WATER TOMORROW

Integrated Water Resources Plan
2015 UPDATE

Report No. 1518

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Integrated Water Resources Plan

2015 Update

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WATER TOMORROW

Integrated Water Resources Plan

The Metropolitan Water District's decision nearly a generation ago to develop and implement a long-term water vision is benefiting all of Southern California each and every day during this historic drought. The first Integrated Water Resources Plan (IRP) in 1996 anticipated moments of potential shortages. We hope and firmly believe that this updated 2015 IRP Update will prepare the next generation just as capably.

That first IRP embodied the lessons learned from a historic drought in late 1980s and early 1990s that prompted a complete rethinking about Southern California water planning. Expectations of adequate imported supplies regardless of hydrology were set aside. In its place, the inaugural IRP envisioned the diversification of water resources to include water conservation and local resource development. It also envisioned a vast storage network of reservoirs and groundwater banks for Southern California, including Diamond Valley Lake which was completed in 1999. The IRP called for capturing water in wet years, storing those ample supplies for dry years, lowering demand through conservation and developing a more diverse supply portfolio.

Heading into the most recent drought cycle, Metropolitan had developed over 5.5 million acre-feet of storage capacity and had successfully stored over 2.7 million acre-feet. This is a more than 13 times the storage capacity compared to the 1980s, with record quantities of water in reserve. Were it not for the vision of the 1996 IRP and the commitment to implement that vision, Southern California would have not been prepared for this drought. But we were. And to date, significant hardships from drought have been avoided. And with the nation's largest conservation program of its kind, Metropolitan has invested $450 million to remove 175 million square-feet of turf and install tens of thousands of water-saving devices throughout the service area. A cultural shift away from lawns and towards California-Friendly landscapes throughout the Southland is now under way.

Looking ahead, there are challenges facing Metropolitan's imported supplies. The Colorado River essentially has been in drought conditions since the beginning of this century. And the Northern California supplies conveyed via the State Water Project face uncertainties in a changing climate and due to operational constraints in the ecologically struggling Sacramento-San Joaquin Delta. There are plans and initiatives to stabilize these supplies. Locally throughout the service area, there are plans to develop new supplies and lower demands. The 2015 IRP Update starts with some realistic expectations of imported supplies while assuring overall reliability through more conservation, more local supplies and planning for a new generation of supplies should they be needed.

The IRP does not predict the precise water portfolio that Southern California will have in place by the middle of this century. But it does provide both the details and the vision for adaptively managing through the change that is coming. The IRP represents Metropolitan's strategy for navigating the challenging journey that lies ahead.

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Executive Summary

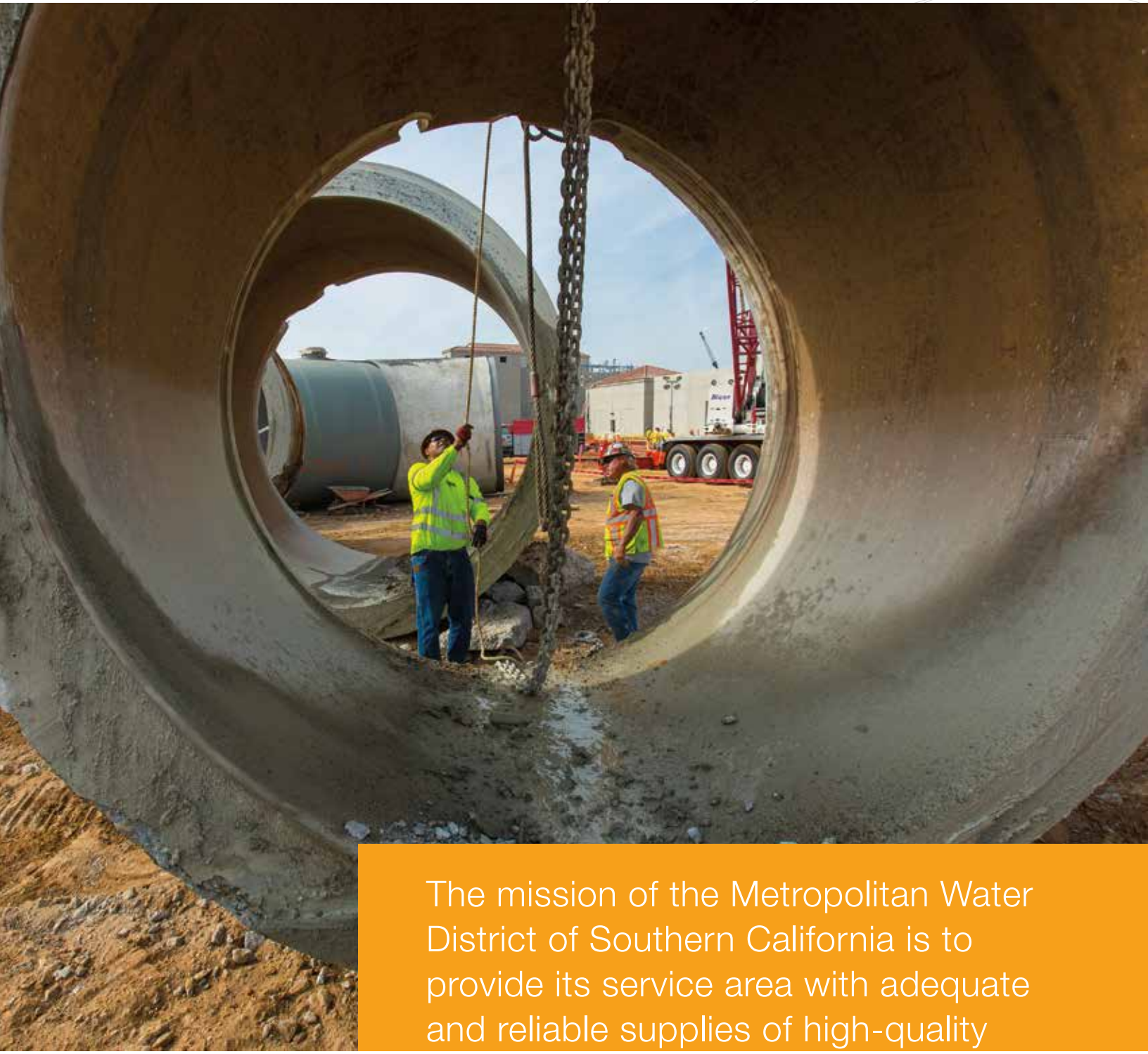
In California water, uncertainty comes with the territory. Being unprepared for tomorrow, however, is simply not an option. The Metropolitan Water District of Southern California prepares for tomorrow with an evolving long-term water strategy known as its Integrated Water Resources Plan, or IRP. The inaugural IRP was adopted in 1996, with updates in 2004 and 2010. The 2015 IRP Update continues the tradition of assessing and adapting to changing conditions facing Southern California.

The fundamental goal of the IRP is for Southern California to have as reliable a water system for tomorrow as the region has enjoyed for decades, regardless of the challenges that emerge along the way. Metropolitan plans to meet this goal through an adaptive management strategy that is the cornerstone of the 2015 IRP Update.

Metropolitan was authorized by the California Legislature in 1928 to advance a regional approach to water supply in Southern California. Metropolitan's initial mission was to construct the 242-mile Colorado River Aqueduct to its service area on the Southern California coastal plain. Metropolitan's service area had an assessed property valuation of approximately $2 billion at the time. Now Metropolitan serves a six-county service area with a property valuation of approximately $2 trillion. Metropolitan imports supplies from both the Colorado River and Northern California via the State Water Project while investing in a variety of storage, local supply and conservation initiatives.

Metropolitan has a long record of promoting alternatives to imported water supplies, dating back to the 1980s. With the IRP, that process became more formalized as a long-term strategy and official policy. Metropolitan has steadily diversified the future water portfolio for Southern California with each revision to the IRP. This update is no exception. Investments to maintain the reliability of imported supplies are complemented by an expansion of local supply development along with a reduction in demand through a variety of conservation and water-use efficiency initiatives.

The necessary suite of actions evolves over time based on the water conditions of tomorrow. Updating the IRP creates a new baseline for managing into the future.



The mission of the Metropolitan Water District of Southern California is to provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way.

SETTING THE 2015 IRP UPDATE RELIABILITY TARGETS

The 2015 IRP Update reliability targets identify developments in imported and local water supply and in water conservation that, if successful, would provide a future without water shortages and mandatory restrictions under planned conditions. For imported supplies, Metropolitan looks to make investments in additional partnerships and initiatives to maximize Colorado River Aqueduct deliveries in dry years. On the State Water Project, Metropolitan is looking to make ecologically-sound infrastructure investments so that the water system can capture sufficient supplies to help meet average year demands and to refill Metropolitan's storage network in above-average and wet years. Lowering regional residential per capita demand by 20 percent by the year 2020 (compared to a baseline established in 2009 state legislation), reducing water use from outdoor landscapes and advancing additional local supplies are among the planned actions to keep supplies and demands in balance. Today's best estimates about future conditions are a sound basis for establishing reliability targets. Table ES-1 shows the 2015 IRP Update supply reliability and conservation targets. These targets represent a combined total of 723,000 acre-feet of increased conservation savings and supply production by the end of the forecast period; 485,000 acre-feet from the total conservation target and 238,000 acre-feet from the total supply reliability target. These targets represent the projected levels of imported supplies, local supplies and water conservation necessary to meet the 2015 IRP Update reliability goals.

TABLE ES-1

2015 IRP Update Total Level of Average-Year Supply Targeted (Acre-Feet)

	2016	2020	2025	2030	2035	2040
Retail Demands before Conservation	4,878,000	5,219,000	5,393,000	5,533,000	5,663,000	5,792,000
Total Conservation Target	1,034,000	1,096,000	1,197,000	1,310,000	1,403,000	1,519,000
Retail Demands after Conservation	3,844,000	4,123,000	4,196,000	4,223,000	4,260,000	4,273,000
Minimum CRA Diversion Target	900,000	900,000	900,000	900,000	900,000	900,000
Average Year SWP Target	1,202,000	984,000	984,000	1,213,000	1,213,000	1,213,000
Total Local Supply Target	2,199,000	2,307,000	2,356,000	2,386,000	2,408,000	2,426,000
Total Supply Reliability Target	4,301,000	4,191,000	4,240,000	4,499,000	4,521,000	4,539,000

CONSIDERING RISKS/FACTORING IN CHANGES

Uncertainty is a given in today's water world. Planning for reliability has to take uncertainty into consideration. Metropolitan cannot with absolute certainty predict what supply initiatives will fare perfectly or miss the mark, but the 2015 IRP Update process does consider the many potential risks. Diversifying the water portfolio provides an important hedge against risk, but also adds complexity to the process of considering the many positive and negative scenarios of how supplies may be affected by future conditions. Through the 2015 IRP Update process, foreseeable challenges and risk scenarios were identified that point to the potential of 200,000 acre-feet of additional water conservation and local supplies needed to address these risks.

FUTURE SUPPLY ACTIONS

Future water supply and demand conditions may be beyond any reasonable estimate that can be made today. That said, water agencies can take actions in the coming years to position themselves for what could be a very different future. Metropolitan's 2015 IRP Update calls for considering Future Supply Actions, which are important steps to prepare the region to adapt to water supply condition changes that are different than what is currently anticipated. These steps range from exploring the feasibility of new local supply options, investing in water-saving technologies, acquiring land and proposing ways to reduce regulatory impediments to supply development. The 2010 IRP Update referred to these forward-looking steps as Foundational Actions.

ADAPTIVE MANAGEMENT

Adaptive water management, as opposed to a rigid set of planned actions over the coming decades, is the most nimble and cost-effective manner for Metropolitan and local water districts throughout Southern California to effectively prepare for the future. An adaptive management approach is nothing new. It began to evolve with Metropolitan's first IRP in 1996, after drought-related shortages in 1991 prompted a rethinking of Southern California's long-term water strategy. Reliance on imported supplies to meet future water needs has decreased steadily over time, replaced by plans for local actions to meet new demands. The 2015 IRP Update continues to build a robust portfolio approach to water management.

The 2015 IRP Update Process

Developing a long-term water strategy for a region as complex as Southern California does not happen in a vacuum. Metropolitan is the largest regional water cooperative of its kind in the nation. The development of the 2015 IRP Update reflects the intensely collaborative nature of water planning in Southern California, involving member agencies and numerous stakeholders.

The 2015 IRP Update focuses on ascertaining how conditions have changed in the region since the last IRP update in 2010. This involves developing new reliability targets to meet the evolving outlook of the region's reliability needs, assessing strategies for managing short and long-term uncertainty and communicating technical findings. The 2015 IRP Update also identifies areas where policy development and implementation approaches are needed. These discussions will follow the adoption of this report, and involve extensive interaction with Metropolitan's Board of Directors and member agencies.

Metropolitan faces challenging circumstances with its traditional sources of imported supplies from Northern California and the Colorado River. Using feedback and input from numerous stakeholders, Metropolitan makes projections of the availability of these supplies from a range of potential scenarios. Water agencies throughout the region also offer visions of their futures through their Urban Water Management Plans. These and other planning documents provide important insight into both

local supplies that are likely to come on line in the near future, as well as supplies with a more uncertain future. Any robust outlook about supplies must take into account the many variables that face all the potential sources of water for the region.

Future demands are largely a function of Southern California's projected population growth and the amount of water that each person uses, commonly known as per-capita water use. These two factors have been shifting lower over time. Population growth estimates are not as high as previously forecasted, along with per-capita water use. The 2015 IRP Update reflects the latest and best estimates of these patterns.

A rigorous modeling analysis of supply and demand scenarios under the 2015 IRP Update points to two fundamental findings:

First, if Southern California stopped adapting and rested on its existing supply assets and achievements in conservation, shortages would likely occur at an unacceptable level of frequency in the years ahead. This finding is not a surprise. It is a reminder that working to maintain a reliable water supply is never complete.

Second, if Southern California continued to implement its existing long-term plan as described in the 2010 IRP Update, potential future shortages would be significantly addressed, but not entirely. This finding is equally not a surprise as the 2010 IRP Update provided a robust plan for future reliability. Perhaps the more important piece of this finding is that, although drought conditions in Southern California and throughout the West have dramatically shifted the baseline, maintaining existing water resources will be just as important as developing new approaches.

Together, these findings point to the need for a refinement – not an overhaul – of the adaptive management strategy.

Reliability Strategy

Effective modeling of supply and demand can point out the need to take action. Crafting the right strategy is an entirely different exercise. Lessons from history are to be learned. New possibilities are to be realized.

Overall, the 2015 IRP Update represents a refinement – not an overhaul – of Southern California's water management strategy. Similar to the 2010 IRP Update, the 2015 IRP Update looks to local solutions to close any potential gap between supply and demand. In this refinement, the 2015 IRP Update projects a need for more than 723,000 acre-feet of growth in imported and local supplies and reduced water demands from conservation. This reliability target encompasses the 25-year horizon of the plan and it frames the upcoming Implementation Policy discussion process with Metropolitan's Board of Directors and member agencies.

Within the overall strategy, there are potential new planning shifts for the years to come. The potential completion of the California WaterFix and a modernized water system in the Delta, for example, would create a new physical ability to move additional supplies in average and above-average years. In addition to providing water for storage management, this could also create opportunities for new markets and partnerships. Likewise, the long-time success of Metropolitan's land management program on the Colorado River in the Palo Verde Valley points to the potential of new partnerships with farming communities on the river to stabilize the supply/demand future on the Colorado River.

The 2015 IRP Update represents an evolving point of Southern California's future water strategy that will undoubtedly adapt in expected and perhaps surprising ways in the years to come.

Conclusions

The mission of the Metropolitan Water District is to provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way. This is not a singular mission. It reflects the diversity of the challenges of balanced water management and the many facets of any successful IRP.

Overall, Southern California is in an enviable position to approach tomorrow. A generation of diversification of the region's water portfolio provides an asset base and choices on how to adapt to changes ahead.

The Delta water system and ecosystem improvements being advanced by the state and federal administrations, for example, would advance California's official co-equal goals of improving the Delta ecosystem and providing a more reliable water supply for the state. Shoring up the reliability of Metropolitan's baseline imported supplies has proven to be a highly cost-effective investment that protects broad public interests as well as Southland ratepayers.

Looking locally to close the gap between supplies and demands, while making the necessary investments and initiatives to maintain the reliability of imported supplies, is a responsible approach from a regional and statewide perspective. This achieves California's policy for all regions to reduce their reliance on the Delta to meet future needs, while building upon imported supplies in ways that further diversify the Southern California water portfolio.

This vital planning exercise has served Southern California well for a generation. The 2015 IRP Update represents a further step in the iterative planning process of a "living" strategic plan that evolves and adapts as needed to address the needs of the next generation.

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Acronyms and Abbreviations

CII	Commercial, Industrial and Institutional
CPP	Conservation Credits Program
CRA	Colorado River Aqueduct
CVP	Central Valley Project
DWR	California Department of Water Resources
FAF Program	Foundational Actions Funding Program
GHG	Greenhouse Gas
GPCD	Gallons per Capita per Day
HECW	High-Efficiency Clothes Washer
HET	High-Efficiency Toilet
ICP	Innovative Conservation Program
IID	Imperial Irrigation District
IRP	Integrated Water Resources Plan
IRPSIM	Integrated Resources Planning Simulation Model
LAA	Los Angeles Aqueduct
LADWP	City of Los Angeles Department of Water and Power
LRP	Local Resources Program
M&I	Retail Municipal and Industrial
Metropolitan/MWD	The Metropolitan Water District of Southern California
MFR	Multifamily Residential
MOU	Memorandum of Understanding
MW	Megawatt
MWD-EDM	Metropolitan Water District-Econometric Demand Model
MWELO	Model Water Efficient Landscape Ordinance
PVID	Palo Verde Irrigation District
RDM	Robust Decision Making
RFP	Request for Proposals
RTP	Regional Transportation Plan
SANDAG	San Diego Association of Governments
SCAG	Southern California Association of Governments
SDCWA	San Diego County Water Authority
SDGE	San Diego Gas and Electric
SFR	Single-Family Residential
SNWA	Southern Nevada Water Authority
SoCal Gas	Southern California Gas Company
SWP	California State Water Project
USBR	United States Bureau of Reclamation
UWMP	Urban Water Management Plan
WSAP	Water Supply Allocation Plan
WSDM Plan	Water Surplus and Drought Management Plan
WUCA	Water Utility Climate Alliance

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1.

Every Generation, a Challenge:

Background, Changed Conditions and Continued Reliability

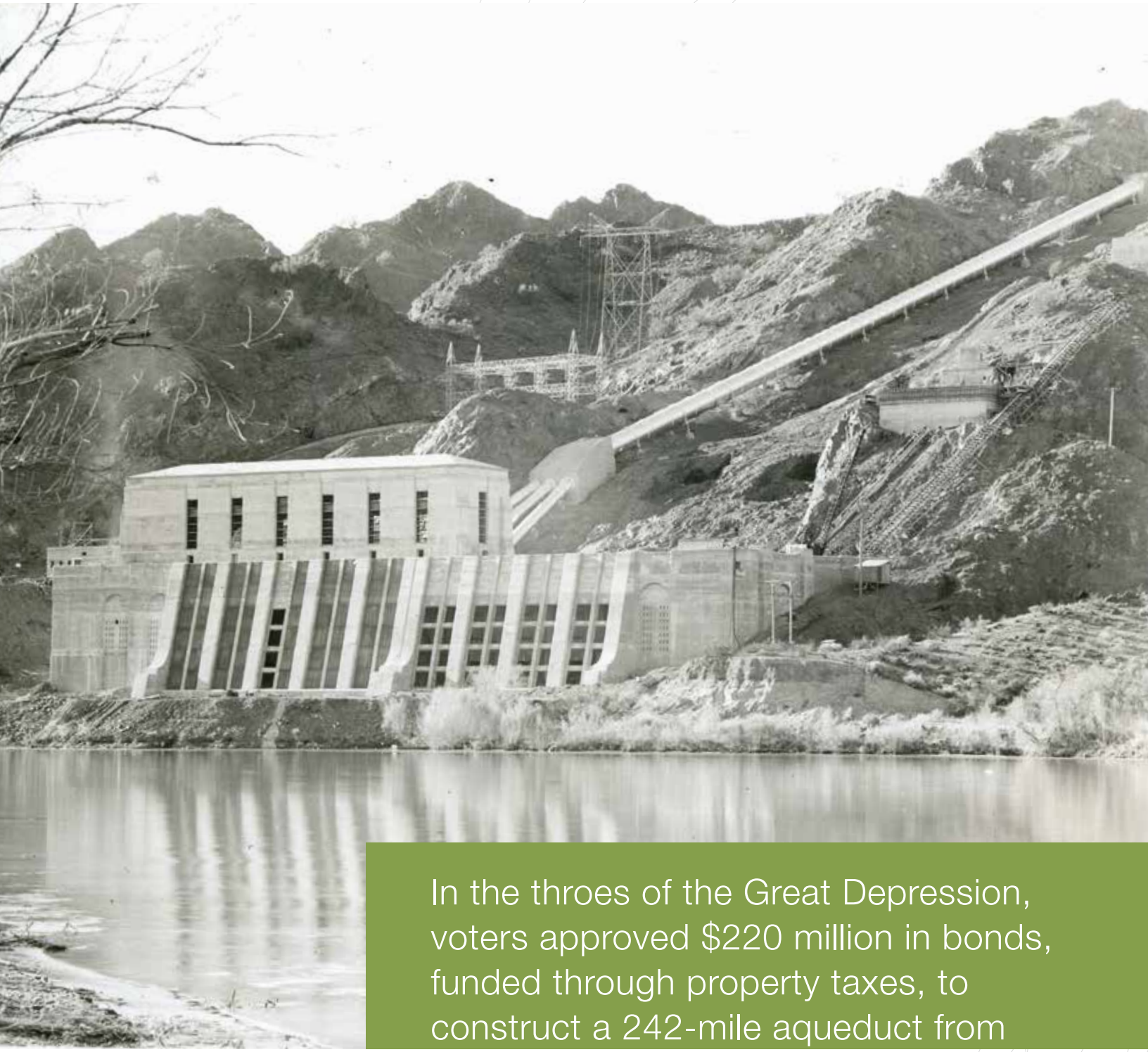
Every generation of Southern Californians has had to face drought and in every generation, Metropolitan has made the necessary investments to ensure water supply reliability for the region. Metropolitan was authorized by the California Legislature in 1928 to form a regional water cooperative of the rapidly urbanizing areas of Southern California. In the throes of the Great Depression, voters approved $220 million in bonds, funded through property taxes, to construct a 242-mile aqueduct from the Colorado River that would provide a needed water supply for future generations of Southern Californians. At that time, Metropolitan's service area had a combined assessed value of approximately $2 billion. Today, urban Southern California has an assessed property value of approximately $2 trillion – a thousand-fold increase. A secure reliable water supply has supported the great economic engine of this region for decades. If Southern California were a nation, it would be the 16th largest economy on the globe, just behind Mexico and ahead of Indonesia. Additional background information on Metropolitan, its Board of Directors, member agencies and other planning efforts can be found in Appendix 1.

A generation after Metropolitan was formed it became the cornerstone of the effort to build the California State Water Project (SWP). In 1960, the state's voters approved bonds to finance the construction of the project. The SWP was the most expensive water project ever constructed and Metropolitan agreed to finance approximately 50 percent of the project with a 75-year financing commitment. This water system, a modern engineering marvel, provides an additional water supply to the region from Northern California via the Feather River in the northern Sierra Nevada Mountains, down into the Sacramento River and then across the Delta. From there, pumps lift the water into aqueducts that eventually lead to the San Francisco Bay Area, San Joaquin Valley, the Central Coast and Southern California. The SWP now provides about 30 percent of Southern California's water supply.

A Drought Gives Birth to Metropolitan's IRP

The weather of the West is marked by dramatic shifts in hydrology ranging from deluges to droughts. Yet, Southern California's economy depends on a steady and reliable water supply. Drought cycles in particular have played an important role in spurring re-examination of water policies to better prepare for the future.

A generation after the historic investment in the SWP came the drought of the late 1980s and early 1990s. This led to significant water supply challenges in the Southland, prompting a complete rethinking of Metropolitan's water management programs, investments and planning objectives. Since that time, Southern California has invested billions of dollars to



In the throes of the Great Depression, voters approved $220 million in bonds, funded through property taxes, to construct a 242-mile aqueduct from the Colorado River that would provide a needed water supply for future generations of Southern Californians.

develop new and improved infrastructure that can transport and store imported water supplies in wet years in order to have sufficient supplies in reserve for drought and emergencies. Overall, Metropolitan has increased its network of storage assets more than 13-fold since the early 1990s. Metropolitan currently has capacity to store more than 5.5 million acre-feet of water above and below ground. Thanks to these investments, Southern California entered the current drought cycle with more water in storage than at any time in its history.

Investing in storage was one important lesson learned from previous droughts. Diversification of supply was another. The drought of 1991 provided the impetus for Metropolitan to develop its first long-term water vision, the Integrated Water Resources Plan (IRP).

Metropolitan and Integrated Water Resources Planning

In 1993, Metropolitan commenced an Integrated Water Resources Planning Process as the beginning of this new era of regional reliability planning. As this planning process began, Metropolitan held a series of three regional assemblies from 1993 through 1995 addressing strategic planning issues. Attendance at these regional assemblies included Metropolitan's Board of Directors, Metropolitan's senior management, member agency managers, local retail water providers, groundwater basin managers and invited public representatives. The purpose of these regional assemblies was to gain consensus on resource policy issues, provide direction for future work and to endorse regional objectives, principles and strategies.

A key outcome of the regional assemblies was the establishment and adoption of water supply principles which provided critical guidance for the development and adoption of future Metropolitan IRPs. In summary, these principles state:

- No water supplier in Southern California is an isolated, independent entity unto itself and all, to varying degrees, are dependent upon a regional system of water importation, storage and distribution.
- Metropolitan is Southern California's lead agency in regional water management, having the responsibility for importing water from outside the region and convening dialogues on regional water issues, encouraging local water development and conservation, advocating the region's interests to the state and federal governments and leading the region's water community.
- Water suppliers at all levels have a responsibility to promote a strong water ethic both within the water community and among the public, developing plans through open processes, committing to achieving adopted regional goals and strategies and committing to a policy of equity and fairness in development and implementation of water management programs.

These regional assemblies laid the foundation for Metropolitan's integrated regional planning path from 1996 to the present, which has guided Metropolitan's water resources strategy from the initial adoption of Metropolitan's IRP in 1996 to the successive IRP updates in 2004 and 2010.

1996 IRP

Metropolitan's IRP established a long-term, comprehensive water resources strategy to provide the region with a reliable and affordable water supply. One of the fundamental outcomes of the 1996 IRP was the implementation of a diverse portfolio of resource investments in both imported and in-region supplies, and in water conservation measures. The 1996 IRP further emphasized the construction and creation of a network of water storage facilities, both below and above ground.

The 1996 IRP process identified cost-effective solutions that offered long-term reliability to the region. Having identified the need for a portfolio of different supplies to meet its demands, the 1996 IRP analyzed numerous resource portfolios seeking to find a "Preferred Resource Mix" that would provide the region with reliable and affordable water supplies through 2020. The analysis determined the best mix of resources based on cost-effectiveness, diversification and reliability. Establishing the "Preferred Resource Mix" was an integral part of the 1996 IRP and subsequent updates have continued to focus on how best to diversify Metropolitan's water portfolio and establish the broad resource targets for the region.

2004 IRP UPDATE

The 2004 IRP Update reviewed the goals and achievements of the 1996 IRP, identified the changed conditions for water resource development and updated resource development targets through 2025. These targets included increased conservation savings and planned increases in local supplies. The 2004 IRP Update also explicitly recognized the need to handle uncertainties inherent in any planning process. Some of these uncertainties included:

- Fluctuations in population and economic growth
- Changes in water quality regulations
- Discovery of new chemical contaminants
- Regulation of endangered species affecting sources of supplies
- Changes in climate and hydrology

As a result, a key component of the 2004 IRP Update was the addition of a 10 percent "planning buffer." The planning buffer identified additional supplies, both imported and locally developed, that could be implemented to address uncertainty in future supplies and demands.

2010 IRP UPDATE

In keeping with the reliability goal of meeting full-service demands at the retail level under foreseeable hydrologic conditions, the 2010 IRP Update sought to stabilize Metropolitan's traditional imported water supplies and establish additional water resources to withstand California's inevitable dry cycles and growth in water demand. Metropolitan acknowledged the increasing impact of emerging challenges such as environmental regulations, threats to water quality, climate change and economic unknowns and the uncertainty that these challenges would have on planning for a reliable, high quality and affordable water supply. By 2010, the Colorado River had experienced below-average precipitation conditions for most of the previous decade, and the SWP was facing historic regulatory cutbacks significantly reducing its supplies from the Sacramento-San Joaquin Delta in Northern California. Recognizing that the conditions for developing and maintaining water supply reliability had changed, Metropolitan set out to not only update the IRP but also to examine how best to adapt to the new water supply paradigm.

ADAPTIVE MANAGEMENT STRATEGY

The 2010 IRP Update specifically planned for uncertainty with a range of adaptive management strategies that both meets demands under observed hydrology and responds to future uncertainty. The plan provided solutions by developing diverse and flexible resources that perform adequately under a wide range of future conditions. Specifically, the adaptive management strategy was a three-component plan that included the following:

Core Resources Strategy: Designed to maintain reliable water supplies under known conditions.

The core resources strategy represented baseline efforts to manage water supply and demand conditions. This strategy was based on "what we know today," including detailed planning assumptions about future demographic scenarios, water supply yields and a range of observed historical weather patterns. Under this strategy, Metropolitan and its member agencies advanced water-use efficiency through conservation and recycled water, along with further local supply development such as groundwater recovery and seawater desalination. The 2010 IRP Update also sought to stabilize traditional imported supplies from the Colorado River and Northern California.

Uncertainty Buffer: A suite of actions that help to mitigate short-term changes.

The 2010 IRP Update set goals for a range of potential buffer supplies to protect the region from possible shortages in a cost-effective manner, starting with a further expansion of water-use efficiency on a region-wide basis. The buffer sought to enable the region to adapt to future circumstances and foreseeable challenges that were not assumed under the Core Resources Strategy, such as short-term loss of local supplies or regulatory restrictions.

Foundational Actions: Strategies for additional water resources to augment the core or buffer supplies.

Foundational Actions were designed to prepare the region by determining viable alternative supply options for long-range planning. These preparatory actions, including feasibility studies, technological research and regulatory review, were designed to lay the foundation for potential alternative resource development.

Changed Conditions since the 2010 IRP Update

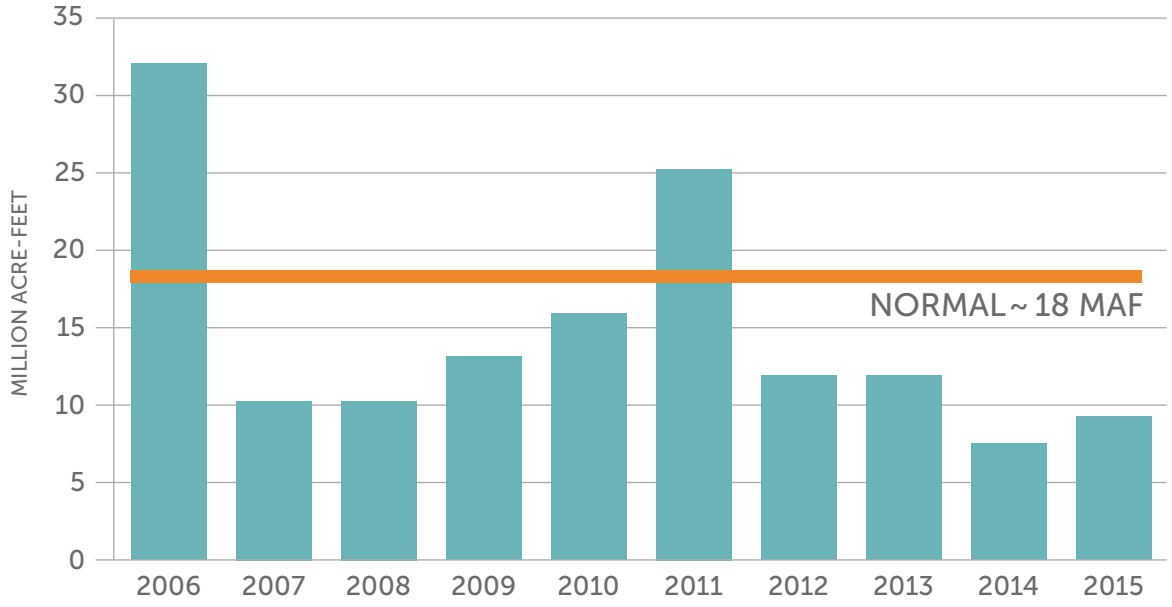
Southern California continues to face a wide range of challenges that impact the future of water supply reliability. The region must continually adapt to changing conditions, including severe droughts, shifts in demographics and climate change.

UNPRECEDENTED DROUGHT CONDITIONS

Since the 2010 IRP Update, drought in California and across the southwestern United States has put the IRP adaptive management strategy to the ultimate stress test. Dry conditions in California have persisted into 2015, resulting in a fourth consecutive year of drought. The year 2015 began with the driest January on record, resulting in the earliest and lowest snowpack peak in recorded history at only 17 percent of the traditional snowpack peak on April 1st. Figure 1-1 illustrates that in the ten years since 2006, there were only two wet years, with the other eight years having been below normal, dry, or critically dry. The Colorado River watershed has also experienced an extended reduction in runoff. Within Southern California, continuing dry conditions have impacted the region's local supplies, including its groundwater basins.

FIGURE 1-1

Annual Northern California Runoff 2006-2015
Compared to the Long-Term Average



IMPORTED SUPPLIES

Within the region's water portfolio, supplies from the SWP and Colorado River Aqueduct (CRA) remain essential baseline supplies for Southern California. Water from Northern California delivered through the SWP has provided key supplies in wet years to manage against dry years, and it is the only imported supply that can physically reach significant portions of Metropolitan's service area. However, in calendar year 2014, Metropolitan and other state water contractors received only 5 percent of their contracted amounts. This was by far the lowest allocation ever delivered by the SWP and posed unprecedented challenges to Metropolitan's planning and operations.

A key element of the 2015 IRP Update was developing approaches for how Metropolitan will advance conservation and local resources development and maximize its storage reserves in the future.

The other major source of imported water to the region is the CRA. The ongoing drought in the Colorado River basin has increased the challenge to Metropolitan to augment these deliveries in order to mitigate the reduced availability of Northern California water via the SWP.

All river systems have their challenges, and those of the Colorado Basin and western Sierra Nevada have similar attributes. On one hand, both systems historically experience massive precipitation seasons that can refill reservoir systems, particularly on the Colorado River and the impressive capacities of Lake Mead and Lake Powell. But other factors can lead to limited supplies. Droughts can limit deliveries. So can increased regulatory burdens for environmental protection. Metropolitan is not a senior water right holder on either system, increasing the impacts of diversions by other users. Climate change is an emerging factor as well, either by increasing the frequency of droughts or decreasing runoff as temperatures rise. Imported supplies remain the foundation for Southern California. But their challenges speak to the wisdom of a portfolio approach to water for the region.

LOCAL SUPPLIES AND CONSERVATION

Within the region, groundwater is a significant source of water supply, and effective use of local groundwater basins is a significant component of any comprehensive water supply plan for Southern California. The drought has upset the balance of production and recharge, and regional groundwater levels are approaching historically low levels. The drought has a similar effect on local watersheds as local surface supplies have also been reduced.

But the severity of this drought also prompted extraordinary response across California by state, regional and local agencies, as well as intense interest by the news media and the general public. For example, Metropolitan expanded its existing rebate programs for turf removal and numerous water-saving products from $20 million to $450 million, funding the largest single investment in water conservation incentives in the nation's history. These and other efforts, such as Governor Brown's Executive Order calling for a 25 percent reduction in consumer water use, have had major effects on water conservation, some of which will endure even after the drought abates.

Overall, the ongoing drought has reinforced Metropolitan's strategy of diversifying water resources and using its significant storage capacity to ensure reliability. However, the availability of excess flows for storage under future hydrology is coming into question. A key element of the 2015 IRP Update was developing approaches for how Metropolitan will advance conservation and local resources development and maximize its storage reserves in the future.

DEMOGRAPHICS

Continuing effects of the 2007-2009 Great Recession have changed the trajectory of population and job growth. The latest demographic and economic projections for the region anticipate much lower growth into the future than was forecasted in the 2010 IRP Update. Lower growth signifies slower increases in water demand, which has major implications for prudent planning and investment in future water supplies.

Climate Change

Climate change may prove to be the most significant challenge to water supply reliability for Southern California. Although it remains uncertain as to how the climate is changing in California, the potential outcomes of a changing climate will affect both supplies and demands. The vast majority of Global Circulation Models show increasing air temperatures in Metropolitan's service area and in both Northern California and Colorado River watersheds. In these watersheds, the reduced snowpack that will result from warmer temperatures will lead to the loss of the natural water management that snowpack provides. Warmer temperatures in Southern California will affect water demands by increasing the water requirements for plant life and landscapes and will also increase evaporation rates in storage reservoirs. Reduced precipitation will also affect the natural recharge of groundwater and surface water resources.

The past 10 years have given Southern California a glimpse of the challenges that climate change will pose. Local rainfall has been sharply below normal, and imported supply watersheds have already experienced the range of higher temperatures and reduced snowpack that is being foreseen by climate change scientists. The record conditions of temperature and precipitation in the recent drought have a severe impact on water supply reliability for Southern California and the rest of the state. It has also exposed that the State's water system, storage and conveyance facilities are inadequate with regard to managing the highly variable water supplies and conditions brought about by extreme changes in rain and snowpack.

While uncertainties remain regarding the exact timing, magnitude, and regional impacts of these temperature and precipitation changes, researchers have identified several areas of concern for California's water resources. These include:

- Reduction in Sierra Nevada snowpack
- Reduction in runoff and river flow in the Colorado River Basin
- Increased intensity and frequency of extreme weather events
- Rising sea levels resulting in
  - Impacts to coastal groundwater basins due to seawater intrusion
  - Increased risk of damage from storms, high-tide events, and the erosion of levees
  - Potential pumping cutbacks on the SWP and Central Valley Project due to increased salinity

Other important issues of concern due to global climate change include:

- Effects on local supplies such as groundwater
- Changes in urban and agricultural demand levels and patterns
- Impacts to human health from water-borne pathogens and water quality degradation
- Declines in ecosystem health and function
- Alterations to power generation and pumping regimes

As a major steward of the region's water supply resources, Metropolitan has been committed to facing the challenge of climate change for well over a decade. In 2000, Metropolitan convened a panel of leading climate change experts to gain a clearer perspective on the state of the sciences and on the potential impacts to California. In 2002, Metropolitan's Board of Directors adopted a set of climate change Policy Principles that recognized the importance of incorporating potential climate change impacts in the planning and environmental review of water supply and infrastructure projects. A second expert panel on climate change was convened in 2007 to present and explain new findings from the climate change science community. Also in 2007, Metropolitan took a major step by becoming one of the eight founding members of the Water Utility Climate Alliance (WUCA). Now consisting of ten of the largest nationwide water utilities serving over 40 million people, WUCA provides a collaborative avenue for knowledge sharing and research support on climate change. The member agencies of WUCA annually share individual agency actions to mitigate greenhouse gas emissions. WUCA monitors and analyzes the development of climate change-related research, technology, programs, and federal legislation. WUCA continues to pursue these opportunities and partnerships with water providers, climate scientists, federal agencies, research centers, academia and key stakeholders.

Metropolitan's previous IRPs have recognized and moved the region towards comprehensive planning and adaptation for climate change impacts. The 2004 IRP Update introduced a planning buffer to the resource planning framework to help the region become more prepared for uncertainties including climate change. The 2010 IRP Update expanded this into a supply buffer consisting of climate-proof conservation and local water recycling, and added a Foundational Actions component to prepare future resources for implementation in response to the longer-term risks of climate change. In support of the 2010 IRP Update, Metropolitan collaborated with the RAND Corporation to adapt a complex uncertainty modeling technique to Metropolitan's IRP resource plan and included a suite of global climate model output to help examine the region's vulnerability to climate change. In addition to Metropolitan's own efforts in identifying and analyzing the risk of climate change, it also participated in the US Bureau of Reclamation's 2012 Colorado River Basin Water Supply and Demand Study.

ACTIONS TO MITIGATE AND REDUCE METROPOLITAN'S CARBON FOOTPRINT

Metropolitan has recognized the role of greenhouse gas emissions in the climate change arena and has taken many steps to reduce the Carbon Footprint of its operations.

It is widely reported that California's "Water Sector" uses 19 percent of the state's electricity and 32 percent of the state's natural gas that is not used for power generation. However, these facts are often misinterpreted by attributing the water-related energy use to urban water agencies such Metropolitan. In fact, most of the water-related energy use in California is attributed to the end-users of water, i.e. customers , and not to the capture, transportation, treatment and distribution of water supplies.

The California Energy Commission's 2005 report on California's Water – Energy Relationship is the original source of the energy use information. This report comprehensively analyzed water-related energy use data for 2001 for a broad range of water utilities and end uses. Based on the information in the report, approximately 3 percent of California's water-related electricity use is associated with urban water agency conveyance,

treatment and distribution. Of the remaining 16 percent, 0.8 percent is attributed to wastewater treatment, 4.2 percent is associated with agricultural use, and 11 percent is due to urban end uses – including the heating and cooling of water by customers. For non-power plant natural gas consumption, over 99 percent of the use is attributed to urban end uses, while just 0.14 percent is used for urban water supply. Table 1-1 shows the breakdown of energy use in California attributed to water related uses.

TABLE 1-1

Water Related Energy Use in California as a Percent of Total Energy Use

	ELECTRICITY (GWh)	NATURAL GAS (MILLION THERMS)
Urban Water Supply	3.0%	0.1%
Waste Water Treatment	0.8%	0.2%
Urban End Uses	11.1%	31.1%
Agricultural Total	4.2%	0.1%
Total Water Sector Use	19.2%	31.6%

SB 1036 (Pavley-2014) states that water agencies may voluntarily provide information on estimated energy usage in their Urban Water Management Plans (UWMPs). Metropolitan provides system-wide energy intensity values. Metropolitan's energy intensity determination for the water it provides to its member agencies considers the following uses:

- Source of Supply
- Conveyance
- Treatment
- Distribution
- Storage

Metropolitan also voluntarily reports its Greenhouse Gas Emissions (GHG) to California's Climate Registry. Actions that have been taken by Metropolitan to reduce its GHG emissions, such as the installation of solar power, as well as an overall effort to replace coal-fired power plants that supply power to the major water transportation systems, have resulted in a notable reduction in Metropolitan's GHG emissions over time. As of its most recently reported figures in 2013, Metropolitan had reduced its GHG emissions to only a third of its estimated carbon footprint in the base year of 1990, from 754,420 to 244,023 million metric tons of carbon dioxide equivalent.

Most water projects in California have been designed to minimize energy use and maximize energy recovery. Energy has always been a key factor in the development of Metropolitan's water supply infrastructure. Metropolitan continues to pursue energy efficiency in its facility operations and has developed extensive renewable energy facilities, both hydroelectric and solar, throughout its service area.

PIPELINE HYDROELECTRIC POWER PLANTS

Metropolitan has 16 hydroelectric power plants that recover the energy from the water flowing through its pipelines. The plants have a generation capacity of more than five times the total amount of energy needed by Metropolitan's facilities, including treatment plants, office buildings and small pumping plants not associated with the Colorado River Aqueduct. The production of energy by these plants does not result in any GHG emissions and the energy is certified renewable by the California Energy Commission. Metropolitan has also been evaluating potential sites for new innovative in-line hydropower technologies to increase the renewable energy generated in the distribution system.

SOLAR POWER FACILITIES

In 2009, Metropolitan installed a one megawatt (MW) photovoltaic power facility at the Skinner Water Treatment Plant, the fourth largest water treatment plant in the US. Solar power has replaced approximately 17 percent of the energy supplied to the Skinner Water Treatment Plant from California's electricity grid. In addition, Metropolitan is in the process of developing an additional four MWs of solar power at the Jensen and Weymouth treatment plants. These two projects are estimated to cost nearly $18 million and will be funded by a combination of Metropolitan funds and grants. At the local level, the member agencies have also been aggressively developing solar power generation at their facilities.

COLORADO RIVER AQUEDUCT ENERGY

Metropolitan was one of the original contractors for energy from the Hoover Dam and paid one-half of the cost of the power plant at the Parker Dam. Today, on average, clean energy from the Hoover and Parker Dams make up over 70 percent of the energy needs of the CRA. Metropolitan and the other contractors for Hoover energy pay for the cost of operating, upgrading and maintaining the dam and power plant and have been working with the Bureau of Reclamation to modernize the equipment to increase energy production even as the elevation of Lake Mead has declined due to the multi-year drought on the Colorado River. Additional energy from Hoover Dam means Metropolitan has to buy less energy from other sources that would likely have associated GHG emissions.

HYBRID VEHICLES

Metropolitan has a diverse fleet of vehicles to assist in the operation and maintenance of its water system that is spread over 5,200 square miles. Of the 164 sedans in the fleet, over 40 percent are hybrids, reducing the amount of gasoline consumed and the resulting GHG emissions as well.

OTHER ACTIONS

Metropolitan has been taking proactive steps to track and reduce overall energy use and GHG emissions. This includes energy audits and upgrades at Metropolitan facilities, voluntary reporting of GHG emissions reporting to The Climate Registry and forming a Water Energy Nexus Team to engage in state and federal water-energy nexus proceedings. In 2010, Metropolitan completed an Energy Management and Reliability Study which established policies and strategies for reducing GHG emissions, increasing revenue and mitigating price volatility.

ADAPTATION ACTIONS FOR A CHANGING CLIMATE

Over the course of the past two decades, many actions have been taken to increase the proportion of the region's resources that are more resilient to projected impacts of climate change. Metropolitan also continues to take steps to maintain and improve its distribution system to minimize energy use and to improve resiliency to climate change.

WATER CONSERVATION PROGRAMS

Increased water-use efficiency through the implementation of conservation programs is a baseline adaptation action that reduces the overall demands for water. Metropolitan is a leader in the development and implementation of conservation savings programs. All of Metropolitan's water conservation incentive programs save energy as well. From the water-energy nexus perspective, water saved also saves embedded energy; while programs targeting hot water use, appliances and industrial processes also save energy associated with the actual use of the water. Metropolitan collaborates on projects with Southern California Gas Company (SoCal Gas) including landscaping workshops, marketing of Metropolitan rebates through energy conservation kits, sharing collateral materials, and joint speaking engagements. In December 2014, Metropolitan entered into a Memorandum of Understanding (MOU) that enables SoCal Gas to receive Metropolitan incentives for a High Efficiency Clothes Washer (HECW) direct installation program targeting low income customers. Metropolitan also collaborates with San Diego Gas and Electric (SDGE) in offering HECW rebates. In this case, SDGE adds its HECW incentive to Metropolitan's, and the combined incentives are disbursed by Metropolitan's regional program administrator to consumers in San Diego County. Increased focus on outdoor efficiency with devices like improved irrigation controllers and programs like the Turf Removal program continue to further the decades of commitment to conservation.

LOCAL SUPPLIES

For decades, Metropolitan and its member agencies have actively promoted efforts to conserve water and energy through its pioneering region-wide programs in water conservation, water recycling and groundwater recovery. These local supplies have generally lower energy requirements for the production of water supplies. In addition, they provide a drought-proof supply that is more resilient to the projected impacts of climate change. Development of these supplies offset the need to develop additional imported supplies, which have historically been more vulnerable to droughts and climate change and can have high energy requirements as well.

DISTRIBUTION

Metropolitan's distribution system was designed to maximize the use of gravity as its primary source of power. Metropolitan's major water supplies from the SWP and CRA start at high elevation. Very little pumping (and electricity use) is needed to distribute treated and untreated water to its member agencies. Instead, gravity, not electricity, is primarily used to deliver water supplies through Metropolitan's distribution system.

STORAGE

Metropolitan uses very little energy to store water in its internal storage programs. The primary sources of water are delivered by gravity flow into reservoirs and basins. An example of this is Metropolitan's Diamond Valley Lake. In order to maximize the efficiency of Diamond Valley Lake, Metropolitan built the large capacity Inland

Feeder specifically for its ability to fill the lake without requiring pumping. When water is withdrawn from Diamond Valley Lake it re-enters Metropolitan's distribution system without requiring additional energy and even produces energy by passing the withdrawn water through hydroelectric generators. External water storage and recovery is managed by other parties and is often transacted through exchange arrangements that minimize the actual pumping required to recover water.

FUTURE ADAPTATION ACTIONS

The 2015 IRP Update continues to emphasize water conservation and local supply development as a key to future water supply reliability. However, Metropolitan's imported supply sources also need to have greater attention paid to adaptation to climate change impacts. On the Colorado River, management actions and programs have been identified to increase resiliency to climate change. On the State Water Project, the water system improvements identified in the California Water Fix can vastly improve the resiliency of that water supply. The current California water system and the State Water Project are inadequate and undersized with respect to water conveyance and storage. Without increased conveyance and storage, the State Water Project is not equipped to manage the challenges that climate change will bring in the form of rising sea levels and associated salinity intrusion as well as the shift to a world of rain-dominated precipitation and the loss of snowpack and the associated storage that snowpack had provided in the past.

The Goal: Continued Supply Reliability

With a reliable water supply, Southern Californians never have to wonder whether water will flow from their taps on any given day. They are not frequently forced to face mandatory water use restrictions enforced by fines and penalties and never have to endure a water shortage that threatens their livelihoods or jobs. Metropolitan's mission is to provide that reliable water supply. It is important that Metropolitan and its member agencies maintain reliable and adequate water supplies to support the Southland's $1 trillion plus economy. True water supply reliability is far more than crisis avoidance; it requires thorough and careful planning. Demands should not come perilously close to outstripping supplies. The region's storage reserves should not be depleted to the point where there is insufficient protection for extended droughts. For the 2015 IRP Update, reliability means determining the right level of investment in water conservation, local water supplies and imported water in order to meet demands and maintain sufficient levels of water in storage reserves.

Metropolitan over the years has established several plans and tools to advance the region toward its goals of reliability. One such plan is a shared vision of water management. Another is a shared approach to restricting supplies to protect Southern California from a far more onerous shortage. And yet another is a standard and strategy for achieving reliability, which is refined and advanced in the 2015 IRP Update.

A VISION FOR WATER MANAGEMENT

Diversifying the region's water supplies and developing adequate and healthy water storage reserves has proven to be the backstop for reliability. Stored water reserves provide certainty for meeting the needs of the region's vast service area when traditional sources of supply are challenged by drought, climate change and other risks. But these storage resources must be developed, managed and enhanced. The important elements of using storage to manage water supplies and enhance reliability have been detailed since 1999 in Metropolitan's Water Surplus and Drought Management Plan (WSDM Plan).

THE WATER SURPLUS AND DROUGHT MANAGEMENT PLAN

The principles of the WSDM Plan define a regional water management strategy for Metropolitan and its member agencies. The WSDM Plan's guiding principle is: Metropolitan will encourage storage of water during periods of surplus and work jointly with its member agencies to minimize the impacts of water shortages on the region's retail consumers and economy during periods of shortage.

The WSDM Plan has five supporting principles to further the goal of minimizing the impacts of water shortages:

- Maintain an ongoing coordinated effort among Metropolitan and its member agencies to encourage efficient water use, develop cost-effective local resource programs and inform the public on water supply and reliability issues
- Encourage local and regional storage during periods of surplus and use of storage during periods of shortage
- Manage and operate Metropolitan's regional storage and delivery system in coordination with local facilities to capture and store surplus water in local groundwater and surface reservoirs
- Arrange for secure sources of additional water from outside the region for use during periods of shortage
- Call upon sources of additional water from outside the region and water stored locally to meet the needs of consumers and protect the economy during periods of shortage

These principles have served Metropolitan and Southern California well over the years and highlight the basic tenet that water shortages need to be minimized for Southern California to thrive. Thanks to this comprehensive water management strategy, Metropolitan entered this recent drought cycle with a record quantity of water held in reserve. These reserves were used to avoid what would have been severe and devastating water shortages. Experience has shown Metropolitan that withdrawing storage reserves is not a blank check. As storage reserves are used and depleted there is increasing need to restrict further use of those storage reserves. Restricting supplies in a careful, coordinated fashion allows for preserving remaining storage reserves, which is vital to maintain readiness to provide adequate and reliable supplies in the coming years. That is when a regional plan to allocate water becomes necessary.

Metropolitan will encourage storage of water during periods of surplus and work jointly with its member agencies to minimize the impacts of water shortages on the region's retail consumers and economy during periods of shortage.

METROPOLITAN'S WATER SUPPLY ALLOCATION PLAN

Under severe drought conditions it can be necessary and prudent to call for greater reductions in the use of limited water supplies and reduce reliance on storage reserves. The challenge is how to allocate supplies to avoid acute and harmful localized shortages amongst the member agencies. Southern California is one region, and the region is better off sharing available water supplies as opposed to splitting into an area of haves and have nots. Few planning tools embody Metropolitan's role as regional provider as much as Metropolitan's Water Supply Allocation Plan (WSAP).

First developed in 2008, Metropolitan's WSAP takes one basic premise – to fairly distribute a limited amount of water supply – and applies it through a detailed methodology to reflect a range of local conditions and needs of the region's retail water consumers.

All of Metropolitan's member agencies, through a regionally agreed-upon formula, establish a basic ongoing need, a baseline of demands for water. A variety of unique local circumstances are factored in, such as the availability of other local supplies and the recognition that previous achievements in conservation should continue to be a benefit and not a punishment.

In drought cycles, member agencies typically increase their overall need for Metropolitan water supplies as their own supplies become limited. This is when Metropolitan's water management strategy, the WSDM Plan, becomes increasingly important, with staff providing the Board of Directors with regular updates and forecasts on supplies, demands and reserve levels. In the case of dire forecasts of supplies and demands that will put undue pressure on storage reserves, the Board of Directors can decide to limit the availability of supplies by triggering the WSAP. The WSAP has 10 levels of water supply allocations, each corresponding to an additional 5 percent reduction of supply. A Level 2 allocation, for example, reflects what is essentially a 10 percent reduction in overall water supply available to each member agency.

Tying all the pieces together, the WSDM Plan provides an overall vision for operational supply management. The WSAP provides a method for maintaining reliability when the Board of Directors decides that reserves need to be more carefully managed. The IRP defines the vision of water supply and conservation actions needed for achieving water supply reliability.

EMERGENCY STORAGE

The IRP addresses storage needs and management for dry-year water supply reliability. Additionally, Metropolitan has a long-standing policy to develop and maintain emergency storage reserves to ensure that Southern California has access to water during emergency conditions such as earthquakes and other disasters. Metropolitan's emergency storage planning criteria was codified in the 1991 Environmental Impact Report for Diamond Valley Lake. The emergency storage planning criteria defined that the region should maintain adequate surface storage reserves to serve 75 percent of the firm retail demands for a six-month period. Further, it defined that these surface storage reserves should reside inside of the major earthquake fault lines that cross the SWP, CRA and Los Angeles Aqueduct (LAA). In 2015, approximately 650,000 acre-feet of storage is maintained in the major surface reservoirs in Southern California. Although these storage reserves are not part of the IRP resource portfolio, they serve to increase the overall water supply reliability and security for the people of the Metropolitan's service area.

The 2015 IRP Update follows the tradition of Metropolitan providing adequate and reliable supplies of water and determines the necessary actions to continue that tradition.

THE 2015 IRP UPDATE: A VISION FOR RELIABILITY

In creating the vision of achieving water supply reliability for the region, 2015 IRP Update follows the tradition of Metropolitan providing adequate and reliable supplies of water and determines the necessary actions to continue that tradition.

The extended drought of 1986 through 1991 was a serious wake up call for Southern California and the entire state. The drought and accompanying

water shortages highlighted that an over-reliance on dry-year supplies, particularly from the SWP's northern Sierra watersheds, was fraught with risk and would be an unsustainable strategy for the future. The water supply shortages led to mandatory water rationing by some local water purveyors, and in many areas the cutbacks came with penalties for enforcement of reduced water uses. Some areas of the state, especially those with little local supply and a high degree of reliance on interruptible water supplies, faced more severe water shortages. These shortages and mandatory reduced uses had an economic impact on all users, whether they were residential, commercial/industrial, or agricultural.

In response to the significant economic and lifestyle impacts associated with the 1986 through 1991 drought, Metropolitan convened a Southern California stakeholder process to address how the region could work together to achieve water supply reliability in the future. Metropolitan's new mission statement, adopted in 1992, sought to develop "adequate and reliable supplies of high quality water." As a result of this extensive stakeholder process, which ultimately resulted in the 1996 IRP, Metropolitan's Board of Directors adopted a reliability goal which said that the region would "meet all retail-level water demands under all foreseeable hydrologic conditions" and that, "through the implementation of the IRP, Metropolitan and its member agencies will have the full capability to meet full-service demands at the retail level at all times." The implication of the reliability goal was clear. Based on the then-recent experience of the severe drought and the consequences of the resulting water shortages and rationing, the stakeholders in Southern California wanted a future of reliable water supply.

The subsequent updates to the IRP in 2004 and in 2010 reaffirmed the goals of supply reliability and strengthened the goal with additional planning and implementation elements to create a buffer to guard against the risk of having conditions outside of "foreseeable hydrologic conditions." Carrying this forward into the 2015 IRP Update, the task remains to provide Southern California with a future free from severe water supply shortages and restrictions.

Summary

Metropolitan came into existence in 1928 to respond to changing conditions generated by a fast-growing region in need of water. By the time the Board of Directors adopted the 2010 IRP Update, Metropolitan had transformed into to one of the most sophisticated regional planning agencies in the world. Challenges in 2015 are different from those in 1928 – or even 2010 – and Metropolitan continues to adapt to meet the water supply reliability goal for Southern California. The progress of the IRP from 1996 to 2015 has seen a broadening range of issues to which Metropolitan must adapt. The 2010 IRP Update established adaptive management as a continuing process, and the 2015 IRP Update continues to refine the adaptive management strategy to ensure water supply reliability.

2.

Process of Regional Collaboration

Southern California has a remarkable, unparalleled tradition of meeting its water challenges as a single cohesive region. Metropolitan serves as both importer of water and regional water planner. For the past generation, the IRP has served as the reliability road map for the region.

Integrating into a single plan the many local water actions that take place throughout the Metropolitan service area is an intensely human and technical process. Local supply surveys, estimates of retail demands and data within local urban water management plans are among the many key building blocks. In addition, planning processes for the CRA and the SWP provides estimates of water supply availability given a range of possible future circumstances. The data are analyzed through Metropolitan's planning models. A picture of the future, and of planning choices, begins to emerge.

Data and documents are important. But it is the collaboration – with Metropolitan's 26 member agencies, its 38-member Board of Directors, numerous important stakeholders and the general public – that truly enriches this process and shapes the final product. Broad policy discussions and reviews are held at the board level. Member agency workshops dive into considerable technical detail. Public meetings, even social media, provide important feedback on how best to plan for a reliable water future.

The end result is the integration of many strategies, and many possible future water scenarios, into one adaptable plan – an Integrated Water Resources Plan. The comprehensive process behind the 2015 IRP Update continues the tradition of Southern California working together to have reliable supplies of water for tomorrow.

The 2015 IRP Update Approach

Throughout 2015, Metropolitan engaged in a comprehensive process with its Board of Directors and member agencies to review how conditions have changed since the 2010 IRP Update and to establish targets for achieving regional reliability, taking into account known opportunities and risks. Areas reviewed in the 2015 IRP Update include demographics, hydrologic scenarios, water supplies from existing and new projects, water supply reliability analyses and potential resource and conservation targets. This process produced the findings presented in this report and the 2015 IRP Update Issue Paper Addendum. The 2015 IRP Update Issue Paper Addendum builds upon the technical issue papers published in the 2010 IRP Update on various local resource topics including conservation, groundwater, recycled water, stormwater and seawater desalination. For more information on the 2015 IRP Update Issue Paper Addendum, see Appendix 2 of this report.

The 2015 IRP Update approach explicitly recognizes that there are remaining policy discussions that will be essential to guiding the development and maintenance of local supplies and conservation. Following adoption of the 2015 IRP Update and its

It is the collaboration - with Metropolitan's 26 member agencies, its 38-member Board of Directors, numerous important stakeholders and the general public – that truly enriches this process and shapes the final product.

targets for water supply reliability, Metropolitan will begin a process to address questions such as how to meet the targets for regional reliability, what are local and what are regional responsibilities, how to finance regional projects, etc. This discussion will involve extensive interaction with Metropolitan's Board of Directors and member agencies, with input from the public.

Board of Directors Oversight and IRP Committee

Metropolitan's Board of Directors provided oversight throughout the 2015 IRP Update process. The 2015 IRP Update process commenced with a presentation to the Water Planning and Stewardship Committee (WP&S Committee) in February 2015. To provide focused involvement of the Metropolitan Board in the 2015 IRP Update Process, the Board of Directors created an Integrated Resources Planning Committee (IRP Committee), which is made up of 17 Metropolitan board directors. Beginning in March 2015, the IRP Committee met on a regular basis to provide guidance and receive information from Metropolitan staff. The IRP Committee held 10 meetings between March 2015 and January 2016. IRP Committee meetings are summarized in Table 2-1.

TABLE 2-1
Summary of Metropolitan Board of Directors Committee Meetings

DATE	COMMITTEE	TOPIC
February 9, 2015	WP&S Committee	Overview of the 2015 IRP Update process
Mach 24, 2015	IRP Committee	Overview of the 2015 IRP Update process, Historical overview of previous IRPs
April 28, 2015	IRP Committee	Detailed review of 2010 IRP Update targets and initial look at changed conditions
May 26, 2015	IRP Committee	Expert presenters on Conservation Rates and Conservation Potential; Member Agency Technical Process Update
June 23, 2015	IRP Committee	Expert presenters on Groundwater and Stormwater; Member Agency Technical Process Update
July 28, 2015	IRP Committee	Expert presenters on Climate Change and Uncertainty; Member Agency Technical Process Update
August 18, 2015	IRP Committee	Initial Results and Water Balances, 2015 IRP Update Outreach, California WaterFix overview
September 29, 2015	IRP Committee	Draft Results; 2015 IRP Update Outreach, Colorado River outlook
October 27, 2015	IRP Committee	2015 IRP Update Outreach, Technical Recommendations, Draft 2015 IRP Update Issue Paper Addendum
December 7, 2015	IRP Committee	Draft 2015 IRP Update, Overview of the Policy Inventory and the following Policy Process
January 12, 2016	IRP Committee	Final 2015 IRP Update

Collaboration with Member Agencies

IRP MEMBER AGENCY TECHNICAL WORKGROUP

For guidance, discussion and information-sharing on technical topics, Metropolitan staff collaborated with its member agencies through an IRP Member Agency Technical Workgroup. The Technical Workgroup met 11 times between April and October 2015. Each meeting focused on specific subjects. Through the workgroup, member agency staff provided Metropolitan staff with data and information essential for updating the 2015 IRP Update forecasts, feedback on draft analyses, and policy topics for the policy discussions following the adoption of the 2015 IRP Update. Additionally, member agency staff and external experts provided input and direction on the development of the 2015 IRP Update Issue Paper Addendum and collaborated with Metropolitan staff during the writing process.

REGIONAL PLANNING MEETINGS

In addition to the 2015 IRP Update Technical Workgroup process, Metropolitan staff utilized existing regional planning meetings outside of the 2015 IRP Update Technical Workgroup for further technical discussions to efficiently use time and resources without duplicating efforts. 2015 IRP Update briefings were periodically presented during regular Member Agency Managers meetings held at Metropolitan. The 2015 IRP Update process coordinated dialogue with the Monthly Water-Use Efficiency Meeting held with conservation coordinators from Metropolitan's member agencies and their retail sub-agencies. These meetings served as a forum for input on Metropolitan's conservation model methodology and on the conservation portion of the 2015 IRP Update Issue Paper Addendum. Metropolitan staff also met with the member agency Conservation Program Advisory Committee for technical discussion and comments on Metropolitan's Conservation Savings Model. Additional meetings included the Local Resources Program Coordinator's meeting and webinar where member agencies and retailers provided input to the recycled water discussion in the 2015 IRP Update Issue Paper Addendum. Member agency participation meetings are summarized in Table 2-2.

TABLE 2-2

2015 IRP Update Process Member Agency Participation

DATE	GROUP	TOPIC
April 8, 2015	Member Agency Technical Workgroup	Introduction to 2015 IRP Update process
April 16, 2015	Water-Use Efficiency Meeting	Introduction to 2015 IRP Update process, Conservation
April 22, 2015	Member Agency Technical Workgroup	Uncertainty planning in the 2015 IRP Update
April 29, 2015	Conservation Program Advisory Committee	Conservation Savings Model
May 13, 2015	Member Agency Managers Meeting	Introduction to 2015 IRP Update approach and schedule
May 18, 2015	Member Agency Technical Workgroup	Imported Supplies (CRA, SWP, Central Valley Transfers and Storage)
May 20, 2015	Efficiency Meeting	Conservation

TABLE CONTINUED ON NEXT PAGE...

TABLE 2-2 CONTINUED

2015 IRP Update Process Member Agency Participation

DATE	GROUP	TOPIC
May 27, 2015	Member Agency Technical Workgroup	Groundwater (Part 1 of 2)
June 11, 2015	Member Agency Technical Workgroup	Groundwater (Part 2 of 2)
June 16, 2015	LRP Coordinators Meeting	Issue Paper Addendum: Recycled water section
June 18, 2015	Water-Use Efficiency Meeting	Long-term impacts of water use restrictions, 2015 IRP Update Issue Paper Addendum
June 24, 2015	Member Agency Technical Workgroup	Local Resources (Part 1 of 2)
July 8, 2015	Member Agency Technical Workgroup	Local Resources (Part 2 of 2)
July 16, 2015	Water-Use Efficiency Meeting	Conservation savings forecast, Draft 2015 IRP Update Issue Paper Addendum
July 22, 2015	Member Agency Technical Workgroup	Retail Demands and Conservation
August 3, 2015	Member Agency Technical Workgroup	Draft 2015 IRP Update Technical Results
August 21, 2015	Member Agency Managers Meeting	Draft 2015 IRP Update Technical Results briefing
September 15, 2015	Member Agency Technical Workgroup	Draft 2015 IRP Update Technical Results
September 25, 2015	Member Agency Managers Meeting	2015 IRP Update Technical Process Overview
October 5, 2015	Member Agency Technical Workgroup	Final Technical Results
October 16, 2015	Member Agency Managers Meeting	Final Technical Results

Public Outreach

Public involvement is an important element of this 2015 IRP Update process. Public outreach efforts complement the technical processes with the IRP Committee and the member agencies. Most importantly, the efforts that were implemented during 2015 established a means for the public to provide input to the policy discussions that will occur following the adoption of the 2015 IRP Update.

Metropolitan's three key objectives for the public involvement element of the 2015 IRP Update were as follows:

- Ensure that the 2015 IRP Update process is understandable and accessible to anyone who has an interest in Southern California's water supplies
- Provide opportunities for learning, dialogue and input
- Create a pathway to encourage continued engagement in future policy discussions

To achieve the first objective, Metropolitan branded this 2015 IRP Update as "Water Tomorrow," which underlined the purpose of the plan and its importance to the region. Metropolitan then created a new website, MWDWaterTomorrow.com, which provided extensive information on the current update process as well as the history of Metropolitan's IRP over the past two decades. For the 2015 IRP Update, the site included a calendar of past and future meetings, technical analysis and presentations, brief descriptions of Southern California's water resources, a comment section and ways to participate. Metropolitan shared news and updates about Water Tomorrow through traditional and social media, Metropolitan's "Your Water" e-newsletter and a variety of social media platforms. Metropolitan also provided speakers for community and business organizations throughout its service area.

While the first objective addresses public awareness, the second objective sought to ensure that public involvement advances the region's understanding of water issues, challenges and perspectives and benefits Metropolitan's planning process. Metropolitan worked with the Southern California Water Committee to present the 2015 IRP Update process and technical issues at two workshops held at Metropolitan. Approximately 150 people participated in the first workshop in June to discuss a "Drought Proof Strategy." The second workshop was held in August where approximately 125 attendees discussed the future of outdoor water conservation. In September, Metropolitan met with the Southern California Water Dialogue whose diverse membership includes environmental organizations, private industry and public agencies. The Southern California Association of Governments presented an overview of demographic projections and Metropolitan staff provided an introduction to the technical analysis for the 2015 IRP Update. The IRP Committee Chair facilitated discussion on the 2015 IRP Update among the approximately 75 participants.

Following the three focused workshops held with the Southern California Water Committee and the Southern California Water Dialogue, Metropolitan convened the Water Tomorrow public workshop on October 22, 2015. More than 450 people participated in the all-day workshop, which was offered both in person and online to encourage broad participation throughout Metropolitan's service area. Staff recapped the technical analysis and key findings. Professional facilitators guided participant discussion in key resource areas: conservation, local resources, groundwater and imported supplies. Among the key discussion points, ideas and outcomes were reported to the IRP Committee to help inform future policy discussions.

The third outreach objective looks to the future. One of Metropolitan's overarching communication goals is to develop the general public's knowledge of water resource issues and the range of solutions available to Southern California. An informed public is better able to contribute to the discussions and understand the implications and opportunities afforded by decisions. Metropolitan is building on the progress of the 2015 IRP Update to encourage continued involvement in future discussions for the IRP and other water issues. These discussions will focus on solutions to challenges, and topics will range from policy and regulations to technology and behavior change.

As social media has become part of mainstream communications, Metropolitan tried a supplemental means of public engagement. Metropolitan worked with Northern Rift, a firm that has created a software platform to engage the public in raising and collaborating on ideas, to offer an online Water Tomorrow Innovation Game. Participants proposed ideas to solve Southern California's water challenges and then collaborated on the ideas to help grow them or discuss their limitations. The top ideas selected by the community of participants and those selected by a panel of water resource and policy experts were recognized at a reception hosted by Metropolitan. The Board of Directors may consider the ideas in future discussions on implementation of the 2015 IRP Update.

3.

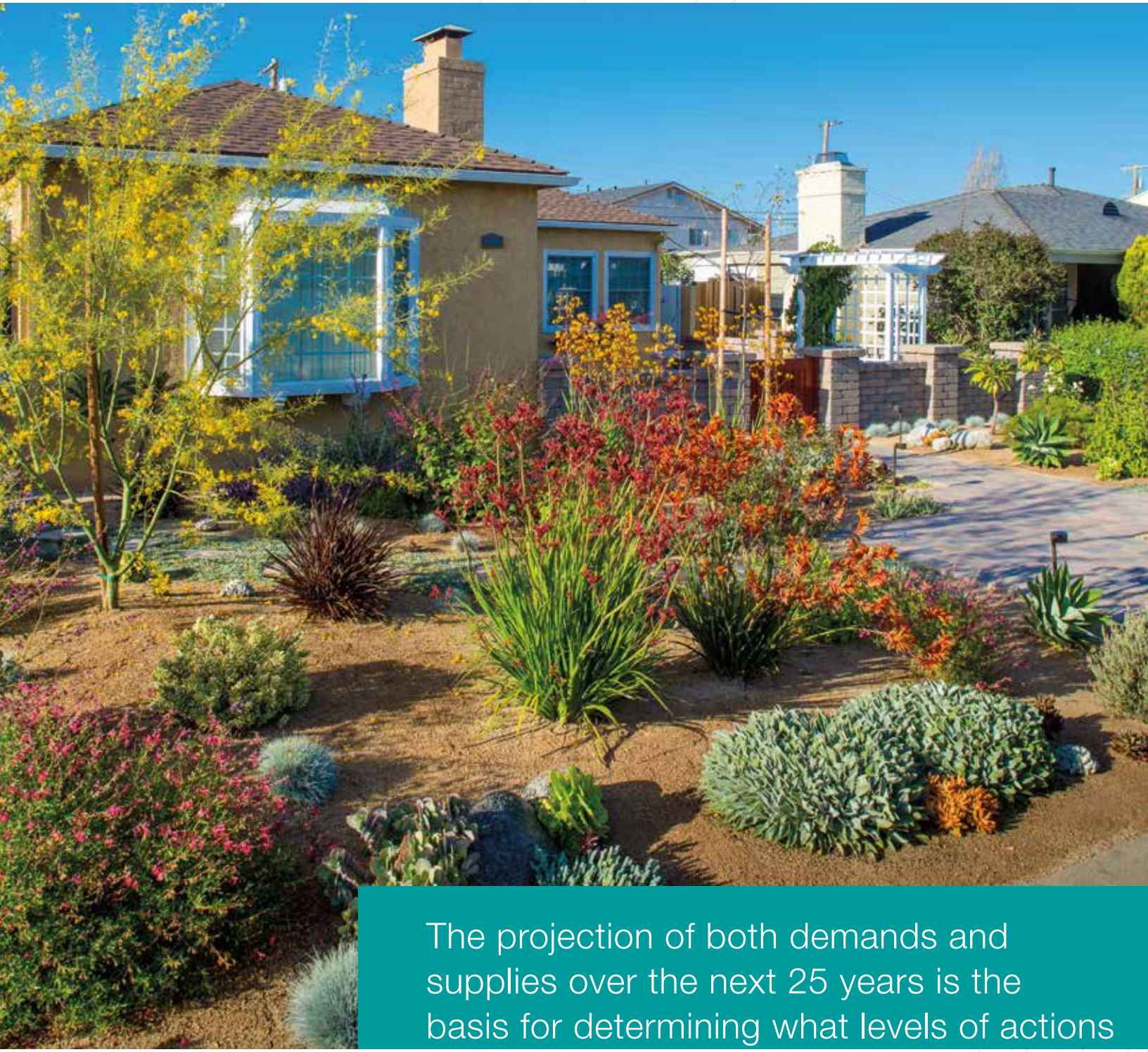
Outlook of Demands and Supplies

The first step in assessing regional needs is to evaluate the outlook of existing regional water supplies and demands and evaluate what water supply reliability would look like without new investment. Metropolitan and its member agencies have developed a wide array of water supplies, both local and imported, and a large portfolio of water storage programs. Even without investment in new water supplies or water conservation, these existing water supplies and programs will continue to provide water and water management. The question is whether they are sufficient to meet future demands.

Retail-level water demands are largely a function of Southern California's future population and its expected level of water use. These two factors have been shifting over time. Population increases are estimated to be less than previously projected. Per-person water use has declined over the past 25 years as water conservation efforts increase.

The 2015 IRP Update reflects the latest and best estimates of these patterns. As detailed in this section, there are some important changes to note. Potential demands in the future appear to be lower than expected. Earlier projections about population growth have been updated with expectations of less growth, which translates into less new demand. Conversely, the supply picture is not as robust as estimated during the 2010 IRP Update. Groundwater supplies in the region may be less than what earlier projections predicted. This is largely due to the ongoing drought, as pumping levels have not been matched with either natural recharge or replenishment with imported supplies. Additional environmental restrictions are also leading to lower projections of SWP supplies, although Metropolitan is taking actions to stabilize these supplies.

The projection of both demands and supplies over the next 25 years is the basis for determining what levels of actions are necessary in the 2015 IRP Update adaptive management strategy. The following section provides detailed descriptions and forecasts of the water supplies and demands that are expected to be in place through 2040. It also shows that, with no new investment, these existing supplies and storage resources are insufficient to meet future demands. These findings reinforce the need to update the IRP periodically to determine whether supply/conservation actions are either on course or need adjusting to meet the reliability targets and that the targets themselves are correct.



The projection of both demands and supplies over the next 25 years is the basis for determining what levels of actions are necessary in the 2015 IRP Update adaptive management strategy.

Description of Water Conservation

Metropolitan and its member agencies have long been leaders in water conservation. Water conservation is encouraged through financial rebates and incentives for water-efficient fixtures and devices, and through plumbing codes and regulations that facilitate water savings. In addition, retail customer conservation and efficient water use is encouraged through tiered pricing: as consumers are shown the higher cost-of-service of increased water use in higher priced tiers, they tend to seek ways to become more efficient and reduce their use. Public outreach and education brings awareness for the need to adopt conservation measures in dry years. Water savings can be achieved through active, code-based and price-effect conservation. In Southern California, where there is a wide array of local and imported water supplies and an interconnected regional water infrastructure, water conservation serves the important regional function of reducing the demand for imported water supplies and thereby making regional water system capacity and storage available and accessible to meet the needs of users in the region.

ACTIVE CONSERVATION

Active conservation is water saved directly as a result of conservation programs by water agencies, including implementation of Best Management Practices by the California Urban Water Conservation Council. Active conservation is unlikely to occur without agency action.

METROPOLITAN'S CONSERVATION CREDITS PROGRAM

Metropolitan fosters active water conservation through its Conservation Credits Program (CCP). A regional program, the CCP provides financial incentives and rebates to residential and commercial customers for water-saving fixtures, devices retrofits and water audits. Since the program's inception in 1990, Metropolitan has provided $487 million in rebates and incentives.

By the end of fiscal year 2015/16, Metropolitan will have invested an additional $315 million, bringing the total cumulative spending on conservation to $802 million. Thanks to programs and rebates offered on over 80 types of water-efficient devices and fixtures, the CCP generated a cumulative 2.2 million acre-feet of water savings to date for the region. In addition, Metropolitan's member agencies at times administered their own conservation programs that are complementary to the CCP.

In the past 25 years, Metropolitan has developed numerous conservation programs targeting specific groups of water users under the CCP. For example, the former Save-Water-Save-A-Buck program successfully targeted industrial customers to improve water consumption efficiency in manufacturing processes. In recent years, Metropolitan consolidated the residential and commercial rebate programs into a singular regional program called SoCal Water$mart. SoCal Water$mart provides customers with easy access to rebates for water efficient products.

Launched in 2008, SoCal Water$mart provides rebates to residential customers for turf removal, high-efficiency clothes washers, high-efficiency toilets, multi-stream rotary sprinkler nozzles, smart irrigation controllers and residential water audits, among other items. Rebates for commercial customers include water-efficient plumbing fixtures, landscape equipment, food service equipment, HVAC equipment, medical and dental equipment, and turf removal.

Indoor conservation continues to play an important role in the region's overall goal of achieving water-use efficiency. Among the items popular with residents are high-efficiency clothes washers (HECW) which can save up to 10,000 gallons per washer per year over a conventional top loading clothes washer. HECWs with an integrated water factor of 3.7 or less are eligible to receive rebates. The integrated water factor is the measure of the amount of water used to wash a standard load of laundry. High-efficiency toilets (HETs) are also very popular among residents and businesses. Since 1990, Metropolitan and its member agencies across Southern California have provided financial incentives to residents and businesses to replace about 3.4 million high-water-consumption toilets (3.5 gallons or more per flush) with ultra-low-flush toilets and HETs. HETs use about 20 percent less water than its predecessor, the ultra-low-flush toilets (1.6 gallons per flush). Recent program changes on toilet rebates reflect the great success in the installation of efficient toilets. Revised rebates are provided for Premium HETs which use even less than HETs.

Metropolitan's Water Savings Incentive Program is a regional pay-for-performance program targeting large water users in the commercial, industrial, institutional, agricultural and large landscape sectors to improve efficiency. This program allows large-scale water users to customize their conservation projects and receive financial incentives for up to ten years of water savings for proven water-use efficiency improvement.

The Turf Removal Program presented an opportunity to focus on outdoor conservation and to affect a cultural shift in outdoor landscape water uses.

THE NATION'S LARGEST TURF REMOVAL PROGRAM

The unprecedented California drought increased consumer awareness of the serious water supply situation. Following Governor Brown's declaration of a drought emergency in 2014, Metropolitan's Board of Directors approved an expansion of the region's Turf Removal incentive program to meet consumer demands for new ways to save water. The Turf Removal Program presented an opportunity to focus on outdoor conservation and to affect a cultural shift in outdoor landscape water uses. The Turf Removal Program provides residential and commercial customers with financial incentives to replace their turf lawns with California Friendly® landscapes. Metropolitan doubled the existing rebate for Turf Removal to $2 per square foot of turf removed. This increase was on top of a previous increase from $0.30 per square foot to $1 per square foot. Coupled with additional member agency contributions, many Southland residents and commercial and industrial customers were able to remove and replace turf with an incentive of more than $3 per square foot. Following the step-up in the Turf Removal Program, an estimated 175 million square feet of lawn turf was removed. In total, $450 million was invested through the Turf Removal Program and the Conservation Credits Program over a two year period by Metropolitan. Including local and member agency programs, more than half a billion dollars were invested region wide, with the conservation program reaching an estimated 400,000 people. It is expected that the successes of the Turf Removal Program will result in a significant market transformation where consumers

will be aware and motivated to remove and replace turf with California Friendly® landscapes without a financial incentive. Metropolitan's Turf Removal Program and administrative process also served as a model for the rest of the state as part of the Governor's emergency drought responses, with the state calling for the removal of 50 million square feet of turf.

RESEARCH AND DEVELOPMENT

Metropolitan's Innovative Conservation Program (ICP) promotes studies of new water saving technologies through a competitive grant process. Since 2001, the ICP has issued 57 grants with the goal of fairly evaluating new conservation ideas. Metropolitan provided $2 million dollars through the ICP. The U.S. Bureau of Reclamation (USBR), Central Arizona Project and the Southern Nevada Water Authority also provided funding. Examples of projects funded through the ICP include soil amendment, water audit mobile apps, home graywater systems, soil moisture sensors and agricultural irrigation improvements. Metropolitan has also partnered with the Alliance for Water Efficiency to conduct water conservation research. Recent projects include a drought management case study from Australia, a water-neutral development ordinance, a study on commercial kitchen efficiency and a study on the rationale for landscape choices.

CODE-BASED CONSERVATION

Code-based conservation is water saved as a result of changes in water efficiency requirements for plumbing fixtures in plumbing codes. Also referred to as "passive conservation," this form of conservation would occur as a matter of course without additional financial incentives from water agencies.

For more than two decades, Metropolitan has supported plumbing and building code legislation consistent with its water conservation policy. For example, the Energy Act of 1992 required all toilets manufactured after 1994 to flush at 1.6 gallons or less thereby eliminating the manufacturing of new 3.5 gallons per flush toilets. Other recent noteworthy water conservation legislation includes Assembly Bill 715 (Laird 2007), Senate Bill 407 (Padilla 2009) and Assembly Bill 1881 (Laird 2006). AB 715 required toilets and urinals sold in California after January 1, 2014 to have a flush rate of 1.28 gallons or less per flush for toilets and 0.5 gallons or less per flush for urinals. The projected water savings attributed from this law is about 20 percent for each toilet sold and about 50 percent for each urinal compared to what the national standards required. SB 407 required the installation of water conserving plumbing fixtures for all building alterations or improvements to single-family residential real property made after January 1, 2014. The bill also required, on or before January 1, 2017, that all noncompliant plumbing fixtures in any single-family residential real property be replaced by the property owner with water-conserving plumbing fixtures.

For outdoor water use, AB 1881 (Laird 2006), required local agencies to adopt the state's updated Model Water Efficient Landscape Ordinance (MWELO) by January 2010 and required the Energy Commission to adopt performance standard irrigation equipment. On April 1, 2015, the Governor's Executive Order (EO B-29-15) further advanced the objectives of AB 1881. Among other things, the executive order directed the California Department of Water Resources (DWR) to update the state's MWELO through expedited regulation. The California Water Commission approved the revised ordinance on July 15, 2015. The revised MWELO increases water efficiency standards for new and retrofitted landscapes through more efficient irrigation systems, graywater usage, onsite stormwater capture and by limiting the portion of landscapes that can be covered with turf. It also requires reporting on the implementation and enforcement of local ordinances, with adoption and required reports due

by December 31, 2015. As currently written, MWELO does not include the type of enforcement at the local levels that will be required for all new home construction to be compliant.

PRICE-EFFECT CONSERVATION

With price-effect conservation, efficient water usage can be attained through behavioral usage reductions resulting from increases in the price of water. Retail agencies use tiered pricing and water budgets to promote efficient use of water.

Many economic studies have shown that consumers respond to changes in the price of water by reducing usage when faced with higher water rates. The overall cost of water supply and the water systems needed to deliver that water supply have steadily increased, leading to increases in the rates that are paid by the consumers. This trend is expected to continue as the future cost of water will include the higher cost of water supply acquisition, environmental mitigation and infrastructure maintenance and improvement. In addition to the rising cost of water, retail agencies are shifting towards using tiered pricing and water budgets that reflect the higher cost-of-service for providing increasing amounts of water. Under these marginal rate structures, consumers face the true (and higher) cost of incremental water supplies which in turn promotes more efficient use of water and higher water conservation savings.

WATER-USE EFFICIENCY STRATEGY

The Water Conservation Act of 2009 (Senate Bill X7-7) requires a statewide 20 percent reduction in urban per capita water use by 2020. Commonly known as "20x2020," this legislation requires urban retail water suppliers to develop urban water use targets to help meet the 20 percent reduction in per capita water use by 2020, with interim targets for 2015. Per capita reductions can be accomplished through any combination of increased water conservation, improved water-use efficiency and increased use of recycled water to offset potable demand. Retail water suppliers receive partial credit for past efforts in conservation and recycled water; therefore, not all agencies need to reduce per capita demand by an additional 20 percent in order to comply with this law.

Metropolitan, as a water wholesaler, is not covered by this law. However, Metropolitan provides support for Southern California retail agencies through program implementation such as the CCP for conservation and the Local Resources Program (LRP) for the development and use of recycled water. Metropolitan also provides technical assistance, support for legislation, code and standards updates and other financial incentives where needed to increase water-use efficiency.

"Let's All Take A Turn" emphasized the seriousness of the drought and shared the message that if everyone does a little more to save water, it adds up to make a substantial difference.

COMMUNICATION AND OUTREACH

Outreach and education increase the awareness of drought and water shortage with the public and encourage a conservation ethic that increases the adoption of water-saving devices and practices. Metropolitan conducts annual advertising, education and community outreach campaigns to urge residents and business owners to make permanent changes in their everyday uses of water. In the recent drought, Metropolitan in cooperation with member agencies conducted multi-lingual, multi-cultural water conservation advertising and outreach campaigns that turned the goal of saving water into measurable results throughout the region. In 2015, as Southern California entered its fourth year of drought, Metropolitan mounted a visually strong campaign that showcased knobs and faucets and used the tagline "Let's All Take A Turn" to emphasize the seriousness of the drought and share the message that if everyone does a little more to save water, it adds up to make a substantial difference. The research-based campaign included television, radio, digital and outdoor advertising as well as other customized materials and outreach events throughout the Southland. The entire campaign was produced in five languages: English, Spanish, Mandarin, Korean and Vietnamese. The media strategy was developed to effectively target diverse communities, age groups, homeowners and renters and the major languages spoken in the region. The campaign supplemented Metropolitan's other outreach activities and educational programs to inform and assist residents, businesses, public agency officials, community leaders and elected officials on the importance of water conservation.

In addition to advertising and outreach campaigns, Metropolitan continues to maintain a strong presence in community water resource education and conservation activities. Through its Community Partnering Program, Metropolitan co-sponsors water-related education and outreach events for member agencies, community groups and non-profit organizations. Projects include community events, conservation and garden projects, publications in multiple languages and educational materials dealing with watersheds, conservation and water recycling. Metropolitan also continues to update and expand a comprehensive K-12 water education curriculum that meets state standards for each grade level in the areas of science, math, language arts and social studies classroom materials.

Description of Regional Water Resources

The region's water supply portfolio consists of local water supplies, imported water supplies, and the utilization of storage and transfers to provide water supply reliability to Southern California.

LOCAL WATER SUPPLIES

Local supplies are a significant and growing component to the region's diverse water portfolio. Local supplies can provide over half of the region's water in a given year, and it is important to maintain these supplies. Similar to water conservation, local supplies serve the important function of reducing demands for imported

water supplies and thereby making regional water system capacity and storage available and accessible to meet the needs of the region.

The following segment provides background information and discussion on the current state of local water supplies, including:

- Groundwater
- Recycled water
- Seawater desalination
- Los Angeles Aqueduct
- Local surface water
- Other identified resources

These resources are generally developed and managed by local water agencies within the Metropolitan service area. Appendix 2 (2015 IRP Update Issue Paper Addendum) includes additional discussions on groundwater, recycled water, seawater desalination, stormwater direct use and graywater.

GROUNDWATER

Groundwater is the production of water extracted from underground aquifers. Many people in Southern California depend on groundwater as a primary source of water supply. Effective use of local groundwater basins is a significant component of comprehensive water supply planning for Southern California. Groundwater basins within Metropolitan's service area provide an average of 1.4 million acre-feet per year.

Groundwater basins within Metropolitan's service area provide the potential for operational flexibility to manage water supplies in Southern California. Many local groundwater storage programs have been implemented over the years to maximize the use of in-region water supplies. The integration of groundwater and surface water has been part of the local water management in Metropolitan's service area since the 1950s. In addition, flood control agencies have captured local stormwater runoff for groundwater replenishment for more than 100 years, and operated seawater barrier projects in Los Angeles and Orange counties to prevent seawater intrusion into the coastal groundwater basins for more than 60 years. More recently, the expansion of recycled water recharge has improved groundwater sustainability in the region.

To further improve water supply reliability, groundwater recovery projects have been implemented to

recover otherwise unusable groundwater that has been degraded by minerals and other contaminants. These projects include the treatment of groundwater contaminated by various industrial operations and the desalination of brackish groundwater, which has a higher salinity than fresh water, but a lower salinity than seawater.

In the last 10 years, groundwater storage levels in the region have dropped more than 1 million acre-feet. Storage levels in key groundwater basins are nearing or have exceeded previous low levels reached in 1977. However, groundwater production has remained relatively constant despite a substantial decrease in groundwater recharge. Use of imported water for groundwater recharge has also declined in recent years, and has partially been replaced with greater recharge of recycled water. Expansion of recycled water recharge has buffered the region from more severe declines in groundwater supplies.

Groundwater sustainability – the long-term balance of production and recharge – is an integral part of ensuring long-term reliability in the region. The replenishment of the groundwater basins, both passively and actively,

To encourage recycled water development, Metropolitan established the Local Projects Program in 1982 to provide financial incentives to its member agencies for the development of recycled water projects.

is important to meeting that goal. Passive recharge is groundwater replenishment that occurs naturally and includes return flows,mountain recharge and infiltration of precipitation. Today, active (or artificial) groundwater recharge through spreading basins and injection wells supports on average of around 50 percent of the total groundwater production in region.

Threats to sustainability in the region include loss in groundwater production capacity due to ongoing drought, continued loss in recharge due to urbanization, future climate change and groundwater contamination and salt loading.

RECYCLED WATER

Recycled water is wastewater that has been treated so that it can be beneficially used for a variety of purposes ranging from landscape irrigation to groundwater recharge. Recycled water use categories include:

- Non-potable reuse for non-consumptive use such as agriculture and landscape irrigation and industrial uses
- Indirect potable reuse for groundwater recharge and surface water augmentation
- Direct potable reuse to serve purified water directly into a potable water supply distribution system

Recycled water plays an important role in maintaining regional water supply reliability. In 2014, non-potable

and indirect potable reuse projects in the Metropolitan service area collectively produced a total of 414,000 acre-feet. Regulations are currently under development for direct potable reuse and surface water augmentation.

To encourage recycled water development, Metropolitan established the Local Projects Program in 1982 to provide financial incentives to its member agencies for the development of recycled water projects. In 1991, Metropolitan established the Groundwater Recovery Program to provide financial assistance for the development of groundwater recovery projects. In 1995, these two programs evolved into the LRP. The success of the LRP is due to its adaptability to changing conditions. Periodically, Metropolitan and its member agencies review and update the LRP in response to water supply conditions. In October 2014, Metropolitan made significant enhancements to the LRP that consisted of: increasing the incentive amount; providing three incentive payment structures; incorporating seawater desalination as an eligible supply; including onsite retrofit costs; and providing reimbursable services to member agencies to expedite development of ready-to-proceed projects. Since 1982, Metropolitan has provided about $372 million for production of more than 2.2 million acre-feet of recycled water in the region to date. The LRP has incentivized an increased use of recycled water in the region by almost 200 percent.

Metropolitan continues to explore ways to help incentivize recycled water use. In order for a site to receive recycled water, it must be plumbed for recycled water use. On-site conversion costs (borne by customers) are generally high. In July 2014, Metropolitan established the On-site Retrofit Pilot Program to provide financial incentives to customers for the conversion of their potable industrial and irrigation systems to recycled water.

SEAWATER DESALINATION

Seawater desalination utilizes advanced technology to convert ocean water to potable water. The constant availability of ocean water is one of the key benefits of seawater desalination. Thus, Metropolitan and its member agencies have been considering seawater desalination as a potential new supply source since the 1960s. Up until the 1990s, seawater desalination was considered too expensive compared to other resource alternatives, especially imported water. However, advances in membrane technology, energy recovery and process design in the 1990s lowered desalination costs. In the early 2000s, several member agencies began pursuing local seawater desalination projects to diversify their resource portfolios and in 2001, Metropolitan created an incentive program to support these projects. Soon after, the Board of Directors approved Metropolitan's role as a regional facilitator for seawater desalination with the purpose of assisting the member agencies with state and regional development issues. In 2014, Metropolitan included seawater desalination projects in the LRP for the development of additional local supplies.

Most recently, the San Diego County Water Authority (SDCWA) completed construction of the 56,000 acre-foot capacity Carlsbad Desalination project, which is expected to be online by the end of 2015.

LOS ANGELES AQUEDUCT

The city of Los Angeles Department of Water and Power (LADWP), a Metropolitan member agency, imports water from the eastern Sierra Nevada through the LAA. The original LAA, completed in 1913, imported water from the Owens Valley. In 1940, the aqueduct was extended to the Mono Basin. A second aqueduct, which parallels the original, was completed in 1970 increasing the capacity to deliver water from the Mono Basin and the Owens Valley to the city of Los Angeles from 485 cubic feet per second to 775 cubic feet per second.

Over time, environmental considerations have required that LADWP reallocate approximately one-half of the LAA water supply to environmental mitigation and enhancement projects. Limiting water deliveries to the Los Angeles area from the LAA has directly led to increased dependence on imported water supply from Metropolitan.

LAA deliveries are made up of approximately 40 percent of the total runoff in the eastern Sierra Nevada in an average year. Annual LAA deliveries are dependent on snowfall in the eastern Sierra Nevada and are subject to significant hydrologic variability.

Hydrologic impact to LAA water supplies in the Mono Basin and Owens Valley is amplified by the requirements to release water for environmental restoration efforts in the eastern Sierra Nevada. Since 1989, when city water exports were significantly reduced to restore the Mono Basin's ecosystem, LAA deliveries from the Mono Basin and Owens Valley have ranged from a low of 36,000 acre-feet in 2015 to a high of 467,000 acre-feet in 1998. Average LAA deliveries since 1990 have been approximately 240,000 acre-feet, meeting about 40 percent of the LADWP's total water needs.

LOCAL SURFACE WATER

Local surface water resources consist of runoff captured in storage reservoirs and diversions from streams. Reservoirs hold the runoff for later direct use, and diversions from streams are delivered directly to local water systems. Within Metropolitan's service area, local water agencies currently own and operate 34 reservoirs. Although these reservoirs provide a storage capacity of 737,000 acre-feet, annual yield is dependent on rainfall, runoff and other operational considerations. The historic average yield of these local surface supplies, which come from reservoir releases and stream diversions, is about 104,000 acre-feet per year (based on the 2005-2014 average). The annual yield varies widely between wet and dry years, and most reservoirs that capture local surface runoff are operated with minimal carry-over storage. San Diego County has the greatest storage capacity for these types of reservoirs, with approximately 80 percent of the total local agency storage capacity in Metropolitan's service area.

OTHER IDENTIFIED RESOURCES

There are other local resources that have the potential for future development. Current development is on a smaller scale with studies and pilot projects underway.

On-Site Stormwater Capture and Use

Project examples of on-site stormwater use include: on-site cisterns and the collection of rainwater for use in cooling towers, truck washes, drip irrigation, toilet flushing, rain barrels and other non-potable uses such as restrooms, onsite irrigation and subregional/regional storage. Over the past few years, the movement to capture and use stormwater at homes and businesses in multi-beneficial ways has developed significantly.

Metropolitan currently offers a rebate of up to $75 per rain barrel. This rebate was expanded to encourage the use of large-capacity cisterns with a rebate of $300 per unit. Agencies such as LADWP offer an additional $25 per rain barrel. Other agencies offer rain barrel distribution events to encourage outdoor conservation. Rain barrels and cisterns can also increase public awareness of water issues leading to additional conservation activities and provide educational opportunities.

Graywater

Graywater includes wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines and laundry tubs. Graywater does not include wastewater from toilets, kitchen sinks, or dishwashers, or wastewater from diaper cleaning. Graywater is differentiated from blackwater (i.e., wastewater from toilets), treated recycled water and stormwater.

The effectiveness of graywater systems can vary based on recycled water programs that are in place. For example, communities in the Metropolitan service area with centralized recycling facilities may not be suitable for graywater promotion if no net new supplies would be created.

IMPORTED WATER SUPPLIES

The following section provides background information and discussion on the current state of imported water supplies from the Northern Sierra and the Colorado River Basin regions.

THE STATE WATER PROJECT

In 1960, voters statewide paved the way to construct

the SWP by approving the bonds for its construction, with Metropolitan to be the largest investor in the project. Metropolitan became the first of 29 agencies that contracts for a long-term water supply from the SWP, which consists of facilities to capture, store and transport water from the Feather River in Northern California. Metropolitan's contract is the largest of all of the State Water Contractors, with its 1,911,500 acre-foot contract amount comprising almost half of the total contract amount of 4,172,686 acre-feet. Each contractor is responsible for paying for its proportionate share of the physical facilities needed to deliver water supplies to its service area. Metropolitan's contract rights under the State Water Contract are described below.

SWP Contract Provisions

Table A Contract Amount: Metropolitan's basic contract amount is for 1,911,500 acre-feet. This represents the amount of water supply that would be available to Metropolitan in years where there is sufficient water supply for the SWP to deliver 100 percent of its total contract amounts. The amount of supply actually available on an annual basis is allocated to the State Water Contractors based on their proportionate Table A amounts. As a percentage of total contract amounts, annual SWP allocations have ranged from 5 percent to 100 percent of the Table A contract amounts. Metropolitan fully recognizes the range of deliveries and does not rely on a full Table A contract amount in its planning or operations.

Article 21 Interruptible Supplies: Metropolitan has a contract right to water supplies that are made available on an intermittent basis. Storm flows can occasionally make water supplies available that are in excess to the Table A allocation. State Water Contractors can take delivery of these supplies, with their rights being based on their proportional Table A contract amounts. Historically, Article 21 interruptible supplies have ranged from 0 to 240,000 acre-feet annually.

Turnback Pool: State Water Contractors have an option to return unused water supplies. These unused supplies are then made available through the Turnback Pool and

Photo by Florence Low, Courtesy of the CA Department of Water Resources

can be purchased by other contractors. Historically, Turnback Pool supplies have ranged from 0 to 282,000 acre feet annually. However, Turnback Pool supplies are not frequently available.

Other SWP Supplies and Agreements

In addition to the basic SWP contract provisions, Metropolitan has other contract rights that accrue to the overall value of the SWP. In addition to the contracted provisions, because each contractor is paying for physical facilities, they also have the right to use the facilities to move water supplies associated with agreements, water transfers and water exchanges. Metropolitan has also entered into agreements and exchanges that provide additional water supplies. These contract rights and agreements are detailed below:

Article 56 Carryover Storage: Metropolitan has the right to store its allocated Table A contract amount for delivery in the following year. Metropolitan can store between 100,000 and 200,000 acre-feet, depending on the final water supply allocation percentage.

SWP Terminal Storage: Metropolitan has contractual rights to store up to 65,000 acre-feet of water in

Lake Perris (East Branch terminal reservoir) and 153,940 acre-feet of water in Castaic Lake (West Branch terminal reservoir). This storage provides Metropolitan with additional options for managing SWP deliveries to maximize yield from the project. Any water used must be returned to the SWP within five years or it is deducted from allocated Table A amounts in the sixth year.

Desert Water Agency/Coachella Valley Water District SWP Table A Exchange Agreement: Desert Water Agency and Coachella Valley Water District are State Water Contractors. They are located in the Coachella Valley, near Metropolitan's CRA. Instead of building physical facilities to deliver SWP water, Desert Water Agency/Coachella Valley Water District entered into an exchange agreement with Metropolitan to exchange SWP supplies for Colorado River supplies. Although this exchange is a net-zero in terms of water supply, the exchange agreement adds system flexibility, cost savings and water quality benefits for Metropolitan.

Desert Water Agency/Coachella Valley Water District Advance Delivery Agreement: Metropolitan can deliver Colorado River water to these two agencies in advance of the actual exchange of SWP Contract Table A allocations (see Exchange Agreement above). By delivering water in advance, Metropolitan can cover exchange obligations in advance of a given year and thus is able to receive Desert Water Agency/Coachella Valley Water District's available SWP supplies in a future year without having to deliver an equivalent amount of Colorado River water. This is essentially a storage program and allows for an increase in total water supplies for Metropolitan when needed.

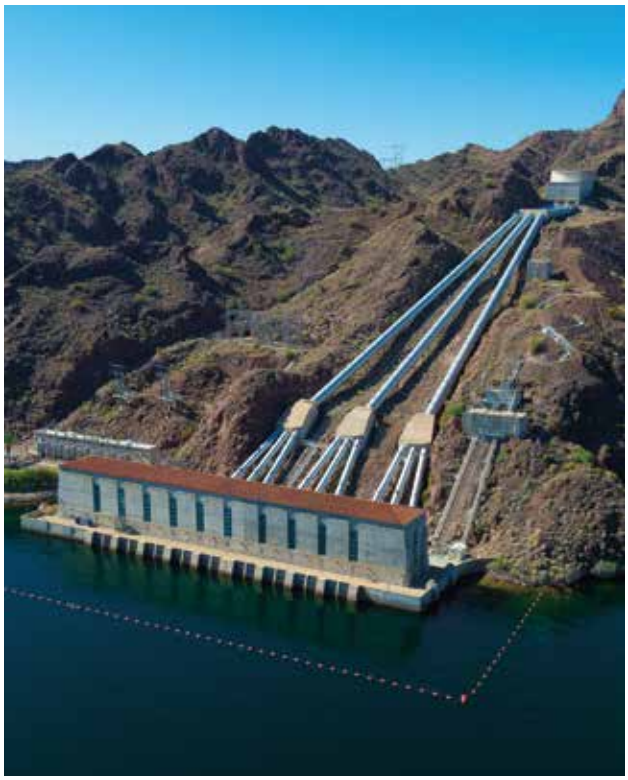
Desert Water Agency/Coachella Valley Water District SWP Table A Transfer: Metropolitan transferred 100,000 acre-feet of its SWP Table A amount (reducing Metropolitan's 2,011,500 acre-foot Table A contract amount to the current 1,911,500 acre-feet) to the Desert Water Agency/Coachella Valley Water District effective January 1, 2005. The Desert Water Agency/Coachella Valley Water District pays all SWP charges for this water, including capital costs associated with capacity in the SWP to transport this water to Lake Perris, as well as the associated variable costs. Water is delivered through the existing Desert Water Agency/Coachella Valley Water District exchange agreements. Metropolitan retains the option to recall and take delivery of the SWP transfer water (subject to the associated contract rights and provisions) in any year. The agreement reduces Metropolitan's SWP fixed costs in years when it has sufficient supplies while preserving an option for dry-year SWP supply.

Desert Water Agency/Coachella Valley Water District Other SWP Deliveries: Since 2008, Metropolitan takes delivery of non-SWP supplies acquired by the Desert Water Agency/Coachella Valley Water District. These deliveries have included water acquired from the Yuba Dry-year Water Purchase Program, the 2009 Drought Water Bank and Multi-Year Water Pool Demonstration Program.

Yuba Dry-Year Water Purchase Program: In December 2007, Metropolitan entered into an agreement with DWR for participation in the Yuba Dry-year Water Purchase Program. Under this program, water is made available for transfer. There are four components to this water purchase program, with differing transfer amounts and prices.

Factors that Could Impact SWP Supplies in the Future

The Sacramento-San Joaquin Delta is the hub of the SWP system. However, multiple stressors have impaired the ecological functions of the Delta. Various regulatory requirements are placed on the SWP's Delta operations to protect special-status species such as Delta smelt and spring- and winter-run Chinook salmon. The terms of biological opinions by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service have become increasingly restrictive over the years. SWP exports have decreased since 2005 as the federal biological opinions went into effect, restricting operations. Without a permanent fix in the Delta, standards that restrict flow and exports are expected to be the status quo. Pumping and exports would likely continue to decline through time as conditions for native species degrade.



THE COLORADO RIVER AQUEDUCT

Metropolitan built, owns and operates the 242 mile CRA. The CRA originates at Lake Havasu on the Colorado River and winds through a series of pump stations and reservoirs through the California desert to its terminal reservoir at Lake Mathews in Riverside County. The CRA has a full delivery capacity of about 1.2 million acre-feet.

The state of California holds a 4.4 million acre-foot normal apportionment to Colorado River water. Within the state's amount, Metropolitan has the Fourth Priority right to a normal apportionment of 550,000 acre-feet per year. Metropolitan also holds the Fifth Priority right for an additional 662,000 acre-feet per year, but this amount is outside of California's 4.4 million acre-feet per year normal apportionment and is only available when surpluses are declared or when unused supplies from other Colorado River users are available.

CRA Supply Development

Metropolitan has developed a number of supply and conservation programs to increase the amount of supply available from the CRA.

Imperial Irrigation District/Metropolitan Conservation Program: Since 1988, Metropolitan has funded water conservation programs within Imperial Irrigation District's (IID) service area. The conserved water from these programs is then transferred to Metropolitan. Conservation approaches range from distribution system improvements – such as the installation of non-leak irrigation gates – to water saving practices such as delivering water to farmers on a 12-hour rather than a 24-hour basis. Through this program, a total of 105,000 acre-feet per year of water is conserved.

Palo Verde Land Management & Crop Rotation Program: In 2005, Metropolitan entered into a 35-year program with the Palo Verde Irrigation District (PVID). Under the program, participating farmers in PVID are paid to reduce their water use by leaving up to 35 percent of their PVID acreage unirrigated. Between 33,000 and 133,000 acre-feet are made available to Metropolitan under this program.

Southern Nevada Water Authority Exchange: In 2004, Metropolitan and Southern Nevada Water Authority (SNWA) entered into an interstate storage and release program, in which Metropolitan stores otherwise unused SNWA supplies with an agreement to return the stored water in the future when needed by SNWA. As of 2015, Metropolitan had stored more than 400,000 acre-feet of water on behalf of SNWA, with a commitment to return 330,000 acre-feet at a later date.

Lower Colorado Water Supply Project: In March 2007, Metropolitan, the city of Needles and the USBR executed the Lower Colorado Water Supply Project contract. Under the contract, Metropolitan receives water that is unused by the project participants. Metropolitan receives 2,000 to 7,000 acre-feet per year from this project.

Intentionally Created Surplus Program: Under this program, Metropolitan may store conserved water in Lake Mead. Only water that has been conserved through extraordinary conservation measures, such as land fallowing, is eligible for storage in Lake Mead. These storage accounts are made up of water conserved by

fallowing in the Palo Verde Valley, projects implemented with IID in its service area, groundwater desalination, the Warren H. Brock Reservoir Project and the Yuma Desalting Plant pilot run.

Additional Non-Metropolitan CRA Supplies

In addition to Metropolitan's supply programs on the CRA, the SDCWA participates in two projects that also result in increased amounts of Colorado River water being delivered into the CRA to Southern California.

Imperial Irrigation District Transfer to San Diego County Water Authority: On April 29, 1998, SDCWA executed an agreement with IID to purchase conserved water. In order to deliver that water to SDCWA, Metropolitan and SDCWA entered into an exchange contract under which SDCWA makes the conserved water available to Metropolitan at Lake Havasu and Metropolitan delivers an equal amount of water to SDCWA. The transfer amount is scheduled to ramp up to 200,000 acre-feet by 2023. In 2015, 100,000 acre-feet were delivered.

All-American Canal and Coachella Canal Lining Projects: The state of California primarily funded, with support from Metropolitan and SDCWA, the lining of portions of the All-American and Coachella canals. The lining conserves approximately 96,000 acre-feet annually that were being lost through the formerly unlined canals. About 80,000 acre-feet of conserved water are delivered to the SDCWA via exchange with Metropolitan. The remaining 16,000 acre-feet are purchased by Metropolitan from the La Jolla, Pala, Pauma, Rincon and San Pasqual Bands of Mission Indians, the San Luis Rey River Indian Water Authority, the city of Escondido and the Vista Irrigation District, all of which will eventually receive the water directly upon completion of a water rights settlement.

Factors that Could Impact CRA Supplies in the Future

Other users along the Colorado River have rights that allow their water use to increase as their demands for water increase. Because Metropolitan holds the lowest priority Colorado River rights in California, any increase in these Present Perfected Rights will reduce supply available to Metropolitan. The Colorado River faces long-term challenges as demands on the river exceed available supply. In 2015, Lake Mead reached its lowest level in history since being filled, and the long-term outlook is for continued decline of the reservoir. These factors could reduce the amount of Colorado River water currently available to Metropolitan.

STORAGE AND TRANSFERS

Over the past two decades, Metropolitan has developed a large regional storage portfolio that includes both dry-year and emergency storage capacity. Storage is a key component of water management. Storage enables the capture of surplus amounts of water in normal and wet climate and hydrologic conditions when it is plentiful for supply and environmental uses. Stored water can then be used in dry years and in conditions where augmented water supplies are needed to meet demands. Storage generally takes two forms: surface reservoirs and groundwater basin storage. Since 1990, Metropolitan has invested billions of dollars to develop both forms of storage. In total, Metropolitan has developed dry-year storage with a capacity of more than 5.5 million acre-feet, a thirteen fold increase in storage capacity available to manage regional water supplies.

Some examples of storage resources that have been developed since 1990 include:

SURFACE WATER RESERVOIRS

- Diamond Valley Lake (810,000 acre-feet)
- SWP Article 56 Carryover Storage (up to 200,000 acre-feet)
- Flexible Storage in Castaic Lake and Lake Perris (219,000 acre-feet)
- Intentionally Created Surplus in Lake Mead (1.5 million acre-feet)

GROUNDWATER STORAGE

- Member Agency Conjunctive Use Programs (210,000 acre-feet)
- Semitropic Storage Program (350,000 acre-feet)
- Arvin-Edison Storage Program (350,000 acre-feet)
- San Bernardino Municipal Water District Storage Program (50,000 acre-feet)
- Kern Delta Water District Storage Program (250,000 acre-feet)
- Mojave Storage Program (390,000 acre-feet)

Table 3-1 shows the total storage capacity, aggregated put and take capacities (i.e., how much that can be "put" into storage, or taken out) and the projected 2015 end of year storage balance.

TABLE 3-1

Storage Program Capacities by Region and Estimated 2015 Ending Balances in Storage (Acre-Feet)

	PROGRAM STORAGE CAPACITY	MAXIMUM PUT CAPACITY	MAXIMUM TAKE CAPACITY	2015 ESTIMATED ENDING BALANCE[1]
Central Valley and SWP	1,630,000	540,000	560,000	460,000
Colorado River	2,390,000	650,000	600,000	290,000
In-Region	1,300,000	900,000	940,000	190,000
Subtotal Dry-Year Storage	5,320,000	2,090,000	2,100,000	940,000
Emergency Storage	647,000	647,000	0	647,000
Total Storage	5,967,000	2,737,000	2,100,000	1,587,000

[1]Based on the current trend as of September 2015; may vary depending on demands and hydrologic conditions for the remainder of the calendar year

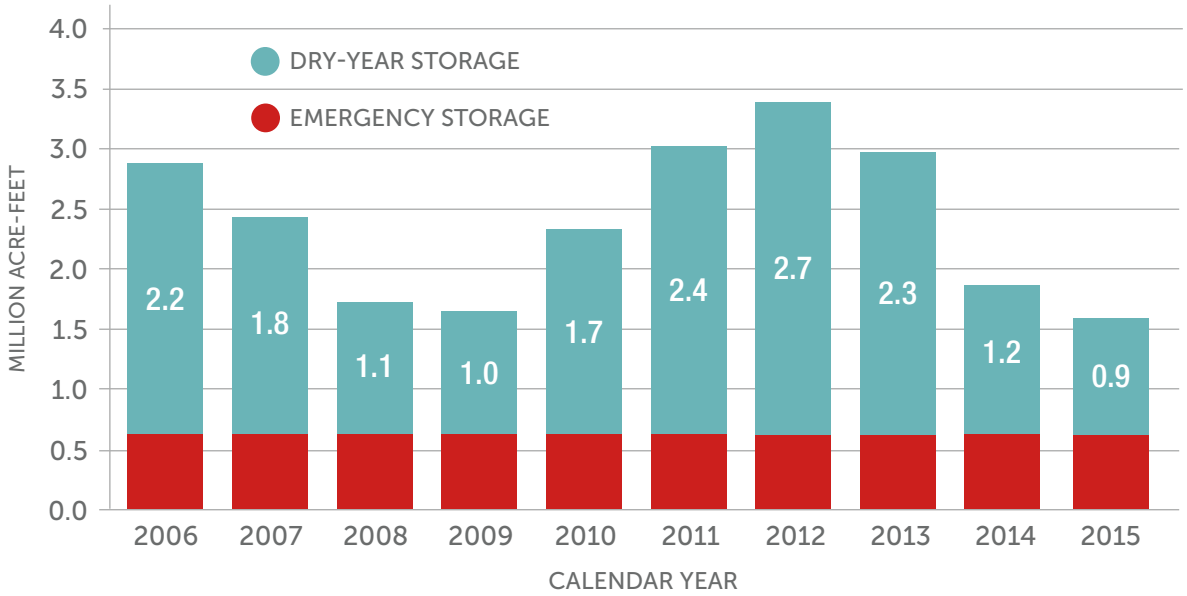
The withdrawal of water from Metropolitan's storage in dry years and the purchase of "transfer" water from willing sellers in these years, have played an integral role in maintaining Metropolitan's water supply reliability. Under the 2015 IRP Update, the role of storage and transfers will continue to be critically important for balancing water supplies and demands.

Figure 3-1 shows the actual end of year balances in Metropolitan storage from 2006 through 2014, and the estimated balance for the end of 2015 based on current trends. In addition, Metropolitan maintains roughly 650,000 acre-feet of emergency storage in all years. Figure 3-1 further illustrates how storage has been used to successfully manage annual differences between supplies and demands. At the end of 2006, Metropolitan's dry-year storage

reserves reached 2.2 million acre-feet. From 2007 through the end of 2009, Metropolitan withdrew 1.2 million acre-feet from its storage reserves to help mitigate shortfalls between supplies and demands. These shortfalls were due in large part to low SWP deliveries, new fisheries restrictions and a sequence of dry hydrologic conditions. From the end of 2009 through the end of 2012, improved hydrologic conditions on the SWP, combined with low demands, allowed Metropolitan to return 1.7 million acre-feet to its storage reserves. Due to unprecedented dry conditions throughout California in 2013 and 2014, Metropolitan again called on storage reserves to manage reduced water supplies. In 2013 and 2014, Metropolitan withdrew a combined 1.5 million acre-feet from its dry-year reserves. At the time that the 2015 IRP Update was being developed, Metropolitan planned on drawing an additional 260,000 acre-feet from storage reserves in 2015. Metropolitan's dry-year storage reserves were projected to end the year at around 940,000 acre-feet.

FIGURE 3-1

Ending Storage Balances 2006-2015[1]



[1]2015 projection based on the current trend as of September 2015; may vary depending on demands and hydrologic conditions for the remainder of the calendar year

Water transfers are an integral part of the water management strategy for Metropolitan. Water transfers are generally described as temporary or limited-term voluntary transactions of water supplies between willing parties. There are a number of programs that are considered to be water transfers. Some of these programs, particularly those with a longer term, are described in previous sections on the SWP and CRA. Metropolitan also regularly explores opportunities for shorter-term water transfers that provide water supply benefits in dry years. In the drought of the late 1980s and early 1990s, Metropolitan participated in dry-year transfers and water bank programs to help manage through that period. However, in the most recent drought period, these types of transfers were not as readily available. As a result, Metropolitan did not pursue large amounts of water transfer supplies in 2014 or 2015 primarily due to very limited transfer water availability, high water transfer costs, and potential high water losses that would result from conveying the transfer supplies through the Delta.

The limited availability of dry-year transfers in 2014 and 2015 is an important lesson learned for the 2015 IRP Update. The value of water transfers for water supply reliability in the 2015 IRP Update will come from a comprehensive water transfer approach. This approach seeks to procure water transfers in normal and wet years and integrate these water transfers with the regional storage portfolio to maximize their dry-year value. The regional storage portfolio is also a key to facilitating unbalanced water exchanges in the future. In an unbalanced exchange, a participant will commit to deliver a quantity of water in a given year in exchange for receiving a greater or lesser proportion of that quantity in a future year. This type of water transfer agreement extends the use of Metropolitan's storage to manage other water user's surplus supplies in exchange for additional water deliveries.

Appendix 3 and Appendix 4 provide additional information on Metropolitan's storage and transfer programs.

Forecasting the Regional Need: Demands and Water Conservation

Retail water demand forecasting is essential for planning total water requirements in Metropolitan's service area. Retail water demand can be met through a combination of conservation, local supplies, and imported supplies. As a wholesale water supplier, Metropolitan's long-term plans focus on the future demands for Metropolitan's imported supplies. In order to project the need for resources and system capacity, Metropolitan begins with a long-term projection of retail water demands. Total retail demands include:

- **Retail Municipal and Industrial (M&I):** Retail M&I demands represent the full spectrum of urban water use within the region including residential, commercial, industrial and institutional water uses. To forecast retail M&I demands, Metropolitan uses econometric models that have been adapted for conditions in Southern California. The econometric models are statistical models that can capture and explain the impacts of long-term socioeconomic trends on retail M&I demands. The econometric models incorporate projections of demographic and economic variables from regional transportation planning agencies to produce forecasts of water demand.

- **Retail Agricultural Demand:** Retail agricultural demands consist of water use for irrigating crops. Metropolitan's member agencies provide projections of agricultural water use based on many factors, including farm acreage, crop types, historical water use and land use conversion.

- **Seawater Barrier Demand:** Seawater barrier demands represent the amount of water needed to hold back seawater intrusion into the coastal groundwater basins. Groundwater management agencies determine the barrier requirements based on groundwater levels, injection wells and regulatory permits.

- **Replenishment Demand:** Replenishment demands represent the amount of water member agencies plan to use to replenish their groundwater basins in order to maintain sustainable basin health and production. Replenishment demands reflect updated estimates which include water needed to recover basins from current drought conditions.

RETAIL M&I DEMAND FORECAST

In forecasting retail M&I water demand, Metropolitan employs an econometric model (the Metropolitan Water District - Econometric Demand Model or MWD-EDM). MWD-EDM utilizes multiple regression, which is generally favored by academics and practitioners for long-term water demand analysis. It uses demand relationships based on actual observed behavior to consider the effect of anticipated changes in demand factors on long-term demand.

The MWD-EDM is comprised of three separate regression models:

- Single-Family Residential (SFR) Model
- Multifamily Residential (MFR) Model
- Commercial, Industrial and Institutional (CII) Model

The SFR and MFR models forecast average monthly household consumption before conservation while the CII model forecasts average monthly consumption per employee. Each of the models estimates water demand before conservation. More information on the regression models can be found in Appendix 7.

DEMOGRAPHICS

Metropolitan's retail demand modeling is driven by key demographics such as projected population, households, employment and median household income. These projections are produced by regional transportation planning agencies as part of their long-term regional growth plans. The forecasts that were previously used in Metropolitan's 2010 IRP Update represented the most recent forecast of retail demands based on then-current growth projections. Since then, data from the 2010 Census showed that the earlier growth projections had overestimated growth trends. In addition, the economic recession that began in 2007 had widespread and persistent impacts that prompted government agencies to revise growth projections. The 2015 IRP Update uses the revised growth forecasts that incorporate effects from the 2010 Census recalibration and the economic recession.

Metropolitan uses demographic growth projections produced by two regional transportation planning agencies, the Southern California Association of Governments (SCAG) and the San Diego Association of Governments (SANDAG). Together they represent more than 200 cities in Southern California and produce long-term transportation and housing plans for sustainable communities. Among other responsibilities, SCAG and SANDAG also prepare projections of population, households, income and employment for their regions. Both planning agencies update their regional growth forecasts approximately every four years, at different times. SCAG is the regional planning agency for six counties: Imperial, Los Angeles, Orange, Riverside, San Bernardino and Ventura. SANDAG is the regional planning agency for San Diego County. Metropolitan uses the forecast for every county except Imperial, which is outside of Metropolitan's service area. Significantly, SCAG and SANDAG official growth projections are backed by environmental reports. These regional growth forecasts provide the core assumptions underlying Metropolitan's retail demand forecasting model.

Recent Demographic Forecasts

In April 2012, SCAG released the *2012-2035 Regional Transportation Plan/Sustainable Communities Strategy* growth forecast (RTP-12). The RTP-12 incorporated updated data and assumptions that reflected the 2007-2009 economic recession, the 2010 Census count and 2011 employment data from the California Employment Development Department for the Imperial, Los Angeles, Orange, Riverside, San Bernardino and Ventura counties.

In October 2013, SANDAG released the Series 13: 2050 Regional Growth Forecast, a comprehensive projection of the regional demographic, economic and housing trends expected over the next four decades for the San Diego region. Metropolitan uses the forecast for the San Diego County Water Authority's service area in the retail demand forecast.

In March 2011, the U.S. Census Bureau released the decennial 2010 population count for the counties served by Metropolitan, which was much lower than existing estimates. SCAG and SANDAG lowered their growth projections to account for the decennial census count as well as changed economic conditions due to the Great Recession. Their current growth forecasts reflect these adjustments. The following table provides the forecast of population, households, and employment.

TABLE 3-2
Forecast of Primary Demographic Drivers

	2016	2020	2025	2030	2035	2040
Population	18,928,000	19,354,000	20,019,000	20,637,000	21,206,000	21,791,000
Households	6,154,000	6,413,000	6,653,000	6,872,000	7,095,000	7,323,000
Employment	8,276,000	8,538,000	8,875,000	9,166,000	9,356,000	9,628,000

Effects of the Great Recession on SCAG's and SANDAG's Forecasts

The Great Recession of 2007-09 severely impacted the region's economic growth. Economic growth is a major factor in population growth through migration. Job availability attracts people to the region. Conversely, a scarcity of employment leads to out-migration as people leave in search of work. Between 2007 and 2010, the region lost approximately 750,000 jobs. The state and the region experienced disproportionately high job losses compared with the nation. Because patterns of migration are influenced by job availability, Southern California saw net out-bound domestic migration. Other major factors that affect population growth are fertility and mortality. The acute economic uncertainties also affected people's decision to start a family. Consequently, delayed family formation and reduced birth rates contributed to slower population growth than was anticipated before the recession. However, mortality rates are projected to be lower as well, and the proportion of older people (age 65+) significantly increases. As a result, the net growth in population in the post-recession era is projected to be lower than previously projected in the 2010 IRP Update. Appendix 6 provides a detailed comparison of the demographic projections used in Metropolitan's 2010 and 2015 IRP Updates.

Total demand in Table 3-3 represents the amount of water need in Metropolitan's service area for consumption and for maintaining production of local groundwater and surface reservoirs.

TABLE 3-3
Forecast of Retail Demands by Type (Acre-Feet)

DEMAND	2016	2020	2025	2030	2035	2040
Retail M&I[1]	3,344,000	3,669,000	3,732,000	3,801,000	3,870,000	3,925,000
Retail Agricultural	110,000	130,000	167,000	163,000	161,000	160,000
Seawater Barrier	72,000	72,000	72,000	72,000	72,000	72,000
Replenishment	326,000	292,000	295,000	297,000	297,000	297,000
Total Demand	3,852,000	4,163,000	4,266,000	4,333,000	4,400,000	4,453,000

[1]Retail M&I demand post-conservation.

CONSERVATION SAVINGS MODEL

Unlike traditional water supplies, which can be directly measured, conservation reduces water demand in ways that can only be quantified indirectly. Demand is reduced through changes in consumer behavior and savings from water-efficient fixtures, such as toilets and showerheads. There are numerous approaches for estimating and projecting conservation savings, and many are utility-specific to meet the unique needs of different water agencies. Metropolitan has developed a Conservation Savings Model (Conservation Model) to estimate savings from the extensive existing conservation programs funded by Metropolitan, as well as those produced by plumbing codes. Metropolitan also incorporates the savings due to the impacts of price on consumers in its demand forecasts. The retail demand estimates shown in Table 3-3 already reflect the reductions achieved from these conservation savings projections.

Conservation savings are commonly estimated from a base-year water-use profile. Beginning with the 1996 IRP, Metropolitan identified 1980 as the base year for estimating conservation because it marked the effective date of a new plumbing code in California requiring toilets in new construction to be rated at 3.5 gallons per flush or less. Between 1980 and 1990, Metropolitan's service area saved an estimated 250,000 acre-feet per year as the result of this 1980 plumbing code and unrelated water rate increases. Within Metropolitan's planning framework, these savings are referred to as "pre-1990 savings." Pre-1990 savings were estimated for the 1996 IRP. Metropolitan's conservation accounting combines pre-1990 savings with estimates of more recently achieved savings.

The Conservation Model also estimates water savings from the new state landscape ordinance known as MWELO. Water savings from MWELO are estimated with two primary constraints. First, the MWELO ordinance applies only to new home construction and existing households and businesses when permits are required for large landscape retrofits. This comprises only a small proportion of the region's total households and businesses. Second, the current MWELO does not have a uniformly effective enforcement mechanism, leading to questions on whether all parts of Metropolitan's service area would comply with the new standards. The Conservation Model accounts for this by

discounting the percentage of new homes that would comply. In addition, for this analysis MWELO is assumed not to affect existing homes and businesses; therefore savings associated with MWELO compliance are not calculated for existing stock.

The Conservation Model accounts for the following sources of conservation savings:

- **Active Conservation:** Water saved directly as a result of conservation programs by water agencies, including implementation of Best Management Practices established by the California Urban Water Conservation Council. Active conservation is unlikely to occur without agency action.
- **Code-Based Conservation:** Water saved as a result of changes in water efficiency requirements for plumbing fixtures in plumbing codes. Sometimes referred to as "passive conservation," this form of conservation would occur as a matter for course without any additional financial incentives from water agencies. Water savings from MWELO, discounted to include 50 percent of new home construction, is included in the estimates of code-based conservation.
- **Price-effect Conservation:** Water saved by retail customers attributable to the effect of changes in the real (inflation-adjusted) price of water. Because water has a positive price elasticity of demand, increases in water price will decrease the quantity demanded.

The following table represents the conservation savings estimates by source. More detailed discussion of the Conservation Savings Model can be found in Appendix 9.

TABLE 3-4
Conservation Savings Estimates by Source (Acre-Feet)

CONSERVATION	2016	2020	2025	2030	2035	2040
Active[1]	230,000	210,000	196,000	184,000	166,000	159,000
Code-Based	341,000	381,000	423,000	462,000	497,000	532,000
Price-Effect[2]	205,000	215,000	258,000	304,000	350,000	398,000
Pre-1990	250,000	250,000	250,000	250,000	250,000	250,000
Total Conservation Savings	1,026,000	1,056,000	1,127,000	1,200,000	1,263,000	1,339,000

[1]Active conservation savings achieved through Metropolitan's Conservation Credits Program and from member agency-funded programs installed up to fiscal year 2015/16.

[2]Price-effect savings include water use savings as a result of reduced demands.

LOCAL SUPPLY PROJECTIONS

Local supplies represent water produced by Metropolitan's member agencies to meet their total demands. Local supplies are a key component in determining how much Metropolitan supply is needed. Projections of local supplies use information from multiple several sources, including Urban Water Management Plans submitted to the state by the member agencies, Metropolitan's annual local production surveys and interaction between Metropolitan and member agency staff. The following provides a brief overview of the local supplies included.

- **Groundwater and Surface Water:** Groundwater production consists of extractions from local groundwater basins. Surface water comes from stream diversions and rainwater captured in reservoirs.
- **The Los Angeles Aqueduct:** A major source of imported water is conveyed from the Owens Valley via the LAA by LADWP. Although LADWP imports water from outside of Metropolitan's service area, Metropolitan classifies water provided by the LAA as a local resource because it is developed and controlled by a local agency.
- **Seawater Desalination:** Highly treated seawater suitable for municipal and industrial potable use.
- **Groundwater Recovery and Recycled Water:** Developed and operated by local water agencies, groundwater recovery projects treat contaminated groundwater to meet potable use standards and recycled water projects treat wastewater for municipal and industrial use.
- **Non-Metropolitan Imports:** Water supplies imported by member agencies from sources outside of the Metropolitan service area.

In order to forecast the quantities of local supplies its member agencies are more certain to produce, Metropolitan only includes projects that are currently producing water or are under construction. Projects in these categories of development provide a higher level of certainty, and are more likely to produce as forecasted. The following table shows the average-year forecast of local supplies.

TABLE 3-5
Projections of Existing and Under Construction Local Supplies by Project Type (Acre-Feet)

LOCAL SUPPLY	2016	2020	2025	2030	2035	2040
Groundwater Production	1,277,000	1,290,000	1,288,000	1,288,000	1,288,000	1,289,000
Surface Production	105,000	110,000	110,000	110,000	110,000	110,000
Los Angeles Aqueduct	243,000	261,000	264,000	264,000	266,000	268,000
Seawater Desalination[1]	51,000	51,000	51,000	51,000	51,000	51,000
Groundwater Recovery[1]	125,000	143,000	157,000	163,000	165,000	167,000
Recycling[1]	387,000	436,000	466,000	486,000	499,000	509,000
Recycling - M&I	219,000	243,000	267,000	285,000	298,000	308,000
Recycling - Replenishment	111,000	126,000	129,000	131,000	131,000	131,000
Recycling - Seawater Barrier	56,000	67,000	70,000	70,000	70,000	70,000
Other Non-Metropolitan Imports	13,000	13,000	13,000	13,000	13,000	13,000
Total Local Supplies	2,199,000	2,304,000	2,348,000	2,374,000	2,392,000	2,406,000

[1]Projections only include projects that are currently producing water, or are under construction.

Appendix 5 contains a complete inventory of local projects provided by the member agencies. This inventory also includes projects within the service area that are in development categories which are not included in the forecast: full design and appropriated funding, advanced planning, feasibility, and conceptual. This inventory includes potential future projects that could be developed toward meeting regional IRP targets.

DETERMINING DEMANDS ON METROPOLITAN

Imported water from Metropolitan serves as an additional source of supply to its 26 member agencies. For many member agencies, their primary source of water is produced locally from groundwater basins, surface reservoirs, the LAA, recycled water projects, groundwater recovery projects and seawater desalination projects. When local supplies are not enough to meet retail demands, member agencies purchase imported water from Metropolitan to meet their remaining needs. However, a number of agencies rely heavily on Metropolitan due to their limited local supplies.

In determining demands for imported water, Metropolitan developed its Sales Model to calculate the difference between total forecasted retail demands and local supply projections. The balance is the demand on Metropolitan's imported water supply. The Sales Model calculates the difference between forecasted demands and projected local supplies after factoring in climate impacts. It employs a modeling method using historical hydrologic conditions from 1922 to 2012 to simulate the expected demands on Metropolitan supplies based on hydrologic conditions. Each hydrologic condition results in one possible outcome for the forecast year in the planning horizon. Each forecast year has 91 possible outcomes, one for each historical hydrology year. This method of modeling produces a distribution of outcomes ranging from the driest to the wettest years within this historical period.

The Sales Model forecasts three types of demands on Metropolitan:

- **Consumptive Use:** Metropolitan's non-interruptible supplies that are used to meet retail M&I demand
- **Seawater Barrier:** Water needed to hold back seawater intrusion into the coastal groundwater basins
- **Replenishment:** Water for groundwater or reservoir replenishment, when available, to meet replenishment demands

The following table provides the forecast of average-year demands on Metropolitan. For additional information on Metropolitan's Sales Model, see Appendix 8.

TABLE 3-6
Forecast of Demands on Metropolitan by Type (Acre-Feet)

DEMAND ON METROPOLITAN	2016	2020	2025	2030	2035	2040
Consumptive Use	1,423,000	1,689,000	1,750,000	1,791,000	1,840,000	1,879,000
Seawater Barrier	16,000	5,000	2,000	2,000	2,000	2,000
Replenishment	214,000	166,000	166,000	166,000	166,000	166,000
Total Demand on Metropolitan	1,653,000	1,859,000	1,918,000	1,959,000	2,008,000	2,048,000

Imported Supply Forecasts

Imported supplies serve not only as supplies for Metropolitan's member agencies, but also as the primary source of water delivered to storage. Storage reserves are essential to ensuring reliability for the region, and for guarding against risk and uncertainty. Imported supplies are the key to building and maintaining storage reserves. The following describes the forecasts of supplies available from the SWP and CRA with no new investments.

STATE WATER PROJECT SUPPLY FORECAST

A description of Metropolitan's SWP supply programs and agreements can be found earlier in this report. Expected deliveries from the SWP will vary in a given year and through time due to weather/climate and hydrology, regulatory/operating guidelines and restrictions, land use in the watershed and the physical system and facilities.

WEATHER/CLIMATE AND HYDROLOGY

The SWP forecast is significantly affected by weather/climate and hydrology. In a given year, variations in temperature, rainfall and snowpack greatly affect the amount of water available from the SWP. These weather-based factors directly affect the amount of water that accumulates and runs off from the SWP watersheds. Closely related to weather-based impacts is the corresponding hydrology. Many factors, such as land cover and development within the watershed or antecedent soil conditions, affect how weather-based factors translate into hydrologic factors like runoff and river flow. Over time, the underlying climate can also change both the estimates of weather-based factors and hydrology. The forecasts of SWP supplies used in the 2015 IRP Update analyses include a full range of 91 different weather and hydrologic impacts taken from a sequential historical sample from 1922-2012. In addition, a change in the weather and hydrology due to projected climate change are also included in the forecasts from 2020 through 2040.

REGULATORY/OPERATING GUIDELINES AND RESTRICTIONS

The SWP forecast is significantly affected by regulatory and operating conditions and restrictions that govern SWP operations. In a given year, these conditions and restrictions dictate how much water can be pumped and exported. The SWP forecasts include the expected deliveries under the regulatory and operating conditions that are expected to be in place in given years in the forecast period.

PHYSICAL SYSTEM AND FACILITIES

The physical system and facilities that comprise the SWP are key factors in determining how much water can be delivered. Changes in the physical system and facilities would change the amount of water that the SWP can store, pump and export given a particular weather/climate, hydrology and regulatory and operating conditions. The SWP forecasts include the expected deliveries under projected changes in the physical system and facilities. These projected changes will vary by scenario.

Under a "Do Nothing" or no new investment forecast for the SWP, there are notable changes that will occur through time. The most notable is the decline in SWP supplies due to climate change and the likelihood of more restrictive regulatory and operating conditions. Average SWP deliveries in 2016, given underlying climate and regulatory and operating conditions, were estimated to be 1.2 million acre-feet. Without significant actions and investments to protect these supplies against new regulations and flow restrictions from biological opinions, a sharp and permanent decline in pumping and exports could occur. These declines are projected to become more severe in 2020, consistent with the scheduled timetable for the review of Biological Opinions for key fisheries in the Delta. More restrictive regulations and operating conditions, combined with the impacts of projected climate change, could reduce average year SWP deliveries to 837,000 acre-feet.

The following table summarizes the minimum, average and maximum expected Table A and Article 21 supplies available to Metropolitan over the forecast period. The forecasts of SWP supplies used in this analysis include a full range of 91 different climate impacts from 1922-2012. Additional information on the specific SWP modeling studies and assumptions used in this analysis can be found in Appendix 10.

TABLE 3-7

Summary of State Water Project Supplies Available to Metropolitan Without Additional Investments (Acre-Feet)

SWP	2016	2020	2025	2030	2035	2040
Minimum	210,000	154,000	154,000	154,000	154,000	154,000
Average	1,202,000	837,000	837,000	837,000	837,000	837,000
Maximum	2,022,000	1,695,000	1,695,000	1,695,000	1,695,000	1,695,000

COLORADO RIVER AQUEDUCT SUPPLY FORECAST

In addition to its Fourth and Fifth Priority entitlements from the CRA, Metropolitan has access to a number of other supply and conservation programs; these programs are described earlier in this report. Programs such as the IID/Metropolitan Conservation Program provide supplies in all years, regardless of hydrology, and are considered base supply programs. Other programs such as the PVID program and Intentionally Created Surplus provide flexibility in different year types. These flexible programs work in conjunction with the base supply programs to manage water into storage in wet years, and provide additional supply in dry years. The following table shows the forecast of base CRA supply programs over the forecast period. Some of these supplies are expected to change over time, and these changes are reflected in the table. The flexible supplies are not shown in the table. Additional information on the specific CRA modeling studies and assumptions used in this analysis can be found in Appendix 10.

TABLE 3-8

Forecast of Colorado River Aqueduct Base Supplies and Adjustments (Acre-Feet)

CRA	2016	2020	2025	2030	2035	2040
Basic Apportionment	550,000	550,000	550,000	550,000	550,000	550,000
Present Perfected Rights	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000
SNWA Return Obligations	0	0	0	0	-5,000	-10,000
IID-MWD Conservation Program	85,000	85,000	85,000	85,000	85,000	85,000
Palo Verde Program Minimum	30,000	30,000	30,000	30,000	30,000	30,000
IID-SDCWA Transfer and Exchange	100,000	193,000	200,000	200,000	200,000	200,000
Canal Lining Projects SDCWA	80,000	80,000	80,000	80,000	80,000	80,000
Canal Lining Projects	16,000	16,000	16,000	16,000	16,000	16,000
Lower Colorado Water Supply Project	8,000	8,000	7,000	6,000	5,000	4,000
Total Base Supply Programs	867,000	960,000	966,000	965,000	959,000	953,000

Remaining Need: The Regional Water Balance

The first step in determining the remaining need is to evaluate the balance of existing levels of supplies against future projections of demands. Constructing a "Do Nothing" water balance provides a picture of what future reliability would look like with no additional actions or investments in water supply or demand management. The "Do Nothing" analysis determines whether additional developments that help to balance supplies and demands are needed to ensure reliability into the future. This look at the regional water balance incorporates all of the forecasts of demands and supplies described previously in this report.

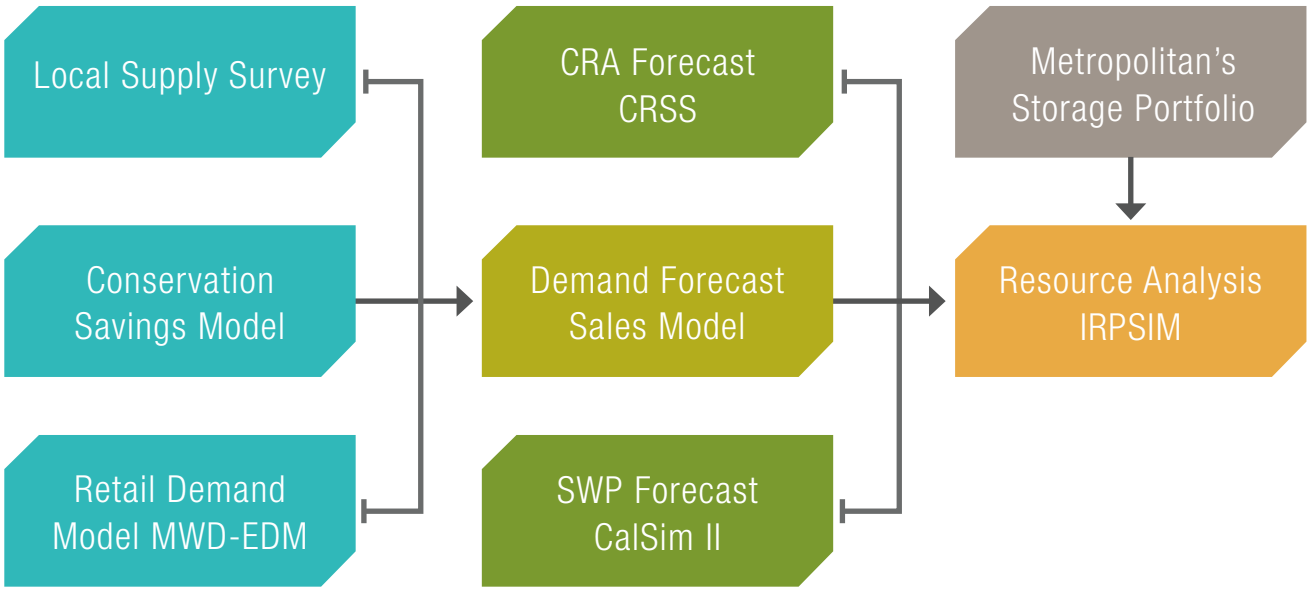
MODELING RELIABILITY

In order to evaluate reliability under future scenarios of water supplies and demands, Metropolitan uses a sophisticated water resources modeling platform called the Integrated Resources Planning Simulation Model (IRPSIM). IRPSIM is designed to integrate projections of demands, conservation, imported supplies and storage out to 2040, and to simulate outcomes and water balances under a set of varying hydrologic and weather/climate conditions. IRPSIM uses a sample of 91 years of historical hydrology and weather/climate from 1922 to 2012 as a test of reliability. This methodology generates 91 different outcomes for each forecast year, and thus allows Metropolitan to evaluate the probabilities of surpluses and shortages over the forecast horizon.

The IRPSIM methodology of sequential hydrology analysis is also very effective in capturing the operation of storage resources over time. Metropolitan's entire regional storage portfolio is included in the IRPSIM modeling framework, with individual programs operated based on defined parameters for put, take, and total storage capacity as described in Appendix 11. The regional storage portfolio is used in the IRPSIM model to manage the year-to-year differences between supplies and demands across the forecast horizon. Storage resources are drawn down and refilled over time to balance these differences; storage use in one year then informs the starting storage balance in the next year.

The following figure illustrates the relationships between IRPSIM and the various planning models used by Metropolitan. These planning models generate the forecasts of supplies, demands and conservation described in this report, which serve as inputs to IRPSIM. Appendix 11 contains a detailed description of the IRPSIM model and methodology.

FIGURE 3-2
Diagram of Metropolitan Planning Models and Forecasts



METRICS FOR MEASURING RELIABILITY: SHORTAGES AND SUPPLY ALLOCATIONS

The regional goal of the 2015 IRP Update is to provide a high level of water supply reliability. IRPSIM provides the water resource simulation modeling outputs that allow Metropolitan to measure whether or not a potential resource mix is likely to be reliable. In order to evaluate the results of a water balance analysis, one or more defined metrics are needed to measure against modeling outputs. A metric is a measurable figure that the outputs from the model can be compared to in order to make an evaluation. In the case of the IRP modeling, a metric will help determine if individual water balance outcomes are reliable or not. The quantity of water supply shortages is a traditional metric of reliability. Shortages within an IRPSIM simulation show when the region is either out of water, or unable to deliver available water supplies due to constraints such as conveyance capacities. Water shortages represent an inability to provide water to the retail-level customer, which is considered to be a severe situation and a definite measure of unreliability. In fact, a true water shortage is a situation that the region has not faced up to this point.

A second metric for reliability is a determination on whether the region would be required to impose shortage restrictions. More commonly known as allocation or mandatory rationing, this situation occurs when water resources, particularly storage resources, reach a point of depletion where limitations are imposed in an attempt to stretch remaining resources to be prepared for future shortage conditions. Instead of using water shortages as the only metric for reliability, Metropolitan also evaluates low levels of storage as a metric for measuring reliability. Low storage levels are a primary driver for the implementation of Metropolitan's WSAP and is reflective of how the region reacted during droughts in the last two decades. From the retail consumer's point of view, imposed restrictions are similar to actual water shortages in terms of having an unreliable water supply. In the droughts of the early 1990s, 2009-2010 and 2015, Metropolitan implemented supply allocations to its member agencies in an effort to extend low storage reserves even though the region was not out of water. Actions in the last two implementations of Metropolitan's WSAP show that when regional dry-year storage levels approach 1.0 million acre-feet (an indicator of low storage), supply allocations will be considered.

WATER BALANCE RESULTS: THE "DO NOTHING" CASE

IRPSIM was used to analyze future reliability and storage outcomes for the "Do Nothing" water balance. The results of the IRPSIM analysis include probabilistic outcomes of demands, conservation, local supplies, shortages, and storage balances.

Figure 3-3 shows the reliability, or shortage, results of the "Do Nothing" water balance analysis in the year 2020. The blue area shows 91 outcomes of supplies versus demands in 2020, before any storage actions are taken. The 91 outcomes are ranked in order, from the largest shortage on the left of just over 850,000 acre-feet, to the largest surplus on the right of almost 1.4 million acre-feet. These results also show that before any storage actions are taken, Metropolitan would expect to have shortage conditions (below the 0 axis) 46 percent of the time and surplus conditions (above the 0 axis) 54 percent of the time.

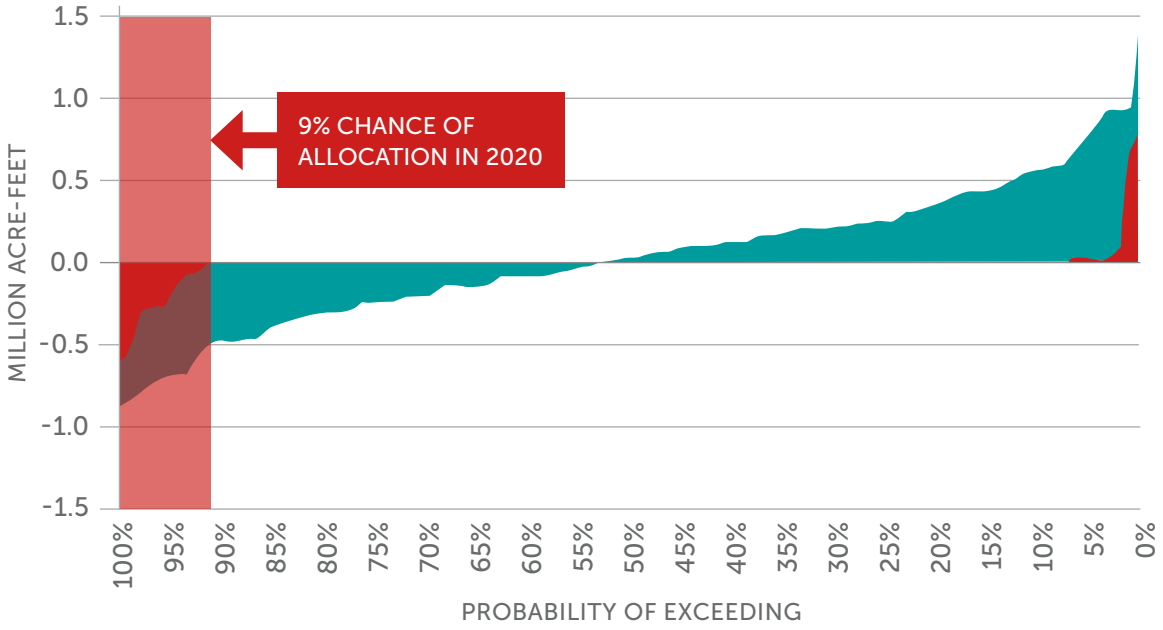
The solid red area shown in Figure 3-3, illustrates the remaining surpluses and shortages after Metropolitan's storage portfolio is used to help manage differences between supplies and demands. On the surplus supply side, the results show that approximately 8 percent of the time, there would be surplus water supplies that could not be managed using available storage; with

a maximum surplus remaining of almost 800,000 acre-feet. On the shortage side, 9 percent of the time, the results show remaining water shortages beyond what can be managed through withdrawals from available storage reserves; with a maximum shortage of around 600,000 acre-feet. The remaining 84 percent of the time,the differences between supplies and demands can be managed completely using storage with no shortages to the region and no surplus water that could not be stored.

Although Figure 3-3 only shows reliability results for 2020, IRPSIM generates this same information for every year in the forecast period from 2016 to 2040. The following figure summarizes the results for the "Do Nothing" case over time, showing the probability of shortages in five year increments before and after storage actions. These results are based upon the detailed information shown in Figure 3-3; the red shaded area showing a 9 percent chance of shortage corresponds to the 2020 results in Figure 3-4. These results show that the probability of shortages increases dramatically over time under the "Do Nothing" case, reaching nearly a 60 percent chance of shortages by 2040.

FIGURE 3-3

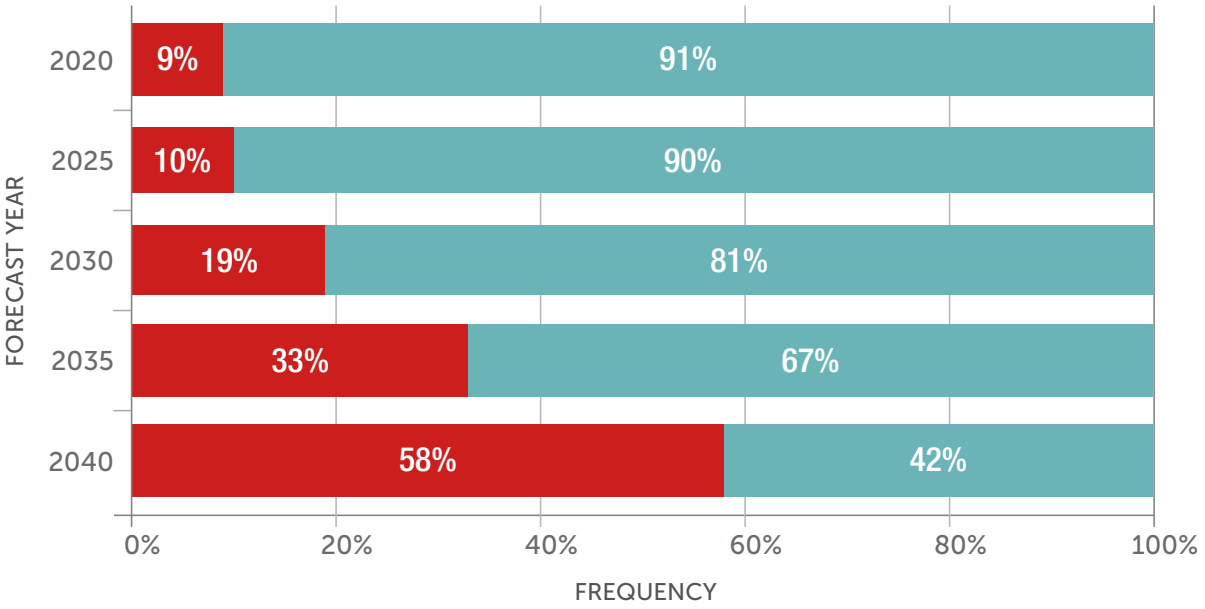
2020 Water Balance Under the "Do Nothing" Case[1]



[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

FIGURE 3-4

Summary of Shortage Probabilities Under the "Do Nothing" Case[1]

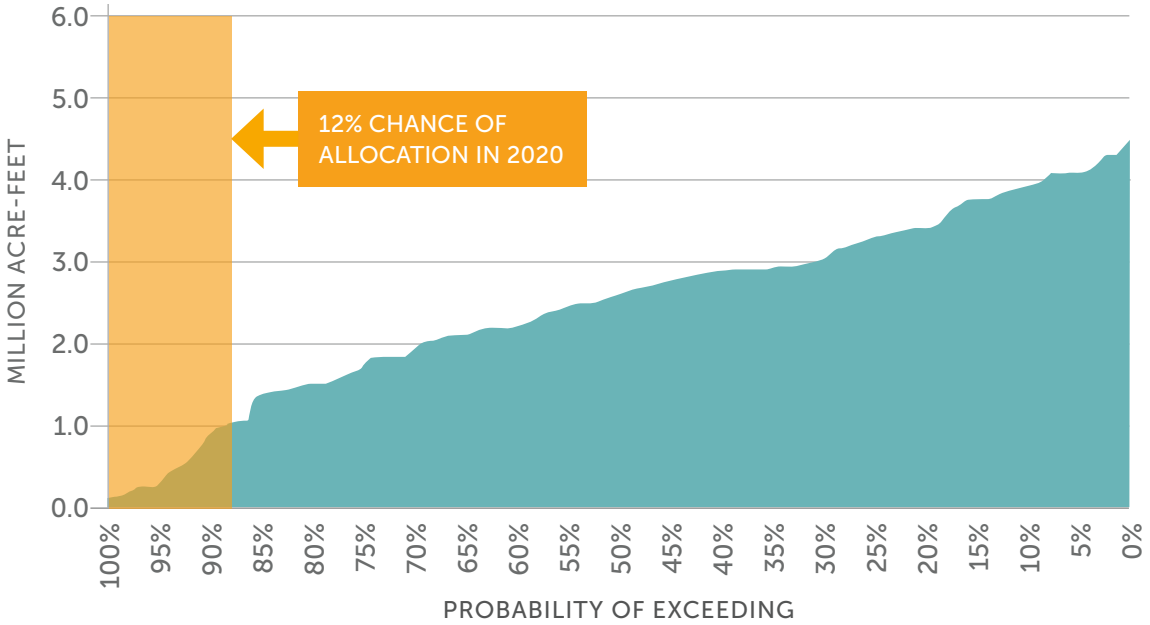


[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

In addition to producing the reliability results described in the previous figures, the IRPSIM model provides simulation data that evaluates the corresponding impacts to storage reserves. Storage levels are critical because low storage levels have led to consideration of water supply allocation in the past and thus are an indicator of low reliability. Figure 3-5 shows the range of potential dry-year storage balances for the year 2020. Again, these results show 91 different outcomes of water in storage, ranked from lowest to highest. The balances of ending dry-year storage range from

FIGURE 3-5

2020 Probability of Dry-Year Storage Ending Below 1 Million Acre-Feet Under the "Do Nothing" Case[1]



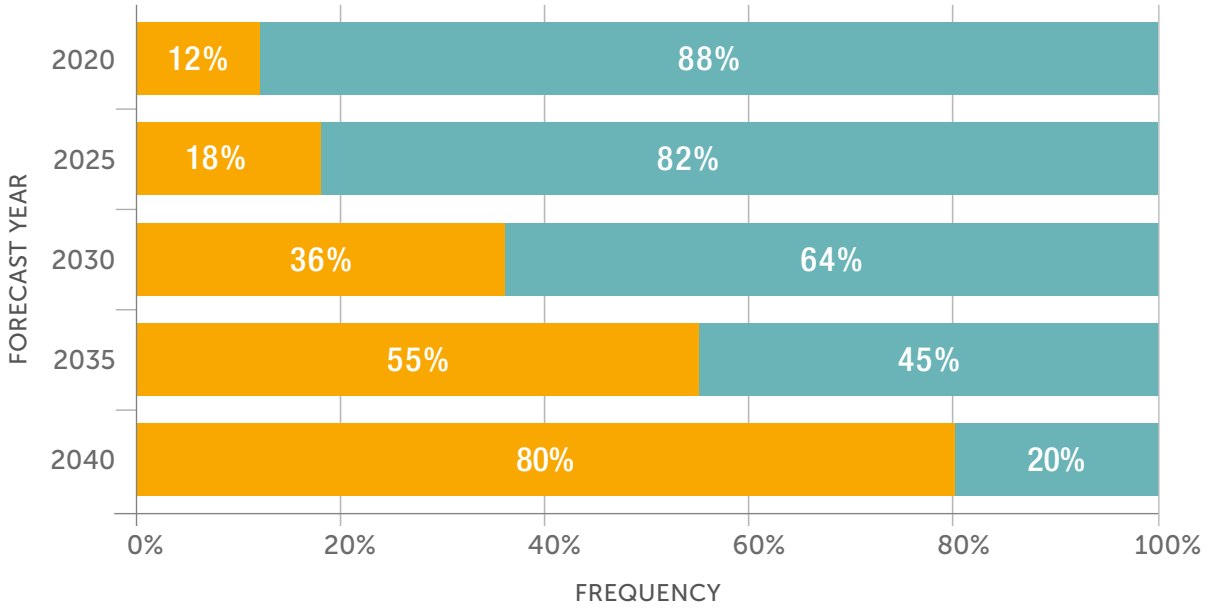
[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

about 75,000 acre-feet up to almost 4.5 million acre-feet. When evaluated against the metric of low storage, which is defined as regional dry-year storage levels below 1.0 million acre-feet, the results show that 12 percent of the time storage would be below the low storage metric. This equates to the region facing a 12 percent chance of implementing Metropolitan's WSAP in 2020.

In a similar fashion to the reliability results shown above, Figure 3-6 summarizes the probabilities of implementing supply allocations in 5 year increments. The shaded orange area in Figure 3-6 corresponds to the 12 percent chance of allocation shown below for the year 2020. These results show that the probability of supply allocation increases dramatically over time under the "Do Nothing" case, reaching an 80 percent likelihood in 2040.

FIGURE 3-6

Summary of Allocation Probabilities Under the "Do Nothing" Case[1]



[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

WATER BALANCE CONCLUSIONS: NEED TO TAKE ACTION

The "Do Nothing" water balance clearly illustrates how if Southern California stopped adapting and relied only upon on its existing supply assets and current achievements in conservation, shortages and implementation of Metropolitan's WSAP would likely occur in an unacceptable level of frequency in the years ahead. This finding is a reminder that working to maintain a reliable water system is never done. In this case, "doing nothing" and making no further investments in water supply and demand management would impose a huge cost on all Southern Californians. The same shortage conditions facing the region in the early 1990s, in 2009-2010, and this year, with imposed fines and penalties for exceeding water use limits, would occur a large percentage of the time. That potential threat of unreliability is too great to ignore; in order to achieve levels of high reliability, significant water supply and conservation investments will be needed.

4.

An Adaptive Management Strategy

The drought cycle that occurred between the 2010 IRP Update and the 2015 IRP Update reinforced the importance of storage in maintaining a reliable water supply for Southern California. The region entered this cycle with a record quantity of water stored within Metropolitan's network of reservoirs and groundwater banks. Tapping these reserves allowed the region to avoid severe shortages and economic disruption. These storage investments have proved to be extremely valuable. It is important to remember that these reserves consist entirely of supplies from Northern California and the Colorado River. However, many of the key strategies envisioned in the 2015 IRP Update for maintaining adequate storage reserves focus on local actions. Developing new in-region supplies and reducing demands allows Metropolitan to place sufficient imported supplies into storage reserves.

If Southern California had not dramatically lowered demand over the years through the region's suite of conservation and water-use efficiency actions, there likely would have been little water in reserve entering the current drought. Whatever diminished supplies were available would have been depleted to meet higher demands. That is why additional conservation is a cornerstone to the 2015 IRP Update reliability strategy.

Increasing conservation and local supplies will be essential. The more that conservation and local supplies can contribute to the baseline each and every year, the more Metropolitan can direct a portion of its imported supplies into storage to prepare for droughts of unknown duration. The 2015 IRP Update calls for increasing the targets for conservation and local supply development and an emphasis on the importance of protecting and maintaining existing local supplies.

Local supplies such as recycling go hand in hand with traditional supplies such as the SWP. In order to produce and use increasing amounts of recycled water, it is imperative that original source waters be of high quality and low salinity. This is one of the reasons why imported supplies will remain an important foundation of the Southland's water portfolio. Not only does imported water help maximize the effectiveness of regional storage, it also helps to maximize the use of recycled water. While there may be fluctuations in the availability of these supplies due to hydrologic conditions and other potential future uncertainties, it remains sound policy to invest in maintaining these traditional imported water sources.

Adaptive management entails starting from a baseline and adjusting from there. The 2015 IRP Update establishes a new important baseline, the reliability target of new local supply and conservation actions needed over the coming 25 years. The 2015 IRP Update is the reference point for when Metropolitan re-examines this plan in five years for the 2020 IRP Update.

Together with water conservation savings, the development of new local supplies and the protection of existing local supplies are the cornerstones to the strategy of meeting growing demands in Southern California.

Additional Risk and Uncertainty that Challenges Reliability

The "Do Nothing" case with no new investment shows a projection of outcomes with the best available forecasts of supplies and demands. Some known risks and uncertainties are included in these forecasts. For example, many of the supply and demand forecasts can vary due to weather. Good estimates have been developed that show, in a given year, the amount of change per supply and demand type that occurs due to fluctuations in the weather. However, there is a significant uncertainty as to what the weather will be in a given year. To manage that uncertainty, the forecasts of supply and demand include a range of weather variation from a sequential sample of 91 years from 1922-2012.

In addition to the more known types of risk and uncertainty like weather variation, there are also other risks and uncertainties that may affect future supplies and demands. There is a degree of risk and uncertainty in every supply source, every conservation effort, and to the underlying drivers of water demand that go into the 2015 IRP Update. These risks and uncertainties come from a variety of sources. Some of these sources are:

- Water quality
- Climate change
- Regulatory and operational changes
- Project construction and implementation issues
- Infrastructure reliability and maintenance
- Demographic and growth uncertainty

This is certainly not a complete list of the risks and uncertainty that the future may bring. Any of these risks and uncertainties, should they occur individually or collectively, may result in a negative impact to water supply reliability. While it is impossible to know how much risk and uncertainty to guard against, the region's reliability will be more secure with a long-term plan that recognizes risk and provides resource development to offset that risk.

Resource and Conservation Reliability Targets

RELIABILITY GOALS, APPROACHES AND TARGETS

The following sections describe the goals, approaches and targets for each of the resource areas that are needed to ensure reliability under planned conditions. Some resource areas place greater focus on maintaining existing capabilities, while others emphasize increasing net quantities over the next 25 years. While securing imported supplies from the CRA and SWP falls under Metropolitan's core activities, developing and maintaining other resources such as conservation and local supplies are wider regional efforts that involve a number of entities from across Southern California.

MAINTAIN COLORADO RIVER AQUEDUCT SUPPLIES

The goal for CRA supplies is to maintain current levels of water supplies from existing programs, while also developing flexibility through dry-year programs and storage. Much of this goal involves protecting existing supply and storage programs in the face of risks that could impact CRA supplies in the future. Identified risks to future CRA supplies include increased demands from Colorado River uses whose rights to Colorado River water exceed Metropolitan's rights and climate change that can impact the frequency and depth of shortage declarations on the river.

In order to accomplish this goal, the 2015 IRP Update calls for developing sufficient base supply programs to ensure that a minimum of 900,000 acre-feet of diversions are available when needed and to ensure access to 1.2 million acre-feet of supplies in dry years through flexible programs and storage. This will require an approach that maintains existing base supply availability, minimizes reductions in base supplies from risks and challenges and augments base supply amounts to increase resilience to any reductions that may occur. The following table summarizes the targets for CRA supplies.

TABLE 4-1

Summary of Colorado River Diversion Targets (Acre-Feet)

CRA	2016	2020	2025	2030	2035	2040
Minimum Diversion Target	900,000	900,000	900,000	900,000	900,000	900,000
Dry-Year Diversion Target	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000

STABILIZE STATE WATER PROJECT SUPPLIES

The goal for SWP supplies is to adaptively manage flow and export regulations in the near term and to achieve a long-term Delta solution that addresses ecosystem and water supply reliability challenges. Achieving this goal will require continued participation and successful outcomes in the California WaterFix and the California EcoRestore efforts. As previously discussed, the primary challenge to water supply reliability from the SWP is from the water required for regulatory and flow-based actions to protect environmental concerns. It is also expected that the scheduled review and revision to Biological Opinions and operating rules would present further challenges to water supply reliability. Continued participation in the California WaterFix and California EcoRestore efforts will have both a near-term and long-term effect.

In the near-term, the efforts to permanently address pumping and flow-based environmental through the California WaterFix and the attention to environmental and ecosystem restoration in the California EcoRestore is expected to facilitate a continuation of collaborative adaptive management with the key regulatory agencies. Collaborative adaptive management has been occurring for a number of years with current biological standards and has resulted in a better balance of water supply reliability and regulatory compliance than what would have occurred with a strict adherence to flow-based standards. With agencies committed to a long-term solution to these issues in the Delta, it is anticipated that collaborative adaptive management would continue in the face of more stringent flow-based standards that could result from a review and strengthening of Biological Opinions.

In the long-term, the preferred alternative identified in the California WaterFix is expected to provide more flexible water diversions through improved conveyance and operations. The new conveyance and diversion facilities will allow for increased water supply reliability and a more permanent solution for flow-based environmental standards. The preferred alternative in the California WaterFix would also provide additional access to storm flows and interruptible water supplies that are occasionally available hydrologically but cannot be diverted due to system conveyance constraints.

Based on modeling done for the California WaterFix, it is estimated that the goal for SWP supplies in the IRP will result in an average of about 980,000 acre-feet of SWP supplies in 2020 and 1.2 million acre-feet on average starting in 2030 when a long-term Delta solution is estimated to be in place. The following table summarizes the SWP supply targets.

TABLE 4-2
Summary of State Water Project Supplies Available to Metropolitan With 2015 IRP Update Target Development (Acre-Feet)

SWP	2016	2020	2025	2030	2035	2040
Minimum	210,000	229,000	229,000	314,000	314,000	314,000
Average	1,202,000	984,000	984,000	1,213,000	1,213,000	1,213,000
Maximum	2,022,000	1,695,000	1,695,000	1,863,000	1,863,000	1,863,000

ACHIEVE ADDITIONAL CONSERVATION SAVINGS

The goal for conservation is to achieve additional savings through an emphasis on outdoor water-use efficiency. While Metropolitan and its member agencies continue to work towards achieving water savings consistent with 20x2020 goals, the 2015 IRP Update approach is to seek conservation savings through enhanced regional compliance with the state's MWELO. MWELO is essentially a new standard for outdoor landscape water use. MWELO is already in place, but there is uncertainty as to how effective compliance will be given limitations in the current enforcement mechanisms. Estimated water savings from MWELO, equivalent to 50 percent compliance for new home construction, are already included in estimates of code-based conservation. Metropolitan and the member agencies should develop policy approaches to target achieving a full 100 percent MWELO compliance for new home construction.

Existing households and businesses make up the majority of total landscape water use in the region. The majority of potential savings from efficient landscape water use lies in these existing households and businesses and not in new construction. MWELO only applies to existing households and businesses when permits are required for large landscape retrofits. However, large permitted landscape retrofits do not occur frequently. The 2015 IRP Update evaluated the potential savings from varying rates of annual replacement, or retrofit, for existing homes and businesses. Based on input from the Board of Directors and member agencies, the 2015 IRP Update reliability target includes a conservation savings approach that seeks a reasonable middle ground of annual retrofit of MWELO-compliant landscapes from existing homes and businesses. The 2015 IRP Update targets the estimated additional savings associated with a replacement and retrofit rate of 1 percent of the existing stock of homes and businesses per year. In addition, Metropolitan expects to continue offering device-based programs for residential,

commercial and industrial customers. In total, a conservation program policy that achieves this approach would result in approximately 485,000 acre-feet of additional annual savings between 2016 and 2040. The following table summarizes the total amount of targeted conservation savings (Table 4-3).

TABLE 4-3
Summary of Conservation Savings Target (Acre-Feet)

CONSERVATION	2016	2020	2025	2030	2035	2040
Existing Conservation	1,026,000	1,056,000	1,127,000	1,200,000	1,263,000	1,339,000
New Savings	8,000	40,000	70,000	110,000	140,000	180,000
Total Conservation Target	1,034,000	1,096,000	1,197,000	1,310,000	1,403,000	1,519,000

DEVELOP AND PROTECT LOCAL WATER SUPPLIES

Local supplies are a key to providing and maintaining water supply reliability into the future. Over half of the region's water supplies come from locally-developed sources. Together with water conservation savings, the development of new local supplies and the protection of existing local supplies are the cornerstones to the strategy of meeting growing demands in Southern California. In order for this component of the 2015 IRP Update to be successful, the significant amount of annual local supply production must be maintained. The 2015 IRP Update goal for local water supplies is primarily to protect existing resources from future risk.

The 2015 IRP Update identifies that approximately 200,000 acre-feet of new local supply and water conservation is needed, in conjunction with stabilizing, protecting and restoring the region's imported supplies. The approach for water conservation is targeting water-use reductions through aggressive implementation of MWELO landscape standards. The water conservation approach, if successful, will result in approximately 180,000 acre-feet of new water conservation savings. The approach for local supplies is to develop the remaining 20,000 acre-feet of additional need through recycling, groundwater recovery and seawater desalination. The goal is also to maintain the base of existing supplies. The additional 20,000 acre-feet of new local supply combined with existing and under-construction local supplies equal a total local supply target of 2.4 million acre-feet by 2040. This level of development represents a total increase of 227,000 acre-feet from 2016 to 2040.

Developing and maintaining 2.4 million acre-feet of diversified local supplies is not a straightforward exercise. Local supplies face many challenges, and these challenges are comprised of several of the changed conditions that the 2015 IRP Update considers and guards against. Most of the local supply types, whether it be groundwater, surface water, LAA or recycled water, have suffered from reduced yields from environmental and regulatory issues and from the recent

drought. The existing and under-construction local supplies that are estimated to produce nearly 2.2 million acre-feet in 2016 produced 1.94 million acre-feet in the challenging drought year of 2014. If this reduction is indicative of the challenge of maintaining local supplies in the future, it shows an additional shortfall of over 250,000 acre-feet that would have to be developed to keep local supplies on track for water supply reliability.

Given the relatively limited inventory of potential local supply projects (see Appendix 5 – Local Resources Projects) there needs to be a policy discussion that results in a strategy for the development and maintenance of local supplies. The comprehensive strategy needs to consider Metropolitan's role in local investment strategies as well as regional participation in the development of new local supplies. Regional policy concerning local supply and water conservation development is particularly important because of the limited opportunities for increasing imported supplies in the future. Southern California is empowered to maintain a reliable water system by taking local actions that are entirely under the region's control. Despite comprehensive efforts to maintain the reliability of supplies from Northern California and the Colorado River, these water systems face inherent vulnerabilities. Local actions have proven to be a tried and true method of maintaining reliability.

TABLE 4-4
Summary of Local Supply Target (Acre-Feet)

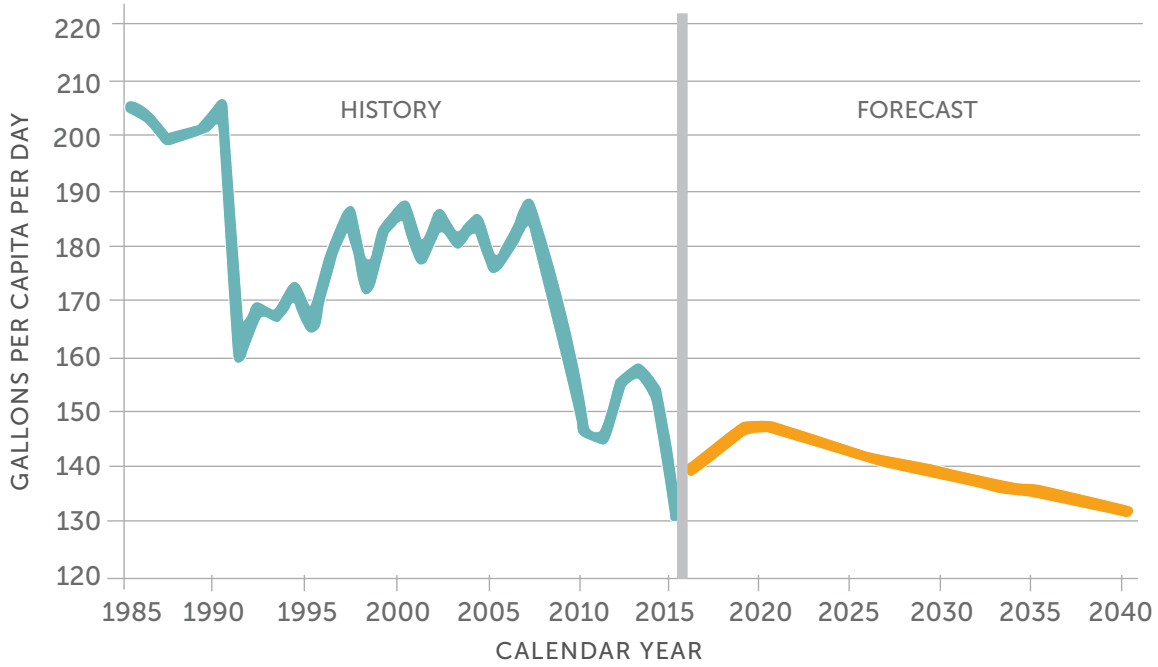
LOCAL SUPPLIES	2016	2020	2025	2030	2035	2040
Existing and Under Construction Local Supplies	2,199,000	2,304,000	2,348,000	2,374,000	2,392,000	2,406,000
New Local Supply	0	3,000	8,000	12,000	16,000	20,000
Total Local Supply Target	2,199,000	2,307,000	2,356,000	2,386,000	2,408,000	2,426,000

IMPACTS ON POTABLE WATER DEMANDS

Figure 4-1 illustrates the impact of the total conservation savings target and the portion of the total local supply target that is recycled water on potable water use within Metropolitan's service area. The blue line shows the historic potable water use in gallons per capita per day (GPCD). This history highlights the dramatic decreases in potable water use already achieved through the region's investments in conservation and recycling. From 2014 to 2015 potable water use per person dropped from 154 GPCD to just over 130 GPCD. This decline reflects the region's extraordinary response to statewide calls for a 25 percent reduction in water use and shows the ability of the region to respond. However, making these gains permanent will require continued effort and investments. The orange line shows the forecast of potable GPCD going forward. Based on the 2015 IRP Update forecasts of demands, conservation and local supply development, potable GPCD is expected to increase slightly until 2020 as demands rebound towards more normal levels. After 2020, the potable GPCD begins to decrease steadily as savings from existing conservation and recycled water projects continue to grow, and new targeted savings are developed. By the end of the forecast period potable GPCD would be back down to 2015 levels, however, these savings would be achieved in a sustainable, permanent way that protects the region's retail consumers and economy.

FIGURE 4-1

Historic and Forecasted Potable Water Demands (Gallons Per Capita Per Day)



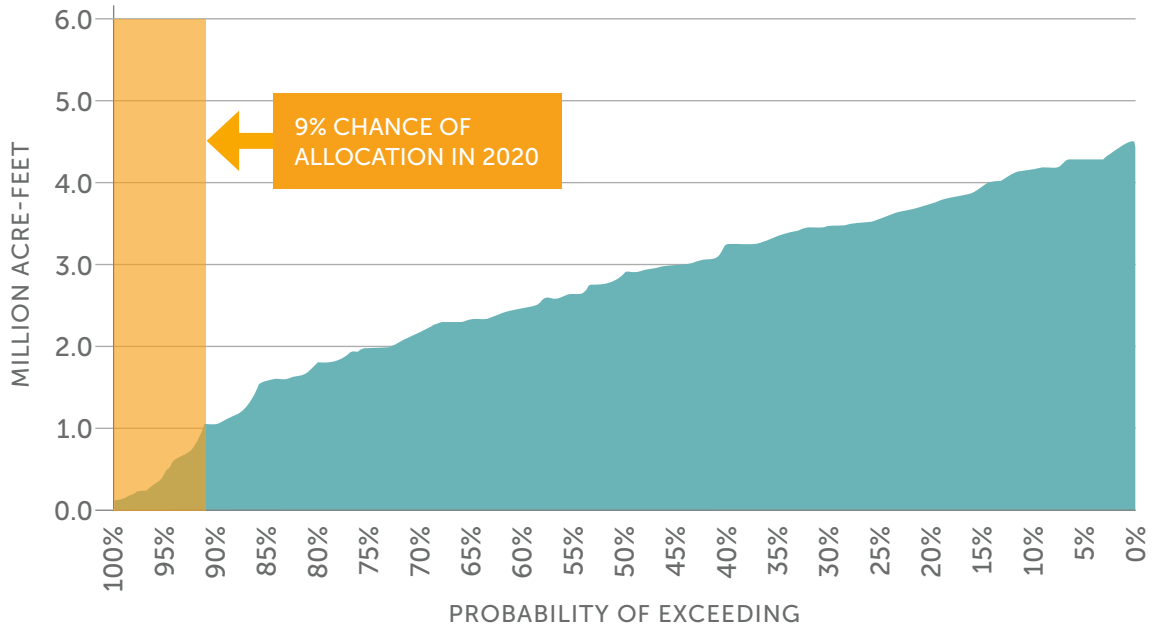
RELIABILITY WITH TARGET DEVELOPMENT: THE "IRP APPROACH" CASE

Together, these targets significantly improve the reliability outlook for the region. In a previous chapter, Figure 3-5 and Figure 3-6 illustrate substantial degradation in expected water supply reliability in a hypothetical "Do Nothing" case, where no further investment occurs. Under the "Do Nothing" case, frequency for water supply allocations rose to 55 percent by 2035 and to 80 percent by the year 2040. IRPSIM was used to repeat the reliability analysis done for the "Do Nothing" case, this time with the 2015 IRP Update reliability targets.

The "IRP Approach" case builds in the additional development targeted for CRA, SWP, conservation, and local supplies described above. Figure 4-2 shows the potential range of ending dry-year storage balances in 2020 under the "IRP Approach" case; the orange shaded area highlights when dry-year reserves are less than 1 million acre-feet. This analysis shows that the region would face a 9 percent chance of water supply allocation in 2020. Figure 4-3 summarizes the probabilities of implementing Metropolitan's WSAP over time under the "IRP Approach" case. The results of this analysis show that the probabilities of supply allocations decrease slightly in the near-term, and are substantially ameliorated in the longer-term. This summary suggests that the "IRP Approach" case performs well under the planning conditions outlined in this report. These results also highlight that the 2015 IRP Update reliability targets do not entirely eliminate reliability issues in the near-term; there is a 9 percent chance of implementing Metropolitan's WSAP in 2020 and a 4 percent chance remaining in 2025.

FIGURE 4-2

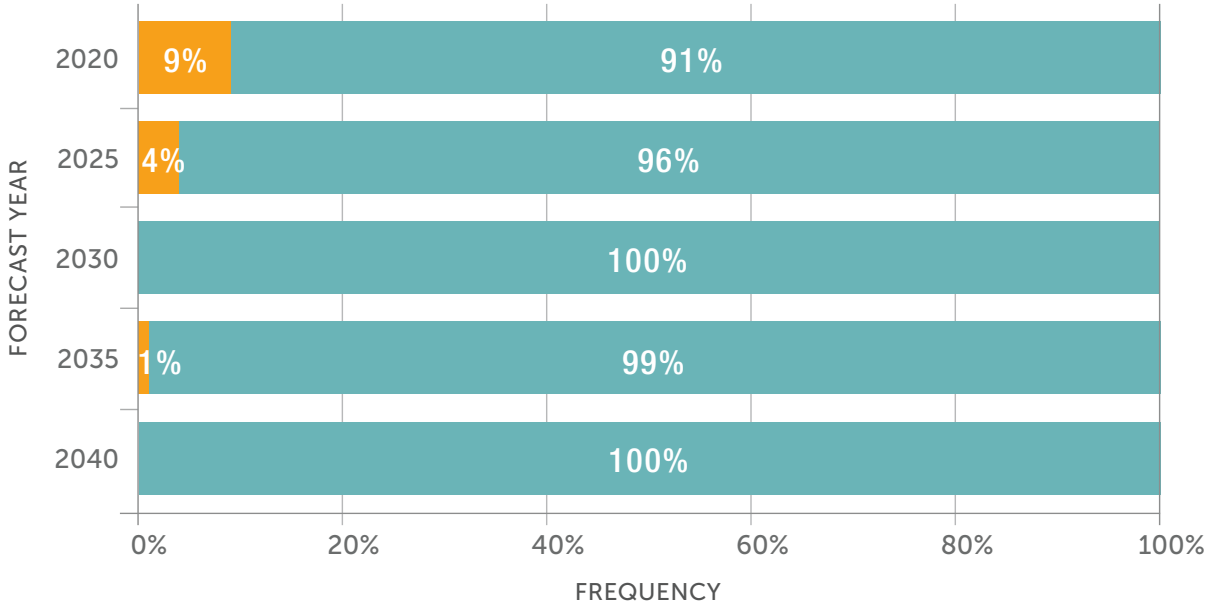
2020 Probability of Dry-Year Storage Ending Below 1 Million Acre-Feet Under the "IRP Approach" Case[1]



[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

FIGURE 4-3

Summary of Allocation Probabilities Under the "IRP Approach" Case[1]



[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

PURSUE A COMPREHENSIVE TRANSFERS AND EXCHANGES STRATEGY

A major outcome of the 2015 IRP Update reliability analysis was that there is significant potential near-term vulnerability to water supply reliability that cannot be addressed through development of the 2015 IRP Update targets. The primary reason for the near-term vulnerability is that actual storage levels in 2015 are low. The recent extended drought has required the use of most of Metropolitan's dry-year storage reserves. Without an increase in those actual storage reserves, Metropolitan remains vulnerable to continuing drought and water supply challenges.

In addition, investments in water supply projects and water conservation take time. New water supply projects, particularly large-scale projects, require planning, design, environmental review, permitting and construction. There is simply not enough time to bring sizable amounts of local projects or conservation on line to meet demands in the near-term. As a result, some vulnerability will carry forward until either a Delta solution is achieved, or additional conservation and local supplies are developed, or preferably both.

Water transfers and exchanges can play a major role in addressing near-term vulnerability. A comprehensive strategy to pursue transfers and exchanges can be used to hedge against these shorter-term imbalances until long-term solutions are in place. Water transfers and exchanges can be used to augment water supplies, offset storage withdrawals and add to storage reserves. This strategy places an emphasis on obtaining larger amounts of transfer and exchange supplies in wet and normal years.

Wetter Years: In wetter years, export capacity to convey North-of-the-Delta water transfer supplies becomes limited. Metropolitan, however, could actively pursue mutually beneficial water supply partnerships with other South-of-Delta water users. Metropolitan, through its significant storage assets, is uniquely positioned to generate yield in wetter years via unbalanced exchanges. Metropolitan will take steps to develop partnerships with other South-of-the-Delta water users who have not invested in storage programs to manage their wet year supplies.

Average Years: In average years, Metropolitan will actively pursue purchasing North-of-Delta water transfer supplies. During these conditions, export capacity will be available and prices and competition for North-of-Delta transfer supplies will be lower than in drier years.

Drier Years: In drier years, Metropolitan, will continue to attempt to purchase North-of-Delta water transfer supplies if service area demands cannot be fully met by available supplies and storage reserves. However, recent experience suggests prices will be very high and water transfer availability will be low.

The limited availability of dry-year transfers in 2014 and in 2015 is an important lesson learned for the 2015 IRP Update. The value of water transfers for water supply reliability in the 2015 IRP Update will come from procuring water transfers in normal and wet years and leveraging these water transfers with the regional storage portfolio to maximize their dry-year value. The regional storage portfolio is also a key in facilitating unbalanced water exchanges in the future. This type of water transfer agreement extends the use of Metropolitan's storage to manage other water user's surplus supplies in exchange for additional water deliveries.

A water transfers and exchanges program policy that authorizes implementation of a comprehensive strategy will aid the region in reducing the risk of shorter-term vulnerability and help close the gaps in water supply reliability.

ADDITIONAL SUPPLIES NEEDED TO ADDRESS RISKS AND UNCERTAINTIES

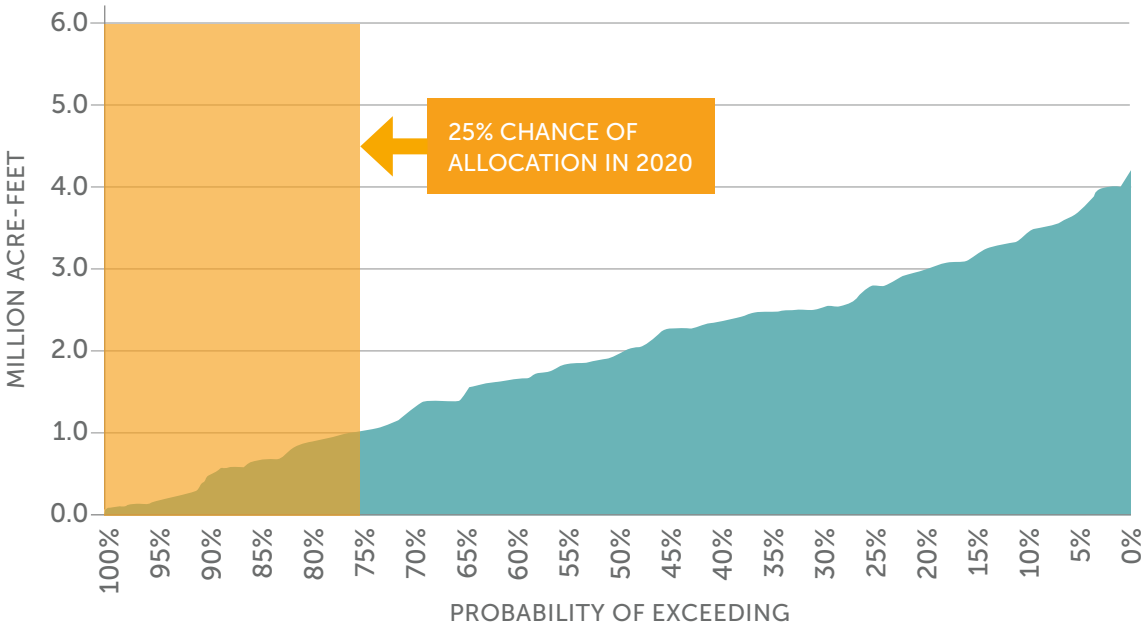
Based on forecasts of supplies and demands, successful implementation of the 2015 IRP Update targets provides for a robust water supply mix that will ensure a high degree of reliability. These targets specifically include

additional development to manage risk associated with regulatory and flow-based restrictions in the Delta. Through the process, it was identified that risk in local supply development also exists; the range of risk in local supplies could be up to 10 percent of the total local supplies in the region. The 2015 IRP Update targets a considerable amount of local supply development, a large portion of which comes from growth in existing and under construction local supply projects. Ensuring that these local supply projects are implemented and developed as planned is critical to achieving reliability under the 2015 IRP Update. The reasonable way to address this risk is to develop additional water conservation and local supplies to ensure a stable base of local supplies in the future. An additional supply goal of 200,000 acre-feet should be considered in developing implementation policies and approaches for conservation and local resource development.

To show the reliability benefits that these additional supplies can provide in the event of reductions in available water supplies, an additional water balance analysis was completed to evaluate the sensitivity of the "IRP Approach" case to local supply risks. IRPSIM was used to determine the reliability impacts of a 10 percent reduction in local supplies. Figure 4-4 shows the potential range of ending dry-year storage balances in 2020 with additional local supply risk applied to the "IRP Approach" case; the orange shaded area highlights when dry-year reserves are less than 1 million acre-feet. This analysis shows that the region would face a 25 percent (1 in 4) chance of water supply allocation in 2020. Figure 4-5 summarizes the probabilities of implementing Metropolitan's WSAP over time. The results of this analysis show that the probabilities of supply allocations increase significantly in the near-term, and decline only slightly in the longer-term as targeted development is brought online. This summary suggests that although the "IRP Approach" case performs well under planned conditions, it is highly vulnerable to a loss of local supply of this magnitude.

FIGURE 4-4

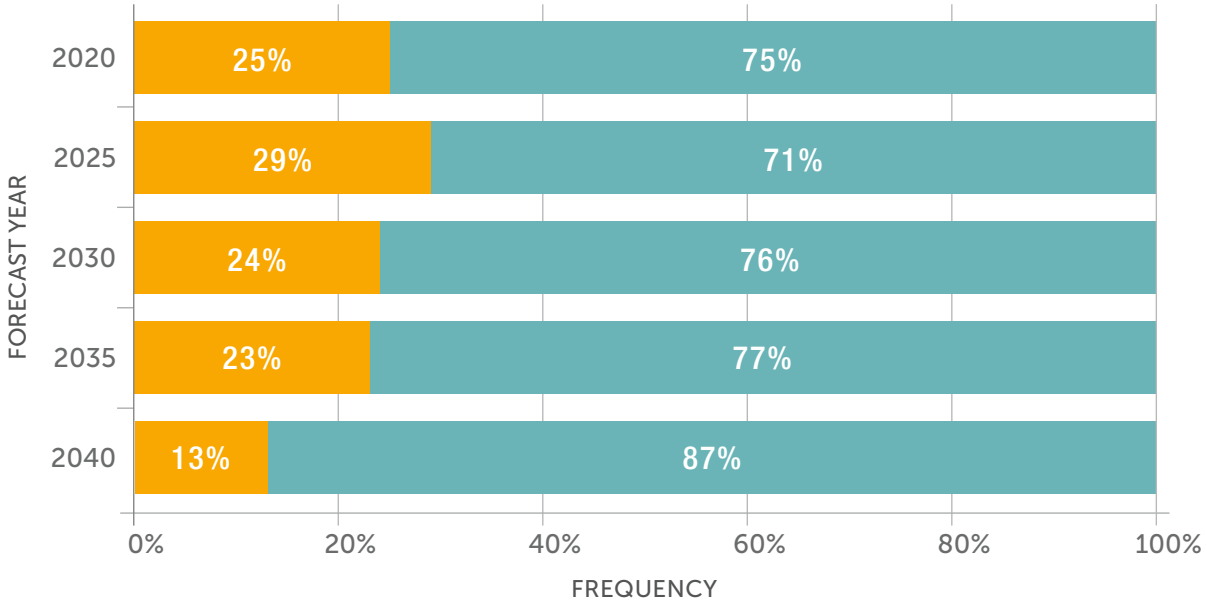
2020 Probability of Dry-Year Storage Ending Below 1 Million Acre-Feet Under the "IRP Approach" Case With Additional Local Supply Risk[1]



[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

FIGURE 4-5

Summary of Allocation Probabilities Under the "IRP Approach" Case With Additional Local Supply Risk[1]

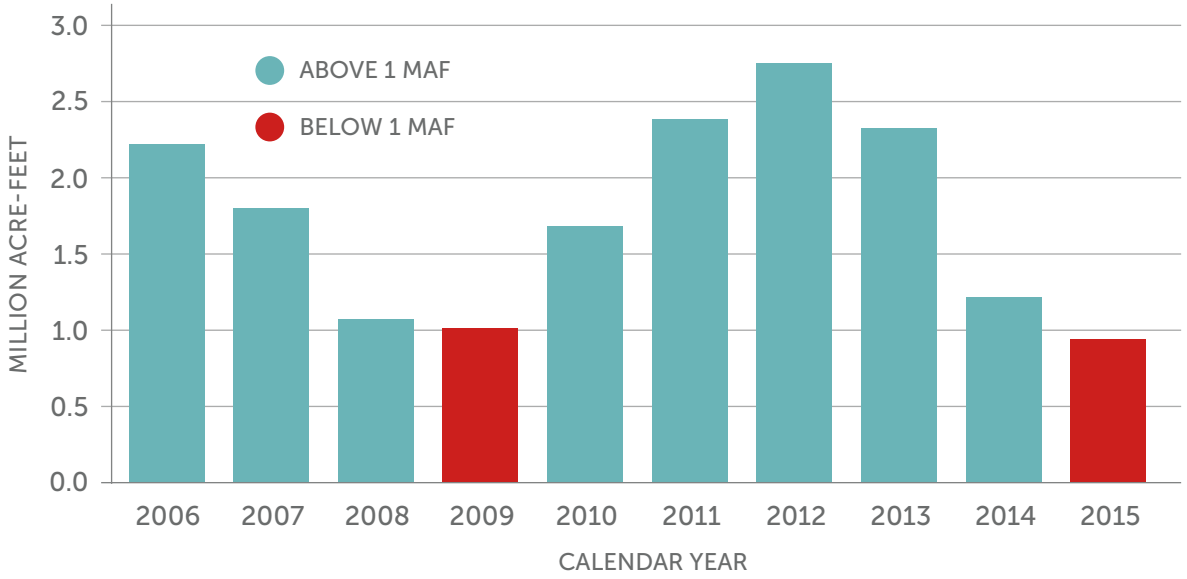


[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

In a second look at the reliability benefits of additional supplies, an analysis was completed looking at the actual conditions that the region faced from 2006 through 2015 and examining the impact of reduced local supplies. Over this 10 year period, the region faced two drought periods and a significant reduction in imported water supplies from the SWP due to pumping restrictions imposed to protect Delta smelt. Although Metropolitan was able to use its regional storage portfolio to manage the imbalances in supplies and demands, storage reserves fell below 1 million acre-feet in two years (2009 and 2015) which resulted in implementation of Metropolitan's WSAP. The continued threat of low regional storage reserves following the allocation in 2009 resulted in a third year of allocation in 2010. Figure 4-6 displays the actual dry-year storage balances from 2006 to 2015, storage balances ending below 1 million acre-feet are shown in red.

FIGURE 4-6

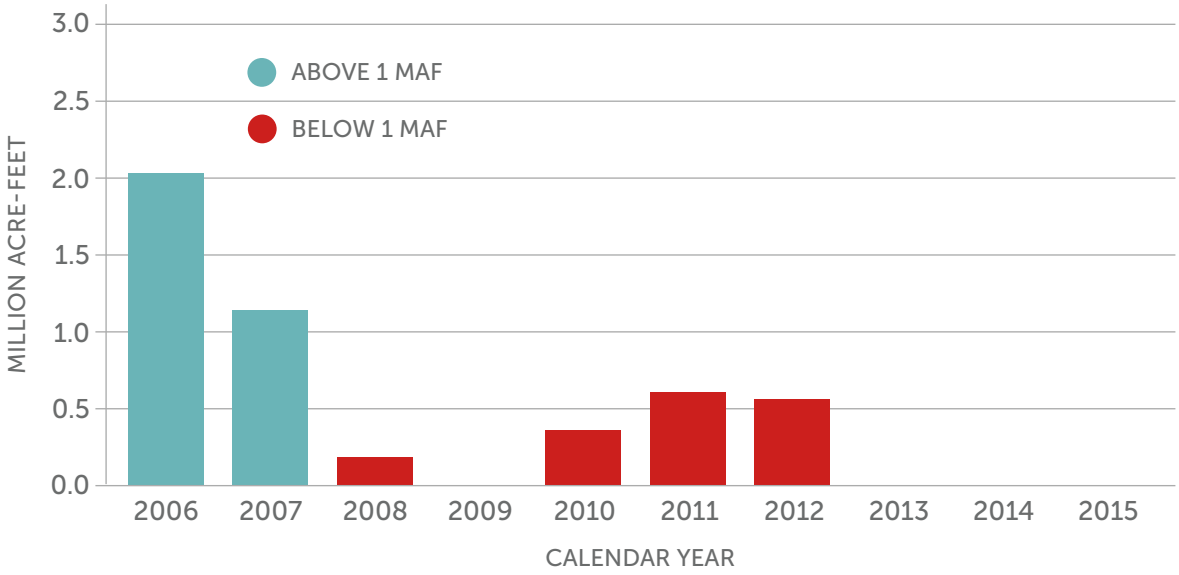
Dry-Year Storage Reserves (2006-2015)



To analyze the impacts of reduced local supplies, actual local supplies that were available from 2006 through 2015 were reduced by 10 percent. The reduction in supplies placed additional stress on the regional storage portfolio both by increasing withdrawals from regional storage and by decreasing available supplies to store. As a result, regional storage levels in this analysis fell below 1 million acre-feet in eight out of the ten years. Only two years in that period would not have had the threat of supply allocations. Figure 4-7 shows the resulting storage balances with a 10 percent reduction in local supplies.

FIGURE 4-7

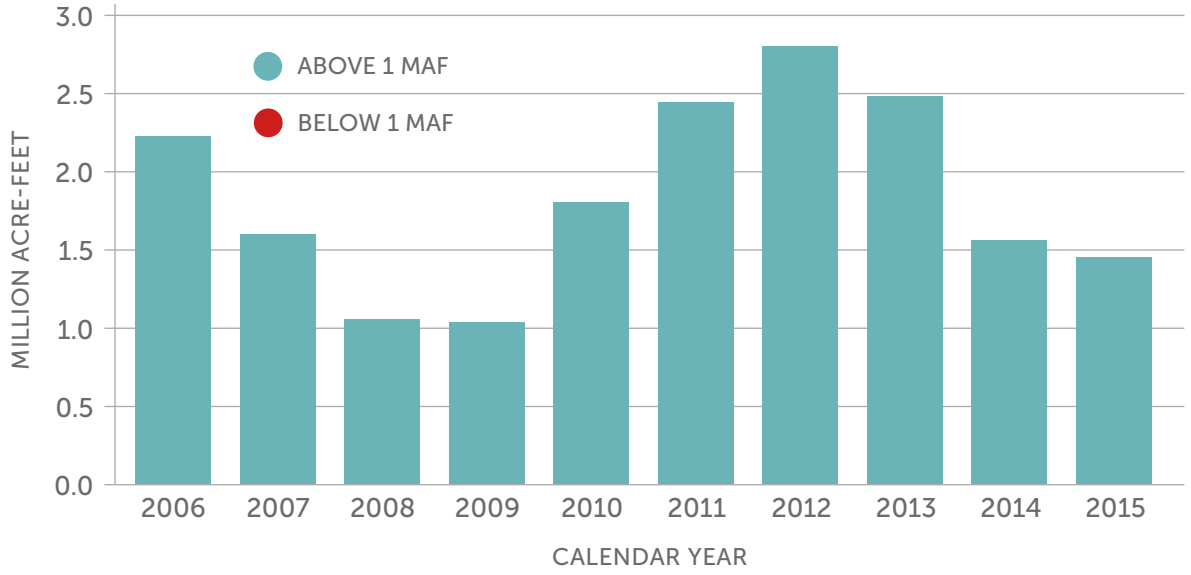
Dry-Year Storage Reserves With Additional Local Supply Risk (2006-2015)



To look at the potential benefits of developing additional supplies to guard against the risk of reduced local supplies, 200,000 acre-feet was added to the supplies available in 2006 through 2015. In this case, even with actual local supplies being reduced by 10 percent, the additional supplies improved storage reserves and allowed for effectively managing drought and reduced imported supplies. The additional supplies also improved the overall balance between water supplies and demands in each year. In this analysis, regional storage levels never fell below 1 million acre-feet. Having an additional 200,000 acre-feet available would have fully mitigated the risk from reduced supplies and allowed for managing through the 10 year period without a need for a supply allocation in any of the years. Figure 4-8 shows the ending dry-year storage balances with reduced local supplies and 200,000 acre-feet of additional development.

FIGURE 4-8

Dry-Year Storage Reserves With Additional Local Supply Risk and 200,000 Acre-Feet of Additional Supply Development (2006-2015)



Designing a comprehensive strategy to ensure the stability of imported water supplies and the development and maintenance of local supplies is critical to addressing future risks and uncertainty. This is particularly true because of the limited opportunities for increasing imported supplies in the future. However, new local supply projects, particularly large scale projects, generally require long lead-times due to the need for extensive planning, design, environmental review, permitting and construction. This highlights a challenge to the region's ability to quickly address risks and adapt to changing circumstances.

Preparing for Uncertainty: Future Supply Actions

Part of adapting to changing conditions includes preparing for an uncertain future that may bring beyond what can be reasonably estimated today. At the same time, it is important to balance the risk of potential water shortages against the risk of potential over-building. The 2010 IRP Update established a planning framework that included Foundational Actions, which are low cost, low risk preparatory actions intended to accelerate additional development as needed. This 2015 IRP Update continues to integrate these actions, now described as Future Supply Actions, in its adaptive management strategy to help prepare the region for long-term changes to the climate, demographics the economy, water quality and regulations.

Future Supply Actions aim to improve the viability of potential contingency resources and position the region to effectively implement these resources in a timely manner should they be needed. These resources include recycled water, seawater desalination, stormwater capture and groundwater cleanup.

GENERAL CATEGORIES OF FUTURE SUPPLY ACTIONS

Metropolitan has identified categories of actions that could reduce the time needed to develop future contingency resources. These categories are public outreach, legislation/regulations, technical studies/support and land/resource acquisition.

Public Outreach: The public's acceptance of developing additional in-region supplies and further advancing conservation is critical to successful progress. Messaging and sharing of information has successfully heightened water awareness in the region. However, continued public education on the various supplies, development and application is essential.

Legislation/Regulation: Legislative support can be helpful to create funding, streamline regulatory processes and increase and preserve opportunities to develop new resources. To enable cost-effective and timely project implementation, it is important to work through regulatory hurdles in collaboration with regulatory agencies.

Technical Studies/Support: Technical studies provide critical information needed for effective planning, and are essential to reducing barriers to future water resource development. Technical studies help advance new technology and water supply options, and the results help address regulatory, utility and community concerns.

As new challenges arise and the need for additional resources becomes more probable, performing baseline project studies (e.g., water quality studies and demonstration projects) can provide the data needed for project permitting and design, and will help set the stage for quicker implementation of specific water supply projects.

Land/Resource Acquisition: Reserving property may be a key to preserving the opportunity for certain project developments. Coastal lands purchased can be set aside for potential seawater desalination projects. Lands purchased in heavily populated urban areas can be reserved for compact treatment facilities. Depending on the location of the land purchased, potential infrastructure would require crossing multiple political, watershed and groundwater basin boundaries. Future storage sites can likewise be preserved from potential development. Purchasing land prior to project implementation provides an opportunity for earlier coordination with the necessary parties. Similarly, acquisition of water rights or other resources can preserve options for the future.

RECENT EXAMPLES OF FUTURE SUPPLY ACTIONS

Since the 2010 IRP Update, Metropolitan and its member agencies executed various Future Supply Actions to advance options for future resources. They continue to carry out public outreach and legislative/regulatory efforts, and perform various technical studies. These include an assessment of various seawater desalination integration practices, a study on regional groundwater replenishment with recycled water and a water quality study on seawater desalination integration.

Metropolitan's Board of Directors has approved a joint study with the Sanitation Districts of Los Angeles County on the feasibility of a regional recycled water project to purify and reuse wastewater for the recharge of groundwater basins and to augment water supplies within the Southern California region. The study includes a demonstration plant to verify treatment design parameters for a full-scale project, a feasibility study to determine the parameters of the delivery

system and a comprehensive finance plan. At full build-out, this project could provide 150 million gallons per day or more of purified water for the region.

THE FOUNDATIONAL ACTIONS FUNDING PROGRAM

In April 2013, Metropolitan's Board of Directors approved a two-year pilot Foundational Actions Funding (FAF) Program with its member agencies for technical studies and pilot projects that reduce barriers to future production of recycled water, stormwater capture, seawater desalination and groundwater cleanup. As one component of the 2010 IRP Update Foundational Actions strategy, the FAF Program aims to reduce barriers to project implementation, and:

- Advance the field of knowledge for future water resource production
- Provide results that are unique yet transferable to other areas in the region
- Represent a catalytic/critical path to water resource implementation

In May 2013, Metropolitan issued a Request for Proposals (RFP) to member agencies under the FAF Program. In early 2014, Metropolitan executed agreements for 13 projects, totaling approximately $3 million in funding. These projects are evaluating new water treatment technologies, developing data to inform regulations, studying options for infrastructural innovation and identifying future resource potential. Through successful completion of the projects, Metropolitan expects to reduce barriers and enhance regional understanding of the challenges and technical requirements necessary to develop future water supplies.

More information on Metropolitan's FAF Program can be found at: mwdh2o.com.

CONTINUING TO ADAPT WITH FUTURE SUPPLY ACTIONS

The 2015 IRP Update calls for the region to continue to perform Future Supply Actions to prepare for long-term changes that the future may bring by:

- Increasing public awareness and acceptance of resource implementation
- Advocating and informing legislation and regulatory efforts to increase use and acceptance of water resources
- Developing the technical groundwork to enable effective resource planning and implementation
- Reserving land, infrastructure, and resources for potential project development

Specific Future Supply Actions may be discussed following the 2015 IRP Update process. These discussions would include topics identified through the IRP Member Agency Technical Workgroup, such as a potential second round for Metropolitan's FAF Program and potential land and resource acquisition needs.

Overall, regional collaboration on these actions will improve the viability of potential contingency resources and prepare the region for timely implementation as the need arises.

5.

Information for Future Discussions:

Costs and Uncertainties

The 2015 IRP Update sets out a plan of reliability targets and Future Supply Actions to collectively balance supplies and demands under foreseeable conditions and risks, and prepare the region to adapt to an uncertain future. Following adoption of the 2015 IRP Update, an in-depth policy review process will be conducted to develop a comprehensive strategy for implementing the plan. In examining implementation approaches, factors to consider include resource development costs and implementation timing based on monitoring uncertainties and vulnerabilities.

A Glance at Future Resource Development Costs

Relative cost-effectiveness will be one of many key factors in evaluating future resource development options, particularly in the area of local supplies and conservation. Figure 5-1 provides a general picture of unit costs ($/acre-foot) of the following potential future water resource development:

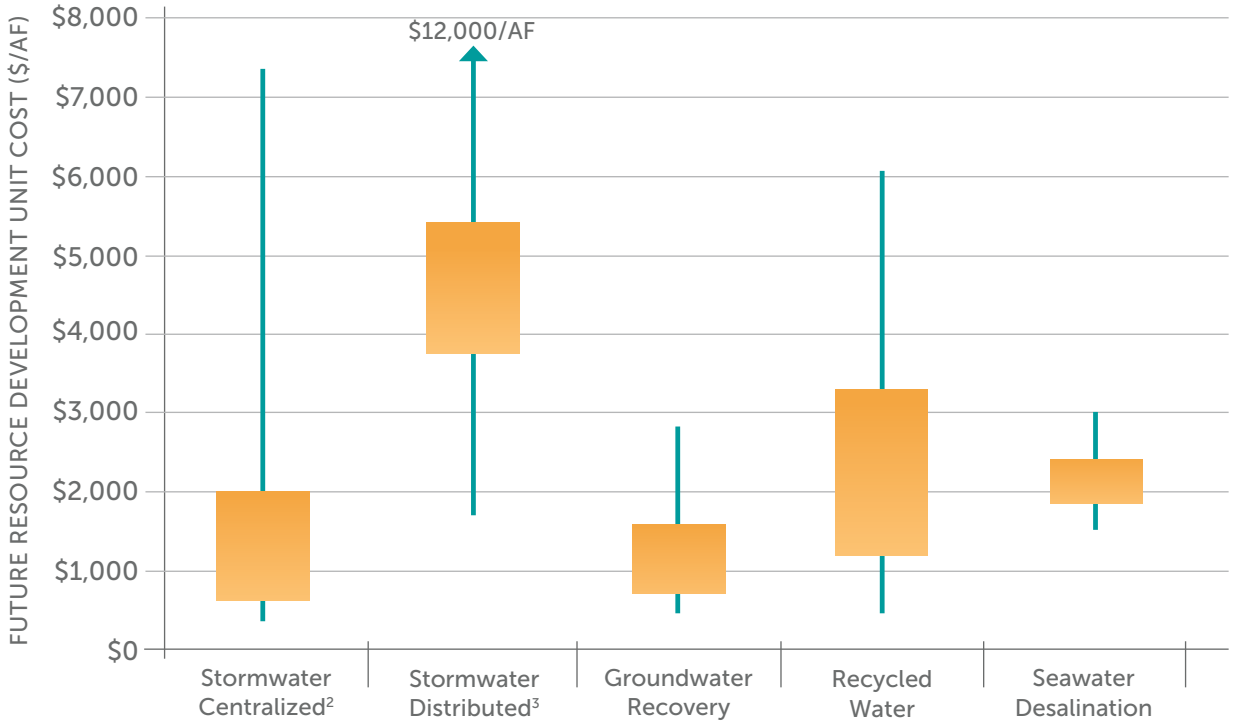
- Stormwater centralized capture and recharge
- Stormwater distributed capture and recharge
- Groundwater recovery
- Recycled water
- Seawater desalination

The vertical lines in the graph represent the low and high unit costs per resource, and the boxed area represents the 25th and 75th percentile values. Data on the in-region resources was compiled in coordination with Metropolitan member agencies, and is based on identified future projects through the 2015 IRP Update project inventory list, stormwater database (developed through the Southern California Water Committee Stormwater Task Force) and project reports. Unit cost estimates include capital and operations and maintenance costs associated with treatment and distribution of the potential water supply. Additional information on the assumptions and methodology is included in Appendix 12.

The 2015 IRP Update sets out a plan of reliability targets and Future Supply Actions to collectively balance supplies and demands under foreseeable conditions and risks, and prepare the region to adapt to an uncertain future.

FIGURE 5-1

Summary of Future Resource Development Unit Costs[1]



[1]In 2015 dollars.

[2]Stormwater Centralized: large-scale recharge projects that collect stormwater runoff from multiple parcels.

[3]Stormwater Distributed: smaller-scale projects and not centralized.

Monitoring Uncertainty and Identifying Vulnerability

Prudent resource development recognizes another type of risk: investing too much too early, and overbuilding supplies that may not be needed, or that become stranded by shifts in development. On the other hand, waiting too long to take action can expose the region to the risk of water shortages and the need and expense to fast-track additional resource development.

Some risk and uncertainty will be addressed by following the findings of the 2015 IRP Update. The larger base of new local resources and conservation development guards against risks of decreased existing supplies. The new local supplies and conservation also provide a ready replacement for lost supplies.

But there are other risks that may take longer to manifest, like climate change or shifts in demographic growth patterns that increase or move the demands for water. Metropolitan has established an intensive, comprehensive technical process to identify key vulnerabilities. This Robust Decision Making (RDM) approach was used with the 2010 IRP Update resource plan. The RDM approach can show how vulnerable the region's reliability is to longer-term risks and can also establish "signposts" that can be monitored to see when critical changes may be happening. Signposts include monitoring the direction of ever-changing impacts from improved Global Climate Models, and housing and population growth patterns. The RDM approach will be revisited with the new resource reliability targets identified in the 2015 IRP Update.

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6.

Findings and Conclusions

Metropolitan's tradition of providing reliable supplies to a growing, dynamic region will be put to the test with the challenges that undoubtedly lie ahead. Yet Metropolitan's ability to make key investments at the right time, and to adapt to ever-changing circumstances, provide confidence that a reliable water portfolio will continue to be maintained as events unfold.

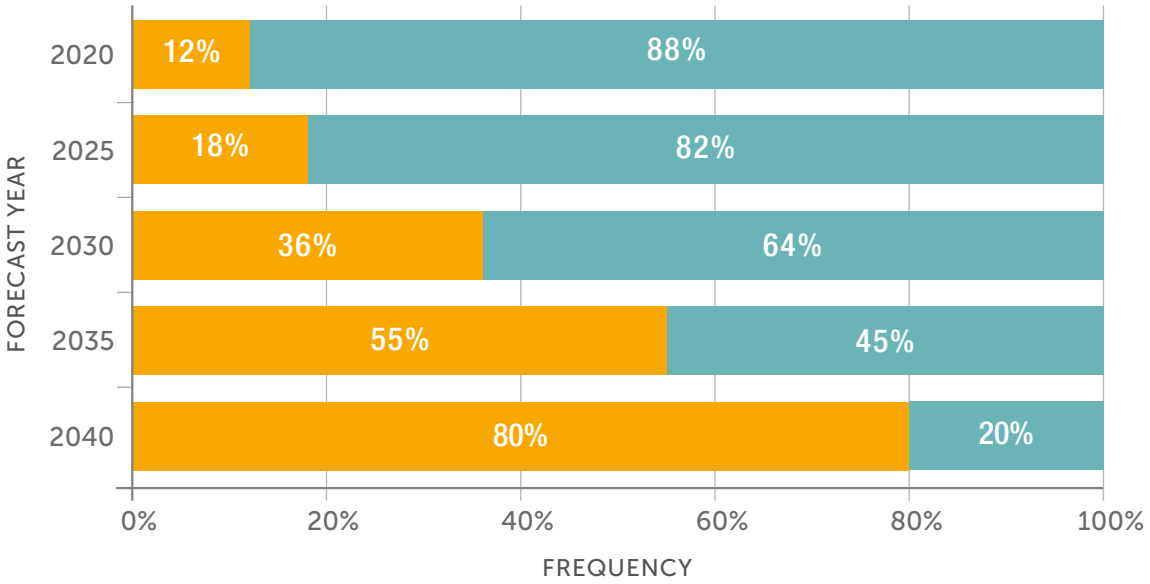
Several findings and conclusions have emerged as particularly important in this 2015 IRP Update process.

Action is Needed

Without the investments in conservation, local supplies and the California WaterFix targeted in the 2015 IRP Update, shortages and implementation of Metropolitan's WSAP would likely occur in an unacceptable level of frequency in the years ahead. Modeling results show that under a "Do Nothing" case, the probability of supply allocation increases dramatically over time, reaching an 80 percent likelihood in 2040. Doing nothing is not an option.

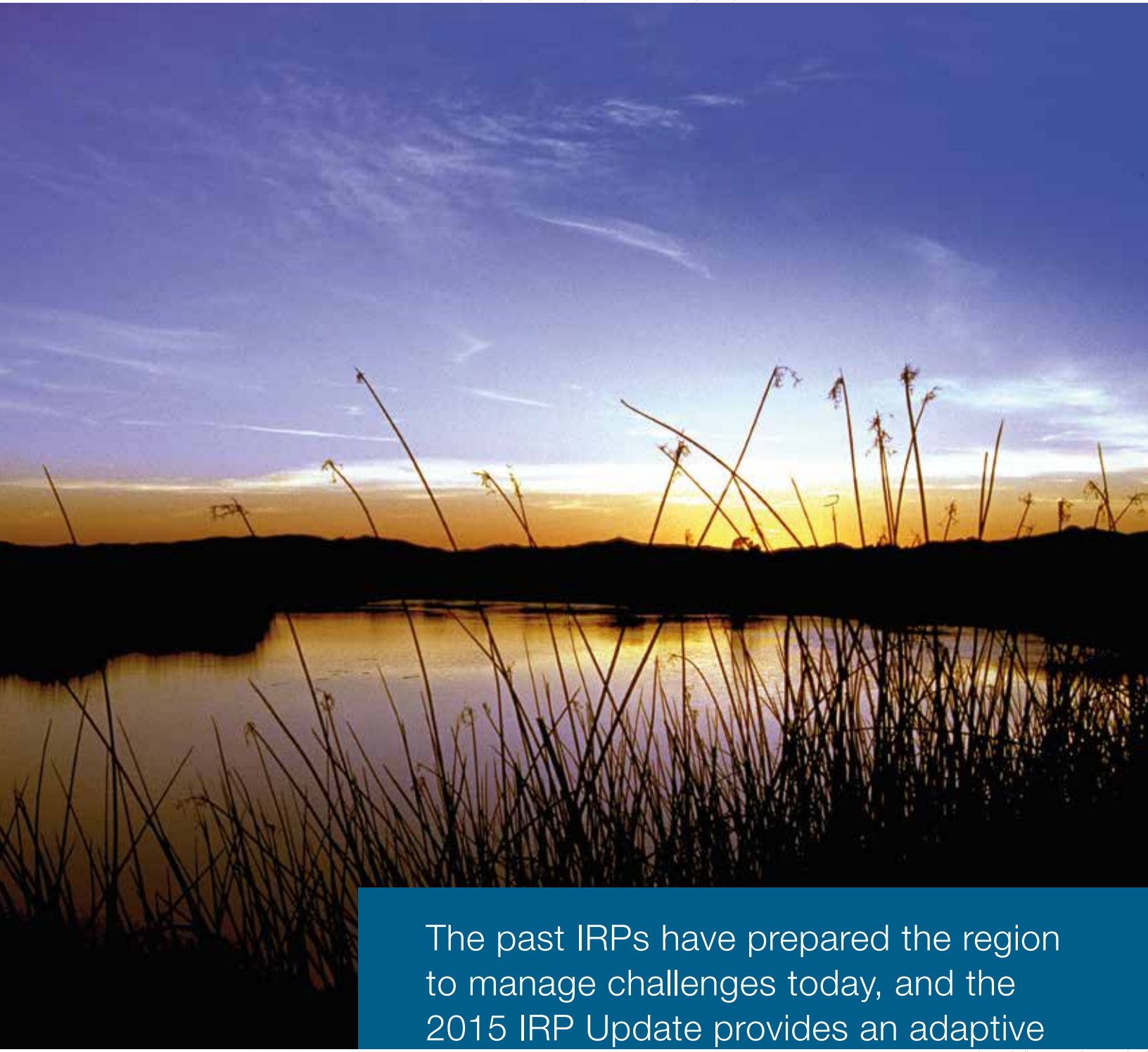
FIGURE 6-1

Summary of Allocation Probabilities Under the "Do Nothing" Case[1]



[1]IRPSIM results represent 91 modeled outcomes based on weather/climate and hydrology from 1922-2012. This is intended to be an indicator of reliability.

Photo by Paul Hames, Courtesy of the CA Department of Water Resources



The past IRPs have prepared the region to manage challenges today, and the 2015 IRP Update provides an adaptive strategy for overcoming the challenges of tomorrow.

MAINTAIN COLORADO RIVER SUPPLIES

The plan to stabilize deliveries at 900,000 acre-feet in a typical year will require more than 900,000 acre-feet of planned actions. A portion of the base allocation is at risk from some senior water right-holders using more than their historic use. Some programs and partnerships may not deliver initial estimates. A robust set of actions and partnerships on the river will be necessary to meet both average-year projections as well as plans for a full aqueduct in dry years. Shortage is undeniably a larger risk compared to the 2010 IRP Update. The potential for shortage speaks to the need for a portfolio approach to stabilizing this vital imported supply.

STABILIZE STATE WATER PROJECT SUPPLIES

Since the 1990s, deteriorating environmental conditions have steadily decreased the availability and reliability of supplies. While water supply restrictions have not resulted in stabilizing the population of a single threatened fish species, incrementally greater restrictions are likely with incrementally worsening conditions – unless decisive actions are taken. State and federal agencies are advancing such actions through the tandem California WaterFix and EcoRestore efforts. Yet even if final plans are reached and Metropolitan joins other public water agencies to invest in system modernization, California must rely on the existing water delivery system until an improved one is built. Until then, earthquakes and floods will represent additional risk for the SWP. Long-term yields likely will not be precisely identified until numerous regulatory processes are completed. The value of a collaborative approach with state and federal agencies to resolve questions about proper SWP operations cannot be understated. The roles of better science and inter-agency collaboration will shape the future Delta and profoundly determine whether the coequal goals of Delta restoration and statewide water supply reliability are advanced.

DEVELOP AND PROTECT LOCAL SUPPLIES AND WATER CONSERVATION

The 2010 IRP Update was the first to explicitly state how new demands from population growth in Southern California will be met by increasing in-region supplies and lowering per-capita regional demands. The 2015 IRP Update embraces and advances this regional self-sufficiency ethic by increasing the targets for additional local supplies and conservation. Any historic local supply cannot be taken for granted as reliably maintaining historic production levels. Groundwater basin managers collectively are estimating decreased yields due to a reliance on these basins during the current drought

ACHIEVE ADDITIONAL CONSERVATION SAVINGS

Pursue further water conservation savings of 485,000 acre-feet annually by 2040 through increased emphasis on outdoor water-use efficiency using incentives, outreach/education and other programs.

DEVELOP ADDITIONAL LOCAL WATER SUPPLIES

Develop 230,000 acre-feet of additional local supplies produced by existing and future projects. The region would reach a target of 2.4 million acre-feet by 2040, a key to providing water supply reliability into the future.

MAINTAIN COLORADO RIVER AQUEDUCT SUPPLIES

Develop programs to ensure that a minimum of 900,000 acre-feet is available when needed, with access to 1.2 million acre-feet in dry years.

cycle. More frequent droughts would reduce projected yields of the Owens River system for LADWP. Actual local supply production could be lower in the future than what is assumed in the 2015 IRP Update. Yet the region is fortunate to have a robust portfolio of potential local supply opportunities. Increasing the target for local supply and water conservation development sends a powerful signal that work to maintain a reliable system is never done. As for water conservation, the region showed its remarkable potential for ratcheting down demand by exceeding Metropolitan's WSAP reduction targets during the 2015 drought. Making these conservation gains permanent, particularly outdoors, will require a continued conversion of residential and business landscapes, stronger conservation ordinances and perhaps additional incentives as well.

MAXIMIZE THE EFFECTIVENESS OF STORAGE AND TRANSFERS

Rebuilding Metropolitan's supply of water reserves is an imperative when the drought is finally over. So is carefully managing the remaining reserves in the meantime. Metropolitan's vast network of groundwater banks and reservoirs is only as impressive as Metropolitan's ability to replenish it. The role of the water market, and transfers, is undergoing much rethinking statewide, and Metropolitan is no exception. The water transfer market in the current drought period has proven to be both small and expensive. The dry-year water transfer market likely cannot be relied upon to provide a dry-year solution for future droughts. However, water transfers in average and above-average hydrologic years may prove to be both plentiful and affordable. Thanks to Metropolitan's investments in storage and distribution system conveyance (for example, the Inland Feeder system that fills Diamond Valley Lake), Metropolitan has the infrastructure capability for purchasing, moving and storing water in years that are not severely dry. A comprehensive water transfer approach that takes advantage of water when it is available will help to stabilize and build storage reserves; increasing the ability for Metropolitan to meet demands in dry years. Water transfers can also augment core water supplies in the near term to strengthen water supply reliability while longer term projects are being constructed. While Metropolitan has the capability to move and store this water once it is conveyed through the Delta, the statewide delivery system remains constricted because of the ongoing problems in the Delta. The future water market is inextricably tied to the future of the Delta.

STABILIZE STATE WATER PROJECT SUPPLIES

Manage SWP supplies in compliance with regulatory restrictions in the near-term for an average of 980,000 acre-feet of SWP supplies. Pursue a successful outcome in the California WaterFix and California EcoRestore efforts for long-term average supplies of about 1.2 million acre-feet.

MAXIMIZE THE EFFECTIVENESS OF STORAGE AND TRANSFER

Develop a comprehensive strategy to pursue transfers and exchanges to hedge against shorter-term water demands and supplies imbalances until long-term solutions are in place.

Continue With the Adaptive Management Approach

Although we cannot know for certain what is in store in the future, Metropolitan has an adaptable plan that increases future reliability. Reliability targets are only as good as the assumptions and information at the time they are developed. Identifying and implementing additional resources that expand the ability to meet future changes and challenges helps to manage the risk associated with those changes and challenges. But just as important as the reliability targets, is clearing the way to adapt based on changing circumstances. By updating the IRP, the region is able to incorporate changed conditions into its plans. Also, by advancing a new generation of local supplies through the 2015 IRP Update's Future Supply Actions, Metropolitan can continue to set a solid foundation of alternatives that can be implemented in the face of change. This change may be greater or lesser than what we may anticipate. But it is a certainty. Simply put, no matter what the adversity that the region may face, the 2015 IRP Update is a response and a way to adapt.

THE 2015 IRP UPDATE TARGETS

In order to meet the goal of providing water supply reliability, there are significant reliability targets identified, as summarized in Table 6-1. Table 6-1 begins with retail demands before conservation; this is the estimated amount of water the region would need on average if no investments in conservation were made. The following line shows the total conservation savings targeted under the 2015 IRP Update. Total targeted conservation savings are projected to increase by 485,000 acre-feet from 2016 to 2040; this increase goes a long way towards reducing retail demands, as well as offsetting future growth in demands. Retail demands after conservation are projected to increase by 429,000 acre-feet over the forecast period, compared to an increase of 914,000 acre-feet without conservation. The bottom half of Table 6-1 shows the total amount of imported and local supplies targeted under the 2015 IRP Update. The total supply reliability target increases by 238,000 acre-feet from 2016 to 2040, with 227,000 acre-feet coming from local supplies, and the remainder from imported supplies. Although the combined CRA and SWP supply targets seem relatively fixed, there is significant effort needed to stabilize and preserve these supplies. For example, when looking at the net change from 2016 to 2040 SWP deliveries only increase by 11,000 acre-feet. This hides the projected declines in SWP supplies projected to begin in 2020. The projected increase in SWP supplies from 2020 to 2040 is actually 229,000 acre-feet. Overall, the total conservation target and the total supply reliability target result in a combined 723,000 acre-foot increase by 2040. This number would be closer to 940,000 acre-feet if the 229,000 acre-feet of net change in SWP supplies were considered. To achieve these levels of development and overall reliability, it is critical to maintain CRA supplies, stabilize SWP supplies and engage in policy discussions that result in a strategy for the development and maintenance of local supplies and conservation.

TABLE 6-1

2015 IRP Update Total Level of Average-Year Supply Reliability Targets (Acre-Feet)

	2016	2020	2025	2030	2035	2040
Retail Demands before Conservation	4,878,000	5,219,000	5,393,000	5,533,000	5,663,000	5,792,000
Total Conservation Target	1,034,000	1,096,000	1,197,000	1,310,000	1,403,000	1,519,000
Retail Demands after Conservation	3,844,000	4,123,000	4,196,000	4,223,000	4,260,000	4,273,000
Minimum CRA Diversion Target	900,000	900,000	900,000	900,000	900,000	900,000
Average Year SWP Target	1,202,000	984,000	984,000	1,213,000	1,213,000	1,213,000
Total Local Supply Target	2,199,000	2,307,000	2,356,000	2,386,000	2,408,000	2,426,000
Total Supply Reliability Target	4,301,000	4,191,000	4,240,000	4,499,000	4,521,000	4,539,000

ADDITIONAL SUPPLIES TO ADDRESS RISKS AND UNCERTAINTIES

The 2015 IRP Update reliability targets are based on a wide range of potential future conditions. Beyond that range, the 2015 IRP Update process identified additional foreseeable challenges and risk scenarios. To address these risks, an additional 200,000 acre-feet of water conservation and local supplies would be needed. This additional supply goal should be considered when examining implementation polices and approaches.

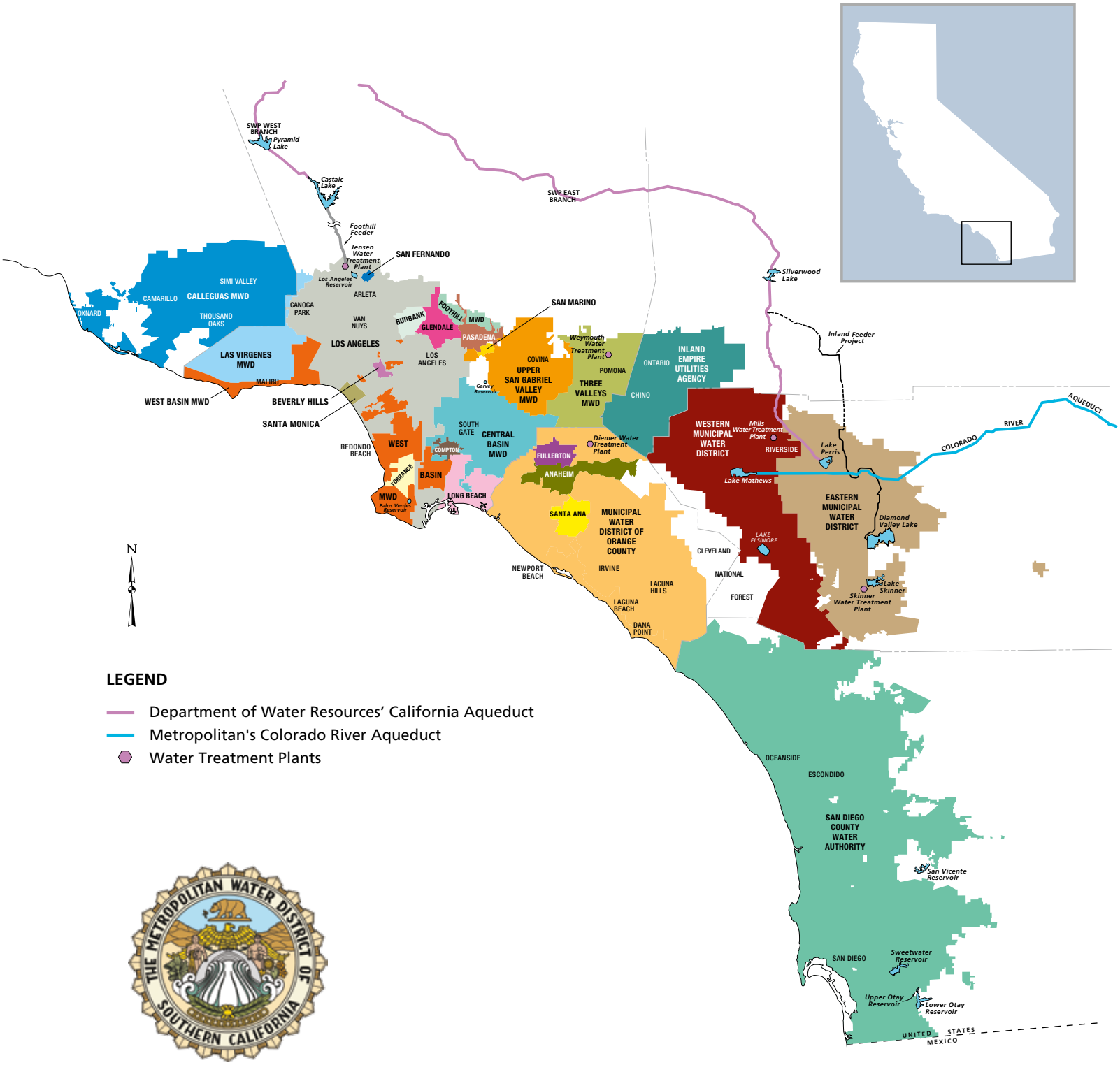
Summary

Southern California finds itself at a moment in its water history unlike any other, given the unprecedented drought conditions and the barrage of challenges facing existing supplies. The past IRPs have prepared the region to manage these challenges today, and the 2015 IRP Update provides an adaptive strategy for overcoming the challenges of tomorrow. This strategy for continued water supply reliability includes a diversified portfolio of actions that calls for stabilizing and maintaining imported supplies; meeting future growth through increased water conservation and the development of new – and protection of existing – local supplies; pursuing a comprehensive transfers and exchanges strategy; building storage in wet and normal years to manage risks and drought; and preparing for uncertainty with Future Supply Actions.

Southern California has grown by 5 million people over the past generation with the same supply of imported water. Through the vision advanced in the 2015 IRP Update, Southern California can repeat this achievement in the coming generation.

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Agency Map



LEGEND

- Department of Water Resources' California Aqueduct
- Metropolitan's Colorado River Aqueduct
- Water Treatment Plants

MEMBER AGENCIES

MEMBER CITIES

City of Anaheim

City of Beverly Hills

City of Burbank

City of Compton

City of Fullerton

City of Glendale

City of Long Beach

City of Los Angeles

City of Pasadena

City of San Fernando

City of San Marino

City of Santa Ana

City of Santa Monica

City of Torrance

MEMBER WATER AGENCIES

Calleguas Municipal Water District

Central Basin Municipal Water District

Eastern Municipal Water District

Foothill Municipal Water District

Inland Empire Utilities Agency

Las Virgenes Municipal Water District

Municipal Water District of Orange County

San Diego County Water Authority

Three Valleys Municipal Water District

Upper San Gabriel Valley Municipal Water District

West Basin Municipal Water District

Western Municipal Water District of Riverside County

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Pictured on page XII: F.E. Weymouth Water Treatment Plant, La Verne, CA (MWD Image Collection)

Pictured on page 1.1: Whitsett Intake Pumping Plant on the Colorado River, Circa 1938 (MWD Image Collection)

Pictured on page 1.3: Diamond Valley Lake, Hemet, CA (MWD Image Collection)

Pictured on page 1.7: Drought Tolerant Garden, Long Beach, CA (MWD Image Collection)

Pictured on page 1.10: Solar panels at Robert A. Skinner Water Treatment Plant, Riverside County, CA (MWD Image Collection)

Pictured on page 2.1: Metropolitan's Union Station Headquarters Boardroom, Los Angeles, CA (MWD Image Collection)

Pictured on page 3.1: Drought Tolerant Garden, Long Beach, CA (MWD Image Collection)

Pictured on page 3.3: Drought Tolerant Plant (MWD Image Collection)

Pictured on page 3.7: "Take Your Turn" water conservation signage at Randy's Donuts, Inglewood, CA (Sal Vazquez)

Pictured on page 3.8: Recycled water project at Eastern Municipal Water District, Riverside County, CA (MWD Image Collection)

Pictured on page 3.11: Sandhill Crane, Acampo, CA, courtesy of the CA Department of Water Resources (Florence Low)

Pictured on page 3.13: Whitsett Intake Pumping Plant on the Colorado River (MWD Image Collection)

Pictured on page 4.1: Orange County Sanitation District Wastewater Treatment, Orange County, CA (MWD Image Collection)

Pictured on page 5.1: Metropolitan's Union Station Headquarters, Los Angeles, CA (Matthew Hacker)

Pictured on page 6.1: Suisun Marsh, Suisun City, CA, courtesy of the CA Department of Water Resources (Paul Hames)

WATER TOMORROW

Integrated Water Resources Plan

To view an online version of this report, the Executive Summary, and the Technical Apendices visit www.mwdh2o.com

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

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