Chapter Nine

Other Water Supplies

Proposed Site for Discontinued Desalination Pilot Project: Scattergood Generating Station

9.0 Overview

LADWP continually investigates potential water supplies that may diversify and expand the City of Los Angeles' water supply portfolio for improved reliability. LADWP has actively pursued or investigated various supply options including water transfers, water banking, brackish groundwater recovery, and seawater desalination. Evaluating the viability of these and other water resource options is a key element to ensuring the City's future water supply reliability, sustainability, and cost-effectiveness. Such options, with proper planning, can contribute toward fulfilling future demand under various conditions. Future water resource challenges, which include increased demand that must be met without increasing imported supply, warrant thoughtful consideration of these and other feasible water supply resources.

The following is a discussion of other water resource options as mentioned above, highlighting LADWP's efforts in developing each alternative source of water. Also discussed are factors that affect feasibility and influence potential implementation, as well as advances that facilitate development of each resource option.

9.1 Water Transfers and Banking

Water transfers involve the lease or sale of water or water rights between consenting parties. Water Code Section 470 (The Costa-Isenberg Water Transfer Act of 1986) states that voluntary water transfers between water users can result in a more efficient use of water, benefiting both the buyer and the seller. The State Legislature further declared that transfers of surplus water on an intermittent basis can help alleviate water shortages, save capital outlay development costs, and conserve water and energy. This section of the Water Code also obligates the California Department of Water Resources (DWR) to facilitate voluntary exchanges and transfers of water.

DWR is required to establish an ongoing program to facilitate the voluntary exchange or transfer of water and implement the various State laws that pertain to water transfers. In response to this mandate, DWR established an internal office dedicated specifically to water transfers in June 2001 and has developed various definitions and policies for transfers. Of particular importance are the rules protecting existing water rights. Water rights cannot be lost when they are transferred to another user if the transferor has an underlying right to the transferred water. DWR also developed three fundamental rules specifically regarding water transfers:

- There can be no injury to any legal user of water.
- There can be no unreasonable effect on fish and wildlife.
- There can be no unreasonable economic effects to the economy in the county of origin.

Voluntary exchanges and transfers of water may or may not require approvals from State agencies dependent on the supply sources and facilities utilized for conveyance. Water transfers involving State Water Project (SWP) or Central Valley Project (CVP) facilities, water, or contractors requires approval of DWR. SWRCB manages water transfers involving surface waters that the State has jurisdiction over.

The Governor's Executive Orders issued on January 17, 2014, April 25, 2014, and December 22, 2014 known as the Drought Proclamation has expedited the processing of water transfers through DWR and the SWRCB. Through the Executive Orders, certain California Environmental Quality Act (CEQA) requirements for actions by DWR and SWRCB related to water transfers have been suspended. However, CEQA compliance on behalf of local agencies is still required to facilitate transfers.

Water banking, a form of conjunctive use, is the storage of water in groundwater basins for future use. Typically, during wet periods water is stored or banked within groundwater basins for potential extraction during dry periods. Water banking sets up accounts to track the volumes of water recharged and extracted per terms of contract agreements between water agencies. Water banking may occur outside of a water agency's service area. If the water agency's own conveyance facilities are not directly adjacent to the water bank, stored water can be extracted and transferred through wheeling and exchange via other conveyance and storage facilities. Such movements of water involve institutional transfer agreements among water users and agencies.

9.1.1 LADWP Opportunities

LADWP plans on acquiring water through transfers to replace a portion of the Los Angeles Aqueduct (LAA) water used for environmental enhancements in the eastern Sierra Nevada. The City would purchase water when available and economically beneficial for storage or delivery to LADWP's transmission and distribution system. The City is seeking non-SWP water to replace the reallocation of LAA water supply for environmental enhancements. MWD holds an exclusive contractual right to deliver SWP entitlement water into its service territory, which includes the City of Los Angeles. Purchasing only non-SWP supplies will ensure the City's compliance with MWD's SWP contract.

To facilitate water transfers, LADWP is constructing an interconnection between the LAA and the SWP's California Aqueduct, located where the two aqueducts intersect in the Antelope Valley (see Exhibit 9A). This interconnection, the Neenach Pumping Station, will allow for water transfers from the East Branch of the SWP to the LAA system, as well as provide operational flexibility in the event of a disruption of flows along the LAA System. Currently, construction of the infrastructure is complete and ongoing work is focused on bringing the pumps and equipment online. Operation of the Neenach Pumping Station is expected in 2017/18. Construction of the Neenach Pumping Station required a four-way agreement between DWR, MWD, LADWP, and the Antelope Valley-East Kern Water Agency (AVEK). When completed, the Neenach Pumping Station facility will be designated an AVEK interconnection that is operated by LADWP. MWD is involved in the agreement to provide consent for the transferred water to enter its service territory. The pump station may also be operated as an MWD connection via a separate coordinated use agreement, Agreement 47396-5.

LADWP's current goal is to transfer up to 40,000 Acre-Feet per Year (AFY) once the Neenach Pumping Station facilities are in place. This will provide LADWP with the ability to replace some LAA supplies that have been reallocated, pursuant to legally binding obligations, to environmental enhancement projects in the Mono Basin and Owens Valley. This will also provide increased operational flexibility and cost savings for LADWP customers.

A demonstration study will be performed during the Neenach Pumping Station's first two years of operations. This study will include an evaluation of the operational and water quality impacts of the Neenach Pumping Station.

To supplement water transfers, LADWP also investigated the feasibility of water banking. A request for proposal (RFP) was issued in 2008 and five proposals were received for evaluation to identify the most mutually beneficial water banking program. However, after this evaluation process, LADWP decided to not pursue full scale water banking projects at this time.

The City supports statewide water transfer legislation that will ensure the efficient use of the State's limited water resources and provide safeguards for the environment, public facilities, water conservation efforts and local economies. LADWP will continue to develop a responsible water transfer program that can assist in replacing City supplies that have been reallocated, pursuant to legally binding obligations, to the environment in the Eastern Sierra Nevada.

Exhibit 9A
Neenach Pump Station

Neenach Temporary Pumping Station, construction site, looking northerly, taken May 4, 2015, by Aqueduct Aerial Patrol.

9.1.2 MWD Opportunities

MWD has historically utilized water banking, transfer, exchange, and storage programs to mitigate supply shortages in southern California during dry periods. Through these programs, MWD has been able to store water during wetter years for withdrawal during dry years, and make spot purchases of transfer water in drier years for direct delivery to MWD's service area. MWD has successfully stored, recovered, and delivered hundreds of thousands of acre-feet with these programs. Currently MWD has multiple supply opportunities under development and continues to seek out and implement agreements and cooperative arrangement opportunities to enhance their dry year supply portfolio.

MWD's 2015 IRP Update recognizes that a comprehensive transfer and exchange program can reduce the likelihood of shorter-term water imbalances until long term permanent solutions are developed. Water transfers and exchanges can be utilized in three ways:

- Water supply augmentation,
- Offsets to withdraws from storage, and
- Additions to storage reserves.

MWD has successfully developed and implemented transfer and storage projects in the Central Valley and along the Colorado River System. Between 2012 and 2015, MWD has used approximately 457 thousand acre feet of water from its SWP storage and transfer programs to supplement SWP supplies. MWD continues to pursue additional transfer and storage projects and further improve optimization of existing projects to supplement dry year supplies. In 2015, MWD sought to further improve existing storage projects in the Central Valley by providing storage partner agencies with up-front capital for infrastructure to improve water return capabilities. Water storage and transfers programs, including the programs highlighted below, are an important element of the California plan to live within its 4.4 million acre-feet per year entitlement to Colorado River water. These programs have also helped MWD adjust to regulatory restrictions on SWP pumping from the San Francisco Bay-Delta. Current and potential MWD transfer, storage, and exchange agreements/activities include, but are not limited to:

- Westside Mutual Water Company and Kern County Water Agency Exchanges
- Antelope Valley- East Kern Water Agency Exchange and Storage Program
- Semitropic Water Banking and Exchange Program
- Mojave Water Agency Demonstration Program
- Kern Delta Water District Water Management Program
- Arvin-Edison Water Management Program
- San Bernardino Valley Municipal Water District Transfer and Storage Program
- San Gabriel Valley Municipal Water District Program
- Central Valley/State Water Project Storage and Water Transfers
- California Drought Water Bank
- Multi-Year Water Pool Demonstration Program
- State Water Contractors Water Transfer Program
- Imperial Irrigation District/MWD Conservation Program
- Desert Valley Agency/Coachella Valley Water District/MWD Exchange and Advanced Delivery Program
- Palo Verde Land Management, Crop Rotation, and Water Supply Program

- Land Management of MWD Owned Land in Palo Verde Valley
- Southern Nevada Water Authority and Metropolitan Storage and Interstate Release Agreement
- Southern Nevada Water Authority Interstate Banking Agreement
- Yuba Accord Dry Year Purchase Program
- Lower Colorado Water Supply Project
- Lake Mead Intentionally Created Surplus Storage Program
- Binational Intentionally Created Surplus
- Southern Nevada Water Authority Interstate Banking Agreement
- Drop 2 Reservoir Funding
- Yuma Desalter Pilot Project
- Expansion of Palo Verde Irrigation District Land Management Program (under development)
- Arizona Storage and Interstate Release Program (under development)
- Bard Water District and California Indian Tribes Exchange (under development)
- Antelope Valley/East Kern Acquisition and Storage (under development)

During dry years MWD has purchased significant amounts of water on the spot water market or through option contracts to further augment existing banking and transfer programs. Spot market purchases make water available through contracts entered into the same year that the water is delivered. Option contracts are multi-year or single-year contracts that allow MWD to obtain water on an as-needed basis.

MWD's water rate structure is designed to allow water transfers using MWD infrastructure by establishing a water wheeling rate, which is a combination of the System Access Rate, Water Stewardship Rate, System Power Rate, and if treated water is delivered, a Treatment Surcharge. This wheeling rate applies to all water conveyed through MWD's infrastructure, regardless of the agency using the system. MWD's unbundled rate structure and its associated wheeling rate encourage development of water markets by providing for competition at the supply level; MWD's member agencies can purchase supplies from any source and pay MWD's wheeling rate to transmit the water. MWD's current water rate structure establishes charges for each component on a per acre-foot basis for all water moving through MWD's system. As of January 1, 2016, current wheeling rate charges are:

- System Access Rate: $259/AF
- Water Stewardship Rate: $41/AF
- System Power Rate: $138/AF
- Treatment Surcharge: $348/AF

The System Access Rate recovers costs associated with conveyance and distribution capacity to meet average annual demands. The Water Stewardship Rate recovers the cost associated with providing financial incentives for investments in local water resources, such as water conservation and recycled water programs. The System Power Rate recovers the cost of power required to move water through MWD's system. The Treatment Surcharge applies to all water that is treated at one of MWD's five treatment plants.

MWD's water rate structure also incorporates a tiered supply rate format. The first tier price applies to a fixed base quantity of water as defined by each MWD member agency's purchase order contract. The second tier price reflects the incremental cost for MWD to acquire additional supplies that are above the first tier contract base amount.

9.2 Brackish Groundwater Recovery

The City's groundwater is one of the most reliable and cost effective sources of our supply portfolio. Much of the groundwater sources will require remediation, but the City's overlying basins also present the opportunity for increased pumping. LADWP is investigating the potential for Brackish groundwater recovery: the process of pumping and treating water saltier than acceptable drinking water standards, but significantly less salty than seawater. The Total Dissolved Solids (TDS) content of brackish groundwater water typically ranges between the drinking limit of 1,000 mg/L and the TDS of seawater, which is in excess of 30,000 mg/L. The main advantage of treating brackish over seawater is achieved through the energy savings associated with pushing lower salt concentration water through reverse osmosis membranes, resulting in a more cost-beneficial supply. While consideration of brackish groundwater recovery is merely in the concept phase, LADWP hopes to use this additional pumping strategy to help maximize its groundwater basin pumping potential.

9.3 Seawater Desalination

Seawater desalination, the process of removing salts and other impurities from seawater, has reached an all-time high in terms of worldwide production capacity. According to the International Desalination Association, between 2009 and 2013, worldwide total seawater desalination capacity increased from 9.5 billion gallons per day to 21.1 billion gallons per day. This is partly driven by technology and process advancements that have led to significantly reduced costs. Of the more than 17,000 seawater and groundwater desalination plants in operation worldwide, the majority are located in the Middle East, where energy costs are relatively low. The world's largest seawater desalination plant in Saudi Arabia became operational in 2014 and produces 264 million gallons per day (mgd) of desalted water. In contrast, the largest facility in the United States is located in Carlsbad, California and produces 50 mgd. The Carlsbad Desalination Plant became operational in December 2015.

LADWP's current water resource strategy does not include seawater desalination as a water supply. There are concerns over the cost and environmental impacts associated with implementation of desalination. LADWP is primarily focused on enhancing local supplies including recycling and conservation. While desalination may be further explored in the future, it currently represents only a potential supply alternative.

9.3.1 Desalination Technology

Technology to desalt seawater and produce potable water that meets or exceeds drinking water standards has been available for some time. However, desalination has not been widely implemented, primarily due to its high cost. Continued research and development are driving costs down. Additionally, increasing costs associated with new and existing supplies are narrowing the cost differential between desalinated water and other water sources and increasing the viability of desalination.

The two basic seawater desalination processes are: 1) use of the distillation process to evaporate water from salts; and 2) use of semi-permeable membranes to filter the water through while straining out the salts. While distillation was historically the dominant seawater desalination technology (primarily in the Middle East), current worldwide desalination development is rapidly migrating toward membrane technology. Facilities using distillation are still prevalent in the Middle East. However, new plant installations are increasingly taking advantage of technological advancements (higher yield and lower energy requirements) in membrane-based process technology. As of 2013, approximately 60% of all installed desalination capacity in the world relies on membrane filtration.

9.3.2 DWR Desalination Efforts

Recognizing the potential of seawater as a water resource, the DWR through a legislative mandate, convened a California Water Desalination Task Force in 2002. The task force was responsible for making recommendations to the State Legislature on potential opportunities, impediments, and the State's role in furthering desalination technology.

The task force was effective in providing a forum in which stakeholders could convene and discuss critical issues related to desalination. Key seawater desalination issues that have been raised through the task force fall into six general categories: environmental, economic, permitting, engineering, planning, and coordination.

To assist in addressing these issues, the California Water Desalination Task Force has developed draft guidelines for developing environmentally and economically acceptable desalination projects. These include the following:

- Each project should be considered on its own merits.
- Sponsoring agencies should be determined early in the planning process.
- Public and permitting agencies should be engaged early in the planning process.
- Collaborative processes should be used to enhance support for project implementation.
- A feedback loop should be incorporated to allow for continuously revisiting and revising the project at each step of the planning process.
- Key decision points (e.g., costs, environmental acceptability) should be identified to test the general feasibility of the project as early in the planning process as possible.

After establishment of the task force, desalination was added to the California State Water Plan as an alternative for consideration in regional water supplies. Furthermore, in 2008, DWR published the California Desalination Planning Handbook, building upon the task force's efforts. The handbook provides guidance on determining appropriate conditions for desalination plants, addressing concerns, and building public trust.

DWR offers funding for desalination through its Water Desalination Grant Program. Proposition 50, Chapter 6, has provided over $55 million in grant funding through three rounds of funding for desalination research, feasibility studies, pilot projects, and construction of new facilities. DWR will offer a fourth round of funding in 2016 for $49.6 million using a combination of funds from Proposition 50 and Proposition 1 and a fifth round in 2018/19 for $43.5 million using solely Proposition 1 funding. Over $45 million was distributed under this proposition in two rounds of funding for both seawater and groundwater desalination.

With increasing demand for water and limited new supply options, the future value of seawater desalination as a part of California's water supply portfolio has become apparent. Within southern California, a range of 251,000 AFY to 502,000 AFY of desalinated seawater could be potentially produced based on current efforts (see Exhibit 9A). While this production represents less than five percent of the region's total water supplies, it is nonetheless considered by water planners as an important part of the region's water supply portfolio.

9.3.3 MWD Desalination Efforts

MWD first incorporated desalinated seawater as a potential new water supply source in its 2003 Integrated Resources Plan Update. Subsequently in 2009, MWD's Board of Directors created a special committee on Desalination and Recycling to study MWD's role in regional efforts to develop desalination facilities. In October 2014, MWD revised its Local Resources Program (LRP) to include desalination as an eligible supply. MWD provides financial incentives to member agencies through its LRP to financially assist in development of eligible local resources. Additionally, to support seawater desalination MWD provides technical assistance and regional facilitation of research and information exchanges to its member agencies.

In response to a Seawater Desalination Program proposal solicitation in 2001, MWD received proposals from five member agencies to provide up to 142,000 AFY of potable water. To provide an incentive for the development of desalinated seawater, MWD is offering subsidies for each acre-foot (326,000 gallons) of desalinated seawater produced. The LRP incentive structure offers three options: sliding scale incentives up to $340/AF over 25 years, sliding scale incentives up to $475/AF over 15 years, or fixed incentives up to $305/AF over 25 years. LADWP, Long Beach Water Department (LBWD), West Basin Municipal Water District (WBMWD), Municipal Water District of Orange County, and San Diego County Water Authority (SDCWA) submitted detailed proposals that qualified for the MWD's Seawater Desalination Program. MWD currently has three agreements under the program. LADWP's project is no longer part of the program, and SDCWA's project proceeded without Seawater Desalination Program incentives. SDCWA's facility moved forward to completion and operation in late 2015, Poseidon Water's Claude "Bud" Lewis Carlsbad Desalination Plant. Through a 30-year agreement Poseidon Water will provide SDCWA 56,000 AFY. MWD has included this source as a local supply in its 2015 UWMP projections as providing 51,000 AFY during average hydrologic conditions and 56,000 AFY in dry years. Exhibit 9B summarizes the status of the desalination efforts in MWD's service area, including projects not in the Seawater Desalination Program. All of these agencies serves coastal areas, and is looking to desalination as a means to further diversify its water supply portfolio.

Exhibit 9B
Desalination Efforts in MWD Service Area

Project Name	Member Agency	Capacity (AFY)	Status
MWD Seawater Desalination Program			
Long Beach Seawater Desalination	Long Beach Water Department	10,000	Long-Term Intake Testing
Doheny Desalination Project	Municipal Water District of Orange County/South Coast Water District	5,000 - 16,000	Pre-EIR Studies
Claude "Bud" Lewis Carlsbad Desalination Plant	SDCWA	56,000	Online
West Basin Seawater Desalination	WBMWD	20,000 – 60,000	Pre-EIR Studies
	Subtotal	91,000 - 142,000	
Other Potential Projects in MWD Service Area			
Huntington Beach Seawater Desalination	Municipal Water District of Orange County/Orange County Water District	56,000	Permitting
Camp Pendleton Seawater Desalination	SDCWA	56,000 - 168,000	Planning
Ventura County	Calleguas Municipal Water District	20,000 - 80,000	Feasibility Study
Rosarito Beach Seawater Desalination	SDCWA/Otay Water District	56,000 – 112,000[1]	Feasibility Study
	Subtotal	160,000 - 360,000	
	Total	251,000 - 502,000	

[1.] MWD's service area would receive a share of the total water produced.

Source: MWD 2015 Urban Water Management Plan, Tables 3-10 to 3-11.

9.3.4 LADWP Seawater Desalination Efforts

Scattergood Generating Station Seawater Desalination Plant

LADWP initiated efforts in 2002 to evaluate seawater desalination as a potential water supply source with the goals of improving reliability and increasing diversity in its water supply portfolio. These efforts led to the selection of Scattergood Generating Station as a potential site for a seawater desalination plant. For the City, seawater desalination is a potential resource that could also offset supplies that had been committed from the LAA for environmental restoration in the eastern Sierra Nevada. As an identified project in MWD's Seawater Desalination Program, the proposed full-scale project would have qualified for MWD's LRP incentive of up to $475/AF. However, in May 2008, LADWP decided to focus on water resources development, including conservation and water recycling, as part of its primary strategy to create a sustainable water supply for the City.

While seawater desalination is not a potential water supply strategy for the LADWP at this time, studies performed to date have provided beneficial data that can assist LADWP in future evaluations of seawater desalination. Completed studies include:

- the LADWP Proposed Seawater Desalination Plant Site Selection Fatal Flaw Analysis (2002),
- LADWP Seawater Desalination Facility Feasibility Study for the Scattergood Generating Station in Playa Del Rey (2004),
- Brine Dilution Study for the LADWP Desalination Project at Scattergood Generating Station (2005), and
- Scattergood Seawater Desalination Pilot Project Preliminary Evaluation Report (2008).

To determine the proper site location for a City desalination plant, LADWP conducted the LADWP Proposed Seawater Desalination Plant Site Selection Fatal Flaw Analysis evaluating three City-owned coastal power generating plants. Based on the findings from this analysis, LADWP initially decided to investigate development of a 12 to 25 mgd desalination facility at the Scattergood Generating Station.

Optimum capacity of a future desalting facility at the Scattergood Generating Station was evaluated in the LADWP Seawater Desalination Facility Feasibility Study. Results of the study indicated a 25 mgd facility would be the most economical. Estimated capital costs for a 25 mgd facility were approximately $148.5 million in 2004 dollars with an annual operations and maintenance cost of $28.9 million (2004 dollars) resulting in a total water cost of approximately $1,257 per AF (2004 dollars). The study also identified the five-mile Hyperion Treatment Plant Outfall, which is adjacent to the Scattergood Generating Station, as the most environmentally advantageous method to dispose of the brine concentrate produced from the desalting process.

In an effort to develop an environmentally compatible project, LADWP evaluated the feasibility of discharging the desalted concentrate into Hyperion Wastewater Treatment Plant's 5-mile outfall. The Brine Dilution Study for the LADWP Desalination Project at Scattergood Generating Station performed by the Scripps Institute of Oceanography found that there are potential environmental benefits to the Santa Monica Bay's marine biology due to improved salt balance if the effluent discharged by the Hyperion Wastewater Treatment Plant were to include brine from a desalination facility.

In March 2008 the Preliminary Evaluation Report of the Scattergood Generation Station Seawater Desalination Pilot Project was completed. This was the first task of multiple tasks that was to ultimately result in the operation of a pilot plant. Co-funded by the US Bureau of Reclamation and DWR through Proposition 50 funding the overall goal was to further investigate the viability of seawater desalination for LADWP. Recommendations on site specific technologies and processes were provided for carry over to the pilot plant design stage. Items for further study included subsurface intake evaluation, cooling alternatives for warm water, second pass reverse osmosis, post treatment stabilization, and finished water blending strategy.

After completion of the first task, the subsequent tasks were not initiated. Instead, the City established a new sustainable water supply strategy that focused on local resources including conservation and recycled water. Studies completed to date and LADWPs other seawater desalination efforts discussed below have provided important data that could assist LADWP if the decision is made to move forward with seawater desalination in the future.

Other LADWP Seawater Desalination Efforts

LADWP historically engaged in multiple partnerships to advance seawater desalination in southern California. Seawater desalination is hindered by multiple challenges including, but not limited to, capital costs, operating costs, environmental considerations, water quality, and public acceptance. To overcome these challenges, LADWP has supported efforts to lower the capital and operating costs of producing desalinated ocean water. LADWP also participated with California stakeholders through multiple venues, such as the MWD and the California Water Desalination Task Force to develop desalination study projects within Southern California.

LADWP, the Long Beach Water Department (LBWD), and the United States Bureau of Reclamation partnered in the construction of a 300,000 gpd prototype seawater desalination facility to complete testing of LBWD's proprietary two-stage nanofiltration process (using membranes that require lower operating pressures and thus, the potential for lower operating costs). LBWD successfully performed a 9,000-gpd bench-scale testing of this technology and began testing on a larger scale in October 2006 at LADWP's Haynes Generating Station in Long Beach. In March 2010, LBWD completed its testing and subsequently prepared the final report.

LADWP also partnered with the WBMWD and other agencies in the American Water Works Association Research Foundation Tailored Collaboration project titled Water Quality Implications for Large-Scale Applications of MF/RO Treatment for Seawater Desalination. A 30,000-gpd pilot facility operating off the coast of El Segundo, California, from 2002 to 2008, was tested for membrane performance, water quality, and operational cost.

In a joint study by LADWP, LBWD, and WBMWD, preliminary sampling of raw seawater quality was initiated at three potential seawater desalination sites - Scattergood Generating Station in Playa Del Rey, Haynes Generating Station in Long Beach, and El Segundo Power Generating Station. Water quality analysis on the seawater was performed at various times of the year to analyze seawater quality variations during storm events when city surface runoffs drain into the ocean. The next step would be to collaborate with the California Department of Health Services on developing guidelines to ensure that product water from future desalting facilities will meet all State and Federal water quality regulations.

9.4 Other Water Supplies Yield and Cost

The range of water supplies, the unit cost, risks, and other benefits besides reductions in water demands for water transfers are presented in Exhibit 9C. LADWP recognizes the value of this water supply in offsetting unanticipated changes to supply or demand. Strategic water planning necessarily includes continuous monitoring of existing and future alternative water resources.

Exhibit 9C
Other Water Supplies

Water Supply Alternatives	Potential Water Yield (AFY)	Average Unit Cost ($/AF)	Implementation Risks	Additional Benefits
Water Transfer	40,000	$220-$700[1]	Wheeling and other institutional issues must be addressed.	Replaces water committed to the environment, pursuant to legally binding obligations
Seawater Desalination	N/A	$1,500-$3,000[2]	Environmental permitting may be difficult.	Replaces water committed to the environment. Hedges against climate change.

For Comparison Purposes:
Local Groundwater Unit Cost = $ 341 /AF
MWD Treated Tier 2 Water Supply Unit Cost (1/1/16) = $942/AF

Notes:

1. Cost does not include wheeling fees. Treatment costs not included.

2. Source: Metropolitan Water District of Southern California Integrated Water Resources Plan 2015 Update 3.

Chapter Ten

Integrated Resources Planning

Japanese Garden at Donald C. Tillman

10.0 Overview

Integrated resources planning is a process used by many water, stormwater (flood control), and wastewater agencies to meet their future goals in the most effective way possible, and with the greatest public support. The integrated resources planning process in general incorporates:

- Public stakeholders in an open, participatory process;
- Multiple objectives such as reliability, cost, water quality, environmental stewardship, and quality of life;
- Risk and uncertainty;
- Partnerships with other agencies, institutions, and non-governmental organizations.

LADWP has been involved in integrated resources planning since the development of its first UWMP in 1985 which incorporated conservation, recycled water, stormwater capture, and supplies from the Metropolitan Water District of Southern California (MWD). LADWP also participated when MWD initiated the Southern California region's first Integrated Resource Plan (IRP) in 1993. LADWP was an active member of the technical workgroup that oversaw the development of alternatives and recommendations from MWD's IRP. In 1999, the City embarked on its first IRP for wastewater, stormwater and water supply. LADWP was a partner in this effort, working with the City's Bureau of Sanitation (LASAN). LADWP has continued as a partner in integrated resources planning through its ongoing efforts associated with the update of the City's IRP, known as One Water LA 2040 (One Water LA). In 2006, the first Greater Los Angeles County Integrated Regional Water Management Plan (IRWMP) was published. It was subsequently updated in 2013 and approved in 2014. In addition, LADWP is a member of the Integrated Regional Water Management (IRWM) Leadership Committee and, along with the Council for Watershed Health, serves as co-chair of the of the Upper Los Angeles River Watersheds sub-region for the IRWM region.

10.1 City of Los Angeles Integrated Water Resources Plan and One Water LA 2040 Plan

10.1.1 Description and Purpose

The City's IRP is a unique approach of technical integration and community involvement to guide policy decisions and

Echo Park Lake

water resources facilities planning. The IRP recognizes the inter-relationship of water, wastewater, and runoff management. Initiation of the IRP began in 1999 and culminated in its unanimous adoption by the City Council in 2006. Through the stakeholder driven IRP process, detailed facility plans were developed for the City's wastewater and stormwater systems through the 2020 planning horizon. Utilization of an integrated watershed approach identified opportunities that would not have been traditionally identified if water, wastewater, and stormwater were continued to be viewed independently. In the past, the City utilized single-purpose planning efforts for each agency, such as one plan for wastewater and a separate plan for water supply. The IRP included capital improvement programs for wastewater and stormwater, a recycled water master plan, and a programmatic Environmental Impact Report. With the IRP, the City was able to develop a vision for meeting 2020 needs in a more cost-effective and sustainable way by addressing and integrating all its water resources. A further outcome of the IRP process was the identification of partnerships between City departments, other agencies, and non-governmental organizations. For its efforts, the City won multiple awards for excellence, including the 2011 U.S. Water Prize from the U.S. Water Alliance, and the 2007 Grand Prize from the Academy of Environmental Engineers and Scientists. Completion of the IRP led to multiple successful programs in the City, including:

- Deferment of large wastewater capital projects totaling over $500 million due to reductions in water demands, related to the "go-if triggered" management approach adopted in the IRP;

- Increases in water conservation programs, such as high-efficiency clothes washer rebates, high-efficiency toilet rebates, and rebates for turf replacement with California friendly landscaping;

- Creation of the Recycled Water Advisory Group and completion of detailed Recycled Water Master Planning documents with the goal of reducing dependence on imported water by 59,000 AFY;

- Planning of a Groundwater Replenishment Project for the San Fernando Basin utilizing purified water from the Donald C. Tillman Water Reclamation Plant to recharge up to 30,000 AFY into the basin; and

- Passage of the City's Proposition O to fund multi-purpose water quality and stormwater management projects through a $500 million bond, resulting in projects such as Echo Lake Restoration, Machado Lake Restoration, South LA Wetlands, LA Zoo porous pavement, green street initiatives, and various other projects throughout the City.

To build on the success of the IRP, the City has initiated the development of the One Water LA 2040 Plan. One Water LA extends the IRP planning period to year 2040 and takes into consideration an additional emphasis on environmental, social, and sustainability factors. The overarching goal of One Water LA is to maximize resources through the integration of multi-beneficial collaborative programs and projects to make the City greener and more sustainable. One Water LA will follow in the footsteps of the IRP and will be a stakeholder driven process with a goal of increased public involvement to represent LA's diversity in geography, interests, and demographics. One Water LA will not supersede the 2015 UWMP, as the purpose of One Water LA is to identify collaboration opportunities as a result of integrated efforts between agencies.

10.1.2 One Water LA Approach

One Water LA will be developed in a two-phase process. Phase 1, completed in 2015, consisted of two components: 1) development of a vision, objectives, and guiding principles and 2) development of an initial water balance tool to serve as a starting point for detailed analysis scheduled to occur in Phase 2. Phase 1 included three stakeholder workshops to develop initial planning baselines as well as guiding principles to coordinate water management and citywide facilities planning. Since completion of the IRP, various new reports and studies provided updated projections. Updated projections contained in LADWP's 2015 UWMP will serve as a baseline for One Water LA which will evaluate additional collaborative integration opportunities to further address water related challenges, such as:

- Adoption of the 2012 Municipal Separate Storm Sewer System (MS4) permit for Los Angeles County by the Los Angeles Regional Water Quality Control Board (LARWQCB) allowing municipalities to develop a more integrated approach through the use of Enhanced Watershed Management Plans to meet Total Maximum Daily Loads (TMDLs) associated with stormwater discharges.

- Impacts of climate change, which may reduce snowpack levels and result in earlier snow melt impacting long-term availability of imported water to Los Angeles; and increase stress on local ecosystems, increase the risk of localized flooding, cause sea level rise, which may impact critical coastal water infrastructure,

- Decreased wastewater flows and water demands from increased water conservation;

- Citywide impacts of long-term and severe droughts; and

- Stormwater and wastewater infrastructure and facilities improvements to meet future citywide needs.

Phase 2 will refine baseline projections developed during Phase 1 through the completion of technical studies and continued stakeholder engagement to develop and compare projects, policies, and additional opportunities. Final documents from Phase 2 will include the updated facility plans for stormwater and wastewater, and recommended policies and procedures for increasing coordination and integration of the City's water related goals, beyond the goals established in this UWMP. Additionally, Phase 2 will provide guidance for completion of future integration master plans in the City. Phase 2 is estimated to be completed in December 2016 with a Programmatic Environmental Impact Report scheduled for completion in December 2017.

10.1.3 Stakeholder Participation

At the beginning of Phase 1, a goal was established to increase stakeholder engagement and widen the stakeholder audience. Phase 1 had five levels of stakeholder involvement as illustrated in Exhibit 10A. At the core of the outreach program, the Steering Committee, Inter-Department/Agency Coordination, and Stakeholder Advisory Group helped identify the topics for discussions and solicitation of feedback at the public stakeholder workshops. In turn, the public stakeholder workshops assisted in conveying the information to the public at large. Additionally, LADWP and LASAN conducted over two dozen outreach meetings and conferences with the public. A culmination of the outreach process was the creation of the vision, objectives, and Guiding Principles.

Exhibit 10A
One Water LA Phase 1 Stakeholder Involvement

10.1.4 Vision, Objectives, and Guiding Principles of One Water LA

A vision statement, objectives, and guiding principles were developed through the outreach process to guide development of Phase 2. The vision statement serves to define the purpose of One Water LA:

One Water LA is a collaborative approach to develop an integrated framework for managing the City's water resources, watersheds, and water facilities in an environmentally, economically and socially beneficial manner.

One Water LA will lead to smarter land use practices, healthier watersheds, greater reliability of our water and wastewater systems, increased efficiency and operation of our utilities, enhanced livable communities, resilience against climate change, and protection of public health.

Objectives were developed to describe the major goals of the plan in a clear and easily understood manner. Objectives also can serve as the basis for development of evaluation criteria to compare potential choices and actions. Objectives developed for One Water LA are:

1. Integrate management of water resources and policies by increasing coordination and cooperation between City departments, partners, and stakeholders.

2. Balance environmental, economic, and societal goals by implementing affordable and equitable projects and programs that provide multiple benefits to all communities.

3. Improve health of local watersheds by reducing impervious cover, restoring ecosystems, decreasing pollutants in our waterways, and mitigating local flood impacts.

4. Improve local water supply reliability by increasing capture of stormwater, conserving potable water, and expanding water reuse.

5. Implement, monitor, and maintain a reliable wastewater system that safely conveys, treats, and reuses wastewater, while also reducing sewer overflows and odors.

6. Increase climate resilience by planning for climate change mitigation and adaption strategies in all City actions.

7. Increase community awareness and advocacy for sustainable water by active engagement, public outreach and education.

A total of 38 guiding principles were developed to guide development of detailed planning and policies during Phase 2 of One Water LA. Principles were developed for each objective, however the principles are not intended to define specific targets or mechanisms for project implementation. Development of the guiding principles was a long process to ensure multiple rounds of internal discussions and stakeholder engagement occurred. Ultimately, the guiding principles reflect multiple viewpoints and are balanced among various interests.

10.1.5 City's IRP and One Water LA Implications for City's Urban Water Management Plan

One of the primary purposes for developing the IRP was to explicitly consider the relationship between wastewater facility planning and other water resources issues, such as water supply and urban runoff. Implementation of the IRP has and will continue to result in increased beneficial reuse of water, water conservation, and groundwater supplies. IRP alternatives examined ways to decrease potable water needs by expanding the City's recycled water program; increase water efficiency by installing smart irrigation and other water efficient devices that reduce irrigation and indoor water demands; and increase groundwater resources by using wet weather runoff to recharge the aquifer. The IRP demonstrated that by integrating water resources planning for the City, more opportunities for water supply development can be identified. These past IRP efforts have helped to guide the long term goals of the UWMP.

One Water LA further builds upon the efforts of the IRP by extending the water resources planning horizon to year 2040. Through the One Water LA process, new policies and capital improvement projects will be identified to meet the aforementioned objectives established in Phase 1. These projects will improve the sustainability of LA's water supply while addressing unknowns, such as climate change, in coordination with achieving local water supply targets and goals established in ED No. 5 and the City Sustainability Plan (pLAn).

10.2 Greater Los Angeles County Integrated Regional Water Management Plan (IRWMP)

10.2.1 Description and Purpose

The first Greater Los Angeles County (GLAC) Integrated Regional Water Management Plan (IRMWP) was completed in 2006 after a multi-year effort led by the Los Angeles County Department of Public Works. Water quality, resource, and supply issues within the region are complex and managed by a myriad of government agencies subjected to a plethora of regulations. Exponential growth over the last century has required water managers to develop creative solutions to meet growing demands. Previously, projects addressing water issues were designed to appease single-focused visions and solutions of organizations operating independently. At the core of the plan, a clear vision and direction for the sustainable management of water resources within the region for the next twenty years was formulated. In 2013, an updated IRWMP was completed. This was followed by approval of the updated plan by the IRWM Leadership Committee on August 27, 2014. The updated plan was done to comply with new requirements, improve content, and maintain eligibility for funding opportunities. The updated plan allowed stakeholders to revisit goals and objectives established in the original plan to reflect updated conditions thru 2035.

Since the first IRWMP, 1,600 projects were collected and synthesized for inclusion in the plan. This required hundreds of local government agencies to cooperatively develop cost-effective, sensible, and economically feasible solutions to address regional water issues in an integrated manner. As of January 2016, the cutoff data for inclusion in the 2013 Plan Update, 215 projects were on the approved project list. Projects are reviewed and added to the list on an ongoing quarterly basis.

Throughout the IRWM process, new partnerships continued to be forged between potential funding partners from within and outside the region. The IRWM process led to the formation of the GLAC, an innovative partnership between agencies creating a new model of integrated regional planning to address competing water demands, water supply reliability, and project financing. Since inception of the GLAC IRWM region in 2006, 40 projects in the region have been awarded over a combined $74 million in IRWM implementation grant funding through Propositions 50 and 84.

Region

The IRWM region encompasses 84 cities, portions of four counties, and hundreds of government agencies and districts spread over 2,058 square miles. Approximately 9.6 million residents, or equivalent to roughly 26 percent of the population of California, reside within the region. To facilitate input, variations in geographic and water management strategies, and effective planning, the region was further subdivided into five sub-regions:

- Upper Los Angeles River Watersheds
- Lower San Gabriel and Los Angeles River Watersheds
- North Santa Monica Bay Watersheds
- South Bay Watersheds
- Upper San Gabriel River and Rio Hondo Watersheds

The City of Los Angeles is within the Upper Los Angeles River Watershed sub-region.

Mission and Purpose

As part of the IRWM Update a collaborative process resulted in the formation of a revised mission statement:

To address the water resources needs of the Region in an integrated and collaborative manner to improve water supplies, enhance water supply reliability, improve surface water quality, preserve flood protection, conserve habitat, and expand recreational access in the Region.

The 2013 Plan Update recognizes that in order to meet future needs, water supply planning must be integrated with other resource strategies. Additionally, in a region with significant urban challenges, including population growth, densification, traffic congestion, poor air quality, and quality of life issues, it is imperative to consider water resources management in conjunction with other urban planning issues. Ultimately, the purpose of

Headworks Aerial

the 2013 Plan Update is to develop a comprehensive vision for sustainable management of water resources allowing the Region to procure local funding, position the Region to be eligible for State bonds, and develop opportunities to obtain federal funding.

10.2.2 Stakeholder Involvement

Stakeholders include water retailers, wastewater agencies, watershed groups, stormwater and flood managers, disadvantaged communities, business community members, public community members, Native American tribes, agriculture, and non-profits. To facilitate management of the GLAC Region and stakeholders, the region is organized into the aforementioned five watershed subregions. Stakeholders participated in workshops, project identification, and development of the 2013 Plan Update. Stakeholders were involved in the development of the 2013 Plan Update through participation in the Leadership Committee, Leadership Committee Subcommittees, Steering Committees for subwatershed regions, and regional and subregional workshops. As a water retailer in the Los Angeles Basin, LADWP is a member of the IRWM Leadership Committee and with the Council for Watershed Health, co-chairs the Upper Los Angeles River Watersheds subregion. The stakeholder process allows all participants to coordinate and share their plans facilitating mutual development of projects.

10.2.3 Recommended Projects

The 2013 Plan Update included 135 approved projects. In the interim period after completion of the original IRWMP, the GLAC region further defined and improved the process for including projects on the approved list of projects. Submission of projects is an open process where projects can be submitted at any time, however, the GLAC region only reviews projects for potential inclusion on the approved list on a quarterly basis. Periodic calls are made for projects in response to deadlines, such as upcoming grant funding application submittal dates, therefore, the number of recommended projects will fluctuate based on a given point in time. Projects are reviewed using a two stage process at the Subregional Steering Committee level:

- Stage I – Projects are evaluated to determine if the project meets the basic minimum criteria of addressing IRWM objectives and targets.
- Stage II – Projects are evaluated to determine if key elements of the project are complete enough for the Subregional Steering Committee to

determine if the project will meet DWR requirements and GLAC region objectives and targets.

In the 2013 Plan Update, the Leadership Committee does not prioritize projects on the approved list as projects are constantly evolving. Prioritization may lead to prioritizing certain objectives above others, and the region wants to maintain the flexibility to prioritize projects on an as needed basis in response to current issues, such as the ongoing drought, and specific grant solicitation requirements.

Objectives and Targets

Projects must meet objectives and targets adopted by the GLAC region in order for a project to be added to the approved list of projects. During the 2013 Plan Update process, the five previous objectives developed for the IRWMP were refined and updated to reflect stakeholder input and needs of the overall GLAC region. Objectives were developed through a summation of subregional targets involving a two-step process consisting of technical input and stakeholder input. Targets were developed through a combination of three Water Management Subcommittees; Water Supply, Water Quality & Flood Management, & Habitat and Open Space. Stakeholders provided input to Subregional Steering Committees by providing comments on the methods and formats used to develop the targets. Stakeholders also provided documents and data to assist in developing the objectives and targets. Additionally, stakeholders provided multiple data sources, including water resource management plans, habitat and open space inventories, City general plans, water quality impairment listings, and FEMA flood management and County Sediment Management Plans.

Objectives and targets identified in the 2013 Plan Update for Year 2035 are:

- **Improve water supply** - optimize local water resources to reduce the region's reliance on imported water with targets of conserving 117,000 AFY; creating the ability to pump an additional 106,000 AFY of groundwater; increase indirect potable reuse of recycled water by 80,000 AFY; increase non-potable reuse of recycled water by 83,000 AFY; increase capture and direct use of stormwater runoff by 26,000 AFY; increase stormwater infiltration by 75,000 AFY; and develop seawater desalination of 26,000 AFY;

- **Improve surface water quality** - comply with water quality regulations, inclusive of TMDLs, by improving the quality of urban runoff, stormwater, and wastewater with targets of 54,000 AF of stormwater capture capacity spatially dispersed;

- **Enhance habitat** - protect, restore, and enhance natural processes and habitats with targets of preserving or protecting 2,000 acres of terrestrial habitat, enhancing 6,000 acres of terrestrial aquatic habitat, and restoring or creating 4,000 acres of terrestrial aquatic habitat;

- **Enhance open space and recreation** - increase watershed friendly recreational space for all communities with targets of creating 38,000 acres of open space and 25,000 acres of urban parks;

- **Reduce flood risk** - reduce flood risk in flood prone areas by either increasing protection or decreasing needs using integrated flood management practices with targets of reducing flood risks in 11,400 acres of flood prone areas, remove 68 million cubic yards of sediment from debris basins and reservoirs; and

- **Address climate change** – adapt to and mitigate against climate change vulnerabilities by increasing local supplies by an additional 7-10% beyond water supply targets by 2050, and implement "no regrets" adaptation and mitigation strategies that decrease emissions of greenhouse gases.

Projects

In the 2013 Plan Update, 135 projects were on the approved list for the GLAC region, with LADWP serving as the implementing organization for 14 projects. Projects can be added and removed through an online database that tracks the GLAC region. As a regional plan encompassing an area larger than LADWP's service area, many of the IRWM projects do not directly benefit LADWP's service area, but rather provide benefits towards improving water resources in the region as a whole. However, LADWP can utilize the results of these projects and apply the knowledge to potentially develop similar programs within the service area. LADWP serves as the implementation agency for the following projects as classified by primary benefits as determined in the 2013 Plan Update:

Water Quality

- Bull Creek Los Angeles Reservoir Water Quality Improvement Project

Water Supply

- Boulevard Pit Stormwater Capture Project
- Elysian Park Water Recycling Project
- Groundwater Treatment Facilities
- Hansen Dam Golf Course Recycling Project
- Los Angeles State Historic Park Water Recycling Project
- Mission Wells Improvement
- Sheldon Pit
- Valley Generating Station Stormwater Recharge Project
- Whitnall HWY Powerline Easement Stormwater Capture Project

Habitat/Open Space

- Elysian Reservoir Water Quality Improvement Project
- Headworks East Reservoir
- Headworks Ecosystem Restoration
- Silver Lake Reservoir Bypass and Regulator Station

LADWP received funding for three projects in the amount of $9 million as part of the Proposition 84, 2014 IRWM Drought Solicitation, funding round. Brief descriptions of these three projects are as follows:

Manhattan Wells Improvement Project

The Manhattan Wells Improvement Project is split to two phases. Phase I of the Project will install up to 2 off-site groundwater monitoring wells to characterize the vertical extent of contamination. Phase II will install up to 8 production wells, well collector lines, and related infrastructure in the existing wellfield. With these improvements, more than 10,000 AFY of production capacity will be restored.

Mission Wells Improvement Project

The Mission Wells Improvement Project will restore overall capacity to produce groundwater and utilize annual water rights and stored water credits. Stage 1 of the Project includes installation of up to five monitoring wells and three production wells at LADWP's Mission Wellfield in the Sylmar Basin. Stage 2 includes a hypochlorite generating station, to be constructed later, to comply with Stage 2 Disinfection Byproduct Rule. With these improvements, 3,570 AFY of production capacity will be restored.

Terminal Island Water Reclamation Plant Advanced Purification Facility and Distribution System Expansion

The Terminal Island WRP Advanced Water Purification Facility (TIWRP) and Distribution System Expansion Project is split to two phases, and is expected to be completed by October 2017. In Phase I, TIWRP will expand the production of highly purified recycled water by expanding the capacity of the current MF/RO treatment train and adding an advanced oxidation process (AOP) to produce high quality water. In Phase II, approximately 9,000 linear feet of pipeline will be constructed to reach all planned and potential recipients of product water from TIWRP. The Project is expected to offset up to 12,880 AFY of potable water demand.

Terminal Island Water Reclamation Plant

10.2.4 Implications of IRWM Planning for City's Urban Water Management Plan

LADWP is a member of the IRWM Leadership Committee and additionally serves as co-chair with the Council for Watershed Health for the Upper Los Angeles River Watersheds sub-region of the GLAC region. As member of the Leadership Committee, LADWP is a signatory to the Memorandum of Understanding for the IRWM approved by the Board of Water and Power Commissioners on July 15, 2008.

Participating agencies in the IRWM Leadership Committee coordinate and share information concerning water resources management planning programs, projects, and grant funding. Participation improves and maintains overall communication among the participants. Coordination and information sharing assists LADWP and other agencies in achieving their respective missions and contributes to overall IRWM goals.

Funding received through the IRWM process assists LADWP and the City in meeting local water supply reliability and sustainability goals defined in ED No. 5 and the Sustainability City pLAn in addition to assisting the overall GLAC region in meeting its targets and objectives. In addition to the $9 million for the three aforementioned projects through the 2014 Drought Solicitation Process under Proposition 84, LADWP received $5.5 million for Tujunga Spreading Grounds Enhancement and Griffith Park South-Central. To date LADWP has received $14.5 million for five projects through the IRWM process.

10.3 MWD's 2015 Integrated Water Resources Plan

MWD is developing its 2015 Integrated Water Resources Plan (IRP) Update using a two-phase process. Phase 1, the 2015 IRP Update, consisted of updates to data and projections that were included in the 2010 Plan and established targets for water supply reliability. This encompassed:

- Updating demographics, economic conditions, and water demands;
- Climate change and hydrologic scenarios;
- Water supplies from existing and new projects; and

- Future resource and conservation targets for regional reliability

Phase 1 was approved by the MWD Board on January 12, 2016. Phase 2 will consider implementation policies to reach the resource targets established in Phase 1. Together both phases will serve as MWD's strategic plan for water reliability through the year 2040. Phase 1 was developed through a collaborative process which incorporated input from water districts, local governments, stakeholder groups and the public. The earliest version of the IRP, which dates back to 1996, sets a regional reliability goal of meeting "full-service demands at the retail level under all foreseeable hydrologic conditions." The 2015 IRP Update maintains this reliability goal by seeking to stabilize MWD's traditional imported water supplies and establish water reserves to withstand California's inevitable dry cycles and growth in water demand. Phase 1 recognizes that remaining policy discussions regarding the development and maintenance of local supplies and conservation need to occur in Phase 2. The 2015 IRP Update resulted in development of six main findings and conclusions as described in MWD's 2015 UWMP, and summarized here:

- **Action is Needed** – MWD's service area would experience an unacceptable level of shortage allocation frequency in the future without investments in conservation, local supplies, and the California WaterFix identified in the 2015 IRP Update.

- **Maintain Colorado River Supplies** – MWD plans to stabilize minimum deliveries of 900,000 AF in a typical year through programs and partnerships to meet average-year projections and maintain a full aqueduct during dry years.

- **Stabilize SWP Supplies** – Beginning in the 1990's, environmental conditions along the SWP and in the Delta have decreased supply availability and reliability. Additionally, the existing system remains vulnerable to earthquakes and floods. A collaborative approach, involving state and federal agencies, to pursue better science for resolving issues about SWP operations and advancing the coequal goals of Delta restoration and statewide water supply reliability is needed in the near and long term.

- **Develop and Protect Local Supplies and Water Conservation** – The 2015 IRP Update supports and advances regional self-sufficiency ethics by increasing targets for additional local supplies and conservation. Development of new local supplies, protection of existing supplies, and improving water conservation are major components to maintaining the region's future reliability.

- **Maximize the Effectiveness of Storage and Transfers** – A comprehensive water transfer approach that utilizes water when it is available will assist in stabilizing and building storage reserves and increase the ability of MWD to meet water demands in dry years. In the near term, water transfers can also be utilized to supplement core supplies while long term projects are under construction. MWD acknowledges that ongoing problems in the Delta can limit its ability to transfer water obtained upstream of the Delta to areas south of the Delta.

- **Continue with the Adaptive Management Approach** – MWD's adaptive management strategy, first developed in the 2010 IRP Update, assists MWD in preparing the region for long-term changes to demographic, climate, water quality, economic, and regulatory conditions. MWD will continue to manage future risk and uncertainty through the 2015 IRP Update's adaptive management strategy. The strategy focuses on stabilizing and maintaining imported supplies, using increased conservation, and developing new local supplies to meet expected growth. The strategy also focuses on developing a transfers and exchange strategy, accumulating storage in wet and normal years to mitigate against droughts and risks associated with future uncertainty. Future supply actions, which are low cost and low risk designed to accelerate developments on an as needed basis, are a key component of the adaptive management approach to buffer against uncertainties. Future supply actions include recycled water, seawater desalination, stormwater capture, and groundwater cleanup.

10.3.1 Technical Update Issue Recommendations

As part of MWD's 2015 IRP Update process, the 2015 IRP Technical Update Issue Paper Addendum was prepared to inform water resource managers and policy-makers of the latest developments in local resources and conservation efforts. During the 2010 IRP process, six Issue Papers were prepared to address the local resource areas. The Issue Papers provided findings from workgroup discussions, described the current state of local supplies and programs, and provided recommendations for opportunities. The 2015 addendum was developed in a collaborative regional process with input from the IRP Member Agency Technical Workgroup, Water Use Efficiency Meetings, resource experts, and stakeholders. Issue Papers identified current and potential resources issues, opportunities, lessons learned in the interim period, and provided updated recommendations. Exhibit 10B summarizes the resource issues, opportunities, and recommendations.

Exhibit 10B: Resource Issues, Opportunities, and Recommendations

Issues	Opportunities	Recommendations[1]
	Conservation	
• Long-term commitment to conservation can be difficult to sustain during non-drought years. • Institutional objectives and priorities may not be aligned to promote water conservation. • Communicating to the retail level customers • Demand hardening makes further conservation increasingly difficult • Proposition 218 compliance regarding conserving water rate structures • Availability of water savings data	• Drought has created momentum • Technological advances are available to increase conservation • Consumer behavioral changes and market transformation have potential for future water savings	• Evaluate existing programs for areas of improvement. • Explore new programs and devices • Expand partnerships with government agencies and utilities • Continue to assist with model ordinances • Explore ways to communicate water use to the end user • Provide targeted outreach and education, including to land-use planners • Study successes in retail water pricing • Explore research opportunities and technology development • Develop opportunities for information sharing and program integration • Explore strategies to help incentivize additional water conservation

<table>
<tr><th>Issues</th><th>Opportunities</th><th>Recommendations[1]</th></tr>
<tr><td colspan="3">Groundwater (including stormwater and other recharge)</td></tr>
<tr><td>• Region is experiencing historic low groundwater levels
• Urbanization reduces groundwater recharge and increases flood risk
• Climate change may alter precipitation patterns
• Costs/funding
• Institutional challenges
• Water quality
• Operational and environmental issues</td><td>• Adjudication amendments increase flexibility for groundwater management
• Regulatory changes maximize recycled water recharge
• New treatment and brine disposal technologies
• Collaboration on multi-benefit projects</td><td>• Explore opportunities to address ongoing threats to sustainability
• Explore innovative project and partnership development
• Continue to provide an avenue for open regional discussion on stormwater</td></tr>
<tr><td colspan="3">Recycled Water</td></tr>
<tr><td>• Lengthy and variable permitting process
• Negative public perception and conflicting messaging
• Costs
• Source control and effluent water quality needs
• Operational issues
• Confliction institutional objectives</td><td>• Progress toward new regulatory process
• Improving public perception
• New funding opportunities
• Partnerships
• New technologies, research, and information sharing</td><td>• Explore opportunities to improve permitting process
• Improve public education and awareness of water recycling
• Explore various investments strategies such as incentives, ownership, and partnerships
• Consider joint technical studies and projects</td></tr>
<tr><td colspan="3">Seawater Desalination</td></tr>
<tr><td>• New regulations affect future development
• Costs
• High energy use
• Conflicting messaging</td><td>• Improve permitting process
• Regional, state, and federal funding
• Technology and innovation
• Partnerships and collaboration with stakeholders
• Communicating benefits</td><td>• Explore legislative, regulatory, and communications opportunities
• Continue investment in new research, studies, and innovation
• Investigate partnership opportunities for managing risk
• Evaluate options for capacity building</td></tr>
</table>

Issues	Opportunities	Recommendations[1]
Stormwater Direct Use		
• Availability of supplies due to uncertain rainfall patterns • Operation and maintenance needs • Potential impacts to groundwater recharge and quality	• Rainwater capture is now available for non-potable uses without permitting requirements • Public awareness of water issues	• Evaluate a business case analysis and cost/benefit analysis for providing regional incentives • Continue to facilitate regional discussion on stormwater direct use • Encourage information sharing of challenges and lessons learned
Graywater		
• Permitting and regulations • Cost • Drain-line carry • Potential health and environmental risks • Potential conflict with other resources	• Changes to plumbing and building codes • Removed authority to prohibit graywater use • Public awareness increased due to drought	• Continue to encourage research • Explore additional public education efforts
Resource Interrelations		
• Water quality • Regulatory challenges • Costs and limited funding • Lack of public support	• Collaborations on multi-benefit projects • Collaboration on grant funding • Technology, research, and information sharing • Heightened public awareness and regulatory reform during drought • Optimizing resource interactions	• Explore partnership opportunities for multi-benefit approaches • Explore research and technology development opportunities • Investigate integrated regulatory, outreach, and education efforts • Explore integrating resource, programs, and planning opportunities • Explore funding strategies that improve economic feasibility of multi-benefit projects

1. Recommendations do not obligate future policy or implementation for any agency, but instead aim to help advance the regional discussion on water resources issues.

Source: MWD, 2015 IRP Technical Update Issue Paper Addendum, October 27, 2015.

10.3.2 Stakeholder Participation

Like the preparation of previous IRPs, the development of MWD's 2015 IRP update was a collaborative effort. MWD sought input from its 26 public member agencies, retail water agencies, the public and other stakeholders including water and wastewater managers, environmental interests, and the business community. LADWP was an active member and participated in the technical workgroup meetings.

To provide more direct involvement by MWD's Board in the 2015 IRP Update preparation, the Board created an Integrated Resources Planning Committee composed of 17 Board of Directors. Los Angeles served as vice-chair of this committee. This committee met ten times throughout the 2015 IRP Update Process.

Throughout the development of the 2015 IRP Update, MWD member agencies met with MWD staff through an IRP Member Agency Technical Workgroup. The Technical Workgroup provided opportunities to provide guidance, discussion, and information-sharing on technical topics. This workgroup facilitated the transfer of member agency data and information necessary for updating the 2015 IRP Update forecasts, feedback, and development of policy topics for Phase 2. Updates on the IRP and UWMP were also provided during Member Agency Managers meetings and multiple other MWD related meetings and committees.

MWD recognized public involvement was an important element to incorporate into development of the 2015 IRP and UWMP. To encourage public involvement in the 2015 IRP Update and UWMP, MWD established three key objectives:

- Ensure that the 2015 IRP Update/UWMP process is understandable and accessible to anyone interested;
- Provide opportunities for learning, dialogue, and input; and
- Create a pathway to encourage continued engagement in future policy discussions.

10.3.3 MWD's 2015 IRP Update Implications for City's Urban Water Management Plan

It is important to understand the significance of a reliable and cost-effective water supply from MWD. The City's water supply reliability is directly linked to MWD's reliability. Through its 2015 IRP Update, MWD has shown additional actions needed to maintain long term reliability, which is critical to the City during prolonged dry periods when Los Angeles Aqueduct supply and other local supplies may be significantly curtailed.

Chapter Eleven
Water Supply Reliability and Financial Integrity

11.0 Overview

Providing a reliable water supply in a semi-arid climate with high variability in weather is challenging. Since LADWP relies on imported water from the Los Angeles Aqueduct (LAA) and Metropolitan Water District of Southern California (MWD) for a significant amount of its total water supply, it is challenging to ensure water supply reliability. Imported surface supplies are highly variable due to climate and hydrology, and are also subject to environmental regulatory restrictions. To diversify its water supply portfolio and meet targets established in Mayor Garcetti's Executive Directive No. 5 (ED5) and LA's Sustainable City pLAn, LADWP has made and will continue to make significant investments in local groundwater, recycled water, stormwater capture, and water conservation. Local water supplies tend to be more reliable than imported water because they have less variability due to climate, weather, and environmental restrictions. Additionally, by investing in these local supplies, the City's urban environment can be protected and enhanced.

11.1 Unit Cost and Funding of Supplies

11.1.1 Unit Cost Summary of Supplies

Unit costs play an important role in planning future water supply development and determining where supply investments provide the greatest benefits to our customers. Unit costs of production vary dramatically by water supply source. Exhibit 11A summarizes the unit cost for each of LADWP's water supply sources.

Among LA's existing and planned water supplies, unit costs ranged from a high of $1,550/AF for certain stormwater capture projects to a low of $341/AF for locally produced groundwater. LAA supply requires operation and maintenance costs regardless of the amount of water the aqueduct delivers. Therefore, hydrology and increased water for environmental enhancements in the Eastern Sierras result in LAA unit costs fluctuating from year to year. During Fiscal Year (FY) 2014/15, the LAA experienced a sharp increase in unit cost due to the lowest LAA deliveries on record. Local groundwater supply is the least expensive source. However, its production is currently limited by groundwater basin contamination. Unit costs for MWD purchased water vary based on tier allocations. MWD's treated water rates for FY 2016 are $942/AF for Tier 1 and $1,076/AF for Tier 2. LADWP has a Tier 1 allocation of 335,663 AF. Any purchases above 3.35 million AF in a 10-year period will be at the Tier 2 rate. Conservation costs to LADWP have historically been minimal as the majority of incentives provided to LADWP's customers for installation of water-efficient fixtures and turf removal are paid by MWD through the region's Water$mart program. However, future costs for conservation savings that will be required to comply with the aggressive targets established in the City's pLAn will likely increase as MWD reduces funding and demand-hardening increases. Recycled water costs are project specific and vary widely depending on the infrastructure requirements of each project. Water transfers using a future connection between the LAA and the California Aqueduct are also planned. Water transfer costs will not only require the purchase of the water supply, but will also require payment of conveyance or wheeling fees to deliver the water into LADWP's system.

Unit costs for potential water supplies such as stormwater capture and reuse, as well as increased groundwater production from stormwater recharge are highly variable based on a variety of factors including the size of the overall program, project locations, etc. The SCMP presents not to exceed costs for infiltration ($1,100/AF) and direct use ($1,550/AF) in 2025, respectively. As described in Chapter 7, Watershed Management, the estimated costs are inclusive of the avoided cost of MWD Tier 1 untreated imported water and the value assigned by MWD for participation in MWD's Local Resource Program. Projects in excess of these amounts will be considered if partnerships or outside funding can reduce the unit cost to these specified levels. Projects in excess of the specified not to exceed levels may be considered by LADWP on a case by case basis.

Exhibit 11A
Unit Costs of Supplies for LADWP

Water Source	Chapter Reference	Average Unit Cost ($/AF)
Conservation[1,2]	Chapter 3 - Water Conservation	$50 - $1,300
Recycled Water	Chapter 4 - Recycled Water	$600 - $1,500
Los Angeles Aqueduct[3]	Chapter 5 - Los Angeles Aqueduct System	$1,481
Groundwater[3]	Chapter 6 - Local Groundwater	$341
Stormwater Capture[4]	Chapter 7 - Watershed Management	$1,100; $1,550
Metropolitan Water District[5]	Chapter 8 - Metropolitan Water District Supplies	$942 - $1,076
Water Transfers[6]	Chapter 9 - Other Potential Supplies	$220 - $770
Seawater Deslination[7]	Chapter 9 – Other Water Supplies	$1,500 - $3,000

1. Upper end of future conservation costs for LADWP to be determined from Water Conservation Potential Study.
2. MWD Funds conservation at $195/AF, our share is estimated at 15% of MWD's cost.
3. Los Angeles Aqueduct supply and groundwater supply are based on FY2010/11 – 2014/15 10 five-year average.
4. Costs presented are not to exceed costs for infiltration ($1,100/AF) and direct use ($1,550/AF) in 2025, respectively. Projects with higher per unit costs may be implemented if outside funding is obtained or partnerships are implemented. Additionally, LADWP may implement higher per unit cost projects on a case by case basis.
5. MWD water rates for treated water, tier 1 and tier 2, effective on January 1, 2016.
6. Excludes costs associated with wheeling.
7. Cost range presented in MWD Integrated Water Resources Plan 2015 Update.

11.1.2 Funding of Supplies

Funding for water resource programs and projects are primarily provided through LADWP water rates, with supplemental funding provided by the MWD, and state and federal grants. LADWP will also seek reimbursement from potential responsible parties to assist with groundwater treatment program costs.

Funding for water resources projects consists of the following:

- Water Rates – The revenue collected for the LADWP's water resource programs through water rates is the primary funding source to achieve projected goals in conservation, water recycling, stormwater capture, and remediation of contamination in the San Fernando Basin.

- MWD – Currently provides funding through their Local Resources Program (LRP) for the development of water recycling, groundwater recovery, and seawater desalination. The LRP incentive structure offers three options: sliding scale incentives up to $340/AF over 25 years, sliding scale incentives up to $475/AF over 15 years, or fixed incentives up to $305/AF over 25 years. MWD also promotes conservation through its Conservation Credits Program. Since its inception in 1990, the Conservation Credits Program has provided $487 million in rebates and incentives throughout its service area cumulatively saving 2.2 million AF through 2015.

- State Funds – Funds for water recycling, groundwater, water conservation, and stormwater capture have been available on a competitive basis though voter approved initiatives, such as Propositions 50, 84 and 1. Proposition 1 allocates $900 million to prevent or clean up contaminated groundwater. Occasionally low or zero-interest loans are also available through State Revolving Fund programs.

- Federal Funds – Federal funding for water recycling is available through the U.S. Army Corps of Engineers, via periodic Water Resource Development Act legislation, and the U.S. Bureau of Reclamation's Title XVI program.

- Potentially Responsible Parties – LADWP may be able to recover some costs for groundwater cleanup from potentially responsible parties.

Receipt of state or federal funding will allow water resource goals to be achieved sooner than projected, or allow for increased local supply development.

11.2 Reliability Assessment Under Different Hydrologic Conditions

11.2.1 Los Angeles Aqueducts

Water supply from the LAA can vary substantially from year to year due to hydrology. In very wet years, LAA supply can exceed 500,000 AFY. The LAA historical average is based on the 50-year average hydrology from FY 1961/62 to 2010/11. During average year weather conditions, the LAA supply is projected to increase from 275,700 AFY in 2020 to 293,400 AFY in 2025 in response to water savings from Owens Lake Dust Mitigation after the implementation of the Master Project in 2024. However, over time the overall supply source is expected to decline as a result of climate change at 0.1652% annually resulting in a reduction of more than 10,000 AFY in the next 25 years. Critical dry year (defined as a repeat of FY 2014/15 drought) supplies can be as low as 32,000 AFY.

In the last decade, environmental considerations have required the City to reallocate approximately one-half of the LAA water supply to environmental mitigation and enhancement projects. Reducing water deliveries to the City from the LAA has resulted in an increased dependence on imported water supply from MWD. However, as outlined in pLAn, the City has set a target to reduce imported water purchases from MWD by 50 percent from FY 2013/14 levels.

11.2.2 Groundwater

Groundwater is also affected by local hydrology. However, the groundwater basins are operated utilizing conjunctive use management practices, which is to reduce production to increase the storage of water in the groundwater basins during wet years and to increase production to remove water from storage during dry years. During average weather conditions through FY 2039/40, LADWP projects that on a safe yield basis it may pump between 106,670 AFY and 114,670 AFY of groundwater, excluding stormwater recharge and groundwater replenishment supplies. These projections are based on multiple assumptions: (1) Basin groundwater elevations can support this level of pumping on a safe yield basis (2) LADWP's planned Groundwater Treatment Facilities will be operational in FY 2021/22; (3) groundwater storage credits of 5,000 AFY will be used to maximize production in FY 2019/20 and thereafter; and (4) Sylmar Basin production will increase to 4,170 AFY from FY 2015/16 to FY 2038/39 to avoid expiration of stored water credits and then return to the entitlement of 3,570 AFY in 2039/40. Although in dry years LADWP can pump larger quantities of groundwater, a more conservative approach was adopted by assuming the same level of projected groundwater production for both single dry year and multi-dry year analysis.

Groundwater is vulnerable to contamination. The contamination clean-up in San Fernando Basin will facilitate groundwater replenishment utilizing advanced treated recycled water and stormwater recharge for future extraction, which are critical to ensuring the future reliability of the City's groundwater supplies. The Groundwater Treatment Facilities will remediate San Fernando Basin and restore LADWP's ability to fully utilize its local groundwater entitlements, and will facilitate additional storage and extraction programs.

11.2.3 Conservation

The ED5 and Sustainable City pLAn include water use efficiency targets of reducing per capita water use by 20 percent by 2017 and 25 percent by 2035 from FY 2013/14 levels, respectively. LADWP is planning to reduce potable water use levels by an additional 125,800 AFY by 2020, and from 2020 to 2040, LADWP plans to maintain these aggressive reduction levels to achieve LA's Sustainable City pLAn goals.

Since 2014, LADWP has already achieved a significant amount of active and passive conservation through its ED5 conservation strategies and is on track to meet the ED5's 2017 target of 20 percent reduction. A significant portion of the passive conservation achievements from ED5 will be sustained permanently and will continue to contribute to meeting the long-term pLAn targets from 2020 through 2040. In addition, LADWP has recently implemented multiple new initiatives, such as its new rate structure and amendments to the Emergency Conservation Plan Ordinance, and plans to develop additional passive conservation programs to help further increase passive savings through 2040.

As discussed in Chapter 3, LADWP's Water Conservation Potential Study (WCPS) will determine the remaining conservation potential from water-efficient appliances. LADWP will use the final results from the WCPS to help develop its future Conservation

Program. A combination of active and passive conservation strategies will be implemented to develop a Conservation Program that is cost-effective and helps achieve the pLAn targets from 2020 to 2040.

Conservation can be seen as both a demand control measure and/or a source of supply. Of the local supplies being pursued, additional planned conservation is the biggest contributor toward reducing MWD purchases and increasing local supply reliability through 2040 and is therefore considered to be a crucial supply asset for LADWP.

11.2.4 Recycled Water

Recycled water is derived from wastewater effluent flows, which do not vary significantly due to hydrology. Therefore, recycled water use is mainly limited by system capacities and demands. These facts make recycled water a more reliable supply than imported water. As outlined in Chapter 4, Recycled Water, LADWP is planning extensive expansion of its recycled water system not only to include expansion of irrigation and industrial uses, but also to include groundwater replenishment. Under average weather conditions, recycled water supply for irrigation and industrial purposes is projected to increase from 10,000 AFY in 2015 to 45,400 AFY by 2040. Groundwater replenishment with recycled water is projected to be 30,000 AFY by 2024. During a critical dry year, available recycled water supplies would not change.

11.2.5 Stormwater Capture

Capturing stormwater for groundwater recharge is essential to maintaining groundwater supplies, addressing the decrease in stored groundwater, protecting the safe yield of the groundwater basin, and ensuring the long-term water supply reliability of the San Fernando Basin (SFB). Proposed centralized stormwater capture projects will enable the City to utilize its stored water credits in a sustainable manner and prevent conditions of overdraft in the basin. The UWMP projects that by 2040 there will be a minimum of 15,000 AFY of increased groundwater pumping in the SFB due to water supply augmentation through centralized stormwater infiltration. Anticipating that groundwater basin elevations will respond to enhanced groundwater replenishment, LADWP will work with the ULARA Watermaster to continue observing actual water levels and re-evaluate basin safe yield to allow additional increases in groundwater production over time as SFB elevations rebound.

By 2040, the UWMP projects 400 AFY in dry years or 2,000 AFY in average years of additional water savings through distributed direct use stormwater capture projects offsetting potable water use. These water savings contribute to the overall water conservation goal to meet Mayor's water use reduction targets.

11.2.6 MWD Imported Supplies

LADWP has historically purchased MWD water to make up the deficit between in-City demand and local supplies. The City has relied on MWD water to a greater extent during dry years when LAA deliveries diminish. Recently, the LAA supplies have been reduced by the current drought and increased environmental mitigation and enhancement demands. However, pLAn sets a target for the City to ultimately reduce dependence on imported water by 50 percent by 2025 from FY 2013/14 levels. This reliability assessment takes into account this target and reduces reliance on MWD even as demands continue to increase during average weather years. During dry years LA will continue to rely on MWD to provide supplies when LAA supply availability declines during droughts.

Historically, water supplies feeding the MWD system (like LADWP supplies from the LAA) have been subject to variability due to water shortages (i.e., 1976/77, 1987-1992, 2007-2010, and the current drought). This is a result of MWD's core sources of water supply being the Colorado River and SWP, both of which are affected by hydrology. More recently, the current drought coupled with restrictions to protect threatened fish species have decreased pumping from the Bay-Delta, and limited SWP supplies available to MWD. After the 1987-1992 water shortage, MWD started to diversify its water supply portfolio. Partnering with its member agencies, MWD launched its first Integrated Resource Plan (IRP) in 1993, and most recently updated Phase 1 of the 2015 IRP Update in January 2016. Phase 2 of the 2015 IRP Update will consider implementation policies to reach the resources targets established in Phase 1. Together both phases will serve as MWD's strategic plan for water reliability through 2040.

MWD's past IRP efforts have resulted in implementation of a variety of projects and programs designed to reduce its dependency on imported water during water shortages and environmental triggering of SWP pumping restrictions. Efforts have included: (1) providing financial incentives for local projects and conservation; (2) increasing surface storage via Diamond Valley Lake, Lake Mead, and the use of SWP terminal reservoirs; (3) groundwater storage programs in the Central Valley, Imperial Valley, and Coachella Valley; (4) short- and long-term water transfers; and (5) contracted groundwater storage programs with participating member agencies.

Phase 1 of the 2015 IRP Update builds upon the adaptive management approach adopted with the 2010 IRP Update. MWD will manage future risk and uncertainty through the 2015 IRP Update's adaptive management strategy. The strategy focuses on stabilizing and maintaining imported supplies, using increased conservation, sustaining and developing new local supplies, developing a transfer and exchange strategy, and accumulating storage in wet and normal years. These future supply actions, which are low cost and low risk actions designed to accelerate developments on an as needed basis, are key part of the IRP's adaptive management strategy.

MWD's 2015 Urban Water Management Plan indicates that MWD will continue to provide 100 percent reliability through 2040 for its member agencies during average (1922 – 2012 hydrology), single dry (1977 hydrology), and multiple dry years (1990 - 1992 hydrology). For each of these scenarios there is a projected surplus of supply in every forecast year (see Exhibit 11B). The projected surpluses are based on the capability of current supplies and range from 0.1 percent to 87 percent. When including supplies under development for all scenarios, the potential surplus ranges from 5 percent to 11 percent of projected demand.

Exhibit 11B
MWD Supply Capability and Projected Demands (in AFY)

Single Dry Year MWD Supply Capability and Projected Demands (1977 Hydrology)					
Fiscal Year	2020	2025	2030	2035	2040
Capability of Current Supplies	2,584,000	2,686,000	2,775,000	2,905,000	2,941,000
Projected Demands[1]	2,005,000	2,066,000	2,108,000	2,160,000	2,201,000
Projected Surplus	579,000	620,000	667,000	745,000	740,000
Projected Surplus % (Proj. Surplus/Proj. Demands)	29%	30%	32%	34%	34%
Supplies under Development	63,000	100,000	316,000	358,000	398,000
Potential Surplus	642,000	720,000	983,000	1,103,000	1,138,000
Potential Surplus % (Potential Surplus/Proj. Demands)	32%	35%	47%	51%	52%
Multiple Dry Year MWD Supply Capability and Projected Demands (1990-1992 Hydrology)					
Fiscal Year	2020	2025	2030	2035	2040
Capability of Current Supplies	2,103,000	2,154,000	2,190,000	2,242,000	2,260,000
Projected Demands[1]	2,001,000	2,118,000	2,171,000	2,216,000	2,258,000
Projected Surplus	102,000	36,000	19,000	26,000	2,000
Projected Surplus % (Proj. Surplus/Proj. Demands)	5%	2%	1%	1%	0.1%
Supplies under Development	43,000	80,000	204,000	245,000	286,000
Potential Surplus	145,000	116,000	223,000	271,000	288,000
Potential Surplus % (Potential Surplus/Proj. Demands)	7%	5%	10%	12%	13%
Average Year MWD Supply Capability and Projected Demands (1922 - 2012 Hydrology)					
Fiscal Year	2020	2025	2030	2035	2040
Capability of Current Supplies	3,448,000	3,550,000	3,658,000	3,788,000	3,824,000
Projected Demands[1]	1,860,000	1,918,000	1,959,000	2,008,000	2,047,000
Projected Surplus	1,588,000	1,632,000	1,699,000	1,780,000	1,777,000
Projected Surplus % (Proj. Surplus/Proj. Demands)	85%	85%	87%	89%	87%
Supplies under Development	63,000	100,000	386,000	428,000	468,000
Potential Surplus	1,651,000	1,732,000	2,085,000	2,208,000	2,245,000
Potential Surplus % (Potential Surplus/Proj. Demands)	89%	90%	106%	110%	110%

Source: MWD 2015 Urban Water Management Plan, Tables 2-4 to 2-6.

1. Total demands Imperial Irrigation District and San Diego County Water Authority Transfers and canal linings

As part of the implementation of MWD's IRP, MWD and its member agencies worked together to develop MWD's Water Surplus and Drought Management Plan (WSDM Plan) in 1999. The WSDM Plan established broad water resource management strategies to ensure MWD's ability to meet full service demands at all times and provides principles for supply allocation if the need should ever arise. The WSDM Plan splits MWD's resource actions into two major categories: Surplus Actions and Shortage Actions. The Shortage Actions of the WSDM Plan are split into three sub-categories: Shortage, Severe Shortage, and Extreme Shortage. Under Shortage conditions, MWD will make withdrawals from storage and interrupt long-term groundwater basin replenishment deliveries. Under Severe Shortage conditions, MWD will call for extraordinary drought conservation in the form of voluntary savings from retail customers, interrupt 30 percent of deliveries to Agricultural Water Program users, call on its option transfer water, and purchase water on the spot market. The overall objective of MWD's IRP is to ensure that shortage allocations of MWD water supplies are minimized.

Under Extreme Shortage conditions, MWD allocates supplies to its member agencies in accordance with its Water Supply Allocation Plan (WSAP). If shortage allocations are required, MWD will rely on the calculations established in its WSAP initially adopted in 2008 with the latest amendment adopted in 2014. The plan allocates shortages among its member agencies based on need with adjustments for growth, local investments, changes in supply conditions, demand hardening, water conservation programs, and drought impacted groundwater basins.

11.2.7 Water Transfers

Water transfers are being developed as a potential supply to replace a portion of the City's Los Angeles Aqueduct water that has been dedicated for environmental enhancement in the Eastern Sierra Nevada, and to provide increased operational flexibility and cost savings for LADWP customers. Water acquired through transfers helps increase water supply reliability for the City. The Los Angeles Aqueduct and California Aqueduct interconnection, known as the Neenach Pumping Station, is expected to be operational by 2017/18. LADWP may potentially enter agreements to obtain up to 40,000 AFY under average weather conditions, if market water transfers are available.

11.2.8 Service Area Reliability Assessment

To determine the overall service area reliability, LADWP defined three hydrologic conditions: average year (50-year average hydrology from FY 1961/62 to 2010/11); single-dry year (such as a repeat of the FY 2014/15 drought); and multi-dry year (such as a repeat of FY 2012/13 to FY 2014/15). These defined conditions are used to determine the corresponding level of LAA water supply. The corresponding demand under each hydrologic condition is also determined. The average year demand is based on the forecasted median demand as shown in Exhibit 2K. Weather patterns and water demands were further studied to determine single dry year demand and multi-dry year demands. The single-dry and multi-dry year demands are estimated to be 5 percent higher than the forecasted median demand.

The water supply reliability summaries are shown in Exhibit 11C through 11E. Exhibit 11C illustrates the 5-year average from FY 2010/11 to FY 2014/15, Exhibit 11D illustrates single-dry and multi-dry year conditions for FY 2039/40, and Exhibit 11E illustrates the average year condition for FY 2039/40. The projected supply portfolio under multiple dry year conditions is almost identical to that under single dry year conditions. New water conservation is shown as a combined supply source with stormwater reuse. Groundwater is combined with increased pumping due to groundwater replenishment with purified wastewater and captured stormwater. The exhibits show that the City's locally-developed supplies will increase from the current 14 percent to 49 percent in dry years, or to 47 percent in average years. These local supplies are not influenced by variability in hydrology and will become the cornerstone of LA's future water supplies. As a result, the City's combined imported supplies will decrease significantly from the current 86 percent to 51 percent in dry years, or to 53 percent in average years. As for the breakdown of the City's imported supplies, it is still highly influenced by hydrology. The Los Angeles Aqueduct system has limited storage capacity and is therefore subject to the variability of hydrology while MWD (with its ample storage) is capable of providing supplemental water supply to the City with less variability due to hydrologic conditions. By FY 2039/40 LAA deliveries are projected at 7 percent in dry years and 42 percent in average years, MWD will make up the remaining 44 percent in dry years or 11 percent in average years to meet the City's need for supplemental water.

Exhibit 11C
LADWP Supply Reliability FYE 2011-2015 Average

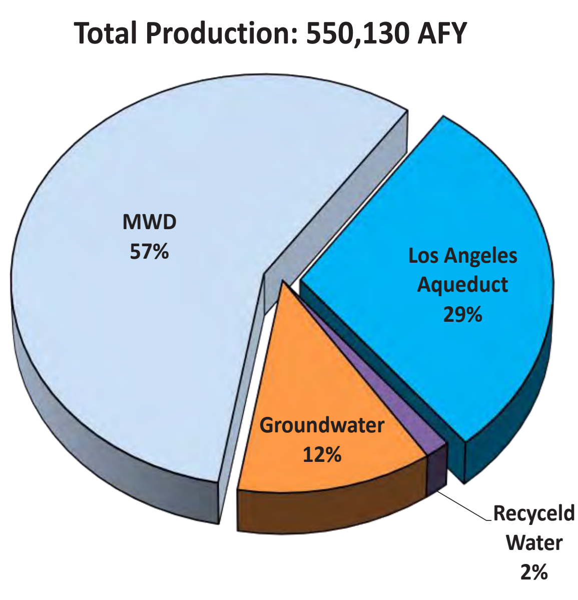


Exhibit 11D
LADWP Supply Reliability Under Single/Multiple Dry Year Conditions in Fiscal Year 2039-40

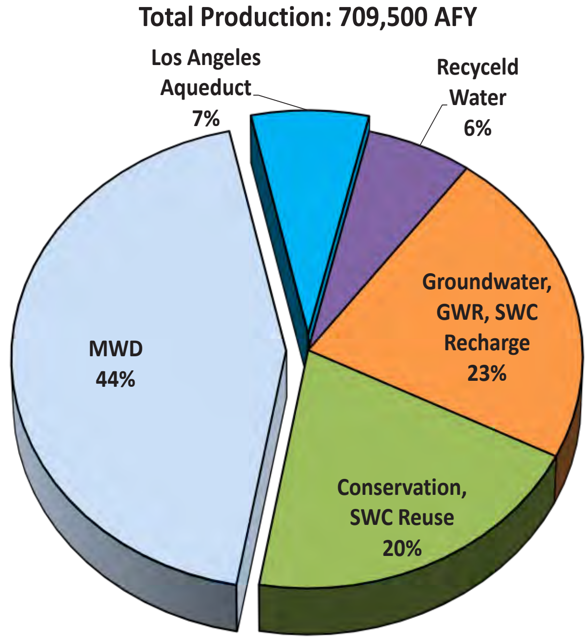
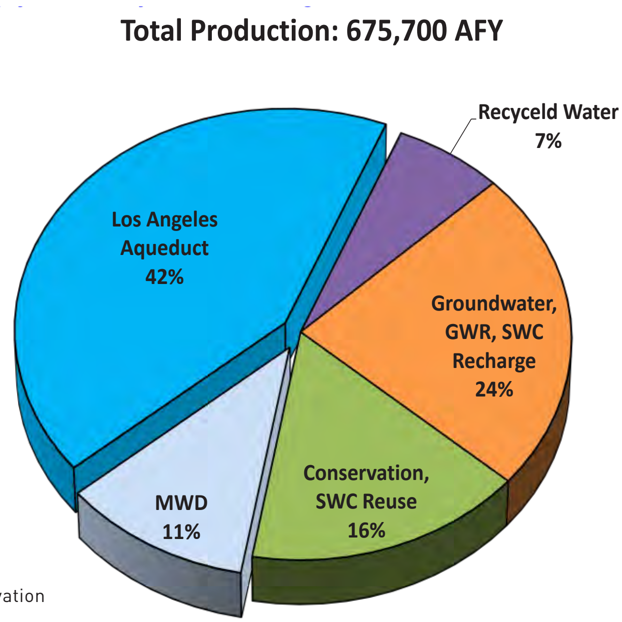


Exhibit 11E
LADWP Supply Reliability Under Average Year Conditions in Fiscal Year 2039-40



Note: Charts do not reflect 118,034 AF of existing conservation

Exhibits 11F through 11H tabulate the service reliability assessment for single dry year, multiple dry year, and average year conditions, respectively. For these reliability tables, existing water conservation has already been subtracted from projected demands, but new water conservation is included as a supply source. Demands are met by the available supplies under all scenarios. In addition to the total water demand, Tables 11F through 11H provide projected water demands aligned to The Sustainable City pLAn's targets.

Exhibit 11F
Service Area Reliability Assessment for Single Dry Year

Demand and Supply Projections (in acre-feet)	Single Dry Year (FY2014-15) Fiscal Year Ending on June 30				
	2020	2025	2030	2035	2040
Total Water Demand[1]	**642,400**	**676,900**	**685,500**	**694,900**	**709,500**
pLAn Water Demand Target	**485,600**	**533,000**	**540,100**	**551,100**	**565,600**
Existing / Planned Supplies					
Conservation (Additional Active[2] and Passive[3] after FY14/15)	156,700	143,700	145,100	143,500	143,500
Los Angeles Aqueduct[4]	32,200	51,900	51,400	51,000	50,600
Groundwater[5] (Net)	112,670	110,670	106,670	114,670	114,070
Recycled Water					
- Irrigation and Industrial Use	19,800	29,000	39,000	42,200	45,400
- Groundwater Replenishment	0	30,000	30,000	30,000	30,000
Stormwater Capture					
- Stormwater Reuse (Harvesting)	100	200	300	300	400
- Stormwater Recharge (Increased Pumping)	2,000	4,000	8,000	15,000	15,000
Subtotal	323,470	369,470	380,470	396,670	398,970
MWD Water Purchases					
With Existing/Planned Supplies	318,930	307,430	305,030	298,230	310,530
Total Supplies	**642,400**	**676,900**	**685,500**	**694,900**	**709,500**
Potential Supplies					
Water Transfers[6]	40,000	40,000	40,000	40,000	40,000
Subtotal	40,000	40,000	40,000	40,000	40,000
MWD Water Purchases					
With Existing/Planned/Potential Supplies	278,930	267,430	265,030	258,230	270,530
Total Supplies	**642,400**	**676,900**	**685,500**	**694,900**	**709,500**

1. Total Demand with existing passive conservation
2. Cumulative hardware savings since late 1980s reached 118,034 AFY by 2014-15.
3. Additional non-hardware conservation required to meet water use reduction goals set in the Sustainable City pLAn.
4. LADWP anticipates conserving 20,000 AFY of water usage for dust mitigation on Owens Lake after the Master Project is implemented in FY 2023-24. Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impact.
5. Net GW excludes Stormwater Recharge and Groundwater Replenishment supplies that contribute to increased pumping. The LADWP Groundwater Remediation project in the San Fernando Basin is expected in operation in 2021-22. Storage credit of 5,000 AFY will be used to maximize pumping in 2019-20 and thereafter. Sylmar Basin production will increase to 4,170 AFY from 2015-16 to 2038-39 to avoid the expiration of stored water credits, then go back to its entitlement of 3,570 AFY in 2039-40.
6. Potential water transfer occurs in dry years with stored water acquired in average and wet years.

Exhibit 11G
Service Area Reliability Assessment for Multi-Dry Years (2011-2015)

Demand and Supply Projections (in acre-feet)	Multiple Dry Years (FY 2012-13 to FY2014-15) Fiscal Year Ending on June 30				
	2020	2025	2030	2035	2040
Total Water Demand[1]	**642,400**	**676,900**	**685,500**	**694,900**	**709,500**
pLAn Water Demand Target	**485,600**	**533,000**	**540,100**	**551,100**	**565,600**
Existing / Planned Supplies					
Conservation (Additional Active[2] and Passive[3] after FY14/15)	156,700	143,700	145,100	143,500	143,500
Los Angeles Aqueduct[4]	33,500	53,200	52,800	52,400	51,900
Groundwater[5] (Net)	112,670	110,670	106,670	114,670	114,070
Recycled Water					
- Irrigation and Industrial Use	19,800	29,000	39,000	42,200	45,400
- Groundwater Replenishment	0	30,000	30,000	30,000	30,000
Stormwater Capture					
- Stormwater Reuse (Harvesting)	100	200	300	300	400
- Stormwater Recharge (Increased Pumping)	2,000	4,000	8,000	15,000	15,000
Subtotal	324,770	370,770	381,870	398,070	400,270
MWD Water Purchases					
With Existing/Planned Supplies	317,630	306,130	303,630	296,830	309,230
Total Supplies	**642,400**	**676,900**	**685,500**	**694,900**	**709,500**
Potential Supplies					
Water Transfers[6]	40,000	40,000	40,000	40,000	40,000
Subtotal	40,000	40,000	40,000	40,000	40,000
MWD Water Purchases					
With Existing/Planned/Potential Supplies	277,630	266,130	263,630	256,830	269,230
Total Supplies	**642,400**	**676,900**	**685,500**	**694,900**	**709,500**

1. Total Demand with existing passive conservation
2. Cumulative hardware savings since late 1980s reached 118, 034 AFY by 2014-15.
3. Additional non-hardware conservation required to meet water use reduction goals set in the Sustainable City pLAn.
4. LADWP anticipates conserving 20,000 AFY of water usage for dust mitigation on Owens Lake after the Master Project is implemented in FY 2023-24. Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impact.
5. Net GW excludes Stormwater Recharge and Groundwater Replenishment supplies that contribute to increased pumping. The LADWP Groundwater Remediation project in the San Fernando Basin is expected in operation in 2021-22. Storage credit of 5,000 AFY will be used to maximize pumping in 2019-20 and thereafter. Sylmar Basin production will increase to 4,170 AFY from 2015-16 to 2038-39 to avoid the expiration of stored water credits, then go back to its entitlement of 3,570 AFY in 2039-40.
6. Potential water transfer occurs in dry years with stored water acquired in average and wet years.

Exhibit 11H
Service Area Reliability Assessment for Average Weather Year

Demand and Supply Projections (in acre-feet)	Average Weather Conditions (FY 1961/62 to 2010/11) Fiscal Year Ending on June 30				
	2020	2025	2030	2035	2040
Total Water Demand[1]	**611,800**	**644,700**	**652,900**	**661,800**	**675,700**
pLAn Water Demand Target	**485,600**	**533,000**	**540,100**	**551,100**	**565,600**
Existing / Planned Supplies					
Conservation (Additional Active[2] and Passive[3] after FY14/15)	125,800	110,900	111,600	109,100	108,100
Los Angeles Aqueduct[4]	275,700	293,400	291,000	288,600	286,200
Groundwater[5] (Net)	112,670	110,670	106,670	114,670	114,070
Recycled Water					
- Irrigation and Industrial Use	19,800	29,000	39,000	42,200	45,400
- Groundwater Replenishment	0	30,000	30,000	30,000	30,000
Stormwater Capture					
- Stormwater Reuse (Harvesting)	400	800	1,200	1,600	2,000
- Stormwater Recharge (Increased Pumping)	2,000	4,000	8,000	15,000	15,000
Subtotal	536,370	578,770	587,470	601,170	600,770
MWD Water Purchases					
With Existing/Planned Supplies	75,430	65,930	65,430	60,630	74,930
Total Supplies	**611,800**	**644,700**	**652,900**	**661,800**	**675,700**
Potential Supplies					
Water Transfers[6]	40,000	40,000	40,000	40,000	40,000
Subtotal	40,000	40,000	40,000	40,000	40,000
MWD Water Purchases					
With Existing/Planned/Potential Supplies	35,430	25,930	25,430	20,630	34,930
Total Supplies	**611,800**	**644,700**	**652,900**	**661,800**	**675,700**

1. Total Demand with existing passive conservation
2. Cumulative hardware savings since late 1980s reached 118,034 AFY by 2014-15.
3. Additional non-hardware conservation required to meet water use reduction goals set in the Sustainable City pLAn.
4. LADWP anticipates conserving 20,000 AFY of water usage for dust mitigation on Owens Lake after the Master Project is implemented in FY 2023-24. Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impact.
5. Net GW excludes Stormwater Recharge and Groundwater Replenishment supplies that contribute to increased pumping. The LADWP Groundwater Remediation project in the San Fernando Basin is expected in operation in 2021-22. Storage credit of 5,000 AFY will be used to maximize pumping in 2019-20 and thereafter. Sylmar Basin production will increase to 4,170 AFY from 2015-16 to 2038-39 to avoid the expiration of stored water credits, then go back to its entitlement of 3,570 AFY in 2039-40.
6. Potential water transfer occurs in dry years with stored water acquired in average and wet years.

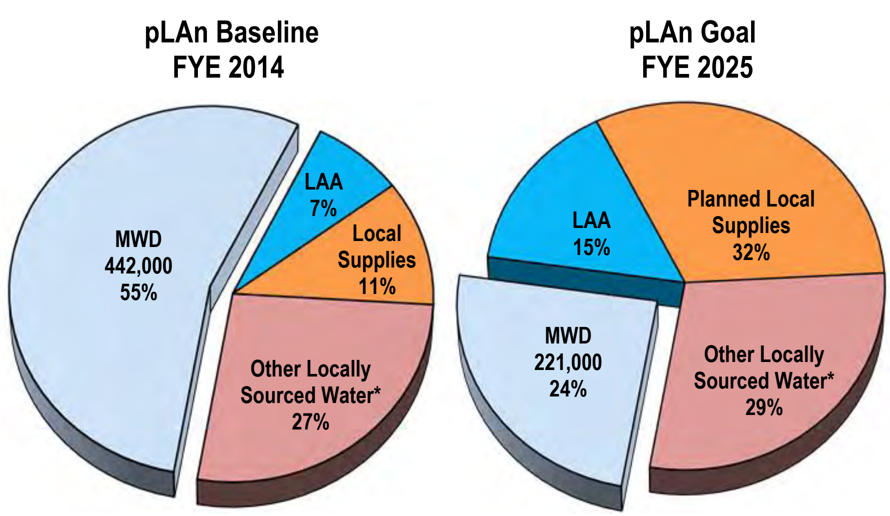
11.3 Sustainable City pLAn Targets for Conservation and Local Supplies

In April 2015 the Mayor released the City's first ever Sustainable City pLAn (pLAn), with a long term focus of improving the environment, economy, and equity in Los Angeles. The pLAn contains a number of water resources goals to:

- Reduce average per capita potable water use by 20 percent from FY 2013/14 by 2017
- Reduce average per capita potable water use by 22.5 percent from FY 2013/14 by 2025
- Reduce imported water purchases from MWD by 50 percent from 2013/14 by 2025
- Reduce per capita potable water use by 25 percent from 2013/14 by 2035
- Expand all local sources of water so that they account for at least 50 percent of the total supply by 2035

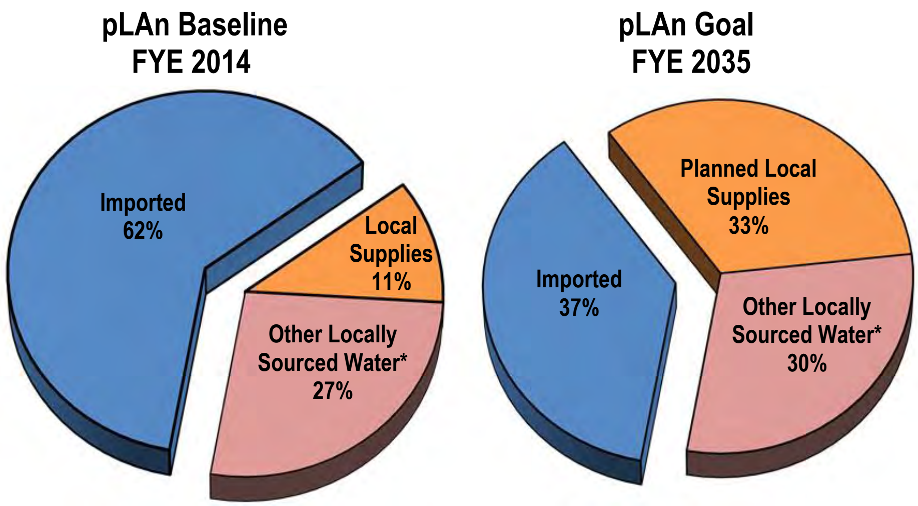
Using the average year 2025 and 2035 supply projections for the LAA, recycled water, groundwater, conservation savings, and stormwater capture (inclusive of historical conservation, stormwater capture, and beneficial reuse of treated wastewater), LADWP's long term strategy for reliability can meet all of the water resources goals established in the City's pLAn. Exhibit 11I illustrates the significant contributions of the additional local supply development in achieving the pLAn's targeted reduction of imported water purchases from MWD by 50 percent in the year 2025. In FY 2013/14 MWD purchases were 442,000 AFY. In FY 2025, accounting for the planned local supplies summarized in Section 11.2, MWD purchases under most hydrologic conditions will be 221,000 AFY or less. Only during extreme dry hydrologic conditions for the LAA (approximately 11 percent of the time) will MWD purchases be greater than the target established by the City's pLAn.

Exhibit 11I
Achieving 50 Percent Reduction in MWD Water Purchases by 2025



*Other Locally Sourced Water consists of: Historical Conservation, Stormwater Capture, Beneficial Reuse/Other

Exhibit 11J
Expanding Local Sources of Water to Account for 50 Percent of Total Supply by 2035



*Other Locally Sourced Water consists of: Historical Conservation, Stormwater Capture, Beneficial Reuse/Other

Exhibit 11J presents how the target of expanding locally-sourced water to achieve 50 percent local water supply by 2035 will be accomplished. In FY 2013/14 all local sources of water (inclusive of historical conservation, stormwater capture and beneficial reuse of treated wastewater) accounted for 38 percent of the total water supply. In FY 2035, accounting for the planned local supplies summarized in Section 11.2, all local sources of water are projected to account for 63 percent of the total water supply.

11.4 Water Shortage Contingency Plan

The Los Angeles City Municipal Code Chapter XII, Article I, Emergency Water Conservation Plan (Appendix I) is the City's water shortage contingency plan (or "ordinance"). It was developed to provide for a sufficient and continuous supply of water in case of a water supply shortage in the service area. There are two scenarios that can cause a water shortage: 1) a severe hydrologic dry period affecting surface and groundwater supplies and 2) a catastrophic event that severs major conveyance and/or distribution pipelines serving water to the City. On June 12, 2015, Los Angeles adopted an amendment to the Emergency Water Conservation Plan Ordinance providing more options for restricting outdoor water use and to add a sixth phase. On May 3, 2016, additional amendments to the Emergency Water Conservation Plan Ordinance were adopted to increase existing surcharges for ordinance violations, create unreasonable use of water penalties, and incorporate the use of technology to improve ordinance enforcement. The City is currently in Phase 2 and has been in this stage since 2009. The following discusses LADWP's compliance with the UWMP Act as outlined in Section 10632 (a) (1) through (9) of the California Water Code.

11.4.1 Stages of Action – 10632 (a) (1)

As set forth in the Emergency Water Conservation Plan, the City has conservation phases or stages of action that can be undertaken in response to water supply shortages. Although there are no specific percentages of water shortage levels assigned to each phase, LADWP continually monitors water supplies and demands on a monthly basis. As necessary, LADWP's Board of Water and Power Commissioners makes recommendations to the Mayor and City Council on the suggested conservation phase to address the water shortage conditions.

The implementation of progressive conservation phases will cope with a 50 percent or greater reduction in water supplies and roughly correspond to the water shortage percentages described below:

No Shortage, Phase I (0 to 15 percent reduction)

Phase I prohibited uses of water are in effect at all times within the City. These prohibited uses, defined in article 10632 (a) (4) (see section 11.4.4), are intended to eliminate waste and increase public awareness of the need to conserve water. There are further stages of compounding actions in addition to the Phase I prohibited uses that might be imposed. Phase II to Phase VI progressively responds to different severities of shortage and implement additional prohibited uses of water.

Moderate Shortage, Phase II (roughly corresponding to 15 to 20 percent reduction)

1. Should Phase II be implemented, uses applicable to Phase I shall continue to be applicable, except as specifically provided herein.

2. No landscape irrigation shall be permitted on any day other than Monday, Wednesday, or Friday for odd-numbered street addresses and Tuesday, Thursday, or Sunday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address. Watering times shall be limited to: (a) Non-conserving nozzles (spray head sprinklers and bubblers) – no more than eight minutes per watering day per station for a total of 24 minutes per week; (b) Conserving nozzles (standard rotors and multi-stream rotary heads) – no more than 15 minutes per cycle and up to two cycles per watering day per station for a total of 90 minutes per week.

3. Upon written notice to LADWP, irrigation of sports fields may deviate from non-watering days to maintain play areas and accommodate event schedules; however, to be eligible for this means of compliance, a customer must reduce his overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 5 percent from the customer baseline water usage within 30 days.

4. Upon written notice to LADWP, large landscape areas may deviate from the non-watering days by meeting the following requirements (1) must have approved weather-based irrigation controllers registered with LADWP (eligible weather-based irrigation controllers are those approved by MWD or the Irrigation Association Smart Water Application Technologies (SWAT) initiative (2) must reduce overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 5 percent from the customer baseline water usage within 30 days; and (3) must use recycled water if it is available from LADWP.

5. These provisions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase II except between the hours of 9:00 am and 4:00 pm.

Significant Shortage, Phase III (roughly corresponding to 20 to 25 percent reduction)

1. Should Phase III be implemented, uses applicable to Phases I and II shall continue to be applicable, except as specifically provided herein.

2. No landscape irrigation shall be permitted on any day other than Monday or Friday for odd-numbered street addresses and Sunday and Thursday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address. Watering times shall be limited to: (a) Non-conserving nozzles (spray head sprinklers and bubblers) – no more than eight minutes per watering day per station for a total of 16 minutes per week; (b) Conserving nozzles (standard rotors and multi-stream rotary heads) – no more than 15 minutes per cycle and up to two cycles per watering day per station for a total of 60 minutes per week.

3. Recommended use of pool covers to decrease water loss from evaporation.

4. Recommended washing of vehicles at commercial car wash facilities.

5. Upon written notice to LADWP, irrigation of sports fields may deviate from the specific non-watering days to maintain play areas and accommodate event schedules. To be eligible for this means of compliance, a customer must reduce their overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 5 percent from the customer baseline water usage within 30 days.

6. Upon written notice to LADWP, large landscape areas may deviate from the specific non-watering days by meeting the following requirements (1) must have approved weather-based irrigation controllers registered with LADWP (eligible weather-based irrigation controllers are those approved by MWD or the Irrigation Association Smart Water Application Technologies (SWAT) initiative (2) must reduce overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 5 percent from the customer baseline water usage within 30 days; and (3) must use recycled water if it is available from LADWP.

7. These provisions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase III except between the hours of 9:00 am and 4:00 pm.

Severe Shortage, Phase IV (roughly corresponding to 25 to 35 percent reduction)

1. Should Phase IV be implemented, uses applicable to Phases I, II, and III shall continue to be applicable, except as specifically provided herein.

2. No landscape irrigation shall be permitted on any day other than Monday for odd-numbered street addresses and Tuesday for even-numbered street addresses. Street addresses ending in ½ or any fraction shall conform to the permitted uses for the last whole number in the address. Watering times shall be limited to: (a) Non-conserving nozzles (spray head sprinklers and bubblers) – no more than eight minutes per watering day per station for a total of eight minutes per week; (b) Conserving nozzles (standard rotors and multi-stream rotary heads) – no more than 15 minutes per cycle and up to two cycles per watering day per station for a total of 30 minutes per week.

3. Mandate use of pool covers on all residential pools when not in use.

4. No washing of vehicles except at commercial car wash facilities.

5. No filling of decorative fountains, ponds, lakes, or similar structures used for aesthetic purposes, with potable water.

6. Upon written notice to LADWP, irrigation of sports fields may deviate from the specific non-watering days. To be eligible for this means of compliance, a customer must reduce their overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 10 percent from the customer baseline water usage within 30 days.

7. Upon written notice to LADWP, large landscape areas may deviate from the specific non-watering days by meeting the following requirements (1) must have approved weather-based irrigation controllers registered with LADWP (eligible weather-based irrigation controllers are those approved by MWD or the Irrigation Association Smart Water Application Technologies (SWAT) initiative (2) must reduce overall monthly water use by LADWP's Board of Water and Power Commissioners' adopted degree of shortage plus an additional 10 percent from the customer baseline water usage within 30 days; and (3) must use recycled water if it is available from LADWP.

8. These provisions do not apply to drip irrigation supplying water to a food source or to hand-held hose watering of vegetation, if the hose is equipped with a self-closing water shut-off device, which is allowed everyday during Phase III except between the hours of 9:00 am and 4:00 pm.

Critical Shortage, Phase V (roughly corresponding to 35 to 50 percent reduction)

1. Phase I, II, III, and IV shall continue to remain in effect.

2. No landscape irrigation allowed.

3. No filling of residential swimming pools and spas with potable water.

4. Upon written notice to LADWP, golf courses and professional sports fields may apply water to sensitive areas, such as greens and tees, during non-daylight hours and only to the extent necessary to maintain minimum levels of biological viability.

Super Critical Shortage, Phase VI (roughly corresponding to greater than a 50 percent reduction)

1. Phase I, II, III, IV, and V shall continue to remain in effect.

2. The Board of Water and Power Commissioners is hereby authorized to implement additional prohibited uses of water based on the water supply situation. Any additional prohibitions shall be published at least once in a daily newspaper of general circulation and shall become effective immediately upon such publication and shall remain in effect until cancelled.

Unreasonable Use of Water

It shall be unlawful for any Customer to waste, or engage in the unreasonable use of water. If any SingleFamily Residential Customer enters the Department's highest rate tier during Phase II-VI, that Customer may be subject to a Water Use Analysis performed by the Department. Department will use available resources, including, but not limited to, water consumption history, land use data, and aerial photographs, to analyze the reasonableness of a Customer's water use.

1. **Notification.** Department may issue a notification to a Customer requesting access to the property for purposes of completing a Water Use Analysis. Within thirty (30) days following written notification by the Department, to the Customer's billing address, the Customer shall provide the Department reasonable access to the property for purposes of completing a Water Use Analysis and for verifying compliance with any existing Customer Conservation Plan.

2. **Cooperation.** Customer, or his designated representative, shall be present and fully cooperate with the Department in the Water Use Analysis, including, but not limited to providing water use information relating to landscaping, agriculture, fixtures, ponds, cooling towers, and other water features and uses located on the property.

3. **Customer Conservation Plan.** Upon completion of the Water Use Analysis, Department may prepare a Customer Conservation Plan that includes an evaluation of all water uses on the property, directions to reduce waste and unreasonable use of water, and a water budget based on the reasonable use of water on the property. Department will discuss with the Customer the findings of the Water Use Analysis and explain the Customer Conservation Plan.

4. The Department shall adopt criteria and process for implementing the Water Use Analysis. When possible the Department will use approved industry standards and methodologies to calculate indoor and outdoor water use.

5. Customer shall comply with all terms of the Department's Customer Conservation Plan, including any water budget provided by Department, and failure to comply shall be deemed an unreasonable use of water that is a threat to public health, safety and welfare and is deemed a nuisance pursuant to Government Code § 38771.

6. **Violation.** Customer failure to (1) provide reasonable access to property following notice, (2) cooperate with Department in the development of a Customer Conservation Plan, or (3) comply with Customer Conservation Plan shall be deemed a new violation of this section, and shall be noticed by the Department by written citation. Violation of this section shall subject Customer to penalties as described in Section 10632 (a) (6).

11.4.2 Driest Three-Year Supply – 10632 (a) (2)

In the event that three consecutive dry-years curtailing the City's LAA System deliveries should follow the FY 2014/15 water supply conditions, LADWP will rely on increased groundwater pumping and purchases from MWD to meet City water demands. This particular sequence is quantified in Exhibit 11K, including relevant assumptions.

Exhibit 11K
Driest Three-Year Water Supply Sequence

Demand and Supply Projections (in acre-feet)	Actual FY	Driest Three Consecutive Years (FY2012-13 to FY2014-15) Fiscal Year Ending on June 30		
	2015	2016	2017	2018
Total Water Demand[1]	**520,905**	**538,900**	**580,700**	**601,300**
pLAn Water Demand Target		**492,300**	**478,700**	**484,300**
Existing / Planned Supplies				
Conservation (Additional Active[2] and Passive[3] after FY14/15)	0	46,600	102,000	116,900
Los Angeles Aqueduct[4]	57,535	77,800	111,400	33,700
Groundwater[5] (Net)	90,438	72,803	73,641	90,748
Recycled Water				
- Irrigation and Industrial Use	10,421	11,000	13,000	19,000
- Groundwater Replenishment	0	0	0	0
Stormwater Capture				
- Stormwater Reuse (Harvesting)	0	0	0	100
- Stormwater Recharge (Increased Pumping)	0	0	0	0
Storage Change	96	0	0	0
Subtotal	158,394	208,203	300,041	260,448
MWD Water Purchases				
With Existing/Planned Supplies	362,607	330,697	280,659	340,852
Total Supplies	**520,905**	**538,900**	**580,700**	**601,300**

1. Total Demand with existing passive conservation
2. Cumulative hardware savings since late 1980s reached 118,034 AFY by 2014-15.
3. Additional non-hardware conservation required to meet water use reduction goals set in the Sustainable City pLAn.
4. LADWP anticipates conserving 20,000 AFY of water usage for dust mitigation on Owens Lake after the Master Project is implemented in FY 2023-24. Los Angeles Aqueduct supply is estimated to decrease 0.1652% per year due to climate change impact.
5. Net GW excludes Stormwater Recharge and Groundwater Replenishment supplies that contribute to increased pumping. The LADWP Groundwater Remediation project in the San Fernando Basin is expected in operation in 2021-22. Storage credit of 5,000 AFY will be used to maximize pumping in 2019-20 and thereafter. Sylmar Basin production will increase to 4,170 AFY from 2015-16 to 2038-39 to avoid the expiration of stored water credits, then go back to its entitlement of 3,570 AFY in 2039-40.

During such severe drought periods, the City's supplemental water supplier MWD will use its WSAP in conjunction with the framework developed in its WSDM Plan. Developed by MWD with substantial input from its member agencies, the WSDM Plan provides for the WSAP's needs-based allocation strategy, and establishes priorities for the use of MWD's water supplies to achieve retail reliability.

The following are actions that could be taken by MWD, in accordance with their WSDM Plan, to augment its water supplies prior to implementation of any WSAP drought allocation action:

1. Draw on Diamond Valley Lake storage.
2. Draw on out-of-region storage such as Semitropic and Arvin-Edison Groundwater Banks.
3. Reduce/suspend local groundwater replenishment deliveries.
4. Draw on contractual groundwater storage programs in MWD's service area.
5. Draw on State Water Project terminal reservoir storage (per Monterey Agreement).
6. Call for voluntary conservation and public education.
7. Call on water transfer options contracts.
8. Purchase transfers on the spot market.
9. Allocate imported water in accordance with the WSAP if necessary.

In 2008 MWD adopted the WSAP which is designed to allocate supplies among its member agencies in a fair and efficient manner. MWD's latest revisions were adopted on December 9, 2014 in response to a third year of severe drought and mandatory supply allocations in 2015. The WSAP establishes the formula for calculating member agency allocations if MWD cannot meet firm demands in a given year.

11.4.3 Catastrophic Supply Interruption Plan – 10632 (a) (3)

11.4.3.1 Seismic Assessment of Major Imported Supplies

MWD performed a seismic risk assessment of its water distribution network to evaluate the impacts of seismic activity in the greater Southern California area. For MWD, there are three sources of imported water to the region: the Colorado River Aqueduct (CRA), the East SWP branch, and the West SWP branch. Each source was evaluated for the potential of failure during a seismic event. The SWP East branch is considered more vulnerable because the California Aqueduct's alignment follows the San Andreas fault-line and crosses over the San Andreas Fault at multiple locations. The SWP West branch and CRA are somewhat less vulnerable due to their proximity to the San Andreas fault-line, although the San Andreas Fault crosses all aqueducts entering the Southern California region. It crosses the SWP East branch three times, the SWP West branch once, the CRA once, and the LAA once. MWD has determined its Diamond Valley Lake, SWP terminal reservoir storage, and member-agency emergency storage can adequately provide for a six-month supply of water for the entire MWD service area with a temporary 25 percent reduction in demand. MWD's engineering studies have shown six months is an adequate time to repair and resume deliveries from the SWP.

LADWP investigated the ability of MWD to deliver Colorado River water into the west San Fernando Valley in the event that SWP supplies and LAA supplies are interrupted. This investigation included the two MWD service areas adjacent to the West San Fernando Valley, the Calleguas and Las Virgenes Municipal Water Districts. If imported supply from the SWP and LAA are severed, MWD has prolonged emergency storage in Castaic and Pyramid Lakes. Given the proximity of MWD infrastructure to seismic activity on the San Andreas Fault, MWD staff predicts that if Castaic and Pyramid Lakes become disconnected from the City emergency repairs can be made to ensure that supply is not interrupted for an extended period of time. In a worst case scenario, if these sources are cut off from the City, 50 cubic feet per second of CRA water could be moved through MWD's system to serve the west San Fernando Valley, Calleguas MWD, and Las Virgenes MWD until repairs to the MWD facilities could be made. On-call contractors working around the clock could be deployed to repair seismic damage in as short as a two-week time period depending on the severity and location of the break(s). Due to these risks MWD's current storage policy is to maintain maximum emergency storage in both Pyramid and Castaic Lakes.

11.4.3.2 Emergency Response Plan

LADWP has Emergency Response Plans (ERPs, revised January 2016) in place to restore water service for essential use in the City if a disaster, such as earthquakes and power outages, should result in the temporary interruption of water supply. Department personnel responsible for water transportation, distribution, and treatment have established ERPs to guide the assessment, prioritization, and repair of City facilities that have incurred damage during a disaster.

An Emergency Operations Center (EOC) serves as a centralized point for citywide management of information about disasters and for coordination of all available resources. The EOC supports the City's Emergency Operations Organization to achieve its mission of saving lives, protecting property, and returning the City to normal operations in the event of a disaster. LADWP coordinates its efforts with the EOC and will utilize the EOC to resume water supply service after a catastrophic event.

Earthquakes

In the event of a major earthquake, LADWP has a Disaster Response Plan dedicated for the LAA in addition to its overall ERP. The Disaster Response Plan details procedures for operating the LAA following an earthquake in order to prevent further damage of the LAA. If the LAA is severed by seismic activity on the San Andreas fault and is temporarily unable to provide water to the City, LADWP will be able to use its water storage in Bouquet Reservoir to provide water supply to the City while repairs are made. In addition to this resource, if the California Aqueduct is intact south of the Neenach Pump Station (First Los Angeles Aqueduct – State Water Project Connection), arrangements may be made to transfer LAA water through this connection into the California Aqueduct for delivery to MWD. Arrangements can then be made to deliver water to the City through one of MWD's connections.

Power Outages

Most of LADWP's major pump stations have backup generators in the event a major power outage disrupts the primary energy system. Backup generators are either powered by a separate electric source or have independent diesel power. The diesel powered backup supplies are capable of running for at least 24 hours. In the event of a major power outage, all pump stations are designed to automatically switch to their backup generators to prevent disruption of water service. In addition, LADWP keeps an adequate storage supply which is able to keep the water distribution system operable until power is restored.

11.4.4 Mandatory Water Use Prohibitions – 10632 (a) (4)

Phase I prohibited uses of the Emergency Water Conservation Plan contains 13 wasteful water use practices that are permanently prohibited for all City of Los Angeles customers. Additional prohibited uses under other conservations phases can be found in section 11.4.1. These prohibited uses are intended to eliminate waste. During times of shortage, education and enforcement will be increased to enhance public awareness of the need to conserve water. The following are the 13 Phase 1 provisions:

1. No customer shall use a water hose to wash any paved surfaces including, but not limited to, sidewalks, walkways, driveways, and parking areas, except to alleviate immediate safety or sanitation hazards. This section shall not apply to LADWP approved water conserving spray cleaning devices. Use of water pressure devices for graffiti removal is exempt. A simple spray nozzle does not qualify as a water conserving spray cleaning device.

2. No customer shall use water to clean, fill, or maintain levels in decorative fountains, ponds, lakes, or similar structures used for aesthetic purposes unless such water is part of a recirculating system.

3. No restaurant, hotel, cafe, cafeteria, or other public place where food is sold, served, or offered for sale shall serve drinking water to any person unless expressly requested.

4. No customer shall permit water to leak from any pipe or fixture on the customer's premises; failure or refusal to affect a timely repair of any leak of which the customer knows or has reason to know shall subject said customer to all penalties for a prohibited use of water.

5. No customer shall wash a vehicle with a hose if the hose does not have a self-closing water shut-off device or device attached to it, or otherwise to allow a hose to run continuously while washing a vehicle.

6. No customer shall irrigate during periods of rain and within 48 hours after a measureable rain event.

7. No customer shall water or irrigate lawn, landscape, or other vegetated areas between the hours of 9:00 a.m. and 4:00 p.m. During these hours, public and private golf courses greens and tees and professional sports fields may be irrigated in order to maintain play areas and accommodate event schedules. Supervised testing or repairing of irrigation systems is allowed anytime with proper signage.

8. All irrigating of landscape with potable water using spray head sprinklers and bubblers shall be limited to no more than ten minutes per watering day per station. All irrigating of landscape with potable water using standard rotors and multi-stream rotary heads shall be limited to no more than fifteen minutes per cycle and up to two cycles per watering day per station. Exempt from these irrigation restrictions are irrigation systems using very low drip type irrigation when no emitter produces more than four gallons of water per hour and micro-sprinklers using less than fourteen gallons per hour.

9. No customer shall use in a manner that causes or allows excess or continuous flow or runoff onto an adjoining sidewalk, driveway, street, gutter, or ditch.

10. No installation of single pass cooling systems shall be permitted in buildings requesting new water service.

11. No installation of non-recirculating systems shall be permitted in new conveyor car wash and new commercial laundry systems.

12. Operators of hotels and motels shall provide guests with the option of choosing not to have towels and linens laundered daily. The hotel or motel shall prominently display notice of this option in each bathroom using clear and easily understood language. LADWP shall make suitable displays available.

13. No large landscape areas shall have irrigation systems without rain sensors that shut-off the irrigation systems. Large landscape areas with approved weather-based irrigation

controllers registered with LADWP are in compliance with this requirement.

11.4.5 Consumption Reduction Methods During Most Restrictive Stages – 10632 (a) (5)

Short-Term Actions

During a water shortage or emergency condition, LADWP utilizes its Emergency Water Conservation Plan (11.4.1) to decrease water use as needed based on the severity of the shortage. The Emergency Water Conservation Plan is capable of reducing water use in excess of 50 percent.

In addition, since 1993, LADWP's rate structure served as a basis to further reduce consumption. First tier water allotments were reduced during shortages by the degree of the shortage. For single-family residential users, the adjusted first tier allotments applied for the entire year. For other users, the adjusted first tier allotments applied only during the high season (June 1 through October 31). In July 2015, LADWP proposed a new rate structure to the Board of Water and Power Commissioners. The new rate structure sought to, among other objectives, further reinforce foundational water use efficiency. Following the proposal to the Board of Water and Power Commissioners, LADWP conducted extensive community outreach on the new rate structure at over 90 neighborhood council, community, business and civic meetings and webinars. Through the outreach campaign, LADWP shared more information on the proposed rate structure, which include:

- Budget Based Allocations;
- Seasonal rates;
- Four tiered rate for single-dwelling-unit residential customers;
- 100% volumetric pricing;
- Decoupled rates; and
- Revenue predictability.

On March 15, 2016, LA City Council approved the new rate structure. Details on the water rate structure are provided in Appendix C – Water Rate Ordinance.

To provide immediate demand reductions and increase public awareness of the need to conserve water, additional measures can be phased in as the dry period continues. Included among these measures are water conservation public service announcements (through television and/or radio), billboard ads, flyer distributions, and conservation workshops. LADWP also actively participates in public exhibits to disseminate water conservation information within its service area. Conservation is a permanent and long-term ethic adopted by the City to counter the potentially adverse impacts of water supply shortages.

State law further regulates distribution of water in extreme water shortage conditions. Section 350-354 of the California Water Code states that when a governing body of a distributor of a public water supply declares a water shortage emergency within its service area, water will be allocated to meet needs for domestic use, sanitation, fire protection, and other priorities. This will be done equitably and without discrimination between customers using water for the same purpose(s).

Long-Term Actions

LADWP's long-range water conservation program is driven by the need to continuously increase water use efficiency. This will reduce demand, extend supply, and therefore, provide greater reliability. Dry cycle experiences, public trust responsibilities, and regulatory mandates have raised the level of awareness within the City of Los Angeles of the need to approach demand reduction from a permanent and long-term perspective.

LADWP will continue to maintain and increase its existing conservation programs and pursue the development of new and innovative programs as outlined in Chapter 3, Water Conservation, and the Water Conservation Potential Study to meet the pLAn water demand target of 565,600 AFY by FY 2039/40. It should, however, be recognized that the ability to achieve water reduction during shortages by requesting additional voluntary measures is likely to be more difficult in the future. As customers adjust to a conservation ethic and adopt permanent measures to reduce water use, their water demands harden and become less susceptible to voluntary conservation.

11.4.6 Penalties for Excessive Use (Non-Compliance to Prohibited Use) – 10632 (a) (6)

The Emergency Water Conservation Plan sets penalties for violations of prohibited and unreasonable uses outlined in Sections 11.4.1 and 11.4.4. The specific penality for each violation is summarized in Exhibits 11L and 11M. The penalties vary by water meter size for Penalty Schedule A.

Exhibit 11L
Penalty Schedule A - Prohibited Use Violations

Water meter smaller than two (2") inches						
	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
1st Written Warning	$0	$0	$0	$0	$0	Board Authority
2nd Written Violation	$50	$100	$200	$300	$400	Board Authority
3rd Written Violation	$100	$200	$400	$600	$800	Board Authority
4th Written Violation	$150	$300	$600	$900	$1200	Board Authority

Water meter two (2") inches and larger						
	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
1st Written Warning	$0	$0	$0	$0	$0	Board Authority
2nd Written Violation	$100	$200	$400	$600	$800	Board Authority
3rd Written Violation	$200	$400	$800	$1200	$1600	Board Authority
4th Written Violation	$300	$600	$1200	$1800	$2400	Board Authority

Exhibit 11 M
Penalty Schedule B - Unreasonable Use Violations

Number of Consecutive Months with Violation	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Violation during months 1-5	N/A	$1,000	$2,000	$5,000	$10,000	Board Authority
Violation during months 6-11	N/A	$2,000	$4,000	$10,000	$20,000	Board Authority
Violation during months 12-17	N/A	$3,000	$6,000	$15,000	$30,000	Board Authority
Violation during months 18-23	N/A	$4,000	$8,000	$20,000	$40,000	Board Authority

11.4.7 Analysis and Effects on Revenues and Expenditures of Reduced Sales during Shortages – 10632 (a) (7)

The City's Water Rate Ordinance, adopted in June 1995, was last amended on March 15, 2016 to incorporate a new rate structure. The revised rate ordinance replaced the previous General Provision H with a decoupling component known as the Base Rate Revenue Target Adjustment (BRRTA). The BRRTA allows for LADWP to recover any shortage in revenue from base rates if sales decrease or credit back any excess collection if sales increase over the target. The BRRTA Factor is calculated once each year, separately for each schedule, and takes effect on January 1. The BRRTA eliminates the link between volume of sales and revenue collected, provides financial stability, and removes inherent barriers for conservation.

For more details on the water rate structure, please see Appendix C – Water Rate Ordinance.

11.4.8 Water Shortage Contingency Resolution or Ordinance – 10632 (a) (8)

A draft water shortage contingency declaration resolution is shown in Exhibit 11N.

Moreover, the City's Emergency Water Conservation Plan Section 121.07.B has the following conservation phase implementation procedures:

"The Department (LADWP) shall monitor and evaluate the projected supply and demand for water by its Customers monthly, and shall recommend to the Mayor and Council by concurrent written notice the extent of the conservation required by the Customers of the Department in order for the Department to prudently plan for and supply water to its Customers. The Mayor shall, in turn, independently evaluate such recommendation and notify the Council of the Mayor's determination as to the particular phase of water conservation, Phase I through Phase VI, that should be implemented. Thereafter, the Mayor may, with the concurrence of the Council, order that the appropriate phase of water conservation be implemented in accordance with the applicable provisions of this Article. Said order shall be made by public proclamation and shall be published one time only in a daily newspaper of general circulation and shall become effective immediately upon such publication. The prohibited water uses for each phase shall take effect with the first full billing period commencing on or after the effective date of the public proclamation by the Mayor. In the event the Mayor independently recommends to the Council a phase of conservation different from that recommended by the Department, the Mayor shall include detailed supporting data and the reasons for the independent recommendation in the notification to the Council of the Mayor's determination as to the appropriate phase of conservation to be implemented."

Exhibit 11N
Draft Water Shortage Contingency Declaration Resolution

BE IT RESOLVED that the Board of Water and Power Commissioners (Board) recognizes that a Water Shortage Contingency Plan has been prepared and incorporated into the City of Los Angeles 2015 Urban Water Management Plan pursuant to the Urban Water Management Planning Act; the Urban Water Management Plan is on file with the Secretary of the Board; this Board has reviewed and considered the information and recommendations contained in this document, and makes the following findings and determinations:

1. The water supply available to the City of Los Angeles is insufficient to meet the City's normal water supply needs; and
2. The Department of Water and Power has developed a Water Shortage Contingency Plan for the City of Los Angeles that compiles with all the requirements of the Urban Water Management Planning Act; and
3. The Urban Water Management Plan has been developed, adopted, and implemented pursuant to Article 3, Sections 10640 through 10645 of the Urban Water Management Planning Act; and
4. The Water Shortage Contingency Plan includes stages of action that can be taken in response to water supply shortages, including up to a 50 percent reduction in water supply, a driest three-year water supply scenario, mandatory water use prohibitions, and penalties for non-compliance; and
5. The Water Shortage Contingency Plan identifies both short-term and long-term actions to maximize water use efficiency and minimize the effects of the current water shortage as well as future water supply shortages.

BE IT FURTHER RESOLVED that this Board has adopted the Water Shortage Contingency Plan as incorporated in the Urban Water Management Plan, and declares the provisions of the Water Shortage Contingency Plan in full force and effect during the duration of this period of water shortage.

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of the resolution adopted by the Board of Water and Power Commissioners of the City of Los Angeles at its meeting held

11.4.9 Methodology to Determine Actual Water Use Reductions during Shortages – 10632 (a) (9)

Water use is monitored closely by LADWP throughout its service area regardless of the supply conditions. With 100 percent of its over 700,000 service connections metered, there is a high degree of accountability on the quantity of water used within the LADWP service area. Information from meter reads is collected for billing and accounting purposes, with reports prepared on a monthly basis from the data compiled. The actual water reductions are determined by comparing the metered water use to the normal water use under average weather condition when no mandatory water conservation is imposed. Based on these criteria, the water use level of FY 2006/07 was selected as the base year or the normal year to determine the effectiveness of water reduction measures during the recent water supply shortage.

11.5 Water Supply Assessments

Background

In 1994, the California Legislature enacted Water Code Section 10910 (Senate Bill 901), which requires cities and counties, as part of California Environmental Quality Act (CEQA) review, to request the applicable public water system to assess whether the system's projected water supplies were sufficient to meet a proposed development's anticipated water demand. The intent was to link the land use and water supply planning processes to ensure that developers and water supply agencies communicate early in the planning process. However, a study of projects approved by local planning agencies revealed that numerous projects were exempted due to loopholes in the statute, and that the intent of the legislation had largely gone unfulfilled.

Subsequently, California Senate Bill (SB) 610 and SB 221, modeled after SB 901, amended State law effective January 1, 2002, to ensure that the original intent of the legislation is fulfilled. SB 610 and 221 are companion measures which seek to promote more collaborative planning between local water suppliers and cities and counties. These bills improve the link between information on water supply availability and certain land use decisions made by cities and counties. Both statutes require detailed information regarding water availability to be provided to the city and county decision-makers prior to approval of specified large development projects. Both statutes also require this detailed information be included in the administrative record that serves as the evidentiary basis for an approval action by the city or county on such projects. Both measures recognize local control and decision making regarding the availability of water for projects and the approval of projects.

Under SB 610, a water supply assessment (WSA) must be furnished to local governments for inclusion in any environmental documentation for specified types of development projects subject to CEQA. Specifically, SB 610 requires that for certain projects, the CEQA lead agency must identify a public water system that may supply water to the proposed project and request the public water system to determine the water demand associated with the project and whether such demand is included as part of the public water system's most recently adopted UWMP. If the projected water demand associated with the proposed project is accounted for in the most recently adopted UWMP, the public water system may incorporate the supporting information from the UWMP in preparing the elements of the assessment. If the proposed project's water demand is not accounted for in the most recently adopted UWMP, the WSA for the project shall include a discussion with regard to whether the public water system's total projected water supplies available in normal, single-dry, and multiple-dry water years during a 20-year projection will meet the proposed project's water demand.

Per Section 10912 of the California Water Code, a project which is subject to the requirements of SB 610 includes: (1) a proposed residential development of more than 500 dwelling units; (2) a proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space; (3) a proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space; (4) a proposed hotel or motel, or both, having more than 500 rooms; (5) a proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area; (6) a mixed-use project that includes one or more of the projects specified in this subdivision; or (7) a project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project.

The assessment would include an identification of existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project and water received in prior years pursuant to those entitlements, rights, and contracts. If the assessment concludes that water supplies will be insufficient, plans for acquiring additional water supplies would need to be presented.

Under SB 221, approval by a city or county of new large development projects requires an affirmative written verification of sufficient water supply; which is a "fail safe" mechanism to ensure that collaboration on finding the needed water supplies to serve a new large development occurs before construction begins.

Methodology

Each WSA performed by LADWP is carefully evaluated within the context of the currently adopted UWMP and current conditions, such as restrictions on SWP pumping from the Sacramento-San Joaquin Delta imposed by a Federal court and drought conditions. MWD, from whom the City purchases its SWP and Colorado River water supplies, has also been actively developing plans and making efforts to provide additional water supply reliability for the entire Southern California region. LADWP coordinates closely with MWD to ensure implementation of MWD's water resource development plans and supplemental water reliability report prepared by MWD.

LADWP's UWMP uses a service area-wide method in developing City water demand projections. This methodology does not rely on individual development demands to determine area-wide growth. Rather, the growth in water use for the entire service area was considered in developing long-term water projections for the City to the year 2040. The driving factors for this growth are demographics, weather, and conservation. LADWP used anticipated growth in the various customer class sectors as provided by MWD who received projected demographic data from the Southern California Association of Governments (SCAG). The data used was based on SCAG's 2012 Regional Transportation Plan (RTP) Forecast.

As governed by City Charter Sections 673 and 677, LADWP can serve surplus water supplies to areas outside of the City boundary. LADWP's demand projections are based on its entire service area, which includes approximately 5,400 services for customers outside of the City. The combined annual water use of customers outside of the city is less than 1 percent of all water delivered. Water served outside of the City includes a surcharge to account for the increased MWD purchased water.

The water demand forecast model in the UWMP was developed using LADWP total water use, including the water served by LADWP for use outside of the City. The service area reliability assessment was performed for three hydrologic conditions: average year, single-dry year, and multiple-dry years; and a Shortage Contingency Plan was developed to provide for a sufficient and continuous supply in LADWP's service area. This

Shortage Contingency Plan included water provided for use outside of the City.

An important part of the water planning process is for LADWP to work collaboratively with MWD to ensure that anticipated water demands are incorporated into MWD's long-term water resources development plan and water supply allocation plan. The City's allotment of MWD water supplies under MWD's Water Supply Allocation Plan is based on the City's total water demand which includes services to areas outside the City. The ongoing collaboration between LADWP and MWD is critical in ensuring that the City's anticipated water demands are incorporated into the development of MWD's long-term Integrated Resources Plan (IRP). MWD's IRP directs a continuous regional effort to develop regional water resources involving all of MWD's member agencies. Successful implementation of MWD's IRP has resulted in reliable supplemental water supplies for the City from MWD.

In summary, the WSAs are performed to ensure that adequate water supplies would be available to meet the estimated water demands of the proposed developments during normal, single-dry, and multiple-dry water years, as well as existing and planned future uses of the City's water system. LADWP will continue to perform WSAs as part of its long-term water supply planning efforts for its service area.

WSA Procedure

The City of Los Angeles Department of City Planning (City Planning) is the CEQA lead agency for most projects within the LADWP service area, although other City departments or even the County of Los Angeles may perform this role. The CEQA lead agency must evaluate proposed projects against the requirements for a WSA, in accordance with the Water Code. If a proposed project falls within CEQA requirements for a WSA, the lead agency must submit a formal WSA request to LADWP.

Once a formal request is received, LADWP staff coordinates with the CEQA lead agency and project developer to clarify project scope and estimate project water demand. The existing water demand for uses to be removed on site, as well as proposed voluntary water conservation by the developer, are subtracted from the estimated gross proposed project demand to arrive at the net additional water demand. Existing, on-site water demand is typically established by historical billing records. WSAs include a discussion of the impacts of the annual net additional water demand of the project on the City's potable water supply. Elements of the water demand calculation are briefly described below.

Proposed Water Demand

Proposed water demand includes proposed indoor and outdoor water uses as well as cooling towers and/or parking. For indoor uses, base demand is first estimated by applying sewer generation factors (SGFs), published by City of Los Angeles Bureau of Sanitation, to elements of the project scope such as square footage and use type (restaurant, office, etc.). Because SGFs and water conservation codes and ordinances are updated at different times, current SGFs may not account for water savings from the most current ordinances. Required water savings are due to the Water Efficiency Requirements Ordinance No. 180822 and any other current City and State water conservation requirements. Much of the required water savings are achieved through high-efficiency plumbing fixtures. To account for water savings from codes and ordinances, required water savings is subtracted from indoor base demand to arrive at the indoor proposed water demand.

Water demand for outdoor uses is estimated per California Code of Regulations Title 23, Division 2, Chapter 2.7. Model Water Efficient Landscape Ordinance (MWELO). MWELO sets the maximum allotment through the Maximum Applied Water Allowance (MAWA). The proposed project water demand is known as the Estimated Total Water Use (ETWU) and is based on a formula using local environmental factors as well as project scope. LADWP establishes an outdoor base demand assuming no water conservation or restrictions are applied, and ordinance savings for irrigation are determined by subtracting MAWA from outdoor base demand. Similarly, voluntary conservation is determined by subtracting ETWU from MAWA.

Additional (Voluntary) Water Conservation

LADWP encourages developers to implement additional water conservation measures above and beyond the current water conservation ordinance requirements. Indoor voluntary measures might comprise inclusion of plumbing fixtures with flow rates below those required by current codes. As stated above, outdoor voluntary conservation is estimated by subtracting ETWU from MAWA. ETWU represents water needs for specific plant types while considering the efficiency of proposed irrigation systems. Developers may achieve outdoor additional conservation by proposing drought tolerant plants and efficient irrigation systems that bring ETWU below MAWA.

Additionally, if a proposed development is near an existing or planned, future recycled water pipeline system, commitment to use of recycled water for non-potable uses, such as irrigation, cooling towers, and toilet flushing, is highly recommended as part of the additional conservation measures for the proposed development, as long as City and County codes and ordinances are followed.

Basis for Approval

The basis for approving WSAs comes from the demographic projections by the Southern California Association of Governments (SCAG) and their link to the UWMP. The CEQA lead agency for proposed projects in LADWP's service area, in most cases City Planning, is responsible for determining if projects requiring discretionary actions conform to the use and intensity of development permitted by the City's General Plan or if it otherwise requires General Plan amendments, using the latest SCAG demographic projections. The General Plan framework establishes the "Policy" growth level as the basis for the planning of land use, transportation, infrastructure, and public services. CEQA lead agencies representing projects within the LADWP service area must ensure that a proposed development is consistent with the latest demographic growth projection by SCAG.

WSAs must include a discussion on whether projected water supply availability during a 20-year projection will meet a proposed development's water demand. SCAG utilizes a land use-based planning tool that allocates its projected demographic data into water service areas for MWD's member agencies, which was adopted for water demand projections in the UWMP. Because LADWP has performed an analysis of future City water demand based on SCAG population projections and has determined that adequate water supplies do exist out to 2040 to meet projected demand, developments that are consistent with the most recent SCAG projections have been captured in LADWP's demand forecast. This is the basis of approval for projects requiring WSAs.

All WSAs are subject to approval by the Board of Water and Power Commissioners. Upon approval, the CEQA lead agency is responsible for enforcing the requirements of the WSA.

11.6 Estimated Valuation of Water Supply Reliability

In 2012, LADWP participated in a study led by Los Angeles County Economic Development Corporation to estimate the economic impacts on Los Angeles County due to a major disruption of California Aqueduct. The study report titled "Total Regional Economic Losses from Water Supply Disruptions to the Los Angeles County Economy" was released on November 29, 2012 and updated on July 23, 2013. This study can be found at: http://laedc.org/wp-content/uploads/2012/11/FINAL-LA-Water_Report-7-23-2013.pdf.

This study estimated the total regional economic impacts of one major set of disruption scenarios stemming from a Bay Delta earthquake that would cause the closure of the California Aqueduct (State Water Project) for 6, 24, or 36 months. It also incorporated possible resilience, or tactics such as storage and diversion of replenishment water to reduce the impacts of a disruption. Moreover, water suppliers could adapt to the crisis by undertaking extra levels of conservation and recycling, and implementing technological innovations.

The partial conclusions of the study are highlighted below:

- The 6-month shutdown of the California Aqueduct in normal years relating to weather and hydrology conditions and reasonable levels of resilience, primarily conservation and production recapture, will result in no negative economic impacts.

- A24-month shutdown of the California Aqueduct could lead to a total two-year loss of 742,000 job-years of employment, $75 billion of gross domestic product (GDP), and $135 billion of sales revenue for businesses in LA County. Reasonable levels of several types of resilience could reduce this outcome significantly.

- Existing water storage is able to mute the potential impacts considerably. Maximum potential losses would be doubled for the 24-month and 36-month scenarios with zero storage, and even more in the cases of adverse hydrological conditions, such as extreme dry years.

- Resilience tactics other than water storage can reduce losses considerably if implemented close to their maximum potential. Under adverse hydrological conditions, however, even the full implementation of these tactics would still result in GDP losses in the tens of billions of dollars and employment losses in the tens of thousands of job-years.

Based on the LAEDC Study, it is reasonable to assume an economic benefit from the reliability associated with local water resources as compared to imported supplies. The economic value placed on the increased reliability associated with locally sourced supplies by MWD ranges from $340/AF to $475/AF based on the local project's life. This range of value was also used in the 2015 UWMP Update.

Chapter Twelve

Climate Change and Water and Energy Nexus

Eastern Sierra Nevada Mountains near Alabama Hills

12.0 Overview

LADWP is considering the impacts of climate change on its water resources as an integral part of its long-term water supply planning. Climate change is a global-scale concern, but is particularly important in the Western United States where potential impacts on water supplies can be significant for water agencies. Climate change can impact surface supplies from the Los Angeles Aqueduct (LAA), imported supplies from Metropolitan Water District (MWD), and local demands. As part of this impact analysis, LADWP completed a study to analyze the operational and water supply impacts of potential shifts in the timing and quantity of runoff along the LAA system due to climate change in the 21st Century. Such potential shifts may require LADWP to modify both the management of local water resources and LAA supplies. Projected changes in climate are expected to alter hydrologic patterns in the LAA's Eastern Sierra Nevada watershed through changes in precipitation, snowmelt, relative ratios of rain and snow, winter storm patterns, and evapotranspiration.

To understand some of the key issues surrounding climate change impacts, it is important to put it into the context of LADWP's water supplies. California lies within multiple climate zones. Therefore, each region will experience unique impacts due to climate change. Because LADWP relies on both local and imported water sources, it is necessary to consider the potential impacts climate change could have on the local watershed as well as the Western and Eastern Sierra Nevada watersheds. The Western Sierra Nevada is where a portion of MWD's imported water originates and the Eastern Sierra Nevada is where LAA supplies originate. It is also necessary to consider impacts in the Colorado River Basin where Colorado River Aqueduct supplies originate.

Generally speaking, any water supplies that are dependent on natural hydrology are vulnerable to climate change, especially if the water source originates from mountain snowpack. For LADWP, the most vulnerable water sources subject to climate change impacts are imported water supplies from MWD and the LAA. However, local sources can expect to see some changes in the future as well. In addition to water supply impacts, changes in local temperature and precipitation are expected to alter water demand patterns. However, there is still general uncertainty within the scientific community regarding the potential impacts of climate change within the City of Los Angeles. LADWP continues to monitor the latest developments in scientific knowledge and will continue to assess future research for the potential impacts of climate change on its water resources.

A widely held belief in the scientific community is that increases in concentrations of greenhouse gas (GHG) emissions in the atmosphere are a contributing factor to climate change. A substantial amount of energy and GHG emissions are associated with the production, conveyance, treatment, and distribution of water. LADWP has taken the initiative to study the nexus between water and energy consumption and to evaluate the associated carbon footprint of its water system. Department of Water Resources (DWR) strongly encourages urban water suppliers to voluntarily report energy intensity (energy consumed for every unit of water conveyed or processed) in their 2015 Urban Water Management Plan (UWMP).

12.1 Potential Impacts of Climate Change on Water Service Reliability

Scientists predict future climate change scenarios using highly complex computer global climate models (GCMs) to simulate climate systems. Although most of the scientific community agrees that climate change is occurring and, as a result, mean temperatures for the planet will increase, the specific degree of this temperature increase cannot be accurately predicted. Predictions of changes in precipitation are even more speculative, with some scenarios showing precipitation increasing in the future and others showing the opposite.

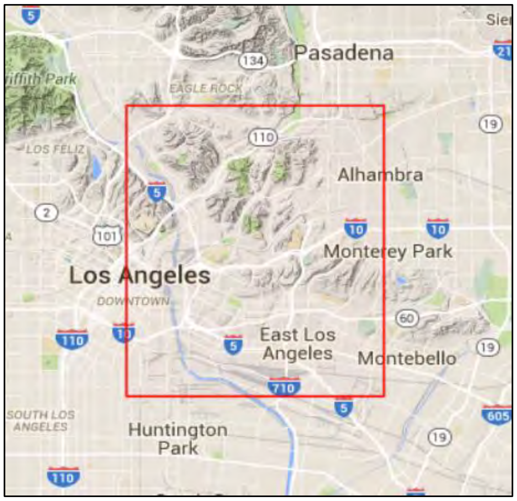
It is important to acknowledge that the predictions of the GCMs lack the desired precision due to the presence of uncertainties inherent in the analyses. The uncertainty relating to future emissions of GHG and the chaotic nature of the climate system leads to uncertainty in regard to the response of the global climate system to increases in GHGs. In addition, the science of climate change still lacks a complete understanding of regional manifestations resulting from global changes, thus restraining the projecting ability of these models. However, these models' projections are consistent with the state of science today, and they help predict the manner in which hydrologic variables are likely to respond to a range of possible future climate conditions, and thus they provide invaluable insight for water managers in their decisions pertaining to water supply reliability.

The regional areas of interest in assessing climate change impacts to LADWP include the local service area and sources of origination for imported water supplies in northern California, Eastern Sierra Nevada Mountains, and the Colorado River Basin. Data regarding climate change impacts for the various regions of interest are provided in this section.

12.1.1 Water Demand and Local Impacts

Climate change has the potential to impact the local climate and in turn alter projected water demands. Most scientific experts believe that because of the uncertainty involved with each climate change model, several models should be used to test the potential impact of climate change. To downsize the global coarse-scale climate projections to a regional level incorporating local weather and topography, the GCMs are "downscaled". Downscaled GCM data was obtained for the area indicated in Exhibit 12A by the red box. For the City of Los Angeles, future projections of precipitation and temperature were obtained for all available GCMs from the Lawrence Livermore National Laboratory through the World Climate Research Program's Coupled Model Intercomparison Project Phase 5 (CMIP5) dataset for representative concentration pathways (RCP).

Exhibit 12A Downscaled Global Climate Change Model Data Area for Los Angeles



Four levels of RCPs were adopted by the Intergovernmental Panel on Climate Change (IPCC) for the Fifth Assessment Report on climate change issued in 2014. Earlier versions of the Assessment Report the IPCC used emission scenarios. The four levels of RCPs, RCP2.6, RCP4.5, RCP6, and RCP8.5 refer to various levels of radiative forcing in the year 2100 in relation to pre-industrial values measured in watts per square meter (W/m2). Radiative forcing is the difference of sunlight absorbed by the Earth and the amount of energy reflected back into space. The following summarizes the RCPs:

- RCP2.6 – Greenhouse gas emissions peak between 2010 and 2020 and then decline, radiative forcing is 2.6 W/m2
- RCP4.5 – Greenhouse gas emissions peak around 2040 and then decline, radiative forcing is 4.5 W/m2
- RCP6 – Greenhouse gas emissions peak around 2080 and then decline, radiative forcing is 6 W/m2
- RCP8.5 – Greenhouse gas emissions rise throughout the 21st century, radiative forcing is 8.5 W/m2.

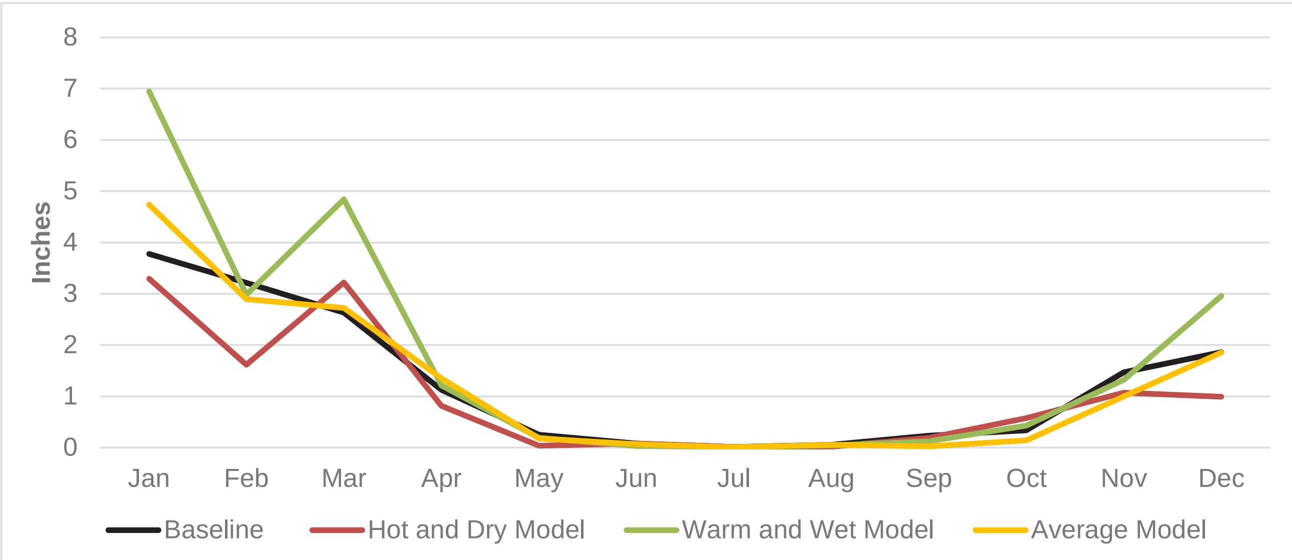
The CMIP5 dataset contains 34 GCMs of which three were selected for input into the demand forecast model to determine the range of uncertainty associated with future projections. The 34 GCMs were analyzed to determine three models representative of potential future climate change:

- Hot and Dry – Micro-ESM-Chem.1 for an RCP of 8.5, model developed by the Japan Agency for Marine Earth Science and Technology, Atmosphere and Ocean Research at the University of Tokyo, and the National Institute for Environmental Studies;
- Warm and Wet – GISS-E2.R.1 for an RCP of 4.5, model developed by the NASA Goddard Institute for Space Studies; and
- Average (or central tendency of all 34 models and RCP variations) – IPSL-CM5B-LR.1 for an RCP of 4.5, model developed by the Institute Pierre Simon Laplace.

The hot and dry and warm and wet models represent a high and low forecast under climatic change conditions and are used to determine impacts on Los Angeles' demands.

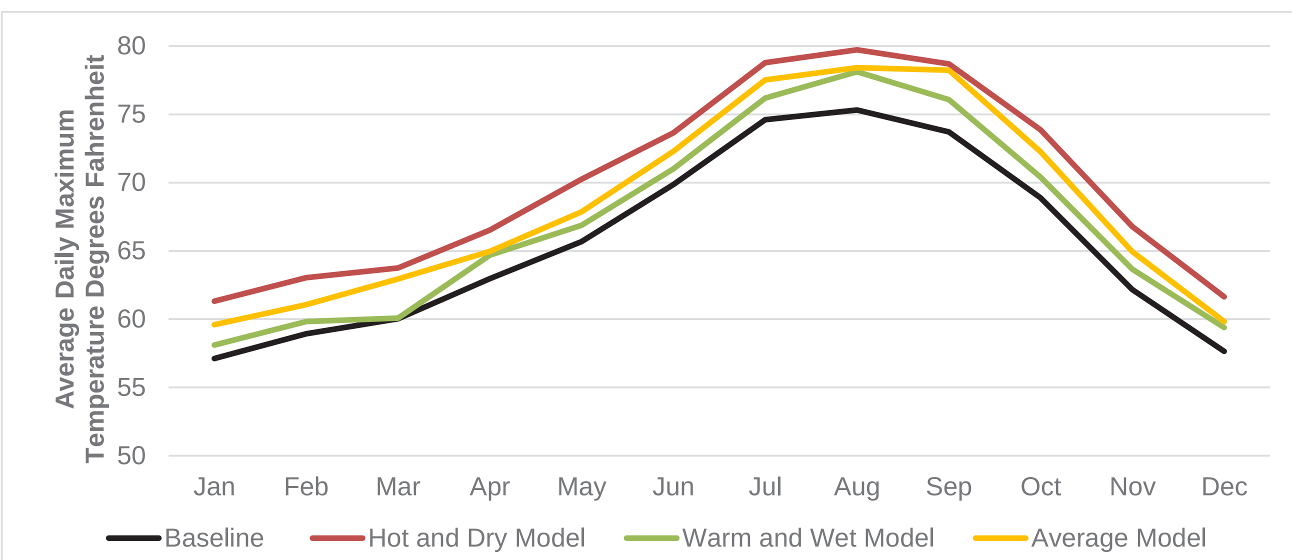
A comparison of average monthly precipitation projected for the three models for the period 2030 to 2050 and the historical long-term average of 1950 to 1999 are provided in Exhibit 12B. Average annual precipitation for the warm and wet model is projected to increase by approximately 6 inches over the baseline period. In contrast precipitation for the hot and dry model is expected to decrease by approximately 3.1 inches in relation to the baseline period. The average model projects annual precipitation will remain relatively unchanged in comparison to the baseline period. Overall, there is a 9-inch range between the hot and dry and wet and warm models. The increases and decreases in rainfall correspond to the rainy season illustrated by the baseline with little or no rain expected to occur during the dry season.

Exhibit 12B
Climate Change Impacts to Monthly Precipitation for GCM Models 2030 - 2050 vs. Baseline 1950-1999



A comparison of average daily maximum temperature for the three models for the period 2030 to 2050 and historical long-term average of 1950 to 1999 is provided in Exhibit 12C. The average daily maximum temperature for the hot and dry model is projected to increase over the baseline ranging from 3.57 to 4.99 °F, dependent on the month. The greatest increase is projected for September and the lowest increase for April. The warm and moist model has an increase range of 0.05 to 2.8°F over the baseline. Even the average model shows an increase ranging between 2.01 and 4.54°F.

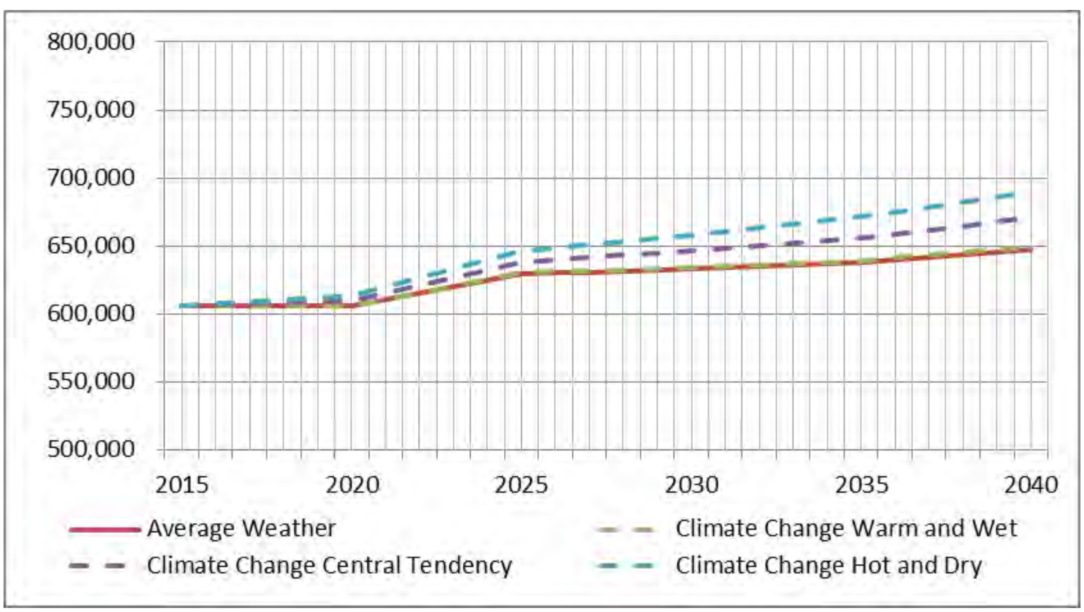
Exhibit 12C
Climate Change Impacts to Local Average Daily Maximum Temperature 2030 - 2050 vs. Baseline 1950-1999



Furthermore, detailed studies performed by the University of California, Los Angeles (UCLA) evaluated the potential impacts of climate change on the Los Angeles region and are generally consistent with the projected local climate changes from past reports. In December 2014, the Journal of Climate published a study by the Department of Atmospheric and Oceanic Sciences at UCLA titled Twenty-First-Century Precipitation Changes over the Los Angeles Region. The study concluded that the most likely projected outcome for the Los Angeles region in the 21st century is a small change in local mean precipitation compared to natural variability with large uncertainty in whether the change would mean an increase or decrease. A previous UCLA study, Mid-Century Warming in the Los Angeles Region, released in June 2012, found that by the mid-21st century, the most likely increase in warming over the Los Angeles region is roughly 4.6 °F under "business-as-usual" emission levels. Under "mitigation emission levels," resulting from a scenario that assumes measures would be taken to reduce emissions, the most likely warming increase was projected to be somewhat smaller.

The impact of these climate effects will likely impact projected water demands. Exhibit 12D illustrates projected demands through 2040 under the current forecast (baseline) and the application of the three selected GCM models. Demands are shown with passive conservation for average weather without climate change, hot and dry climate change, warm and wet climate change, and the most representative central tendency of all 34 GCMs. Impacts vary by the GCM. In general the three climate change scenarios will result in an increase in demands over the current baseline forecast. The greatest increase in demands over the baseline in 2040 with passive conservation is associated with the hot and dry scenario resulting in an increase in demands of 42,900 AF (7 percent increase), followed by the central tendency scenario at 23,400 AF (4 percent increase), and the warm and wet scenario at 2,200 AF (less than one percent increase). Any additional demand due to climate change will result in a required increase in conservation to meet the mayor's targeted demand.

Exhibit 12D[1]
Baseline and Climate Change Scenarios with Passive Conservation



[1]Exhibit 12D was generated using the Demand Forecast Model

Additionally, in partnership with the Bureau of Reclamation and other local agencies, the Los Angeles County Flood Control District (LACFCD) has completed an ongoing three-year study, the Los Angeles Basin Study (LA Basin Study). The study evaluates the capacity of existing LACFCD flood control dams, reservoirs, spreading grounds, and other interrelated facilities to accommodate projected future climate and population changes in the Los Angeles Basin. The LACFCD works in partnership with LADWP on stormwater capture projects that help to recharge the groundwater basins and augment local supply. (see Chapter Seven, Watershed Management and Stormwater Capture). As part of the LA Basin Study, climate-adjusted precipitation and evaporation inputs were developed for use in their Watershed Management Modeling System (WMMS). Three sets of downscaled climate change projections from the World Climate Research Programme's Coupled Model Intercomparison Project Phase 3 (CMIP3) and Phase 5 (CMIP5) were selected and used in WMMS to model stormwater runoff, recharge and peak flood flows. In general, it was found that there would be little to no change in annual average precipitation for the region and this was also reflected in the stormwater runoff projections. The climate change projections and hydrologic modeling results were then used to analyze the response of the existing facilities and to assess the potential for changes in stormwater capture. It was found that there is a wide range of overall efficiency and resiliency within the existing system and that certain facilities are more readily adaptable to future changes than others. Next, a large list of potential concepts were developed and modeled to determine which opportunities could provide the largest future stormwater conservation benefit. Finally, the projects were evaluated in a trade-off analysis to identify which opportunities could benefit the region the most taking into consideration water conservation benefits and environmental, social, and economic measures. For the future opportunities highlighted in the LA Basin Study, implementing widespread, low-impact development, enhancing or constructing new centralized facilities, and improving policies could boost the region's existing stormwater capture potential. These concepts can help the region to adapt to the effects of climate change and improve the overall resiliency of the local water supply portfolio.

South Haiwee Reservoir Bypass Channel

12.1.2 Los Angeles Aqueduct Impacts

The LAA is one of the major imported water sources delivering a reliable water supply to the City of Los Angeles. The LAA originates approximately 340 miles away gathering snowmelt runoff in the Eastern Sierra Nevada; hence the LAA is subject to hydrologic variability which may be impacted by climate change. Since the majority of precipitation occurs during winter in the Eastern Sierra Nevada watershed, water is stored in natural reservoirs in the form of snowpack and is gradually released into streams that feed into the LAA during spring and summer. More detailed information regarding the LAA is presented in Chapter 5, Los Angeles Aqueduct Systems.

Eastern Sierra Nevada

Higher concentrations of GHG in the atmosphere are often indications of pending climate change. These changes threaten the hydrologic stability of the Eastern Sierra Nevada watershed through alterations in precipitation, snowmelt, relative ratios of rain and snow, winter storm patterns, and evapotranspiration, all of which have major potential impacts on the LAA water supply and deliveries.

To address the possible challenges posed by climate change on the LAA, LADWP completed a climate change study. The study, completed in 2011, evaluated the potential impacts of climate change on the Eastern Sierra Nevada watershed and on LAA water supply and deliveries. It also investigated opportunities to improve the LAA system in order to manage the potential impacts in the 21st century. In this study, future climate conditions are predicted using a set of sixteen GCMs and two GHG emission scenarios.

The study of the impacts of these climate change scenarios and the associated hydrology on the LAA's Eastern Sierra Nevada watershed includes an analysis of historical temperature, precipitation, water quality, and runoff records. Hydrologic modeling was performed to estimate runoff changes from current conditions and to determine the impact of these runoff changes on the performance of the LAA infrastructure with regard to storage and conveyance to Los Angeles. As part of the evaluation of potential adaptation measures for the case in which existing infrastructure would prove to be inadequate, recommendations were provided on how to modify the LAA infrastructure and operations to accommodate these impacts.

Results of the study show steady temperature increases throughout the 21st century and are consistent with other prior studies performed in the scientific community. Exhibit 12E displays the time series of 30-year running means of the projected temperature for the A2 GHG emission scenario (higher GHG emissions) averaged over the simulation area for each of the sixteen GCM models. All GCMs project temperature increases throughout the 21st century.

On the other hand, forecasts for precipitation differ widely among the GCMs. Some GCMs projected increases, but the majority of the model outputs projected decreases in precipitation over the study period. Exhibit 12F displays the time series of 30-year running means of the projected precipitation using the A2 GHG emission scenario (higher GHG emissions) averaged over the simulation area for each of the sixteen GCM models.

Exhibit 12E
30-Year Time Series Projected Temperature Means for Eastern Sierra Nevada Watershed

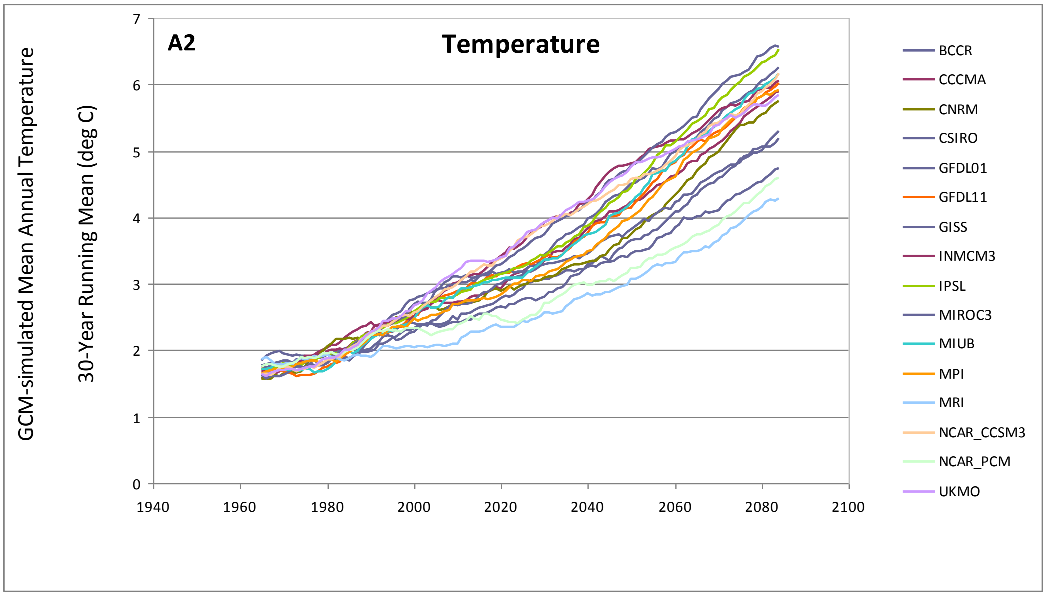
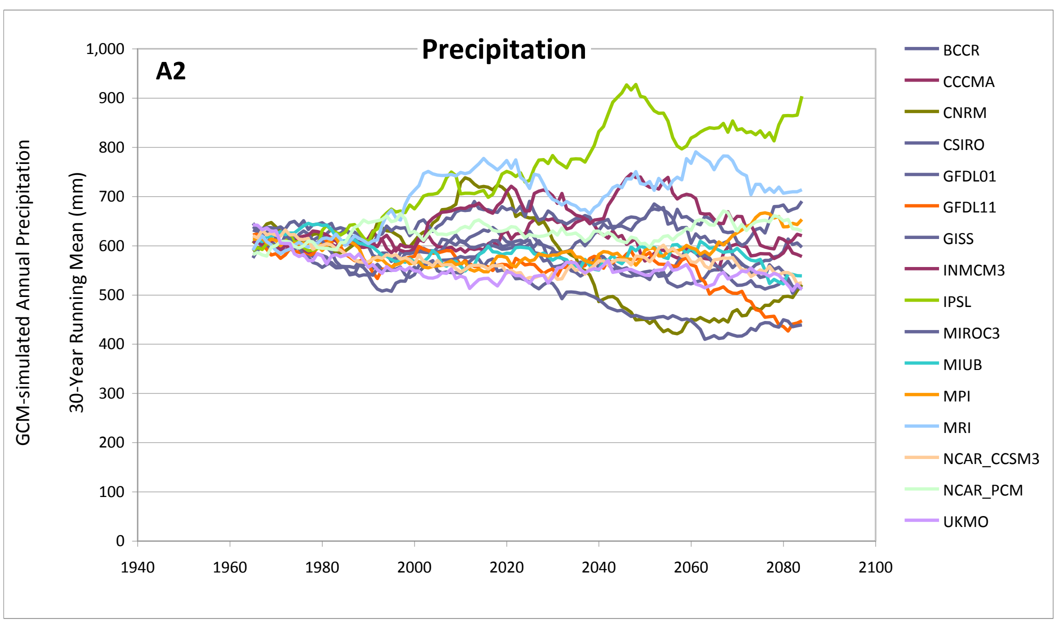


Exhibit 12F
30-Year Time Series Projected Precipitation Means for Eastern Sierra Nevada Watershed



Temperature is the main climate variable that is projected to rise significantly in the coming years and decades. The rise in temperature directly affects several variables including:

- Whether precipitation falls as snow or rain.
- The ground-level temperature that determines the timing and rate of snowmelt.
- The temperature profile in the canopy that determines the rate of evapotranspiration.

Predictions of the study for the early-21st century suggest a warming trend of 0.9 to 2.7 ˚F and almost no change in average precipitation. Mid-21st century projections suggest a warming trend of 3.6 to 5.4 ˚F and a small average decrease in precipitation of approximately five percent. This warming trend is expected to increase by the end of the 21st century, as the results indicate further warming of 4.5 to 8.1 ˚F and a decrease in precipitation of approximately ten percent. In addition, results indicate an increase in the frequency and length of droughts in the end-of-century period.

Projected changes in temperature (warmer winters) will change precipitation patterns from snowfall to rainfall with a larger percentage coming as rain than historically encountered. Consequently, peak Snow Water Equivalent (SWE) and runoff are projected to undergo a shift in timing to earlier dates.

With a long-term shift in mean temperature of 3.6˚F, snowpack of the Eastern Sierra Nevada at elevations of up to approximately 9,800 feet may be susceptible to earlier melt and less accumulation. On average, mean temperature rises are predicted to be in the range of 3.6 to 10.8 ˚F, resulting in a respective 17 to 50 percent loss in snowpack storage. This vulnerability would show up in average to warm winters and would directly affect stream levels and discharge. This raises potential operational concerns for LADWP regarding adequate storage, especially the capacity of the LAA system to store the earlier runoff in surface reservoirs.

The projected temperature and precipitation datasets form the basis of the hydrologic model projections for runoff, SWE, and rain-to-snow ratio. To compare the future projections of these variables, the trends that dominated the second half of the 20th century are considered baselines for future trends. The baseline values for runoff, SWE, and rain-to-snow ratio are 0.6 million acre-feet (MAF), 15 inches, and 0.2, respectively. By early 21st century (2010 – 2039), results indicate runoff is projected to undergo increases and decreases averaging between 0.5 and 0.85 MAF, the SWE is projected to undergo decreases and increases ranging between 10.6 and 19.0 inches, and the rain-to-snow ratio is projected to increase between 0.24 and 0.33. By mid-century (2040 – 2069), the same trends are expected to dominate, with runoff ranging between 0.34 and 0.9 MAF, the SWE ranging between 7.0 and 19.7 inches, and the rain-to-snow ratio increasing between 0.25 and 0.43. These trends are expected to govern until the end-of-century (2070 -2099) with runoff ranging between 0.35 and 1.1 MAF, the SWE ranging between 5.0 and 16.0 inches, and the rain-to-snow ratio increasing between 0.28 and 0.54. Exhibit 12G summarizes the projections for runoff, SWE, and rain-to-snow ratio for the 21st century.

Exhibit 12G
Projected Runoff, Snow-Water Equivalent, and Rain-to-Snow Ratio for Eastern Sierra Nevada Watershed

Timeframe	Runoff(MAF)	April 1 SWE (Inches)	Rain/Snow Ratio
Baseline (Second Half of 20th Century)	0.6	15.0	0.2
Early 21st-century (2010-2039)	0.5 - 0.85	10.6 - 19.0	0.24 - 0.33
Mid-century (2040-2069)	0.34 - 0.9	7.0 - 19.7	0.25 - 0.43
End-of-century (2070-2099)	0.35 – 1.1	5.0 - 16.0	0.28 - 0.54

Exhibit 12H
Projected Rain to Precipitation Ratio Based on Projected Precipitation and Temperature

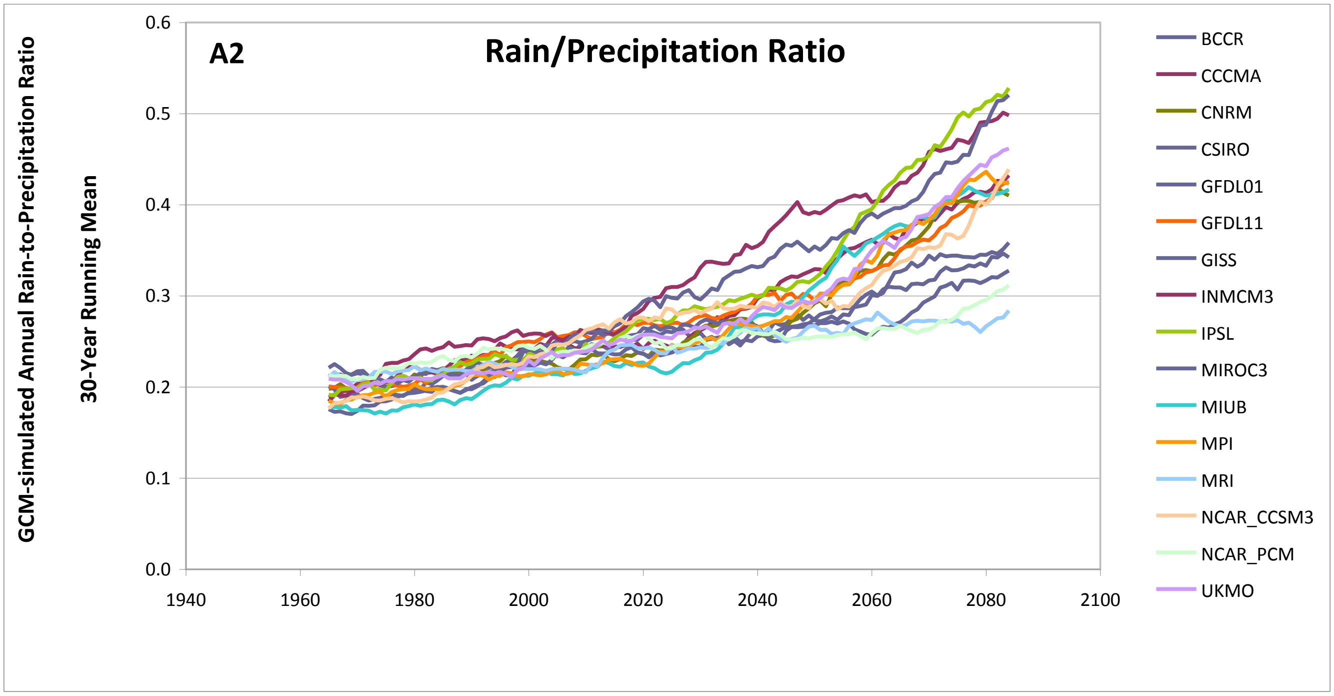


Exhibit 12H displays the rain-to-snow ratio based on the projected precipitation and temperature for the 16 GCMs. The rain-to-snow ratio is projected to increase throughout the 21st century, ranging between 0.24 and 0.33 by early 21st century, between 0.25 and 0.43 by mid-century, and between 0.28 and 0.54 by the end-of-century.

The increase of rain-to-snow ratio indicates the shift from snowfall to rainfall, specifically at low to moderate elevations, where the temperature tends to be warmer. This shift indicates more precipitation as liquid, and in turn, leads to loss of the snowpack. The snowpack is critical in providing seasonal storage by releasing winter precipitation in the spring and summer. The spring and summer snowmelt provides for increased soil moisture and stream flows needed to sustain both ecosystems and human populations.

To evaluate infrastructure capacity impacts, projected runoff for all 16 GCMs and two emission scenarios for the entire 21st century were run through the Los Angeles Aqueduct Simulation Model (LAASM) and analyzed for potential climate change impacts on the LAA system. The model incorporates the existing operational constraints in the LAA system, including maximum and minimum flows and storage capacities. As the hydrologic cycle over the 21st century is projected to become more variable, with years of higher than historical maximum runoff and other years with lower than historical minimum runoff, each of these two extremes could influence the infrastructure of the LAA and/or the ability of the LAA to deliver water to Los Angeles.

As part of the analysis, a hydraulic evaluation was performed on the entire main conveyance conduit of the LAA. Results of the runoff analysis on the existing infrastructure and operating rules, performed under projected 21st century hydrology, show that for a large fraction of periods simulated, the flows are within the range of historic flows observed in the LAA system. However, the study concluded that about seven percent of projected runoff is expected to be above, while ten percent of projected runoff is expected to be below, historical runoff ranges.

The hydraulic analysis results indicate that during projected wet years, when LAASM is able to allocate the flows in the system, the projected flows in LAA are not significantly higher than the current conduit capacities. However, in some instances, high monthly flows in the upper reaches of the watershed result in flows that are too high for LAASM to model given downstream flow constraints and existing storage limits in the Long Valley Reservoir, and the model fails to execute. These high runoff and flow conditions causing failure of the model would likely be handled through spreading in the upper reaches of the watershed. Under wet conditions, and when the model does execute, minimal to no impacts to the LAA main conveyance conduits due to the 21st century climate change are concluded, but there are concerns at the intake structures and reservoir outlet structures. Locations of concern include Lee Vining Intake Structure, Long Valley Reservoir, Pleasant Valley Reservoir Outlet, Tinemaha Reservoir Outlet, LAA Intake Canal, and North/South Haiwee Reservoir Complex Outflow. To the extent possible, preliminary analysis of overflow conditions were performed at these locations using available data on the structures. The preliminary analysis shows that the locations of concern could handle the projected high flows, although further detailed analyses of flow and sediment transport were recommended in order to fully quantify the impacts.

For dry conditions, there are a number of locations where the monthly flows are projected to be lower than historical flows and, in some cases, zero. These conditions do not result in an adverse impact from a hydraulic standpoint, although they are of concern from the perspective of water supply to the city.

Analysis of conveyance capacity of different sections of the two parallel portions of the LAA, the FLAA (First Los Angeles Aqueduct) and the SLAA (Second Los Angeles Aqueduct), showed that there are no obvious design bottlenecks where an infrastructure improvement would allow greater conveyance capacity in the system. Any modification to increase capacity would require a complete redesign of the entire aqueduct. Flows significantly higher than 800 cfs cannot be conveyed through the FLAA and SLAA.

Based on the findings above, eight different adaptation options were developed and analyzed (one of the eight options includes the baseline, status quo condition). To address the potential system impacts identified, the adaptation options involved an operational change and possible infrastructure changes to the LAA system (see Chapter Five for a description of the LAA system) that would maximize Flow to the City (FTC) under a range of conditions. The operational change included a modification of the current Long Valley Reservoir (Crowley Lake Reservoir) operating targets to handle larger peak inflows. The infrastructure changes considered included expansion of Long Valley Reservoir storage to handle larger inflows, expansion of three other downstream reservoirs (Tinemaha, North Haiwee, and Bouquet), and creation of new storage (surface water and groundwater) such that excess flows in wet years could be stored to supply water in extremely dry years. An additional infrastructure change considered included the supply of water from the State Water Project (SWP) at the Neenach Pumping Station in Antelope Valley to supplement low flow periods.

The goal of the adaptation analysis was to improve the delivery of water to Los Angeles, especially for low flow years and for the dry months of the year, while meeting all existing commitments for uses in the Owens Valley and Mono Basin in existence at the time of the study. Overall, the most significant findings of the analysis of the adaptation options are as follows:

- Increasing the volumes of the existing reservoirs does not improve FTC for the long term.

- New subsurface or surface storage down gradient of Owens Valley does not benefit FTC in the long term but is beneficial during dry years by capturing a fraction of run-off during wet years and storing it for use in dry years. The study concluded that groundwater storage appears to be more cost-effective option for meeting the proposed additional storage needs.

- Diverting water from SWP to LAA can produce a significant increase in FTC.

- A combination of all of the above alternatives also produces increases in FTC. However, this option is more costly than other alternatives due to construction requirements.

Hydrologic changes in the Eastern Sierra Nevada, as discussed above, can also impact water quality in the region. Water quality impacts were studied using a comprehensive watershed model, the Hydrologic Simulation Program-Fortran (HSPF) model, that simulates the hydrologic cycle, heat balance in stream reaches, and cycling of pollutants. Pollutants analyzed included total suspended solids (TSS), nutrients, organic carbon, biochemical oxygen demand (BOD), and metals. Six climate models of the 16 used for the over-all climate change study were used to make future projections of water quality impacts due to climate change for the period of 2010-2099. The six models selected for this assessment span a range of future outcomes, ranging from warm and wet to warm and dry climatic conditions.

The HSPF model predicted changes in pollutant concentrations at different locations in the Eastern Sierra Nevada watershed. Although the predictions for some of the constituents considered were potentially adverse, their magnitude was too small to suggest significant negative consequences, in most cases.

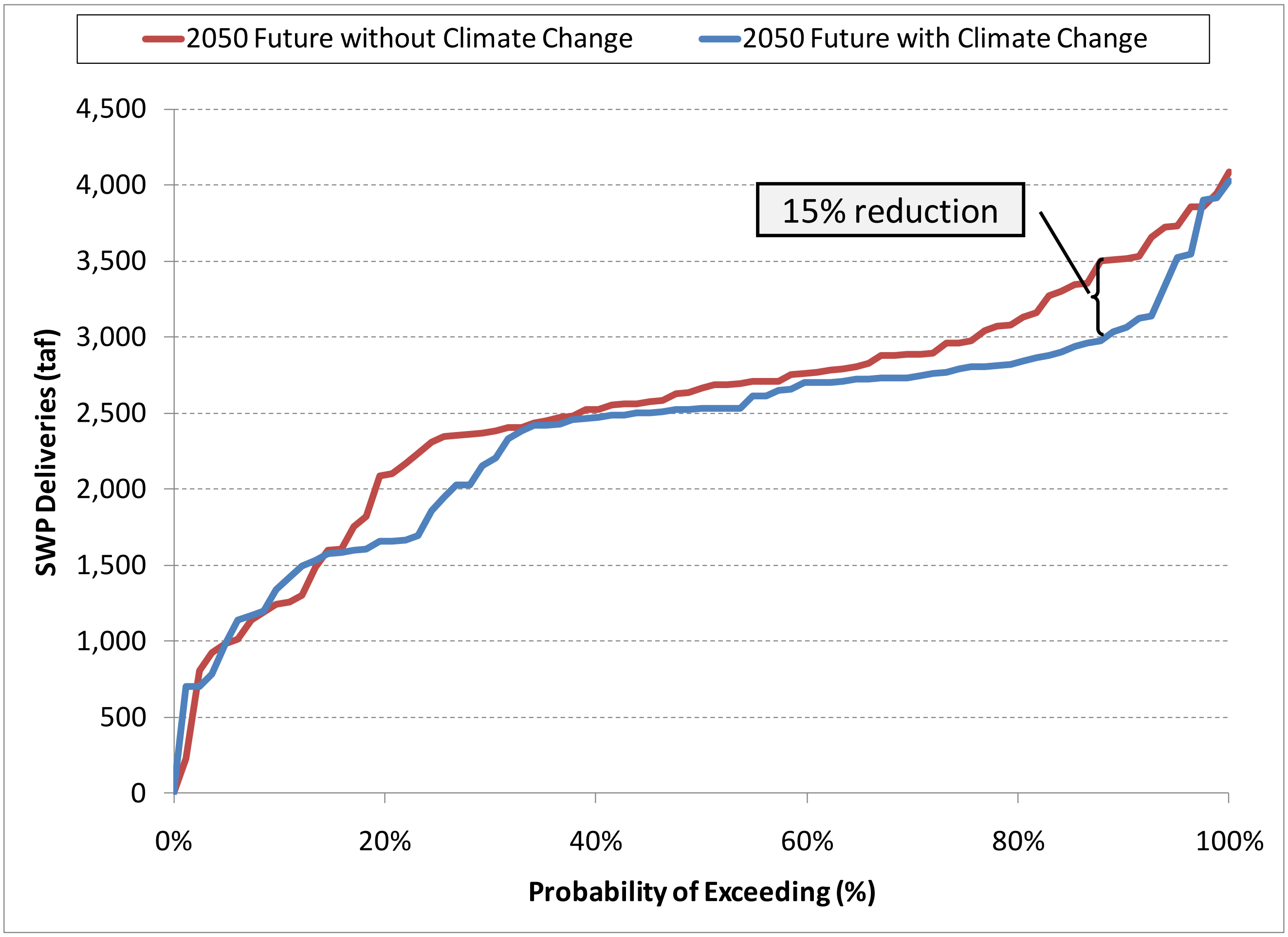
Using the best current information, this study supports continued monitoring of selected parameters to provide a foundation for evaluating long term trends, especially relationships of flows and contaminant concentrations. This is particularly true for TSS, nutrient, and arsenic concentrations. Such data can be used to improve the understanding of how concentrations vary with flows and can also be used to devise changes to operations should future predictions of water quality changes turn out to be significant and/or adverse.

Although many of the results above are quantitative in nature, it is important to account for the uncertainties inherent in these predictions. The results of this study will help guide water managers in planning and developing water supply and infrastructure to ensure the reliability and sustainability of adequate water supply and delivery well into the future.

12.1.3 State Water Project Impacts

To date, most studies on climate change impacts to California's water supply have been conducted for the Northern California region. In August 2010, DWR released the 2009 State Water Project Delivery Reliability Report, which specifically analyzes changes in volume of water available under various climate change scenarios. In the 2009 report, DWR projected that SWP deliveries could be reduced by as much as 15 percent in some cases, as illustrated in Exhibit 12I. In the more recent 2015 State Water Project Delivery Capability Report and in the previous 2011 and 2013 versions titled State Water Project Delivery Reliability Reports, the effects of climate change on SWP operations were incorporated into DWR's modeling, along with other factors related to water supply reliability. However, the reports did not provide a separate estimate for climate change impacts on SWP exports.

Exhibit 12I
Climate Change Impacts on SWP Delivery



To incorporate climate change into its reliability reports, DWR reviewed 6 GCMs for year 2050 projections using lower-emissions and higher-emissions scenarios contained in Using Future Climate Projections to Support Water Resources Decision Making in California (prepared in April 2009 by DWR). DWR selected the model most representing median effects on the SWP, which included a higher GHG scenario.

Climate change has the potential to disrupt SWP source supplies, impact conveyance, and alter storage levels in reservoir carryover storage. Annual Bay-Delta exports to areas south of the Bay-Delta are expected to decline seven percent for the lower-GHG-emissions scenario and ten percent for the higher-emissions scenario. However, it should be noted that for the six GCMs under the lower and higher emission scenarios, the range varies from a two percent increase to a 19 percent decrease, illustrating the variability in the various GCMs.

By 2050, median reservoir carryover storage is projected to decline by 15 percent for the lower-emissions scenario and 19 percent for the higher-emissions scenario, thereby reducing operational options if water shortages were to occur. Furthermore, by 2050, it is projected a water shortage worse than the 1977 drought could potentially occur in one out of every six to eight years, requiring acquisition of other supplies, reductions in water demands, or a combination thereof. An additional 575 to 850 TAF

Upper Colorado River Basin Dillon Reservoir

would be needed to maintain minimum SWP operational requirements and meet regulatory requirements. The main supply reservoirs on the SWP must maintain minimum water levels to allow water to pass through their lower release outlets in the dams. However, the April 2009 report does not consider the SWP vulnerable to a system interruption such as this under current conditions.

The primary effects of climate change on the SWP identified in the 2009 Reliability Report include, among others:

- More precipitation will fall as rain than snow.
- Reductions in Sierra snowpack.
- Sea level rise threatening the Bay-Delta levee system.
- Increased salinity in the Bay-Delta due to sea level rise requiring releases of freshwater from upstream reservoirs to maintain water quality standards.
- Shifted timing of snowmelt runoff into streams – spring runoff coming earlier resulting in increased winter flows and decreased spring flows.
- Increased flood events.

The most severe climate impacts in California are expected to occur in the Sierra watershed, where the SWP supply originates. Therefore, imported SWP water is extremely vulnerable to climate change.

More recent information about the nature of expected climate change in California is provided in California Water Plan Update 2013 (Update 2013). Released by DWR on October 30, 2014, Update 2013 is the State government's strategic plan for understanding, managing and developing water resources statewide. According to the report, higher temperatures are melting the Sierra snowpack earlier in the year and driving the snowline higher, resulting in less snowpack to store water for Californians and the environment. Droughts are likely to become more frequent and persistent in this century. Intense rainfall events are expected to continue to affect the state, possibly leading to more frequent and/or more extensive flooding. Storms and snowmelt may coincide and produce higher winter runoff, while accelerating sea level rise might produce higher surges during coastal storm events. Rising sea levels increase susceptibility to coastal flooding and increase salt water intrusion into coastal groundwater basins. Sea level rise will also place additional constraints on management and water exports from the Bay-Delta. Findings from these reports further illustrate the challenges of water purveyors on the state level in the face of a changing climate.

12.1.4 Colorado River Aqueduct Impacts

Climate change impacts to the Colorado River Basin (Basin) are comprehensively addressed by the US Bureau of Reclamation (USBR) in the Colorado River Basin Water Supply and Demand Study (Basin Study), completed in 2012, as one of four hydrologic supply projections incorporated into a scenario planning process. The climate change hydrology lowers average river flows throughout the Basin to below previously observed volumes and persists in compromising Basin reliability regardless of a wide range of demand and operational scenarios. Climate change projections from 2011 to 2060 are found to exhibit continued warming throughout the basin, shifting peak streamflow at many locations to May instead of June due to earlier snowmelt, and causing more precipitation to fall as rain instead of snow.

The Basin Study incorporates 112 bias-corrected, downscaled climate change projections derived from 3 emissions scenarios and 16 GCMs received from the Lawrence Livermore National Laboratory through the World Climate Research Program's (WCRP) Coupled Model Intercomparison Project Phase 3 (CMIP3; Maurer et al., 2007). The 112 climate projections are parsed into streamflow and evapotranspiration through the variable infiltration capacity (VIC) hydrologic model (Lohmann et al., 1996 and 1998). The resulting Colorado River Basin specific datasets are input to the Basin-wide Colorado River Simulation System (CRSS) model for long-term systems planning.

Several hydrologic indicators are used to help describe potential consequences of climate change on Colorado River Aqueduct (CRA) resources: Lees Ferry flow deficit indicates the decrease in flow from a regulated value of 75 maf over 10 years; Lake Powell pool elevation serves as an important water supply indicator; Lake Mead levels indicate whether a regulatory shortage should be declared for the Lower Basin; and the Lower Basin shortage parameter reflects shortage volumes that may be shared among the Lower Basin states and Mexico. Exhibit 12J below describes how these four indicators may influence Colorado River supplies to California.

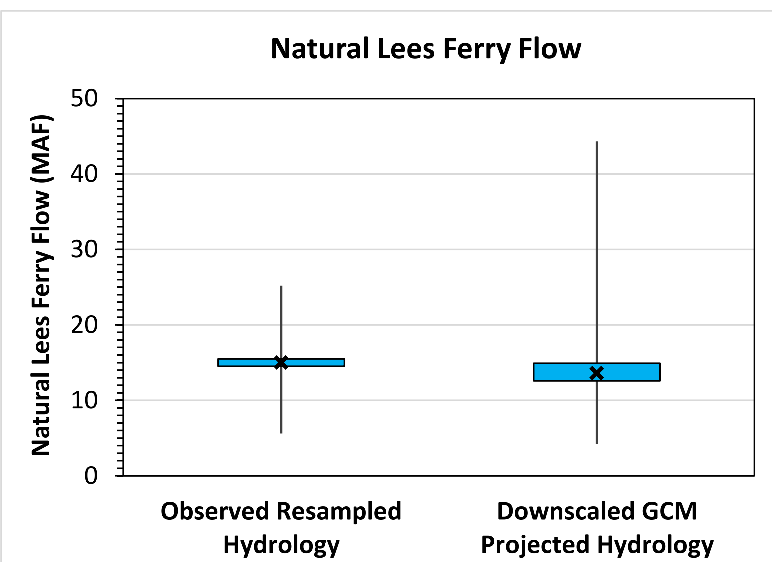
Exhibit 12J
Influence of Hydrologic Indicators on Colorado River Supplies

Hydrologic Indicator	Natural Lees Ferry Flow Deficit	Lake Powell Water Level	Lake Mead Water Level	Lower Basin Shortage
Potential Impacts	Summarizes natural hydrology of the area disregarding man-made impacts, a low value could imply, but does not substantiate, impending Lower Basin shortages.	Levels trigger balancing or equalization releases from Lake Powell to Lake Mead (USBR Record of Decision, 2007.) Additionally, could inhibit electricity generation if levels fall below the 3,490 feet, the minimum level for power generation.	Levels are increased by equalization releases from Lake Powell as well as natural inflows. Levels identified in the 2007 Guidelines (USBR, 2007) trigger Lower Basin shortages.	Includes both the regulatory shortages (declared by the Secretary of the Interior) and hydrologic shortage (low simulated natural supply) to the Lower Basin.

The Basin Study reports the temporal change of each hydrologic indicator for the climate change scenario paired with several demand simulations developed by the USBR in 2007, however, no demand scenario is able to deflect the drying trend imposed by climate change.

The natural flow of the Colorado River at Lees Ferry, Arizona is calculated as the flow that would occur without impacts from upstream depletions and reservoir regulation and provides an indication of natural basin hydrologic conditions. Exhibit 12K compares observed hydrology (which assumes current conditions into the future) and an ensemble of downscaled GCM scenarios. The vertical lines in the graphic show the minimum and maximum flow values, and as seen in Exhibit 12K the GCM ensemble (using 112 GCM models) indicates more variable flows in the future when compared to the observed hydrology. The thickness of the blue bars show the range of 25th to 75th percentile for flows, which again indicate that the GCM ensemble has more variability than observed hydrology. Finally, the "x" marks in the graphic indicate the median flow values. The median flow value for the GCM ensemble is 9 percent lower than the observed hydrology.

Exhibit 12K
Lees Ferry Flow



Supply surplus in the Colorado River basin is defined as at least two consecutive years with annual flow above the historic mean annual flow of 15 maf. Supply deficit is determined by at least two consecutive years of flow below the mean. Exhibit 12L demonstrates the frequency of surpluses and deficits that last for longer than 5 years, and notes the maximum length of surplus and deficit recorded for observed and climate change simulations.

Exhibit 12L indicates that the probability of a 5 year or longer deficit increases from 22 percent for observed conditions to 48 percent for climate change, while the probability of surplus decreases from 28 percent to below 1 percent for the same two hydrologic forecasts. The maximum deficit duration also increases between observed and downscaled GCM projections. Although the probability of surplus decreases, the maximum surplus length increases for climate change conditions, further contributing to climactic variability.

Fewer surplus flow years at Lees Ferry may lead to lower Lake Mead levels. The 2007 Interim Guidelines allocate shortage to Lower Basin delivery volumes based on Lake Mead levels, and forecasted trends may lead to greater shortage declarations due to the guidelines.

Under the 2007 Interim Guidelines, Lower Basin Colorado River deliveries are reduced to Arizona, Nevada, and Mexico, although no reductions in annual deliveries are assigned to California contractors. Drier future trends and increasing demands documented in Exhibit 12M (adapted from the Basin Study) lead to increasingly larger shortfalls in basin supply and may force regulators to change the distribution of Lower Basin delivery shortages.

Exhibit 12L
Deficit and Surplus Periods

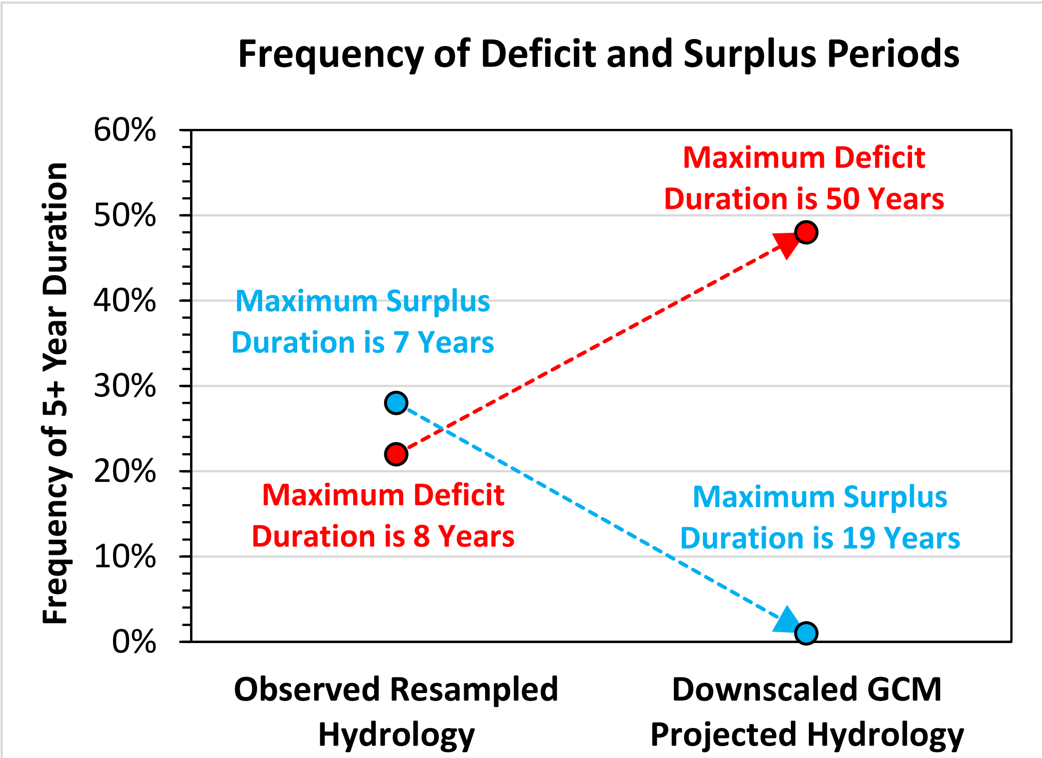
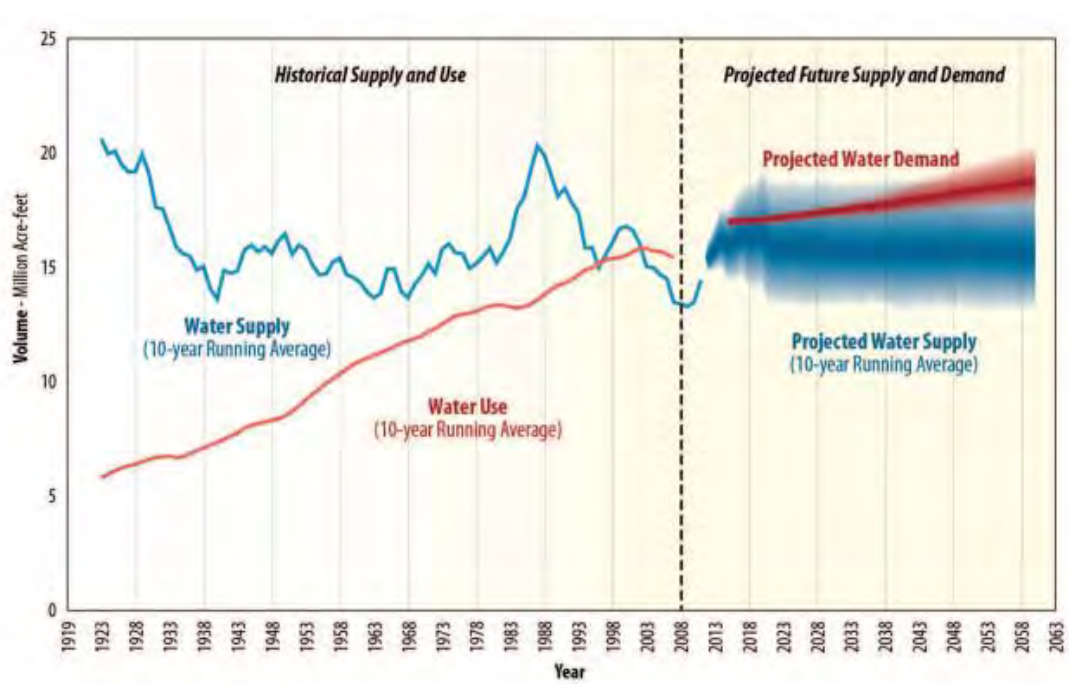


Exhibit 12M
Colorado River Basin Supply and Demand Gap



Despite the modeled results presented in the Basin Study, future shortages to California and the CRA are subject to unknown hydrology and regulations and are difficult to quantify. MWD has initiated endeavors to retain a full aqueduct including the Quantification Settlement Agreement approved in 2003 which contains wheeling and transfers with the Imperial Irrigation District (IID) and Coachella Valley Water District (CVWD), as well as a fallowing agreement with Palo Verde Irrigation District (PVID). MWD continues to investigate opportunities for fallowing and storage which may help to alleviate impacts of low deliveries to Lower Basin states.

12.2 Water and Energy Nexus

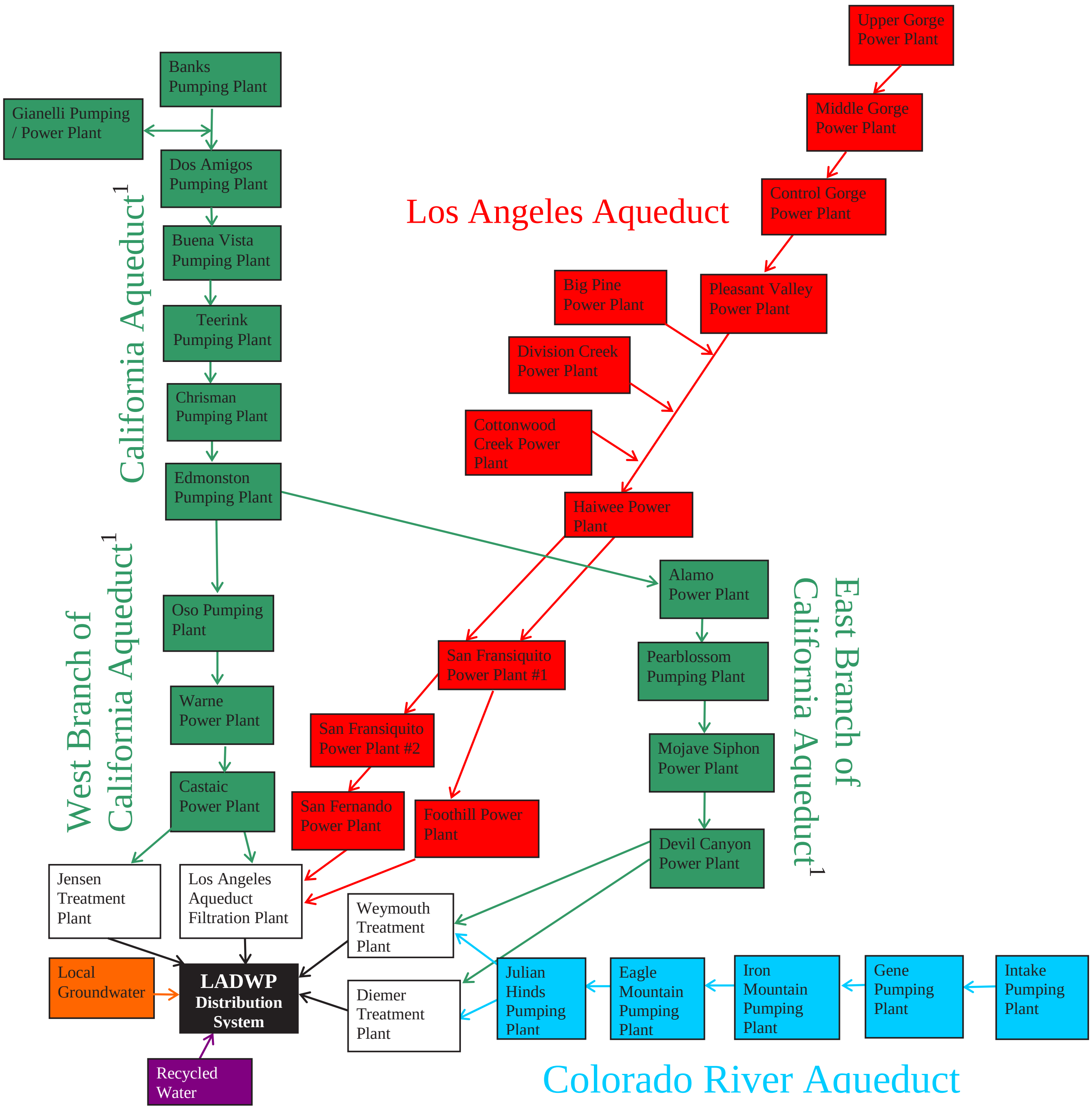
It is widely believed in the scientific community that the increase in concentrations of GHG in the atmosphere is a major contributing factor to climate change. As such, California is leading the way with laws that require reductions in GHG emissions and requirements to incorporate climate change impacts into long range water resources planning.

Carbon dioxide emissions into the atmosphere, and the emissions of other GHGs, are often associated with the burning of fossil fuels like crude oil and coal in the generation of energy. As a significant amount of energy is required for the movement of water over long distances and elevations, a link was subsequently realized between water supply conveyance and corresponding GHG emissions through its energy consumption. This link also applies to other steps in the water cycle, such as source extraction, treatment, and local distribution. The measure of GHG emissions, sometimes referred to as "carbon footprint" and expressed in units of tons (T) carbon dioxide (CO_2), can be estimated for water. Once the size of a carbon footprint is known, a strategy can be developed to better manage and reduce its impact on climate change.

DWR strongly encourages urban water suppliers to voluntarily report energy intensity (energy consumed for every unit of water conveyed or processed) of supply sources per Section §10631.2(a) of the California Water Code (CWC) and has provided voluntary draft reporting guidelines for the 2015 UWMP. Energy intensity reporting can be beneficial for water utilities because it identifies energy savings and GHG reduction opportunities for water conservation programs. This, in turn, provides funding opportunities for these programs.

To comply with CWC §10631.2(a), and to identify opportunities mentioned above, LADWP has taken the initiative to study the nexus between water and energy consumption and to evaluate the associated carbon footprint of its water system. The most energy intensive source of water for LADWP is water purchased from MWD, which imports SWP supplies via the California Aqueduct and Colorado River supplies via the CRA. LADWP also imports water via the LAA, which is a net producer of energy. Local sources of water for LADWP include groundwater and recycled water. Exhibit 12N outlines LADWP's water supply sources as well as the water system facilities that either consume or generate energy to extract, convey, and treat water for distribution throughout LADWP's service area. In the following sections, values for energy intensity or energy generation rate for each of LADWP's water supplies are discussed. The energy intensity or generation rates have been computed by dividing the total energy consumed or generated, respectively, by the total water conveyed or processed by that source. Both values are expressed in kilowatt hours per acre foot (kWh/AF).

Exhibit 12N
Sources and Facilities of LADWP's Water Supply Portfolio



1. Source: *Methodology for Analysis of the Energy Intensity of California's Water Systems*, p. 27.

12.2.1 State Water Project Supplies

Water supplied to Los Angeles via the SWP originates in Northern California and the Bay-Delta and is conveyed along the 444-mile long California Aqueduct to Southern California. Six pump stations are required to lift the water to the point at which the California Aqueduct splits into two branches. At the zenith of the California Aqueduct in the Tehachapi Mountains, approximately 3,846 kWh/AF are required to lift the water from the beginning of the aqueduct. After the water passes through Edmonston Pumping Plant, the California Aqueduct separates into two branches, the West Branch and the East Branch. Along the West Branch, the water is lifted once more at the Oso Pumping Plant and then energy is recovered through hydro-electric generation at the Warne and Castaic Power Plants. By the time the West Branch reaches its terminus at Lake Castaic, the net energy consumed in transporting each unit of water from the Bay-Delta is approximately 2,580 kWh/AF. Water supplied through the West Branch is provided to the San Fernando Valley, Western Los Angeles, and Central Los Angeles communities.

Along the East Branch, the water generates power at the Alamo Power Plant, is lifted once more at Pearblossom Pumping Plant, and is then used for generation at Mojave Siphon and Devil Canyon Power Plants. At the East Branch terminus at Lake Perris, approximately 3,236 kWh/AF of energy per unit has been expended in the transport. Water conveyed through the East Branch is provided to the Eastern Los Angeles and Harbor communities. The water supplied from the SWP is the most energy intensive source of water available to LADWP.

12.2.2 Colorado River Aqueduct Supplies

Water supplied from the Colorado River is imported via the 242-mile CRA operated by MWD. From the start of the CRA at Lake Havasu to its terminus at Lake Mathews, the water is lifted approximately 1,617 feet. Five pumping stations along the aqueduct lift the water to MWD's service area requiring approximately 2,000 kWh/AF. CRA water is the second most energy intensive water source for Los Angeles and is supplied to the Eastern Los Angeles and Harbor communities. Together, SWP water and CRA water comprise the total imports provided by MWD to LADWP. MWD imported water is the most expensive water source for LADWP in terms of both cost and energy.

12.2.3 Los Angeles Aqueduct Supplies

The LAA provides water from the Eastern Sierra Nevada watershed and is entirely gravity fed. As a result, no energy is required to import LAA water, making it the most desirable source of water in terms of energy intensity. There are twelve power generation facilities along the LAA system (upstream of the Los Angeles Aqueduct Filtration Plant). Of these twelve facilities, nine are "on-system," meaning these hydroelectric generation plants are on the main conduit of the aqueduct itself, whereas the other three are "off-system," or are located on the streams that feed into the aqueduct.

On average, the LAA generates approximately 4,736 kWh/AF from water directly used to generate power. This number was determined using the same methodology as was used to determine the energy intensity for the two branches of the SWP. The energy intensities for each individual generating facility were summed up to arrive at the total energy intensity for the water used to generate

San Francisquito Power Plant Number 1

power. However, when considered from the perspective of total amount of water delivered to Los Angeles via the LAA, the energy generated along the LAA is approximately 2,429 kWh/AF. The variance between the numbers can be attributed to the fact that not all water wheeled through the LAA is used to generate power and the fact that a portion of the water is introduced into the aqueduct system, at a point downstream of several of the power plants. The energy intensity of the LAA is not included in LADWP's total water system energy intensity, since the energy generated does not directly offset the energy required for other sources of water. However, in terms of supply, the LAA is able to offset the more energy intensive sources of water, consequently reducing the overall energy intensity of LADWP's water supplies. In dry years, and as LAA flows to Los Angeles are decreased due to environmental enhancement efforts in the Owens Valley and Mono Basin, LADWP is forced to rely more on energy intensive water purchased from MWD; local sources, such as local groundwater and recycled water, have remained relatively constant regardless of hydrologic variability. In low precipitation years, less LAA water supply is available, and LAA hydro-generation decreases. LADWP's purchase of energy intensive MWD water supplies is then needed, which raises the energy intensity of the over-all water supply. LAA has supplied approximately 31 percent of the water demand for Los Angeles, on average, from FYEs 2010 to 2015.

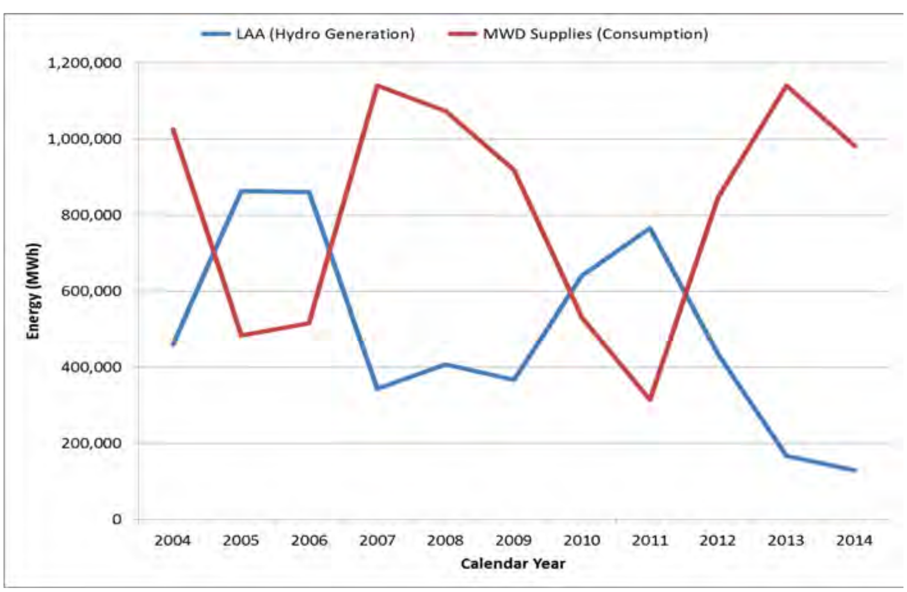
Exhibit 12O illustrates the variation between LAA hydro-generation and energy consumed to convey MWD purchased water to Los Angeles from CY 2004 to CY 2014. In CY 2005, LAA FTC (Flow to the City) was 376,394 AF, and LAA hydro-generation was approximately 863,500 MWh (Megawatt-hours). By contrast, in CY 2007, LAA FTC was 127,392 AF, and LAA hydro-generation was approximately 343,800 MWh. The decrease of approximately 519,700 MWh in hydro-generation between these years was equivalent to powering approximately 84,900 homes in Los Angeles for one year, and the associated quantity of CO_2

emissions to replace lost energy was approximately 293,600 mT, equivalent to adding approximately 57,600 passenger vehicles on the road for one year. The decrease in LAA FTC not only resulted in a loss of renewable energy and increased emissions associated with replacement energy, but also an increase in energy consumption and associated emissions with increased purchases of MWD water. The corresponding increase in MWD water purchased during the same period was 255,526 AF and resulted in an increase of approximately 655,500 MWh in conveyance energy, equivalent to powering approximately 107,100 homes for a year during that time. This increase in conveyance energy generated approximately 202,500 mT of CO_2 emissions, equivalent to adding approximately 39,700 cars on the road for a year. When considering the total impact from lost hydro-generation, increased emissions from replacement energy, and the energy and GHG due to increased MWD purchases, the net effect was an additional requirement of 1,175,200 MWh of energy and GHG emissions totaling 496,100 mT of CO_2.

On the other hand, between CY 2007 and CY 2011, there was an increase in LAA FTC resulting in approximately 421,500 MWh in LAA hydro-generation, equivalent to powering approximately 70,300 homes in Los Angeles for one year. The corresponding quantity of CO_2 emissions avoided was approximately 221,000 mT. Additionally, there was a related reduction in MWD purchased water of 319,872 AF, resulting in an approximate 826,300 MWh savings in conveyance energy and approximately 229,000 mT decrease in CO_2 emissions.

These examples show that hydrologic variability in the LAA watershed generally has a direct impact on the water system carbon footprint. Some exceptions are seen, however, as in CY 2014, when both LAA hydro-generation and MWD conveyance energy consumption decreased. During this dry year, both LAA and MWD purchased water supplies decreased from CY 2013 levels because of a decrease in total City water demand. This was mostly due to water conservation efforts. An increase in local groundwater production also helped the City reduce MWD water purchases. Efforts to reduce reliance on imported MWD water are expected to minimize negative environmental effects substantially, especially during dry periods.

Exhibit 12O
Conveyance Energy for LADWP Imported Water Supplies



12.2.4 Local Groundwater Supplies

Groundwater accounts for approximately 13 percent of LADWP's water supply (FYE 2010 to FYE 2015). The over-all groundwater-well pumping energy intensity depends on various factors including groundwater level, effects of variable water quality on well-pump operations, and pump efficiencies. LADWP's groundwater supply has an average energy intensity of approximately 580 kWh/AF.

As LADWP continues with its cleanup of the contaminated water in the San Fernando Basin, groundwater will play an increasingly important role in Los Angeles' water supply portfolio. Although there is a potential for future increases in the energy required to process groundwater due to the introduction of new treatment technologies such as Advanced Oxidation Processes or others, groundwater is expected to remain a low energy source of water when compared to imported MWD purchases. Increasing groundwater production will allow LADWP to offset the energy intensive MWD sources and reduce its over-all energy intensity.

12.2.5 Recycled Water Supplies

Recycled water is currently the smallest component of LADWP's water supply portfolio, with municipal and industrial uses accounting for approximately two percent of total supplies for FYEs 2014 and 2015. Currently, LADWP receives recycled water directly from three wastewater treatment plants operated by the Bureau of Sanitation (LASAN), two of which provide recycled water treated to a tertiary level: Los Angeles Glendale Water Reclamation Plant (LAGWRP) and Donald C. Tillman Water Reclamation Plant (DCTWRP). Terminal Island Water Reclamation Plant (TIWRP) performs advanced treatment of recycled water in addition to tertiary treatment. LADWP also receives a small portion of recycled water directly from the West Basin Municipal Water District (WBMWD), which provides additional treatment of wastewater originating from Hyperion Water Reclamation Plant in El Segundo. Since all water at the plants directly supplying recycled water to LADWP is treated to at least a tertiary level regardless of disposal or reuse, the energy cost to treat the water to this level is considered a sunk cost because the water would be treated whether it offsets potable use or not. The advanced treatment process at TIWRP exceeds the requirements for discharge and is therefore not considered a sunk cost. The incremental energy associated with processing wastewater at TIWRP is approximately 2,318 kWh/AF. Since the treatment energy at the other two plants is not considered additional energy, only the pumping energy is included in the overall LADWP recycled water energy intensity. For LAGWRP, the pumping requires approximately 614 kWh/AF for LADWP customer supply, and for DCTWRP, the pumping requires approximately 467 kWh/AF. The energy intensity associated with the recycled water LADWP purchases from WBMWD is approximately 602 kWh/AF. A weighted average of these values gives recycled water an energy intensity of approximately 1,150 kWh/AF. Recycled water energy intensity depends on various factors including the amount of recycled water being pumped to a higher elevation, amount of advanced treated recycled water being used, extension of recycled water distribution system resulting in additional head loss, and pump efficiencies. In addition to the municipal and industrial recycled water that is considered in LADWP's total supplies, the plants produce significant additional volumes of recycled water that are beneficially used. Beneficial uses include the seawater barrier for the Dominquez Gap using recycled water from TIWRP, and the Japanese Garden and Los Angeles River using recycled water from DCTWRP.

12.2.6 Treatment Energy

Another factor in determining the energy intensity of LADWP's water supply is the energy required to treat water for potable purposes. All LAA water and nearly all West Branch SWP water supplies purchased by LADWP are treated at Los Angeles Aqueduct Filtration Plant (LAAFP). A small percentage (approximately five percent) of West Branch SWP water is treated at Jensen Treatment Plant, owned and operated by MWD and located in Sylmar, adjacent to LAAFP. The energy intensity of the Jensen Plant is approximately 42 kWh/AF. For LAAFP, the treatment energy intensity has averaged approximately 34 kWh/AF. However, in 2014, the Dr. Pankaj Parekh Ultraviolet (UV) Disinfection Facility was commissioned to add UV treatment to the LAAFP treatment processes. UV light treatment provides disinfection while minimizing harmful disinfection by-products thus aiding in achieving compliance with water quality regulations. The UV treatment process is expected to increase the over-all energy intensity for water treated at LAAFP by approximately seven kWh/AF. Other plant efficiency upgrades, however, are expected to offset this increase to some degree. A more precise estimate will be made when sufficient historic data become available.

East Branch SWP and CRA water supplies are primarily treated at both Weymouth Treatment Plant in the San Gabriel Valley, and Diemer Treatment Plant in Orange County. These treatment plants are owned and operated by MWD. The average energy intensity for Weymouth Treatment Plant is approximately 46 kWh/AF, and this plant supplies water to the East Los Angeles community. The average energy intensity for Diemer Treatment Plant is 20 kWh/AF, and this plant supplies water to the Harbor community. Historically, a ratio of approximately 55 percent SWP East Branch water and 45 percent CRA water has flowed through both of these MWD treatment plants. However, the proportions through each vary depending on the regional hydrology of the two sources (CRA and East Branch SWP) and the operational goals of MWD.

12.2.7 Distribution Energy

LADWP water distribution infrastructure, with 78 pump stations and 7,263 miles of distribution main, benefits from the topography of its service area in that much of the hydraulic head required for water distribution is provided by gravity. With the major sources of LADWP's water entering the service area at higher elevations than most other parts of the City, the energy required for distribution is lower than distribution energy for many other water distribution systems in Southern California. Distribution energy intensity is influenced by various factors including amount of water being pumped to a higher elevation, head loss in the pipe network, source water elevation, and pump efficiencies. The average energy intensity for LADWP's water distribution system is approximately 174 kWh/AF.

12.2.8 Summation of LADWP Water System Energy Intensity

Exhibit 12P shows the sum of the energy intensities for each of LADWP's individual water supply sources from FYEs 2010 to 2015; Exhibit 12Q shows a graphical representation of the total annual energy intensity for the same time period. An important detail is the influence that LAA water has on the total energy intensity for a given year. In wet years such as FYE 2011, which resulted in a large volume of LAA water, the total energy consumption for the LADWP water system is low, and the energy intensity is correspondingly low. Alternately, dry years with low volumes of LAA water result in high total energy consumption and energy intensity as a consequence of the need to import additional MWD supplies.

Exhibit 12P
LADWP Water System Energy Intensity for FYEs 2010-2015

		2010	2011	2012	2013	2014	2015
Los Angeles Aqueduct (0 kWh/AF)	Volume (AF)	199,739	307,692	266,634	113,411	61,024	53,546
	Treatment Energy Intensity (kWh/AF)[1]	34	34	34	34	34	34
State Water Project West Branch (2,580 kWh/AF)	Volume (AF)	195,536	105,452	157,745	327,326	362,335	301,631
	Treatment Energy Intensity (kWh/AF)[2]	34	34	34	34	34	34
State Water Project East Branch[4] (3,236 kWh/AF)	Volume (AF)	11,518	21,076	23,778	21,027	8,097	0
	Treatment Energy Intensity (kWh/AF)[3]	32	32	32	32	32	32
Colorado River Aqueduct[4] (2,000 kWh/AF)	Volume (AF)	53,720	39,924	28,914	40,107	71,554	60,975
	Treatment Energy Intensity (kWh/AF)[3]	32	32	32	32	32	32
Local Groundwater (580 kWh/AF)	Volume (AF)	76,982	49,354	61,060	58,811	79,403	87,046
Recycled Water[5] (1,150 kWh/AF)	Volume (AF)	6,703	7,894	6,850	7,513	10,054	10,437
Distribution (174 kWh/AF)	Volume (AF)	537,495	523,497	538,131	560,683	582,412	503,199
Spread, Spill and Storage Change (AF)[6]		-58	-1,082	751	-1,743	871	96
Total Volume Delivered (AF)		544,256	532,473	544,230	569,938	591,594	513,540
Total Estimated Energy Intensity (kWh/AF)[7]		1,490	1,063	1,275	2,024	2,161	2,072
Total Energy (MWh)		810,739	565,069	694,952	1,150,125	1,280,136	1,064,325

1. Los Angeles Aqueduct supplies are treated at Los Angeles Aqueduct Filtration Plant.

2. State Water Project West Branch supplies are treated at Los Angeles Aqueduct Filtration Plant and Jensen Treatment Plant, the latter of which is owned and operated by Metropolitan Water District of Southern California. The listed energy intensity is based on a weighted average of the energy intensities for the two plants.

3. Colorado River Aqueduct and State Water Project East Branch supplies are treated at Weymouth and Diemer Filtration Plants, owned and operated by Metropolitan Water District of Southern California. The listed energy intensity is based on a weighted average of the energy intensities for the two plants.

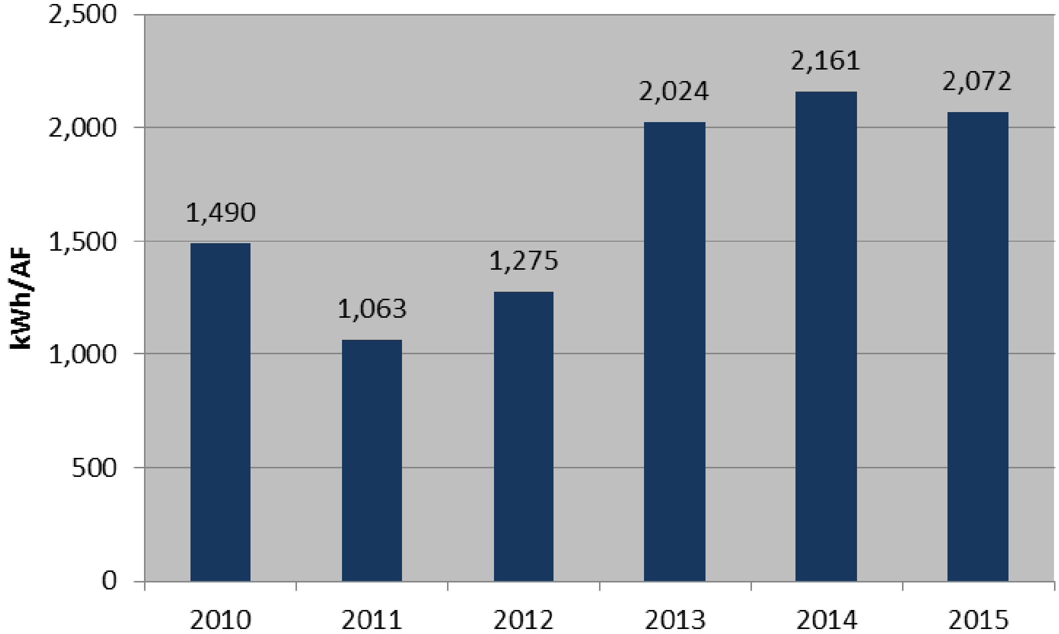
4. The quantities of SWP and CRA water delivered are based on the average ratio of effluent from the two sources at Weymouth and Diemer Treatment Plants, as reported in MWD annual water quality reports.

5. Recycled water volume is based on use for municipal and industrial uses, not on all beneficial uses. Energy intensity is a weighted average of energy used for pumping to customers and the incremental energy to treat from tertiary level to advanced and additional treatment levels.

6. The Spread, Spill and Storage Change category is not included in energy intensity or total energy calculations. Negative values indicate net volumes of potable water taken out of storage within the City or otherwise added to the Total Volume Delivered.

7. Total Estimated Energy Intensity is based on a flow-proportioned, weighted equation of energy intensities of individual supply sources.

Exhibit 12Q
LADWP Water System Annual Energy Intensity for FYEs 2010-2015



12.2.9 Carbon Footprint

All of LADWP's water supply sources have an associated carbon footprint related to the energy required to pump and/or process the water. Exhibit 12R provides the annual carbon footprint by water source. Exhibit 12S shows a graphical representation of the total annual carbon footprint for the same time period. For imported sources, the CYs 2007, 2010 and 2012 CAMX (Sub-region designated by the Western Electricity Coordinating Council) California average carbon emissions factors of 681.01, 610.82 and 650.31 lbs CO_2/MWh, respectively, were used to estimate the amount of carbon emissions produced per AF of imported MWD supply. For local sources, the LADWP Power System CO_2 metric was used to estimate the carbon emissions released in the production of this water. LAA is a net producer of energy and produces only green hydro-electric energy. No carbon emissions are associated with water imported through the LAA.

Exhibit 12R
Annual Footprint by Carbon Source for FYEs 2010-2015

		2010	2011	2012	2013	2014	2015
Los Angeles Aqueduct (0 kWh/AF)	Volume Delivered (AF)	199,739	307,692	266,634	113,411	61,024	53,546
	Carbon Footprint (tons C02)[1]	3,877	5,982	5,161	2,175	1,206	1,016
State Water Project West Branch (2,580 kWh/AF)	Volume Delivered (AF)	195,536	105,452	157,745	327,326	362,335	301,631
	Carbon Footprint (tons C02)[1,3,4]	166,692	85,125	131,343	280,821	311,069	258,718
State Water Project East Branch[2] (3,236 kWh/AF)	Volume Delivered (AF)	11,518	21,076	23,778	21,027	8,097	0
	Carbon Footprint (tons C02)[3]	12,157	21,037	24,501	22,345	8,604	0
Colorado River Aqueduct[2] (2,000 kWh/AF)	Volume Delivered (AF)	53,720	39,924	28,914	40,107	71,554	60,975
	Carbon Footprint (tons C02)[3]	35,257	24,779	18,526	26,502	47,282	40,291
Local Groundwater (580 kWh/AF)	Volume Delivered (AF)	76,982	49,354	61,060	58,811	79,403	87,046
	Carbon Footprint (tons C02)[1]	25,191	16,178	19,925	19,013	26,464	27,854
Recycled Water (1,150 kWh/AF)	Volume Delivered (AF)	6,703	7,894	6,850	7,513	10,054	10,437
	Carbon Footprint (tons C02)[1]	4,349	5,131	4,433	4,816	6,644	6,623
Distribution (174 kWh/AF)	Volume Delivered (AF)	537,495	523,497	538,131	560,683	582,412	503,199
	Carbon Footprint (tons C02)[1]	52,752	51,470	52,668	54,367	58,220	48,294
Spread, Spill and Storage Change (AF)[5]		-58	-1,082	751	-1,743	871	96
Total Volume Delivered (AF)		544,256	532,473	544,230	569,938	591,594	513,540
Total Carbon Footprint (tons CO_2)		300,274	209,703	256,557	410,040	459,489	382,797

1. Based on apportioning CY historical LADWP Power Generation CO_2 Emission factors.

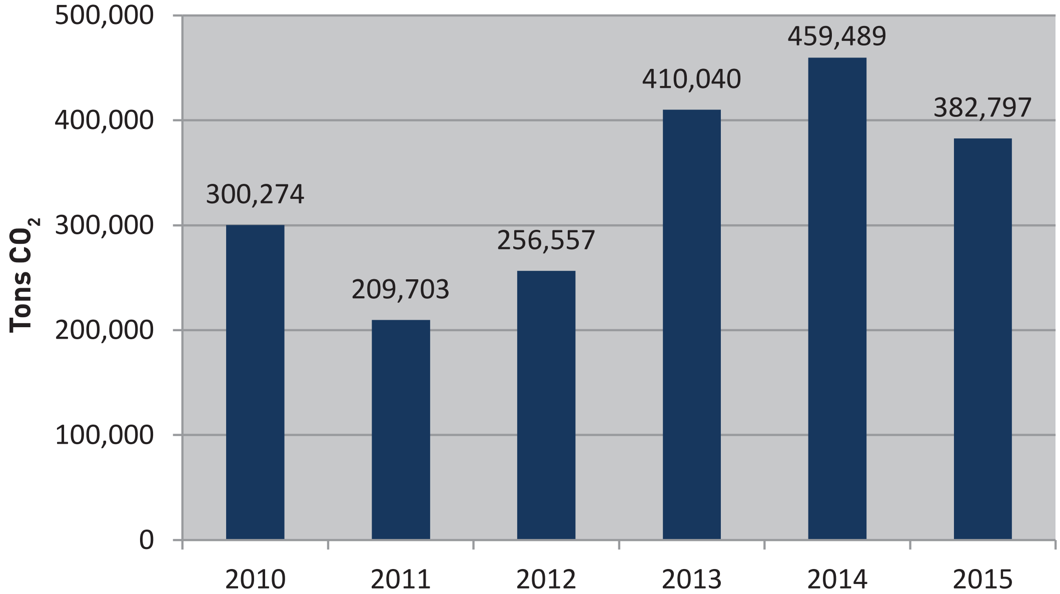
2. Amount of SWP water and CRA water delivered is based on an average of the proportions of the two sources delivered to MWD's Weymouth Treatment Plant and Diemer Treatment Plant over the time period.

3. Based on eGRID 2007, 2010 and 2012 CAMX (California Average) values for respective years.

4. State Water Project West Branch supplies are treated at Los Angeles Aqueduct Filtration Plant and Jensen Treatment Plant. The over-all carbon footprint due to treatment is based on a weighted average of the carbon emission factors for the two plants.

5. The Spread, Spill and Storage Change category is not included in carbon footprint calculations. Negative values indicate net volumes of potable water taken out of storage within the City or otherwise added to the Total Volume Delivered.

Exhibit 12S
Total Annual Carbon Footprint for Water Supply Portfolio FYEs 2010-2015



Reliance on energy intensive imported supplies from MWD increases the City's overall energy intensity and carbon footprint, such as during the current drought when limited LAA water has been available. Reductions in LAA flows due to environmental mitigation have the consequence of increasing Los Angeles' reliance on supplies imported through the SWP via the California Aqueduct, and Colorado River through the CRA.

12.3 Climate Change Adaption and Mitigation

Climate change strategies fall under two main categories: adaptation and mitigation. For water resources planning, a climate change adaptation strategy involves taking steps to effectively manage the impacts of climate change by making water demands more efficient and relying on supply sources that are less vulnerable to climate change. A mitigation strategy involves proactive measures that reduce GHG emissions, such as placing a stronger emphasis on using water resources requiring less GHG emissions. Both LADWP and its wholesale supplier for imported water, MWD, are implementing adaption and mitigation strategies as they become aware of potential climate change impacts.

It is imperative that supply options are carefully vetted and evaluated against both adaptation and mitigation goals, as they may conflict and work against each other. For example, desalination is a typical supply option that performs quite well in adapting to climate change impacts; however, due to the energy necessary to draw from and manage the supply source, it could result in higher GHG emissions if conventional energy sources are utilized.

12.3.1 LADWP Adaption and Mitigation

LADWP has outlined strategies to dramatically increase conservation and water recycling. Increasing conservation and water recycling encompasses both adaption and mitigation goals to address climate change. Additional adaption strategies under investigation by LADWP and the City include beneficial reuse of stormwater as discussed in Chapters Seven and Nine, Watershed Management and Stormwater Capture and Other Water Supplies, respectively.

Conservation has a double savings in terms of energy intensity because not only does it save energy in importing or producing the water, but it also saves energy through reduction of end use, such as heating water for a shower or for a dishwasher and wastewater treatment. The anticipated conservation savings will not only help to provide Los Angeles a secure and dependable water supply, but it will also reduce the energy footprint of the water supply, and consequently the carbon footprint. From FYEs 2008 to 2015, LADWP customers have saved approximately 716,204 AF. Without considering end-uses, this amount of conservation has displaced approximately 1.72 billion pounds of carbon dioxide emissions and an equivalent amount of energy to power approximately 379,070 homes for one year. A further discussion regarding conservation is provided in Chapter Three, Water Conservation.

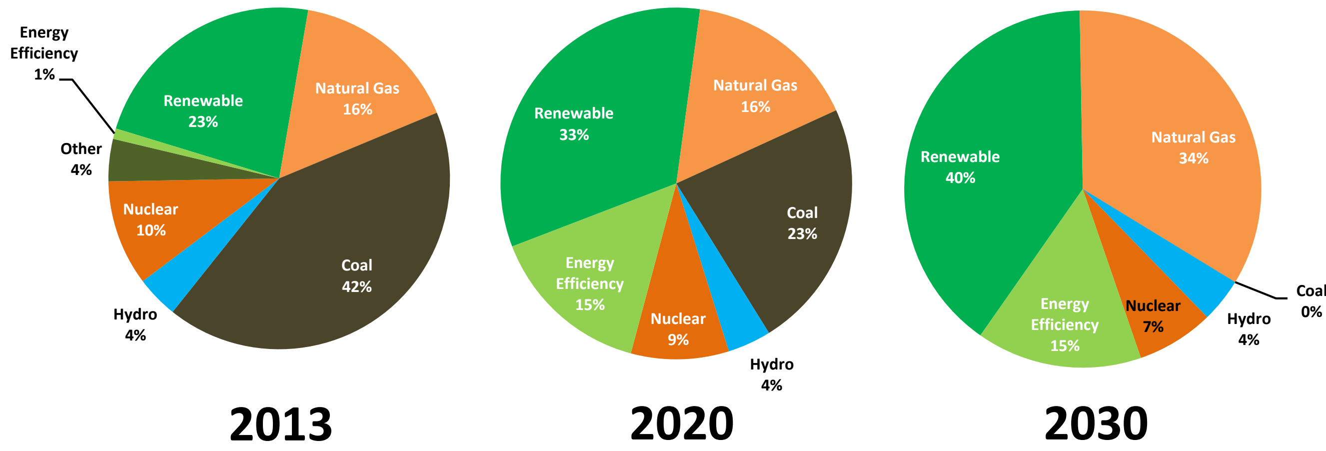
Recycled water use reduces reliance on potable water imported through MWD and provides a year round drought resistant water supply source. While the energy consumption requirements to produce recycled water are greater than local and LAA supply sources, recycled water assists LADWP in bolstering its supply portfolio to address potential supply changes related to climate change. A further discussion regarding recycled water is provided in Chapter 4, Recycled Water.

LADWP Power System resource planning efforts have also complemented Water System strategies to address climate change. To conform to the California Greenhouse Gas Emissions Performance Standard (SB 1368), LADWP is prevented from establishing new contracts, or renewing old contracts, for coal-fired generating stations, and it must comply by June, 2027. State law (SB 2(1x)) requires that California utilities meet the Renewable Portfolio Standard level of 33 percent renewable sources by 2020 and thereafter. Exhibit 12T shows a graphic representation of the historical and projected LADWP Power System supply sources, based on the 2014 Power System Integrated Resource Plan (IRP).

The Power System plans to meet and exceed the mandated goals. The Recommended Strategic Case (RSC) from the 2014 Power System IRP incorporates phasing out of the portion of coal-generated power that LADWP receives each year from Navajo Generating Station in Arizona, and Intermountain Power Plant in Utah, by 2016, and 2026, respectively. In addition, the RSC includes a goal to increase energy efficiency to at least 15 percent and renewable energy sources to 33 percent by 2020. Concurrently, the Power System is increasing the percentage of cleaner burning combined-cycle natural gas-generated energy in its power supply portfolio. This change to natural gas-generated power is intended to balance and complement environmentally dependent solar and wind energy production. Other sources, including nuclear and other purchases, will either be held constant or reduced as a percentage of the energy portfolio, or will be eliminated, by 2030.

Further, on October 7, 2015, California Governor Brown approved Senate Bill SB 350, known as the Clean Energy Pollution Reduction Act of 2015. This bill mandates an increase in the procurement of electricity from renewable sources from 33 percent to 50 percent by 2030 and beyond. The LADWP Power System will update its specific goals to meet

Exhibit 12T
Estimated LADWP Power Supply Portfolio for 2014 Power System IRP Recommended Strategic Case



this requirement in the next Power System IRP. These goals are expected to further and substantially decrease carbon emissions related to LADWP and Water System energy production and consumption, respectively.

Considering the integrated adaptation and mitigation efforts of LADWP's Water and Power Systems, goals established in Mayor Eric Garcetti's Executive Directive No.5 (ED5), and sustainability goals in mayor's Sustainable City pLAn (pLAn), carbon emissions for the Water System are expected to decrease despite an increasing population. These efforts involve minimizing water demand, shifting to less-energy intensive water sources, and reducing the carbon emissions of the energy produced by LADWP.

Looking back historically, Exhibits 12U and 12V represent the estimated historic total energy consumption and associated carbon emissions for the LADWP Water System, respectively, excluding LAA power generation offsets. Exhibit 12U shows the total energy consumption of LADWP's water system, including conveyance, treatment, and distribution of all water supply sources from FYE 1990 to FYE 2015. Each graph shows wide swings spanning a few to several multi-year periods over the 1990-2015 timeline. This is due mainly to variable hydrology and the fact that Water System energy and GHG profiles are highly dependent on LAA water deliveries which displace the need for highly energy intensive MWD supplies. Dry years bring less-abundant LAA supplies due to low precipitation in the Eastern Sierra Nevada Mountains. For those years with large volumes of imported MWD water, such as FYEs 2013 and 2014, the total energy consumption and associated GHG emissions were correspondingly high. Alternately, those years with low volumes of MWD supplies, such as FYEs 1996 and 2011, had low total energy consumption and associated carbon emissions as a result of the reduced energy requirements for imported MWD supplies.

A long-term observation from Exhibit 12U is an increasing trend in over-all energy consumption since the 1990s, represented by the ten year running average which for each year takes the average consumption of the preceding ten years. This trend is not attributable to an increase in water demand as might be assumed. In fact, City demand has not increased significantly over the time period because of aggressive conservation efforts, though it did fluctuate with variable hydrologic conditions and other factors. Understanding what has caused the increasing trend in energy consumption involves considering how supply sources have been affected by various factors over time. For example, it was mentioned that LAA supply is affected in the short-term by variable hydrology, but environmental commitments beginning in the early 1990s and increasing in later years have resulted in less available long-term water to supply the City. Prior to this time, MWD had historically made up a very low percentage of over-all supply, but by FYE 2015, it had increased by over 400 percent while LAA was reduced by nearly 40 percent, as a cumulative average since FYE 1981. There has also been a slight long-term reduction in run-off in the Owens Valley – part of the LAA watershed – since records were kept in 1935, potentially due to climate change. Long-term LAA reductions have had the largest impact on long-term energy consumption.

Since local sources have made up a comparatively small proportion of the supply portfolio, they have had a much smaller impact on long-term energy consumption. For example, the energy required to pump and treat GW is roughly one-sixth to one-third of that of MWD sources, depending on which MWD source is considered, so it has the potential to offset a significant amount of energy, but it has made up a much smaller percentage of total supply than MWD supply, ranging from about 11-13 percent in recent years. There have been reductions in this supply since the 1990's, but they have had much less impact than those for the MWD due to the lower percentage of over-all supply. Similarly, the energy required for RW is about double that of GW, but it has ranged from about one to two percent over most of the time period. The energy required for treatment and distribution of water has not significantly impacted the long-term trend in energy consumption from 1990 to 2015, as both have held relatively constant and comparatively small.

A comparison of Exhibit 12U to 12V illustrates that carbon emissions fluctuations for the Water System have generally mirrored fluctuations in energy consumption. This is because carbon emission rates do not change as dramatically as the Water System energy consumption rates that vary with a dynamic supply portfolio. The same mirroring applies to the ten-year running average trends, although there has been some divergence over the period shown. Carbon emission rates have generally declined in California due to Federal and State legislation that has set goals for reduction over the last decade or so. The result has been a dampening of the direct relationship between energy consumption and carbon emissions, as the rate for the latter has dropped slightly faster than that of the former. For example, the ten-year running average for energy consumption increased by approximately 139 percent from FYE 1990 to FYE 2015, whereas the ten-year running average for the GHG profile increased by approximately 94 percent in the same historic period. This dampening is expected to be more pronounced in the future as progressively robust clean energy goals are reached.

Exhibit 12W shows projections for both energy consumption and carbon emissions for the Water System from FYE 2020 to FYE 2040. Although the population is expected to increase by approximately ten percent over this period, the carbon footprint is expected to decrease. This is due to a combination of factors, some already alluded to above. The energy profile is expected to increase by approximately 26 percent from FYE 2020 to FYE 2040, whereas the GHG profile is expected to decrease by approximately 3 percent in the same time period.

The graphical behavior of the projections is accounted for by development of local supply projects, increased conservation, development of renewable energy sources, and, consequently, reduced reliance on MWD supplies. The results show that over the time period, projections for energy consumption and carbon emissions begin to diverge in FYE 2020, and the gap widens until about FYE 2030 and remains approximately steady until about FYE 2040, as they again mirror each other for the last ten years.

Exhibit 12V
LADWP Historic Water System GHG Profile

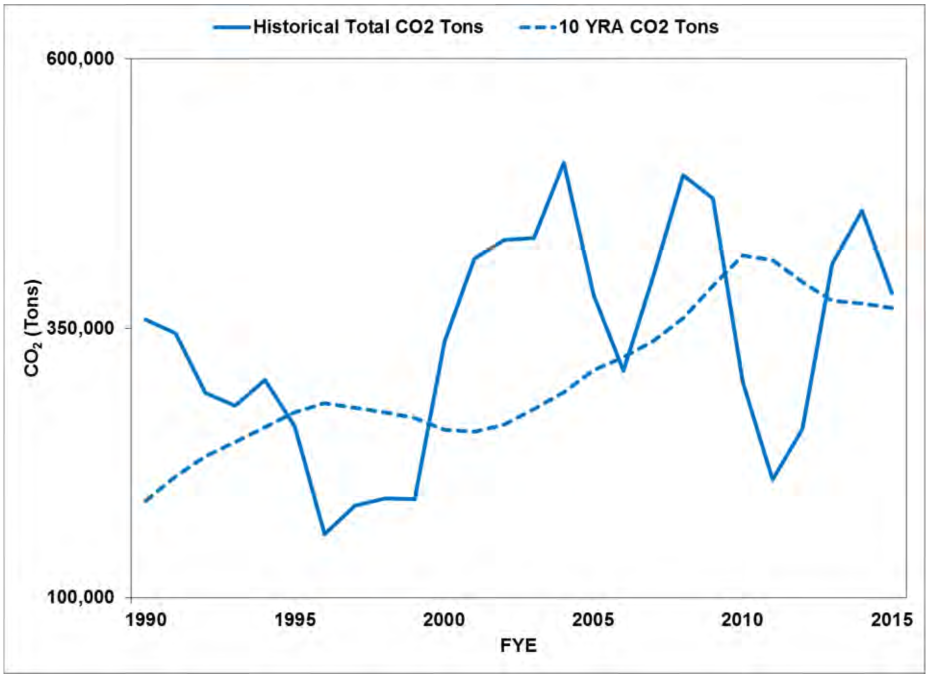
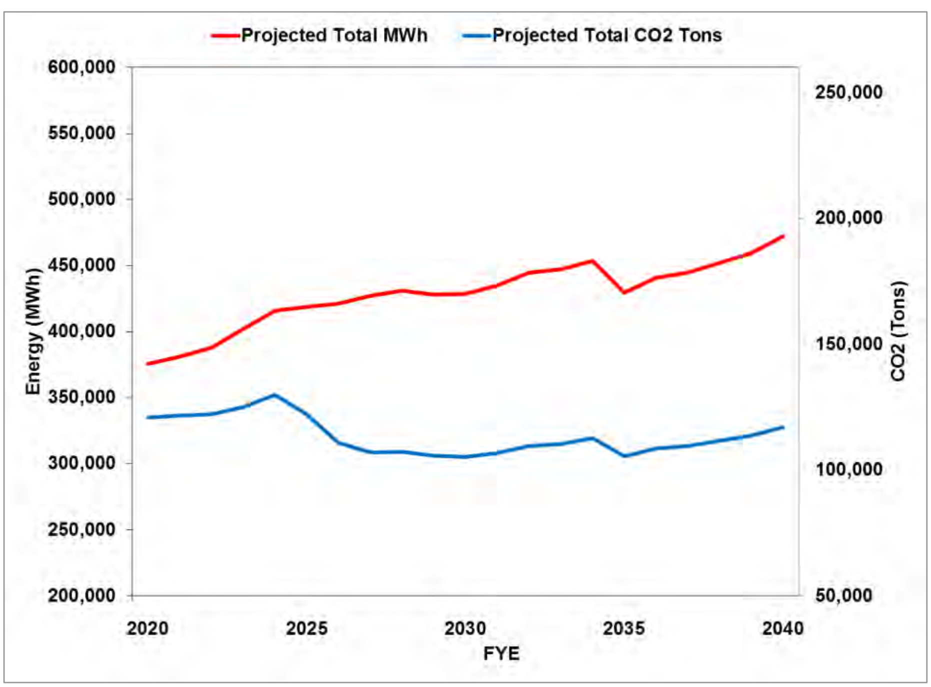


Exhibit 12W
LADWP Projected Water System Energy and GHG Profile



LADWP's current projections also include goals mandated by Mayor Eric Garcetti through ED5, issued on October 14, 2014, although they have been adjusted since the time of original reporting with updated information being made available. This directive established a goal of reducing imported MWD purchases 50 percent by FYE 2024 from base year FYE 2014; this target year was later changed to FYE 2025 by pLAn, released April 8, 2015. Additionally, ED5 set a goal for a 20 percent reduction in per capita water consumption by FYE 2017. LADWP was originally directed to present a report within 90 days that included an estimate of the resulting reductions in greenhouse gas emissions. Based on data available at the time, it was expected that the goal for decreasing per capita consumption would result in a reduction in MWD purchases beyond 50 percent by FYE 2024. Consequently, the percent reduction in GHG was estimated to be 73 percent by that year, assuming average hydrologic conditions and achievement of the 2014 RSC. As stated above, this original projection has since been superseded by current projections. Exhibit 12X represents the original reporting on ED5 and shows estimated Water System energy consumption and associated carbon emissions for baseline FYE 2014 and average and dry conditions for FYE 2024.

Exhibit 12X provides a breakdown of local and imported supply sources for the base year FYE 2014 and target year FYE 2024 along with estimated energy consumption and carbon footprint. Average and dry year conditions are shown for the projections to exemplify the effect of hydrology on the carbon footprint of the water system, although average conditions were used for reporting purposes. Local sources such as groundwater and recycled water are relatively resilient to local hydrological conditions as they are not directly dependent on precipitation quantities for any given year. For this reason, volumes delivered are identical for the projections for average and dry years. The volumes for each were projected to increase according to accelerated 2010 UWMP goals. These goals have since been revised for the 2015 UWMP. Increases in these local sources are expected to displace energy intensive, purchased MWD water thus helping to reduce the carbon footprint. LAA supply is an "energy free" source of water, aside from the energy required to treat it. However, as stated above, LAA supply is extremely dependent on hydrologic conditions. Because FYE 2014 was a dry year, the actual quantity delivered was very close to that for the FYE 2024 dry year projection. For the average year projection, a more abundant supply would offset a significant quantity of MWD water. As stated in previous sections, major swings in the carbon footprint of the water system are largely due to this relationship between hydrology, LAA and MWD supplies. Again, projections for LAA run-off are slightly reduced to account for climate change effects.

Supply sources that are not shown as having a carbon footprint are water transfers and distributed stormwater capture. Sources for future water transfer agreements are currently unknown, so it is not possible to estimate the associated energy intensity. Distributed stormwater capture projects would offset household potable water use for irrigation, etc. and would consist of devices such as cisterns (rain barrels) to collect raw water. As such, they would require no measureable energy for conveyance or treatment.

By far, the projected increase in conservation from baseline year FYE 2014 would have the largest impact on displacement of MWD purchases. To meet the mayor's target of 20 percent per capita reduction by FYE 2017, LADWP planned for highly accelerated conservation measures, and the reductions would be preserved and increased through FYE 2024, as can be seen by the value of 136,943 AFY by FYE 2024. Because conservation is relatively independent of hydrology, the projected values for average and dry conditions are the same. An additional benefit to conservation when compared to local supplies is that there is no associated carbon footprint, so the energy savings is equal to the carbon footprint of imported sources.

Local sources, however, come with an opportunity cost since they do have a carbon footprint.

Other factors included in ED5 estimates of carbon emissions savings for FYE 2024 include reductions in the carbon emissions factors for both LADWP and imported supply sources. As mentioned, LADWP projections for carbon factors were based on the RSC from the 2014 IRP and include measures to convert to more renewable energy sources. These reductions would affect local sources and their treatment, treatment for most of the MWD water and all LAA treatment. State-wide mandates for renewable energy at the time of reporting were also projected to affect carbon emission factors for imported sources, such as the SWP and CRA, as well as treatment for a small part of this supply to LADWP by MWD.

The resulting percent reduction in carbon emissions, based on ED5 goals and other factors current to the reporting period, was 73 percent. The controlling factor for these reductions was the 20 percent per capita reduction goal. Note that these projections, presented within the mandatory 90-day reporting period, were based on information and data available at the time and have since been superseded. They are presented for historical purposes only.

Exhibit 12X
LADWP Water System Initial Estimated Energy Profile and Associated GHG Based on ED5 Goals

		FY 2013-14	FY 2023-24		% change	
			Average	Dry	Average	Dry
Local Groundwater	Volume Delivered (AF)	79,403	111,170	111,170	40%	40%
	Total MWh	46,054	64,479	64,479	40%	40%
	Carbon Footprint (tons CO_2)	25,297	21,581	21,581	-15%	-15%
Recycled Water	Total Volume Delivered (AF)	10,054	50,686	50,686	404%	404%
	Total MWh	13,547	111,425	111,425	723%	723%
	Carbon Footprint (tons CO_2)	7,441	37,294	37,294	401%	401%
Distribution	Volume Delivered (AF)	582,297	459,502	459,502	-21%	-21%
	Total MWh	114,130	90,062	90,062	-21%	-21%
	Carbon Footprint (tons CO_2)	62,691	30,144	30,144	-52%	-52%
Los Angeles Aqueduct	Volume Delivered (AF)	61,024	278,908	79,240	357%	30%
	Total MWh	2,075	17,208	4,889	729%	136%
	Carbon Footprint (tons CO_2)	1,140	5,759	1,636	405%	44%
Metropolitan Water District (MWD)	Volume Delivered (AF)	441,870	29,424	229,092	-93%	-48%
	Total MWh	1,116,586	78,520	611,346	-93%	-45%
	Carbon Footprint (tons CO_2)	347,666	22,440	174,715	-94%	-50%
Water transfers	Volume Delivered (AF)	0	40,000	40,000		
	Total MWh	0	2,468	2,468		
	Carbon Footprint (tons CO_2)	0	826	826		
Stormwater (Distributed)	Volume Delivered (AF)	0	5,000	5,000		
Conservation	Volume Delivered (AF)	0	136,943	136,943		
Transfer, Spill and Storage	Volume Delivered (AF)	5,764				
Total AF		**586,587**	**652,131**	**652,131**	**11%**	**11%**
Total MWh		**1,292,392**	**364,162**	**884,669**	**-72%**	**-32%**
Total CO_2 tons		**444,235**	**118,044**	**266,196**	**-73%**	**-40%**

Although projections are subject to change due to changing climatic conditions, technological improvement and policy changes, the employed strategies represent a long-term, multi-faceted approach to reducing LADWP's carbon footprint.

12.3.2 MWD Adaption and Mitigation

MWD is taking an active approach to adapt and mitigate against climate changes in its operations. Adaption and mitigation measures include:

- Investments in local resources to diversify MWD's water supply portfolio.
- Tracking climate change legislation – MWD provides input and direction on legislation.
- Collaborating on climate change with state, federal, and non-governmental agencies.
- Monitoring state and local climate change actions.
- Investigating the water supply and energy nexus.
- Coordinating with large water retailers.
- Integrating climate change into integrated resource planning as discussed in Chapter 10, Integrated Resource Planning.
- Sharing climate change knowledge and providing support – founding member of Water Utility Climate Alliance.
- Adopting energy management policies to support cost-effective and environmentally responsible programs, projects, and initiative.

MWD has also taken structural adaption measures including construction of the Inland Feeder. The Inland Feeder, completed in 2009, connects MWD's SWP supplies with MWD's CRA supplies and allows delivery of SWP supplies to MWD's major reservoir, Diamond Valley Lake. In relation to climate change, the project will increase conveyance capacity by allowing more rain to be conveyed as projected snowpack levels decrease and allow MWD to capture rain associated with projected short duration high intensity storms.

With MWD sources remaining relatively constant between FYEs 2020 and 2040 (assuming average hydrologic conditions) and conservation remaining steady as a percentage of total model water demand, local supply energy requirements will be the primary contributing factor for the increase in energy consumption observed in Exhibit 12W. Energy consumption rates for local supplies will increase due to additional advanced treatment processes to be commissioned in approximately FYE 2024, and steady increases in energy consumed for RW will result from continued expansion of tertiary level treated RW projects. Since RW has the highest energy intensity of all local sources, and because RW supply will increase the most as a fraction of local supply between FYEs 2020 and 2040, RW development will be a significant factor for total energy consumed for local sources.

Exhibit 12U
LADWP Historic Water System Energy Profile