City of Glendale Water & Power

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2010

City of Glendale *Water & Power* Urban Water Management Plan

Volume III
MWD Attachments

LIST OF ATTACHMENTS (Volume III)

A. MWD INTEGRATED RESOURCES PLAN (IRP)

B. MWD WATER SURPLUS AND DROUGHT MANAGEMENT (WSDM) PLAN

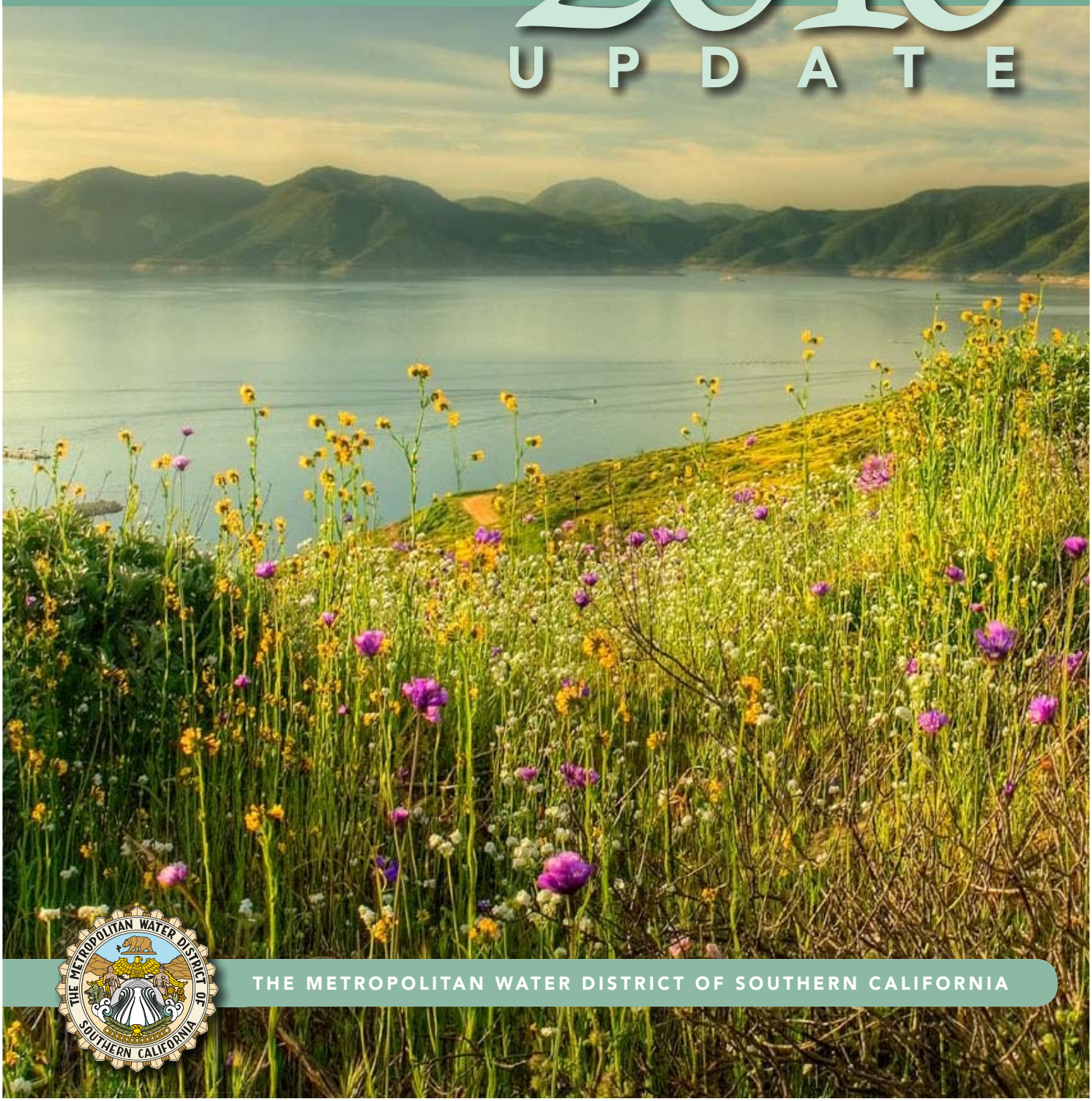
ATTACHMENT A

METROPOLITAN WATER DISTRICT'S INTEGRATED RESOURCES PLAN (IRP)

INTEGRATED WATER RESOURCES PLAN

Report No. 1373

2010 UPDATE



THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

INTEGRATED WATER RESOURCES PLAN

2010 Update

Prepared by:

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

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Report No. 1373
October 2010

FOREWORD

Planning for a reliable, high quality and affordable water supply has never been such a moving target. Water resources in Southern California are challenged by nature and law and unforeseen circumstances. Emerging challenges include climate change, new environmental regulations and economic unknowns. Embracing the reality of change requires an adaptive strategy that allows water managers to plan for today and the future.

As the wholesale provider of water supplies for a six-county service area consisting of 19 million people, the Metropolitan Water District of Southern California plans for the future through a blueprint known as the Integrated Resources Plan (IRP). The original IRP in 1996 came in the wake of a dry cycle that created the first shortage conditions in Metropolitan history. The 1996 IRP emphasized the construction and creation of a network of water storage facilities, both below and above ground, while investing in a mix of local and imported supply options. An update in 2004 further emphasized conservation and local resource development options and targets through 2025 and included the addition of a 10 percent "planning buffer." This buffer underlined the necessity for a back-up plan to deal with scenarios that eluded worst-case modeling.

However, neither version of the previous IRPs anticipated today's dramatic changes. The Colorado River has experienced below-average precipitation conditions for most of the past decade. And the State Water Project has faced historic regulatory cutbacks significantly reducing its supplies that pass through the Sacramento-San Joaquin Delta in Northern California.

The 2010 IRP manages these challenges. It has three components that begin with baseline efforts – or, the core resource strategy – designed to maintain reliable water supplies. The second component – the uncertainty buffer – activates a suite of buffer actions which help to mitigate short-term changes. If changed conditions turn dramatic and persistent, there is a final component – foundational actions – which detail strategies for securing additional water resources. All three plan components are explained in greater detail in this report.

Like the preparation of previous IRPs, the crafting of the 2010 IRP was a collaborative effort. Metropolitan sought input from its 26 public member agencies, retail water agencies, the public and other stakeholders including water and wastewater managers, environmental interests, and the business community. Metropolitan's board of directors was involved in the 2010 IRP preparation through creation of an IRP board Steering Committee, which met on a regular basis to be briefed by Metropolitan staff and provide input. A Strategic Policy Review was conducted through a series of board workshops to help Metropolitan evaluate its future role for the region.

The 2010 IRP remains true to the original IRP goal of meeting "full service demands at the retail level under all foreseeable hydrologic conditions." It offers the additional steps

FOREWORD

of promoting water use efficiency as a means of greater reliability and advances long-term planning for potential future contingency resources such as stormwater capture and large-scale seawater desalination. The 2010 IRP also recognizes the goals of providing for expected needs while making the most financially prudent responses. This plan, with its aggressive region-wide conservation and water use efficiency targets, serves as a model for meeting California's new goal to lower residential per-capita water use by 20 percent by the year 2020.

Adoption of the 2010 IRP by Metropolitan's Board of Directors marks the culmination of a two-year planning milestone and the start of additional collaborative efforts to meet its goals. This will include development of a long-term conservation plan and a comprehensive review of local needs and projects under consideration or underway.

Metropolitan came into existence in 1928 to respond to changing conditions generated by a fast-growing region in need of water. First on the agenda was the construction and operation of the Colorado River Aqueduct. A generation later in 1960, Metropolitan became the largest contractor to the State Water Project to supplement the region's water needs. Over time, Metropolitan has assumed important roles in addition to operator and contractor, leveraging the resources and expertise of its member agencies to coordinate a regional response to changing water supply conditions.

Metropolitan's 2010 IRP stays true to the District's historic mission while recognizing the need to create a broader, more robust water portfolio to prepare for this era of change. It is a recognition that in water management, nothing remains constant. The 2010 IRP is a flexible plan that will be reevaluated by Metropolitan's board, staff and its member agencies and updated as conditions change and new needs emerge.

Timothy F. Brick
Chairman, Metropolitan Board of Directors

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Guide to Acronyms

20x2020	Water Conservation Act of 2009 (SB 7)
AB	California Assembly Bill
AF	acre-feet
AMI	advanced metering infrastructure
BDCP	Bay Delta Conservation Plan
BMPs	best management practices
CCP	Conservation Credits Program
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CII	commercial, industrial, and institutional
CRA	Colorado River Aqueduct
CUWCC	California Urban Water Conservation Council
CVWD	Coachella Valley Water District
DWCV	Desert Water Agency/Coachella Valley Water District
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EMMP	Energy Management Master Plan
EMRS	Energy Management and Reliability Study
ESA	Endangered Species Act
GPCD	gallons per capita per day
HCD	California Department of Housing and Community Development
HR	U.S. House of Representatives Bill
IID	Imperial Irrigation District
IRP	Integrated Water Resources Plan
IRPSIM	Integrated Water Resources Plan Simulation Model
IRWMP	Integrated Regional Water Management Plan
LAA	Los Angeles Aqueduct
LADWP	Los Angeles Department of Water and Power
LRP	Local Resources Program
M&I	municipal and industrial
MAF	million acre-feet
MGD	million gallons per day
MOU	memorandum of understanding
MPAs	marine protection areas
MWD	Municipal Water District
MWD-MAIN	Water Use Forecasting System
MWDOC	Municipal Water District of Orange County
O&M	operation and maintenance
OMP&R	operations, maintenance, power, and replacement
PVID	Palo Verde Irrigation District
QSA	Quantification Settlement Agreement
RO	reverse osmosis
SB	Senate Bill
SDCWA	San Diego County Water Authority
SDP	Seawater Desalination Program
SWP	State Water Project
SWRCB	State Water Resources Control Board
USBR	U.S. Bureau of Reclamation

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INTEGRATED WATER RESOURCES PLAN 2010 UPDATE

BACKGROUND, HISTORICAL CONDITIONS & CURRENT STATUS

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

1 Background, Historical Conditions & Current Status

The Metropolitan Water District of Southern California

Formation & Purpose

The Metropolitan Water District of Southern California is a public agency organized in 1928 by a vote of the electorates of 11 cities located in Southern California. The agency was enabled by the Metropolitan Water District Act that was passed into law by the California Legislature. Metropolitan was formed "for the purpose of developing, storing, and distributing water" to the residents of Southern California.

Metropolitan imports and distributes water from the Colorado River through its Colorado River Aqueduct (CRA) and from the Feather River through the State Water Project (SWP). Metropolitan also develops other water resource and conservation projects throughout the state.

In 1992, Metropolitan adopted the following mission statement:

"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."

Member Agencies

Metropolitan is currently composed of 26 member agencies, consisting of 14 cities, 11 municipal water districts, and one county water authority. Metropolitan is a water wholesaler with no retail customers, and it provides treated and untreated water directly to its member agencies. **Table 1.1** shows Metropolitan's member agencies and the type of service provided. Fifteen member agencies provide retail service to customers, nine provide only wholesale service, and two provide a combination of both. Metropolitan's member agencies serve residents in 152 cities and 89 unincorporated communities. Throughout Metropolitan's service area, approximately 250 retail agencies supply water to the public.

Metropolitan's member agencies deliver a combination of local groundwater, local surface water, recycled water, and imported water purchased from Metropolitan. For some member agencies, Metropolitan supplies all the water used within that agency's service area, while others obtain varying amounts of water from Metropolitan to supplement local supplies. Metropolitan has historically provided between 45 and 60 percent of the municipal and industrial (M&I), and agricultural water used within its service area. The remaining water supply comes from local groundwater basins, local surface water, recycling, the city of Los Angeles' aqueduct (LAA) from the eastern Sierra Nevada, and the San Diego County Water Authority's (SDCWA) water transfers from the Imperial Irrigation District (IID) delivered through an exchange of water supplies with Metropolitan. Member agencies also implement conservation programs that can be considered part of their supplies.

Service Area

Metropolitan's service area covers the Southern California coastal plain, as seen in **Figure 1.1**. It extends about 200 miles along the Pacific Ocean from the city of Oxnard on the north to the international boundary with Mexico on the south, and it reaches as far as 70 miles inland from the coast. The total area served is nearly 5,200 square miles and it includes portions of

Metropolitan is a regional wholesaler that provides water for 26 member public agencies to deliver to 19 million people living in Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties spanning 5,200 square miles.

Previous Page Photo: The F.E. Weymouth Water Treatment Plant in La Verne is one of five Metropolitan-owned and operated treatment facilities.

Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. **Table 1.2** shows that although only 14 percent of the land area of the six Southern California counties is within Metropolitan's service area, 86 percent of the populations of those counties reside within Metropolitan's boundaries.

Table 1.1 Metropolitan's Member Agencies by Service Provided

Retail Agencies
Anaheim, City of
Beverly Hills, City of
Burbank, City of
Compton, City of
Fullerton, City of
Glendale, City of
Las Virgenes Municipal Water District
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, City of
Retail & Wholesale Agencies
Eastern Municipal Water District
Western Municipal Water District
Wholesale Agencies
Calleguas Municipal Water District
Central Basin Municipal Water District
Foothill Municipal Water District
Inland Empire Utilities Agency
Municipal Water District of Orange County (MWDOC)
San Diego County Water Authority (SDCWA)
Three Valleys Municipal Water District
Upper San Gabriel Valley Municipal Water District
West Basin Municipal Water District

Board of Directors & Management Team

Metropolitan's Board of Directors currently consists of 37 directors. Each member agency has at least one representative, with the agency's assessed valuation determining its additional representation and voting rights. Directors can be appointed by the chief executive officer of the member agency with the consent of the governing body of the member agency or be elected by a majority vote of the governing body of the member agency. The board includes business, professional, and civic leaders and meetings are generally held on the second Tuesday of each month and are open to the public.

Throughout its history, the board has delegated certain tasks to Metropolitan staff, which are codified in Metropolitan's Administrative Code. In addition, Metropolitan has developed policy principles to help achieve its stated mission. These policies can be found in a variety of documents including: specific policy statements, board-adopted policy principles, and letters submitted to the board. Policy statements are also embedded in formal board meeting discussions and recorded in meeting minutes. The policies established by the board are subject to all applicable laws and regulations.

The management of Metropolitan is under the direction of its General Manager, who serves at the discretion of the board, as do Metropolitan's General Auditor, General Counsel, and Ethics Officer.

Integrated Resources Planning

Since its creation in 1928, Metropolitan has focused on providing reliable water supply to the people and economy of Southern California. Metropolitan's role in contributing to that broad mission has been shaped by a history of important principles and policies. In 1952, the Laguna Declaration positioned Metropolitan to "provide its service area with adequate supplies of water to meet expanding and increasing needs," and established Metropolitan's leadership role in "closing the gap" between the region's water needs and its locally available water supplies. In 1996 Metropolitan developed its first Integrated Water Resources Plan (IRP) to address the complexity of developing, maintaining, and delivering a reliable supply of water to its member agencies. The IRP established targets for a diversified portfolio of investments in water supply that have provided the foundation for continued water supply reliability during a period of prolonged drought and severe regulatory limitations.

The IRP established a long-term water resources strategy to fulfill Metropolitan's mission of providing a high quality, reliable water supply for its service area by identifying a range of

FIGURE 1.1 METROPOLITAN'S MEMBER AGENCIES

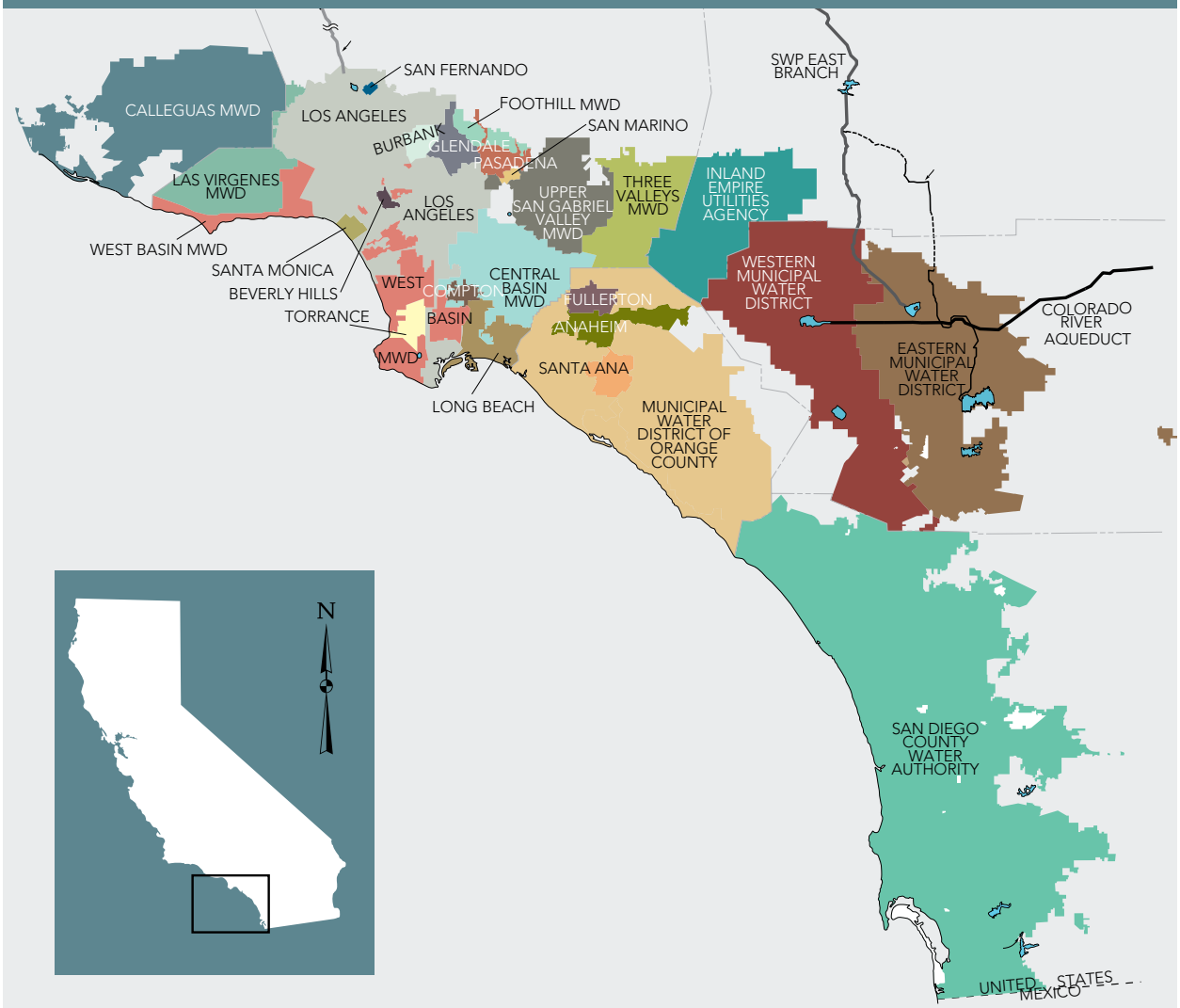


TABLE 1.2 AREA & POPULATION IN METROPOLITAN SERVICE AREA

County	*Los Angeles*	*Orange*	*Riverside*	*San Bernardino*	*San Diego*	*Ventura*	*Total*
Land Area (Square Miles)							
County Total	4,061	789	7,208	20,052	4,200	1,845	38,155
Metropolitan Service Area Total	1,408	699	1,057	242	1,420	365	5,191
Percent in Metropolitan	35%	89%	15%	1%	33%	20%	14%
Population							
County Total	10,409,000	3,155,000	2,128,000	2,064,000	3,208,000	841,000	22,805,000
Metropolitan Service Area Total	9,500,000	3,155,000	1,520,000	816,000	3,076,000	617,000	18,684,000
Percent in Metropolitan	91%	100%	71%	40%	96%	73%	86%

Source: California Department of Finance, California Statistical Abstract, and Metropolitan-developed statistics. Data as of July 1, 2009.

potential resource development needs, supply alternatives, adaptation measures, and program implementation blueprints.

1996 IRP

Metropolitan has gradually shifted from being exclusively a supplier of imported water to collaborating with its member agencies on regional water supply planning issues. After the drought of 1987-1992, Metropolitan recognized the many changing conditions it would be facing in the future and the need to develop a long-term water resources strategy to fulfill its mission. The plan that came out of this process was the IRP. The first IRP was adopted by Metropolitan in 1996. The 1996 IRP was guided by six objectives established by Metropolitan's board early in the process. The goals of the IRP are to acknowledge environmental and institutional constraints, and ensure:

- Reliability;
- Affordability;
- Water quality;
- Diversity; and
- Flexibility.

One of the fundamental outcomes of the 1996 IRP was the understanding that regional water supply reliability could be achieved through the implementation of a diverse portfolio of resource investments and conservation measures. The resulting 1996 IRP strategy is a balance between demand management and supply augmentation. For example, in its dry-year profile, the resource framework counts on an almost equal balance between water conservation and recycled water on one hand and withdrawal from storage and water transfers on the other. The 1996 IRP is also a balance between the use of local resources and imported supplies. In a dry year, about 55 percent of the region's water resources were projected to come from local resources and conservation. Additionally, through the 1996 IRP process Metropolitan found solutions that offer long-term reliability at the lowest cost to the region as a whole.

Having identified the need for a portfolio of different supplies to meet its demands, the 1996 IRP analyzed numerous resource portfolios

Metropolitan imports water from the Colorado River and Northern California to supplement local supplies, and helps its members develop increased water conservation, recycling, storage, and other resource-management programs. The two facilities pictured above mark the beginning of the Colorado River Aqueduct and State Water Project, respectively.

Top Photo: The Whitsett Intake Pumping Plant

Bottom Photo: Harvey O. Banks Pumping Plant

before establishing an optimal blend of supplies, referred to as the "Preferred Resource Mix" that would provide the region with reliable and affordable water supplies through 2020.

The analysis of these supplies determined the best mix of resources and the target supply amount based the cost-effectiveness, diversification, and reliability. Establishing the Preferred Resource Mix was an integral part of the 1996 IRP and subsequent updates have continued to diversify Metropolitan's water portfolio and establish broad resource targets for each of the major supplies available to the region, as described in **Table 1.3**.

2004 IRP Update

In 2004, as part of its commitment to continue to evaluate and adjust to changing water supply conditions, the Metropolitan board adopted an updated IRP. The 2004 IRP Update had three objectives:

- Review the goals and achievements of the 1996 IRP;
- Identify the changed conditions for water resource development; and
- Update resource development targets through 2025.

The 2004 IRP Update process fulfilled the new objectives and updated the long-term plan to account for new water planning legislation. The updated plan contained resource development targets through 2025, which reflected changed conditions, including increased conservation savings, planned increases in local supplies, and increased uncertainty. The 2004 IRP Update also explicitly recognized the need to handle uncertainties inherent in any planning process. Some of these uncertainties include:

- Population and economic growth;
- Water quality regulations;
- New chemical contaminants;
- Endangered species affecting sources of supplies; and
- 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. However, Metropolitan did not implement operational components of the planning buffer to meet any of the aspects of future uncertainty.

IRP & Other Planning Efforts

The IRP is intended as a regional water resource planning document that identifies potential supplies to meet future demands. This also entails contingencies for supply and demand uncertainties. However, Metropolitan recognized that reliable and comprehensive water planning goes beyond resource development. Metropolitan has pursued and developed programs to address emergency response for the Sacramento-San Joaquin Delta (Delta), storage, regional disasters, energy management, long-term financial implications, and coordination with local agencies' own planning efforts.

The IRP sets out a general policy framework only and does not constitute approval of any specific actions by Metropolitan. The IRP process provides flexible planning direction, subject to annual adjustments and periodic updates. Specific initiatives or individually-listed projects are representative only and subject to full environmental study and board deliberation and reconsideration prior to any future approval. Thus, the IRP and its updates do not constitute final, binding decisions by Metropolitan, nor are they projects subject to specific review under the California Environmental Quality Act (CEQA). Potential projects resulting from policies within this 2010 IRP update will be fully analyzed and studied prior to any approval or implementation by Metropolitan. Furthermore, to the extent the IRP serves as the basis for the urban water shortage contingency analysis and is incorporated into Metropolitan's Regional Urban Water Management Plan, its preparation, adoption, and subsequent planning activities are statutorily exempt from CEQA.

Emergency Response

This update to the IRP shows how Metropolitan plans to develop its water resource supply portfolio out to the year 2035, including planning for hydrologic, regulatory and other types of

TABLE 1.3 DESCRIPTION OF REGIONAL RESOURCES

Supply	*Description*	
Colorado River Aqueduct (CRA)	Metropolitan holds a basic apportionment of Colorado River water and has priority for an additional amount depending on availability of surplus supplies. Water management programs supplement these apportionments.	
State Water Project (SWP)	Metropolitan receives water delivered under State Water Contract provisions, including Table A contract supplies, use of carryover storage in San Luis Reservoir, and Article 21 interruptible supplies.	
Conservation	Metropolitan and the member agencies sponsor numerous conservation programs in the region that involve research and development, incentives, and consumer behavior modification.	
	Code-Based Conservation	Water savings resulting from plumbing codes and other institutionalized water efficiency measures.
	Active Conservation	Water saved as a direct result of programs and practices directly funded by a water utility, e.g., measures outlined by the California Urban Water Conservation Council's (CUWCC) Best Management Practices (BMPs). Water savings from active conservation completed through 2008 will decline to zero as the lifetime of those devices is reached. This will be offset by an increase in water savings for those devices that are mandated by law, plumbing codes or other efficiency standards.
	Price Effect Conservation	Reductions in customer use attributable to changes in the real (inflation adjusted) cost of water.
Local Resources	*Groundwater*	Member-agency produced groundwater from the groundwater basins within the service area.
	Groundwater Recovery	Locally developed and operated, groundwater recovery projects treat contaminated groundwater to meet potable use standards. Metropolitan offers financial incentives to local and member agencies through its Local Resources Program for recycled water and groundwater recovery. Details of the local resources programs are provided in **Appendix A.6**.
	Los Angeles Aqueduct (LAA)	A major source of imported water is conveyed from the Owens Valley via the LAA by Los Angeles Department of Water and Power (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.
	Recycling	Recycled water projects recycle wastewater for M&I use.
	Surface Water	Surface water used by member agencies comes from stream diversions and rainwater captured in reservoirs.
Groundwater Conjunctive Use Storage Programs	Metropolitan sponsors various groundwater storage programs, including, cyclic storage programs, long-term replenishment storage programs, and contractual conjunctive use programs. Details of the groundwater storage programs are provided in **Appendix A.4**.	
Surface Water Storage	Metropolitan reservoirs (Diamond Valley Lake, Lake Mathews, Lake Skinner) and flexible storage in California Department of Water Resources (DWR) reservoirs (Castaic Lake, Lake Perris). Details of the surface storage reservoirs are provided in **Appendix A.5**.	
Central Valley Storage & Transfers	Central Valley storage programs consist of partnerships with Central Valley water districts to allow Metropolitan to store SWP supplies in wetter years for return in drier years. Metropolitan's Central Valley transfer programs consist of partnerships with Central Valley Project and SWP settlement contractors to allow Metropolitan to purchase water in drier years. Details of the Central Valley Storage and Transfer programs are provided in **Appendix A.3**.	

uncertainties. However, it does not address other types of emergencies, such as earthquakes, that could negatively affect Metropolitan's delivery of water to its customers. Metropolitan has a long history of emergency planning, and the following describes how Metropolitan organizes and deploys resources to manage emergencies and ensure continuity of water system operations and critical business processes.

Operating Policy A-06 is included as **Appendix A.16**. Under the policies identified, Metropolitan will maintain the following:

- Emergency Response Plan;
- Emergency Response Organization;
- Business Continuity Plan; and
- IT Disaster Recovery Plan.

These policies and resulting plans will ensure that Metropolitan will have the business and organizational capability to continue to deliver water to its customers during an emergency.

The next element of Metropolitan's emergency planning details how Metropolitan will respond to earthquakes within its service area and in the critical Delta. Recognizing the threat of earthquakes to its facilities in Southern California, Metropolitan commissioned Report No. 1335—*System Reliability Plan, Potential Effects of Southern California Seismic Events on Metropolitan's Water Deliveries*. This report provides a perspective on the magnitude of damage that could result from moderate and extreme earthquakes, the corresponding potential impacts on Metropolitan water deliveries, and estimated time frames for restoring service. The report also offers recommendations for reducing the potential impacts of certain significant seismic events.

Metropolitan's board also approved a *Delta Levees Emergency Preparedness and Response Plan* to respond to the risk of a catastrophic failure of the Delta levee system. A copy of this plan is included as **Appendix A.14**.

The final element of Metropolitan's emergency preparedness is its emergency storage program.

Metropolitan established its criteria for determining emergency storage requirements in the October 1991 Final EIR for the Eastside Reservoir, which is now named Diamond Valley Lake. These criteria were clarified in a report to Metropolitan's board titled *Metropolitan's Emergency Storage Requirement*, dated May 11, 2010 and included as **Appendix A.15**.

Emergency storage requirements are based on the potential of a major earthquake damaging the aqueducts that transport Southern California's imported water supplies (SWP, CRA, and LAA). The adopted criteria assume that damage from such an event could render the aqueducts out of service for six months. Therefore, Metropolitan has based its planning on a 100 percent reduction in its imported supplies for a period of six months. The emergency plan outlines that under such a catastrophe, non-firm service deliveries would be suspended, and firm supplies to member agencies would be restricted by a mandatory cutback of 25 percent from normal-year demand levels. At the same time, water stored in surface reservoirs and groundwater basins under Metropolitan's interruptible program would be made available, and Metropolitan would draw on its emergency storage, as well as other available storage. Metropolitan has reserved up to half of Diamond Valley Lake storage to meet such an emergency, while the remainder is available for dry-year and seasonal supplies. In addition, Metropolitan has access to emergency storage at its other reservoirs, at the SWP terminal reservoirs, and in its groundwater conjunctive use storage accounts. With few exceptions, Metropolitan can deliver this emergency supply throughout its service area via gravity, thereby eliminating dependence on power sources that could also be disrupted by a major earthquake.

While it is impossible to completely eliminate the risk of earthquakes and other natural disasters, Metropolitan's planning will significantly reduce the impact of these events to the residents of Southern California.

Energy Management Initiatives

Metropolitan's board established energy as a core initiative at its 2007 board retreat, and subsequently adopted revised Energy Policy Principles in 2008. Since the energy initiative was established, Metropolitan staff has provided a number of energy-related briefings to the board regarding energy reliability and

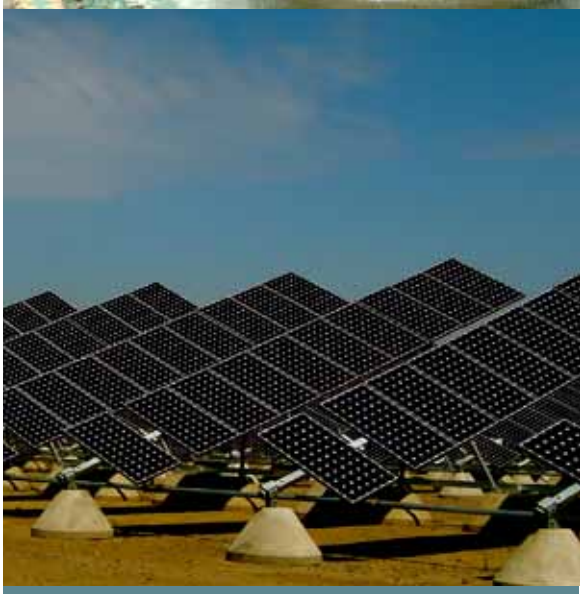
the challenges Metropolitan faces regarding energy independence. In September 2009, the board authorized preparation of an Energy Management and Reliability Study (EMRS)[1]. In January 2010, staff presented a board letter detailing the completed EMRS, and a workshop was held later the same month. The EMRS specifically includes:

- A comprehensive analysis of Metropolitan's power consumption and production profile;
- Identification of cost risks associated with projected power industry rate increases;
- Identification of regulatory and cost risks associated with Senate Bill (SB) 7 legislation;[2]
- Identification of relationships between Metropolitan and potential developers and partners, as Metropolitan proceeds with comprehensive energy management initiatives; and
- Identification of specific programs and projects to help meet the goals of energy reliability, cost containment, and energy independence, with the added benefit of greenhouse gas reduction.

The EMRS identifies potential future actions and serves as a blueprint for an Energy Management Master Plan (EMMP). The EMMP addresses specific actions that may be undertaken immediately, in the near-term, and over a longer term (up to 20 years) to achieve energy reliability, cost containment, and greenhouse gas reduction. Staff has outlined various actions for the EMMP coinciding with three distinct planning phases: immediate (2010-2012), near term (2013-2020), and long-term (by 2030). These proposed actions are aimed at controlling overall operational costs and moving Metropolitan toward energy independence. However, a number of these proposed actions are contingent on various regulatory, legislative, and market-related trigger points that may occur over the three planning phases. Metropolitan's board discussed the adoption of Energy Management Policies in February 2010.

Metropolitan staff presented to the Board of Directors the revised Energy Management

1. MWH Americas, Inc. "Energy Management and Reliability Study, Report No. 1352, Project No. 104194, December 2009.
2. For more information on SB 7 see Sections 2 and 3.



Metropolitan recognizes the need to model conservation in business practices and to nurture new technologies and approaches that will help Southern California achieve long-term sustainability.

Top Photo: An annual Spring Green Expo showcases water and energy saving technologies and innovations for home and business.

Bottom Photo: Metropolitan completed the installation of its first large-scale solar energy project at the Skinner Water Treatment Plant in Winchester, CA which underscores a commitment to renewable energy and marks the first of similar installations.

Policies at the July 2010 Engineering and Operations Committee. Following discussion by the committee, and an update of one policy, the policies were adopted in July 2010 and the Engineering and Operations Committee passed a motion to approve the policies at the adjourned August 2010 board meeting.

Consistent with the aforementioned board discussions, the proposed Energy Management Policies are based on the following overriding objectives for any and all future energy-related projects:

- Contain costs and reduce exposure to energy price volatility;
- Increase operational reliability by providing system redundancy;
- Provide a revenue stream to offset energy costs; and
- Move Metropolitan toward energy independence.

The specific policies are as follows:

- Water/Energy Nexus: Identify collaborative programs and initiatives between the water and energy industries, constructing sustainable partnerships to reduce costs and provide enhanced reliability;
- Regulatory: Track federal and state greenhouse gas regulations and develop strategies to hedge against price and regulatory risks to Metropolitan;
- Legislation: Pursue legislation to protect or enhance reliability of energy supply and mitigate energy cost risk;
- Contracts: Maintain maximum flexibility on existing and future contracts with Hoover and other energy contracts to hedge against cost and regulatory risks;
- Projects/Partnerships: Pursue cost-effective renewable energy projects and partnerships to hedge against energy price increases and regulatory risks, while reducing Metropolitan's carbon footprint;
- Revenue Stream: Pursue revenue-stream renewable energy facilities on operational lands to assist in cost containment;
- Economic & Environmental Stewardship: Develop cost-effective programs, projects and initiatives to control operational costs and move Metropolitan towards energy independence, based on projected economic and regulatory conditions. Implementation of proposed Energy Management Plan activities would result in substantial reductions in greenhouse gas emissions; and
- Energy Management Updates: Return to the board on a regular basis to deliver staff reports on the Energy Management Master Plan and the suitability of these policies, in light of changing regulatory and economic conditions.

Metropolitan is currently embarking on energy management initiatives aimed at working toward operating its facilities in the most energy-efficient and cost-effective manner, and enhancing its ability to provide long-term power reliability. Metropolitan has completed the audit and certification of its 2008 carbon footprint with the California Climate Action Registry as a registered member and submitted emissions data to the Air Resources Board, which is the state agency mandating emissions reporting annually. In May 2009, Metropolitan completed a 10-acre field of solar panels at Metropolitan's Robert A. Skinner Water Treatment Plant in the Temecula Valley of southwestern Riverside County. The 1-megawatt solar installation is designed to generate approximately 2.4 million kilowatt-hours of clean, renewable energy a year, equal to the power used by about 250 homes annually. Metropolitan will receive more than $5 million in rebates during the first five years of the facility's operation. Based on projected power costs, the capital expenditure for this project will be recovered in approximately eight years. Metropolitan also started final design activities for a 2-megawatt solar installation at its F.E. Weymouth Water Treatment Plant. This planned solar installation would meet up to 25 percent of the Weymouth plant's expected daily power consumption. A total of 10-megawatts of solar power generation are proposed for the Joseph Jensen, Henry J. Mills, Weymouth, and Skinner water treatment plants, including the existing 1-megawattt facility at Skinner.

Long Range Finance Plan

The ability to ensure a reliable supply of high quality water for Metropolitan's 26 member agencies depends largely on Metropolitan's ongoing ability to finance O&M, maintain and augment local and imported water supplies, fund replacements and refurbishment of existing infrastructure, and invest in system improvements. Metropolitan's Long Range Finance Plan is the planning document upon which Metropolitan and its member agencies base future capital and operating decisions. As such, it includes a forecast of future costs and the revenues necessary to support operations and investments in infrastructure and resources that are derived from this IRP Update while conforming to Metropolitan's financial policies. These financial policies, which address reserve levels, financial indicators, and capital funding strategies, ensure sound financial management and fiscal stability as Metropolitan implements this IRP Update.

Integrated Regional Water Management Plans

In 2002, SB 1672 created the Integrated Regional Water Management Plan Act (IRWMP) to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the water quality, quantity, and supply reliability. In November 2002, California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, which provided $500 million to fund competitive grants for projects consistent with an adopted IRWMP. Four years later, California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, River and Coastal Protection Bond Act, which provides $1 billion for IRWMP Planning and Implementation.

As a result of the above legislation and resulting bond funding, DWR administers an IRWMP Grant Program. Senate Bill x2-1 repealed and replaced the Integrated Regional Water Management Act and guided DWR in establishing the current criteria and standards for its IRWMP Grant Program. DWR establishes guidelines for establishing Regional Water Management Groups and standards for an acceptable IRWMP. DWR defines a Regional Water Management Group to consist of three or more agencies, at least two of which have a statutory authority over water supply or water management, as well as those persons who may be necessary for the development and implementation of an IRWMP and have been accepted through a regional accepted process. Grant funding opportunities from Propositions 50 and 84 are awarded to Regional Water Management Groups to implement projects consistent with their adopted IRWMPs.

Currently DWR has accepted seven Regional Water Management Groups that cover portions of Metropolitan's service area. They are:

- Watershed Coalition of Ventura County;
- Greater Los Angeles County;
- Gateway Region;
- Santa Ana Watershed Project Authority;
- South Orange County Watershed Management Area;
- Upper Santa Margarita Planning Area; and
- San Diego Region.

Metropolitan has been monitoring and providing technical assistance as requested to its member agencies that belong to various Regional Water Management Groups within the service area in the development of their IRWMPs. As a result, Metropolitan's IRP Update 2004 has been used as a base document for the IRWMPs that have been adopted by groups within the service area. In general, the IRWMPs have water supply and demand management projects, as well as water resources objectives consistent with Metropolitan's IRP.

The Regional Water Management Groups also identified potential projects during the development of the IRWMPs. Project lists from adopted IRWMPs have been updated by Metropolitan member agencies and included as potential local resources in this IRP Update.

Since 2006, Metropolitan has been participating as the surface water management area representative on the Greater Los Angeles County region leadership committee. In addition, Metropolitan staff has actively participated in technical workgroups in the development of

Metropolitan has the responsibility of ensuring the Southland's water supplies are both reliable and safe.

Top Photo: Metropolitan's water quality laboratory samples for more than 120 constituents and performs more than 270,000 quality tests each year. The lab is one of the most sophisticated in the nation.

Bottom Photo: Fast-replicating quagga mussels present water quality and operational challenges in the Colorado River Aqueduct system.

Santa Ana Watershed Project Authority's One Watershed, One Water Plan adopted in 2010.

Metropolitan will continue to work with the Regional Water Management Groups as they update their IRWMPs.

Challenges & Changed Conditions

Metropolitan provides water to a broad and heterogeneous service area with water supplies from a variety of sources and geographic regions. Each geographical area and each particular supply has a unique set of benefits and challenges. The dry hydrology experienced during the last three years has resulted in diminished snow melt and runoff levels in each of the watersheds supplying Metropolitan's water supplies. In addition, severe environmental restrictions were imposed on water imports from the Delta. By the end of 2009, mandatory conservation was in place across much of Metropolitan's service area.

Operations & Water Quality

The region faces challenges in water quality and operations on a variety of fronts. The presence of quagga mussels in the CRA will increase operations and maintenance (O&M) costs and reduce operational flexibility. Salt and concentrate balance from a variety of sources may impact the long-term operation of local groundwater basins. Environmental issues in the Owens Lake and Lower Owens River continue to affect the supply availability in the LAA system. A number of stressors ranging from invasive species to water diversions to wastewater discharges have contributed to the decline of the Delta ecosystem and have triggered a wave of litigation and new pumping restrictions that have dramatically altered water supplies for Metropolitan. Since the early 1990s, layers of new pumping restrictions are in place to address the various migration patterns of Delta smelt, winter- and spring-run salmon, steelhead and other fish species. Pumping restrictions now exist in the Delta for nine out of 12 months in the year. The result is a loss of supply of approximately 30 percent in an average year, compared to delivery levels of 2005. The greatest loss of supply comes in wetter years, meaning that Metropolitan will find it more difficult to

replenish its storage when supplies are available. Prior to these restrictions, Metropolitan could anticipate replenishing its reserve system in seven out of 10 years. With these restrictions, and without enhancing conservation and other water supplies, Metropolitan stands to draw on its reserve system seven out of 10 years.

Policy & Permitting

Besides the challenges presented by changing climatic conditions, there remains considerable uncertainty with regards to future water policies and their effect on Metropolitan's supplies. Difficulty in obtaining and meeting the requirements for environmental review certification, documentation, and permitting for multi-year transfer agreements, recycled water projects, and seawater desalination facilities may hinder regional supply development.

Demand

Metropolitan has historically faced, and will continue to face, key demand uncertainties associated with population and economic growth. The recent economic downturn, coupled with calls for conservation and generally cooler weather, has, as expected, driven down Metropolitan's demand. A robust economy with increased economic activity could cause increased demands in the future. The location of future population growth, which is largely driven by economics, is also a large uncertainty.

Climate & Hydrology

A significant uncertainty in Metropolitan's future is the impact of climate change. Metropolitan's water supply planning has relied upon almost 100 years of hydrological data regarding weather and water supply. This history of rainfall data has provided a sound foundation for forecasting the frequency and severity of future drought conditions, as well as the frequency and abundance of above-normal rainfall. However, analysis of historic climate variability for thousands of years, along with models of potential future climate, indicate that future weather patterns may fall outside the range of the historic data used in Metropolitan's planning models. For example, tree ring data suggest longer and more severe droughts have occurred in the past than have been experienced in the last 100 years. Additionally, the current drought on the Colorado River is more severe than any drought measured during the 20th century[3]. Changes in weather patterns could significantly affect water supply reliability, irrespective of the causes of such changes.

As has already been experienced in Australia, where further declines in rainfall are projected due to climate change, weather patterns can be expected to shift dramatically and unpredictably[4]. These changes in weather significantly affect water supply planning, irrespective of the debate associated with the effects of greenhouse gases on climate.

Summary

Over its more than 80-year history, Metropolitan has faced many uncertainties in fulfilling its mission of providing a reliable, high-quality water supply to Southern California. In its 1996 IRP, Metropolitan established a water resource portfolio with real targets for each of the resources within the preferred mix. In the 2004 IRP Update, as uncertainties continued to grow, Metropolitan established a planning buffer concept to its resource mix to address uncertainty in water resource development. Now, under the strategy of this IRP Update, Metropolitan will continue to develop programs to meet its reliability within its traditional core supplies, collaborate with member agencies to develop a buffer to address uncertainty, and pursue foundational actions to address other future supply vulnerabilities and uncertainties.

3. http://www.ncdc.noaa.gov/paleo/drought/drght_data.html
4. www.climatechange.gov.au

INTEGRATED WATER RESOURCES PLAN 2010 UPDATE

A PROCESS OF REGIONAL COLLABORATION

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

2 A Process of Regional Collaboration

Metropolitan's resource strategy has been based on its IRP, which was first adopted in 1996 and updated in 2004. The IRP has been both a planning framework and a guide for developing resource programs. Past plans were formulated with input from key stakeholders and Metropolitan again sought input from member agencies; retail water agencies; water, wastewater, and groundwater managers; environmental interests; businesses; and the community for this IRP update.

Recognizing that the conditions for developing and maintaining water supply reliability have changed, Metropolitan set out not only to update the IRP, but to examine how best to adapt to the new water supply paradigm. This section describes in detail the regional collaborative process of defining the issues, examining the current state of affairs (including vulnerabilities and uncertainties), understanding Metropolitan's role in those issues, and developing a new road map to regional water supply reliability.

Regional Participation

Metropolitan sought a variety of participants to identify key areas of concern, gather input on important foci, and learn detailed challenges of resource development from experts.

This planning process was implemented through a structured process that organized the various tasks of gathering regional data and input, performing analysis, and establishing future directions, as illustrated in **Figure 2.1**.

Board Oversight & IRP Steering Committee

To provide more direct involvement of the Metropolitan board in the IRP Process, the board created a special committee, the IRP Steering Committee, which is made up of five Metropolitan directors. Each of the directors is also a member of the Water Planning and Stewardship Committee. This IRP Steering committee met on a regular basis to receive information and briefings from Metropolitan staff. The purpose of this Committee is to:

- Develop and recommend policy options to the Water Planning and Stewardship Committee and the board;
- Review proposed planning approaches, resource strategies, and recommendations from Metropolitan staff and the Technical Oversight Committee; and
- Provide a public forum to receive input from stakeholders, including the public, on issues and concerns pertaining to this IRP Update.

Stakeholder Forums

Because of the diverse needs and interests of the institutional entities within the region, this IRP Update was developed through an open and participatory process that involved the major stakeholders. In fall 2008, Metropolitan, its board, member agency managers, elected officials, and community groups collectively discussed strategic direction and regional water solutions at a series of four stakeholder forums with nearly 600 participants.

Previous Page Photo: Reverse osmosis filters at the Groundwater Replenishment System, operated by the Orange County Water District.

Reverse osmosis filters are commonly used to purify degraded water sources which include wastewater, contaminated groundwater, and ocean water. The treatment process allows previously unusable water to be added to the local resource mix. Conservation and water-use efficiency are one of four core resources in Metropolitan's strategy to meet projected levels of demand.

The stakeholder forums were facilitated, half-day workshops. The first part of the workshops were presentations by Metropolitan staff that provided an overview of water demands and supplies in the region and identified the challenges facing Southern California in continuing to provide reliable, high-quality water. Stakeholders at each of these forums were then split into four smaller breakout groups to address specific water planning issues. **Table 2.1** is a list of questions asked of the participants and a summary of the responses.

Participants emphasized the importance of local resources development and resolving issues with the Delta. Participants suggested that Metropolitan should take a leadership position in several areas including:

- Communicate with legislators concerning needs for water supply reliability and quality improvements;
- Facilitate development of concentrate lines to enhance recycled water use;
- Foster partnerships with energy utilities;
- Strengthen relationships with the environmental community;
- Research and develop new technologies; and
- Assist retail agencies in technical analysis.

Public Forums

The collaborative planning process also involved Metropolitan staff seeking input and presenting ideas at a variety of regional forums, including from member agencies' boards, retail water agencies, local interest groups, community gatherings and business meetings. These forums provided valuable feedback and guidance regarding the preferred water resource strategy and reviewed the technical analyses supporting the decision-making process.

Technical Process

The following section outlines the technical process for gathering data and information for this IRP Update.

Technical Oversight Committee

The Technical Oversight Committee, consisting of member agency managers and high level staff, oversaw the technical aspects of the IRP. This committee met several times during the course of the technical process as detailed in **Table 2.2**. The specific role of the Technical Oversight Committee is as follows:

- Provide overall oversight and steering of technical analysis;
- Develop criteria to evaluate new alternatives; and
- Provide input on uncertainty planning strategy.

To accomplish these objectives, the Technical Oversight Committee established and assigned tasks to technical workgroups to provide information to support resource alternative development. It also directed Metropolitan staff to work directly with member agency staff to create a comprehensive list of existing and planned local resource projects throughout the region. The list of recycled water, groundwater recovery, and seawater desalination projects provided the backbone for further analysis and for setting resource targets (see **Appendix A.6**). The member agency managers then met to discuss the policy implication of that information.

Figure 2.1 Organization of IRP Update Process

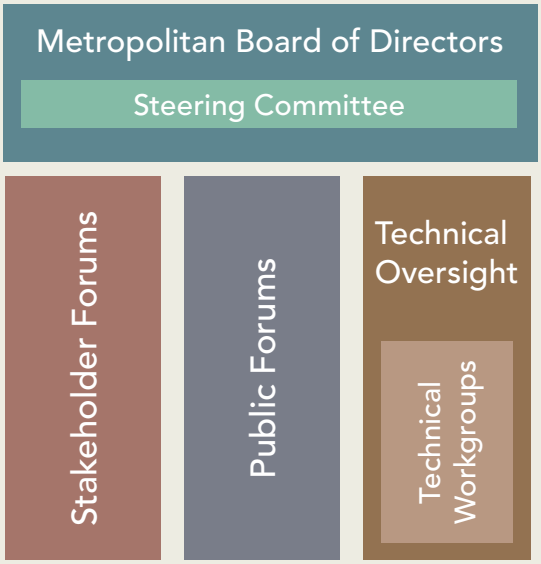


TABLE 2.1 SUMMARY OF QUESTIONS AND RESPONSES FROM STAKEHOLDER FORUMS

Category	*Question*	*Summary of Responses*
Supply Options & Criteria	What new water supply and conservation strategies should the region evaluate for implementation during the next 50 years, and what criteria should be used when evaluating them?	New strategies for the following areas: • Conservation • Seawater desalination • Education • Stormwater • Groundwater • Recycling Water • Transfers • Graywater
Growth & Development	Through various ways (such as connection fees) development has helped pay for new water supplies. In the future, what other ways can development (whether new growth or infill) help mitigate the impacts of growth on water supply? (Examples might include conservation offsets or mixed use development.)	Mitigation mechanisms included: • New development should pay for or offset the costs of additional water demand • New requirements to drive smart, green, water saving development • Development of shared standards for local government and utilities • Encouragement of smart development and technology • Environmental restoration credits • Conservation offsets for annexed areas • Promotion of high density residential development to reduce per capita water use • Elimination of front and back yards from new development designs and install more neighborhood parks so people have alternatives to their own yards • Provision of incentives
Uncertainty	We know the future will not be as projected. And planning for every possible contingency would be financially impractical. Given the challenges presented earlier, what do you think are the most important uncertainties that should be incorporated into the IRP?	Most important uncertainties included: • Natural disasters • Climate change • Environmental concerns • Economic conditions • Regulatory changes • Demographic changes • Water quality • Global and domestic shifts in agricultural land use • Changes in public attitude • Energy availability and cost

Willingness to Pay	The monthly water bill (not including sewer) for an average home in Southern California is about $45. What more would you be willing to pay in the future to ensure 100 percent reliability for essential purposes (such as drinking water, fire protection)? (10 percent more, 20 percent, 30 percent)? What about for landscaping or other outdoor water use? How much more would you be willing to pay not to have this water be interrupted?	• People would be willing to pay more for water supply reliability
		• Significant rate increases (up to 100 percent) or implementing a regional water surcharge would motivate people to use California native landscaping
		• People would be receptive to learning about ways to reduce their water use as an alternative to service interruptions
		• Service interruptions should be prioritized
		• The groups brought up several caveats about increasing rates and options beyond increased rates:
		  • 100 percent reliability can never realistically be achieved. A natural disaster can cut off water supplies, and no increase in water rates can prevent that
		  • Some participants said they would be more willing to make changes to the way they use water in order not to pay more.
		  • Rate increases would need to be justified (new pipelines, etc.) and communicated to enhance customer knowledge and support
		  • The additional amount people would be willing to spend will vary greatly depending on income level
		  • Incentives should be given to encourage conservation, and people who do not conserve water should pay higher rates

TABLE 2.1 SUMMARY OF QUESTIONS AND RESPONSES FROM STAKEHOLDER FORUMS

Category	Question	Summary of Responses
Fostering Partnerships	Because our resources (natural and financial) are limited, it is important to develop multi-benefit projects (e.g., supply, flood control, environmental enhancement, etc.). How can Metropolitan foster equitable partnerships with other utilities (including wastewater, stormwater, and energy) to implement multi-benefit projects?	• Metropolitan should take the lead broadening the number and scope of its partnering arrangements • Partnerships should bridge the gap between environmental groups and water management groups/industries to foster a more collaborative process • Partnerships should be portrayed as mutually beneficial • Partnerships should be formed to develop a uniform educational message about water. There should be incentives or a point system to encourage agencies to participate

Technical Workgroups

Following the 2008 stakeholder forums and direction from the Technical Oversight Committee, Metropolitan embarked upon a technical workgroup process to further explore some of the issues and opportunities identified by forum participants. To facilitate the workgroup process, the technical discussions were grouped into six resource areas:

- Conservation;
- Groundwater;
- Recycled water;
- Seawater desalination;
- Stormwater; and
- Graywater.

The technical workgroup process provided a forum for review of the issues associated with each area and in-depth discussions with area experts. The workgroups included member agency and retail agency staff, non-governmental organizations, staff from groundwater, wastewater, and stormwater management agencies, as well as Metropolitan staff and consultants. These workgroups met on an as-needed basis throughout the IRP Update process as summarized in **Table 2.3**.

Identifying Challenges to Development of Regional Resources

The technical workgroups studied six resource areas, further exploring the issues and opportunities identified in the stakeholder forums, including in-depth discussions with resource area experts. Each workgroup developed an issue paper summarizing the findings of

TABLE 2.2 SUMMARY OF TECHNICAL OVERSIGHT MEETINGS

Date		Topic
2009	January	IRP Update schedule, draft evaluation criteria, Technical Workgroup activities, and analytical approach for modeling uncertainty
	February	Review and discuss updated IRP evaluation criteria
	March	Review and discuss status of technical workgroups and IRP schedule
	April	Review and discuss IRP Update schedule and status of IRP Update technical workgroups, preliminary supply and demand estimates, climate change data, and analytical models
	May	Review and discuss IRP Update schedule, supply and demand estimates, and technical workgroup findings
	June	Review and discuss IRP Update schedule, gap analysis, technical workgroup findings, and the Robust Decision Making (RDM) analytical approach
	September	Review and discuss IRP Update process and schedule, potential policy approaches, and work schedule

TABLE 2.3 SUMMARY OF TECHNICAL WORKGROUP MEETINGS

Date		Conservation	Groundwater	Recycled	Seawater Desalination	Stormwater	Synergy	Graywater
2008	July		√					
	August		√					
	September		√					
	October		√					
	December	√	√	√	√	√		√
2009	January			√		√		√
	February	√	√	√		√		
	March	√		√		√		√
	April	√		√			√	√
	August				√			
	September					√		
2010	January		√					

these discussions, the current status of local supplies and programs, and recommendations for future opportunities. Below are descriptions and background on these resources along with key findings and recommendations from the workgroup issue papers. The full text of which can be found in **Appendices A.7-13.**

Conservation

Metropolitan encourages water-use efficiency through a comprehensive set of approaches including research and development, financial incentives, programs to influence consumer behavior, education, new plumbing, landscape and compliance codes, support of legislation, and retail-level tiered pricing. These efforts can be classified into active, code-based, and price-effect conservation methods.

Metropolitan's conservation strategy framework includes the efforts of member agencies to develop cost-effective conservation programs and implement tiered pricing to achieve price-effect conservation. In addition, the framework recognizes the intended progression from active to code-based conservation for various devices and approaches. To continue this evolution, the framework encourages development of new, innovative approaches by Metropolitan and member agencies that can be launched as active conservation.

Metropolitan and member agencies pursue these approaches while continuing to develop relationships with other interests and potential partners, which can lead to mutually beneficial conservation efforts. These interests include, but are not limited to, the landscape and irrigation industry, energy utilities, organizations that set building, fixture and equipment standards, developers and home builders, agriculture, watershed organizations, and developers of new water saving technologies.

Active Conservation

Active conservation consists of water agency-funded programs such as rebates, installations, and education. Metropolitan currently provides conservation incentives through two regional programs as well as member agency-administered programs. The regional programs include SoCal Water$mart for residential customers and Save Water, Save A Buck for commercial, industrial, and institutional (CII) customers. Both programs are offered throughout Metropolitan's service area and provide rebates for water-conserving devices directly to customers.

The regional programs are highly effective in influencing consumer purchasing decisions and will be an important element of future active conservation. In July 2008, Metropolitan initiated the region-wide SoCal Water$mart program to increase public access to residential

incentives. During its first year of operation, rebate activity exceeded expectations as many residential customers became increasingly aware of the financial incentives available to them to help offset the purchase of water efficient fixtures. In fiscal year 2008/09 Metropolitan issued a record 94,000 rebates for residential fixtures in single and multi-family properties and the Save Water, Save A Buck program provided rebates for 145,000 device retrofits.

Metropolitan provides a wide range of incentives through the regional programs. The devices are evaluated on a regular basis and incentives updated based on water savings, cost, and industry standards.

In addition to regional programs implemented by Metropolitan, member and retail agencies also implement local water conservation programs within their respective service areas and receive Metropolitan incentives for qualified retrofits and other water saving actions. Typical projects include toilet replacements, locally administered clothes washer rebate programs, and residential water audits.

Active conservation will continue to be a fundamental element of Metropolitan's strategy as it establishes the base of public acceptance and water savings data necessary to successfully transition specific approaches to code-based conservation. This interest in Metropolitan programs is echoed in member agency programs throughout the region, all of which help build a foundation for future non-incentive based approaches.

Code-based Conservation

Code-based conservation, formerly described as "passive" conservation, consists of demand reductions achieved through conservation-oriented legislation, building and plumbing codes, ordinances, and usage reductions resulting from increases in the price of water.

Code-based conservation advanced significantly beginning in 2009. As a result of the implementation of Metropolitan's Water Supply Allocation Plan, a wave of new and updated regional water use and conservation ordinances went into effect. Other major advancements are occurring through local implementation of the state's updated model water efficient landscape ordinance, adoption of a state Green Building Code, legislation that requires universal retrofit of inefficient fixtures and other efforts toward SB 7 compliance, described below.

In November 2009, Gov. Arnold Schwarzenegger signed SB 7,[1] the Water Conservation Act of 2009, as part of the historic comprehensive water package designed to address the state's growing water challenges. SB 7 represented the culmination of efforts by water industry leaders (including Metropolitan), non-governmental organizations, and the Legislature to enact legislation that would answer the governor's call for the state to reduce per capita water use 20 percent by the year 2020 (referred to as "20x2020") as part of a larger effort to ensure reliable water supplies for future generations and restore the Delta.

Metropolitan supports legislation consistent with its adopted policies for conservation. In 2009, three conservation bills sponsored by Metropolitan were enacted. The first bill, SB 407, requires the retrofit of inefficient fixtures in residential, multi-family and commercial properties beginning in 2014. The second bill, Assembly Bill (AB) 1061, ensures that common interest developments allow the use of water efficient landscaping. The third bill, AB 474, establishes the use of voluntary contractual assessments to provide financing for water conservation improvements affixed to real property.

Other major milestones that support future conservation include the state's update to its Model Water Efficient Landscape Ordinance in 2009 and the adoption of the California Green Building Code. Beginning in January 2010, cities and counties were required to adopt and enforce local water efficient landscape ordinances that are as effective as the state ordinance. CalGreen, the Green Building Code, will result in new construction that has a 20 percent lower water demand than traditional homes and buildings.

Metropolitan also supports development and enforcement of local ordinances that reduce potable water demand. In June 2008, following Gov. Arnold Schwarzenegger's proclamation of a

1. Unless otherwise noted, all bills refer to state of California legislation.

Metropolitan and its member agencies have long been leaders in water conservation. Water-use efficiency has been encouraged through research and development, financial incentives, programs to influence consumer behavior and support for new plumbing and compliance codes. Residential water saving opportunities have evolved with technology to include many indoor and outdoor fixtures such as the ultra-low-flush toilet, high-efficiency clothes washer, and multi-stream rotary sprinkler nozzle (pictured above left to right).

statewide drought, Metropolitan adopted a Water Supply Alert resolution. Among other provisions, the Alert encouraged cities, counties, and local public water agencies to adopt and enforce local water conservation ordinances. To facilitate ordinance adoption, Metropolitan compiled a library of available local ordinances, developed a model water conservation ordinance, and hosted several workshops. Approximately half of the 19 million residents in Metropolitan's service area are covered by adopted ordinances, and an additional one-third reside in jurisdictions that have taken action toward adoption of ordinances.

Price-Effect Conservation

Price-effect conservation consists of usage reductions resulting from increases in the price of water.

Implementation of Conservation Best Management Practices

These active and code-based programs are closely linked to the efforts of the California Urban Water Conservation Council (CUWCC)—the organization created to administer the Memorandum of Understanding Regarding Water Conservation in California (Urban MOU). As a signatory to the CUWCC's Urban MOU, Metropolitan has pledged to make a good faith effort to implement prescribed urban water conservation best management practices (BMPs). Metropolitan provides technical and financial support needed by member agencies in meeting the terms of the Urban MOU.

In December 2008, the Urban MOU BMPs were re-amended and organized into five categories. Two categories, Utility Operations and Education, are referred to as "Foundational BMPs" because they are considered to be essential water conservation activities by any utility. They are to be implemented by all signatories to the MOU as ongoing practices with no time limits. The remaining BMPs are "Programmatic BMPs" and are organized into residential, CII, and landscape categories.

In addition to implementing cost-effective BMPs, Metropolitan actively supports many

CUWCC committee activities. Metropolitan has historically assisted in CUWCC's ongoing efforts to document and increase the effectiveness of BMP-related conservation efforts including supporting research studies. Metropolitan staff members participate in several CUWCC governing committees, including the following:

- Board (formerly Steering Committee);
- CII Committee;
- Residential Committee;
- Landscape Committee;
- Research and Evaluation Committee;
- Governance/ Finance Committee;
- Education Committee;
- Utility Operations Committee; and
- BMP Reporting Committee.

Conservation Funding

Metropolitan's conservation strategy treats conservation as a core local supply, on par with other resources such as water recycling and storage. Therefore, funding is based on Metropolitan's avoided costs for capital, energy, treatment, and water supply.

The stewardship charge in Metropolitan's rate structure provides a funding mechanism for active programs. The stewardship charge funds Metropolitan's Conservation Credits Program (CCP), which provides the basis for financial incentives and funding for urban BMP and other demand management related activities. Established in 1988, the stewardship charge supports Metropolitan's commitment to conservation as a long-term water management strategy.

Metropolitan currently provides financial support for regional incentives and member agency conservation efforts based on one-half of average retail device cost, up to $195/AF. In general, member agency water conservation project proposals funded through the CCP must have demonstrable water savings, reduce water demands on Metropolitan's system, be technically sound, and require Metropolitan's participation to make the project financially and economically feasible.

Between 1990 and 2008, Metropolitan invested more than $223 million in conservation incentives, saving an average of 120,000 AF annually. Metropolitan has extended incentives to residential, commercial, and industrial sectors and public agencies to encourage the use of water efficient technologies and business practices. Incentive-based programs are complemented by public outreach and education activities, many of them tied to the California Friendly® marketing effort launched in 2006. The findings of the Conservation Technical Workgroup are summarized in the group's issue paper provided in **Appendix A.7**.

Conservation programs currently offered by Metropolitan include:

- SoCal Water$mart: region-wide program for residential customers to identify and apply for product rebates;
- Water Savings Performance Program: provides incentives for documented water savings for landscape and irrigation process improvements;
- Save Water, Save A Buck Program: region-wide program for commercial, industrial, and institutional customers providing incentive for efficient plumbing fixtures, irrigation equipment, food-service equipment, and medical equipment;
- Innovative Conservation Program: encourages research and development of new and creative ways to conserve water. Individuals and organizations can participate;
- Enhanced Conservation Program: provides funding directly to Metropolitan's member agencies to encourage new and creative approaches to implement urban water conservation;
- Bewaterwise.com®: Web site portal that contains information on Metropolitan's rebate programs and tips to save water;
- California Friendly Landscape Training: offers in-person and online courses in irrigation efficiency and water-wise garden design through its California Friendly Landscape Training Program. Since the program's inception in 1994, more than 50,000 people have participated in the classes. Courses are conducted in English and Spanish;

- Community Partnering Program: provides co-sponsorships to support water-related and community education projects, programs, and events; and
- Support for Member Agency Programs: several conservation programs are implemented by Metropolitan's member agencies but receive technical and financial support from Metropolitan.

Research, Evaluation & Technical Assistance

Metropolitan encourages research and development of new and creative ways to conserve water through both active and code-based conservation. Metropolitan staff will pursue research and testing of new technologies in cooperation with other interests, including testing provided by industry organizations. The Innovative Conservation Program provides funding to individuals and organizations to test new technologies.

Metropolitan's staff regularly evaluates conservation programs and projects and has served as technical advisor for a number of state and national studies involving the quantification and valuation of water savings. Efforts to measure water savings and evaluate programs and technologies serve four primary functions:

- Providing a means to measure and evaluate the effectiveness of current and potential conservation programs;
- Developing reliable estimates of various conservation programs and assessing the relative benefits and costs of these interventions;
- Providing technical assistance and support to member agencies in the areas of research methods, statistics, and program evaluation; and
- Documenting the results and effectiveness of Metropolitan-assisted conservation efforts.

Estimating Conservation Savings

Challenges exist in understanding and quantifying actual water savings from various approaches, such as weather-based irrigation controllers and water efficient landscaping. With the 20x2020 requirement to measure

Water-saving opportunities have extended to the commercial and public sector with the introduction and support for new technologies such as the waterless urinal, pre-rinse spray head and centralized irrigation controller (pictured above left to right).

progress through gallons per capita per day (GPCD) reductions, Metropolitan will need to focus on the data gaps and refine water savings assumptions in its water conservation model as data become available.

Currently, conservation savings estimates are based on the professional knowledge and expertise of Metropolitan and member agency staff in evaluating water conserving technologies and approaches. Regional conservation targets for Metropolitan's service area use 1980 as a base year and project active, code-based, and price-effect conservation savings from this baseline.

There are no targeted savings quantities estimated for public awareness campaigns and education. It has been widely accepted that such separate programs are essential and beneficial to prompt consumers to install water saving fixtures and increase the region's conservation savings, which are captured by the savings categorized above.

Conservation Outreach Campaign

Public outreach and education activities increase the effectiveness of these other approaches. The desired outcome is to influence consumer behavior and encourage development of a conservation ethic that will increase adoption of water saving devices and strategies.

Metropolitan has conducted annual advertising, education, and community outreach campaigns since 2003 under its Bewaterwise.com and California Friendly brands to urge Southern California consumers and business owners to make permanent changes in their everyday uses of water. From 2007 through 2010, the board authorized an expansion of these efforts in order to meet the critical water supply crisis facing the state. Outreach campaigns in the latter part of the decade reflected these unprecedented challenges with more urgent calls for water conservation behavior. Creative campaigns such as "Time to Get Serious" and "Cut Your Water Use" were seen and heard across more media outlets at higher frequency levels and over longer periods of time than pre-2007 campaigns. Metropolitan was a lead sponsor of the "California's Water: A Crisis We Can't Ignore" statewide campaign with the Association of California Water Agencies in fall 2007. Leading up to the summer of 2009, Metropolitan's "Move the Needle" outreach campaign (featuring a water supply gauge nearing empty) communicated the change from voluntary to mandatory water conservation in many Southern California cities and communities.

Other activities include:

- Annual reports to the legislature;
- Maintaining and updating the Bewaterwise.com web site in English and Spanish, with more than 1.4 million individuals visiting the site for information on water conservation from 2005 to 2010;
- Maintaining nine California Irrigation Management Information System stations; and
- Conducting consumer focus groups and surveys to measure effectiveness of outreach efforts.

Summary of Recommendations

Achieving additional demand reduction will require local and regional investments and the Technical Workgroup had the following recommendations to encourage more regional conservation:

Regional Benefits

- Reassess existing conservation programs to present a focused and tactical approach to conservation that avoids free ridership, provides good customer service, and continues to facilitate market transformation, while keeping program costs at reasonable levels;
- Refocus the conservation program on regional efforts that benefit all member agencies equally, such as regional education and public outreach, legislative advocacy, and provision of technical assistance within the scope of Metropolitan's expertise;
- Continue to work with federal and state agencies for technical and financial assistance opportunities;
- Bundle conservation incentives programs;

- Streamline Industrial Process Improvement Program criteria for small-scale projects;
- Encourage legislation to establish regional or statewide conservation transfer markets;
- Collaborate with regulatory agencies to coordinate programs and policies; and
- Work with member agencies to have region-wide compliance with state laws and to coordinate conservation programs to optimize regional savings and streamline reporting requirements.

Water Efficiency Standards

- Pursue legislation for standards in water saving devices; and
- Support regional or statewide adoption of a model ordinance to prohibit wasteful water devices.

Member & Local Agency Efforts

- Rely on member agencies to provide local conservation programs appropriate to the circumstances of the member agencies, including conservation-based rate structures, Advanced Metering Infrastructure (AMI) and other improvements to local infrastructure, and customer incentives;
- Assist member agencies with the cost of conducting water system audits;
- Assist local agencies with start-up costs to develop water budgets;
- Offer technical assistance to member agencies seeking help with implementing water budgeting systems and consider mechanisms for funding support and build on existing water budget efforts;
- Encourage AMI by assisting member agencies with co-funding and loans and by lobbying for state grant funding to be eligible for AMI projects and serving as a clearinghouse for technical information on AMI; and
- Continue support for water conservation gardens through Metropolitan's Community Partnering Program.

Research

- Lead an investigation to analyze and evaluate different types of water pricing and rate

Metropolitan's Water Savings Performance Program provides financial incentives for commercial water customers with documented water savings tied to landscape irrigation and industrial process improvements. More than a dozen agreements have been signed with customers that include a paper company (pictured left) and a fresh-cut produce packaging company (pictured right).

structures and make findings available to member agencies; and

- Conduct a region-wide market saturation study of indoor plumbing fixtures for both residential and commercial customers.

Education & Outreach

- Promote efforts to increase brand-name awareness of the U.S. Environmental Protection Agency's WaterSense™ label; and
- Partner with professional associations to inform industry and the public of conservation operations.

Groundwater

Many people in Southern California depend on groundwater as a significant source of drinking water. Effective use of local groundwater basins must be a significant component of any comprehensive water supply plan for Southern California. Although Metropolitan does not own or control the groundwater basins in Southern California, it has played, and must continue to play, a critical role as the region's supplemental water supplier.

In 2007, Metropolitan prepared the Groundwater Assessment Study in collaboration with its member agencies and with groundwater basin managers. This study evaluated the potential for groundwater storage and identified the challenges in developing additional storage programs. To follow up on the findings of the Groundwater Assessment Study, Metropolitan initiated a series of seven groundwater workshops, described in **Table 2.4**, to discuss challenges for increasing conjunctive use and to develop recommendations for addressing the challenges.

The goal of these workshops was to develop a set of broadly supported concepts and recommendations concerning groundwater management and conjunctive use, which can be implemented consistent with the court adjudications and other laws that govern the management of groundwater. Discussions focused on:

- Review of existing policy principles for conjunctive use and a determination of how they can be updated;
- Identification of primary challenges to increased storage and conjunctive use, and potential ways Metropolitan, its member agencies, groundwater producers, and basin managers can overcome these challenges; and

Table 2.4 Stakeholder Participation in Groundwater Process

Date		Groundwater Workshop	
2008	July	1	Initiate process, set ground rules and identify discussion topics
	August	2	Review IRP context, review availability of surplus imported water for groundwater recharge
	September	3	Continued review of availability of surplus imported water for groundwater recharge; discussion of groundwater basin production capabilities
	October	4	Continued discussion of groundwater basin production capabilities
	December	5	Review of opportunities; discussion of Groundwater Workgroup policy recommendations for IRP Update
2009	February	6	Continued discussion of policy recommendations for IRP Update
	April	Synergy Workshop between Groundwater, Recycled Water, and Stormwater Technical Workgroups Groundwater Basin Module Meeting with Orange County Basin	
	September	Groundwater Basin Module Meeting with Orange County Basin Groundwater Basin Module Meeting with Central and West Coast basins	
	November	Groundwater Basin Module Meeting with Main San Gabriel Basin Groundwater Basin Module Meeting with Chino Basin	
2010	January	7	Review initial modeling outcomes using groundwater basin modules; Finalize Groundwater Workgroup policy recommendations for the IRP Update
	March	Groundwater Basin Module Meeting with Main San Gabriel Basin	

- Exploration of other conjunctive use opportunities Metropolitan may wish to address.

The workshops were well attended by Metropolitan member agencies and sub-agencies, groundwater basin managers and groundwater producers, stakeholders, and Metropolitan staff, with up to 50 people attending meetings.

Recommended Policy Principles

From these discussions the group put together a series of recommendations to encourage further development, also found in **Appendix A.9**:

Sustainable Water Supplies

Both surface water and groundwater are critical to future sustainable water supplies for Southern California. Groundwater managers must have access to sufficient water supply resources to recharge and replenish groundwater basins, including recycled and stormwater resources that meet regional, state and federal water quality standards.

Regional Storage & Benefit

Storage by Metropolitan of imported water in reservoirs and groundwater basins is a critical method to provide water for Southern California in dry periods. Surface and groundwater storage programs should provide specified regional benefits at an agreed-upon cost to increase dry-year supply (in accordance with the IRP).

Current Yield

Maintaining the current yield of groundwater basins should be a priority; where possible, the yield should be enhanced.

Groundwater Basin Protection

Programs and policies that protect and encourage the cleanup of degraded groundwater basins should be enhanced and expedited.

Replenishment

Metropolitan imported water should continue to be a component in the management of Southern California groundwater basins.

Recycled water and groundwater are two of six resources that were studied for their potential development as part of the IRP assessment. Also included were conservation, seawater desalination, stormwater, and graywater.

Top Photo: West Basin Municipal Water District's Edward C. Little Water Recycling Facility produces five different qualities of recycled water, including three types that undergo reverse osmosis treatment.

Bottom Photo: Reverse osmosis treatment is used in the pilot operation of the Yuma Desalting Plant near the Colorado River to desalt agricultural drainage water and reclaim up to 29,000 AF of water annually.

Use of Excess Water

Excess imported water should first be allocated to the Metropolitan storage portfolio in quantities to allow Metropolitan to meet the region's full service demands.

Recharge

Recharge of water into groundwater basins is a critical element in the maintenance of a healthy groundwater system. Depth to water, the containment of contaminant plumes, and maintenance of recharge facilities should be considered when decisions are made regarding the availability of water for recharge.

In-Lieu Replenishment

In-lieu groundwater storage is a cost-effective way to provide for storage in Southern California's groundwater basins. Under in-lieu groundwater storage, an agency takes surface water deliveries "in-lieu" of pumping groundwater, resulting in the un-pumped groundwater effectively "stored" in the groundwater basin. It is an efficient method for storing excess imported supplies and recharging local groundwater basins. By turning off wells and providing excess treated supplies when available to its member agencies, Metropolitan, working with basin managers, can put additional supplies into storage within the region. Greater participation should be encouraged in this program. In-lieu replenishment can occur during periods when surface recharge basins cannot be replenished with imported water due to the availability of local water for recharge.

Address Local Needs & Control

Metropolitan will honor and respect local control, legal requirements and existing water rights. Metropolitan should consider the individual needs of a groundwater basin, and local communities. Programs that are implemented should consider issues such as water quality, financial benefits and groundwater levels.

Storage Agreements

Metropolitan should continue the approach to conjunctive use that is grounded in agreements between Metropolitan, its member agencies and local groundwater managers. Agreements should be customized to meet the specific needs of both Metropolitan and other parties to the contract.

Board Policies

Storage agreements should be based upon generally applicable board policy principles, which have strong regional and local support.

Shared Risk

There are risks associated with developing any water resource program, including groundwater storage. Metropolitan should assess the risk of implementing groundwater storage programs and contract with local entities so that benefits are commensurate with the risks for all concerned.

Pricing Signals

Metropolitan will commence a study of data that is expected to help the agency and its partners understand correct pricing signals for replenishment water and storage investments in Southern California. There will be major changes in supply reliability and cost in future years. The issue of storage and conjunctive use needs to be assessed in light of and as part of these changes.

Coordination

Coordination on legislation, regulation and funding issues should be enhanced between Metropolitan, its member agencies, groundwater basin managers and producers.

Recycled Water

Recycled water, formerly called reclaimed water, is wastewater that has been treated so that it can be used beneficially again for a variety of purposes, including agriculture and landscape irrigation, toilet flushing, certain industrial processes, and groundwater recharge. As compared to some of the alternative water supplies, recycled water has the major benefit of being a drought-proof supply since wastewater as a supply source is not subject to the weather-based fluctuations impacting local and imported water supplies. Even though Southern California is recognized as a leader in water recycling, there is significantly more wastewater produced that could potentially be recycled. The U.S. Bureau of Reclamation's (USBR) Southern California Comprehensive Water Reclamation and Reuse

Study estimated that Southern California could have a total recycled water potential of 747,800 acre-feet (AF) by 2040.

Discharges from inland wastewater treatment plants often get used by downstream entities or enhance aquatic habitat. Some of these discharges cannot be re-used because of the quality of the incoming water. The wastewater that can be reused is treated to varying levels depending on its intended recycled water use:

- Tertiary Treatment: Most of the recycled water used in this region is treated to a disinfected tertiary level, also known as Title 22 standards, which refers to Title 22, Chapter 3 (Water Recycling Criteria), Division 4 of the California Code of Regulations. Title 22 recycled water can be used for irrigating parks and playgrounds and for other non-potable uses such as toilet flushing. Based on customer needs, recycled water can be tailored to fit specific commercial and industrial non-potable applications. Both of these require a distribution system (pipelines, pump stations, etc.) and storage facilities for the recycled water completely separated from the potable water system; and
- Advanced Treatment: Advanced treated recycled water is treated to an even higher level, removing salt and other undesirable constituents and is currently used for industrial applications, seawater intrusion barriers, and groundwater recharge.

For example, West Basin MWD currently offers five types of recycled water including:

- Title 22 for a wide variety of industrial and irrigation uses;
- Nitrified water for industrial cooling towers;
- Secondary treated wastewater purified by micro-filtration, followed by reverse osmosis (RO), and disinfection for groundwater recharge;
- Pure RO water for refinery low-pressure boiler feed water; and
- Ultra-pure RO water for refinery high-pressure boiler feed water.

Advanced treated recycled water can be percolated into groundwater aquifers or surface reservoirs and blended with potable water. This blended water can later be pumped out and used as potable water or to maintain seawater barriers. Examples of such "indirect potable" uses are Los Angeles County's Montebello Forebay Groundwater Recharge Program and Los Angeles County's West Coast Basin seawater barrier injection system, which currently blends 25 percent potable water and 75 percent recycled water and soon will be 100 percent recycled water. Another example is Orange County Water District's Groundwater Replenishment System, which uses a high level of treatment to replenish its groundwater supplies with recycled water.

This Technical Workgroup found that barriers to further development of recycled water fall into two general categories: regional challenges and operational challenges as detailed in **Appendix A.10**.

Regional Challenges to Development

Regional challenges include public outreach and political support, local ordinances and regulatory measures, legislation, and permitting processes. For example, in the past, projects have been shelved because of public outcry often fueled by those who have an ulterior motive for not supporting recycled water use (e.g., property values, growth issues, market share of their products, etc.), and permitting for recycled water requires a significant amount of time, effort, resources, and money. Thus, recycled water projects are often faced with delays and difficulties.

Public Outreach & Political Support

In general, the public perception of using recycling water is favorable, particularly in light of current restrictions on imported water supply. Historically, the controversy of using recycled water has focused on direct and indirect potable reuse. Recent successes of indirect potable reuse projects have helped improve public awareness and perception of recycled water use in the region.

The Water Environment Research Foundation funded an interdisciplinary and comprehensive social science study on public perception and

Local water agencies have largely led the development of water recycling and groundwater recovery projects with newer projects incentivized by Metropolitan's Local Resources Program. Pictured left to right, Orange County Water Replenishment District's Groundwater Replenishment System and the Chino Basin Desalter Project.

participation in water reuse within the U.S.[2] It employed a three-phased research protocol consisting of:

1. Literature review and three comprehensive case studies, including interpretive white papers from five different social science disciplines and public health and environmental engineering experts;
2. A multi-stakeholder workshop to promote comprehensive, interdisciplinary analysis of the literature and case study findings; and
3. Peer review among 21 social science and water resource management experts. The case studies included examples of potable and non-potable reuse, with elements of success and failure. Five themes were identified as critical to building and maintaining public confidence in water resource management and water reuse decision-making, which will be instrumental in performing the public outreach:
   a. Managing information for all stakeholders;
   b. Maintaining individual motivation and demonstrating organizational commitment;
   c. Promoting communication and public dialogue;
   d. Ensuring a fair and sound decision-making process and outcome; and
   e. Building and maintaining trust.

To date, most public outreach has consisted of localized efforts to implement local projects and this study helped to identify specific public outreach actions that can supplement those already in existence. Southern California can largely benefit from a regional campaign promoting recycled water, including a general public marketing campaign and a K-12 educational campaign. Metropolitan could form partnerships with wastewater agencies and environmental groups to assist in developing and operating marketing and educational programs and economies of scale can be achieved by launching in conjunction with similar marketing and educational campaigns and utilizing the

2. Hartley, Troy W. , Ph.D. "Water Reuse: Understanding Public Perception and Participation. Water Environment Research Foundation, 2003.

same design, production, and distribution channels.

Local Ordinances & Regulatory Measures

Coordination of a proactive, unified approach to regulation for the region, including ordinances and building standards, will be a critical aspect of implementation.

On February 3, 2009, the State Water Resources Control Board (SWRCB) adopted the highly anticipated Recycled Water Policy. The new policy is intended to support the SWRCB's strategic plan to increase sustainable local water supplies. The purpose of the new policy is to increase the beneficial use of recycled water from municipal wastewater sources in a manner that fully implements state and federal water quality laws. The document is particularly instrumental in addressing salt management, emerging constituents, anti-degradation, and incidental runoff issues. In addition, the new policy establishes consistency on how individual regional water quality control boards should interpret recycled water policy.

In July 2009, the SWRCB also adopted a General Permit for landscape irrigation. The General Permit is consistent with the Recycled Water Policy, state and federal water quality laws, including the statewide water quality standards established by the California Department of Public Health (CDPH). The General Permit facilitates the streamlining of the permitting process and reduces the overall costs normally incurred by producer, distributors, and users of recycled water.

Also in July 2009, the Los Angeles Regional Water Quality Control Board adopted a general use order for non-irrigation uses of recycled water. This general order intends to streamline the permitting process and delegate the responsibility of administrating water reuse programs to local agencies to the fullest extent possible."[3] Although these activities have aided the development of recycled water, the technical workgroup proposed the following actions to address regulatory challenges:

- Work with the WateReuse Association or similar associations to develop local ordinance templates;
- Encourage local ordinances and building codes that promote the use of recycled water;
- Pursue a statewide irrigation and non-irrigation order for recycled water;
- Establish a statewide dual-plumbing or best technology requirement on new buildings;
- Develop funding mechanisms, such as water bonds, that provide matching grants to developers for both dual-plumbing of new development projects and other on-site retrofit expenses, and incentives to agencies for planning;
- Encourage homeowner associations and community groups to support recycled water use on outdoor landscaping of community green areas of an acre or more; and
- Request a lead staff at regulatory agencies to expedite the permitting process for projects in Metropolitan's service area.

Legislation

Legislative support is imperative for creating funding, streamlining processes, and increasing opportunities in which recycled water can be utilized. Legislation can influence the implementation of ordinances and codes, directly affecting recycled water use in the region. Legislative developments on recycled water are ongoing and have been consistent with Section 13512 of the California Water Code that states that California will "undertake all possible steps to encourage development of water recycling facilities so that recycled water may be made available to help meet the growing water requirements of the state."

In 2006, the state Legislature passed AB 32, the Global Warming Solutions Act, which encourages recycled water development and implementation as a means to reduce greenhouse gas emissions by offsetting the need for imported water because recycled water requires less energy to treat and distribute than imported water. Since recycled water projects are a valuable asset to the region's diverse water portfolio, Metropolitan has assisted

3. California Water Quality Control Board Los Angeles Region. (2009). Non-Irrigation General Water Reuse Order No. R4-2009-0049.

in funding recycled water projects, resulting in 59 projects generating 1,323,000 AF since the 1970s.

Within this framework, the Technical Workgroup identified specific areas to develop and support with regards to recycled water legislation. The following list summarizes these proposals:

- Establish legislation that requires the SWRCB to work with regional and local recycled water entities to develop a permit for non-irrigation recycled water use;
- Support legislation that would require revisions to Title 22 to make the recycled water regulations consistent with the proposed revisions to the plumbing code for indoor recycled water use;
- Create legislation that offers federal tax breaks to water agencies for the development of recycled water projects; and
- Work with the Public Utilities Commission to amend its code to allow for recycled water to be incentivized through water rates.

Permitting Processes

Permitting for recycled water requires a significant amount of time and resources. Currently, the regional water quality control boards issue permits in conjunction with the CDPH. CDPH also requires each county health department to conduct its own project inspection, prior to project approval. In some cases, CDPH has delegated the responsibility to review and approve projects directly to the water supplier, where the supplier has demonstrated the ability to implement such a program. Offering this flexibility has significantly streamlined the review process for those agencies, thus reducing development time and cost associated with these procedural requirements.

As discussed above, the recently adopted SWRCB Recycled Water Policy will create a uniform policy for permitting requirements. However, since this policy is fairly new, recycled water purveyors are still evaluating its effect. A key provision of this Recycled Water Policy is the requirement to develop stakeholder-driven salt management plans. The intent is for these plans to ease requirements on recycled water suppliers by taking a more comprehensive and balanced approach to salt management. Acceptance of the stakeholder plans will require active participation of the regional water quality control boards. Metropolitan expects to play a supporting role at the member agencies' request in encouraging active regional board participation and use of reasonable standards in the development of salt management plans.

Operational Challenges to Development

Operational challenges include diurnal and seasonal demands, groundwater recharge and reservoir augmentation, salt and concentrate management, and retrofitting costs.

Diurnal & Seasonal Demand

The demand and supply patterns associated with irrigation and wastewater production, respectively, create challenges in operating a recycled water system. Since diurnal and seasonal wastewater production and irrigation demand patterns are not in sync, storage is needed to accommodate the gap in time-of-production and time-of-use. In addition, conveyance systems need to accommodate larger demand peaks related to the irrigation demands as compared to peaks associated with potable water demands. The Technical Workgroup's recommendations on this challenge are as follows:

- Partnerships should be created so that recycled water storage and demand can be regulated and/or produced in one area and sold in another;
- Focus efforts on areas with new development or little or no existing recycled water infrastructure; and
- Identify other recycled water users, like industries, that can take their water deliveries during the day or encourage users, like golf courses, to develop on-site storage to alleviate the need for diurnal storage.

Groundwater Recharge & Reservoir Augmentation

Reservoirs and groundwater basins must deal with times of extremely high storm flow, reservoir maintenance, basin blend requirements,

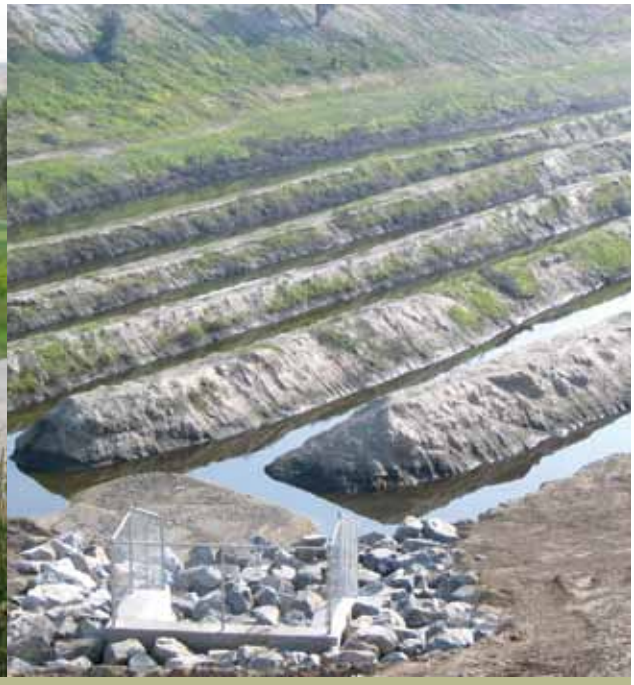
and emerging constituents. Several agencies within the region rely on groundwater basins to regulate seasonal demand of recycled water by taking recycled water when demand is low and augmenting supplies with pumped groundwater to meet peak recycled water demand. However, these basins also serve multiple purposes, e.g., flood control and groundwater replenishment. Interagency coordination is necessary to overcome these scheduling challenges. The Technical Workgroup recommends the following:

- Water agencies and associations should communicate research results and work with the CDPH to address health concerns while promoting recycled water use, including adjustment of CDPH's recycled water recharge and reservoir requirements guidelines; and
- Support monitoring for presence of emerging constituents and work with CDPH and the regional water quality control boards and focus on developing a communication strategy to present the information to the public appropriately.

Salt & Concentrate Management

Salt management plays a crucial role in maintaining water quality in local groundwater basins. Production of recycled water typically requires brine concentrate disposal. In many cases, regional concentrate lines are used to provide concentrate disposal for multiple agencies. Limited concentrate line locations, permitting requirements, and high discharge fees present challenges in sustaining regional salt management objectives. Recommendations from the Technical Workgroup:

- Encourage agencies to pursue state and federal grants through Integrated Regional Water Management Planning processes and other grant programs for concentrate management and recycled water in general;
- Streamline and ease concentrate discharge regulations; and
- Support and facilitate partnerships between utilities to combine discharge lines that would reduce permitting requirements and number of ocean outfalls.



Recycling and groundwater recharge projects reduce or prevent new demand on Metropolitan's imported water supply. Pictured left City of Los Angeles public golf course in Sepulveda Basin. Pictured right Chino Basin spreading grounds.

Retrofitting Costs

Recycled water development can have varying region-wide costs and benefits, both monetary and social. Recycled water may be priced less than the incremental cost of importing more water from other regions, but many private businesses have a difficult time overcoming the large initial investment coupled with the long-payback period to recover costs for dual-plumbing or recycled water retrofits. Retrofits are often more costly than incorporating dual plumbing into new construction and funding is difficult to find for private developers. However, dual-plumbing is not an option for many areas with low potential for new construction.

Construction of recycled water infrastructure can be promoted through various methods. Las Virgenes MWD, Central Basin MWD, West Basin MWD, and others have encouraged recycled water participation by financing the retrofit costs and then charging the customer potable water rates rather than recycled water rates until the loan is paid off. Recommendations to address these costs include:

- Develop funding mechanisms that assist end users with the cost of retrofits. Under Metropolitan's Public Sector Program, about $1.1 million was invested for 85 site retrofits that will use up to 3,300 AF/year of recycled water;
- Develop funding programs, along with wastewater and land use agencies, to help address additional construction costs to install dual-plumbing and distribution lines and additional maintenance and replacement; and
- Revisit the value of recycled water as replacement for imported supply more frequently under Metropolitan's Local Resources Program (LRP).

The region includes a multitude of agencies with unique functions, capabilities, and jurisdictions. In order to optimize existing assets and competencies, the region needs to collaborate on facility operations, management, and planning.

Recycled water has played a crucial role in meeting regional water demands, particularly in time of drought-limited imported water supply. Through advancement in wastewater treatment technology and public health research, recycled water use will continue to expand and diversify.

Seawater Desalination

The Seawater Desalination Issue Paper, found in **Appendix A.11,** identified more than 10,000 seawater desalination facilities worldwide producing more than 13 million AF/year (MAF/year).[4] There are numerous methods for desalting seawater, but the most common involve thermal distillation and membrane separation processes, including RO, the dominant technology in the United States.

Metropolitan has been considering seawater desalination as a potential new supply since the 1960s. Initial efforts included developing a large regional facility near Huntington Beach. In the early 1990s Metropolitan developed and pilot tested its own thermal distillation technology. A companion integration study evaluated potential sites for a Metropolitan facility that would have been co-located with coastal power plants.[5] However, the cost of seawater desalination was not competitive with other resources at that time. The 1996 IRP considered seawater desalination a future resource due to its high cost relative to other available supplies. In the past 10 years, rapid improvements in membrane performance, energy recovery technology and process design have lowered seawater desalination costs to the point where it is now more competitive with other new supply options.

In response to member agency interest, Metropolitan created the Seawater Desalination Program (SDP) in 2000 and in 2001 released a competitive bid process to solicit projects from among its 26 member agencies. Five member agencies—Long Beach, LADWP, Municipal Water District of Orange County (MWDOC), SDCWA, and West Basin MWD—submitted projects totaling a projected yield of 142,000 AF/year. As with Metropolitan's LRP for recycling and brackish groundwater recovery, Metropolitan authorized uniform sliding-scale incentive agreements with these agencies for up to $250/AF produced. Metropolitan's SDP represents a potential investment of about $900 million over

4. www.desaldata.com
5. A brief history of Metropolitan's activities is contained in the May 26, 2009 board presentation item 2a.

25 years for about 3.5 MAF of desalinated supply, depending on which projects move forward. The 2004 IRP set a target for seawater desalination of 150,000 AF by 2020, to help establish a planning buffer supply.

Seawater desalination represents a new local supply that could be used to fill future identified gaps between imported water availability and the overall regional water supply need. It represents a significant opportunity to diversify the region's water resource mix with a new, locally controlled, drought-resistant supply. Seawater desalination produces high-quality potable water that can be delivered through existing distribution systems directly to customers. Like other new local supplies, seawater desalination could help relieve pressure on constrained sources of water like the Delta and Colorado River.

As with other new resources considered for inclusion in this plan, the development of seawater desalination poses a number of unique opportunities and challenges. Challenges to further development of seawater desalination in Southern California fall into three general categories: cost, permitting/regulatory challenges, and planning challenges. Cost challenges include high capital and energy costs. These costs vary by project based on the need for new intake/outfall infrastructure and distribution system facilities. Permitting/regulatory challenges involve the potentially lengthy process to permit a seawater desalination facility, as well as several ongoing state regulatory processes that could affect the future implementation of seawater desalination. Planning challenges include issues related to: site location and system integration, water quality and mitigation for marine organisms, and energy use and greenhouse gas emissions.

Cost

Over the past decade, advancements in membrane design, process configuration, and energy recovery technology have reduced the costs of seawater desalinated supplies relative to other new resource options. However, the high development costs, capital costs, and operating costs could be an obstacle for some agencies. The operating cost of seawater desalination is largely driven by the energy-intensive RO process, but distribution costs may also be significant depending on the conveyance and lift needed. Although per-unit costs have also been reduced, they are still a factor in planning and developing potential projects. Recent estimates for Southern California range from $1,300 to $2,000/AF depending on project size, intake/outfall infrastructure, and distribution integration costs.

Capital Costs

Capital costs associated with desalination projects can vary by site depending on location, as well as the need for intake/outfall infrastructure and distribution pipelines. To reduce capital costs, several proposed projects in Metropolitan's service area are considering siting adjacent to coastal power plants (co-location) to take advantage of existing intakes, outfalls, and industrial-zoned land. Major capital costs are described below:

- Land: Potential sites for seawater desalination plants in Southern California are limited by the availability and cost of coastal real estate;
- Treatment: Costs associated with desalination facilities involve pre-treatment facilities; RO equipment, including membranes; post-treatment; and supporting infrastructure;
- Intakes & outfalls: The cost of new intakes and outfalls can be a significant element of the total project cost. Siting desalination facilities near coastal power plants may avoid these costs by taking advantage of existing open water intakes and outfalls. New regulations developed by the SWRCB may lessen the advantages of co-location for new seawater desalination facilities. The new regulation are described below; and
- Integration: Project size and location significantly affect the cost of integrating desalinated product water into existing distribution systems. Locations requiring long transmission pipelines or elevation gains to tie-in points would have higher integration capital costs.

Operating Costs

Seawater desalination operating costs are largely driven by energy use, but also include membrane replacement, maintenance, chemicals, and labor. Environmental mitigation costs may also contribute to total operating costs. The total power costs of a project will depend on the price of electricity, as well as with pre-treatment and distribution pumping energy requirements. Increasing the energy efficiency of seawater desalination reverse osmosis is still an area of active research that could potentially reduce energy use by 20 percent or more, though there is a minimum energy needed to overcome osmotic pressure. Technologies currently under development include membranes imbedded with specialized nano particles and nano filtration in a two-pass configuration.

Cost Recommendations

The member agency Technical Workgroup suggests securing funding to research and develop more cost-effective technologies. Additionally, the region should acquire potential desalination treatment plant sites to reduce future costs.

Permitting & Regulatory Challenges

The unclear and potentially lengthy permitting process, along with several ongoing state regulatory processes, are key challenges facing the development of seawater desalination

Permits & Approvals

Seawater desalination plants in California must obtain more than 20 federal, state, and local permits and approvals in a complicated process where some regulatory agencies defer review until other agencies approve a project. Many required permits are related to coastal and ocean resources and from a water resource perspective are unique to seawater desalination. In many cases, there is overlap, redundancy and/or inconsistent or unclear regulatory guidance over key resource issues such as marine biology, air quality, land use, and water quality. Since both the California Coastal Commission and CDPH require approvals from other state agencies before issuing permits, they will typically be the last approvals needed prior to construction. **Table 2.5** lists the major permits and approvals that may be required depending on the location of the seawater desalination project.

Streamlining permitting processes has been identified by the member agency Technical Workgroup as a critical factor needed to facilitate seawater desalination project development. This could be accomplished in a variety of ways, including but not limited to: establishing a state desalination commission, similar to the Coastal or Energy commissions, that would centralize the permitting in one agency; forming a watermaster-like permitting coordinator for desalination that could bring together regulatory agencies and desalination developers; or developing a SWRCB policy for the permitting process.

Some of the current obstacles preventing more efficient permitting include a general lack of data for developing standards and regulations that would apply to all seawater desalination projects and a lack of regulatory agency staff time and expertise to process available data. Potential joint work shares between desalination experts and regulatory agencies in reviewing permits and working on developing data-based standards could improve this issue and relieve pressure on permitting agency staff.

Regulatory Process

Legislation can influence the implementation of seawater desalination by changing regulatory and permitting requirements. For example, U.S. House of Representatives Bill (HR) 21, the Ocean Conservation, Education, and National Strategy for the 21st Century Act, if passed, could significantly alter the governance and policy of ocean resources in the U.S. and have major implications for future desalination projects. The goal of HR 21 is to establish a national policy "promoting ecologically sustainable ocean resource use and management." Among other things, it sets guiding principles for protecting and restoring ocean and coastal waters, Great Lakes, and related resources, requires all federal agencies to update regulations to be consistent with the policy, establishes a council of advisors on ocean policy to advise the president, and designates nine ocean regions to promote coordinated regional efforts to implement the national ocean policy.

Table 2.5 Agency Permits & Approvals for Seawater Desalination Projects

	Agency	*Permit or Approval*
Local	Local jurisdiction (city, water agency, etc.)	CEQA, Local Coastal Development Permit (in some cases), encroachment permits, operating agreements, other permits/approvals
State	Coastal Commission	Coastal Development Permit and/or Local Coastal Program Amendment; Consistency with coastal zone management program
	State Lands Commission	State land use lease/amendment
	SWRCB	National Pollutant Discharge Elimination System discharge permit; Waste Discharge Requirements
	Regional Water Quality Control Boards	Section 401 water quality certification
	California Energy Commission	Application for Certification Amendment reviews changes to regulated power plants for co-located desalination facilities
	CDPH	Drinking water permit and Federal Surface Water Treatment Rule
	Public Utilities Commission	For private water utilities
	Department of Parks and Recreation	Encroachment permits
	Department of Fish and Game	California Endangered Species Act permit/consultation, Marine Life Protection Act and Areas of Special Biological Significance consultation
	Caltrans	Encroachment permits
	SWRCB/Division of Water Rights	Surface/groundwater
	Air Pollution Control District – South Coast Air Quality Management District/San Diego County Air Pollution Control District	Permit to construct/operate
Federal	U.S. Coast Guard	Regulates structures in navigable waters
	U.S. Army Corps of Engineers	Section 404 permit for construction in navigable waters; Section 10 permit for structures in navigable waters
	National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service/U.S. Fish and Wildlife Service	Review for potential impacts to endangered species marine mammals, migratory birds, essential fish habitat, and national marine sanctuaries
	Bureau of Land Management/Department of Defense	Encroachment on federal lands
	USBR/Bureau of Land Management/Environmental Protection Agency	National Environmental Policy Act compliance

Besides the federal efforts, there are several ongoing state regulatory processes that could affect the future development of seawater desalination:

SWRCB – 316b Regulations

The SWRCB finalized implementation guidelines for federal regulations of existing open water intakes used by power plants in May 2010. Section 316b of the Clean Water Act provides that the design of structures used for once through cooling must "reflect the best technology available for minimizing adverse environmental impact."[6] The new SWRCB requires existing power plants to re-power using closed-cycle wet cooling systems or reduce seawater intake by 93 percent of historical average flows. Power plants in Southern California have compliance deadlines that range from 2011 to 2022. Next steps for the regulations are evaluation and final approval by the Office of Administrative Law. Although seawater desalination is not addressed in the proposed regulations, how the new regulations are implemented could affect

6. The Clean Water Act. 33 U.S.C. §1251 et seq. (1972). Available at *http://epw.senate.gov/water.pdf*

projects that are being planned to co-locate with coastal power plants.

SWRCB –California Ocean Plan & Seawater Desalination

The SWRCB is responsible for reviewing water quality standards in the California Ocean Plan and for modifying and adopting standards in accordance with the federal Clean Water Act and the California Water Code. In its 2008 triennial review of the California Ocean Plan, the SWRCB originally intended to set new standards for seawater desalination concentrate discharges. Instead, the SWRCB has indicated it may initiate a process to develop a comprehensive set of regulations for seawater desalination concentrate discharges and intakes in late 2010.

Department of Fish & Game – Marine Protection Areas

The Marine Life Protection Act was passed by the California Legislature in 1999 to better evaluate California's coastal waters and to direct the state to create and manage a network of marine protection areas (MPAs) along the California coastline. The purpose of MPAs is to protect critical marine habitats by limiting resource extraction including the "taking" of marine life. MPAs could affect or limit the location, design and operations of new seawater desalination intakes and outfalls in Southern California. The state Department of Fish and Game forwarded new MPA proposals for the Southern California coastline to the California Fish and Game Commission for final consideration in December 2009. In June 2010, the Fish and Game Commission released the Environmental Impact Report (EIR) for the proposed MPAs. Final approval is expected in the winter of 2010.

Steelhead Recovery Plan

In July 2009, the National Marine Fisheries Service released the public review draft of its Southern California Steelhead Recovery Plan. In 1997, the Southern California steelhead was first listed an endangered species under the federal Endangered Species Act of 1973 (ESA). The over-arching goal of the Recovery Plan is the recovery of the Southern California steelhead and its removal from the federal Endangered Species List. These efforts may effect regulations or siting of outfall/intakes for facilities, so it is important to take this into account when investing in land.

Member agency recommendations for regulatory processes are similar to those recommended for the permitting process. Compliance with regulations is challenging because of the variety of agencies and regulations, and there is potential for streamlining, coordination, and consolidation. Recommendations included encouraging a science-based, statewide policy or legislation in support of desalination in order to assist the process further and remove significant hurdles. Additionally, up-front partnerships with environmental groups on desalination projects and public outreach could stem some of the contention and effectively address potential concerns.

Planning Challenges

Site location and system integration, water quality, environmental mitigation, energy requirements, and greenhouse gas emissions are planning issues that need to be addressed by potential project proponents.

Siting & System Integration

A number of variables affect the siting of potential seawater desalination projects, including the availability of suitable coastal land, the location of existing ocean intakes and outfalls, the proximity of system integration delivery points, overlying water demands, water quality requirements, and suitable geological conditions for alternative intakes if used.

The siting of seawater desalination plants with coastal power plants has several advantages, including the use of existing ocean intake/outfall infrastructure and land zoned for industrial use. Using existing infrastructure theoretically reduces intake and outfall costs and can result in minimal new marine life impacts from desalination operations when power plants are running. However, in recent years, co-location has become controversial with key permitting agencies and environmental groups. As described earlier, the SWRCB has developed regulations limiting the use of open water intakes by power plants. The new requirements would reduce many of the environmental benefits and

potentially some of the cost savings associated with co-location.

Metropolitan completed a System Integration Study in 1994 that considered 12 seawater desalination facilities, with project capacities ranging from 20 million gallons/day (MGD) to 100 MGD, and four integration options, including local distribution systems, regional feeders, a combination of local distribution and regional feeders, and construction of new coastal feeders. In general, the study concluded that smaller projects located near water demand centers may integrate effectively into existing local distribution systems while minimizing distribution costs. Larger regional projects or projects located away from demand centers may require conveyance to a regional pipeline, new coastal feeders, or distribution infrastructure to bring supplies to demand centers.

Marine Life Protection

Marine life impacts associated with seawater desalination include impingement and entrainment of marine organisms related to seawater intake system, and impacts to salt-sensitive species due to concentrate discharges. Several member agencies are researching alternative intake technologies with the potential to minimize impingement and entrainment impacts, including Long Beach's sub-surface infiltration galleries, MWDOC's slant-drilled beach wells, SDCWA's deep-infiltration gallery tunnel collector wells, and West Basin MWD's wedgewire screens for open water intakes and sub-surface infiltration gallery pilot study. Sub-surface technologies also have the potential to reduce pre-treatment needs.

Challenges with alternative subsurface technologies include the availability of favorable geologic conditions at the selected desalination plant site, the low permeability of ocean-floor sediments, high construction costs, the uncertain long-term performance yield, maintenance accessibility, replacement costs, and scalability for a large scale project.

Energy Use & Greenhouse Gas Emissions

Greenhouse gas emissions associated with seawater desalination's energy use have become an important planning issue in California. Despite recent advances in energy efficiency, seawater desalination still requires more energy per AF than most other supply options available to Southern California. However, the gap between desalination and imported water supplies is decreasing.

Although minimal greenhouse gases are emitted directly by seawater desalination plants, they cause indirect emissions through electricity use. Until recently, water projects have not been required to be carbon neutral. However, the California Coastal Commission and California State Lands Commission both required a recent project to be carbon neutral by offsetting its "net" greenhouse gas. Although the legislative basis for municipal water projects to be carbon neutral is unclear, it is possible that the recent greenhouse gas emission offset requirements will be a precedent for subsequent seawater desalination projects.

The member agency Technical Workgroup suggested that agencies should continue to pursue energy reduction technologies in addition to exploring future possibilities including exploring alternative and renewable energy sources on a regional scale, e.g., solar panels on Metropolitan-owned land in the desert, or pursuing a policy that desalination energy use be treated comparable to other water resources with regard to required offsets.

Stormwater

Stormwater is an integral part of the hydrologic cycle. Stormwater originates from rainwater that becomes surface runoff or naturally percolates into the ground to replenish groundwater basins. As California has grown and developed, the amount of stormwater flowing off impervious surfaces into surface water streams and flood channels has increased, thereby reducing water allowed to infiltrate into groundwater aquifers and increasing water flowing to the ocean. Systems were engineered to convey stormwater runoff as quickly as possible from populated areas to waterways to reduce flooding. Although this system is efficient in reducing flooding and protecting property, it may also exacerbate local water supply issues experienced today in many of the region's groundwater basins due

to the decrease in natural percolation. The depletion of local storage water, along with other environmental factors, has spurred a change in how local agencies approach stormwater.

The concept of capturing stormwater for groundwater infiltration and reuse is not new. From 1995 to 2004, an average of about 477,000 AF per year of stormwater runoff was captured in spreading basins or other centralized facilities for groundwater recharge within the Metropolitan service area.[7] Despite the advances in stormwater capture, in the urban areas alone, there is estimated to be an average of more than 1 million AF/year of stormwater that is not captured in the Metropolitan service area.[8]

Many local agencies are designing and implementing integrated watershed projects and plans to enhance stormwater and dry-weather recharge and direct use. These projects and plans generally incorporate multiple benefits, such as reduced flooding, increased water supply, enhanced recreational opportunities and wildlife habitat, and reduced stormwater pollution. Projects can incorporate centralized or distributed facilities. Examples of centralized facilities include spreading grounds, wetlands, large underground infiltration or storage tanks, dams, retention basins, median retrofits, urban runoff recycling facilities, surface water reservoirs, and other large-scale projects that collect stormwater runoff from multiple parcels. Distributed single parcel projects involve the implementation of stormwater BMPs such as rain barrels, cisterns, rain gardens, and drain spouts diversions. The Stormwater Technical Workgroup prepared a Stormwater/Urban Runoff Issue Paper (**Appendix A.12**) that identifies issues that need to be addressed, or require further research, to facilitate wide-scale adoption. The issue paper also identifies recommendations to overcome these obstacles and ultimately enhance stormwater runoff capture and use to augment the local water supply.

7. Source: MWD Groundwater Assessment Study: September 2007
8. Source: Stormwater/Urban Runoff Issue Paper

Issues

Quantifying Yield, Costs, & Benefits

One of the largest impediments to investing and relying on local stormwater projects as a water supply resource is that a quantified relationship between stormwater capture and production yield has not yet been determined. Variables include specific groundwater basin geology, water quality (groundwater and stormwater), infiltration and evaporation losses specific to each project, and the groundwater basin management structure. The effects of these variables on production yield are currently not quantified and need further study. Stormwater direct use projects also consist of an assortment of currently unknown variables. Until variables are quantified, investment in stormwater projects may be considered risky because the potential conversion rate from captured stormwater to yield can be anywhere between 0 and 100 percent.

Beyond determining the water supply yield of a project, the cost-effectiveness and economic feasibility of a project is difficult to determine at this time. Stormwater projects generally encompass multiple objectives that incorporate a variety of costs and benefits, many of which overlap, making isolating the water supply component cost problematic. Additionally, there are multiple approaches to calculating the monetary value of the water supply benefit. This quantification is needed to compare benefits to costs, and to make informed investment decisions.

Water Quality

Stormwater projects potentially affect – and are affected by – both surface water and groundwater quality. The extent of this effect varies per project and further study is needed to understand the optimal balance of water quality and water supply.

Legislation & Regulations

Current regulatory and management structures may limit the water supply yield of a stormwater capture and use project. For example, in some groundwater basins, legal rights to extract groundwater may not allow increased production, regardless of increased stormwater

recharge. More dialogue is needed to refine existing regulatory and management structures to maximize the water supply benefit.

Regional coordination is also needed to present a unified front and more effectively influence legislation.

Funding

Total project costs for stormwater projects vary greatly, as do the scopes for each project. Depending on the project scope, these total costs incorporate components to provide a water supply benefit, but also a multitude of other related benefits, such as flood reduction, surface water quality improvements, and habitat and recreational enhancements. The more variety and quantity of benefits the project provides, the more the project tends to cost in total. However, the multiple benefits potentially bring in multiple funding partners, which effectively reduces the individual cost burden to provide each benefit. This holds true for both capital funds and maintenance responsibilities. For example, many of the agencies that have funds to cover capital costs (through their capital budgets and through grant funding) struggle with the ensuing maintenance responsibilities due to a restrictive maintenance budget.

Technical Workgroup Recommendations

- Begin to identify and study various pilot projects within the next year to develop a model to quantify the relationship between capture and production, to quantify water supply component costs and benefits, to optimize partnerships, and to better understand regional challenges;
- Model, per basin, the effect of increased active stormwater recharge on production yield (using IRPSIM);
- Determine a business case and an accurate cost/benefit analysis for providing regional incentives/rebates based on the study of various pilot projects;
- Take the lead in coordinating a proactive, unified approach to legislation and regulation for the region, including ordinances and building standards;
- Continue to encourage enhanced stormwater recharge/use partnerships to educate the public on the benefits and uses of stormwater, including the relationship between stormwater quality and drinking water supply, and facilitate coordination of information to increase message consistency;
- Continue to provide an avenue for open regional discussion on enhanced stormwater capture and use as a water supply resource;
- Create/continue a dialogue between stormwater, water supply, and groundwater managers to refine existing groundwater and surface water management, and maximize stormwater runoff as a local water supply;
- Collectively develop a set of monitoring guidelines to increase technical knowledge; and
- Encourage information sharing of challenges and lessons learned to improve future water supply augmentation efforts, including:
  - Technological improvements;
  - Water quality data;
  - Information gained from the study of pilot projects;
  - Examples of governance;
  - Regulatory processes; and
  - Operations and maintenance.

Synergy (Groundwater, Recycled Water, Stormwater)

During the technical workgroup process, several of the workgroups noticed that they had identified similar recommendations with respect to Metropolitan's participation in legislative affairs, public outreach, and funding efforts. To streamline these ideas, a "synergy" workshop was held on April 20, 2009 that included participants from the groundwater, recycled water, and stormwater technical workgroups. Improved synergy amongst the groundwater, stormwater, and recycled water agencies can enhance basin yield, reduce imported water demands, and normalize water blending targets for use in recycled water spreading throughout the region.

The concept of synergy is reflected by the SWRCB Recycled Water Policy that sets mandates for increased use of recycled water and stormwater, requires salt/nutrient management plans for all groundwater basins, and encourages less stringent monitoring and regulatory requirements for stormwater treatment projects.

Summary of Recommendations

Synergy Workshop participants identified opportunities to work together to optimize the use of groundwater, recycled water, and stormwater in the Metropolitan service area. These include legislative and regulatory issues, education and public support, and funding cooperation and are detailed in **Appendix A.13**.

- Metropolitan should take a leadership role in coordinating with its regional partners to effectively lobby the state Legislature to develop improved policies regarding the treatment and use of recycled water and stormwater. Ensure that legislators are educated on issues before they pass additional rules and requirements. Ensure that new legislation come with funding to help local agencies implement new requirements;
- Stormwater, recycled water, groundwater, and imported water are interrelated. Yet, the public message among the various interests is inconsistent and should be better coordinated to provide maximum impact. For example, a water supply education campaign at a school could also include information about stormwater, recycled water, and groundwater to educate the public on the entire water picture and on ways an individual can be part of the overall solution. Additionally, "cash for grass" and other landscape conservation programs could be augmented to include rain gardens and downspout re-directs for recharge, and rain barrels for direct use. Metropolitan should take a leadership role in coordinating with its regional partners to improve public outreach, education, and support for enhanced stormwater and recycled water use. Metropolitan and other water agencies, flood control agencies, public health agencies, and other partners should work together to develop a clear and consistent message to the public regarding the safety of drinking water and how water supply systems are integrated (recycled water, groundwater, and stormwater); and
- Metropolitan should seek funding partners for stormwater and recycled water projects. Metropolitan should also consider a business model to develop incentives related to use of stormwater.

Graywater

During the 2008 stakeholder forum process, various stakeholders requested that graywater be included in this IRP update and examined as a potential resource for Southern California. To this end, the Technical Oversight Committee created a technical workgroup to determine the challenges to graywater development. The workgroup and Metropolitan staff concluded that graywater is not a significant, viable water supply for Metropolitan in the foreseeable future. In addition to issues with cost and existing regulations, there is the added issue of graywater projects negatively impacting wastewater and recycled water infrastructure. For these reasons, this IRP Update does not recommend action in the area of graywater beyond feasibility studies.

The 2007 California Plumbing Code defines graywater as:

"untreated waste water which has not come into contact with toilet waste. Graywater includes waste water from bathtubs, showers, bathroom wash basins, clothes washing machines, and laundry tubs, or an equivalent discharge as approved by the Administrative Authority[9]*. It does not include waste water from kitchen sinks, photo lab sinks, dishwashers, or laundry water from soiled diapers."*

In California, graywater is currently used for irrigation of landscaping at the site of generation, although graywater still cannot be put to indoor beneficial use, such as flushing toilets and urinals, unless it is treated to Title 22 tertiary recycled water standards[10].

9. This "Administrative Authority" is the same as the "Enforcing Agency" in the HCD regulations in Appendix A.8.b, both of which refer to whatever local or regional government agency has jurisdiction over the proposed graywater location.
10. "Title 22," the California Department of Public Health standard for recycled water, is in reference to Title 22, Chapter 3, Division 4 of the California Code of Regulation.

Graywater was not identified as a water supply component in the 2004 IRP Update. However, the Graywater Technical Workgroup prepared a Graywater Issue Paper, which is provided in **Appendix A.8** that discusses graywater activities, regulations, potential as a resource, and challenges to further development, discussed below.

Background

Historically, California has had one of the strictest plumbing codes when it comes to installation of graywater systems.

SB 1258, signed by the governor into law on July 22, 2008, directed the California Department of Housing and Community Development (HCD) to be the state agency responsible for proposed building standards for the construction, installation, and alteration of residential graywater systems. The bill requires HCD to adopt building standards for residential graywater systems and to submit such standards to the California Building Standards Commission for approval. SB 1258 also modified the existing Health and Safety Code to allow cities, counties, or other local agencies to adopt building standards (after a public hearing and enactment of an ordinance or resolution) that either prohibit entirely the use of graywater or that are more restrictive than the graywater building standards adopted by HCD. Additionally, the California Department of Water Resources (DWR) retained the responsibility for commercial and industrial graywater system standards.

Because graywater is untreated wastewater that can contain pathogens and have a potentially deleterious impact on public health, the California Plumbing Code requires piping, valves, and other graywater components to be separate from potable water systems. Previous versions of the code required that graywater systems must be designed and operated to prevent graywater from reaching the land surface or becoming airborne, restricted graywater use to subterranean irrigation, and prohibited irrigation of vegetables or fruit that grows on the ground. Also, until recent plumbing code changes, the former requirement for subterranean, or subsurface, irrigation entailed drip irrigation lines buried at least nine-inches beneath the ground surface. Because of these restrictions, very few graywater systems were legally installed. It is unclear how many illegal graywater systems have been installed and are operating within the state.

On January 27, 2010, the California Building Standards Commission approved new graywater regulations (Title 24, Part 5, Chapter 16A of the California Code of Regulations), as developed by HCD, that allow for increased use of graywater systems within the state by modifying the subsurface irrigation requirement for graywater drip lines from burial at least nine inches beneath the ground surface to at least two inches beneath mulch, rock or soil, or a solid shield to minimize the possibility of human contact. These regulations are included in **Appendix A.8.b**.

Also, the new regulations created a three-tiered graywater system:

- Clothes Washer System: does not require a construction permit if in compliance with requirements of new regulations;
- Simple System: not including a clothes washer system and discharge capacity is 250 gallons per day or less, but does require construction permit unless specifically exempted; and
- Complex System: not including a clothes washer system or a simple system and discharge capacity is greater than 250 gallons per day, but does require a permit unless specifically exempted.

The new regulations still provide that cities, counties, and other local governments may further restrict or prohibit the use of graywater systems after a public hearing and enactment of an ordinance or resolution.

System Components & Costs

As previously noted, few legal graywater systems have been constructed to date in California. With the recent changes to the California Plumbing Code, local public agencies with permitting authority may still choose to prohibit graywater systems, or enact stricter code regulations that would impact the extent of construction of graywater systems within their jurisdictions. The construction costs for retrofitting existing properties for graywater systems are typically

higher than the costs for including graywater systems within new construction.

As was documented in the Graywater Technical Workgroup Issue Paper, the cost of graywater systems varies widely, depending on compliance with code, level of treatment, and size and sophistication of system. Capital costs under the pre-2009 regulations were found to exceed $20,000 for high-end systems, not including the costs for permitting, maintenance, and inspections.

Currently, sources of public funds for graywater systems in the state are limited, especially with the history of stringent standards for graywater systems in California.

Water Quality Issues

Often the public confuses graywater with recycled water and does not realize that graywater is untreated wastewater while recycled water is highly treated to Title 22 standards. Recycled water is suitable to a much wider range of non-potable beneficial uses than graywater. Likewise, the public may confuse graywater with blackwater, which consists of wastewater from kitchen sinks, dishwashers, and toilets.

There are public health issues associated with increased use of graywater. Using graywater does carry the potential risk of transmission of disease-carrying organisms from sick to healthy individuals. Public health departments are concerned that people might inadvertently reconnect graywater systems into the potable water system. There are public health risks if the graywater becomes airborne, or if there is excessive/extending ponding or runoff of graywater. Also, there are concerns that graywater use may have a detrimental impact on the receiving groundwater quality.

Conclusion

The Graywater Technical Workgroup concluded that more research and development is needed to better understand the water quality impact and cost-effectiveness of graywater. Because of the many unknowns and the negative impact on recycled water and wastewater infrastructure, it is unlikely that graywater will become a significant regional supply.

The Graywater Technical Workgroup recommended that Metropolitan not take an active role in providing financial incentives for installing graywater systems at this time due to high costs, lack of data, and uncertain regulatory environment. Additionally, the Graywater Technical Workgroup found that it would be premature to quantify implementation targets for graywater for this IRP Update.

Strategic Policy Review

As Metropolitan's board members, staff, member agencies, members of the public, and stakeholders participated in the collaborative process described earlier to identify regional resources and the challenges for their development, the question emerged: What should Metropolitan's future role be in managing and developing the region's water supplies?

Process

To address this question, Metropolitan held a series of workshops at the board level to evaluate Metropolitan's future role in the region and its mission. As staff developed and presented potential resource options, the IRP Steering Committee shifted focus to planning policies and goals. A forum called the Strategic Policy Review was created to delve into core policies and establish new directives if necessary. This forum allowed stakeholders to evaluate impacts of current and proposed policies, particularly in the manner in which those policies influence Metropolitan's role in regional development. The purpose of the Strategic Policy Review was to examine the impact of different roles for Metropolitan and its member agencies in developing water resources and supply reliability at the retail service level in the future, akin to the Strategic Plan process of 2000 and the 1995 Strategic Assembly process leading up to the 1996 IRP.

Workshops

The process centered on three facilitated board workshops that were designed to clarify, analyze, and discuss the potential impacts for different roles for Metropolitan. A summary of these workshops is shown in **Table 2.6**.

Table 2.6 Strategic Policy Board Workshops

Date		Content	Outcome
2009	August	• Process and schedule • Guiding principles and evaluation criteria • Alternative for new regional supplies	• Input on evaluation criteria • Input on alternatives
	October	• Review evaluation criteria and alternatives • Technical evaluations of project supply yields, cost, issues, and water quality for water supply options	• Understanding technical assumptions and data • Identification of needed revisions
	November	• Evaluation of alternative approaches • Sensitivity to uncertainties	• Understanding assumptions • Concurrence on validity of initial findings • Identification of additional analysis

The workshops revisited the function and importance of a regional agency with access to imported resources, diverse capabilities, and a flexible scope of services. The dialogue was spirited and far-reaching. Board members expressed diverse views regarding the extent to which the region should depend on Metropolitan's actions and initiatives (with the associated costs and commitments) and the degree to which a member agency should accept responsibility and control over its own water supply reliability. No one questioned, however, the importance of reliable and safe water supply for the people and economy of Southern California – only the means by which that uniformly-upheld goal should be achieved.

Examining Potential Roles for Metropolitan

In examining alternative roles for Metropolitan, the board began by looking at the key balance between Metropolitan's role as a water importer and its role in local supply development.

At present, Metropolitan takes an active role in the development of water resources for the region, both on the imported water side and in local development through partnerships and incentives. The current role for Metropolitan is driven by the policies laid out in the Laguna Declaration, Metropolitan's Mission Statement, and previous IRPs. However, this role could change as deemed regionally necessary. For example, at one end of the spectrum, Metropolitan could focus solely on importation, or on the other end of the spectrum, it could import water in addition to maintaining involvement in local resource development.

The extent and manner of Metropolitan's local resource development participation could have divergent regional impacts as well. Historically Metropolitan has incentivized local resources through its LRP program, but there are other options for funding, ranging from offering incentives to establishing full ownership. In this analysis, several options for local resource development were considered by Metropolitan's board, including incentivizing, partial ownership, and full ownership.

For the purpose of analysis and assessment of key differences in alternative roles for Metropolitan, three approaches were developed that incorporated these varying levels of importing and local involvement:

- Current Approach;
- Imported Focus; and
- Enhanced Regional Focus.

Table 2.7 shows key differences for each role, while all approaches assume the following:

- Demands and demographic projections are consistent with methods outlined in **Appendix A.2**;
- Conservation credits continue unchanged and levels of conservation are consistent with retail-level compliance with 20x2020

TABLE 2.7 COMPOSITION OF ALTERNATIVE ROLES FOR METROPOLITAN

Component	*Current Approach*	*Imported Focus*	*Enhanced Regional #1*	*Enhanced Regional #2*
Successful Delta Solution	√	√		√
New Local Resource & Conservation Incentives	√			
New Regional Supplies			√	√

legislation.[11] Further details on conservation modeling can be found in **Appendix A.2;**

- Metropolitan will honor its current LRP contracts to expiration and the local resources included are those developed or committed to date, and are shown to grow to estimated full yield through 2035;
- The Carlsbad Seawater Desalination Facility is considered to be "Under Construction" and online in 2012;
- CRA supplies include existing/committed programs along with planned Quantification Settlement Agreement program ramp-up;
- Colorado River transactions are available to supply additional water up to the CRA capacity of 1.25 MAF on an as-needed basis;
- SWP supplies are estimated under restrictions from current Delta smelt and Chinook salmon Biological Opinions until 2012, after which an Interim Delta Solution is implemented to lessen the impact of the Biological Opinions;
- Metropolitan can use its existing storage portfolio capacity of approximately 4.9 MAF[12] of surface and groundwater storage, and any existing/committed water transfers; and
- No access to additional SWP water transfers in addition to any existing/committed water transfers are available, including state Drought Bank supplies.

For the modeling process, these common assumptions are projected out to year 2035 and incorporated into Metropolitan's comprehensive Integrated Water Resources Plan Simulation Model (IRPSIM). IRPSIM is based on 83 years of historical hydrology from 1922 to 2004, and estimates of water surplus and shortage are determined over a 25-year planning period. The IRPSIM model allows the analysis of information as to hydrologic and climatic effects on supplies, demands, and storage capability and use. The information calculated by the simulation model provides time series and probabilistic outcomes of resource use and regional surplus and shortage conditions in frequency and magnitude. Additional details on Metropolitan's IRPSIM model and methodology can be found in **Appendix A.1**.

Once the base assumptions common to all scenarios were established, alternative mixes of potential resource investments and implementation timing were developed for each of the Strategic Policy Review alternative roles. These alternative resource scenarios were added to the base assumptions and then modeled using IRPSIM. For the purposes of reliability comparisons between the alternatives, the key measures of each case were the frequency and magnitude of shortages for years 2015, 2025, and 2035. The cost and rate impacts associated with these roles were also evaluated.

Water Rate Impact Assumptions

The first step in calculating Metropolitan's water rates is to identify the various costs associated with providing water service. Staff used the "cash needs" approach, an accepted industry practice for government-owned utilities, which leads to the fixed and variable costs used in this analysis. All of these costs make up Metropolitan's gross revenue requirement that must be made up through rates and charges. Metropolitan generates income from taxes, interest income, hydroelectric power sales, and other miscellaneous activities that is used to offset the gross revenue requirement resulting in a net revenue requirement that is used to set water rates and charges. Details on each of the costs, revenues and rate setting procedures are discussed below.

11. For more information on retail versus regional compliance with 20x2020, see the following section under Component 1: Core Resources Strategy.
12. This does not include Emergency Storage capacity, described in Appendix A.15.

Fixed Costs

Fixed costs include costs incurred annually, independent of the volume of water sold. The total annual cost is divided by projected sales in order to calculate per-acre-foot rates.

Administration

Administrative costs includes salaries and benefits, professional services, travel, material and supplies, and other miscellaneous expenses. The average annual rate of inflation to 2035 was assumed to be 3.7 percent. This is higher than the regional rate of inflation to reflect higher rates of increase for medical and retirement expenses.

Various O&M

Various O&M costs include operating equipment, performance programs, insurance, leases, association dues, property taxes, other post-employment benefits, and contingency. For all of the categories the inflation rate was assumed to be 3.5 percent with the exception of contingency and other post-employment benefits funding. The 2010 and 2011 contingency is assumed to be zero and one percent annually after that. Other post-employment benefits funding levels are still undetermined, so the funding level is assumed to be zero for 2010 and 2011 but is forecast to be funded at $10 million for 2012, $15 million in 2013, and $20 million from then forward. Other O&M costs are expected to increase an annual rate of 5.4 percent through 2035.

SWP

Fixed costs for the SWP include capital charges, minimum operations, maintenance, power, and replacement (OMP&R) charges, and off-aqueduct power charges. The majority of these costs are derived from estimates provided by DWR. However, for the scenarios that included a Delta fix, costs were calculated assuming Metropolitan would be responsible for 23 percent of the total $10 billion capital project leading to an annual cost of $148 million/year over 15 years. Overall, the total fixed SWP with the Delta fix costs are expected to increase at an annual rate of 2.4 percent through 2035. Part of the reason for this relatively low rate of increase is that over this time frame, the off-aqueduct facilities are paid off.

Capital Program Financing

Capital program financing is the same for each scenario and is estimated to increase at an average annual rate of 4.3 percent. An annual average of $374 million in capital investment is assumed, in accordance with the five-year financial summary from the current 2010 budget. The capital investment costs past 2015 are created by combining a forecast of capital for new facilities and replacement and refurbishment of the current system. The new facilities are estimated by taking the 2014 capital requirements for new facilities of $168 million and escalating it at three percent. The replacement and refurbishment component is estimated using Metropolitan's Replacement Planning & Asset Valuation Model, which bases replacement and refurbishment capital requirements on a list of Metropolitan's assets paired with their estimated life. This model calculates the annual replacement and refurbishment capital requirements at $196 million in 2015, increasing to more than $300 million by 2017, and leveling off at roughly $350 million in 2027.

Metropolitan also has General Obligation bond debt service decreasing from $48 million in 2010 to $3 million in 2023 as the bonds are redeemed.

Required Reserves

In additional to the expenditures incurred by Metropolitan to run and maintain the water system, Metropolitan is also required to maintain minimum fund balances to pay for operating costs. When these operating costs increase, the required minimum fund balance also increases. This increase in required reserves needs to be funded by rates and charges at an estimated $30 million/year increasing at 3.5 percent.

Variable Costs

These are costs dependent on the volume of water and are incurred by AF.

Treatment

Costs associated with variable treatment include the cost of power, chemical, and solids handling incurred at the five treatment plants run by Metropolitan. The cost is estimated by

multiplying the total treated AF by the unit cost of treatment. The 2010 and 2011 unit cost was assumed to be $22/AF. Thereafter it was assumed to increase at an annual rate of 6.4 percent for 5 years, reflecting recent rates of increase, and 3.5 percent through 2035. This results in an average annual rate of inflation of 3.9 percent through 2035.

SWP Power

Power sources will need to be replaced in the time frame of the analysis, resulting in higher variable power costs for the SWP. These variable power costs differ for each Strategic Policy Review, based on SWP flow assumptions. However, the Imported Focus, Enhanced Regional #2, and the Current Approach scenarios have roughly the same unit rate of $127/AF escalated at an average of 5.2 percent as a result of similar SWP flows. The Enhanced Regional #1 scenario has significantly lower SWP flows and therefore a lower unit rate, also beginning at $127/AF in 2010 but escalated at an average annual rate of 4.4 percent.

CRA Power

The core power supplies for the CRA come from power plants along the Colorado River that provide roughly enough energy to pump 750,000 AF of water into the service area. Any additional CRA water must be pumped with energy priced at higher market rates. As a result, the more water is pumped, the higher the melded CRA power rate.

Since the Imported Focus, Enhanced Regional #2, and the Current Approach scenarios have roughly the same CRA flows, these scenarios have similar CRA unit costs. Each starts with $35/AF in 2010 and escalates at an average annual rate of 4.9 percent. The Enhanced Regional #1 scenario has somewhat lower CRA flows and therefore lower unit costs.

Supply Program Costs

The supply program costs consist of transfers, exchanges, and groundwater storage programs. The use of these programs in the analysis was determined by the need identified in the IRPSIM analysis. The unit costs of these programs are escalated at inflation unless otherwise dictated in the program contract. In 2015, the four scenarios had almost the same supply program costs, ranging from $76 million to $77 million. By 2035 there was more variance; the Enhanced Regional #1 scenario had less need for these supplies, incurring a cost of $71.1 million, while the Imported Focus scenario relied more heavily on supply programs and incurred $81.3 million in costs.

Demand Management Programs

The Demand Management Programs are comprised of the LRP and the CCP. The LRP provides financial assistance to its member agencies for the development of local water recycling and groundwater recovery projects. The base LRP costs for all four scenarios are an average of $43 million through 2020 and then decrease steadily to $18 million in 2035 as contracts expire. The desalination costs are assumed to be fixed at $14 million for all but the Current Approach scenario, in which it increases to $26 million.

The CCP provides financial assistance for the development of conservation. The CCP costs are $20 million annually, escalated at an average annual rate of 3.5 percent.

Enhanced Regional Programs

The enhanced regional programs in the Enhanced Regional approaches were assumed to cost $1,500/AF in 2009 and escalated at an average annual rate of 3.5 percent. This unit rate was assumed to cover both O&M and capital financing costs.

Revenue Generating Programs

The revenue generated from taxes, interest income, hydroelectric power sales, and other miscellaneous items is used to offset the costs that are met by rates. These other revenue sources, in essence, lower the water rates and charges. The revenue offsets were assumed to be the same for all four scenarios in this report. In 2015, these revenues are estimated to generate $137 million, including $63 million from property taxes and annexation charges, $30 million from interest income, $23 million in hydroelectric power sales, and $21 million from the Build America Bonds Interest Subsidy Payment, Coachella Valley Water District (CVWD) Agreement, leasing fees, and other miscellaneous income. By 2025

these offsets have decreased to $89 million as Metropolitan lowers the tax rates to match the General Obligation bond payment. By 2035, the revenue offsets are assumed to be picking up slightly as a result of inflationary increases in the hydroelectric power sales.

Technical Findings

The resource investment assumptions, implementation timing, reliability impacts and water rate impacts for each of the Strategic Policy alternatives are as follows:

Current Approach

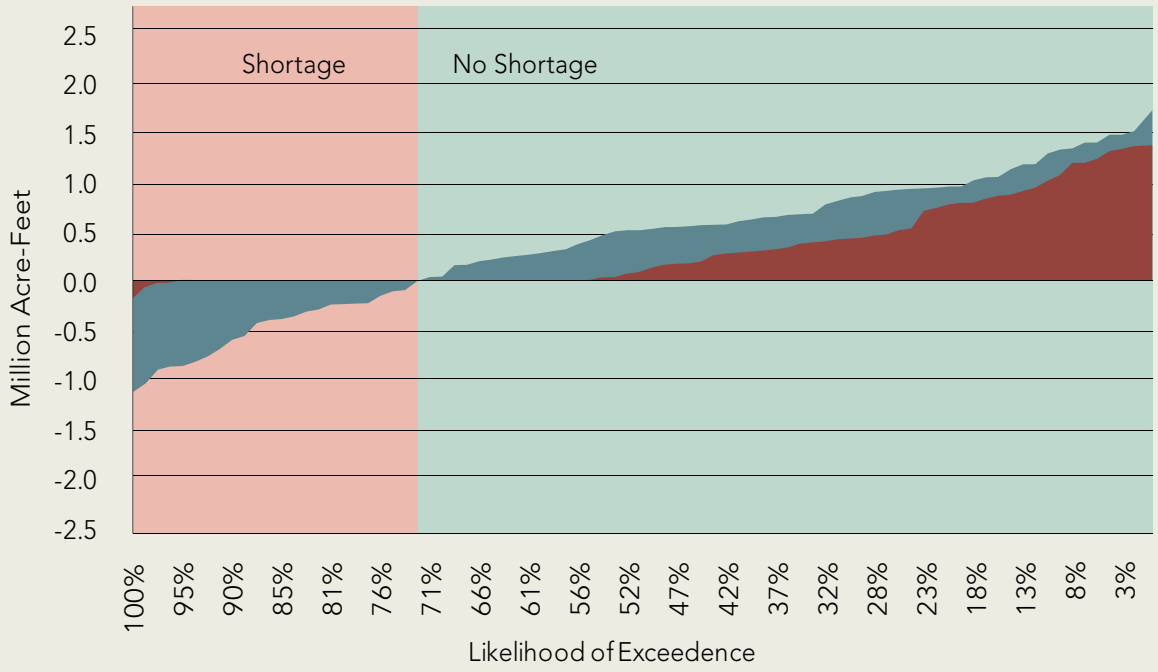
In this approach, Metropolitan and its member agencies would develop future water resources in a manner similar to the path taken following the 1996 IRP and 2004 IRP Update. Metropolitan would take the lead in developing projects and programs to improve the reliability of the SWP and the CRA, maintain existing water management assets and storage, and develop new assets if needed. Member and local agencies would develop local resources and implement conservation with financial incentives provided by Metropolitan. Metropolitan and the member agencies would also continue to work together to develop in-basin groundwater conjunctive use programs.

Under the Current Approach, supplies are assumed to be augmented through a balanced implementation of Delta improvements and moderate additional local resource development. Specific assumptions include:

- Additional local groundwater recovery or seawater desalination of up to 46,000 AF are implemented beginning in 2015 and increasing to full yield in 2025, accounting for the additional $12 million in Demand Management Programs and decreased sales; and
- A Delta fix is implemented in 2022, improving the SWP to yields approximating those estimated prior to the court rulings and Biological Opinions to protect Delta smelt and Chinook salmon.

Figure 2.2 shows reliability in 2035 under the Current Approach. The dark blue area shows supply reliability before storage is utilized, resulting in a regional supply shortage 28 percent

Figure 2.2 Dry-Year Water Supply Reliability Under the Current Approach in 2035



of the time, up to a maximum of 1.1 MAF. The red area shows supply reliability after storage is utilized. With the use of storage, regional supply shortages are reduced to occurring 4 percent of the time, with a maximum shortage of 190,000 AF. This is the lowest magnitude of shortage in 2035, and this option also has low magnitude of shortages in 2015 and 2035.

The Current Approach has the lowest costs between the options in 2025 and 2035 and mid-range costs in 2015. The 2035 costs under this approach are nearly the same as inflation.

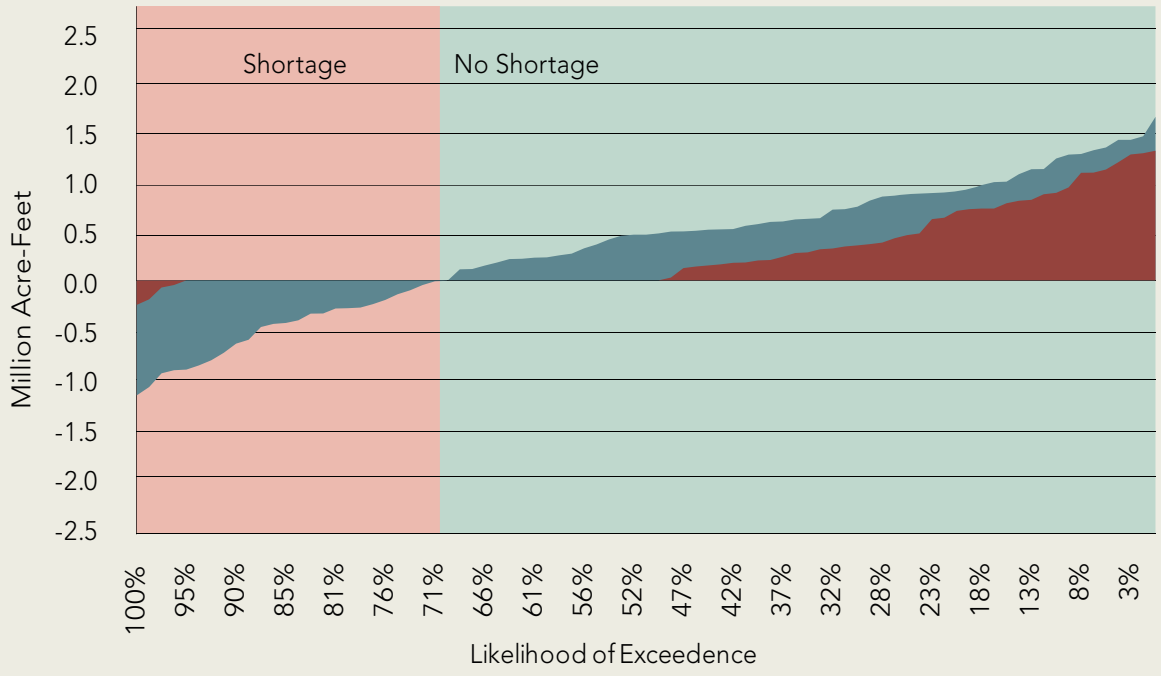
Imported Focus

Metropolitan would take a limited and reduced role in developing regional reliability. Metropolitan would focus on implementing an interim and a long-term Delta solution to improve the reliability of the SWP, while also improving the reliability of the CRA. Metropolitan would maintain its existing water management assets and storage but would not seek to develop new assets. While existing LRP contracts and incentives would be honored, the responsibility for developing new local resources and conservation would fall on member and local agencies, without any participation or financial incentives from Metropolitan. This approach assumes supplies are augmented only through implementation of a Delta fix in 2022, which improves the SWP yield to levels approximating those estimated prior to the court rulings and Biological Opinions to protect Delta smelt and Chinook salmon but it does not include additional Metropolitan-initiated local resource augmentation or participation.

The reliability under the Imported Focus is shown in **Figure 2.3**. The area shaded in dark blue shows supply reliability before storage is utilized, resulting in a regional supply shortage 30 percent of the time, up to a maximum of 1.2 MAF. The red area shows supply reliability after storage is utilized. With the use of storage, regional supply shortages are reduced to occurring four percent of the time with a maximum shortage of 250,000 AF. This is a mid-range shortage magnitude in 2035, but the Imported Focus has the highest magnitude of shortage in 2015 and 2025.

The Imported Focus shows the lowest costs in 2015, and the highest costs in 2025 and 2035. Compared to the Current Approach scenario,

FIGURE 2.3 DRY-YEAR WATER SUPPLY RELIABILITY UNDER THE IMPORTED FOCUS IN 2035



the Imported Focus scenario has lower demand management costs, despite the resulting higher water sales. To meet the additional demands, the Imported Focus scenario includes additional Northern California supply program costs. The net effect leads to a small decrease in the supply rate. These additional supply program purchases do, however, incur high SWP marginal power costs as the water is moved into the service area and this results in a higher system power rate. Overall, the rates are marginally lower than the Current Approach scenario as a result of the slightly higher water sales.

The 2035 costs under this approach are about 2 percent above inflation.

Enhanced Regional Focus

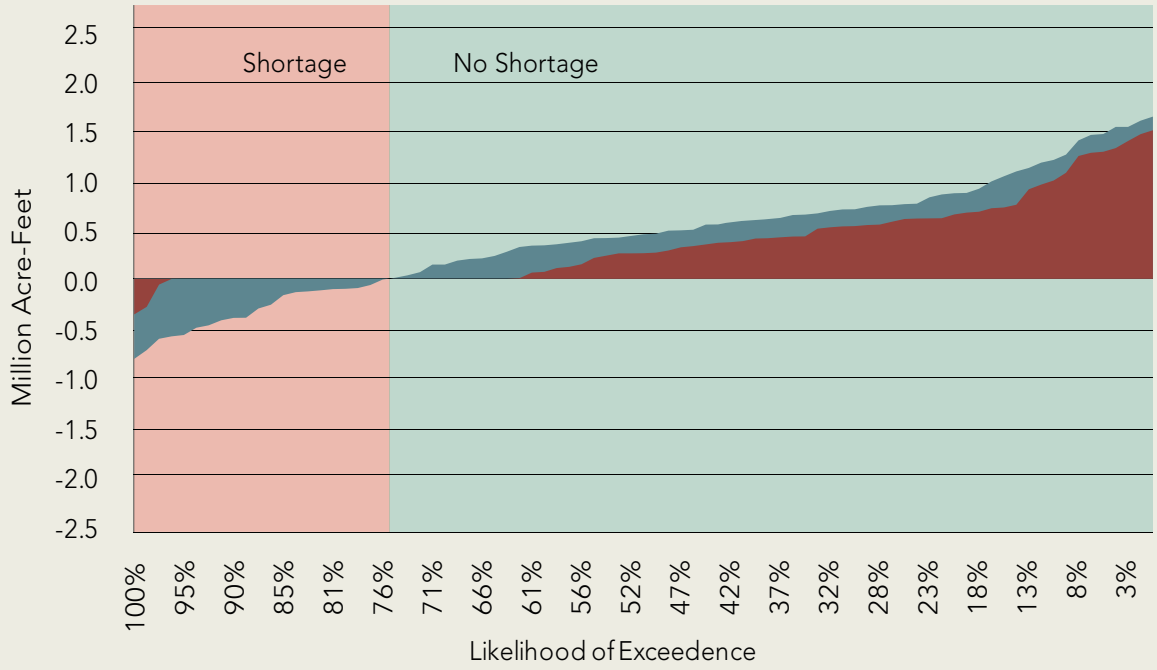
Metropolitan would take steps to increase its current role in developing regional reliability in anticipation of guarding against an indefinite delay in achieving a long-term Delta solution. Metropolitan would take the lead in developing projects and programs to improve the reliability of the SWP and the CRA while maintaining its existing water management assets and storage and developing new assets if needed. Metropolitan would take early steps to incur the cost to identify and develop large, scalable regional water recycling and seawater desalination projects until a long-term Delta solution becomes viable. These two alternatives offer a view of regional reliability and cost should Delta improvements be delayed.

Enhanced Regional Focus #1

This approach assumes that Delta improvements will not be completed by 2035 but regional-scale local projects are implemented at 30,000 AF in 2015, increasing to 351,000 AF by 2025, and 463,000 AF by 2035.

The reliability under the Enhanced Regional Focus #1 is shown in **Figure 2.4**. The blue area shows supply reliability before storage is utilized, resulting in a regional supply shortage 26 percent of the time, up to a maximum of 835,000 AF. The red area shows supply reliability after storage is utilized. With the use of storage, regional supply shortages are reduced to occurring 4 percent of the time with a maximum shortage of 370,000 AF. This is the highest shortage magnitude in 2035, but the lowest in 2015 and 2025.

FIGURE 2.4 WATER SUPPLY RELIABILITY UNDER ENHANCED REGIONAL FOCUS #1 IN 2035



The costs are the highest of the options in 2015 and in the middle for 2025 and 2035. Compared to the Current Approach scenario, the Enhanced Regional Focus #1 scenario has lower SWP and CRA deliveries resulting in a lower system power rate. Similar to the Imported Focus scenario, the Enhanced Regional Focus #1 scenario also has a lower LRP cost that creates some additional demand for water sales. The major impact is caused by the addition of $1.7 billion in enhanced regional project costs, which dramatically increases the rate.

The 2035 costs under this approach are 35 percent above inflation, although this represents little more than one percent annually above inflation.

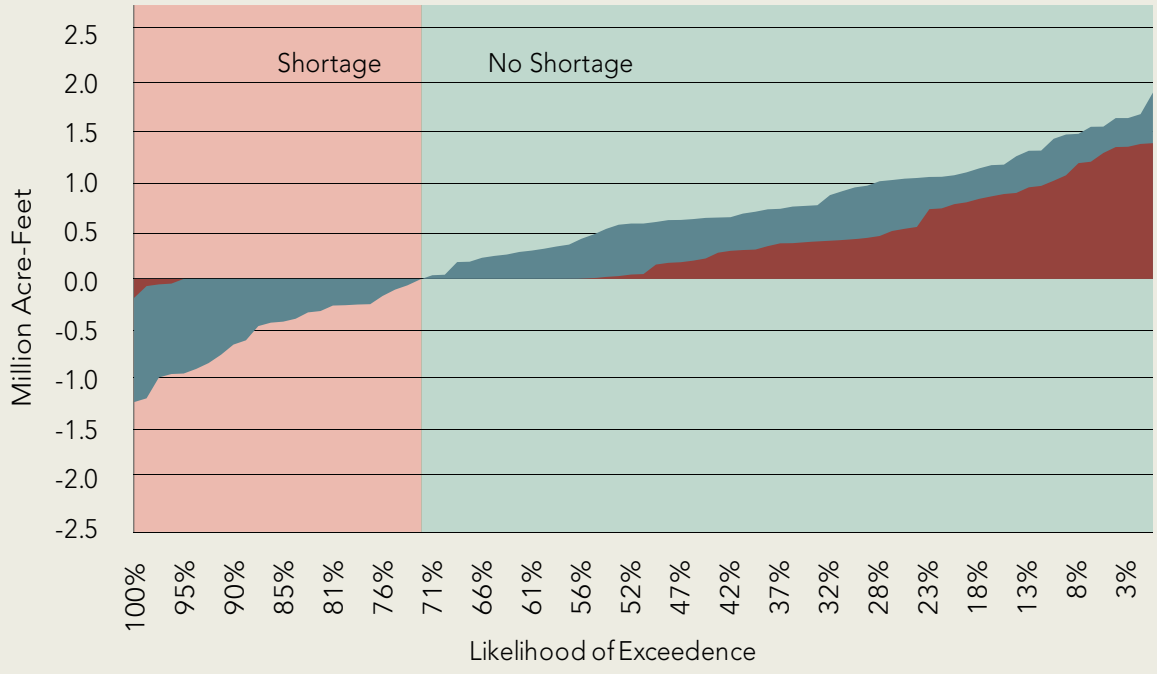
Enhanced Regional Focus #2

This approach assumes that the Delta improvements will be completed in 2022, improving the SWP to yields approximating those estimated prior to the court rulings and Biological Opinions to protect Delta smelt and Chinook salmon. Regional Scale local projects were initiated in the interim with a implementation of only 40,000 AF in regional project in 2015.

The reliability under the Enhanced Regional Focus #2 is shown in **Figure 2.5**. The blue area shows supply reliability before storage is utilized, resulting in a regional supply shortage 28 percent of the time, up to a maximum of 1.1 MAF. The red area shows supply reliability after storage is utilized. With the use of storage, regional supply shortages are reduced to occurring 4 percent of the time with a maximum shortage of 190,000 AF. This is the same magnitude of shortage in 2015 as Enhanced Regional Focus #1, and the same in 2035 as the Current Approach. The 2025 shortage is in the middle.

Costs under this approach fall in the mid-range of all the scenarios for all years. Compared to the Current Approach scenario, the Enhanced Regional Focus #2 scenario has lower LRP costs that create some additional demand for water sales. This additional demand is met by the development of some enhanced regional projects at a cost of $154 million. These projects, however, do not produce enough water to decrease Metropolitan's reliance on the SWP and

Figure 2.5 Water Supply Reliability Under Enhanced Regional Focus #2 in 2035



CRA and as a result, the SWP and CRA costs are similar to the Current Approach scenario. Like the Enhanced Regional Focus #1 scenario, the additional enhanced regional costs result in an increase in the supply rate. All other rate elements are slightly lower as a result of high sales and the shifting of administrative and general costs. Overall, the rates for the Enhanced Regional Focus #2 scenario are somewhat higher than the Current Approach scenario.

The 2035 costs under this approach are about one and a half percent above inflation.

Summary of Technical Findings

Analysis presented for the Strategic Policy Review showed that the different approaches for Metropolitan's role could result in similar water supply reliability outcomes in the 2025 and 2035 time frames. In terms of frequency of shortages, all four of the approaches in the Strategic Policy Review have virtually the same frequency. In all cases, water supply reliability that comes primarily from a combination of water conservation efforts resulting from the 20x2020 legislation and successful investments in either a Delta solution or in large regional-scale recycling and desalination results in shortages roughly averaging 5 to 7 percent of the time, as shown in **Table 2.8**.

In essence, this is because all four alternatives present different approaches for equivalent levels of resource development. The only difference occurs in the Enhanced Regional Approach #1 in 2025 where the frequency of shortages are slightly higher because the Delta improvements have not been completed and regional-scale local projects have not reached full production.

The alternatives do vary, sometimes significantly, in the magnitude of shortages occurring in a single forecast year. There are a number of reasons for this. Most importantly, the timing of the implementation of the resources within an alternative and the interaction of the resources with Metropolitan's existing storage portfolio are the main determinants of the magnitudes of shortages seen in the alternatives. The frequency and magnitude of shortages for each alternative are contained in **Table 2.8**.

Water rate impacts, graphed in **Figure 2.6**, in 2035 are also very similar for all of the approaches that included a long-term Delta solution. The notable exception would be the Enhanced Regional Focus #1. In this case, the inability to successfully implement a long-term Delta solution results in the need for large quantities of regional-scale recycling and desalination to achieve comparable levels of water supply reliability. Regional-scale recycling and desalination are among the highest cost options, but these options can produce enough water supply to offset losses of Delta supplies. Water rates in this case would be significantly higher than in any of the other cases.

In all cases, the average annual rate increase through 2035 would be between zero and 2 percent above inflation, shown shaded in brown.

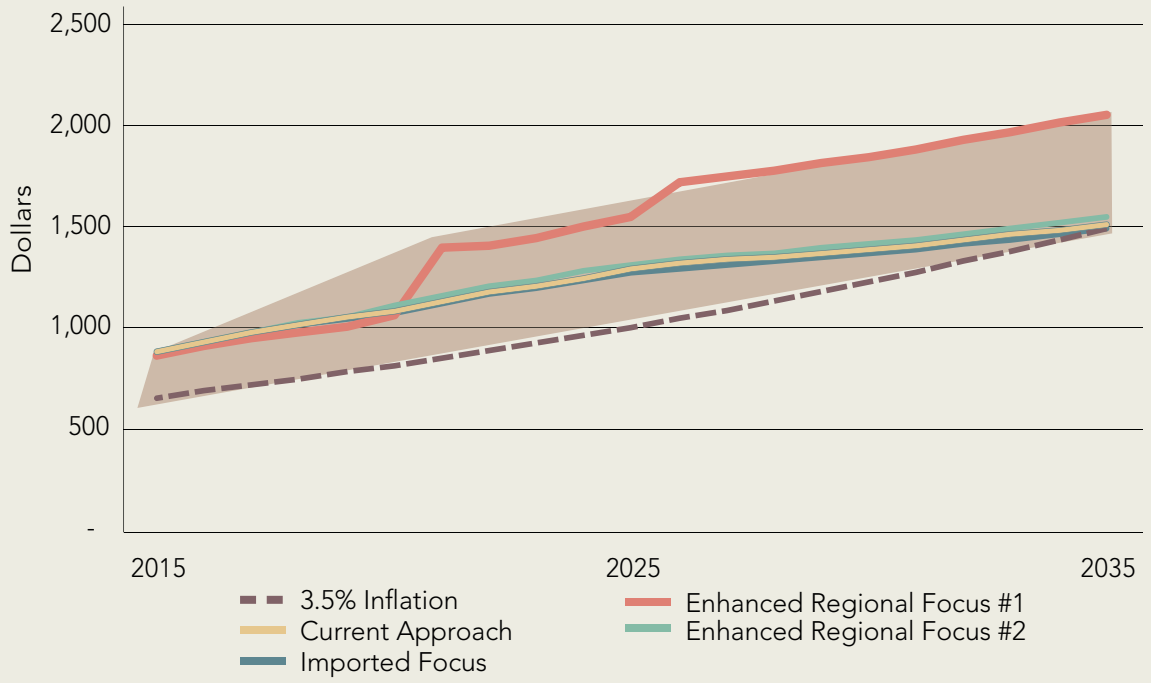
The water rates in **Table 2.8** were estimated by dividing the net costs by the anticipated water sales and range from 1 to 2 percent above inflation. The water sales for each scenario were estimated by taking the water demands and subtracting the average shortage calculated in the IRPSIM analysis. The water sales include only firm sales and wheeling/exchange; also, it was assumed that no replenishment sales would be available and that the Interim Agricultural Water Program will be phased out by 2013.

In 2035, the Imported Focus, Enhanced Regional Focus #1, and Enhanced Regional Focus #2 scenarios all generate roughly the same water

TABLE 2.8 SUMMARY OF IMPACTS BY APPROACH

	Frequency of Shortages			*Magnitude of Shortages (AF)*			*Estimated Rates ($/AF)*		
	2015	*2025*	*2035*	*2015*	*2025*	*2035*	*2015*	*2025*	*2035*
Current Approach	12%	4%	5%	659,000	350,000	191,000	$867	$1,279	$1,501
Imported Focus	12%	4%	5%	665,000	367,000	191,000	$862	$1,261	$1,483
Enhanced Regional #1	12%	7%	5%	689,000	415,000	249,000	$856	$1,536	$2,048
Enhanced Regional #2	12%	4%	5%	659,000	325,000	369,000	$872	$1,303	$1,536

FIGURE 2.6 RANGE OF RATE IMPACTS OF STRATEGIC POLICY REVIEW APPROACHES OVER TIME



sales level of 2.29 MAF. The Current Approach scenario has 46,000 AF lower sales as a result of higher local resource production.

Policy Implications

This analysis revealed key results that can help to guide future water resource development and implementation. These key findings are:

- Conservation and water-use efficiency developed in response to the 20x2020 legislation are a key element to restoring water supply reliability, regardless of the future role of Metropolitan;
- Short-term challenges to water supply reliability will require a focused effort to address water supply reliability solutions and increase water-use efficiency;
- Options for addressing long-term challenges exist and can be implemented; and
- Future uncertainties, including climate change and environmental regulation, can be addressed in a prudent and cost-effective manner through scalable projects and other adaptive management aspects discussed in Section 3.

The Strategic Policy Review analysis supports various perspectives on Metropolitan's role in achieving these results and no one approach was chosen to define Metropolitan's future role. Each approach provided insight into the regional impact of different methods of resource development and the Strategic Policy Review identified the strengths of the various approaches as a guideline for a future role for Metropolitan.

First, improving the Delta by implementing an interim and long-term Delta solution provides the most reliability benefits at the lowest overall cost. To that end, Metropolitan should continue to place a strong emphasis on achieving success in the Delta. However, although the Imported Focus Approach seeks to attain that goal and also results in the lowest Metropolitan rate impact, this approach is not the most robust in terms of preparing the region for additional uncertainty and risk to water supply.

The other approaches increase Metropolitan's role and participation in the development of conservation and local resources, which lessens

the impact of any future losses in water supply. The most robust approach is characterized by Enhanced Regional Approach #2. In this approach, prudent, innovative investments are made ahead of knowing the outcome to guard against future risk. These investments may result in the implementation of smaller quantities of more expensive water resources, but the largest share of the investments can be deferred and results in water rate impacts that are comparable to other approaches.

Further, the early investments would strategically position the region to be able to implement large-scale resource programs if needed. The identification of these early actions is the basis for Metropolitan's Foundational Actions, outlined in Section 3. Other approaches may be marginally less expensive, but could result in a severe loss of water supply reliability given future uncertainty. This approach is similar to the Enhanced Regional Approaches #1 and #2 and supports the principle that Metropolitan will take a leadership role, working in collaboration with its member agencies, to assure that Southern California has the water resources and necessary infrastructure required to meet its future needs.

Summary

Using a structured collaborative approach, Metropolitan, its board, and regional stakeholders together identified key areas of focus for future resource development and designed an approach for Metropolitan's role in that development.

Technical assessments and information gathered through this process have come together to form a preferred approach to confront the new trends and challenges identified. This includes development criteria, overall resource packages, and uncertainty planning approaches for a variety of regional resources, including conservation, groundwater, recycled water, seawater desalination, stormwater/urban runoff, and graywater.

This process also initiated a Strategic Policy Review examining the ramifications of alternative roles for Metropolitan, member agencies, and local retail agencies in future development of water resources. A study of water supply reliability and cost impacts associated with these approaches found that it is in the region's best interest for Metropolitan to continue to explore ways of increasing regional reliability and not limiting itself to singular areas like addressing Delta issues. Instead of picking one role for Metropolitan, the Strategic Policy Review identified the strengths of the various approaches to allow greater regional flexibility in resource development. The result of this process concluded that Metropolitan should:

- Adopt an adaptive management approach for the future;
- Continue to develop its core supplies;
- Diversify its role in developing regional water supply;
- Explore various options under which the region can pursue cooperative development of beneficial projects.

These findings formed the building blocks for a comprehensive adaptive management approach to address uncertainties and were used as the foundation for this IRP Update.

Furthermore, these principles are reflected in a growing body of policy statements, including the following:

- The 1952 Laguna Declaration that stated Metropolitan will "provide its service area with adequate supplies of water to meet expanding and increasing needs";
- The 1992 Metropolitan Mission Statement, reiterating that it will "provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs"; and
- The 1996 IRP reliability goal that "Metropolitan and its member agencies will have the full capability to meet full-service demands at the retail level under all foreseeable hydrologic conditions."

Taken together, these policies indicate that Metropolitan has a long-standing history of leading regional efforts to secure overall water supply reliability for the region and the findings of the Strategic Policy Review confirm and support these efforts.

INTEGRATED WATER RESOURCES PLAN 2010 UPDATE

AN ADAPTIVE INTEGRATED RESOURCES STRATEGY

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

3 An Adaptive Integrated Resources Strategy

Metropolitan has traditionally implemented new water supply resources by looking to the future and anticipating the timing of a gap between supplies and demands. However, changing conditions, such as new environmental regulations, climate change and economic unknowns, can introduce additional uncertainty into the reliability equation. Without a plan to address these types of challenges, the region could be faced with costly shortages or expensive fast-track fixes.

This IRP Update specifically plans for this uncertainty in Metropolitan's future water supplies. To better handle future challenges, Metropolitan evaluated a range of adaptive management strategies in order to develop a robust plan that will both meet demands under observed hydrology and respond to future uncertainty. This type of plan provides solutions by developing diverse and flexible resources that perform adequately under a wide range of future conditions.

Metropolitan's adaptive approach will develop resources in this manner through its **Core Resource Strategy.** This strategy will meet "full-service demands at the retail level would be satisfied for all foreseeable hydrologic conditions," consistent with previous reliability goals. That commitment to reliability remains unchanged, as manifest in the addition of an **Uncertainty Buffer** to address the water supply challenges that are posed by uncertain weather patterns, regulatory and environmental restrictions, water quality impacts, and changes in the state and the region. Finally, this adaptive approach identifies low-cost, low-risk **Foundational Actions** to shorten development time for additional regional resources, should they be necessary.

Fundamentals of Adaptive Management

Identifying Uncertainty

The first step in the process of developing a management strategy was identifying areas in which uncertainty could impact water supply reliability. As discussed in Section 1: "Challenges & Changed Conditions," recent events, such as conveyance restrictions in the Delta, have exemplified new and changing trends in the region's water supply reliability. Changes in climate trends, the cost and use of energy, potential policy and permitting restrictions, endangered species protections, and demographic unknowns show the need for resources to respond to these uncertainties. These variations call for updated planning and suggest the need for hedging actions now and in the future. Moreover, the impact of these uncertainties on Metropolitan's ability to achieve reliability needs to be accounted for explicitly in the decision-making process and calls for an adaptive approach to future resource development.

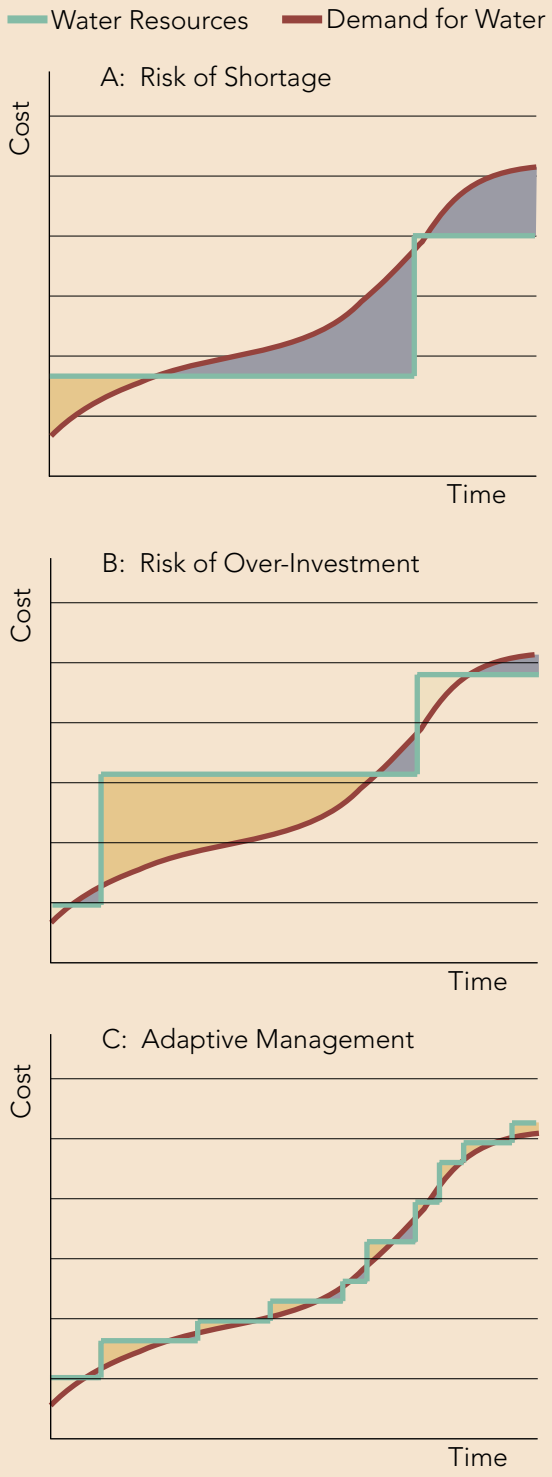
Incorporating Uncertainty into Management Strategy

In response to these uncertainties, Metropolitan has developed an adaptive management approach to mitigate uncertainty. This will ensure that resources can be brought online economically and in time to avoid shortages, without overspending on excess capacity.

The basis of an adaptive management approach is to pursue actions and resource programs

California recently experienced three consecutive years of drought, and the Colorado River basin is just emerging from an eight-year drought.

FIGURE 3.1 RELATIVE MONETARY & SHORTAGE RISKS



that can be implemented to meet observed[1] demands, as well as identify resources to be developed in the occurrence of an unforeseen event or development issue in a core supply. By adopting this approach, Metropolitan is signaling its willingness to invest in alternatives before an actual reduction in supply occurs. If no reduction occurs, then the money spent on the adaptive management components could be viewed as wasted. However, if a reduction in supply does occur, and the adaptive management components were not in place, then Metropolitan and its member agencies would likely face costly shortages.

As the regional water planner for an $800 billion economy, Metropolitan faces two polar opposite potential risks based on changing conditions. There is the risk of water supplies not developing as planned and reacting slowly to the changes because alternatives are not far enough along in the planning stages, creating economic hardships for the region. Conversely, there is the risk of developing more supplies to meet a demand that may react to rate increases, creating excess water costs and economic hardship as well. The adaptive management approach mitigates both potential risks by creating a buffer of additional supplies to be used as needed and taking low-cost foundational actions for supply augmentation, should they prove necessary.

Figure 3.1 illustrates how Metropolitan will implement a measured, adaptive approach to balance the financial and water supply risks of resource development.

In Graph A of **Figure 3.1**, if in planning to meet future demands (illustrated by the red curved line), the region waits to develop supplies (illustrated by the green line) until they are needed, the region is at high risk for shortages (shaded in purple). Graph B shows the opposite; the region has built supplies before they are needed and the brown shading shows the costs of developing those supplies. Graph C depicts the adaptive management approach which falls somewhere in the middle, seeking to achieve the

1. For the purpose of this IRP Update, "observed conditions" refers to those hydrologic and demand-related scenarios seen under the 80-year range of conditions experienced regionally from 1922-2004. This is the span of time used in IRPSIM because it offers the most complete data for all relevant geographical areas. For more information on IRPSIM, see Appendix A.1.

highest protection against future shortages at the lowest financial risk.

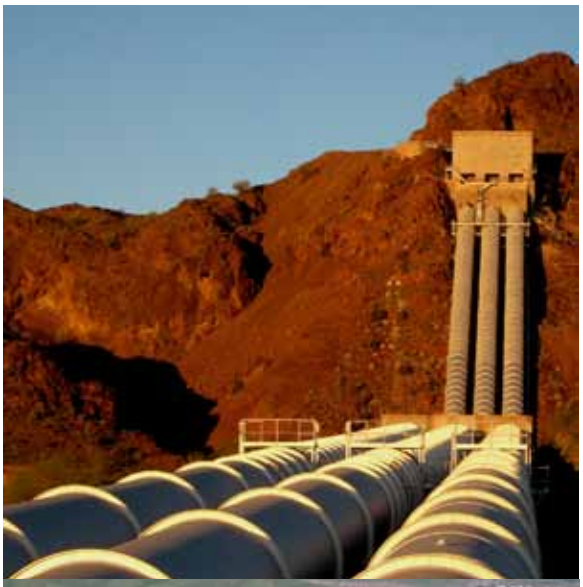
This graphic depiction, however, does not capture the dynamic ability of adaptive management to respond to changing conditions as necessary. The magnitude of the shortage and over-investment "steps" in Graph C vary with the regional value of supply development versus shortage avoidance. This adaptive management approach can provide a blueprint of how the region can quickly adapt and respond to disruptions in its planned water resources. This is achieved through identifying additional resource opportunities and establishing incremental development actions to implement supplies, if needed. This approach balances the need for a cost-effective strategy with the need to invest in actions that ensure water supply and facilities are in place at the time supplies are needed.

In order to achieve maximum supply reliability in a cost-effective and adaptive manner, three main management components have been identified to build on existing supplies. In order to determine the breadth of supplies needed, Metropolitan performed detailed analysis of regional demands and supplies, described below.

Determining Regional Water Need: Gap Analysis

Metropolitan's resource strategy for achieving regional water supply reliability has been to develop and implement water resources programs and activities through its IRP process. Since the 1996 IRP, and more recently the 2004 IRP Update, Metropolitan and its member agencies have continued to develop reliable water supplies for the region, based on the Preferred Resource Mix. Under this mix, new water supplies are developed based on a regional evaluation of reliability, diversification, cost, water quality, and other factors. The diversification of the regional supply portfolio that has resulted from these investments has been an important step in providing flexibility and adaptability.

However, in light of changing conditions, Metropolitan has systematically evaluated existing levels of resource development in terms of future reliability. This analysis looked at the resources available to meet demands, focused



The Core Resources Strategy looks at managing emerging trends by developing traditional sources on the State Water Project and Colorado River as well as planned conservation and local supply development.

Top Photo: Five pumping stations lift the water in the Colorado River Aqueduct a total of 1,617 feet along its 242 mile journey from its intake point at Lake Havasu on the California-Arizona border and its endpoint at Lake Mathews in Riverside County.

Bottom Photo: The State Water Project includes 34 storage facilities, reservoirs and lakes; 20 pumping plants; four generating plants; five hydroelectric power plants, and about 700 miles of canals and pipelines.

specifically on dry years - those years with deficits between supply and demand in the ten percent of the model's estimates by volume, i.e., the driest ten percent. A simple mass balance calculates any gap between supplies and storage available in dry years,[2] measured against projections of future demands, referred to as "dry-year gap analysis."

In order to perform a cohesive dry-year gap analysis, Metropolitan used IRPSIM, a detailed comprehensive model of Metropolitan's imported resource availability, system capabilities, operating rules, storage capacities, local supply assumptions based on member agency surveys, and demand assumptions based on regional forecasts tailored to Metropolitan's service area. A more detailed description of the assumptions and supplies in IRPSIM is included in **Appendix A.1**. A more detailed description of the demand calculations is included in **Appendix A.2**.

IRPSIM provides a plethora of data output with which Metropolitan staff can examine regional operations and resource options. For this IRP Update, staff examined the magnitude and frequency of shortages under the existing level of resource development and under the proposed IRP Update components. These indicators provide insight into regional reliability and use of storage supplies.

Under existing levels of resource development and projected future demands, IRPSIM shows a significant gap, illustrated in **Figure 3.2**. These existing supplies consist of local surface, groundwater, and LAA, recycling and groundwater recovery, SWP Table A supplies, CRA programs, and conservation.

Also included in **Figure 3.2** and **Table 3.1** is transfer and storage availability to demonstrate how these can further meet demand. It is important to note that the storage and transfer supplies have been a key component of the Preferred Resource Mix since the 1996 IRP.

The results of this analysis show that under the existing level of resource development a gap remains even after storage resources have been utilized. The capability of storage and transfers to fill that gap is limited with this level of resource development because of the inability to maintain or add to storage resources. **Figure 3.3** highlights the impact of depending on that storage to meet gaps between supply and demand in dry-years. Storage availability decreases with time as reserves are depleted to meet needs under the existing resource development conditions.

In **Figure 3.4**, the blue area displays supply reliability under the existing level of resource development before storage is utilized. In 2035, staying at the existing level of resource development would result in a regional supply shortage 91 percent of the time, up to a maximum of 1.7 MAF. The red area shows supply reliability after storage is utilized. With the use of storage, regional supply shortages are reduced to occurring 59 percent of the time with a maximum shortage of 1.3 MAF.

Advances in the development of water conservation, water-use efficiency, and in new supply development are needed to improve the overall balance of supply and demand and increase the effectiveness and availability of storage resources in dry-years. The following sections outline how Metropolitan will develop programs within its core resources to meet this gap and assure regional water supply reliability into the future under foreseeable hydrologic conditions.

Component 1: Core Resource Strategy

Through the dry-year gap analysis, findings from the IRP technical workgroups, and the Strategic Policy Review process, it was determined that the continuation of similar resource investments and targets identified in the Preferred Resource Mix, along with an increased emphasis in water-use efficiency, can be an effective "Core Resources Strategy" under which Metropolitan can eliminate the gap between future supply and demand.

Specifically, there are four resource areas where Metropolitan can pursue additional programs and activities as a Core Resources Strategy to meet projected levels of demand. These resource areas are as follows:

- CRA: Develop dry-year programs combined with the continued storage, transfers, and exchanges;

2. A "dry-year" is defined as those modeled scenarios with the top ten percent largest deficits between supply and demand.

FIGURE 3.2 EXISTING DRY-YEAR SUPPLY & DEMAND ANALYSIS RESULTS

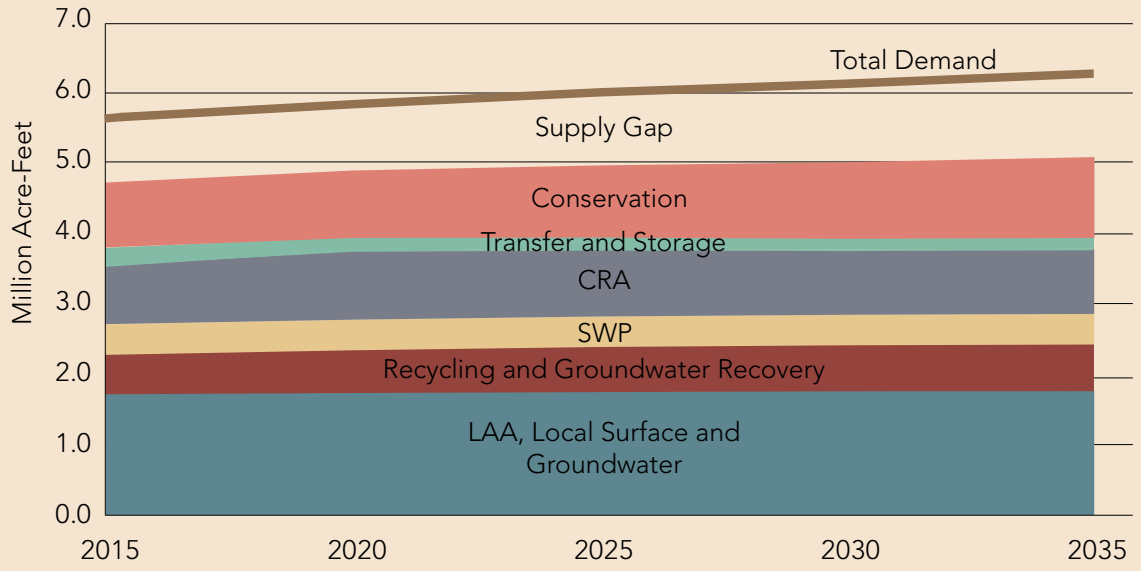


TABLE 3.1 EXISTING DRY-YEAR SUPPLIES WITH STORAGE PORTFOLIO

	2015	2020	2025	2030	2035
Dry-year Total Demand (Without Conservation)	5,597,000	5,804,000	5,951,000	6,094,000	6,229,000
Local Supplies					
Conservation	930,000	965,000	1,032,000	1,097,000	1,158,000
Recycling	353,000	387,000	413,000	422,000	430,000
Groundwater	1,485,000	1,503,000	1,515,000	1,526,000	1,527,000
Groundwater Recovery	122,000	136,000	144,000	148,000	150,000
Local Surface Water	100,000	99,000	99,000	99,000	99,000
LAA	147,000	147,000	147,000	147,000	147,000
Imported Supplies					
SWP	430,000	430,000	430,000	430,000	430,000
CRA	852,000	985,000	957,000	925,000	925,000
Total Supplies	**4,419,000**	**4,652,000**	**4,737,000**	**4,794,000**	**4,866,000**
Dry-year Need after Existing Supplies	1,178,000	1,152,000	1,214,000	1,300,000	1,363,000
Storage & Transfers*					
*In-Region Surface Storage***	256,000	283,000	321,000	320,000	309,000
In-Region Groundwater	151,000	255,000	255,000	255,000	255,000
SWP Surface Storage	43,000	66,000	171,000	207,000	205,000
SWP Groundwater	200,000	200,000	200,000	200,000	200,000
Yuba Accord Transfers	20,000	20,000	20,000	20,000	20,000
SBVMWD Transfers	2,000	2,000	2,000	2,000	2,000
Other Water Transfers	100,000	100,000	100,000	100,000	100,000
Total Storage & Transfers	772,000	926,000	1,069,000	1,104,000	1,091,000
Dry-year Need after Existing Supplies, Storage & Transfers	406,000	226,000	145,000	196,000	272,000

*Not including Emergency Storage.
**For planning purposes, annual In-Region Surface Storage withdrawals are limited to one-third of the total water available.

FIGURE 3.3 AVERAGE DRY-YEAR STORAGE BALANCES UNDER EXISTING RESOURCE DEVELOPMENT

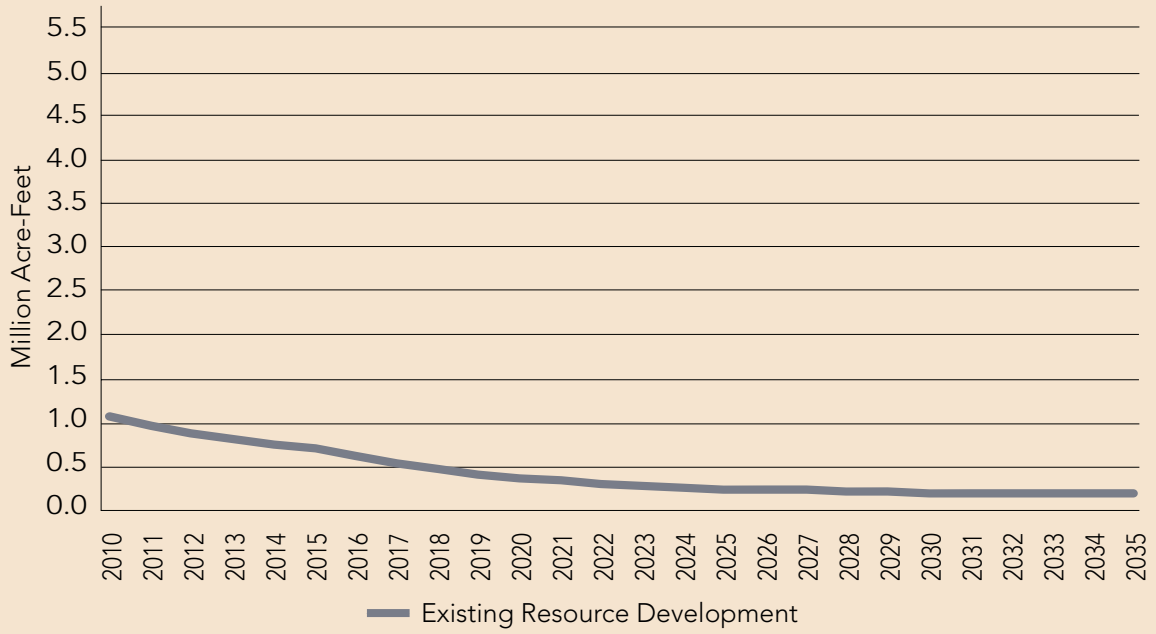
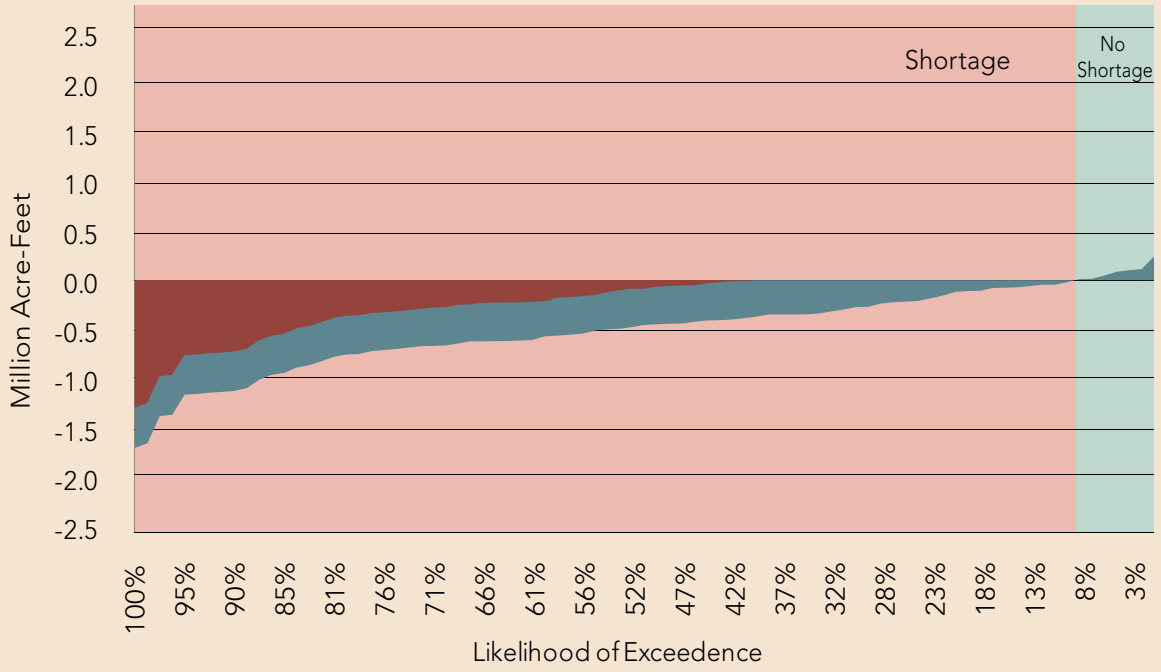


FIGURE 3.4 2035 DRY-YEAR SUPPLY RELIABILITY UNDER EXISTING RESOURCE DEVELOPMENT



Working with local agencies and communities, Metropolitan approaches its goal to maintain a full Colorado River Aqueduct during dry years with innovative projects and programs.

Left Photo: Lining of a leaky, earthen Coachella Canal conserves about 26,000 AF each year and is one of several projects designed to maintain a full Colorado River Aqueduct in dry years.

Right Photo: Metropolitan has a crop rotation and water supply program with the Palo Verde Irrigation District which provides up to 111,000 AF of water annually to Metropolitan's service area from farmland that is not irrigated.

- SWP: Improve reliability through mid- and long-term Delta improvements;
- Conservation & Water-Use Efficiency: Ensure and encourage retail-level compliance with 20x2020 water-use efficiency goals; and
- Local Projects: Enhance options to incentivize and partner in local supply augmentation.

CRA Dry-Year Supply Development

Metropolitan's goal is to develop programs that will maintain a full CRA during dry years. To achieve this level of program development, Metropolitan has explored a number of potential programs, including various water conservation programs with agencies that receive water from the Colorado River or are located in close proximity to the CRA.

It is expected that the ability to deliver a full CRA will also rely upon storage. For this reason, **Table 3.2** shows a range of possible combinations of existing programs and dry-year supplies, all totaling 1.25 MAF, the CRA capacity. The dry-year supplies include storage programs with water that can be withdrawn when needed.

Although not yet sufficient in the short-term to provide the full targeted CRA capacity, Metropolitan has been very successful in developing Colorado River programs to date. Critical to the success of these programs has been implementation of the Quantification Settlement

Table 3.2 CRA Existing & Dry-Year Supplies

		2015	2020	2025	2030	2035
Existing Programs	*CRA*	852,000	985,000	957,000	925,000	925,000
Core Strategies	*CRA Dry-year Supply*	398,000	265,000	293,000	325,000	325,000
Total		***1,250,000***	***1,250,000***	***1,250,000***	***1,250,000***	***1,250,000***

Agreement (QSA) to determine priority and quantity of rights for California parties holding rights to Colorado River water. This specifies how much must be made available to high-priority holders, while allocating any unused supplies to those with subsequent priority rights. On October 10, 2003, after lengthy negotiations, representatives from Metropolitan, IID, and CVWD executed the QSA and other related agreements. Parties involved also included the SDCWA, DWR, the California Department of Fish and Game, the U.S. Department of the Interior, and the San Luis Rey Indian Water Rights Settlement Parties. One of those related agreements was the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement, under which the Secretary of the Interior agreed to specified water deliveries to agencies under priorities 3a and 6a of the Seven-Party Agreement that are consistent on a federal level with provisions under the QSA.

In addition, Metropolitan also gained access to banking water in Lake Mead through the Intentionally Created Surplus program. It must be noted that the Lake Mead Intentionally Created Surplus Program, along with any other storage agreements that potentially augment Colorado River supplies, are storage programs not supplies.

With the adoption of the QSA and the opportunities to store conserved water in Lake Mead, a solid foundation has been laid for developing future programs that will help accomplish the long-term CRA target. The December 2007 federal guidelines concerning the operation of the Colorado River system reservoirs provide more certainty to Metropolitan with respect to the determination of a shortage, normal, or surplus condition for the operation of Lake Mead.

To augment these programs, Metropolitan is continuing to pursue agreements for exchanges and transfers on the CRA to help balance the overall water supply and demand picture for the service area, including:

- IID/Metropolitan Conservation Program: Under a 1988 agreement, Metropolitan has funded water efficiency improvements within IID's service area in return for the right to divert the water conserved by those investments.

Metropolitan is engaged in a number of projects to maximize Colorado River resources including the Drop 2 Storage Reservoir (pictured left) that captures Colorado River water released from Parker Dam which cannot be delivered to Southern California users for a variety of reasons. In exchange for funding Colorado River system efficiency projects, such as the pilot Yuma Desalting Plant (pictured right), Metropolitan can receive storage credits in Lake Mead which can be drawn on during future dry periods.

Under this program, IID implemented a number of structural and non-structural measures, including the lining of existing earthen canals with concrete, constructing local reservoirs and spill-interceptor canals, installing non-leak gates, and automating the distribution system. Other implemented programs included the delivery of water to farmers on a 12-hour rather than a 24-hour basis and improvements in on-farm water management through the installation of tailwater pumpback systems, drip irrigation systems, and linear-move irrigation systems. Through this program, a total of 105,000 AF/year is conserved. Execution of the QSA and amendments to the 1988 and 1989 agreements extended the term to 2078 if the term of the QSA extends through 2077 and provides that up to 20,000 AF of the annual yield would be made available to CVWD upon CVWD's request, guaranteeing Metropolitan at least 85,000 AF/year.

- Palo Verde Land Management & Crop Rotation Program: In May 2004, Metropolitan's board authorized a 35-year land management, crop rotation, and water supply program with the Palo Verde Irrigation District (PVID). Under the program, participating farmers in PVID are paid to reduce their water use by not irrigating a portion of their land. A maximum of 29 percent of lands within PVID can be fallowed in any given year. Under the terms of the QSA, water savings within the PVID service area are made available to Metropolitan.

  This program provides up to 133,000 AF of water to be available to Metropolitan in certain years, and a minimum of 33,000 AF/year. In 2005, 2006, 2007, 2008, and 2009 approximately 108,700 AF, 105,000 AF, 72,300 AF, 94,300 AF, and 120,200 AF of water, respectively, were saved and made available to Metropolitan. In March 2009, Metropolitan and PVID entered into a one-year supplemental fallowing program within PVID that provides for the fallowing of additional acreage, with savings projected to be as much as 61,000 AF. Of that total, about 24,000 AF of water was saved and made available to Metropolitan in 2009, with approximately 37,000 AF anticipated to be made available in 2010.

- Lower Colorado Water Supply Project: In March 2007, Metropolitan, the city of Needles, and the USBR executed a Lower Colorado Water Supply Project contract. Under the contract, Metropolitan annually receives Lower Colorado Water Supply Project water unused by Needles and other entities eligible to receive water from the project. A portion of the payments made by Metropolitan to Needles is placed in a trust fund for potentially acquiring a new water supply for Needles and other users of the Project should the groundwater pumped from the Project's wells become too saline for use. In 2009, Metropolitan received 2,300 AF from the Project.

- Hayfield Groundwater Storage Program: Metropolitan's board approved the Hayfield Groundwater Storage Program in June 2000. The program allows CRA water to be stored in the Hayfield Groundwater Basin in east Riverside County (about 50 miles east of Palm Springs) for future withdrawal and delivery to the CRA. As of 2003, there were over 70,000 AF in storage. At that time, construction of facilities for extracting the stored water began, but construction has been deferred because drought conditions in the Colorado River watershed resulted in a lack of surplus supplies for storage. A prototype well was completed in August 2009. Hydrogeologic investigations indicate that conversion of the prototype well into a production well could extract as much as 5,000 AF/year of stored water. When water supplies become more plentiful, Metropolitan will pursue this program and develop storage capacity of about 400,000 AF.

As with all storage and banking programs, CRA programs face major challenges and changing conditions and are influenced by the reduction of quantity and frequency of surplus water supplies available to Metropolitan from the SWP. Even though the reductions may be on the SWP, the inability for Metropolitan to store water on the SWP means that storage is more likely to be taken from CRA storage programs. If the conditions affecting the loss of surplus water continue, the storage programs that augment Colorado River

supplies will not be able to contribute to filling the CRA when needed.

SWP Delta

Restoring Metropolitan's traditional supply from the SWP supply through short-, mid-, and long-term Delta improvements is a critical piece in achieving regional water supply reliability. Historically, deliveries from the SWP to Metropolitan have represented about 4 percent of the runoff in the Delta watershed in an average year. Metropolitan is committed to a comprehensive ecosystem/water system solution for the Delta, the site of the pumping facilities for the SWP.

It is likely that operational constraints will continue until a long-term solution to the problems in the Delta is identified and implemented, and various efforts are underway toward that end. For example, state and federal resource agencies and various environmental and water user entities are currently engaged in the development of the Bay Delta Conservation Plan (BDCP), aimed at addressing ecosystem needs and securing long-term operating permits for the SWP. Metropolitan has been an active participant in the BDCP, in addition to developing its own action plan, while remaining engaged in related legislation.

Bay Delta Conservation Plan

Metropolitan is actively participating in the BDCP process, a collaboration of state, federal, and local water agencies, state and federal fish agencies, environmental organizations, and other interested parties, that will identify a set of water flow and habitat restoration actions that contribute to the recovery of endangered and sensitive species and their habitats in the Delta.

The goal of the BDCP is to provide for both species/habitat protection and improved reliability of water supplies. Potential habitat restoration and water supply conveyance options included in the BDCP will be assessed through an EIR/Environmental Impact Statement (EIS). The BDCP planning process and the supporting EIR/EIS process are being funded by state and federal water contractors.

The BDCP process to restore habitat for Delta fisheries and improve the Delta water conveyance will help provide reliable water delivery operations to 25 million Californians.

Table 3.3 Summary of Delta Action Plan

Time frame	*Actions*
Short-term	• Secure ESA take authorization • Prepare for emergencies • Enhance Delta smelt habitat • Complete BDCP • Restore ecosystems • Two-gates project
Mid-term	• Implement BDCP • Implement flood control protection • Finalize site selection and environmental documents • Implement new governing structures
Long-term	• Restore ecosystems • Water supply conveyance • Protect against floods • Develop storage

Metropolitan's Delta Action Plan

In June 2007, Metropolitan's board approved a Delta Action Plan[3] that provides a framework for actions to build a sustainable Delta and reduce conflicts between water supply conveyance and the environment.

Building a sustainable Delta will require significant investment and take decades to implement. The Delta Action Plan aims to prioritize immediate short-term actions to stabilize the Delta while an ultimate solution is selected, then prioritize mid-term actions to maintain the Delta while the long-term solution is implemented. A summary of these actions is included in **Table 3.3**.

Short-Term Actions

While a course of action for the long-term restoration of the Delta ecosystem is being developed, actions must be taken in the short-term to stabilize the current situation. These actions include securing state and federal ESA take authorization, taking emergency preparedness steps to prepare for the possibility of catastrophic failure in the event of earthquake

3. Item 8-6 Metropolitan's Delta Action Plan from June 12, 2007 Board Meeting http://edmsidm.mwdh2o.com/idmweb/cache/MWD%20EDMS/003697545-1.pdf

The Delta has been considered "broken" for some time. It has been altered significantly from its natural form and it is not sustainable. Land subsidence in the Delta is a direct threat to the levees (pictured right). Subsidence in the Delta has been caused by the use of land for farming and the composition of the rich peat soil. Some island areas are currently 30 feet below sea level, and extremely vulnerable to flooding. Working towards sustainable solutions in the Delta is one of Metropolitan's Core Resources Strategies.

or flood,[4] pursuing actions to enhance habitat for Delta smelt and other pelagic species, completing the BDCP, and beginning work on ecosystem restoration projects that will help species regardless of which ultimate solution is selected (e.g., marsh restoration, island rebuilding).

Additionally, Metropolitan is continuing to pursue the Two-Gate flow and tidal regulation project as a near-term action in the Delta to provide fishery benefits and mitigate water supply impacts.

The proposed Two-Gate System would provide movable barriers on the Old and Middle Rivers to modify flows and prevent vulnerable fish from being drawn toward the SWP and Central Valley Project pumping plants. The Two-Gate System is anticipated to protect fish habitat while allowing up to an estimated additional 150,000 AF/year of SWP water supply in years when the allocation for SWP contractors exceeds 35 percent. Additional supplies from this interim fix are assumed to materialize by 2013. The proposed Two-Gate system is subject to operational studies, monitoring, environmental documentation and compliance, acquisition of right-of-way, and completion of design and construction.

Mid-Term Action Plan

Upon selection and enactment of an ultimate Delta solution, it will likely take 10 years or more to complete environmental documentation and construct new facilities. During this period, it will be necessary to maintain the stabilization process of the Delta through continuing implementation of the BDCP projects with selected habitat and fishery improvements for Delta native species, beginning to implement flood control protections, including bypasses and levee improvements, finalizing site selection and environmental documentation for new storage projects, and implementing new governance structures for managing the Delta.

Long-term Action Plan

The long-term action plan must take a global, comprehensive approach in solving the fundamental issues and conflicts in the Delta, with true sustainability in mind. A piecemeal approach will not satisfy the many stakeholders

4. For more information on Metropolitan's Delta Levee Emergency response, see Appendix A.14.

The Delta needs wide-scale restoration of the ecosystem and a water conveyance system that will reduce potential conflicts with this estuary. Projects being studied include plans to restore up to 80,000 acres of marsh and vegetated areas along the riverbanks of the Delta.

that have a vested interest in the Delta. Delta improvements require that three basic elements be addressed: (1) ecosystem restoration, (2) water supply conveyance, and (3) flood control protection and storage development.

Delta Legislation

Metropolitan was an active participant in the development of the 2009 Delta legislative package signed into law by Gov. Schwarzenegger. The Legislature developed this package beginning with recommendations received from Gov. Schwarzenegger's Delta Vision "Blue Ribbon" Task Force. The Task Force evaluated existing and proposed land and water uses, ecosystem functions and processes, and management practices in the Delta in order to identify management scenarios and implementation strategies to attain sustainability in the region. In addition to these recommendations, the Legislature held informational hearings with Delta experts, Task Force members, Schwarzenegger Administration officials, as well as the public at large, while engaging in vigorous water policy discussions. Metropolitan's management testified at some of these hearings and staff provided written comments to the Legislature on Southern California's viewpoints. Following the informational hearings, several legislators began work on developing a comprehensive legislative package, followed by further information hearings and public comment. This culminated in a Delta legislative package introduced in the 7th Extraordinary Session of the Legislature.

The suite of Delta/water management reforms enacted by this legislation included a key new policy for water management affecting the many communities throughout California that depend upon the Delta watershed.

The policy reads as follows:

"The policy of the state of California is to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water-use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water-use efficiency, water recycling, advanced water technologies, local and regional water supply

projects, and improved regional coordination of local and regional water supply efforts."

The Delta Legislation, however, was not limited to water management strategies and included the following highlights:

- SB 1: Establishes a framework of coequal goals of a more reliable water supply for California and protecting, restoring and enhancing the Delta ecosystem; creates a new Delta Stewardship Council that will help coordinate the actions of more than 200 local, state, and federal agencies in the estuary; and creates a Delta Conservancy to coordinate restoration activities.
- SB 2: Places an $11.1 billion bond on the November 2010 ballot to help fund Delta restoration, the public benefits associated with new storage projects, groundwater cleanup, recycling, and regional water management efforts. A vote on this bond package was delayed by the Legislature until November 2012.
- SB 6: Provides a mandate for local monitoring of groundwater elevations.
- SB 7: Requires urban water agencies to lower per capita urban water use statewide by 20 percent by the year 2020 (20x2020), described further in the following section.
- SB 8: Improves accounting for Delta water diversions.

SWP Resource Development

Metropolitan's strategy for the SWP depends on the full use of the current State Water Contract provisions in order to restore traditional deliveries prior to recent environmental restrictions. These provisions include its basic Table A supply contract amount, Article 21 interruptible supplies, and Turnback Pool supply provisions. In addition, it requires successful negotiation and implementation of a number of agreements, transfers, exchanges, and programs. The supplies from Delta improvements represent the restoration of supplies lost in recent years due to pumping restrictions. Metropolitan is committed to working collaboratively with DWR, SWP contractors, and other stakeholders to ensure the success of these programs.

The quantitative impacts of these investments in a dry year are shown in **Table 3.4.** In addition to anticipated supplies available from Metropolitan's Delta improvements outlined above, **Table 3.4** assumes continued success of our existing programs, detailed below:

- Sacramento Valley Water Management Agreement (Phase 8 Settlement): Metropolitan is a signatory to the Sacramento Valley Water Management Agreement (Phase 8 Settlement) that includes work plans to develop and manage water resources to meet Sacramento Valley in-basin needs, environmental needs under the SWRCB's Water Quality Control Plan, and export supply needs for both water demands and water quality. The agreement specifies about 60 water supply and system improvement projects by 16 different entities in the Sacramento Valley.
- Monterey Amendment: Metropolitan was a signatory to the 1994 Monterey Amendment to resolve disputes between the urban and agricultural SWP contractors over how contract supplies are to be allocated in times of shortage by amending certain provisions of the long-term water supply contracts with DWR. The Monterey Amendment altered the water allocation procedures such that both shortages and surpluses would be shared in the same manner for all contractors, eliminating the prior "agriculture first" shortage provision. In turn, the agricultural contractors agreed to permanently transfer 130,000 AF to urban

Table 3.4 SWP Dry-Year Supplies & Delta Improvements

		2015	2020	2025	2030	2035
Existing Programs*	*SWP*	430,000	430,000	430,000	430,000	430,000
Core Strategy	*Delta Improvements*	151,000	151,000	283,000	283,000	283,000
Total		**581,000**	**581,000**	**713,000**	**713,000**	**713,000**

*The existing supplies assume that carryover storage in San Luis Reservoir would be available for use in a dry-year, but because of the environmental and regulatory challenges on the SWP, it is possible that this water would not be available in the quantities shown.

Today, those involved with solving Delta problems agree to the coequal priorities of improving water supply reliability and strengthening and restoring the valuable ecosystem. The Bay Delta Conservation Plan is being crafted with the oversight of state and federal wildlife agencies as well as water districts, environmental groups, local Delta interests and members of the public. Each year, 500 million tons of cargo are transported through the Delta, and its estuary is home to 750 species of plants and animals.

contractors and permanently retire 45,000 AF of their contracted supply. The Amendment facilitated several important water supply management practices including groundwater banking, voluntary water marketing, and flexible and more efficient use of SWP facilities including borrowing from Castaic Lake and Lake Perris and use of carryover storage in San Luis Reservoir to enhance dry-year supplies. It also provided for the transfer of DWR land to the Kern County Water Agency for development of the Kern Water Bank. The Monterey Amendment was challenged in court and the original EIR invalidated. Following a settlement, a new EIR was completed and the CEQA process concluded in May 2010. However, the project has been challenged again in a new round of lawsuits.

- SWP Terminal Storage: Metropolitan has contractual rights to 65,000 AF of flexible storage at Lake Perris (East Branch terminal reservoir) and 153,940 AF of flexible storage at Castaic Lake (West Branch terminal reservoir). This storage provides Metropolitan with additional options for managing SWP deliveries to maximize yield from the project.
- Yuba Dry-year Water Purchase Program: In December 2007, Metropolitan entered into an agreement with DWR providing for Metropolitan's participation in the Yuba Dry-year Water Purchase Program between Yuba County Water Agency and DWR through 2025.
- Desert Water Agency/Coachella Valley Water District SWP Table A Transfer: Under the transfer agreement, Metropolitan transferred 100,000 AF of its SWP Table A amount to DWCV effective January 1, 2005. Desert Water Agency/Coachella Valley Water District (DWCV) pays all SWP charges for this water, including capital costs associated with capacity in the SWP to transport this water to Perris Reservoir as well as the associated variable costs. The amount of water actually delivered in any given year depends on that year's SWP allocation. Water is delivered through the existing exchange agreements between Metropolitan and DWCV. While Metropolitan transferred 100,000 AF of its Table A amount, it retained other rights,

including interruptible water service, its full carryover amounts in San Luis Reservoir, its full use of flexible storage in Castaic and Perris Reservoirs, and any rate-management credits associated with the 100,000 AF. In addition, Metropolitan is able to recall the SWP transfer water in years in which Metropolitan determines it needs the water to meet its water management goals. The main benefit of the agreement is to reduce Metropolitan's SWP fixed costs in wetter years when there are more than sufficient supplies to meet Metropolitan's water management goals, while at the same time preserving its dry-year SWP supply.

- DWCV Advance Delivery Program: Under this program, Metropolitan delivers Colorado River water to DWCV in advance of the exchange for their SWP Contract Table A allocations. By delivering enough water in advance to cover Metropolitan's exchange obligations, Metropolitan is able to receive DWCV's available SWP supplies in years in which Metropolitan's supplies are insufficient without having to deliver an equivalent amount of Colorado River water.
- DWCV Other SWP Deliveries: Since 2008, Metropolitan has provided DWCV's written consent to take delivery from the SWP facilities non-SWP supplies separately acquired by each agency. These deliveries include water acquired from the Yuba Dry-year Water Purchase Program and the 2009 Drought Water Bank.

The Delta remains a critical source of supply for Metropolitan for two fundamental reasons. It is of high quality compared to other sources such as the Colorado River, with high source quality key to emerging local initiatives such as recycling. Moreover, the Delta is uniquely capable of providing additional supplies in wet years, when diversions are far less sensitive on the ecosystem, enabling Metropolitan to replenish groundwater basins and its surface storage network.

Although water from the Delta remains a key component of Metropolitan's diverse water portfolio, the Delta will be a decreasing percentage of the resource "pie" as other resources are developed. Development of a diverse resource mix is the foundation of Metropolitan's resource planning and this strategy is supported by every element of the state's new reduced reliance policy for the Delta including emphasizing water-use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.

Water-Use Efficiency through Conservation & Recycling

Conservation continues to be an important part of Metropolitan's water supply planning. Continued investment in cost-effective conservation remains a key component of Metropolitan's resource goals.

This IRP sets conservation goals in terms of the 2009 20x2020 Water Conservation Act signed by Gov. Schwarzenegger. In order to be eligible for future state water grants and loans, this legislation requires urban retail water suppliers to develop urban water use targets to help meet the 20 percent goal by 2020, with interim targets for 2015. The legislation provides flexibility in how targets are established and achieved. 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. Potable demand offsets can occur through direct reuse of recycled water, such as for irrigation, or indirect potable reuse through groundwater recharge and reservoir augmentation. Retail water suppliers receive partial credit for past efforts in conservation and recycled water; therefore, not all agencies need to reduce demand by 20 percent in order to comply with the new law.

The legislation provides additional flexibility by allowing compliance on an individual agency basis or through collaboration with other agencies in a region. Based on Metropolitan's analysis of population and demand and the methodologies for setting targets described in the legislation, compliance with 20x2020 on an individual retail agency basis throughout the region would result in reduced potable demand of 380,000 AF in 2020, shown in **Table 3.5**. Achieving regional consistency with the legislative goal – a 20 percent reduction for the region as a whole – would result in additional

savings of 200,000 AF for a total of 580,000 AF. These additional 200,000 AF regional savings will be an important part of the Uncertainty Buffer described later in this section.

In terms of GPCD, the baseline regional water demand under this legislation was 177 in 2005. With no 20x2020 compliance, under existing levels of conservation and water recycling, the 2020 target would be 166 GPCD. Since the legislation allows for various calculations of this baseline on a retail-agency basis, if all retail agencies in the service area choose their optimal baseline, the resulting use in 2020 will be 150 GPCD. Regionally, however, this is only a 15 percent reduction from the 177 GPCD baseline. In order to reach a full 20 percent reduction on a regional level, average regional 2020 target would need to be 141 GPCD. **Figure 3.5** compares the impact on GPCD of these various levels of conservation.

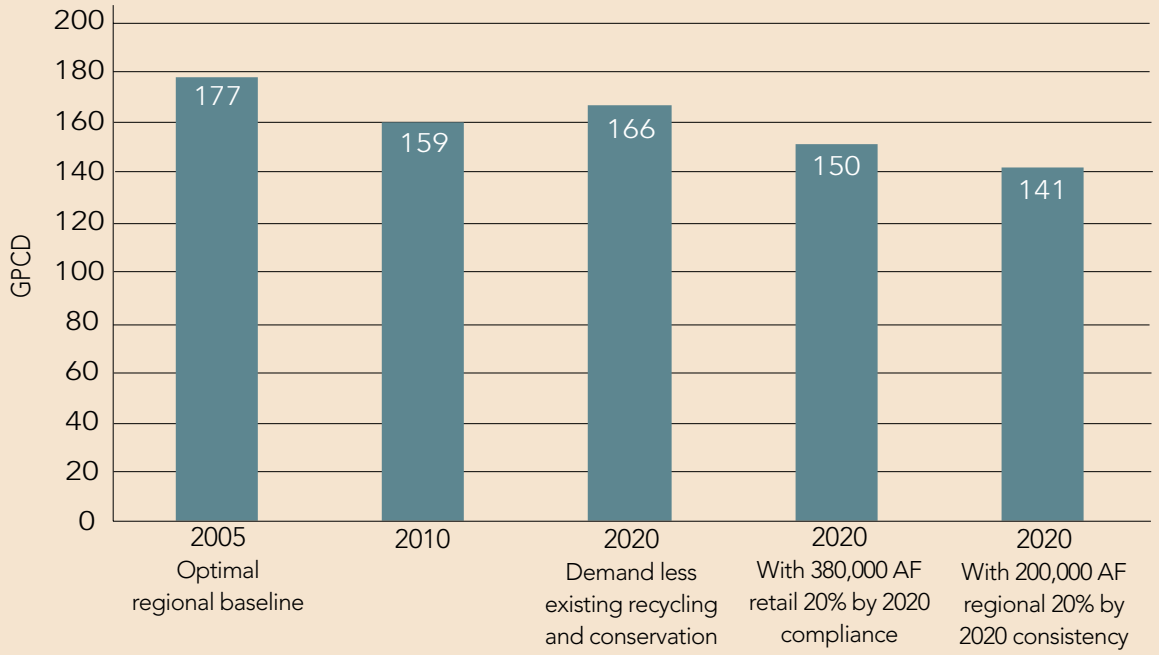
Augmentation of Local Resources through Incentives & Partnerships

Metropolitan continues to pursue local water recycling, groundwater recovery, and seawater desalination. Although recycling is used in meeting the 20x2020 goals, those recycling projects not being considered to meet 20x2020 could go toward meeting local resource augmentation goals. However, the primary supplies considered for augmentation are groundwater recovery and seawater desalination.

TABLE 3.5 ESTIMATED CONSERVATION SAVINGS INCLUDING 20X2020 RETAIL COMPLIANCE

		2015	2020	2025	2030	2035
Existing Program	*Conservation*	930,000	965,000	1,032,000	1,097,000	1,158,000
	Recycling Projects	353,000	387,000	413,000	422,000	430,000
Core Strategies	*20x2020 Retail Compliance (Conservation & Recycling)*	190,000	380,000	380,000	380,000	380,000
Total		**1,473,000**	**1,732,000**	**1,825,000**	**1,899,000**	**1,968,000**

FIGURE 3.5 GPCD COMPARISONS WITH VARYING LEVELS OF REGIONAL WATER EFFICIENCY*



*Per capita GPCD reductions can be acccomplished through any combination of increased water conservation, improved water use efficiency, and increased use of recycled water to offset potable demand.

Local agencies have implemented projects to recover contaminated or degraded groundwater for potable uses to enhance supply reliability of the region by maximizing local groundwater resources. Furthermore, several agencies are progressively pursuing development of seawater desalination projects.

Table 3.6 outlines targets for further development of these local resources, a goal that will require a continued commitment to building key partnerships throughout the region between Metropolitan, its member agencies, and other government entities across a multitude of disciplines and jurisdictions.

Supply Reliability & Storage Sustainability Under Core Resources

Thorough resource simulation analysis using IRPSIM shows that by implementing the Core Resources Strategy, described above and summarized in **Table 3.7**, Metropolitan can achieve its reliability goals under observed conditions.

The successful development of the resources identified in the Core Resources Strategy, and the use of storage and transfers, significantly improves the balance between demand and dry-year supply compared to the existing levels of resource development. The capability of storage and transfers to meet the gap is greatly improved with this level of resource development because

Table 3.6 Existing Dry-Year Local Resource Production & Augmentation

		2015	2020	2025	2030	2035
Existing Programs	*Groundwater*	1,485,000	1,503,000	1,515,000	1,526,000	1,527,000
	Groundwater Recovery	122,000	136,000	144,000	148,000	150,000
	Local Surface Water	100,000	99,000	99,000	99,000	99,000
	LAA	147,000	147,000	147,000	147,000	147,000
Core Strategies	*Local Resources Augmentation (Groundwater Recovery & Seawater Desalination)*	72,000	72,000	102,000	102,000	102,000
Total		**1,926,000**	**1,957,000**	**2,007,000**	**2,022,000**	**2,025,000**

Table 3.7 Dry-Year Demand & Supply Balances under Core Resources Strategy

	2015	2020	2025	2030	2035
Dry-year Need after Existing Supplies	1,178,000	1,152,000	1,214,000	1,300,000	1,363,000
Core Resources Strategy					
Delta Improvements	151,000	151,000	283,000	283,000	283,000
CRA Dry-year Supply	398,000	265,000	293,000	325,000	325,000
20x2020 Retail Compliance	190,000	380,000	380,000	380,000	380,000
Local Resources Augmentation	72,000	72,000	102,000	102,000	102,000
Total Core Resources	**811,000**	**868,000**	**1,058,000**	**1,090,000**	**1,090,000**
Dry-year Need after Core Resources	367,000	284,000	156,000	210,000	273,000
Storage & Transfers Available*					
*In-Region Surface Storage***	256,000	283,000	321,000	320,000	309,000
In-Region Groundwater	151,000	255,000	255,000	255,000	255,000
SWP Surface Storage	43,000	66,000	171,000	207,000	205,000
SWP Groundwater	200,000	200,000	200,000	200,000	200,000
Yuba Accord Transfers	17,000	17,000	17,000	17,000	17,000
SBVMWD Transfers	6,000	6,000	6,000	6,000	6,000
Other Water Transfers	100,000	100,000	100,000	100,000	100,000
Total Storage & Transfers	**773,000**	**927,000**	**1,070,000**	**1,105,000**	**1,092,000**

* Does not include Emergency Storage or CRA Storage, which is assumed to be used as part of Core Resources Strategy.
**For planning purposes, annual In-Region Surface Storage withdrawals are limited to one-third of the total water available.

of the improved ability to maintain or add to storage resources. **Figure 3.6** shows average storage availability through the planning horizon with the Core Resources Strategy as compared with average storage under existing development. No longer is there a declining amount of storage capacity over time, meaning that storage reliance is sustainable. This provides additional evidence that the Core Resources Strategy will be able to provide reliability out into the future. This improved reliability is illustrated in **Figure 3.7**.

Figure 3.7 provides a visual representation of supply reliability in the year 2035 with implementation of the Core Resources Strategy. The blue area shows that the region could experience a supply shortage of up to 870,000 AF about 18 percent of the time before storage is utilized. Storage use would be effective and sustainable under this strategy, allowing the region to achieve 100 percent reliability. When compared to **Figure 3.4** showing reliability under existing levels of resource development, one can see the drastic increase in reliability gained by implementing this Strategy.

Component 2: Developing an Uncertainty Buffer

Planning for water supply reliability is complicated by risk and uncertainty. Foreseeable water supply and demand conditions may differ from those observed in the past and affect regional reliability. Water supply reliability in the Metropolitan service area through 2035 and beyond depends on many factors including the successful implementation of local and imported water supply projects described in previous sections of this report. Inevitably, some projects envisioned for the region will be delayed or not completed. Uncertain regional growth and water demand projections are additional factors that must also be considered when planning future water supplies.

For example, the imposition of additional and unforeseen environmental and regulatory restrictions could cause significant impacts to water supplies. Under additional restrictions, Metropolitan would need to significantly adapt in order to meet anticipated water demands

Because of these uncertainties, the concept of developing a planning buffer was introduced during the 2004 IRP Update. This IRP Update proposes to expand the concept of a planning buffer and create an actual hedge against demand uncertainty, by pursuing an Uncertainty Buffer. However, this IRP Update simply sets the Uncertainty Buffer as a goal. Metropolitan will evaluate specific future projects to implement this goal based on then-existing and changed conditions consistent with the adaptive management strategy outlined in the IRP.

This Uncertainty Buffer would consist of two parts: collaboration between Metropolitan and its member agencies to achieve regional compliance with 20x2020 actions and local resource programs that can be implemented if the board determines the programs are needed. This allows Metropolitan to balance the rate impact of implementing the buffer against the risk of shortage.

The 20x2020 initiative directly addresses the role of demand in providing reliable water supplies and has the potential to provide 200,000 AF regionally in addition to the 380,000 AF reduction in potable demand achieved in the Core Resources Strategy through retail-level compliance. This additional water-use efficiency helps provide a regional buffer to respond to uncertain conditions.

Through the IRP Technical Workgroups, Metropolitan's member agencies have also identified various local supply projects that could be implemented and added to the regional supply portfolio if necessary. For the purposes of the rate discussion in Section 4, this additional local supply development is assumed to be up to 300,000 AF regionally. Combined with the 200,000 AF of regional water-use efficiency buffer, the total regional buffer could be as much as 500,000 AF. These local supply projects would be developed as needed, based on an evaluation of risk, cost and regional benefit. Ultimately the size of the buffer will be determined over time, to account for risk and project development schedules, which can be up to ten years.

As a point of reference, the regional 20x2020 consistency portion of the Uncertainty Buffer alone is roughly equivalent to four percent of

FIGURE 3.6 AVERAGE DRY-YEAR STORAGE BALANCES UNDER CORE RESOURCES STRATEGY

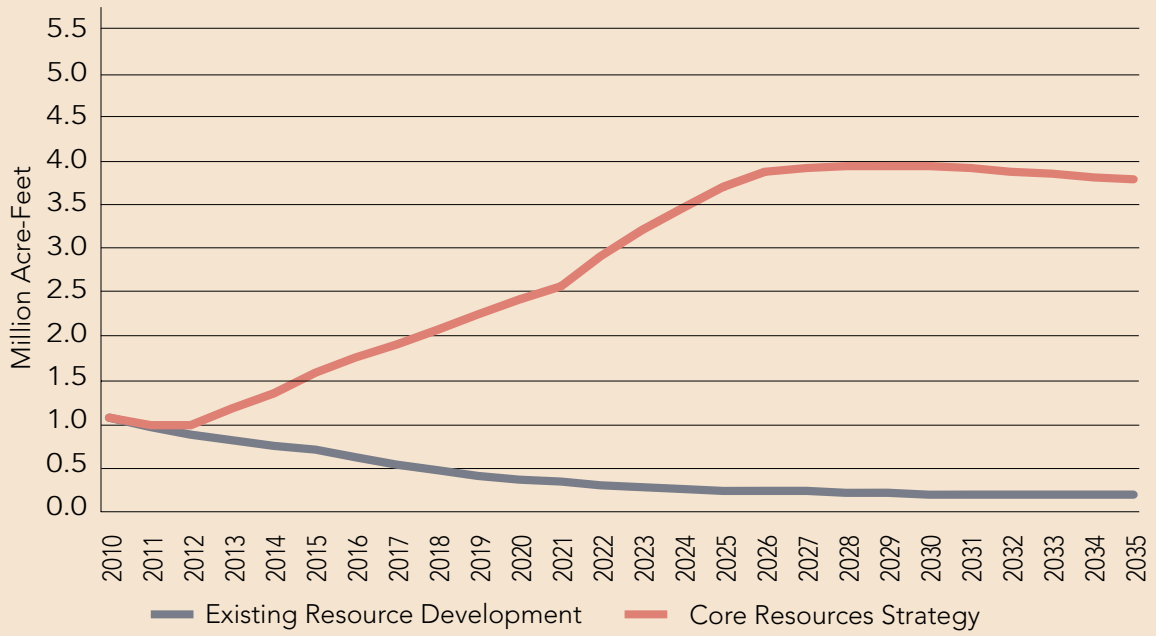
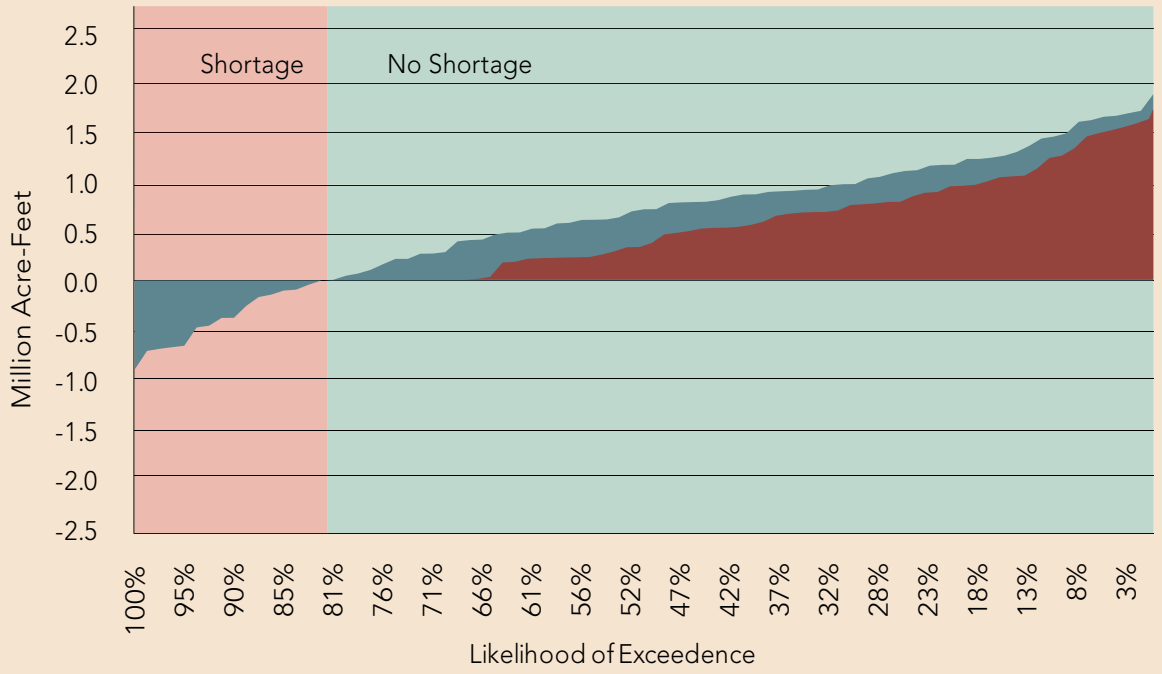


FIGURE 3.7 2035 DRY-YEAR SUPPLY RELIABILITY UNDER CORE RESOURCES STRATEGY



total regional demand, ten percent of regional demand on Metropolitan, or half the losses in recent years from pumping restrictions on the SWP.

Achieving Additional Supply Reliability & Storage Sustainability with Uncertainty Buffer

Pursuing a buffer provides insurance against foreseeable short-term uncertainties, augments storage, and provides reliability without increasing imported supplies. An analysis of the impacts of implementing an Uncertainty Buffer shows that reliability can be made to be robust to changes in the planning assumptions and improve the balance between demand and supply established by the Core Resources Strategy.

Because of this additional supply development and water-use efficiency, the capability of storage and transfers to meet any remaining gap is significantly larger than the projected demand need and even shows an excess of supply if the whole Uncertainty Buffer were implemented under projected supply and demand scenarios, as seen in **Table 3.8.** This is the direct result of the underlying theory of an Uncertainty Buffer: a buffer is purposefully overdeveloped relative to demands, because it is intended to hedge against unknown changes in the planning parameters used in the analysis. The region would hedge against over-development by taking a measured approach to implementation.

Figure 3.8 shows average storage through the planning horizon with the existing supplies, Core Resources Strategy, and the Uncertainty Buffer. Because there is an excess of supply if the entire Uncertainty Buffer is pursued, the need for storage is vastly reduced, and storage programs would conceivably near maximum capacity. However, since the purpose of the Uncertainty Buffer is to help the region deal with unforeseeable change and be implemented as needed, it is unlikely the entire Uncertainty Buffer would be developed under the projected demands and supplies. As noted above, when evaluating future projects to implement this Uncertainty Buffer, Metropolitan will evaluate then-existing and changed conditions adaptively. Should changes occur, the supply and storage that appears to be in surplus would be used to mitigate and meet those changes and provide added reliability as seen in **Figure 3.9**.

Figure 3.9 provides a visual representation of supply reliability in the year 2035 with implementation of the Core Resources Strategy and Uncertainty Buffer. The blue area shows that the region could experience a supply shortage of over 700,000 AF about 12 percent of the time

TABLE 3.8 DRY-YEAR DEMAND & SUPPLY BALANCES UNDER CORE RESOURCES STRATEGY & UNCERTAINTY BUFFER

	2015	*2020*	*2025*	*2030*	*2035*
Dry-year Need after Core Resources Strategy	367,000	284,000	156,000	210,000	273,000
Uncertainty Buffer					
20x2020 Regional Consistency Target	100,000	200,000	200,000	200,000	200,000
Dry-year Need after Buffer Implementation*	267,000	84,000	0	10,000	73,000
Storage & Transfers Availability**					
*In-Region Surface Storage****	275,000	309,000	330,000	323,000	313,000
In-Region Groundwater	178,000	255,000	255,000	255,000	255,000
SWP Carryover	53,000	93,000	208,000	230,000	233,000
SWP Groundwater	200,000	200,000	200,000	200,000	200,000
Yuba Accord Transfers	17,000	17,000	17,000	17,000	17,000
SBVMWD Transfers	6,000	6,000	6,000	6,000	6,000
Other Water Transfers	100,000	100,000	100,000	100,000	100,000
Total Storage & Transfers	829,000	980,000	1,116,000	1,131,000	1,124,000

* When Dry-year Need is zero or below (there is a surplus of water), a zero is shown.
** Does not include Emergency Storage or CRA Storage, which is assumed to be used as part of Core Resources Strategy.
*** For planning purposes, annual In-Region Surface Storage withdrawals are limited to one-third of the total water available.

FIGURE 3.8 AVERAGE DRY-YEAR STORAGE BALANCES UNDER CORE RESOURCES STRATEGY & BUFFER

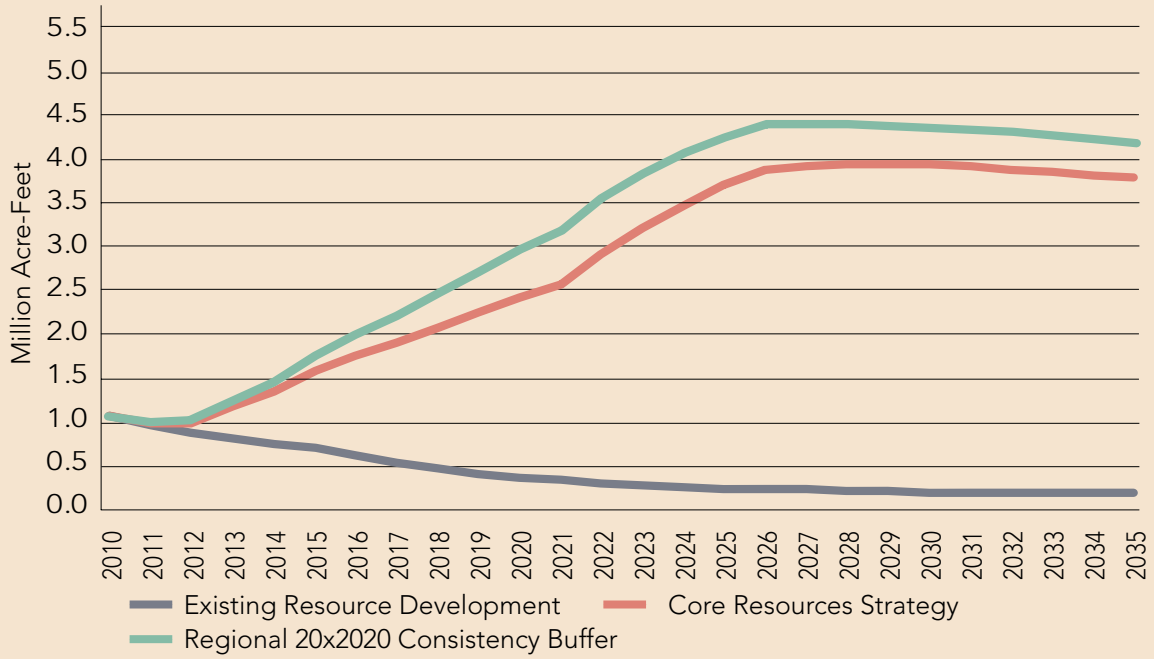
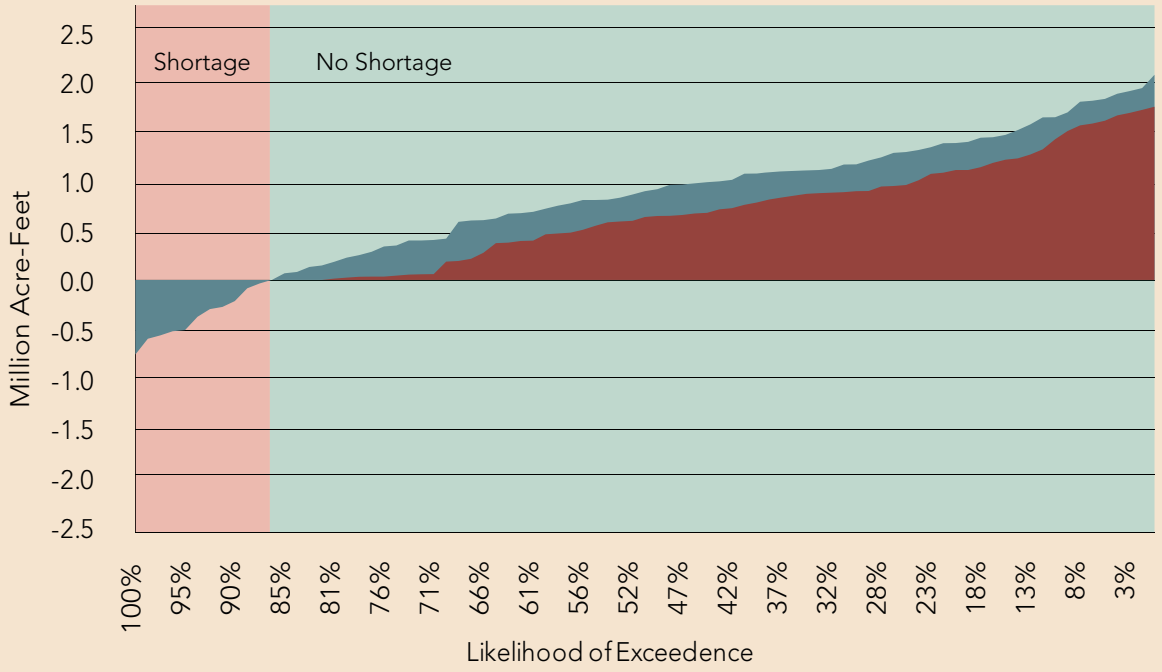


FIGURE 3.9 2035 DRY-YEAR SUPPLY RELIABILITY UNDER CORE RESOURCES STRATEGY & UNCERTAINTY BUFFER



before storage is utilized, reducing what was seen under the Core Resources Strategy alone.

Component 3: Foundational Actions

Metropolitan's policies on reliability have evolved in order to keep current with emerging regional and statewide conditions. Because our region faces escalating water supply uncertainties, it is appropriate at this juncture to take a look at different manners in which to ensure regional water supply reliability.

In order to sufficiently plan for unforeseen circumstance and provide replacements if the Core Resources Strategy or Uncertainty Buffer supplies are reduced, Metropolitan will employ Foundational Actions concurrent with the Core Resources Strategy and Uncertainty Buffer that will focus on further development or study of four local resources:

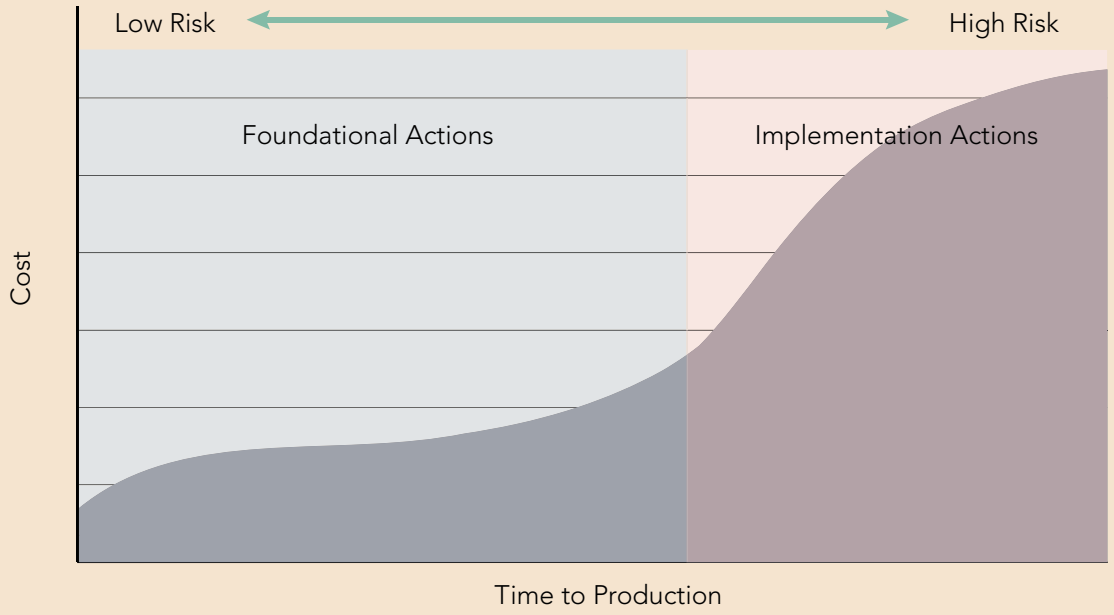
- Recycled water;
- Seawater desalination;
- Stormwater; and
- Graywater.

These Foundational Actions are low-regret, low-risk actions, essentially feasibility studies, legislative efforts, and research, undertaken with the aim of reducing the time it takes for a project to reach full production. These resources can then be used to replace or augment Core Resources or Uncertainty Buffer supplies if the Foundational Actions show that a particular resource is suitable for regional investment. These Actions would be comprised of planning and preparatory actions laying the foundation for full-scale investments. In response to emerging uncertainties, this approach provides a scalable response to varying degrees of shortage, the value of which is seen in **Figure 3.1,** Graph C.

For example, **Figure 3.10** shows a hypothetical progression of actions needed to implement a project. The dark shaded area under the curve represents actions needed to implement a project from start to production. These actions often take years and come with varying degrees of cost risk. Foundational Actions could drastically reduce this time frame, at low cost and risk.

Figure 3.10 shows a hypothetical delineation of those actions that might be considered low-

FIGURE 3.10 HYPOTHETICAL VARIABLE COST & RISK OF PROJECT IMPLEMENTATION



cost, low-risk Foundational Actions in blue and those implementation actions requiring greater risk and cost in pink. Each resource project will have different ratios of Foundational Actions to higher cost and risk actions. The most important aspect of pursuing Foundational Actions is the flexibility with which these supplies can be implemented based on need and urgency. By doing the preliminary feasibility studies and research, time for any future implementation is reduced and the region is better prepared should opportunities arise in the future.

Establishing a Suite of Actions

In order to reduce the lead time necessary to implement the four supplies, Metropolitan has identified specific actions to facilitate this development. By regionally collaborating to complete these Foundational Actions, key planning options are established and critical deterrents to development begin to ease. For example, if capital improvements would be needed to maximize water development of a certain project, the formation of a permitting and inspection work group would expedite this project's application and approval process. Greater synergy and efficiency can be attained by implementing a greater number of Foundational Actions.

Moreover, this approach allows the region to select supply projects from any of the four resources to create supply portfolios that could be used to mitigate future supply gaps. Once these Foundational Actions are established, projects can be implemented to meet specific needs within the region in a scalable manner to respond to varying degrees of shortage.

In order to methodically evaluate development of these resources, Metropolitan's Foundational Actions draw from the findings and recommendations from the IRP technical workgroups (**Section 2 and Appendices A.7-13**). From this data and staff expertise came seven categories of foundational and other resource development actions that can be pursued regionally to aid future implementation of these resources. An overview of these categories is found in **Table 3.9**. Each resource has been evaluated and a series of resource development actions identified for each category.

Inclusion of these Foundational Actions in an adaptive management approach provides the region with a flexible water supply planning and implementation tool that can quickly respond to unforeseen water supply shortages in the Core Resources Strategy or Uncertainty Buffer. Below are summaries and detailed tables (**Tables 3.10-13**) of those Foundational Actions, along with possible future implementation actions, identified for potential pursuit toward development of these four resources. These tables also delineate a Foundational Action versus higher risk actions and the estimated time to completion, mirroring project development concept illustrated in **Figure 3.10**. Like the shaded areas in **Figure 3.10**, the actions shown in blue are Foundational Actions, and those in pink are higher risk and cost implementation actions toward developing each water supply.

Recycled Water

As an existing resource, Foundational Actions for recycled water must take into account existing projects and conditions. These Actions are described below and detailed in **Table 3.10**, along with an estimated time line of 12 years to development, with eight of those years consisting of Foundational Actions.

TABLE 3.9 CATEGORIES OF RESOURCE DEVELOPMENT ACTIONS

Integrational	Integrates existing regional facilities or programming, establishes efficiency and cohesion mainly through collaborative planning processes
Public Perception	Eases or improves public perception on key issues through extensive public outreach
Legislative	Facilitates supply development through legislative or regulatory action
Fiscal	Identifies and establishes funding mechanisms to maximize regional participation
Procedural	Streamlines permitting and regulatory approval processes through collaboration and organizational efforts
Operational	Identifies and mitigates external challenges that impact facility and resource operations
Infrastructural	Pursues facilities and capital required to develop water supply

Integrational

The integration of future water treatment facilities with existing facilities is a key element in ensuring that regional efforts are optimized and assets are used efficiently and effectively. A Regional Recycled Water Facility Master Plan, in collaboration with recycled water stakeholders, would identify future demand; inventory recycled water projects within the region; identify regional facility needs, including specific capital projects; and look for opportunities to share existing and planned treatment, storage, and conveyance facilities. This approach emphasizes synergy and economies of scale in future implementation. Using this information, alternative methods of project implementation could be evaluated and regional treatment facility efficiency objectives created to maximize recycled water.

Public Perception

Public perception greatly influences the successful implementation of recycled water programs. Continued public education on recycled water will be essential, combined with marketing efforts to promote economical and reliable recycled water use. The target audience for the outreach campaign will be the general public, with special focus on students. The region can take advantage of and work in tandem with existing similar education and marketing campaigns by others. Partnerships can be formed between water and wastewater agencies to develop and implement such campaigns.

Legislative

In order to effectively monitor proposed legislation on recycled water and consider developing new recycled water legislation beneficial to the region, a Recycled Water Legislative Task Force would be created that would consist of agencies and organizations throughout the region. The Task Force would meet on a regular basis to seek regional consensus on current and developing legislative issues. Such a forum would provide a valuable opportunity for water agencies and wastewater agencies to seek a consensus on legislative positions for the benefit of the region. Specifically, the Task Force would quantify current and proposed legislation, and identify potential proponents and opponents of legislation and establish a consistent platform for promoting recycled water. From there the Task Force could coordinate support for regulations and work with a proposed financing committee (see below) to seek local, state, and federal funding for recycled water projects and programs through bonds and other measures.

Fiscal

In light of the scarcity of public funds for planning, design, and construction of infrastructure projects and serious competition for those available funds, a regional collaborative approach to securing funding for recycled water projects is not only critical but necessary for the region to successfully implement increased water recycling. Thus, a committee would be created that would prepare a regional finance plan. This Committee would seek to identify and establish funding mechanisms to finance the capital costs needed for treatment and distribution systems. The Finance Committee would also review the availability of existing incentives and bond funds (loans and/or grants) and would recommend proposals for new bond funding of facilities to the Legislative Task Force. With a guiding principle of efficient use of public funds, the Finance Committee would explore regional cost-sharing opportunities among the region's recycled water stakeholders to further enhance recycled water use, seeking partnerships to achieve economies of scale through the region's significant existing recycled water infrastructure.

Procedural

Critical to the successful implementation of recycled water projects is a streamlined application and permitting process. Therefore, a Task Force would be created to work with health departments, and permitting and regulatory agencies to expedite project approvals processes. In conjunction, a clearinghouse consisting of policies, codes, ordinances, and standards related to recycled water would be established to assist in developing consistency on the interpretation and application of rules and standards.

Operational

Effective operations of recycled water projects rely upon knowledge that such operations do

TABLE 3.10 PROJECT DEVELOPMENT ACTIONS & TIMELINE FOR RECYCLED WATER

	Actions		Years to Water Production											
			1	2	3	4	5	6	7	8	9	10	11	12
Integrational	Regional Facility Master Plan	• Project demands and recycled water supplies												
		• Identify regional recycled water facilities and purveyors, service boundaries and jurisdictions, and regional concentrate discharge lines												
		• Identify opportunities for sharing existing storage and conveyance facilities												
		• Establish regional recycled water facility efficiency objectives												
		• Create list of capital improvements needed to maximize regional recycled water use												
		• Prepare an analysis of alternatives for treatment, energy use, siting, scale, integration, etc.												
Public Perception	Outreach Campaign	• Address public questions about recycled water through multi-media campaign												
		• Sponsor career days, science fairs, and other educational events to promote recycled water												
Legislative	Legislative Task Force	• Quantify effects of existing and pending legislation												
		• Establish recycled water platform (benefits, current application, potential)												
		• Identify political proponents and opponents												
		• Advocate legislation that encourages and promotes recycled water use												
Fiscal	Regional Finance Committee	• Identify major recycled water facility and retrofit cost components												
		• Coordinate funding with business groups, municipalities, and financiers												
		• Identify incentive and grant opportunities and disseminate to partners												
		• Identify bond measures to fund recycled water and coordinate with Legislative Task Force												
		• Explore regional cost-sharing opportunities to encourage efficient use of public funds												
		• Establish funding mechanisms to finance capital costs												
Procedural	Regional Policy & Permitting Task Force	• Establish regional clearinghouse for recycled water codes, regulations, ordinances, and standards												
		• Work with CDPH, county health department, etc. to identify barriers to implementation and health risks												
		• Assist in study to quantify and propose solutions to barriers identified by public health agencies												
		• Establish and promote a unified regional policy template												
		• Update and streamline application and permitting process												
Operational	Regional Salt Management Plan	• Collaborate with water supplies, wastewater agencies and watermaster/basin managers to establish regional objectives and strategies												
		• Quantify existing regional salt balances and standards												
	Regional Watershed Management Plan	• Quantify existing basin storage and water quality standards												
		• Collaborate with water suppliers, flood control districts, and water master/basin managers to establish regional objectives and strategies												
		• Establish monitoring protocol and consult with regulatory agencies to streamline process												
		• Coordinate regionally to schedule basin deliveries and extractions												
Infrastructural	Regional Project Development	• Acquire land and design facilities for potential project sites suited for regional coordination and existing infrastructure												
		• Pursue necessary environmental compliance, and permitting												

not negatively impact the receiving waters of the underlying groundwater basin – currently or into the future. As salt levels typically rise in recycled water and as emerging constituents of concern in recycled water are better understood and increasingly subject to regulation, it is proposed that the region pursue the following: 1) prepare and update a Regional Salt Management Plan in collaboration with regulatory agencies and regional stakeholders to quantify and manage regional salt balances, 2) prepare and update a Regional Watershed Management Plan in collaboration with regulatory agencies and regional stakeholders to establish regional recycled water objectives/strategies and quantify and manage impacts to local groundwater basin storage and quality. Additionally, regional water quality monitoring and standards would be created on salt and basin management, which would be readily available to stakeholders in planning for new recycled water facilities.

Infrastructural

The overarching approach to increasing recycled water use is a regional approach – not only to planning, marketing, education, legislation, financing, regulations, policies, and basin management, but to actual facility design and construction. While the efforts of wastewater and water agencies have created the significant existing recycled water infrastructure in the region, enhancing that infrastructure to its full capability necessitates a fully integrated approach. This is especially true when faced with construction of new treatment and distribution facilities within a developed environment already containing numerous other underground utilities. This may require retrofits to existing systems to increase capacity or coordination on land acquisition and construction to prepare for future demand. Additionally, by necessity, increasing recycled water use within the region will result in recycled water service crossing multiple political, watershed, and groundwater basin boundaries and land acquisition, environmental compliance, permitting, and construction will require regional project implementation.

Seawater Desalination

Foundational and other resource development actions for seawater desalination include completion of feasibility, policy, financial, legislative, and management studies and plans estimated to take eight years, with 11 years total for project implementation. Foundational actions and implementation timelines for desalinated seawater are described below and in **Table 3.11**.

Integrational

As a first step to integrate desalinated seawater as a potential resource for Southern California, a Regional Feasibility Study would be put together to document and guide further research and development. Key work elements of this effort include establishing a database of existing practices. Based on this data, the region could propose, implement, and report the findings on new pilot studies for desalinated seawater systems. Only with more complete data and information can the full potential be determined with enough certainty to inform decision makers on the extent to pursue desalinated seawater as a resource and the degree to pursue it.

Public Perception

How the public perceives and understands the costs and benefits of desalinated seawater will be crucial to its effectiveness as a resource. Any educational campaign should include a critical assessment of environmental benefits and risks associated with desalinated seawater while seeking to address public health concerns over water quality, the long-term effect on water rates, and the trade-off of providing locally produced water vs. imported water.

Legislative

Legislative support is imperative in creating funding, streamlining processes, and increasing opportunities in which seawater desalination can be utilized. Legislation can influence the implementation of ordinances and codes, directly affecting recycled water use in the region. The Foundational Actions needed include developing and supporting legislation that would consolidate or coordinate the permits from the various regulatory agencies.

TABLE 3.11 PROJECT DEVELOPMENT ACTIONS & TIMELINE FOR SEAWATER DESALINATION

	Actions		Years to Water Production										
			1	2	3	4	5	6	7	8	9	10	11
Integrational	Regional Feasibility Study	• Identify existing projects or projects near construction and create a centralized database of challenges, issues, practices, research and development, water quality data, and performance monitoring metrics											
		• Use the identified projects and GIS mapping to find areas of opportunity											
		• Model yield vs. cost of existing projects											
Public Perception	Outreach Campaign	• Address public questions about seawater desalination to promote desalination											
		• Sponsor career days, science fairs, and other educational events											
Legislative	Legislative Task Force	• Collaborate to establish a science-based, statewide policy or legislation in support of desalination											
		• Pursue legislation to consolidate or coordinate permitting requirements											
Fiscal	Funding Strategy Plan	• Utilize existing sub-regional efforts/plans to identify funding and cost-sharing opportunities and ongoing financing for O&M											
		• Explore partnerships with private investments, industry, federal, and state agencies to regionally coordinate pursuit of funding and grants											
		• Establish a funding mechanism to finance capital costs											
Procedural	Regional Synergy Task Force	• Work with regulatory agencies to address and revise existing regulatory and management structures that inhibit desalination production											
		• Assist in developing water quality monitoring and treatment guidelines											
		• Centralize the permitting in one agency, watermaster-like permitting coordinator											
		• Develop a SWRCB policy for the permitting process to relieve pressure on permitting agency staff											
Operational	Marine Life Protection Plan	• Encourage a science-based, statewide policy or legislation in support of desalination and best technologies											
	Steelhead Recovery Plan	• Evaluate impacts of Steelhead Recovery Plan											
	Energy Use & Emission Mitigation Plan	• Partner with the power and private industries to support technological research and to reduce energy needs and establish a regional mitigation bank for carbon and environmental impacts											
		• Pursue a policy that desalination energy use be treated comparable to other water resources with regards to required offsets											
Infrastructural	Land Acquisition	• Early strategic real estate planning to reserve prime coastal locations for potential project sites • Acquire land as needed											
	Regional Project Development	• Develop planning and design documents • Pursue environmental compliance and permitting • Inspection preparation											

Fiscal

Once a Regional Feasibility Study is complete, and the resource potential of desalinated seawater has been evaluated, a Regional Desalinated Seawater Funding Strategy Plan would assist in developing potential funding mechanisms to finance capital cost for construction of desalinated seawater projects. Opportunities for current and future bond funding for grants and loans would be identified. A regional approach to financing would be explored.

Procedural

The work of the Regional Synergy Task Force (which would include proposals for improved regulations and identifying necessary administrative and legislative approaches), would be focused on establishing regional permitting, inspection, and policies and coordinating between various agencies. Key elements would include establishing streamlined application and permitting processes for desalinated seawater projects. The Task Force would use data from the Feasibility Study to promote a unified regional desalinated seawater policy in conjunction with efforts of the Regional Desalinated Seawater Legislative Task Force.

Operational

Applying knowledge from the Feasibility Study, a cohesive regional approach to operations would be prepared to establish regional objectives and strategies. The plan would be developed in close collaboration with water suppliers, wastewater agencies, watermasters, basin managers, public health agencies, stormwater agencies, cities, counties, the state, and vendors. This includes understanding the impact of desalination on marine life and working with regulatory agencies to quantify these impacts and establish mitigation methods for wildlife protection. Additionally, working with energy providers and regulatory agencies to address efficiency and emissions mitigation actions is also necessary.

Infrastructural

The regional approach to construction would be facilitated by development of regional standards for planning, design, construction, operations, and maintenance. Regional Implementation would be done in conjunction with the creation of the operational elements and institution of the Regional Desalinated Seawater Outreach Campaign. As the unit costs of desalinated seawater systems decrease and as funding and financing sources become available, construction of desalinated seawater projects would be expected to increase.

Stormwater

To take full advantage of the opportunity to augment our local water supply utilizing stormwater, the region would need to first overcome the barriers to implementation as identified in the Stormwater/Urban Runoff Issue Paper. The following provides a framework of development actions to address these barriers and strategically maximize this local resource. Foundational actions make up about 8 of the estimated 12 years to production of a stormwater project, and are described below and detailed in **Table 3.12**.

Integrational

Data Management

A regional water supply project database would provide a regional picture of stormwater projects, which would assist in the selection of pilot projects, in the development of a regional Stormwater Management Plan, and in the integration of experiences and regulatory approval processes. Several existing stormwater management projects in the region have yielded challenges and lessons learned that can be used to improve future water supply augmentation efforts. A compilation of lessons learned could be established and continually updated through this database.

This regional database could build upon existing local project databases, such as those created for the IRWMPs.

Regional Feasibility Study

For locally captured stormwater to become a reliable water supply in Southern California, techniques for stormwater capture and use must become the norm and research must continue to advance knowledge. By progressing research in stormwater capture while concurrently planning, constructing, and operating new

stormwater facilities, innovative and efficient techniques unique to Southern California can be institutionalized.

The goal of the Regional Feasibility Study Implementation Element is to provide the data, research, and studies needed to overcome technical obstacles, including the following:

- Lack of a quantified relationship between stormwater capture and reduction in imported water demand;
- Difficulty in determining the cost effectiveness of a project from a water supply perspective;
- Unknown water quality impacts;
- Limited safeguards against pollution transport; and
- Lack of information sharing regarding new technology and water quality.

The first critical step would be to identify and study pilot projects. Next, the data gained from the pilot projects could be used to develop water quality models and guidelines, direct use and surface water storage strategies, cost/benefit approaches, a centralized database of technical information, and a business case for regional and local incentives.

Public Perception

Public awareness is a key aspect of the success of enhancing stormwater use. A stormwater education program could be targeted to coordinate with other public awareness programs. Stormwater, recycled water, groundwater, and imported water are inter-related. Yet, the public message among the various interests is inconsistent and could be better coordinated to provide maximum impact. For example, a water supply education campaign at a school could also include information about stormwater, recycled water, and groundwater to educate the public on the entire water picture and on ways an individual can be part of the overall solution. The linkage between stormwater capture and water supply should be emphasized.

Legislative

New regulatory and legal requirements are pushing stormwater/urban runoff programs forward at a faster rate and are emphasizing low impact development principles and collective watershed management. This creates new opportunities to influence these programs and standards early in the development process, to work with local communities so that the programs are implemented as intended, and to ensure a maximum water supply benefit.

The Stormwater Legislative Task Force would work proactively to address legislation through a unified, regional approach and would work collaboratively with other existing regional efforts/groups.

Fiscal

A Funding Strategy Plan is essential to overcoming the funding barrier to implementing stormwater projects. Stormwater projects often provide multiple benefits, which attract multiple funding partners, but may also lead to a large total project cost. Working collaboratively as a region on the Funding Strategy Plan would provide the framework to most effectively utilize the limited funding available, to equitably share project costs, and to establish a comprehensive funding mechanism to finance capital and O&M costs. This effort could build upon existing regional and sub-regional plans and workgroups to increase efficiency and reduce redundant efforts.

Procedural

Upon completion of the Regional Stormwater Feasibility Study, efforts would focus on establishing a Stormwater Policy Task Force. This group would work with the Legislative Task Force and existing regional efforts to identify regulatory and legislative needs to enhance stormwater capture and use. In addition, these task forces would work together to streamline the permitting process for projects to move forward in a timely fashion.

The Stormwater Policy Task Force would further contribute to developing water quality monitoring and treatment guidelines, and to updating the regional water supply project database.

Operational

Upon completion of the Regional Stormwater Feasibility study and upon receipt of the recommendations of the Regional Stormwater

TABLE 3.12 PROJECT DEVELOPMENT ACTIONS & TIMELINE FOR STORMWATER

	Actions		Years to Water Production										
			1	2	3	4	5	6	7	8	9	10	11
Integrational	Regional Project Database	• Identify and track projects, including project attributes, such as construction costs, schedules, production yield, readiness to proceed, etc.											
	Regional Feasibility Study	• Use Project Database to document and study existing projects or projects near construction											
		• Pursue pilot projects, if further data is needed, to study various geographical areas and types administration, including infiltration, direct use, and surface water storage											
		• Add to Regional Stormwater Project Database challenges, lessons learned, water quality data, and performance monitoring											
		• Model the effect, per basin, of stormwater recharge on production yield and basin water quality											
		• Develop surface water storage strategies											
		• Develop a detailed approach to determine the cost/benefit of each project											
		• Develop a stormwater capture direct use model to correlate the amount of stormwater capture to reduction in demand and measure BMP effectiveness											
		• Develop a set of monitoring and treatment guidelines											
		• Develop a business case for providing regional and local stormwater capture and use incentives											
Public Perception	Educational Campaign	• Coordinate with existing public awareness programs to target homeowners, renters, commercial, and industrial property owners, and schools to emphasize the link between stormwater and overall water supply											
Legislative	Legislative Task Force	• Determine the effects of existing and pending legislation and identify barriers to stormwater development											
		• Address and propose changes to legislation through a unified, regional approach											
Fiscal	Funding Strategy Plan	• Research and utilize existing sub-regional efforts/plans to identify funding and cost-sharing opportunities including ongoing financing for O&M											
		• If the Feasibility Study finds projects to be cost effective, establish a funding mechanism/incentive program to offset capital costs											
Procedural	Regional Policy Task Force	• Identify changes to codes, regulations, and standards needed to facilitate implementation of stormwater BMPs											
		• Address existing regulatory and management structures that inhibit increased stormwater yield and assist regulatory agencies in adjusting these and developing water quality monitoring and treatment guidelines											
Opera-tional	Management Plan	• Integrate existing regional plans to establish regional objectives and strategies											
Infrastructural	Regional Project Development	• Develop planning, design, and environmental documents • Procure necessary permits • Acquire land for potential project sites (if necessary)											

Policy Task Force, a Stormwater Management Plan will be developed. This Plan will be prepared to establish regional objectives, strategies, and evaluate appropriate alternatives for enhancing stormwater capture and use in the Metropolitan service area. The plan will build upon existing regional efforts, such as IRWMPs, and will be developed in collaboration with water suppliers, stormwater agencies, wastewater agencies, watermasters, basin managers, and other local agencies and related stakeholders. A critical element to the Stormwater Management Plan will be to maintain and enhance the relationships with partners and stakeholders over the course of this process to ensure the continued success of stormwater as a viable water supply resource for the region.

Infrastructural

Based upon the results of the Regional Feasibility Study and the Stormwater Management Plan, facility implementation needs will be identified. Depending on the type of project, this could include advanced planning, design, permitting, regulatory compliance, financing plans, land acquisition (as needed), and construction.

Based on the knowledge gained from the construction projects, maintenance manuals can be updated to improve long-term maintenance responsibilities for facilities. Identifying metrics to monitor performance will also be included. This process would also include inputting the performance monitoring data into feasibility study updates.

Graywater

The Graywater Technical Workgroup and Metropolitan staff concluded that graywater is not a significant, viable supply for the foreseeable future. In addition to issues with cost and existing regulations, there is the added issue of graywater projects negatively impacting wastewater and recycled water infrastructure. For these reasons, the IRP Update does not recommend actions to further develop graywater until an Impact Study can collect data to better understand these issues.

Unlike the other three resources with Foundational Actions, due to the detrimental effect graywater has on existing water infrastructure, no further Foundational Actions nor estimated timeline for development of graywater can be formed until the Impact Study has been completed.

Graywater Impact Study

The Graywater Impact Study would include summarizing existing practices and issues, examining various administration options, and determining regional potential. Specifically, the following topics were identified for further research:

- The negative effects of graywater on other resource investments, like wastewater and recycled water;
- Water quality, including pathogen removal for indoor use;
- Market potential;
- Impact on existing plumbing infrastructure;
- Indoor vs. outdoor use; and
- Cost-effectiveness for future incentives.

Only with more complete data and information can the full potential of graywater be determined with enough certainty to inform decision makers on whether to pursue graywater as a resource and the degree to pursue it. This would include resolving the issues of reduced flows to existing wastewater and recycled water plants.

Contingent on the findings of this Graywater Impact Study, other Foundational Actions such as policy, financial, legislative, and management studies and plans could be pursued to decrease project development time.

Summary

Metropolitan's approach to reliability is based on an analysis of projected supplies and demands. The high number of variables inherent in this type of analysis makes this a complex undertaking. In an effort to ensure future water supply reliability for Southern California, Metropolitan has adopted the following adaptive goals:

- Core Resources Strategy: Develop programs within the four core resources (SWP, CRA, local resources, and conservation) to meet projected demands under observed conditions;

- Uncertainty Buffer: Regionally collaborate to hedge against uncertainty in projected conditions, through regional consistency with 20x2020 legislation and identification of local projects to be developed if necessary; and
- Foundational Actions: Guard against unknown risks to the Core Resources and Uncertainty Buffer, by pursing low-risk, low-cost actions to shorten implementation time for further resources (recycled water, seawater desalination, stormwater, and graywater), if needed.

INTEGRATED WATER RESOURCES PLAN 2010 UPDATE

FINDINGS & CONCLUSIONS

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

4 Findings & Conclusions

This portion of the report recaps the main steps toward developing an adaptive management approach for this IRP Update, provides a summary of key findings and goals, and the potential cost impact of these efforts.

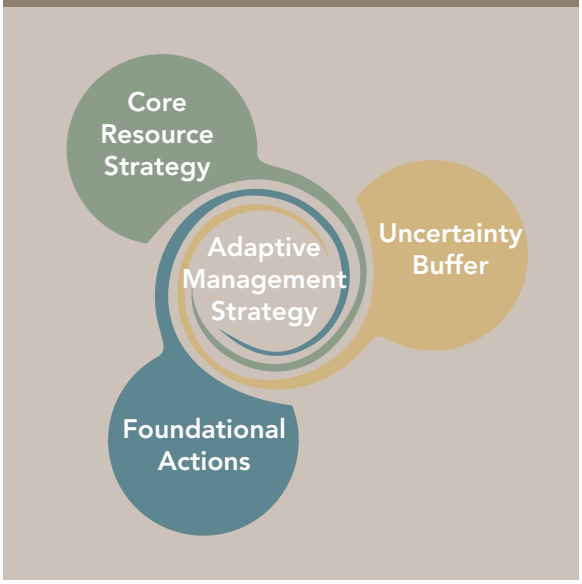
First, Metropolitan recognized the need for more explicit handling of uncertainty. Future variability in climate, demographics, and regulations could have a large impact on Southern California's water resources and a comprehensive plan is needed to effectively respond. Metropolitan has developed an adaptive management approach to these challenges in this IRP Update. This approach allows flexibility in resource development and scalable response to needs in order to balance risk of overproduction against risk of shortage. **Step 1** below summarizes these concepts as the first step in ensuring regional reliability through this IRP Update.

Step 1	Acknowledge future uncertainty and need for adaptive approach in a resource plan to handle these challenges.

With this goal in mind, Metropolitan staff performed **Step 2**, a comprehensive analysis of projected yield of existing resources and anticipated demand through 2035. This revealed a "gap" between demand and supply that existing storage and transfers would be unable to fully bridge.

Step 2	Determine need under existing supplies and demand projections.

Figure 4.1 Three-Component Adaptive Management Strategy



From here, Metropolitan developed a three-part strategy to fill that gap and meet demands through 2035 in a cost-effective, scalable manner that handles future uncertainty. **Figure 4.1** illustrates the three concurrent components of this adaptive management approach: a Core Resources Strategy, Uncertainty Buffer, and Foundational Actions. The first component, the Core Resources Strategy, identifies additional supply development goals to build upon existing programs and meet needs under observed conditions. **Step 3** highlights this below.

This Core Resources Strategy consists of meeting future demands through traditional core resources on the SWP and the CRA, as well as planned conservation and local supply development. Metropolitan and its member

The Sacramento-San Joaquin Delta is the hub of California's water delivery system. It spans approximately 1,200 square miles and overlays parts of five major cities and 14 unincorporated towns and villages in Northern California. Working towards a healthier environment and more reliable water system are the coequal priorities for a Delta "fix."

Step 3 Identify additional supply development goals to meet demands under observed conditions - Core Resources Strategy.

agencies have a long history of investing in these key resources, which have provided the region with reliable water supply over the course of Metropolitan's history. In order to build on these investments, areas within these resources have been identified for future development, as summarized in **Table 4.1**.

The Core Resources Strategy sets out goals under observed conditions, but Metropolitan has acknowledged the need for addressing future uncertainty, whether from an unforeseen climate or regulatory circumstances impacting the core supplies or from demand-side increases due to changes in population, density patterns, behavior, economic outlooks, etc. To this end, Metropolitan proposes an Uncertainty Buffer (**Step 4**) in two parts: pursuit of greater water efficiency through regional consistency with 20x2020 legislation and future identification of specific local projects ready for implementation that can be developed if needed.

Step 4 Regionally develop Uncertainty Buffer goals for foreseeable uncertainty, implementing adaptively as necessary.

This protects the region against future shortages while not over-investing in unnecessary resources. **Table 4.2** summarizes the supply yields expected from the Core Resources Strategy and fully implemented Uncertainty Buffer. Note that supplies are available to meet demands and replenish storage accounts. Although the storage capacity available to balance demands and supplies decreases over time as more water is set aside for emergencies (see detailed description of emergency storage in **Appendix A.15**), the volume of water in storage increases. However, the total volume of water in storage cannot be used at one time due to system constraints, but under the goals set out in this IRP Update, the available storage is more than adequate to meet demand needs after resource development

With core supplies developed and a buffer in place, Metropolitan is well positioned to meet future demands and uncertainty. However, supply vulnerabilities and uncertainties require further contingency planning. The third component of this IRP Update, highlighted in **Step 5**, is regional pursuit of actions in recycling, seawater desalination, stormwater, and graywater that lay a foundation for further

Step 5 Identify Foundational Actions to be pursued regionally and concurrently with the Core Resource Strategy and Uncertainty Buffer, in order to reduce implementation time for other potential resources, to be developed if needed.

TABLE 4.1 SUMMARY OF ACTIONS UNDER CORE RESOURCES STRATEGY

Core Resource	*Development Area*
CRA	• Continued of existing programs and partnerships • Pursuit of further innovations in Colorado River-related storage, conservation, transfers, exchanges, and agreements
SWP	• Delta ecosystem enhancement and species protection • Continued of existing programs and pursuit of new sustainable storage and transfer agreements • Infrastructure improvements and flood control emergency preparation • Conveyance solutions • Continued collaboration with federal, state, and local stakeholders • Legislation supporting the goals above
Water-Use Efficiency	• Support retail-level 20x2020 compliance, consisting of conservation and water recycling
Local Resource Augmentation	• Regionally pursue groundwater recovery, seawater desalination, and further recycling

TABLE 4.2 DRY-YEAR RESOURCE GOALS

	2015	2020	2025	2030	2035
Dry-Year Total Demand (Without Conservation)	5,597,000	5,804,000	5,951,000	6,094,000	6,229,000
Water-Use Efficiency					
Conservation	930,000	965,000	1,032,000	1,097,000	1,158,000
Recycling	353,000	387,000	413,000	422,000	430,000
20x2020 Retail Compliance	190,000	380,000	380,000	380,000	380,000
20x2020 Regional Consistency Target	100,000	200,000	200,000	200,000	200,000
Sub-Total Water-Use Efficiency	1,573,000	1,932,000	2,025,000	2,099,000	2,168,000
Local Resources					
Groundwater	1,485,000	1,503,000	1,515,000	1,526,000	1,527,000
Local Surface Water	100,000	99,000	99,000	99,000	99,000
Groundwater Recovery	122,000	136,000	144,000	148,000	150,000
LAA	147,000	147,000	147,000	147,000	147,000
Local Resources Augmentation	72,000	72,000	102,000	102,000	102,000
Sub-Total Local Resources	1,926,000	1,957,000	2,007,000	2,022,000	2,025,000
State Water Project					
SWP	430,000	430,000	430,000	430,000	430,000
Delta Improvements	151,000	151,000	283,000	283,000	283,000
Sub-total SWP	581,000	581,000	713,000	713,000	713,000
Colorado River Aqueduct					
CRA	852,000	985,000	957,000	925,000	925,000
CRA Dry-year Supply	398,000	265,000	293,000	325,000	325,000
Sub-Total CRA	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000
Total Resource Development	**5,330,000**	**5,720,000**	**5,995,000**	**6,084,000**	**6,156,000**
Dry-year Need after Resource Development*	267,000	84,000	0	10,000	73,000
Storage & Transfers Available**	829,000	980,000	1,116,000	1,131,000	1,124,000
Average Storage Levels**	1,913,000	3,122,000	4,410,000	4,521,000	4,338,000
Total Storage Capacity***	5,438,000	5,410,000	5,417,000	5,400,000	5,378,000

* When Dry-year Need is zero or below (there is a surplus of water), a zero is shown.
** Does not include Emergency Storage or CRA Storage, which is assumed to be used as part of Core Resources Strategy.
***Total Storage Capacity changes as emergency storage requirements increase over time.

development of these resources if needed to meet future demands. These actions are identified as Foundational Actions.

These resources take years to develop from concept to water production, but a portion of this development can be pursued concurrently with the Core Resources Strategy and Uncertainty Buffer at low-cost and low-risk. This will reduce the total development time so that these resources can be implemented in time to add to the water resource portfolio if a core resource should fail to develop as projected. The Foundational Actions are comprised of mainly planning and mitigation actions short of full-scale facility investments.

Regional collaboration will be necessary to pursue these Foundational Actions summarized in **Table 4.3,** and since the entire 2010 IRP Update is meant to be implemented on a regional scale, it will take continued coordination between Metropolitan and its member agencies.

A summary of all of the regional resources considered for potential development in this IRP in order to maximize regional utility are summarized in **Table 4.4**. Allowing resources

to be developed in a variety of ways adds to the flexibility of this plan and better serves the region. This approach will allow Metropolitan to adopt alternative roles as best benefits the region and enhances existing collaboration, like those roles examined in the Strategic Policy Review discussed in Section 2: A Process of Regional Collaboration. In addition to pursuing imported supplies, Metropolitan's role in local supply development could include a range of roles, which will allow Metropolitan to respond to changing regional conditions. A brief description of these possible levels of involvement is provided below:

- Incentivizing: This level of involvement for Metropolitan entails incentivizing local supply development. Metropolitan's existing LRP program is an example of this type of arrangement, wherein Metropolitan provides an incentive for supply yield produced by its member agencies. Facilities would be owned and operated by the local agency;
- Alternative Financing: Metropolitan could offer a wider range of financing options that might include up-front funding of capital projects. This option would increase Metropolitan's level of commitment and risk, but it would also provide greater flexibility for developing projects that require large start-up costs. Facilities would be owned and operated by the local agency;

Table 4.3 Foundational Actions by Category

Category	*Recycled Water*	*Seawater Desalination*	*Stormwater*	*Graywater*
Integrational	• Regional Facility Master Plan	• Regional Feasibility Study	• Regional Project Database • Regional Feasibility Study	• Regional Feasibility Study
Public Perception	• Outreach Campaign	• Outreach Campaign	• Educational Campaign	• Educational Campaign
Legislative	• Legislative Task Force	• Legislative Task Force	• Legislative Task Force	• Legislative Task Force
Fiscal	• Regional Finance Committee	• Funding Strategy Plan	• Funding Strategy Plan	• Regional Finance Committee
Procedural	• Regional Policy & Permitting Task Force	• Regional Synergy Task Force	• Regional Policy Task Force	• Regional Policy & Permitting Task Force
Operational	• Regional Salt Management Plan • Regional Watershed Management Plan	• Marine Life Protection Plan • Steelhead Recovery Plan • Energy Use & Emission Mitigation Plan	• Regional Management Plan	• Regional Management Plan
Infrastructural	• Regional Project Development	• Land Acquisition • Regional Project Development	• Regional Project Development	• Regional Project Development

Table 4.4 Resources Included for Potential Development to Achieve Supply Yields

	Core Resources Strategy	*Buffer*	*Foundational Actions*
CRA	√		
Conservation	√	√	
Groundwater Recovery	√	√	
Recycling	√	√	√
Seawater Desalination	√	√	√
Stormwater			√
SWP	√		
Graywater			√

- Equity Partnership: In an equity partnership, Metropolitan would be part owner of a local facility. An example of this type of arrangement could be a partnership in a desalination facility in which the ownership, funding, and performance of the project is mutually shared among the partners; and
- Full Ownership: In a full ownership type of arrangement, Metropolitan would own the facility. Ownership, funding and yield of the project would fall on the responsibility of Metropolitan.

It is important to note that these roles apply to Metropolitan's role in developing a single project and are not mutually exclusive; the region may find it benefits most from a mixture of them tailored for specific projects. Metropolitan will consider specific future projects under then-existing conditions, deciding if implementation is necessary and appropriate. The process of addressing these regional supply concerns may lead to new and improved forms of Metropolitan participation and collaboration.

Through the process detailed in this IRP Update, Metropolitan and its stakeholders have defined a role and a process for Metropolitan that will ensure water supply reliability for the region into the foreseeable future. Under the auspices of the 2010 IRP Update, Metropolitan will:

- Adopt an adaptive management approach to address future uncertainty;
- Continue to develop its core supplies to meet projected demands up to 2035;
- Initiate Uncertainty Buffer goals to mitigate future uncertainties;
- Pursue Foundational Actions at low-cost and low-risk to minimize time to development of additional resources if core resources fail to develop as planned;
- Explore various options under which the region can pursue partnerships and cooperative development of beneficial projects; and
- Diversify its role in developing regional water supply.

Over its more than 75-year history Metropolitan has faced many challenges in fulfilling its mission

Metropolitan assumes regional responsibilities for water supply but also for providing leadership in addressing challenges and planning for the future.

Top Photo: In 2010, Metropolitan launched a Global Water and Technology Forum to provide pathways for innovators, water suppliers and investors to connect and forward technology advances in the industry.

Bottom Photo: The planning process for the Integrated Resource Plan was interactive and involved nearly a dozen public briefings with input solicited to craft the report.

of providing a reliable, high-quality water supply to Southern California. This IRP Update provides the framework to continue on this mission with greater assertiveness. The Core Resources Strategy, Uncertainty Buffer, and Foundational Actions bring together the adaptive strategy that Metropolitan will use to address uncertainty and vulnerability. Through continued collaboration with its member agencies, and newly formed partnerships throughout the region, Metropolitan and all stakeholders will forge ahead together on the road to reliability.

Water Rate Impact of IRP Strategy

Although this IRP Update simply sets goals for regional development, cost-effectiveness is an important factor in evaluating future resource development options and so Metropolitan staff built on the findings and analysis of the Strategic Policy Review to estimate the rate impact of the Core Resources Strategy and Uncertainty Buffer; the Foundational Actions were not included in the rate impacts because these actions do not incur significant costs until the supplies are implemented.

Historically, Metropolitan has incentivized local resource development by providing funding for actual production, with the risk and burden of financing, constructing, and operating the supplies falling on the local agency. Expanding Metropolitan's participation to include up-front funding, shared equity partnership, or regional ownership based on the individual needs and consent of local agencies may be considered to increase effectiveness in implementing projects within the service area. The impacts of these alternative roles were considered in terms of any potential implementation of the local resource portion of the Uncertainty Buffer in the future.

Core Resources Strategy

All of the Uncertainty Buffer scenarios build off of the Core Resources Strategy. The Core Resources Strategy assumes the following:

- Delta fix costs of $2.3 billion, representing Metropolitan's share of Delta habitat conservation and conveyance program costs;
- Continued funding of LRP contracts plus an additional 102,000 AF of local supplies at up to $250/AF;
- CRA programs costing $300/AF; and
- Continued conservation funding at $20 million/year.

These costs are escalated at the same percentages as those in the Strategic Policy Review described in Section 2.

In addition to funding these programs, Metropolitan sales decrease by the volume of water conserved, which is assumed to be 380,000 AF due to retail-level 20x2020 compliance. The costs of pursuing the Core Resources Strategy are in line with the base rate of inflation.

Water-Use Efficiency Buffer

Building on the Core Resources Strategy costs, there are three cost options examined to implement the Uncertainty Buffer based on implementation style and cost of resources. The first is implementation of the 20x2020 regional compliance of 200,000 AF only. This would decrease Metropolitan's annual sales by an additional 200,000 AF, and impact rates accordingly.

Metropolitan-Incentivized Buffer

Next, there are two alternative methods for potentially implementing the local resource portion of the Uncertainty Buffer, mirroring the Current Approach and Enhanced Regional Approach #1 from the Strategic Policy Review in Section 2. The first option proposes that 300,000 AF of local resources be implemented by member agencies with Metropolitan incentives, as in the Current Approach. This would result in $250/AF for the development of these supplies, as well as decreased Metropolitan sales by the same volume.

Metropolitan-Developed Buffer

An alternative implementation for this 300,000 AF of additional buffer supplies is for Metropolitan to develop these supplies. This scenario assumes that Metropolitan develops these resources at a cost of $1,500/AF, which is an estimate of local supply development based on Metropolitan's experience in the LRP program.

Table 4.5 Estimated Rate Impacts of the Adaptive IRP Strategy

	2015	2025	2035
Core Resources	$853	$1,233	$1,484
Buffer - Water-Use Efficiency	$892	$1,350	$1,608
Buffer - Metropolitan-incentivized local resource augmentation	$919	$1,510	$1,844
Buffer - Metropolitan-developed local resource augmentation	$953	$1,601	$2,021

Although Metropolitan would pay the full cost of developing these supplies, Metropolitan would also sell the water, so the true cost per AF is the net of cost less sales rate.

Table 4.5 shows the costs of these various options and **Figure 4.2** illustrates how the two alternate options for implementation of the local resources part of the Uncertainty Buffer add to the 20x2020 part of the Uncertainty Buffer, all of which are built on the cost of the Core Resources Strategy.

These costs are graphed in **Figure 4.3** over the planning period and overlaid with the range of costs between the Strategic Policy Review options in yellow. Like the Strategic Policy Review, the costs of this IRP strategy range from one to two percent annually above inflation. This was intentional, as Metropolitan wanted to show the costs for the most expensive Uncertainty Buffer implementation, according to the findings of the Strategic Policy Review findings, in order to provide a high-end estimate of Uncertainty Buffer implementation. It is likely that the cost of a fully implemented Uncertainty Buffer would likely fall somewhere in between the highest and lowest cost options studied here; however, actual future costs will be tied to Metropolitan's future decisions of specific project implementation.

Conclusion

This IRP Update expands Metropolitan's planning into a broader water vision and sets goals for the next 25 years on Metropolitan's traditional resources. It also defines a more adaptive role for Metropolitan on a longer timeline. Resource development uncertainties make setting targets more than 25 years in the future difficult. As such, Metropolitan is initiating an adaptive management approach. Major components of this IRP Update are to: (1) explicitly reflect uncertainty in Metropolitan's future water management environment, (2) evaluate a wider range of water management strategies, and (3) seek a robust and adaptive plan that responds to uncertain conditions that may evolve over time. A key evolution from the 2004 IRP Update is the identification of uncertainties and contingency actions that will extend the concept of a planning buffer into an operational approach.

Just as policy has evolved, so too have the technological and programmatic means by which Metropolitan can accomplished the regional reliability goal. From the completion of the CRA in 1941 to the present, Metropolitan has added programs and facilities to accomplish the broad goal of reliable water supply, including:

- Region's largest water treatment facilities and water transmission lines;
- Largest single contract with the SWP;
- Surface storage facilities and new groundwater storage programs to store less predictable deliveries from the SWP;
- Regional conservation programs and leadership in demand management;
- Innovative local resources program to provide support and incentives for the implementation of new and innovative water supply improvements within the service areas of its member agencies; and
- Overall leadership in forecasting, analyzing, and providing for Southern California's current and future water needs.

Today, the challenges posed by continued population growth, environmental constraints on the reliability of imported supplies, and the new uncertainties imposed by climate change require increased vision and leadership. New solutions are available in the form of dramatically improved water-use efficiency, indirect potable use of recycled water, and large-scale application of ocean desalination.

However, big challenges raise equally big questions regarding the most desirable means of

FIGURE 4.2 SUMMARY OF RATE IMPACTS

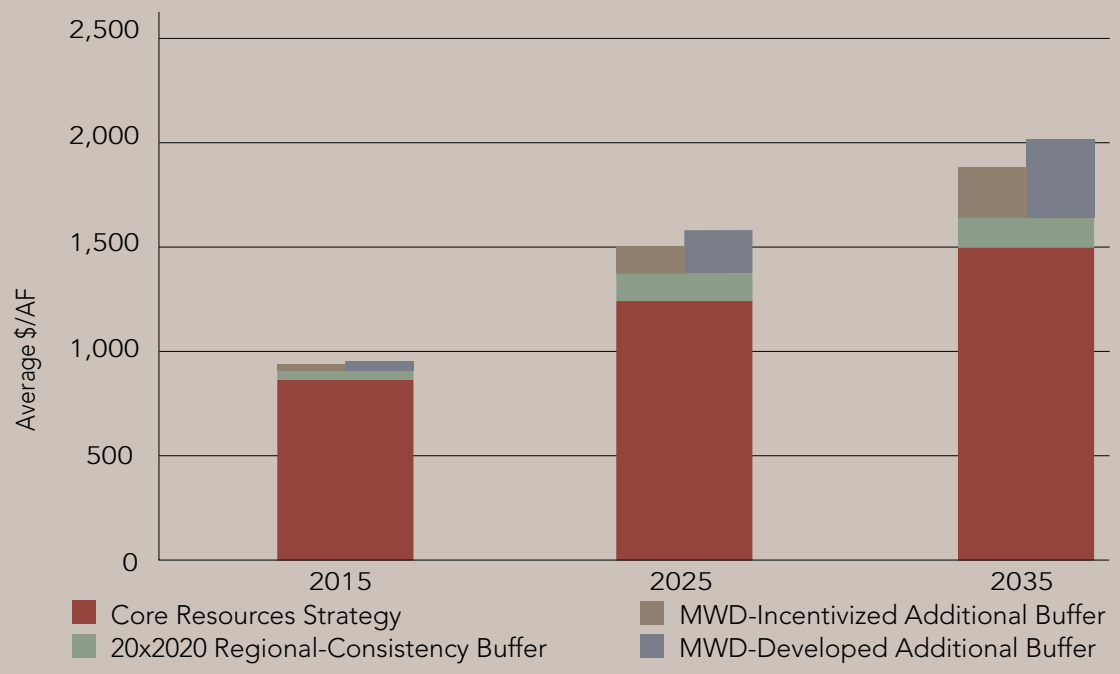
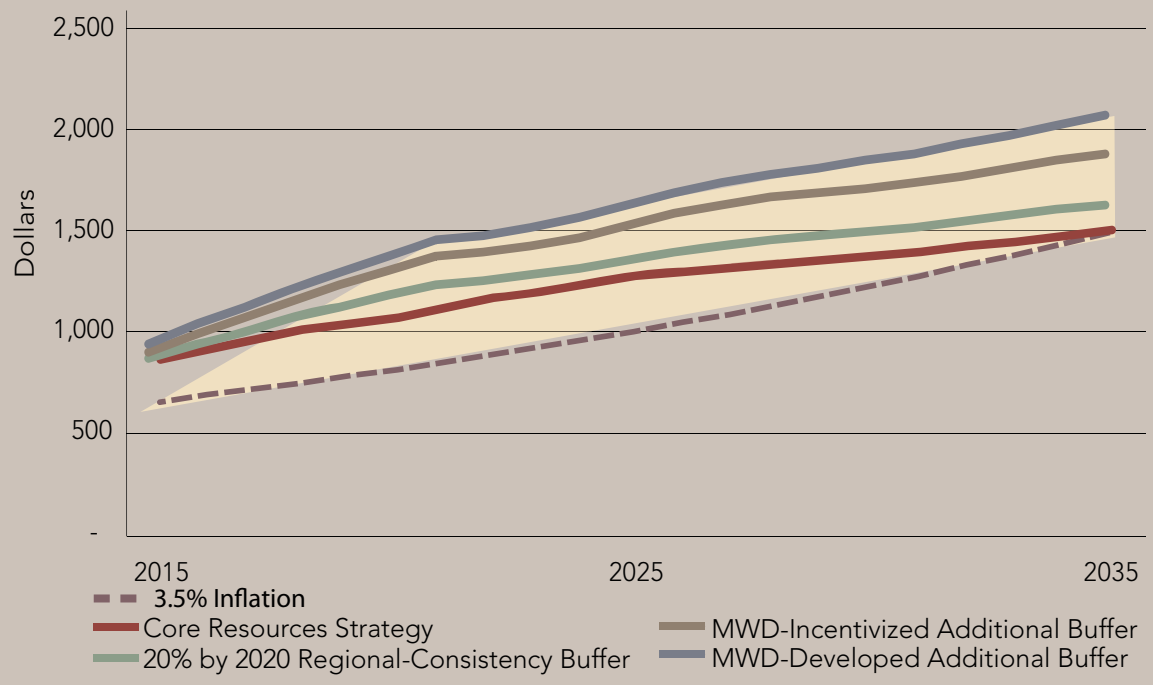


FIGURE 4.3 RATE IMPACTS COMPARED TO THE RANGE OF STRATEGIC POLICY REVIEW RATE IMPACTS



achieving new solutions and outcomes. What is the most reliable, affordable and feasible means of achieving the common goal of adequate and safe water supplies?

As mentioned at the outset, Metropolitan has been employing an integrated planning process that addresses the complexity of this issue. Metropolitan has long focused on both the development of needed facilities and the implementation of conservation-based solutions, balancing both technologies and responsibilities among its member agencies as well as within its own capital program. Metropolitan established targets for a diversified portfolio of investments, both structural and programmatic, that have provided the foundation for continued water supply reliability during a period of prolonged drought and severe regulatory limitations. The accomplishments achieved by both member agencies and Metropolitan have demonstrated the effectiveness of establishing clear responsibilities and a common road map to the future. The diversified portfolio developed in the 1996 IRP has served the region well.

This IRP Update will continue to serve the region by adapting to the challenges and uncertainties of the future. Through a decade of difficult but productive collaboration in the Delta, large and bold solutions have emerged which carry the promise of "fixing" the plumbing in one of the most environmentally sensitive and ecologically complex water sources in the West. There is a clear path forward in the Delta. At the same time, there are opportunities within the Metropolitan service area to develop large-scale regional water recycling and seawater desalination facilities. These projects are also subject to equally complex institutional constraints on implementation and carry significant cost. Overall, solutions are available to address the growing demands for safe and reliable water in Southern California; however, the timing and cost of implementation are hard to predict.

Together, the options presented in this IRP Update are projected to meet the future water supply needs of Southern California, and identify the "low-regret" actions that Metropolitan can take in order to swiftly respond to the uncertainties that exist with all water resource programs.

THE METROPOLITAN WATER DISTRICT
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ATTACHMENT B

METROPOLITAN WATER DISTRICT'S

WATER SURPLUS AND DROUGHT MANAGEMENT (WSDM) PLAN

THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

WATER SURPLUS AND DROUGHT MANAGEMENT PLAN

REPORT NO. 1150

AUGUST 1999

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WATER SURPLUS AND DROUGHT MANAGEMENT PLAN

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

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EXECUTIVE SUMMARY

INTRODUCTION

The Water Surplus and Drought Management (WSDM) Plan for the Metropolitan Water District of Southern California (Metropolitan) is a ten-year plan that will be used to direct Metropolitan's resource operations to help attain the region's 100% reliability goal. The WSDM Plan recognizes the interdependence of surplus and shortage actions and is a coordinated plan that utilizes all available resources to maximize supply reliability. The overall objective of the WSDM Plan is to ensure that shortage allocation of Metropolitan's imported water supplies is not required.

The central effort in developing the WSDM Plan was a participatory process involving Metropolitan and its member agencies. Metropolitan staff and member agency representatives coordinated the Plan's development during a series of meetings of the Rate Refinement Team.

To lay a foundation for the WSDM Plan, participants in the Rate Refinement Process developed a set of proposed WSDM Principles and Implementation Goals which were subsequently adopted by the Metropolitan Board of Directors in September 1998. These Principles and Implementation Goals outline fundamental policies for guiding surplus and shortage management and establish a basis for dealing with shortages in an equitable and efficient manner.

WSDM PRINCIPLES AND IMPLEMENTATION GOALS

Guiding Principle

- 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.

Supporting Principles

- 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

WSDM Plan Implementation Goals

- Avoid mandatory import water allocations to the extent practicable

- Equitably allocate imported water on the basis of agencies' needs

  Considerations to create an equitable allocation of imported water may include:

  - Impact on retail consumers and economy
  - Reclamation/Recycling
  - Conservation
  - Population and economic growth
  - Investment in local resources
  - Change and/or loss of local supply
  - Participation in Metropolitan's Non-firm (interruptible) programs
  - Investment in Metropolitan's facilities

- Encourage storage of surplus supplies to mitigate shortages and improve water quality

SURPLUS AND SHORTAGE ACTIONS

The region's ability to implement a long-term WSDM Plan results from the significant investments Metropolitan and its member agencies have made in a variety of resources since 1991. These additional resources include increased local conservation and water recycling, improvements in the reliability of imported supplies, increased regional storage, and increased conjunctive use groundwater programs. Together these improvements allow a comprehensive approach to water management.

The growing variety of resources available to the region is transforming Metropolitan from an agency with relatively modest storage capacity to one that will have storage sufficient to manage many shortages without impacts to its member agencies or retail customers. To attain this level of reliability, all storage programs and facilities, along with conservation, recycling, and other programs, must be managed as an integrated set of regional resources. To accomplish this, the WSDM Plan establishes the linkage between surplus and shortage resource management actions.

When imported supplies exceed projected demands for imported water within Metropolitan's service area, Metropolitan can operate available storage facilities to maximize the benefits of stored water to its member agencies. A number of factors affect Metropolitan's ability to divert surplus water into storage. Some of these factors include facility outages, system capacity, water quality (including requirements for managing total dissolved solids), and varying supply and demand patterns. The WSDM Plan provides a description of storage options available to Metropolitan and a framework for storing water in these programs and facilities when surplus supplies are available.

Except in severe or extreme shortages (defined in the Introduction) or emergencies, Metropolitan's resource management will allow shortages to be mitigated without impacting retail Municipal and Industrial (M&I) customers. A list of resource management actions and their descriptions are provided

below. This list emphasizes critical storage programs and facilities, and conservation programs that make up part of Metropolitan's response to shortages. The order in which these actions are presented does not imply the exact operational management of resources that would occur during a shortage, rather it represents a general framework and guide. In fact, several actions are likely to be taken concurrently. Many factors will dictate the exact order in which these actions will be taken during shortages. One action, however, will have an assigned prioritization: the curtailment of Full Service (firm) deliveries will be last. The following summarizes the drought actions:

- Draw on storage in the Eastside Reservoir Project
- Draw on out-of-region storage in Semitropic and Arvin-Edison
- Reduce/suspend long-term seasonal and groundwater replenishment deliveries
- Draw on contractual groundwater storage programs in the region
- Draw on State Water Project (SWP) terminal reservoir storage (per Monterey Agreement)
- Call for extraordinary drought conservation and public education
- Reduce Interim Agricultural Water Program (IAWP) deliveries
- Call on water transfer options contracts
- Purchase transfers on the spot market
- Implement the allocation of Metropolitan's imported supplies to its member agencies

For the ten-year period addressed by the WSDM Plan, 1999-2008, the majority of shortage contingencies will be managed by withdrawals from storage, groundwater management and options transfers. Shortages managed using these actions would not impact the quantity of water delivered to member agencies for consumptive uses. In fact, when coupled with other drought actions such as extraordinary conservation and reduction of agricultural deliveries, it is fully expected that an allocation of firm imported water supplies will not be necessary during the next ten years. Under this worse-case scenario, an approach to allocate Metropolitan's firm imported water supplies in a fair and equitable manner will be developed.

The overall policy objective of the allocation method will be to minimize the impacts to any one agency and the region as a whole. To meet that objective, the method of allocating firm imported supply will account for:

- Each agency's demands on Metropolitan,
- Each agency's local resources
- Each agency's total retail demands.

The WSDM Plan allocation method would address each of these supply and demand components and account for each agency's conservation and recycled water programs. A pricing structure will be coupled with the WSDM allocation method to accomplish two goals:

- Encourage conservation and water recycling
- Ensure that the regional impact of the shortage is as small as possible

To provide as much water as possible without changing wholesale prices, the allocation of all available supplies will be made at the prevailing rates for firm deliveries. In order to encourage conservation to the level of allocation, the rate for agency usage from 100-102% of its allocation will be the Full Service rate plus $175. Usage above 102% of allocated supply will be charged at three times the Full Service rate. Any substantial change in Metropolitan's water rate structure may require these rates to be revised.

During severe or extreme shortage conditions, public outreach will play a critical role in shaping consumer response. Public information campaigns will send clear signals if extraordinary drought conservation is required. An effective public information campaign requires a joint effort among Metropolitan and its member agencies. Under this Plan, the administration of the Public Information and Government Affairs program will be the responsibility of a Drought Program Officer (DPO). The DPO will be responsible for integrating the various activities in these areas, coordinating efforts with Metropolitan's Board of Directors and member agencies, and designing the region-wide messages for the general public and various target audiences. Important constituencies are residential users, industrial and institutional users, business interests, agricultural users, elected officials, officials of various agencies such as the Department of Water Resources, and the media.

INTEGRATED RESOURCES MANAGEMENT

Throughout the Integrated Resources Planning process and the development of the WSDM Plan, extensive analysis of resource management strategies focused on maximizing supply reliability while minimizing overall resource costs. Various management strategies were analyzed trader shortage scenarios based on historical hydrologic data. The WSDM Plan presents a resource management framework to guide Metropolitan's integrated approach to supply management.

The resource management framework does not dictate a scripted response to shortage or surplus. The framework recognizes the complexity and variety of conditions that require action. Supporting this framework are general rules that describe the actions to be taken in each stage of surplus or shortage. These rules depend on shortage stage, account for monthly delivery requirements, and depend on when various supplies would be available.

One of the fundamental trade-offs in dealing with supply shortages is the need to maintain flexibility while providing supply certainty to member agencies and consumers. A central focus of the WSDM Plan is the analysis of information about supplies and demands. When do various pieces of information about the supply/demand balance become more certain? When should this information impact policy-making and trigger various resource actions? The WSDM Plan addresses these questions and the actual implementation of the Plan during a shortage.

Appendix A of this report provides a ten-year simulation of projected demands and supplies showing an example of how the region can maintain 100% reliability.

INTRODUCTION

The Metropolitan Water District of Southern California (Metropolitan) provides water to a service area covering approximately 5,200 square miles. Over 16.5 million people live within the service area, which supports a $500 billion economy. Metropolitan provides supplemental supplies to twenty-seven member agencies, both retail and wholesale agencies, who in turn provide water to over three hundred cities and local agencies providing supplies at the retail level. In recent years Metropolitan supplemental deliveries have accounted for about one-half to two-thirds of the region's total water demands. With supplies from its Colorado River Aqueduct (CRA) and the State Water Project (SWP), Metropolitan delivers water for municipal and industrial (M&I) uses, agricultural uses, and augmentation of local storage.

As part of the implementation of the regional Integrated Resources Plan (IRP), Metropolitan and its member agencies have developed the Water Surplus and Drought Management (WSDM) Plan for Southern California. This ten-year plan will direct Metropolitan's resource operations to help attain the region's 100% reliability goal. Over this ten-year period, the WSDM Plan will be updated to account for changes impacting supplies from the Colorado River and California's Bay-Delta. In the past, Metropolitan has developed drought management plans that simply addressed shortage actions and primarily focused on issues of short-term conservation and allocation of imported water. The WSDM Plan recognizes the interdependence of surplus and shortage actions and is a coordinated plan that utilizes all available resources to maximize supply reliability. The overall goal of the WSDM Plan is to ensure that shortage allocation of Metropolitan's imported water supplies is no---At required.

Because it addresses both surplus and shortage contingencies, the WSDM Plans draws clear distinctions among the terms *surplus, shortage, severe shortage,* and *extreme shortage.*

> ***Surplus****: Supplies are sufficient to allow Metropolitan to meet Full Service demands, make deliveries to all interruptible programs (replenishment, long-term seasonal storage, and agricultural deliveries), and deliver water to regional and local facilities for storage.*
>
> ***Shortage****: Supplies are sufficient to allow Metropolitan to meet Full Service demands and make partial or full deliveries to interruptible programs, sometimes using stored water and voluntary water transfers.*
>
> ***Severe Shortage****: Supplies are insufficient and Metropolitan is required to make withdrawals from storage, call on its water transfers, and possibly call for extraordinary drought conservation and reduce deliveries under the IAWP.*
>
> ***Extreme Shortage****: Supplies are insufficient and Metropolitan is required to allocate available imported supplies.*

WSDM PRINCIPLES AND IMPLEMENTATION GOALS

The central effort in developing the WSDM Plan was a participatory process involving Metropolitan and its member agencies. Metropolitan staff and member agency representatives coordinated the Plan's development during a series of meetings of the Rate Refinement Team and the Integrated Resources Planning Workgroup. To lay a foundation for the WSDM Plan, participants in the Rate Refinement Process developed a set of "WSDM Principles and Implementation Goals."

Guiding Principle

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  - Population and economic growth
  - Investment in local resources
  - Change and/or loss of local supply
  - Participation in Metropolitan's Non-firm (interruptible) programs
  - Investment in Metropolitan's facilities.

- Encourage storage of surplus supplies to mitigate shortages and improve water quality

REGIONAL RESOURCES AND DEMANDS

Southern California receives its water supplies from a variety of different sources, both local to the region and imported from outside the region. These sources are summarized below.

Local Supplies

Local supplies include groundwater pumping of local aquifers, surface reservoir production, recycled water, and supplies imported through wheeling arrangements or through the Los Angeles Aqueduct, which is owned and operated by the City of Los Angeles. Local supplies have, in the past, provided as much as 2.1 million acre-feet (maf) of water to meet the region's water demands. By far the largest component of local supplies is groundwater pumping, providing over 75% of historical local supplies.

Colorado River Supplies

The distribution and management of Colorado River water is governed by a complex body of laws, court decrees, compacts, agreements, regulations, and an international treaty collectively known as the "Law of the River." Metropolitan's entitlement is established by the fourth and fifth priorities of California's Seven Party Agreement, included in Metropolitan's 1931 and 1946 contracts with the Secretary of the Interior. These priorities provide 550,000 acre-feet (af) per year and 662,000 af per year, respectively. In addition, Metropolitan holds a surplus water contract for delivery of 180,000 af. The physical capacity of the CRA is slightly in excess of 1.3 maf per year, based on a pumping capacity of 1,800 cubic feet per second (cfs). Metropolitan's long-held objective is to maximize the availability of Colorado River water, up to the maximum capacity of the CRA, subject to environmental, contractual, legal, political, financial, and institutional constraints. A California 4.4 Plan is being developed among California parties that will help ensure that full CRA deliveries are maintained, while addressing the concerns of the other Colorado River basin states that rely on the river. The California 4.4 Plan includes core transfers (such as the IID/MWD conservation agreement and the proposed IID/SDCWA transfer), system conservation (such as the lining of the All American Canal), offstream storage (such as the Arizona groundwater storage program), dry year option transfers (such as PVID land fallowing), and river re-operations.

State Water Project

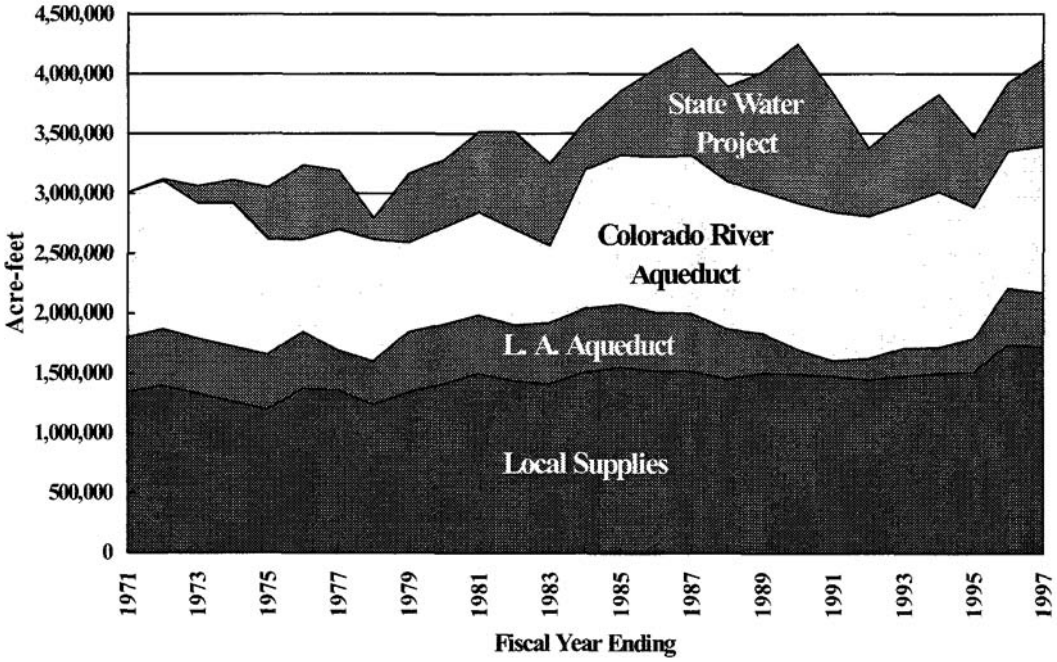
Metropolitan is one of 29 water agencies that have contracted with the State of California, through the Department of Water Resources (DWR), for water deliveries from the SWP system. Metropolitan's contracted entitlement is for 2.01 maf per year, or about 48 percent of the total contracted entitlement of 4.2 maf per year. SWP deliveries to Metropolitan are made via the SWP's California Aqueduct.

Initial SWP facilities, completed in the early 1970's, have produced average supply yields adequate to meet just over half of the total contracted entitlement. While it was intended that additional SWP facilities would be constructed as SWP contractor demands increased up to their contracted entitlements, few facilities have been constructed since that time.

The SWP obtains its supplies primarily from the Sacramento River Basin. About half of the total supply diverted from the Delta for the SWP is regulated flow from the Feather River (a tributary to the Sacramento River), while the other half is unregulated flow from runoff downstream of Sacramento River reservoirs and from other rivers that flow into the Delta. The Sacramento River watershed is subject to wide annual variations in total runoff. The Sacramento River Index (SRI), which measures runoff in the watershed, has averaged about 18 maf per year over the last 90 years. However, runoff varies widely from year to year. For example, the SRI measured 7.8 mafin 1994 and 32.5 mafin 1995.

Figure 1 shows the historical total regional supply production by type. As shown in Figure 1, water supplies were as high as 4.25 mafin 1990 and within two years dropped to 3.4 mar, a 20% decrease.

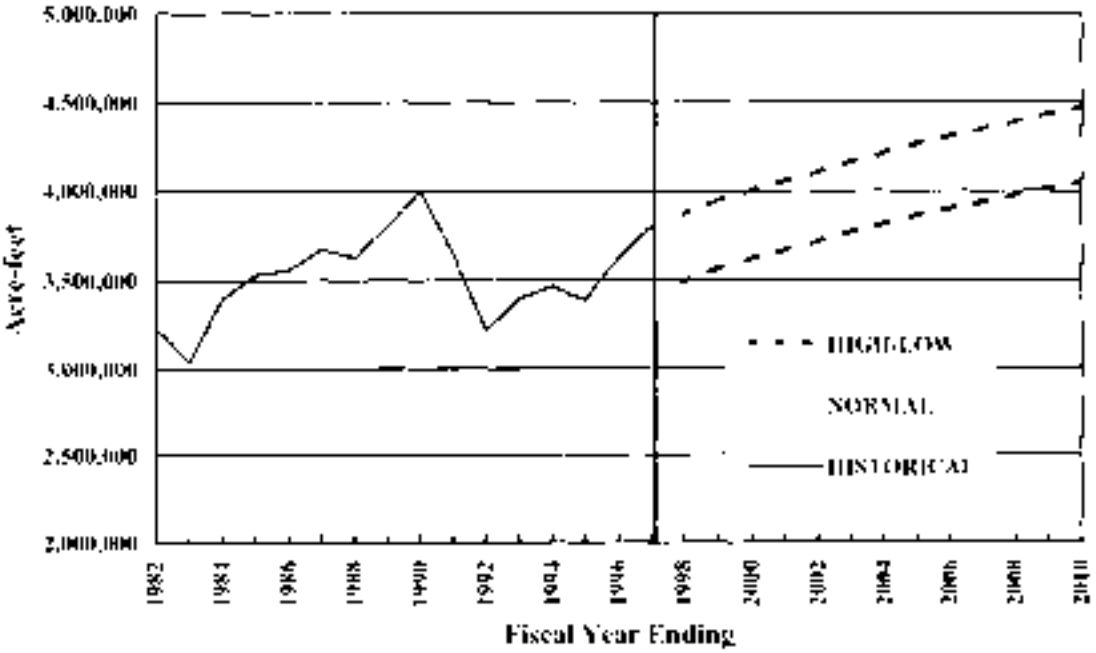
Figure 1. Historical Supply Production by Type of Supply



RETAIL DEMANDS

From 1982 through 1995, the region experienced retail water demands averaging 3.5 mar. In dry years retail demands are approximately 5 to 7% greater than normal years, while demands in wet years are about 6 to 8% below normal demands. Under normal weather conditions, assuming full implementation of conservation best management practices, total regional retail demands are projected to increase from about 3.7 mar in 1997 to almost 4.3 mar in 2010. Without conservation, demands in 2010 would be about 10 to 12% greater than projected. Increases in retail demand are driven by demographics and economics, including changes in population, housing, employment, and income. Figure 2 shows the historical and projected retail demands in Metropolitan's service area.

Figure 2. Regional Retail Water Demands



The historical variability in demands from 1982 to 1997 is mainly due to weather and the economy. In 1983, extreme wet weather caused a significant drop in retail demands. During the period from 1985 to 1990, hot and dry weather coupled with a strong economy resulted in increased demand from 3.5 maf to 4.0 maf, a 14% increase. In 1991, the 5th year of a prolonged drought, conditions forced many communities to implement mandatory supply reductions. These mandatory reductions coupled with extraordinary drought conservation caused a 10 to 15% decrease in retail demands for the region. In addition, the period between 1992 and 1995 was very wet (with the exception of 1994, which was dry), and was a period of severe economic recession. Southern California alone lost some 700,000 jobs from 1990 through 1995. The combination of wet weather, economic recession, and conservation resulted in demands decreasing by over 17%.

DEMANDS ON METROPOLITAN

For many member agencies, Metropolitan's water deliveries represent a supplemental supply. Most member agencies have local water supplies, but agencies differ in how much their supplies alone can meet their respective retail demands. Local supplies are often base-loaded (maximized subject to various constraints) and purchases from Metropolitan are used to meet remaining demands. In addition, to meeting consumptive demands, Metropolitan's deliveries are used to replenish local groundwater and surface reservoirs. To project demands on Metropolitan, projections of member agency's retail water demands and local water supplies are made. Local supplies are then subtracted from retail demands to get consumptive demands on Metropolitan. A projection of Metropolitan's long-term seasonal and replenishment deliveries are made based on safe groundwater yield and weather/hydrology.

Metropolitan forecasts its demands for three different broad categories: Full Service, Seasonal (reservoir storage and groundwater replenishment delivered for shift or long-term storage purposes and sold at a discount), and Agricultural (deliveries of water sold at a discount for agricultural use). Overall, demands on Metropolitan can vary -+ 11 to 18% from normal conditions due to weather and hydrology.

The following four figures show historical and projected demands on Metropolitan by category. Figure 3 shows Basic Water Deliveries, Figure 4 shows Seasonal Water Deliveries, Figure 5 shows Interim Agricultural Water Program (IAWP) Deliveries, and Figure 6 shows Total Water Deliveries for Metropolitan.

Figure 3. MWD Basic Water Deliveries

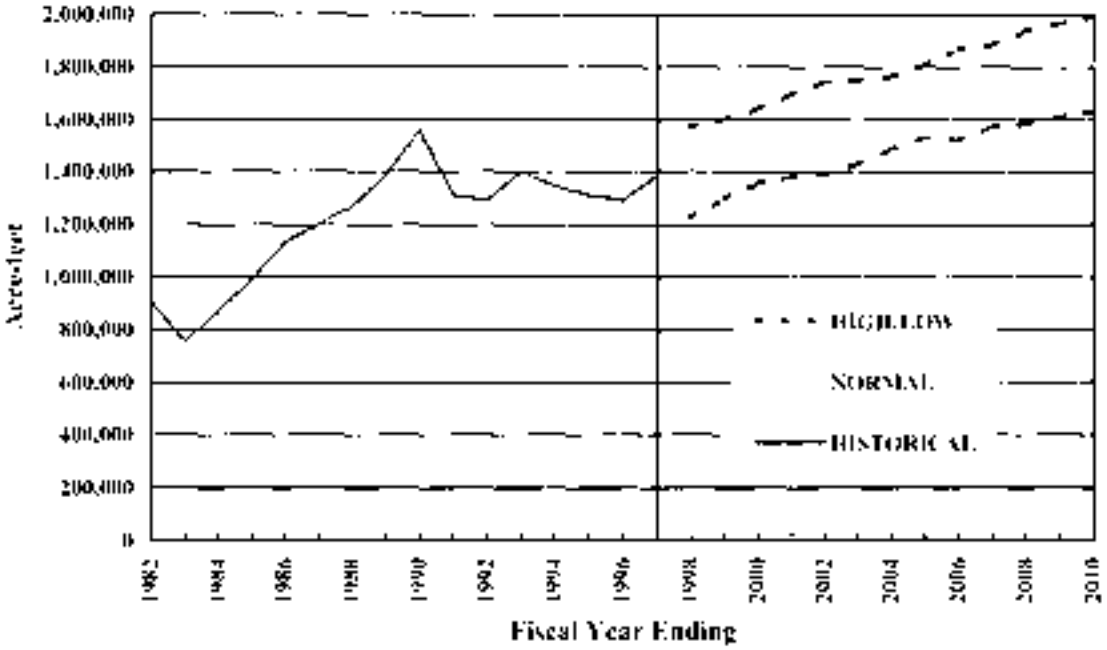
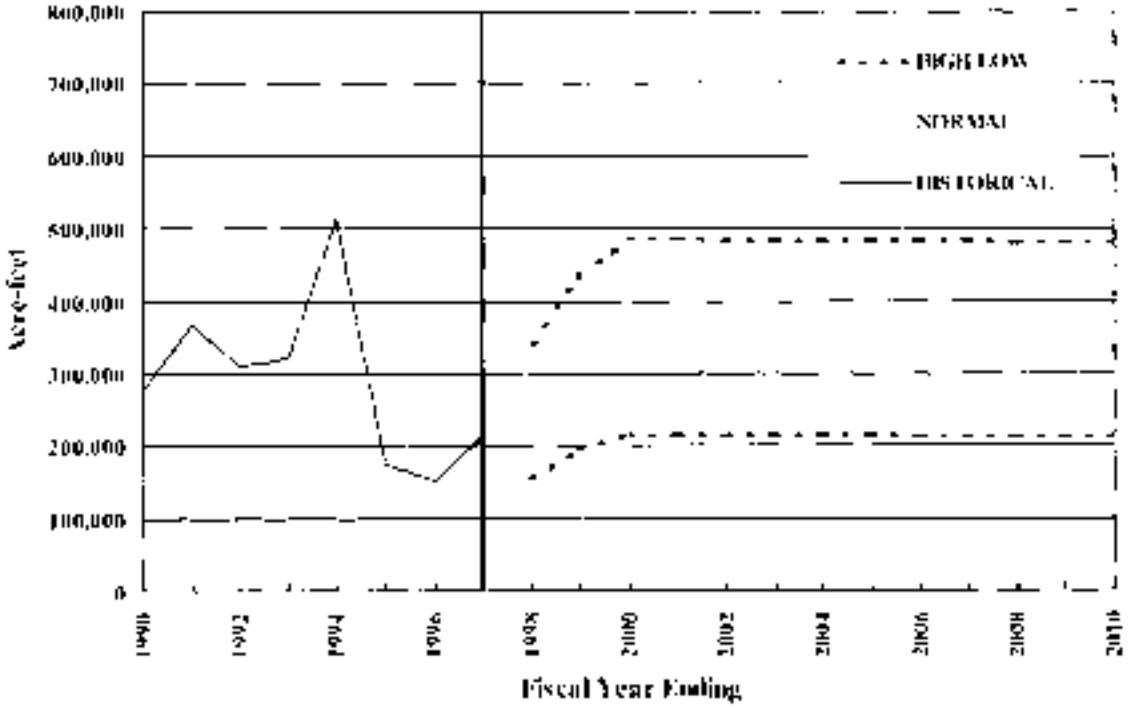


Figure 4. MWD Seasonal Water Deliveries



LIST OF ATTACHMENTS (Volume III)

A. MWD INTEGRATED RESOURCES PLAN (IRP)

B. MWD WATER SURPLUS AND DROUGHT MANAGEMENT (WSDM) PLAN

INTEGRATED RESOURCES PLANNING

To ensure supply reliability under various drought conditions, Metropolitan and its member agencies developed an Integrated Resources Plan (IRP). The IRP, adopted by Metropolitan's Board of Directors in January 1996 and periodically updated, guides Metropolitan's resource and capital improvements investments. The region's ability to develop a long-term WSDM Plan results from the significant investments Metropolitan and its member agencies have made in resources since 1991. To date, these investments include:

- Local supplies: Metropolitan co-funded over 23 local projects and 200 conservation programs that will yield a total of 160,000 af per year.

- **Colorado River Aqueduct:** Metropolitan developed transfers and storage programs to help ensure a full aqueduct. The landmark Metropolitan/Imperial Irrigation District Conservation Program (IID), will result in a savings of 107,000 af per year. Storage programs in Arizona and California, combined with the IID savings, yield a total of 280,000 af of annual core, dry year options, and storage supply.

- **State Water Project:** Metropolitan and other parties negotiated the Bay-Delta Accord and the Monterey Amendment. The Bay-Delta Accord and subsequent efforts will increase the reliability of Metropolitan's entitlement deliveries. The Monterey Amendment provides access to 220,000 af of SWP storage.

- **In-Basin Storage:** Metropolitan is constructing the Eastside Reservoir Project, with 800,000 af of storage (400,000 af of which is emergency storage for use in case of facility failure as a result of earthquake or other event).

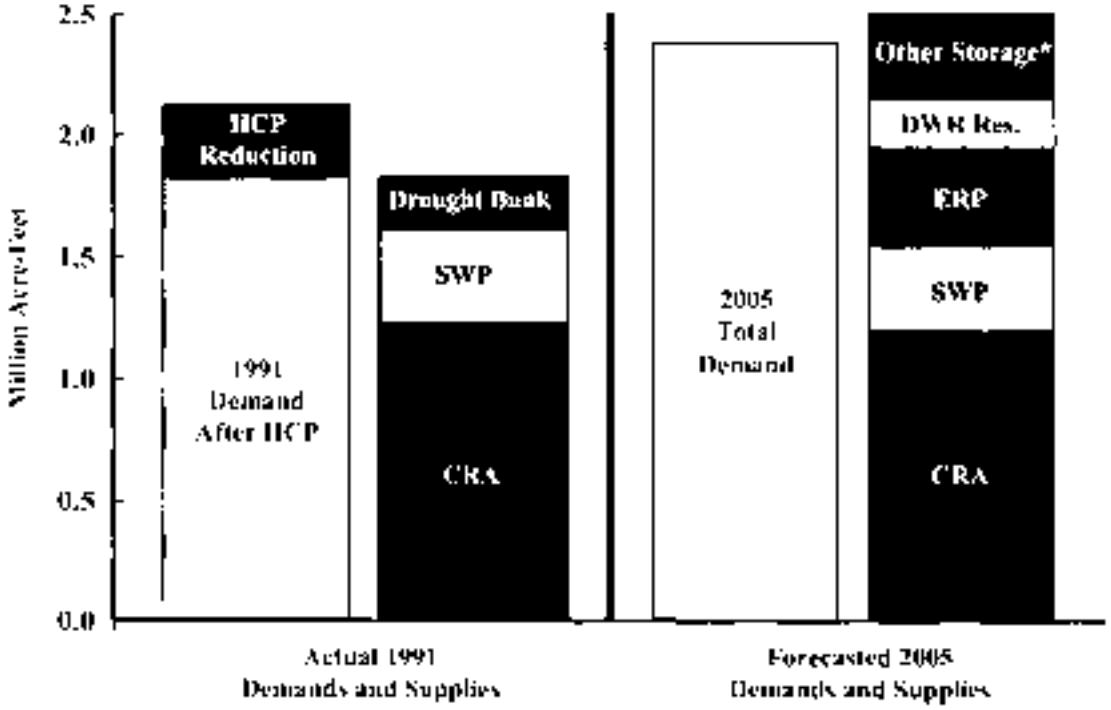
- **Groundwater Conjunctive Use Storage:** Metropolitan developed a conjunctive use storage program in the North Las Posas Basin in Ventura County with an anticipated capacity of 210,000 af and a dry-year withdrawal rate of up to 70,000 af.

- **Transfers and Storage:** Metropolitan developed the Semitropic Storage Program, with 350,000 af of storage and dry-year withdrawals averaging about 60,000 af. Metropolitan also approved the Arvin-Edison Storage and Transfer Program, with 250,000 af of storage and dry-year withdrawals averaging about 70,000 af. Metropolitan is also exploring storage and transfer programs with the Coachella Valley Water District and the Cadiz Land Company.

As a result of these investments, it is anticipated that Metropolitan and its member agencies will be 100% reliable over the next 10 years even under a repeat of the 1991 drought condition. Figure 7 compares actual Metropolitan demands and supplies during 1991 (the last year in a multiyear severe drought) and projected demands and supplies in year 2005 (assuming a repeat of 1991 conditions). In 1991, the region faced shortages that required Metropolitan to allocate water under the Incremental Interruption and Conservation Plan (IICP). The reduction in deliveries came after demands had already been reduced as a result of local conservation. In addition, water had to be purchased from the Governor's drought emergency water bank. By the year 2005 with the investments made to date,

Metropolitan's additional water supplies will be more than adequate to meet demands under a repeat of the 1991 drought event--even with increased demands due to growth.

Figure 7. Historical and Projected Metropolitan Supplies and Demands Under Drought Conditions



* Groundwater management, Semitropic Storage Program, and Arvin-Edison Storage Program

SURPLUS AND SHORTAGE RESOURCE ACTIONS

Metropolitan's investments in water resources, facilities, and programs has transformed it from an agency with relatively modest storage capacity to one that will have storage sufficient to manage many shortages without negative impacts to its member agencies or retail customers. To attain this level of reliability, storage programs and facilities, along with conservation, recycling, and other programs, must be managed as an integrated set of regional resources. To accomplish this, the WSDM Plan recognizes the linkage between surplus and shortage resource management actions.

SURPLUS ACTIONS

The combination of Metropolitan's regional storage facilities, such as Lake Mathews, Lake Skinner, the future Eastside Reservoir Project, and the storage capacity available to Metropolitan in Castaic Lake and Lake Perris as a result of the Monterey Amendment, allows Metropolitan great flexibility in managing its water resources. The development of storage programs both outside and within the service area provides even greater flexibility in storing surplus water. Each of the storage facilities and programs plays an important role in achieving Metropolitan's reliability goal.

When imported supplies exceed projected demands for imported water within Metropolitan's service area, Metropolitan can operate storage facilities to maximize stored water to benefit its member agencies. A number of factors affect Metropolitan's ability to divert surplus water into storage. Some of these factors include facility outages, system capacity, water quality (including requirements for managing total dissolved solids), and varying supply and demand patterns. This section provides a description of storage options available to Metropolitan and a framework for storing water in these programs and facilities when surplus supplies are available.

Storage of Colorado River Supplies

Metropolitan has participated in a number of programs to maximize the reliability of supplies from the Colorado River. The landmark Metropolitan/Imperial Irrigation District Conservation Program will result in a savings of 107,000 af per year. These supplies will increase the reliability of Metropolitan's entitlement of Colorado River water. Other programs yield shortage benefits by increasing amounts of water stored for use during shortages. Between August 1992 and July 1994, Metropolitan and the Palo Verde Irrigation District conducted a Test Land Fallowing Program. Approximately 20,000 acres of farmland in the Palo Verde Valley were not irrigated, saving 186,000 af of water which was stored in Lake Mead for later use by Metropolitan. With Arizona and Nevada water agencies, Metropolitan is participating in a Central Arizona Groundwater Storage Demonstration Program that has encouraged the storage of water. To date, 139,000 af of supplies have been stored in groundwater basins in Central Arizona. The Desert Coachella program is an exchange and storage program with agencies situated along the Colorado River Aqueduct. Metropolitan releases Colorado River water for storage in the Coachella Groundwater Basin. Metropolitan then exchanges these supplies for the

participating agencies' SWP supplies. These programs serve as models for future programs that could increase the reliability of Colorado River supplies. Metropolitan continues to explore other possible options that would increase the reliability of supplies. The California 4.4 Plan is being developed among California parties to increase storage programs for Colorado River supplies. In addition to core transfers and conservation programs, the California 4.4 Plan includes offstream storage (such as the Arizona groundwater storage program), dry year option transfers (such as PVID land fallowing), and river re-operations. These programs, in conjunction with favorable supply determinations by the Secretary of Interior, will ensure the highest possible reliability of Colorado River supplies.

In addition to the programs mentioned above, the Colorado River system itself contributes to the high reliability of Metropolitan's Colorado River supplies. Currently, the average Colorado River runoff exceeds basin-wide demands by over 1.0 maf per year. The Colorado River system also contains a great deal of reservoir storage capacity. The total storage capacity in the Colorado River Basin is approximately 60 maf, almost four times the Colorado River's average annual flow. For much of 1997, system storage levels were at 80% or more of total capacity. These factors allow the Bureau of Reclamation, operators of the Colorado River system, to store significant supplies for use during shortages.

Storage of State Water Project Supplies

Total storage capacity is a critical factor in comparing the operations of the Colorado River system with the SWP. On average, both systems have similar amounts of water available on an annual basis. The SWP's watersheds in the Sacramento River Basin have produced about 18 maf per year over the long term, as represented by the Sacramento River Index (SRI.) Long-term runoff on the Colorado River has averaged more than 16 maf annually since 1906. However, the ability to carry over unused water from a wet year for use in a dry year differs substantially between the two systems. State Water Project storage facilities have storage capacity of about 4.5 maf, while system storage in the Colorado River Basin totals nearly 60 maf. This gives the operators of the Colorado River reservoirs much more flexibility in storing unused water from a wet year for use in a subsequent dry year.

When water from the SWP cannot be put to immediate use in Metropolitan's service area, the water may be stored for future use. Provided storage capacity is available, the water may remain in either Oroville Reservoir (as SWP storage for delivery to all contractors the following year) or San Luis Reservoir (as carryover storage assigned to Metropolitan). Through the carryover storage program, as amended by the Monterey Amendment, Metropolitan can place a maximum of 200,000 af per year of allocated supplies in SWP surface reservoirs. The program also allows for carryover storage in non-project facilities, including surface reservoirs and groundwater basins. In the case of carryover storage in San Luis Reservoir, SWP supplies allocated to but unused by a contractor may, under certain conditions, be assigned as carryover if storage capacity is available at the end of the calendar year. However, carryover water stored for a contractor has lower priority than storage of SWP water and consequently "spills" first as San Luis Reservoir fills.

LIST OF ATTACHMENTS (Volume III)

A. MWD INTEGRATED RESOURCES PLAN (IRP)

B. MWD WATER SURPLUS AND DROUGHT MANAGEMENT (WSDM) PLAN

LIST OF ATTACHMENTS (Volume III)

A. MWD INTEGRATED RESOURCES PLAN (IRP)

B. MWD WATER SURPLUS AND DROUGHT MANAGEMENT (WSDM) PLAN

Even with dedicated programs to meet the reliability goal for the region, proper management and operations of these resources is critical to ensure reliability. The prioritization of both surplus and shortage actions need to account for several important criteria. It is also important to recognize that these criteria will need to be balanced. The criteria include:

Location: Out-of-region storage is more vulnerable than in-basin-storage due to the risks of seismic events. To only maximize out-of-region storage will put reliability at risk.

Take capacity: Surface reservoirs generally have the ability to be filled and drawn down very quickly. Certain groundwater storage programs have limited take capacities--requiring several years at full take capacity to withdraw **all** available storage. Stored water will be balanced so that dry year supplies are maximized.

Cost: Programs vary with respect to their marginal operating costs. Program actions will be taken to maximize supply reliability while minimizing cost.

Flexibility: Not all storage programs and transfers offer the same flexibility to Metropolitan. Some programs can only meet specific overlying demands, while others can meet demands anywhere in the system.

DESCRIPTIONS OF RESOURCE ACTIONS

Draw on storage in the Eastside Reservoir Project: Withdrawals from the Eastside Reservoir Project would provide a flexible supply for meeting a shortage. Eastside Reservoir Project supplies can be drawn upon quickly. The amount of water drawn from the Eastside Reservoir Project before exercising other shortage actions will depend on the severity of the shortage and the overall condition of other resources available to Metropolitan.

Draw on out-of-region storage in Semitropic and Arvin-Edison programs: Out-of-region programs such as Semitropic and Arvin-Edison provide cost-effective shortage supplies. These supplies also provide flexibility, as they can be distributed as effectively as any SWP supplies coming into Metropolitan's service area. Exercising these programs relatively early in the order of actions reduces the risk of leaving supplies out-of-region. Based upon the ratio of storage capacity to take capacity, these programs will generally provide supplies over several years. This provides the rationale for calling on these programs relatively early in a shortage.

Reduce Long-Term Seasonal and Replenishment Deliveries, and call on cyclic storage accounts: Certain interruptible supply programs provide benefits during shortage. Reducing deliveries to interruptible programs established for storage purposes, while continuing expected levels of groundwater production, allows limited supplies to go toward meeting direct consumptive uses. In addition, calling on cyclic storage accounts can extend the replenishment needs for several years. Most replenishment supplies would be expected to be interruptible for a minimum of two years before agencies would be allowed to claim a local supply adjustment on such supplies. Some programs have longer interruption requirements. For example, most Groundwater Recovery Programs are governed by contracts that require supply production through a three-year interruption in service.

Draw on contractual groundwater storage programs: In-region contractual groundwater programs provide cost-effective supplies that would be drawn upon during shortages. These programs are also

limited by their take capacities and generally have several years of withdrawals in storage. For this reason, these programs might be called upon before withdrawing heavily from surface reservoir storage.

Draw on SWP terminal reservoir storage: The storage available in the SWP terminal reservoirs provides a flexible and cost-effective shortage supply. Supplies withdrawn from this program must be replaced within five years of withdrawal. For this reason, the storage in these reservoirs would be reserved for more serious shortage conditions and would be utilized after the programs and facilities listed above were used to meet the shortage.

Call for extraordinary drought conservation: Voluntary conservation programs have historically been effective in reducing water demand during drought. However, voluntary conservation programs are not without impact to the retail customer and can be perceived as a failure of water agencies to properly plan for shortages. Therefore, the call for extraordinary drought conservation will only be taken with the consent of Metropolitan's Board of Directors.

Reduce agricultural deliveries: The Interim Agricultural Water Program (IAWP) offers interruptible water to southern California's agricultural industry at discounted rates. These supplies will be interrupted as part of Metropolitan's shortage actions. Metropolitan will work with IAWP participants to provide as much advance warning of interruption as possible. The IAWP reflects current policies toward agricultural water users. The policies underlying this program are due to be reviewed during the ten-year period of the WSDM Plan. The WSDM Plan will be changed accordingly.

Call on water transfer option contracts: Transfer options programs provide cost-effective supplies when the region is faced with reducing deliveries to meet consumptive demands. These programs might also be used to increase storage levels in Metropolitan storage facilities. Replenishment of these facilities reduces the risk of leaving available supplies outside the region and helps to protect the region during extended shortages.

Purchase transfers on the spot market: During the 1987-92 drought, the Drought Water Bank proved to be one mechanism for California to reduce the overall impacts of the shortage. However, the cost of spot market supplies may cause Metropolitan to use them as a last increment of supply before the region implements reductions in M&I deliveries. It is likewise possible that availability and cost will make spot market options more favorable under certain conditions. If this occurs then spot market supplies will be sought prior to calls on option transfers. However, participation in the spot market may be restricted to those agencies that have already taken significant actions in response to the shortage.

Implement allocation plan: As the final stage in responding to shortages, Metropolitan will implement an allocation plan to deliver reduced supplies to its member agencies. The issues of allocation and the methods of allocation are outlined in the following section.

ALLOCATION OF SUPPLY FOR M&I DEMANDS

The equitable allocation of supplies is addressed by the Implementation Goals established for the WSDM Plan, with the first goal being to "avoid mandatory import water allocations to the extent practicable." The second fundamental goal is to "equitably allocate imported water on the basis of agencies' needs." Factors for consideration in establishing the equitable allocation include retail and economic impacts, recycled water production, conservation levels, growth, local supply production, and participation and investment in Metropolitan's system and programs. In the event of an extreme shortage an allocation plan will be adopted in accordance with the principles of the WSDM Plan.

INTEGRATED RESOURCE MANAGEMENT STRATEGY

Throughout the Integrated Resources Planning process and the development of the WSDM Plan, extensive analysis of resource management strategies focused on maximizing supply reliability while minimizing overall resource costs. Various management strategies were analyzed under shortage scenarios based on historical hydrologic data. Certain strategies yield high reliability but incur very high costs. This is the case for strategies that utilize relatively costly transfer programs early in a shortage while maintaining high storage levels. If a shortage is short, this results in high transfer costs and shortage storage programs that are not fully utilized. Other strategies draw more heavily on storage early in a shortage and do not use options transfer programs. Later in a shortage, the yields from these transfer programs, combined with low yields from depleted storage facilities, might not make up for continuing or deepening shortages. Overall, such approaches may be inexpensive to pursue at the wholesale level but have high costs associated with retail level impacts. The resource management framework presented results from extensive analysis of various strategies for managing available resources under a variety of surplus and shortage conditions. Although the extent to which various actions are exercised may still vary depending on specific shortage conditions, the ordering presented does reflect Metropolitan's anticipated order of actions during shortages.

RESOURCE MANAGEMENT FRAMEWORK

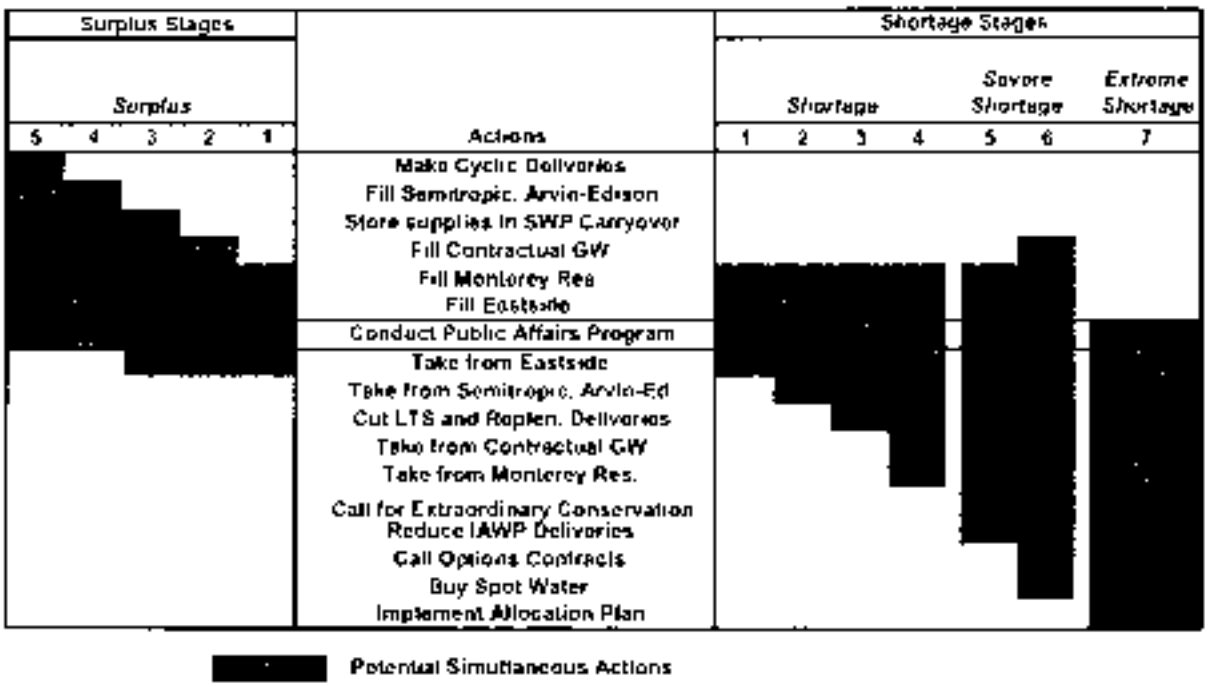
The analysis of surplus and shortage actions yields a water management framework that accounts for the degree or "stage" of surplus and shortage. These stages are defined by parameters such as storage levels and expected SWP supplies. Each stage has associated actions that could be taken as part of the response to prevailing shortage conditions. For example, Surplus Stage 1 might have as associated actions to place water in the highest-priority storage resources. Figure 8 shows the mapping between actions and stages. The darkly shaded diagonal area identifies actions that can be undertaken concurrently, while the lightly shaded areas show actions that will not be taken. For example, Metropolitan will not withdraw water from most storage resources during a surplus.

Figure 8 highlights several aspects of the WSDM Plan's approach to supply management. First and most importantly, it does not dictate a response to shortage or surplus. The framework recognizes the complexity and variety of conditions that could require various responses. Supporting this framework are general "rule curves" that dictate the extent to which particular actions are taken in various stages of surplus or shortage. For example, the rule curves indicate approximately how much water should be taken from the Eastside Reservoir Project before calling on supplies from the Semitropic or Arvin-Edison storage programs. If a shortage were greater than the desired initial withdrawal from the Eastside Reservoir Project, then Stage 2 actions would be taken. The rule curves for a particular resource would take into account shortage stage, monthly delivery requirements, and when various supplies are available.

Surplus and Shortage Stages are determined by the total amount of water that would be stored or produced by exercising the actions in that Stage. Overall storage levels in each stage are determined by the extent to which storage is increased or reduced by earlier actions. Therefore, each Stage is defined by supplies (stored or produced) and an approximate overall level of storage remaining in all resources. Up through Shortage Stage 4, the actions taken will not result in negative impacts to any consumptive uses. Shortage Stages 1 through 4 constitute shortage management without retail level impacts. The conservation efforts and reductions in IAWP deliveries in Shortage Stage 5 will result in retail impacts.

Action by the Metropolitan Board of Directors would be required before actions corresponding to Stages 5, 6, and 7.

Figure 8. Resource Stages and Actions Matrix



The Stages and Actions Matrix (Figure 8) is read from the center moving outward. Moving from the center to the left, are actions that Metropolitan will take during surplus conditions. For instance, in a Stage 3 Surplus, Metropolitan will be adding water to the Eastside Reservoir Project, the Monterey Reservoirs (if any water is due for repayment), Contractual Groundwater Programs, and carryover storage on the State Water Project. Moving from the center to the right are actions that Metropolitan will take during periods of shortage. For instance, in a Stage 3 Shortage, Metropolitan will be pulling water from the Eastside Reservoir Project, the Semitropic and Arvin Edison programs, and interrupting deliveries of Long-Term Seasonal and Replenishment program water. In addition, the Stages and Actions Matrix allows for surplus actions to be taken during shortages and vice versa, but these actions are strictly a result of prudent water management. For example, in a Stage 6 Shortage, Figure 8 shows Metropolitan potentially filling the Eastside Reservoir Project, the Monterey Reservoirs, and contractual groundwater programs while calling on spot transfers and buying spot water. Through these actions Metropolitan will be ensuring that water supply opportunities during a drought are realized--ultimately adding to the drought reserves of southern California.

Figure 8 also highlights the on-going efforts by Metropolitan and its member agencies in the conduct of public outreach and active conservation programs. Through all conditions, effective pubilc outreach and conservation programs are an integral part of Metropolitan's management of resources. In addition to ongoing conservation and water efficiency programs, Stage 5 of the Stages and Actions Matrix calls for participation of the citizens of southern California to take extraordinary conservation measures to cut water demand during droughts.

As with the listing of shortage actions earlier in the report, the Stages/Actions matrix in Figure 8 only highlights certain programs and response actions. However, unlike the discussion of actions earlier, Figure 8 is intended to convey Metropolitan's currently anticipated ordering for those actions listed. As the supply and demand outlooks, programs, and other factors continue to change, the analysis of the ordering of actions will continue during the ten-year period of the WSDM Plan.

SUPPLY CERTAINTY AND THE TIMING OF RESOURCE ACTIONS

One of the fundamental trade-offs in dealing with supply shortages is the need to maintain flexibility while providing supply certainty to member agencies and consumers. A central focus of the WSDM Plan is the analysis of information about supplies and demands. When do various pieces of information about the supply/demand balance become more certain? When should this information impact policy-making and trigger various resource actions? The WSDM Plan addresses these questions and the actual implementation of the Plan during a shortage.

Figure 9 shows a hypothetical shortage year. With respect to the supply and demand outlook, a typical shortage year will have periods of certainty and stability, and other periods of relative uncertainty and transition. Important supply components--such as the SWP, CRA, Los Angeles Aqueduct (LAA), and local supplies--are closely monitored through the early part of the year. These supplies and demands are fairly well-known through the April-September period. Storage is assessed in the post-summer period and decisions about certain programs, such as long-term (LT) seasonal deliveries could be made at this time.

Figure 9. Water Supply Outlook Throughout the Year

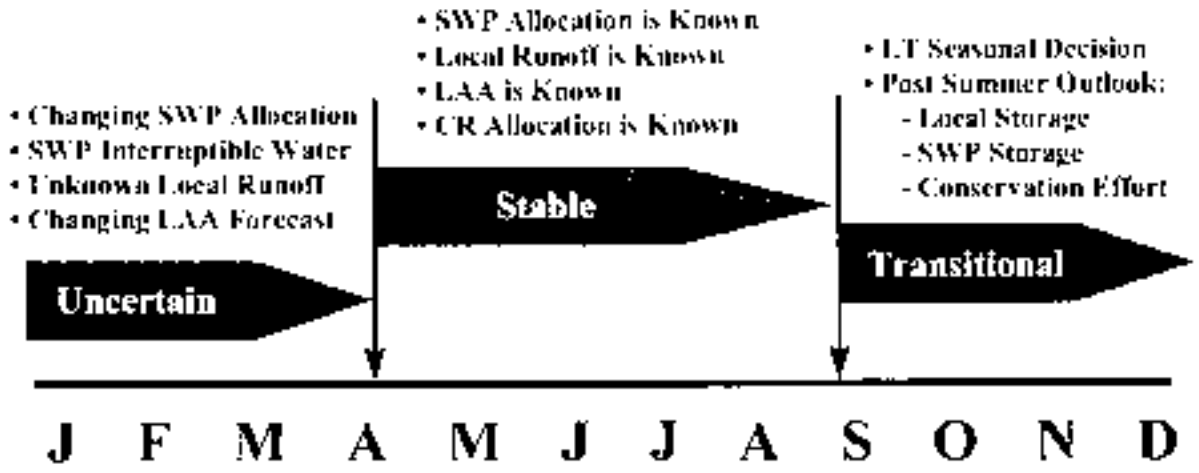
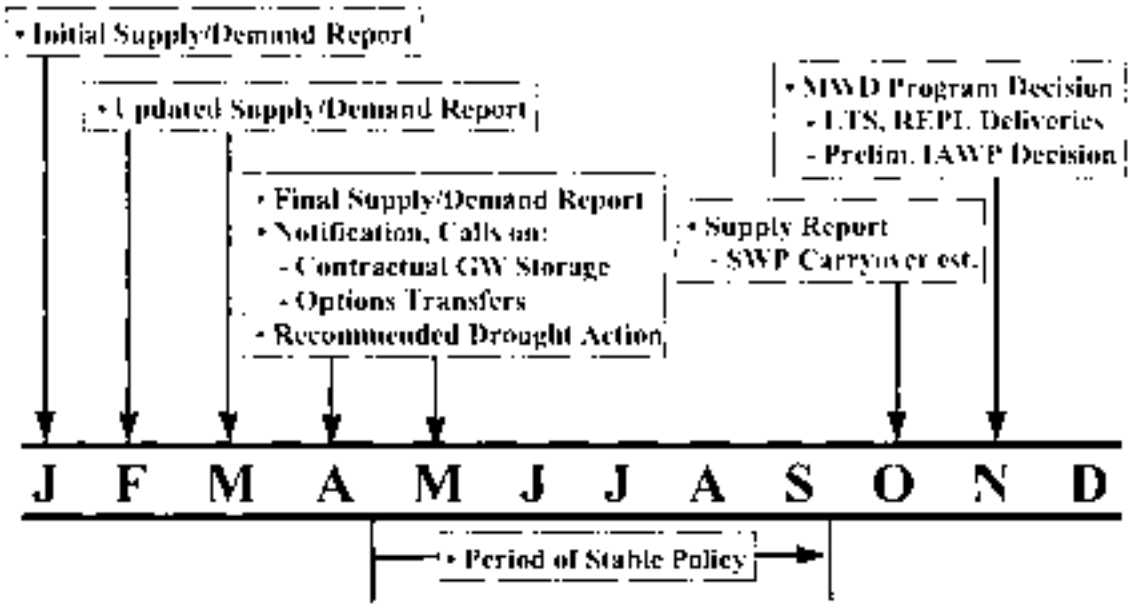


Figure 10 presents the annual schedule for actions taken in response to shortage conditions. Starting in January, an initial supply/demand report will be presented to the Metropolitan Board of Directors. SWP allocations are still only estimates in January and become more certain towards April and May. Demands for Metropolitan deliveries depend in part on how the winter hydrology develops and the condition of local supplies. These factors start to become known during the February-March period and will be reported to the Board in the Supply Report Update. By April-May, the outlook for imported supplies is known to a fairly high degree of certainty and a Final Supply Report will be produced. The May-September period will be one in which the import supply situation does not change drastically and drought policies can be implemented. Demands can be more or less than anticipated as a result of unusually hot or cool weather. At the end of summer, carryover SWP storage will be determined. October through December is a transitional period during which early assessments of available supplies for the following year will be made. During this period, Board actions would determine the management of various Metropolitan programs such as long-term seasonal (LTS) and IAWP deliveries. The following list presents major information and decision points during the year.

Month	Information/Action
January	Initial Supply/Demand Reports
February, March	Updated Supply/Demand Reports
April, May	Final Supply/Demand Report
	Notification on Contractual GW and Options Transfer Programs
	Recommended Drought Actions
May-September	Stable Policy Period
October	Supply and Carryover Storage Report
November	MWD Program Decisions - LT Seasonal, Replenishment, IAWP

Figure 10. One Year of a Hypothetical Shortage - Supply and Demand Reports and Response Actions



PUBLIC OUTREACH AND CONSERVATION

Mechanisms are already in place to implement most of the water management actions and programs that are addressed in the WSDM Plan. Under the majority of supply and demand conditions, the actions of Metropolitan's Board of Directors, the General Manager, the operational activities of Metropolitan, and its member agencies would constitute all actions necessary to mitigate the shortage. Several aspects of the WSDM Plan, however, require additional attention to the administration of programs and actions. In particular, a shortage contingency requires special programs in the areas of public and governmental affairs and conservation. Metropolitan maintains an on-going public information program to encourage efficient water use. Public outreach programs are conducted at all times under both surplus and shortage conditions (see Figure 8). The actions discussed in this section constitute special actions in times of shortage.

During shortage conditions, public outreach will play a critical role in shaping consumer response. Public information campaigns need to send clear signals if extraordinary drought conservation is to achieve needed reductions in demands. Given Metropolitan's diverse set of customers and the varying impacts that shortages can have on different consumer groups, an effective public information campaign will require a joint effort among Metropolitan and its member agencies. Under this Plan, the administration of the Public Information and Government Affairs programs will be the responsibility of a Drought Program Officer (DPO). The DPO will be responsible for integrating the various activities in these areas, coordinating efforts with Metropolitan's Board of Directors and member agencies, and designing the region-wide messages for the general public and various target audiences. Important constituencies that have been identified in the process are residential users, business interests, agricultural users, elected officials, officials of various agencies (such as the Department of Water Resources), and the media.

Many conservation programs, such as Metropolitan's ultra-low flush toilet rebate program, are driven by member agency requests. Based on history, Metropolitan expects member agency requests to increase during droughts. Metropolitan is committed to increasing overall conservation program funding to meet member agency requests during droughts and attain higher levels of savings. These programs will be implemented by Metropolitan and member and local agency conservation staff. As many of the short-term conservation objectives during a shortage would be dependent upon an effective public information program, the Drought Program Officer will also be responsible for monitoring the effectiveness of the augmented conservation programs. A monthly conservation reporting process will be implemented. Quarterly estimates of regional conservation will be developed to track the progress of various actions in mitigating the shortage.

APPENDIX A: RESOURCE AND STORAGE SIMULATION

The Water Surplus and Drought Management Plan (WSDM Plan) uses the Stages and Actions Matrix (Figure 8) as a guide for the operation of storage and transfers for the next ten years, 1999-2008**.** Metropolitan asserts that the investments that Metropolitan and its member agencies have made in water supply and storage, managed in a coordinated manner as presented in the WSDM Plan, will be sufficient to assure that retail firm water demands will be met 100% of the time through the year 2008. Metropolitan performed an extensive analysis of projected water demands, current and expected water supplies, along with hydrologic variations to support this assertion. Appendix A presents a summary of this analysis which includes statistical probabilities of actions under the WSDM Plan and two illustrative examples of how supply resources may be used in the future under worst-case drought events. Although the WSDM Plan is intended to be in effect through 2008, for the purposes of analysis the planning horizon was extended through 2010.

The WSDM Plan seeks to define the operational envelope for the Metropolitan system into the near future. Although the WSDM Plan only looks out ten years, it nonetheless involves the operation of some storage and water transfer projects that have not yet become fully operational. This makes the estimation of storage and transfers operations difficult. Compounding this problem is the lack of certainty around future demands, economic conditions, or even the weather over the next ten years. To manage these uncertainties, Metropolitan has developed a computer based simulation model called the Integrated Resources Planning Simulation Model or IRPSIM.

IRPSIM uses a modeling method known as sequentially indexed monte-carlo simulation. Simply put, the model looks at projected regional retail demand and supplies of water over the next twelve years and adjusts each, up or down, based on an assumed pattern of future weather. For instance, if Metropolitan expected the weather over the next twelve years (1999-2010) to be the same as the last twelve years (1987-1998), then IRPSIM would adjust the projected 1999 demands and supplies based on the historical 1987 hydrology, and adjust the projected 2000 demands and supplies using the historical 1988 hydrology, and so on. One obvious drawback to this approach is that Metropolitan does not know what future weather will be. Therefore, Metropolitan runs the models over and over again until all recorded hydrologies, 70 in all, have been tried. In this way, Metropolitan can look at probabilistic results of being in shortage year by year through 2010.

Although the projections of water supplies used in this analysis required certain assumptions to be made, they were based on most likely or probable outcomes. In most cases, projected water supplies represented projects that are currently operational, under construction, or in the final stages of negotiations. The following represents a summary of these assumptions:

- Local recycling and groundwater recovery: assumes currently operational projects with expected increases in supply yield as demand increases

- Conjunctive use groundwater storage: assumes Las Posas (under final stages of construction) and implementation of similar programs which are under negotiation (such as Raymond, Orange, and Chino Basins)

- Semitropic and Arvin-Edison storage: assumes use of both programs which are operational with water already stored

- Eastside Reservoir Project: assumes use of non-emergency storage from the reservoir currently under construction and an initial fill projected to start in approximately one year

- The Monterey Reservoirs: assumes use of State Water Project terminal reservoir supplies, Castaic and Perris Reservoirs, per the Monterey Amendment

- Colorado River Aqueduct: assumes a full aqueduct through the implementation of the California Plan (including lining of All American and Coachella canals, SD/IID water transfer/exchange, conjunctive use off-aqueduct storage, and river re-operations)

- State Water Project: assumes continuance of Bay-Delta Accord (with only current facilities)

One way of viewing the result of Metropolitan's WSDM Plan analyses is by summary statistics. Table A- 1 gives the probabilities of shortage actions over the next twelve years.

Table A-1. Probability of Shortage Stage[1] by Forecast Year

1999	13%	13%	11%	7%	3%	0%	O%
2000	13%	13%	11%	9%	3%	O%	0%
2001	19%	17%	13%	10%	6%	O%	0%
2002	19%	17%	13%	10%	4%	1%	0%
2003	19%	19%	14%	11%	4%	0%	0%
2004	20%	19%	16%	13%	4%	0%	0%
2005	21%	19%	17%	13%	6%	O%	O%
2006	21%	19%	19%	13%	6%	0%	0%
2007	23%	20%	19%	13%	4%	0%	0%
2008	26%	21%	19%	16%	6%	1%	0%
2009	26%	24%	19%	17%	6%	1%	0%
2010	26%	26%	19%	19%	6%	1%	O%

Table A-1 can be read in one of two ways, by column or row. The Stage 7 column indicates that there are no historical weather conditions that require allocation over the next twelve years. This is the single most important conclusion of the WSDM Plan analysis. The Stage 6 column indicates that only in a few years--2002, and 2008 through 2010--would Metropolitan need have a need for option or spot transfer water. Read by row, Table A-1 indicates that in the year 2008 there is a 21% likelihood of taking some water from the Eastside Reservoir Project, a 19% likelihood of taking water from Semitropic or Arvin-Edison storage programs, a 17% likelihood of interrupting long-term seasonal and replenishment deliveries for two years, and so on. It should be noted that these probabilities represent the best current estimates by Metropolitan, but are based entirely on historical weather conditions. Conditions that fall outside of historical ranges, either in duration or severity, are not represented by this data.

Another way to view the WSDM Plan analysis is by observing the operation of a single hydrology. Table A-2 provides an example of resource operations for the period 1999 through 2010 assuming a repeat of the 1923 through 1934 hydrology. The table provides descriptions of hydrologic conditions to aid in understanding the example.

[1] Stage 1 consists of withdrawal from the Eastside Reservoir Project. Stage 2 consists of the above plus withdrawals from the Semitropic and Arvin-Edison water storage and transfer projects. Stage 3 consists of the above plus an interruption of Long-Term Seasonal and Replenishment discount water. Stage 4 consists of the above plus withdrawal from contractual groundwater programs and the Monterey Reservoirs. Stage 5 consists of the above plus a call for extraordinary drought conservation and interruption in agricultural discount water. Stage 6 consists of the above plus calls on option contract water and purchases of water on the open market. Stage 7 consists of the above plus allocation of remaining shortages. For a full description of stages and action, see Surplus and Shortage Resource Actions section and Figure 8 above.

For instance, 1923 was considered to be a dry year in southern California (defined as less than 9 inches of rain at the Los Angeles Civic Center) and is categorized by the California Department of Water Resources (DWR) as a below normal year for State Water Project deliveries. In this example, 1923 weather increases southern California's demand for water and decreases imported State Water Project supplies. The Colorado River Aqueduct supplies are influenced by yet another hydrologic indicator, but for the next ten year Metropolitan expects the Aqueduct to be full.

Table A-2 indicates that retail water demands in 1999, assuming a 1923 hydrology, will be 3.979 million acre-feet (maf). Adding expected long-term seasonal and replenishment demands of 0.165 maf gives a regional total water demand of 4.144 maf. After subtracting local supplies of 2.192 maf, which are also adjusted for 1923 weather, Metropolitan expects to see a demand of 1.952 maf. In 1999, under a 1923 hydrology, Metropolitan expects to see 2.954 maf of supply. This is enough to meet all expected demands and put over 1.0 maf into storage.

The 1923 through 1934 hydrology is significant because it starts and ends dry with little recovery in the middle. However, even in these most adverse conditions the actions proposed by the WSDM Plan provides the region with enough water to avoid shortage allocation. Again the most important result of this example is read from the last line, which indicates that there are no remaining shortages through 2008

Table A-3 provides a second example of using the 1980 through 1991 hydrology. This hydrology contains the most significant drought in recent record, ending with a critically dry year on the State Water Project that is expected to yield a mere 0.389 maf. However, even under these conditions the WSDM Plan provides a method to avoid firm water allocation.

The analyses performed using the prioritized action of the Stages and Actions Matrix support Metropolitan's assertion that water supply reliability can be attained through the use of regional storage, interruption of discounted water supplies, and transfers. And, through the implementation of the WSDM Plan, Metropolitan does not expect to allocate firm water deliveries for at least the next ten years.

Table A-2. A Simulation of Water Supplies and Demands 1923-1934 Hydrology

Forecast Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Hydrology Year	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934
Hydrologic Conditions												
Southern California Year Type	Dry	Dry	Dry	Wet	Wet	Dry	Dry	Normal	Wet	Normal	Wet	Normal
Sacramento River Index D1630 Year Type	Below Normal	Critically Dry	Dry	Dry	Wet	Above Normal	Critically Dry	Dry	Critically Dry	Dry	Critically Dry	Critically Dry
Demands												
Retail Demand	3.979	4.152	4.149	4,018	4.005	**4.249**	4.237	4.223	4.280	4.280	4.407	4.500
Long-term/Replenishment Demand	0.165	0.182	0.226	0.188	0.149	0.176	0,213	0.203	0.164	0.175	0.141	0.163
Total Demand	4.144	4.334	4.375	4.205	4.154	4.425	4.450	4.426	4,443	4.455	4.548	4,663
Local Supplies												
Groundwater Production	1.529	1.545	1.537	1.288	1.299	1.575	**1.568**	1.434	1.307	1.439	1.318	1.454
L. A. Aqueduct Production	0.383	0,287	0.304	0.316	0.392	0.302	0,245	0.235	0.174	0,324	0.251	0.220
Recycling Production	0.152	0.162	0.174	0.186	0,197	0.207	0.217	0.230	0,242	0.254	0.266	0.277
Surface Production	0,128	0,089	0,076	0.116	0.154	0.147	0.108	0.094	0,133	0,136	0.151	0.145
Total Local Supply	2,192	2.084	2.091	1.905	2,043	2.231	2,139	1.993	1.856	2.153	1.986	2,097
Total MWD Demand	1.952	2.250	2,284	2,300	2.112	2.194	2.311	2.433	2.587	2.302	2.562	2.566
MWD Supply Sources												
Colorado River Aqueduct Supply	1.200	1.200	1.200	1.200	1.200	**1.200**	1.200	1.200	1.200	1.200	1.200	1.200
State Water Project Supply	1.754	0.812	0.783	1.280	1.678	1.438	0,764	1.163	0,589	0.843	0.559	0.620
MWD Cyclic Groundwater Deliveries	0.000	0.060	0.060	0.000	0.000	0,000	0.060	0,060	0.060	0.059	0.000	0.000
Eastside Reservoir	0.000	0.066	0.058	0.000	0.000	0.000	0,060	0.010	0.425	0.023	0.219	0.041
Arvin/Semitropic Groundwater Storage	0.000	0.111	0.115	0,000	0.000	0,000	0,119	0,000	0.115	0.117	0.059	0.041
Longterm Seasonal Demand Cuts	0.000	0,000	0,166	0.000	0.000	0.000	0.153	0.000	0.104	0,116	0.000	0.000
Cyclic Benefits	0.000	0.000	0.000	0.000	0.000	0.000	0,000	0,000	0,000	0,000	0.060	0.060
Contractual Groundwater Storage	0.000	0.000	0.000	0,000	0.000	0.000	0.000	0,000	0.095	0.000	0.095	0.084
DWR Reservoirs (Monterey Agreement)	0.000	0.000	0,000	0.000	0.000	0.000	0.000	0.000	0,000	0,000	0.131	0.088
Voluntary Conservation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0,000	0.000	0.206	0.210
MWD Ag Cuts	0.000	0.000	0.000	0.000	0.000	0,000	0.000	0.000	0.000	0.000	0.033	0.031
Central Valley Transfers	0.000	0.000	0,000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.193
Storage Puts	1.003	0.000	0.097	0.180	0.549	0.438	0.045	0.000	0,000	0.056	0.000	0.000
Remaining Shortage	0,000	0,000	0.000	0,000	0.000	0.000	0.000	0,000	0.000	0.000	0.000	0.000

Table A-3. A Simulation of Water Supplies and Demands 1980-1991 Hydrology

Forecast Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Hydrology Year	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934
Hydrologic Conditions												
Southern California Year Type	Wet	Normal	Normal	Wet	Dry	Dry	Wet	Normal	Normal	Dry	Dry	Normal
Sacramento River Index D1630 Year Type	Above Normal	Dry	Wet	Wet	Wet	Dry	Wet	Dry	Critically Dry	Dry	Critically Dry	Critically Dry
Demands												
Retail Demand	3.781	4.170	3.930	3.647	4.308	4.250	4.151	4.281	4.380	4.550	4.663	4.497
Lon£1-term/Replenishment Demand	0.105	0.141	0.171	0.101	0.136	0.187	0.183	0.201	0.191	0.219	0.224	0.214
Total Demand	3.886	4.311	4.101	3.748	4.444	4.437	4.334	4.483	4.572	4.769	4.887	4.712
Local Supplies												
Groundwater Production	1.292	**1.440**	**1.381**	1.248	1.546	1.565	1.275	1.413	1.438	1.588	1.600	1.446
L. A. Aqueduct Production	0.462	0.372	0.499	0.529	0.516	O.367	0.472	0.400	0.326	0.278	0.213	0.223
Recycling Production	0.152	0.162	0.174	0.186	0.197	0.207	0.217	0.230	0.242	0.254	0.266	0.277
Surface Production	0.225	0.175	0.154	0.194	0.195	0.151	0.115	0.116	0.115	0.081	0.068	0.081
Total Local Supply	2.131	2.149	2.208	2.156	2.455	2.290	2.081	2.159	2.122	2.200	2,146	2.027
Total MWD Demand	1.755	2.162	1.894	1.591	1.989	2.147	2.253	2.324	2.450	2.569	2.741	2.684
MWD Supply Sources												
Colorado River Aqueduct Supply	1.200	1.200	1.200	1,200	1.200	1.200	1.200	1.200	**1.200**	1.200	1.200	1.200
State Water Project Supply	1.561	1.441	1.725	1.886	1.643	1.590	1.441	1.292	0.611	1.285	0.877	0.389
MWD Cyclic Groundwater Deliveries	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.060	0.060	0.060
Eastside Reservoir	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.199	0.024	0.222	0.209
Arvin/Semitropic Groundwater Storage	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.115	0.000	0.122	0.104
Long-term Seasonal Demand Cuts	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.131	0.000	0.164	0.154
Cyclic Benefits	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractual Groundwater Storage	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.133	0.000	0.095	0.085
DWR Reservoirs (Monterey Agreement)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.216
Voluntary Conservation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.235
MWD Ag Cuts	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032
Central Valley Transfers	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Storage Puts	1.006	0.260	0.344	0.240	0.200	0.200	0.388	0.168	0.000	0.000	0.000	0.000
Remaining Shortage	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000