is limited in the amount of land available to install wind farms. In addition, San Diego County has lower wind velocities and durations, and projects would require extensive permitting and have more visual impacts.

10.4.4.2 Feasibility

Due to the limited land available, new wind projects for the Water Authority do not appear to be feasible. However, indirect purchase of wind energy from other entities could be an option. Offsite wind farms could be developed in conjunction with other parties, and the Water Authority could take a percentage of the output from a larger wind farm located in an area more suitable to maximize generation from wind resources, or the Water Authority could enter into a PPA with a wind developer.

10.5 Funding Options

Several funding options are available through local, state, and federal government for various renewable energy programs and projects. Potential funding options including low interest loans, grants, incentives, and rebates available to the Water Authority for renewable energy are summarized in this section. These funding options will reduce the project costs on the investment in energy development projects.

10.5.1 Low Interest Loans

The California Energy Commission (CEC) has received funding from the federal government as part the American Recovery and Reinvestment Act (ARRA). This funding makes available low interest loans or grants for several different programs: Clean Energy Business Financing Program, Energy Conservation Assistance Act, and Energy Efficiency Block Grant Program. Many of these programs currently have funding committed to projects or have expired. Legislation may renew funding for these or similar programs in the future.

- Clean Energy Business Financing Program – Low interest loans from $0.5 million to $5 million are available to expand existing or retool facilities for energy efficiency or renewable energy.
- Energy Conservation Assistance Act – Three percent interest loans are available for energy efficient projects including pumps and motors, and renewable energy generation projects. The energy savings payback period must be 15 years or less.

10.5.2 Grants

Grants have historically been available through local, state, and federal governmental agencies for various renewable energy programs and projects.

- **Local Grants –** Currently, there are no local governmental agency grants for renewable energy programs or projects that meet eligibility requirements for the Water Authority. In the future, there may be other opportunities for local grants.
- **California State Grants –** The Water Authority took advantage of the solar rebates offered by state grants that provided funding for new solar energy projects completed by July 31, 2011. The grants were acquired by Borrego Solar as part of its agreement with the Water Authority that ultimately reduced the cost to the Water Authority for installation of solar energy panels at the Administration Office, Escondido Operation Center, and the Twin Oaks Valley WTP. Currently, no state grants are available for renewable energy programs or projects that meet eligibility requirements for the Water Authority. In the future, there may be other opportunities for state grants.
- **Federal Grants –** Through ARRA funding, the federal government made available renewable energy grants for renewable energy projects that began construction by December 31, 2011. This program provided federal grants for renewable energy projects such as hydroelectric, solar, wind, and others for commercial users. Grants typically equal 10 to 30 percent of the cost of the property for hydroelectric, solar, wind, and others. Legislation may renew funding for these or similar programs in the future.

10.5.3 Incentives and Rebates

The following are incentive and rebate programs offered by various governmental agencies for renewable energy programs and projects that meet eligibility requirements for the Water Authority.

- Self-Generation Incentive Program – The California Public Utilities Commission (CPUC) has a program for incentives for implementation of self-energy generation projects. Types of projects include turbine, wind, and advanced energy storage (pumped storage), among others. This program is intended for all sectors including commercial and governmental agencies. Wind rebates are currently set at $1.25/watt; turbines at $0.50/watt; and advanced energy storage at $2.00/watt. Incentives are limited up to 3 MW with a reduced incentive scale (0 to 1 MW = 100 percent; 1 to 2 MW = 50 percent; and 2 to 3 MW = 25 percent). This program is in effect through January 1, 2016. Recently, CPUC expanded the program to include in-conduit hydroelectric projects with up to $5 million in incentives.
- Energy Efficiency Business Rebates – SDG&E has a program for businesses to receive rebates for energy efficient systems. This program is intended for commercial users and includes water utilities such as the Water Authority. Several incentives exist that the Water Authority could pursue including the following:
  - Cool Planet Rebate – rebate of $15,000 for energy savings of 500,000 kW
  - Lighting – various rebates for reduced energy use for lighting
  - Motors and Variable Frequency Drives – up to $2,000 per motor and $80 per horsepower (HP) for variable frequency drive

  These rebates could be received in new or upgraded facilities.

- Emerging Renewables Program – The CEC has a program for incentives for implementation of emerging renewable energy including small wind (50 kW or less) and fuel cell (30 kW or less). This program is intended for small commercial users. Small wind rebates are currently set at $3/watt for the first 10 kW and $1.50/watt for 10 to 30 kW.
- California Solar Initiative – This program is a rebate, either through a performance-based incentive paid for actual generation over a five-year period or an expected performance based on buy-down incentive, which is a single payment when the project is brought online. These programs started in 2007, and the incentive is reduced each year as the aggregated capacity of solar photovoltaic increases in each region. The rebates are administered by the California Center for Sustainable Energy within SDG&E's service area. Current rebate amounts can be found at www.csi-trigger.com.
- Modified Accelerated Cost Recovery System – This program allows businesses to recover investments in fuel cells, wind, and solar, among other renewable energy technologies, by allowing these investments to be fully depreciated on a five-year timeline. The Water Authority would need to partner with a tax equity investor to capitalize on this incentive, for example through entering into a PPA.
- United States Department of Energy (DoE) Renewable Energy Production Incentives (REPI) – Originally authorized in 1992, the REPI program was renewed by the Energy Policy Act of 2005 to be extended until 2026. The program provides payments of 1.5 cents per kWh of generation every year for a period of 10 years. Eligible facilities must begin generation prior to October 1, 2016. Wind, solar, and fuel cells operating on biogas are eligible. However, funding is allocated on an annual basis, and since 2003, the program has been under-funded.

10.6 Energy Management

10.6.1 Energy Management Policy

The Water Authority recognizes the importance of managing energy use and generation, particularly in light of potential impacts due to climate change and GHG emissions. In response, the Board adopted an Energy Management Policy, which is intended to provide direction in the implementation and administration of energy efficiency projects and programs. The Energy Management Policy also addresses consideration of cost-effective energy generation at existing and planned facilities. As new energy consumption increases to meet future increased demands, energy management and adherence to the energy policies will continue to be a major focus.

The State of California has adopted policies and goals to reduce human emissions of GHGs. The Water Authority, as a local government agency, has voluntarily developed a CAP, a GHG reduction plan, in conjunction with this 2013 Master Plan Update. The Water Authority is one of the first local agencies to develop a CAP, which identifies emission reduction strategies consistent with statewide goals for attainment by the year 2020. The CAP allows the Water Authority to look at agency-wide emissions and utilize its unique resources to reduce those emissions.

The Water Authority understands that changing climate conditions have significant implications for long-term water supply, resilient facilities planning, and the need for energy efficiency and water supply adaptations. Development of a CAP is a part of the Water Authority's commitment to energy efficiency and its contribution to attainment of statewide goals for GHG reductions.

10.6.2 Strategies for Future Energy Management

The Water Authority is committed to continued focus on future energy management of existing and future infrastructure facilities. Suggested additional energy strategies for energy management include the following:

1. Minimize energy use at existing facilities to the extent practical.
2. Optimize energy use at pumping stations through best TOU operation.
3. Maximize development of renewable energy generation to offset energy use.
4. Increase use of in-conduit hydroelectric generation to harness otherwise lost energy.
5. Continue operation of solar facilities at the Twin Oaks Valley WTP, Administration Office, and Escondido Operations Center after expiration of the PPA depending on market conditions and whether SDG&E implements grid connection fees for net metering.

10.6.3 Recommended Additional Studies

Based on the energy management analysis conducted and presented in this chapter, additional studies are recommended to further detail the feasibility of various renewable energy projects.

- Conduct further planning level feasibility and economic evaluations of select in-conduit hydroelectric facilities determined in this report to have a positive payback period. Possible facilities for further evaluation include the following:
  - Oceanside 6 FCF
  - Twin Oaks Valley Flow Regulatory Structure
  - Crossover Pipeline Terminal Structure
  - Miramar Hydroelectric Facility Re-Power
  - Alvarado Hydroelectric Facility Re-Power
  - Otay 12 FCF
  - Carlsbad 5 FCF
- Continued evaluation of a large-scale pumped storage operation at San Vicente Reservoir.
- Evaluation of continued use of solar power at the Twin Oaks Valley WTP, Administration Office, and Escondido Operations Center after the PPA has expired. A sinking fund could be established to budget for Water Authority purchase of the solar power facilities at the cost indicated in the PPA at the end of the contract.
- Continued tracking of GHG emissions and budgeting appropriate funding for future impacts of the cap and trade program recently implemented by the state of California for existing facilities and planned 2013 Master Plan facilities.

Chapter 11.0 Summary, Conclusions, and Recommendations

11.1 Overview

The 2013 Regional Water Facilities Optimization and Master Plan Update provided a comprehensive evaluation of future infrastructure needs based on recent projections of water supplies and demands. The 2013 Master Plan also considered system improvements necessary for the safe and reliable operation of the aqueduct system and identified risk areas where the future improvements may be needed to assure continuous operation following natural or manmade events that interrupt water deliveries to the member agencies. Lastly, the 2013 Master Plan evaluated opportunities for development of renewable energy resources that could provide a new revenue source and mitigate greenhouse emissions. Results from these evaluations have shown that while the Water Authority's system of conveyance, treatment, and storage facilities is robust, new infrastructure improvements will be needed to alleviate potential conveyance constraints and supply shortages resulting from projected demand increases as the region's population grows throughout the 20-year planning horizon of the 2013 Master Plan.

Figure 11-1 shows the overall 2013 Master Plan process and the associated chapters. Highlighted in Figure 11-1 are the elements described in this *Summary, Conclusions, and Recommendations* chapter (Chapter 11).

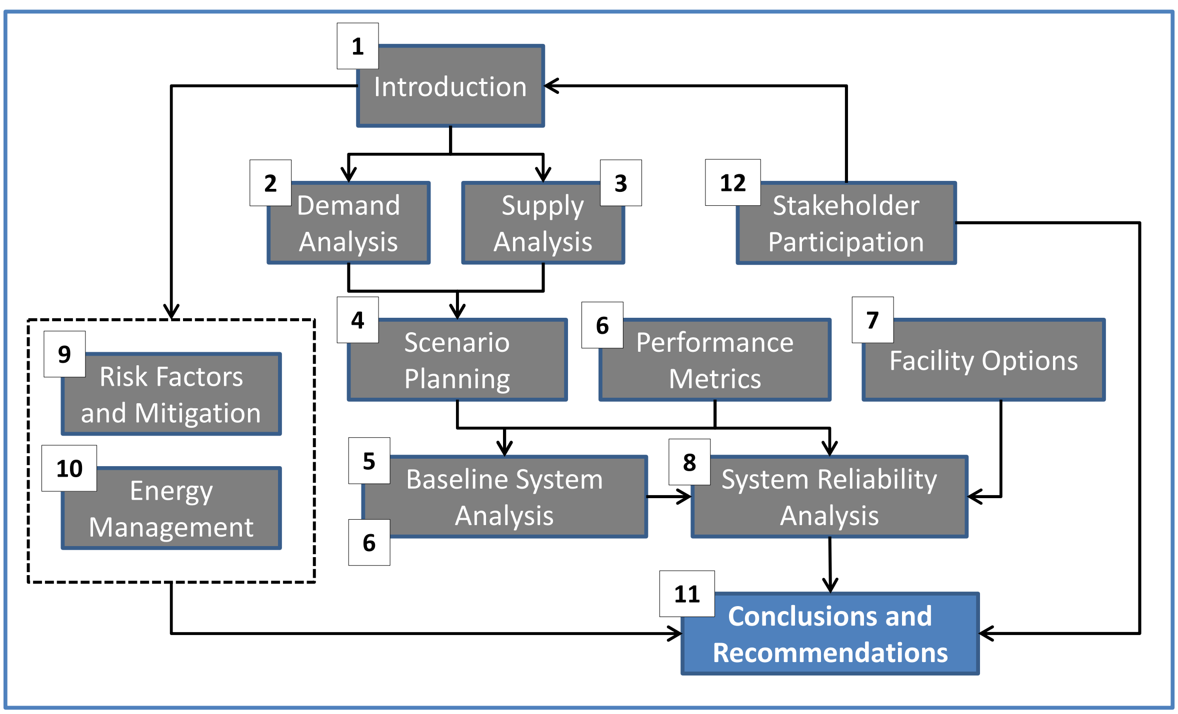


FIGURE 11-1
Relationships between 2013 Master Plan Chapters and Planning Process

11.2 Summary of Planning Process

The planning process followed by the 2013 Master Plan assures that the scope and timing for newly proposed projects, as well as the scope and timing for projects in the current CIP, are optimized with recent infrastructure investments made by the Water Authority and its member agencies. A comprehensive review and analysis of the Water Authority's existing aqueduct system and its ability to meet future demands for the San Diego region was also part of the 2013 Master Plan process. Key elements of the planning process, leading to the evaluation and screening of proposed new infrastructure projects, include an analysis of projected supplies and demands, the development of planning scenarios that bracket a plausible range of future supply and demand outcomes, the selection of infrastructure evaluation metrics and performance thresholds, and the evaluation of the current aqueduct system.

11.2.1 Supply and Demand Analysis

The supply and demand analyses included in the 2013 Master Plan, as discussed in *Chapter 2 – Regional Demand Analysis* and *Chapter 3 – Regional Supply Analysis*, are based on projections included in the 2010 UWMP. These projections were refined in the 2013 Master Plan to develop daily demand patterns unique to each member agency and to apply historical hydrological data to better assess surface water supplies and local storage operations. Planning scenarios, also consistent with the 2010 UWMP, were developed to consider variations for local supply development, conservation savings, imported water supplies, and climate change impacts. The planning scenarios, discussed in *Chapter 4 – Scenario Planning*, assume imported supplies from MWD are reliable for normal and single dry-year demand patterns. However, for a multiple dry-year pattern, MWD supplies are assumed to be restricted in accordance with MWD's preferential rights allocation. When imported supplies are restricted to preferential rights, a performance gap will occur between available supplies and projected demands.

The planning scenarios also considered impacts from additional local supply development, such as the City of San Diego's proposed DPR/IPR project and the Otay Water District's Rosarito Beach Seawater Desalination Project. Finally, the planning scenarios reviewed potential impacts on demand resulting from preliminary Series 13 demographic forecasts by SANDAG, which may result in a slightly lower demand profile for the region.

11.2.2 System Reliability Evaluation

The evaluation of system reliability, beginning with the Baseline System described in *Chapter 5 – Description of Baseline System and CIP Projects Considered in the Master Plan*, was accomplished using a computer simulation model that processes member agency normal and peak demands on conveyance, treatment plant utilization, reservoir operations, and overall system response based on historical operations or system design. Modeling results were evaluated against performance metrics that include Delivery Reliability, Conveyance Usage, WTP Utilization, Energy Usage, Storage Utilization, and Supply Diversification. As shown in *Chapter 6 – Baseline System Reliability*, two of the more strategic metrics include delivery reliability (expressed as an annual system shortage threshold) and conveyance utilization, which provided the basis for determining when additional new water supplies or added conveyance capacity may be required to offset projected supply-demand gaps. The threshold values, summarized in Table 11-1, were established to strike a reasonable balance between infrastructure needs, expected system operations, computer modeling capabilities, and extreme weather events that may be more appropriately addressed through discrete management actions, such as invoking drought response actions included in the Water Authority's *Water Shortage and Drought Response Plan* (Water Authority, 2013c). A sensitivity analysis on the threshold values was also conducted to further justify modeling results and risk potentials.

TABLE 11-1
Delivery Reliability and Conveyance Utilization Evaluation Metrics

Metric	Threshold	Basis for Threshold
Delivery Reliability	Annual system shortage of 20 TAF, two consecutive years. Sensitivity range up to 50 TAF.	Shortage of 20 TAF mitigated by management actions, and would not provide a basis for new supply development.
Conveyance Utilization	Conveyance at 95 percent capacity for 15 sequential days/45 peak season days, two consecutive years. Sensitivity range to 120 days.	System may not meet peak demands or refill storage if conveyance utilization exceeds threshold durations.

11.2.3 Projects and Portfolios

Project options and portfolios were developed early in the planning process to provide different strategies to alleviate performance gaps. New and existing projects are described in *Chapter 7 – Project Options and Portfolios* to resolve the critical conveyance constraints and supply-demand gaps. Infrastructure development was also focused on assuring timely completion of the Emergency Storage Project and appropriate implementation of the remaining projects in the current CIP. Other projects were developed to improve operations, reduce risk (*Chapter 9 – Risk Factors and Mitigation*), manage energy usage, and identify renewable energy development opportunities (*Chapter 10 – Energy Management Analysis*). The identified projects were combined into portfolios and evaluated using the computer simulation model. Modeling results provided an analysis of proposed system improvements on system shortcomings (*Chapter 8 – System Reliability with Facility Options*).

A series of workshops and meetings were conducted with the project stakeholders (Chapter 12 – *Stakeholder Participation*) to solicit input, guidance, and acceptance of the strategies employed to plan recommended future improvements.

11.3 Anticipating an Uncertain Future

The Water Authority must maximize value on its future investments. As the water wholesaler serving the San Diego region, the Water Authority must also assure sustainable investments that require a focus on managing aggregate risk exposure. While the planning process for this report has attempted to identify the best and most plausible range of future outcomes, there still exists a significant level of uncertainty on how the many combinations of supplies, demands, and facilities will actually come together in the future, presenting an inherent risk associated with long-term planning. It is understood that maximizing facility investments would cover a wider range of future demand conditions, but the cost for a lower-risk exposure could be prohibitive. This 2013 Master Plan worked through a process for optimizing water facilities and maximizing the probability of the Water Authority's success in the right sizing and timing of facilities. The process involved a methodical and transparent approach to evaluating uncertainty that included defining critical needs, identifying evolving member agency programs, and working through scenario planning to address a range of plausible future conditions.

With anticipated population growth over the next several decades, the water demand is expected to rise considerably, although at a slower rate resulting from continued conservation and compliance with state-mandated per capita use reductions. While outreach and conservation efforts have made the public more aware of their water use, the Water Authority must continue to plan ahead to ensure that a reliable water supply is available to meet all demands. It is critical that water continues to be made available to the San Diego region in the event of an interruption in imported water deliveries.

Uncertainties with the water portfolio for the region include the ongoing environmental and conservation challenges in the Bay Delta, the probability of member agency implementation of local supply development projects, and the aging infrastructure that comprises the existing distribution system. The system is also susceptible to the vulnerabilities and risk from natural disasters. The Water Authority is aware of these uncertainties and, with the process followed in preparing this 2013 Master Plan, has been proactive in developing a strategy to accommodate the range of potential challenges and risks.

11.4 Conclusions

As noted previously, the aqueduct system is comprised of a robust system of pipelines, reservoirs, pump stations, and treatment facilities. Recent investments developing increased storage at the San Vicente Reservoir, new treatment facilities at the Twin Oaks Valley WTP, and a new drought-proof local supply from the Carlsbad Desalination Project further bolster regional supply reliability. With the addition of these new facilities, along with planned near-term investments under the Water Authority's Asset Management Program that will maintain the service life of existing facilities, the aqueduct system is fully capable of meeting regional demands through the mid-2020s. However, going beyond this timeframe, there is limited operational flexibility to meet peak demands for untreated water supplies. Specific conclusions and observations regarding performance of the Water Authority aqueduct system are provided in the following subsections.

11.4.1 Delivery Reliability

Delivery Reliability is a measurement of the frequency and magnitude of regional supply shortages that may occur as a result of insufficient supply, extreme dry weather demands, or constraints in the aqueduct system. The following conclusions are based on a Delivery Reliability threshold allowing for an annual supply shortfall of 20 TAF or less:

- Under normal and wet weather patterns, there is a very low occurrence of supply-demand gaps through 2035. During multiple dry-year weather patterns, when imported supplies are assumed to be restricted to MWD preferential rights, supply-demands gaps will likely occur.

- Under planning scenarios that place a higher reliance on the Water Authority aqueduct system to meet regional demands, supply-demand gaps are more likely to occur beginning in 2025. Under these scenarios, additional supply development would be needed before the end of the 2035 planning horizon.
- The frequency and magnitude of supply-demand gaps under all planning scenarios is strongly influenced by member agency achievement of local supply development and conservation saving goals. Additional local supply development, such as the City of San Diego's proposed DPR/IPR project and the Otay Water District's Rosarito Beach seawater desalination project, would essentially alleviate supply-demand gaps that occur near the end of the planning horizon.
- Regulatory restrictions on imported water supplies were not considered in the planning process but could further erode supply reliability.
- All four portfolios will reduce the occurrence of supply shortages. The North and East conveyance portfolios provide additional supplies during wet and normal years to improve system reliability but do not significantly alleviate shortages during multiple-year dry weather patterns. The Storage portfolio would delay the need for new supply development by one to two years but would otherwise not reduce the occurrence of supply shortages. The West supply portfolio provides a new supply source that will significantly reduce supply shortage under all hydrologic conditions.

11.4.2 Conveyance Constraints

The treated and untreated water conveyance systems were separately analyzed, with the member agency allocation of these sources based on the relatively recent expansions of local WTPs. The expansion of local treatment plants has placed a greater emphasis on untreated water conveyance. The following conclusions are based on a conveyance utilization threshold that operates the aqueduct pipelines at 95 percent of capacity for 45 days during the peak summer season.

- Treated water conveyance capacity is adequate to meet all current and projected demands through 2035.
- An untreated water conveyance constraint currently exists at the existing 30-inch Pipeline 3/Pipeline 4 interconnection at Lake Murray. This constraint may limit the ability to meet peak demands for the Perdue and Lower Otay WTPs.
- Under all supply-demand scenarios, a future untreated water conveyance constraint will occur between 2020 and 2025 at the MWD Delivery Point that will constrain peak deliveries to local WTPs. Except for the high-demand scenario, the Pipeline 3/Pipeline 4 Conversion project will reduce the occurrence of exceeding the delivery reliability to acceptable levels. Under the high-demand scenario, additional conveyance capacity may be required.
- Under the higher supply-demand scenarios, a future untreated water conveyance constraint may occur at the Crossover Pipeline between 2030 and 2035.
- Prior to the implementation of improvements that will alleviate a conveyance constraint, coordination with the member agencies to reduce peak delivery requirements and use of

Water Authority-owned seasonal storage pools will be necessary to mitigate the impacts of exceeding the conveyance utilization threshold.

- All four portfolios will reduce the occurrence of conveyance constraints. The North and East portfolios provide new imported water conveyance capacity that directly addresses conveyance-related constraints. The West portfolio, while not providing new imported conveyance, develops a new local supply that frees capacity in the existing aqueduct pipelines. The Storage portfolio, while providing marginal benefit to reducing the occurrence of conveyance constraints, does not lower the risk to acceptable levels.

11.4.3 System Storage Utilization

System storage is used to mitigate peak demands on the Water Authority's aqueduct system. Efficient use of system storage prevents peak flow delivery constraints, optimizes system operations, and assures timely implementation of system improvements. Both in-region and out-of-region storage were evaluated to reach the following conclusions:

- The use of existing Water Authority-owned storage to provide a seasonal storage pool is required to alleviate peak untreated delivery conveyance constraints. On average, seasonal storage use will vary between 40 and 50 TAF.
- Drawdown of the carryover storage pool at San Vicente Reservoir will help mitigate supply-demand gaps during multi-year dry weather periods and delay the need for new supply development. Annual drawdown for carryover use ranges from 30 to 35 TAF.
- While an increase in regional storage (either though development of new storage or coordinated operation of existing storage facilities) will further alleviate multi-year dry weather impacts, additional imported water conveyance capacity would be required to fully optimize reservoir filling and drawdown needs.

11.4.4 Operational Flexibility

The CIP contains a number of remaining projects that will improve system operations and assure continued reliable operation of the existing aqueduct system. The 2013 Master Plan included an evaluation of these remaining CIP projects to assure improvements are implemented to match recent estimates for regional supplies and demands.

- Completion of the ESP is needed to assure supply reliability throughout the Water Authority service area. The remaining ESP projects include the North County ESP Pump Station (to serve the northern reaches of the Water Authority service area) and the San Vicente Pump Station 3rd Pump Drive and Power Supply (allows for use of the full design capacity of this pump station). Opportunities for phased implementation of the remaining ESP projects will allow project development to match current and future ESP demands.
- Except as noted as follows, completion of the remaining CIP projects in the Water Authority's fiscal year 2015 budget will assure operational reliability. The timing and scope of certain CIP projects should be re-assessed to better align with current and projected demand profiles. Three existing projects may be deleted from the CIP as result

of lower demands: SD12 FCF expansion, SD24 FCF, and Evaluation of the LSME Pipeline.

- Delivery reliability is predicated on continued functionality of all components of the existing aqueduct system through the 2035 planning period and beyond. Maintaining or extending facility service life through the Asset Management Program should be emphasized.

11.4.5 System Vulnerability

A system vulnerability assessment was performed as part of this study. This assessment identified a number of potential vulnerabilities that should be further investigated to confirm the condition and operability of a number of facilities following extreme events such as fires, earthquakes, and power outages.

- Installation of system isolation valves at strategic locations will reduce member agency supply disruptions during both planned and unplanned shutdowns of the aqueduct system.

11.4.6 Energy Management

A strong nexus exists between energy use and the conveyance and treatment of water supplies. While overall energy consumption by the Water Authority is relatively low compared to the quantity of water delivered by the aqueduct system, energy use will continue to grow.

- In-line hydroelectric generation opportunities exist at multiple locations within the aqueduct system. Approximately 2 MW of new hydroelectric power may be developed with favorable payback terms. In-line hydroelectric generation will neither impact water operations nor effect current member agency delivery regimes.

11.5 Recommendations

The results and conclusions from the planning process have provided a distinct time-related separation for the implementation of new improvements that are required to assure system reliability. A near-term timeframe can be established out to the year 2025 for implementation of projects that will address conveyance constraints and operational improvements. Supply-related concerns do not occur until after 2025. As a result, the recommendations for new facilities are categorized as either near- or long-term projects.

It is important to note that the 2013 Master Plan is considered the first step in identifying improvements that are needed to assure system reliability. The project descriptions provided in the 2013 Master Plan included sufficient detail to determine a reasonable range of project costs and a timeframe for implementation. The projects recommended in the 2013 Master Plan will require follow-up planning-level and pre-design studies to provide further project definition, refine cost and schedule estimates, and confirm integration requirements compatible with existing aqueduct system components.

11.5.1 Recommendations for Near-Term Projects

The near-term projects include improvements that are to be considered for implementation prior to 2025. These projects are needed to alleviate a near-term constraint or assure timely completion of needed system improvements included in the existing CIP. The near-term projects also include planning initiatives that will evaluate potential system vulnerabilities, water quality concerns, and the potential for new hydroelectric development. It is recommended that the following projects be approved for further evaluation to determine project sizing and confirm implementation timeframe. The anticipated implementation timeframe for each project is summarized in Table 11-2.

- **Pipeline 3/Pipeline 4 Conversion** (New Project): This project will alleviate the potential untreated water conveyance constraint at the MWD Delivery Point. The project will increase untreated water conveyance capacity in the Second Aqueduct north of Twin Oaks Valley by converting an existing segment of Pipeline 4 to untreated water service and converting an existing parallel segment of Pipeline 3 to treated water service. Total untreated water delivery capacity would increase by 190 cfs. Coordination with MWD is required to determine new infrastructure requirements outside the Water Authority service area that will facilitate the conversion of Pipelines 3 and 4.

- **North County ESP Pump Station** (Existing Project): This project consists of a new 30 cfs pump station to deliver treated water to the northern reaches of the Water Authority service when supplies from MWD are interrupted. Project location and pumping capacity is dependent on implementation of the Pipeline 3/Pipeline 4 Conversion project.

- **Mission Trails Projects** (Existing Project): This project will alleviate the existing untreated water conveyance constraint south of Lake Murray. The project provides regulatory storage for improved aqueduct operations and increases untreated water conveyance capacity for deliveries to south county WTPs. The project includes a new storage facility sized up to 12 MG, flow control valve structure, and connections to the completed Mission Trails Tunnel project. An alternative to this project would be constructing a new interconnection or placing the existing Flow Balancing Structure back in service, both which would only address the conveyance constraint south of Lake Murray.

- **ESP San Vicente 3rd Pump and Power Supply** (Existing Project): This project provides station upgrades and a new power supply to allow operation of the existing pump station at full design capacity. The project is needed to fully utilize an expanded San Vicente Reservoir for emergency storage operation and provide operational flexibility to deliver additional supply from the reservoir to meet peak seasonal demands. New power supply options include a new 12 kV overhead circuit or onsite power generation using diesel- or natural gas-powered generator sets.

- **System Isolation Valves** (New Project): This project allows for more efficient isolation of segments of the aqueduct system to perform required inspections, maintenance, and repair work and isolates segments of the aqueduct system during low flow periods to address potential water quality concerns. High-risk areas generally include river and stream crossings, lake crossings, and other areas where damage may result from a seismic or flood event.

- **System Storage** (Existing Project): This project provides new regulatory storage to manage daily flow changes and unanticipated flow interruptions. The project includes two possible locations: at the Twin Oaks Diversion Structure (sized 10 to 20 million gallons) and at the First Aqueduct/Valley Center Pipeline connection (sized 2 to 3 million gallons).
- **Facility Planning Studies** (New Project): This project includes new planning-level studies that would evaluate infrastructure requirements related to the assessment of water quality concerns and nitrification in the treated water system, system vulnerabilities at river and stream crossings resulting from flood and seismic events, and the evaluation of new in-line hydroelectric generation opportunities.

TABLE 11-2
Summary of Project Implementation Timeframe

Project	Implementation Timeframe
Pipeline 3/Pipeline 4 Conversion	2020–2025
North County ESP Pump Station	2015–2020
Mission Trails Projects	2015–2025
ESP San Vicente 3rd Pump and Power Supply	2020–2025
System Isolation Valves	2015–2025
System Storage	2020–2025
Facility Planning Studies	2015–2020

11.5.2 Recommendations for Long-Term Projects

The long-term projects include improvements that are to be considered for implementation beyond the 2025 timeframe. These projects will significantly alleviate projected conveyance constraints or supply shortages that may occur towards the end of or beyond the 2013 Master Plan planning horizon. Given the long-term implementation needs, no specific action is recommended to proceed with immediate development of the long-term projects. Instead, the recommendations provide a course of action that allows for further evaluation of project feasibility and cost while monitoring various local and statewide water resource decisions that will affect local supply development and imported water supply reliability. As these local and statewide water resource decisions unfold, appropriate incremental actions regarding the long-term projects may be taken by the Water Authority. As an initial and prudent step that recognizes the complexity and duration required for the various project approvals, continuing to advance project feasibility and cost assessments of the long-term projects is critically important to achieving long-term system reliability.

- **Camp Pendleton Desalination Project (Supply from the West):** This project will provide a new water supply of up to 150 mgd and involves construction of a seawater desalination plant on MCB Camp Pendleton property, intake and discharge facilities connected to the plant, and the associated pipeline and pumping facilities that would convey the product water to the Second Aqueduct. Two sites within the MCB have been approved for further evaluation.

Recommendation: Continue with the next phase of project evaluation and conduct pilot plant testing of seawater RO treatment technologies. The duration for the pilot plant testing evaluations is 30 months. This phase of the project would also include discussions with Camp Pendleton related to preserving the approved sites for future development.

- **Colorado River Conveyance Facility (Conveyance from the East):** This project would provide a new conveyance facility to transport QSA supplies from the westerly terminus of the AAC directly to the San Vicente Reservoir. Depending on the alignment selected, facilities would include a combination of pipelines, tunnels, pump stations, forebays, power-generating facilities, pressure control facilities, transmission lines, and substations.

  Recommendation: Continue with monitoring of financial and legal matters related to the wheeling of QSA supplies through MWD's conveyance system. Further analysis of project feasibility to determine financial impacts, permitting requirements, interagency agreements, salinity concerns, system integration requirements, and impact on San Vicente Reservoir operations is not recommended at this time. These project feasibility concerns should be considered upon resolution of the financial and legal matters or with the next update of the 2013 Master Plan.

- **Pipeline 6 (Conveyance from the North):** This existing CIP project includes construction of a new conveyance facility that would provide up to 500 cfs of new untreated water delivery capacity. The project limits extend from the MWD delivery point to Twin Oaks Valley. Project alignment studies were complete jointly with MWD.

  Recommendation: Continue with monitoring of regional demands and local water supply development projects. Further analysis of the Pipeline 6 project is not recommended at this time. The existing CIP budget should be modified to reflect an implementation date beyond 2030.

- **Second Crossover Pipeline** (Existing Project): This project alleviates a potential untreated water conveyance constraint south of Twin Oaks that serves east county WTPs connected to the First Aqueduct.

  Recommendation: Continue with monitoring of untreated water capacity constraints. Further analysis of the Second Crossover Pipeline is not recommended at this time. The existing CIP budget should be modified to reflect an implementation date beyond 2030.

- **Enhancement of Storage Portfolio:** This 2013 Master Plan found that additional investments in conveyance capacity would need to be made to derive more benefits from increased regional storage. The value of storage will not diminish over time, and the additional benefits may be derived from future investments in the regional conveyance system.

Recommendation: Conduct detailed studies on optimized storage operations and regional storage coordination, and evaluate options and benefits of interconnecting of reservoirs.

11.6 Summary Conclusions and Limitations

Implementation of the near-term projects will result in significant reductions in vulnerabilities to the Water Authority's system related to potential conveyance constraints and supply shortages. Utilization of existing storage at the San Vicente Reservoir to meet peak seasonal delivery requirements will further alleviate conveyance constraints. Planning-related activities should continue on proposed improvements so they can be implemented prior to the timing of critical need. In addition, most system vulnerabilities are linked to the rate of demand growth in comparison to supply reliability. The sensitivity of option implementation across scenarios suggests that monitoring metrics and performance thresholds should be developed and regularly updated to assure the latest trends, demographics, and interagency coordination are considered.

Finally, the reliability analysis suggests that the elimination of all vulnerabilities is not possible. The ability of the Water Authority to deliver water to its member agencies can be affected by a number of uncontrollable events, including but not limited to prolonged drought, natural disasters, and court-ordered mandates following environmental and water rights litigation. The Water Authority and member agencies must continually balance the tradeoffs between improved reliability and the cost and appropriateness of new infrastructure investments. Concerted efforts by the Water Authority and its member agencies on water supply improvements, effective demand management measures, and optimizing regional infrastructure will contribute to improving reliability within and beyond the 2013 Master Plan.

Chapter 12.0 Stakeholder Participation

12.1 Overview

To be successful, the master planning process needs to take into account and be responsive to the views and opinions of the project stakeholders. Stakeholder participation has been a key element of the master planning process and assures regional water supply reliability goals are achieved. Stakeholder participation will continue as the Water Authority's planning process moves forward in an effort to encompass ever-changing regional needs and plans. The goals and objective for stakeholder participation include the following:

- Seek a common understanding of local and regional planning concerns
- Provide an opportunity to actively participate in developing a coordinated approach to regional infrastructure planning
- Optimize recent investments in both regional and member agency infrastructure
- Seek consensus on new regional infrastructure needs

Topics covered by this chapter are summarized in Table 12-1 and are described in more detail in the sections that follow.

TABLE 12-1
Overview of Stakeholder Participation Activities

Stakeholder Participation Component	Description
Master Plan Stakeholder Engagement	Early and continuing stakeholder engagement was provided to ensure the use of current and accurate information consistent with parallel planning efforts. Results and findings were communicated early to assess their validity and verify assumptions.
Intra-agency (Water Authority) Stakeholders	Staff from several Water Authority departments were actively involved in the master planning process through regularly held meetings of the Water Authority's Master Plan Project Team and through focused workshops to address model baseline data, the options development process, project analysis, and other topic-specific meetings.
Interagency (Member Agency) Stakeholders	Water Authority member agencies were kept informed through General Managers' meetings, Board meetings, and meetings with the Master Plan's TAC. A subcommittee of the TAC was formed to evaluate reservoir operations and opportunities for coordination.
Ongoing Stakeholder Participation	The 2010 UWMP involved extensive coordination and communication with the member agencies. As the 2010 UWMP is updated every five years, the 2013 Master Plan will be revisited in the light of new supply/demand projections.

Figure 12-1 shows the overall 2013 Master Plan process and the associated chapters. Highlighted in this figure are the elements described in this Stakeholder Participation chapter (Chapter 12).

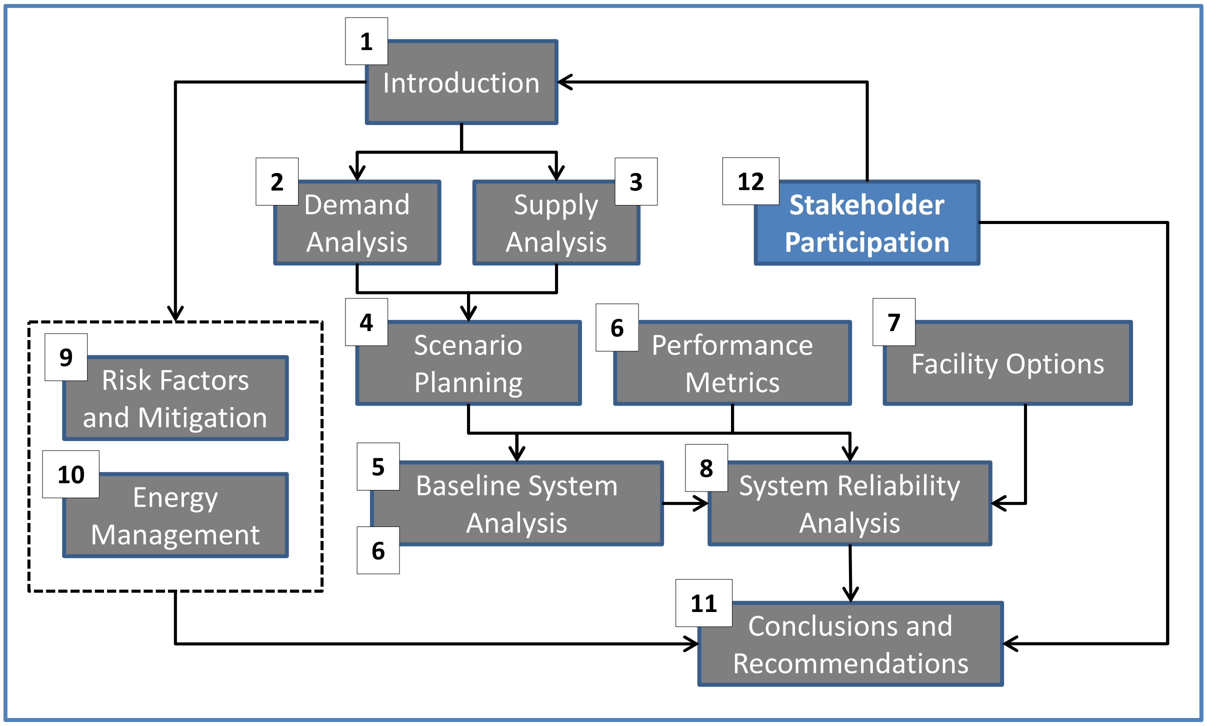


FIGURE 12-1
Relationships between 2013 Master Plan Chapters and Planning Process

12.2 2013 Master Plan Stakeholder Engagement

Development of the 2013 Master Plan included participation from a cross section of both Water Authority and member agency representatives. Engagement early on in the planning process was critical to 1) ensure that current and accurate data and information was used for the planning analyses, 2) identify parallel planning efforts that could influence the 2013 Master Plan analyses and recommendations, and 3) communicate the results from the metric and threshold analyses to assess their validity and verify assumptions.

The CEQA process for public review and comment on the documents prepared in support of the 2013 Master Plan will provide opportunities for public engagement. The public also had opportunities to participate in the process through comments at Board meetings. Key stakeholder meetings held in association with this 2013 Master Plan are summarized in Table 12-2.

12.2.1 Intra-agency (Water Authority) Stakeholders

Within the Water Authority, staff from appropriate departments were actively engaged in considering and reviewing elements of the master planning process. The Water Authority's Master Plan Project Team was led by staff from the Water Resources Department and included staff from the Departments of Engineering and Right of Way, Operations and Maintenance, and Public Affairs. Twelve Project Team meetings were held, on average, on a bimonthly or quarterly basis over the 2013 Master Plan development process.

Staff meetings and workshops provided opportunities for identification and discussion of key issues, clarification of assumptions, and decision making. Additional topic-specific meetings were held during the course of the project with various Water Authority staff to solicit input and discuss results, review conclusions and recommendations, and make significant decisions. The Water Authority staff was updated on the progress and status of the 2013 Master Plan at the Project Team meetings. Meetings were used to introduce and familiarize the team with both the methods for analyzing the system and the analysis results. Three workshops were conducted to discuss in detail topics such as the model baseline data, the options development process, and options analysis results.

12.2.2 Interagency (Member Agency) Stakeholders

The Water Authority's member agencies were kept informed throughout the 2013 Master Plan development process through several forums: General Managers' meetings, meetings and special workshops of the Board, and meetings with the Member Agency TAC, which consisted of technical staff representatives from self-selected member agencies. In addition, member agencies were invited to request individual meetings with Water Authority staff to discuss their unique concerns and perspectives, and such discussions were held as requested.

A Reservoir Coordination Subcommittee of the TAC was formed to consider whether there was interest on the part of the member agencies with surface storage to integrate operations to address regional storage needs. Through these discussions, current and planned member agency reservoir operations were verified for inclusion in the 2013 Master Plan system model. The conclusions of these discussions are presented in Section 3.4.4 of Chapter 3.

TABLE 12-2
Stakeholder Involvement in the Development of the 2013 Master Plan

Activity	Date
Water Planning Committee Board approval of CH2M HILL contract	December 9, 2010
Member Agency TAC meeting Process overview; request for input and data	September, 2011
Member Agency TAC meeting Discuss supply/demand scenarios and performance metrics	November, 2011
Water Planning Committee – Special Meeting Workshop on supply/demand scenarios and performance metrics	February 9, 2012
Water Planning Committee Incorporate Colorado River Conveyance option	March 22, 2012
Water Planning Committee – Workshop Planning for climate change	January 10, 2013
Water Planning Committee Status of key master planning issues	January 24, 2013
Member Agency TAC meeting Discuss initial master planning results	February, 2013

TABLE 12-2
Stakeholder Involvement in the Development of the 2013 Master Plan

Activity	Date
Water Planning Committee Assessment of preliminary results	February 28, 2013
Water Planning Committee – Special Meeting Workshop on stresses on the system, storage, and energy management	March 14, 2013
Member Agency TAC meeting Planning results analyzing TAC input	April 2013
Water Planning Committee Camp Pendleton and Colorado River Conveyance evaluations	April 25, 2013
Public Hearing Notice of Preparation Public Scoping Meeting	April 29, 2013
Water Planning Committee – Special Meeting Workshop on solutions for reliability of the Water Authority System – thresholds	May 16, 2013
Water Planning Committee Recommended near-term solutions	May 23, 2013
Member Agency TAC meeting Discuss facility options and portfolio recommendations	June, 2013
Water Planning Committee Discuss facility options and portfolio recommendations	June 27, 2013
Water Planning Committee – Special Meeting System needs and recommended projects	July 11, 2013
Water Planning Committee Approval of recommended projects for further evaluation under CEQA	July 25, 2013
Water Planning Committee Project evaluations and hydroelectric opportunities	August 22, 2013
Water Planning Committee – Special Meeting Workshop on Draft CAP and SPEIR	September 12, 2013
Water Planning Committee Master Plan Conclusions and schedule	September 26, 2013
Member Agency TAC meeting Discuss near- and long-term recommendations	October 10, 2013
Water Planning Committee CAP analysis results	October 24, 2013

12.3 Ongoing Stakeholder Participation

The 2010 UWMP, whose demand and supply projections served as the foundation for the 2013 Master Plan analyses, involved extensive coordination and communication with the member agencies and outreach to the general public. Urban water suppliers are required to update their UWMPs every five years in accordance with the Urban Water Management Planning Act of the Water Code.

The next UWMP update will be conducted in 2015 and will involve a similar stakeholder effort as was required for the previous UWMP. Once the revised demand and supply projections are prepared and the UWMP update is completed, the analyses conducted for the 2013 Master Plan can be revisited to reflect the revised UWMP supply and demand projections.

The coupling of these planning exercises can provide an opportunity for the Water Authority and stakeholders to evaluate the change in supplies and demands. This continued monitoring and coordination assures that previously identified or potential new projects are implemented at the right time. Continued coordination also provides the opportunity to confirm or modify the demand patterns as they change temporally or geographically during the intervening years following the completion of the 2013 Master Plan.

The continued participation of the Water Authority stakeholders in these regional planning activities will be critical to making informed and measured decisions about Water Authority system improvements or enhancements to continue to reliably serve the San Diego region.