THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

Report

Water Resource Management Group

- 2015 IRP Technical Update Issue Paper Addendum

Summary

Transmittal of the 2015 IRP Technical Update Issue Paper Addendum.

Purpose

Informational

Attachments

Attachment 1: 2015 IRP Technical Update Issue Paper Addendum

Detailed Report

Local water resources and conservation play a critical and growing role in the region's water portfolio. For effective implementation, managers and policy-makers should be aware of the latest information in the development of these local resources and conservation efforts. The 2015 IRP Technical Update Issue Paper Addendum (Issue Paper Addendum) seeks to help inform future water resource discussions by identifying current and potential resource issues, opportunities, and actions.

Content and Organization

The 2010 IRP included the development of six individual Issue Papers based on each of the different resource areas, which summarized the findings of in-depth workgroup discussions, the status of local supplies and programs, and recommendations for future opportunities. The 2015 Issue Paper Addendum builds on the previous Issue Papers, providing a discussion on current challenges and opportunities, lessons learned since 2010, and updated recommended actions in the areas of conservation, groundwater, recycled water, seawater desalination, stormwater direct use, graywater, and resource interrelations.

Development Process

The Issue Paper Addendum is a product of regional collaboration. Multiple meetings were held between April and October 2015 to discuss and obtain input from the IRP Member Agency Technical Workgroup, the Water Use Efficiency Meetings, other resource experts, and stakeholders.

Key Outcomes

Table 1 provides a general overview of the types of challenges, opportunities, and recommendations identified in the Issue Paper Addendum.

Date of Report: 10/27/2015

Table 1

Challenges	• Lack of public awareness and support • Regulatory hurdles • Operations and maintenance issues • Sustainability issues • Water quality issues • Costs/funding
Opportunities	• Drought has created momentum • Technological advances • New funding avenues • Collaboration
Recommendations*	• Explore research, information sharing, and technological development opportunities • Explore legislative and regulatory opportunities • Continue to improve public education, awareness, communication, and perception • Pursue collaboration • Explore various investment strategies

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

More detailed information is provided in **Attachment 1:** 2015 IRP Technical Update Issue Paper Addendum.

2015 IRP Technical Update Issue Paper Addendum

October 27, 2015

WATER TOMORROW

Integrated Water Resource Plan | 2015

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1. Summary

The 2015 IRP Technical Update Issue Paper Addendum builds on the information provided in the 2010 IRP Issue Papers, and was developed through a collaborative regional process to ultimately help inform future water resource discussions. Specifically, this paper identifies current and potential resource issues, opportunities, and actions in the areas of conservation, groundwater (including stormwater and other recharge), recycled water, seawater desalination, stormwater direct use, graywater, and resource interrelations.

The following table provides a summary of the 2015 IRP Technical Update Issue Paper Addendum. More detailed information is provided in the subsequent sections of this report.

Table 1: Summary

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

	Issues	Opportunities	Recommendations*
Groundwater (including stormwater and other recharge)			
	• Region is experiencing historic low groundwater levels • Urbanization reduces groundwater recharge and increases flood risk • Climate change may alter precipitation patterns • Costs/Funding • Institutional challenges • Water quality • Operational & environmental Issues	• Adjudication amendments increase flexibility for groundwater management • Regulatory changes maximize recycled water recharge • New treatment and brine disposal technologies • Collaboration on multi-benefit projects	➢ Explore opportunities to address ongoing threats to sustainability ➢ Explore innovative project and partnership development ➢ Continue to provide an avenue for open regional discussion on stormwater
Recycled Water			
	• Lengthy and variable permitting process • Negative public perception & conflicting messaging • Costs • Source control and effluent water quality needs • Operational issues • Conflicting institutional objectives	• Progress toward new regulatory process • Improving public perception • New funding opportunities • Partnerships • New technologies, research, & information sharing	➢ Explore opportunities to improve permitting process ➢ Improve public education and awareness of water recycling ➢ Explore various investment strategies such as incentives, ownership, and partnerships ➢ Consider joint technical studies and projects
Seawater Desalination			
	• New regulations affect future development • Costs • High energy use • Conflicting messaging	• Improve permitting process • Regional, state, and federal funding • Technology and innovation • Partnerships and collaboration with stakeholders • Communicating benefits	➢ Explore legislative, regulatory, and communications opportunities ➢ Continue investment in new research, studies, and innovation ➢ Investigate partnership opportunities for managing risk ➢ Evaluate options for capacity building
Stormwater Direct Use			
	• Availability of supplies due to uncertain rainfall patterns • Operation and maintenance needs • Potential impacts to groundwater recharge and quality	• Rainwater capture is now available for non-potable uses without permitting requirements • Public awareness of water issues	➢ Evaluate a business case analysis and cost/benefit analysis for providing regional incentives ➢ Continue to facilitate regional discussion on stormwater direct use ➢ Encourage information sharing of challenges and lessons learned

	Issues	Opportunities	Recommendations*
Graywater			
	• Permitting and regulations • Cost • Drain-line carry • Potential health and environmental risks • Potential conflict with other resources	• Changes to plumbing and building codes • Removed authority to prohibit graywater use • Public awareness increased due to drought	➢ Continue to encourage research ➢ Explore additional public education efforts
Resource Interrelations			
	• Water quality • Regulatory challenges • Costs and limited funding • Lack of public support	• Collaboration on multi-benefit projects • Collaboration on grant funding • Technology, research, and information sharing • Heightened public awareness and regulatory reform during drought • Optimizing resource interactions	➢ Explore partnership opportunities for multi-benefit approaches ➢ Explore research and technology development opportunities ➢ Investigate integrated regulatory, outreach, and education efforts ➢ Explore integrating resource, program, and planning opportunities ➢ Explore funding strategies that improve economic feasibility of multi-benefit projects

* Recommendations (identified potential actions) do not obligate future policy or implementation for any agency, but instead aim to help advance the regional discussion on water resource issues.

2. Introduction

Local water resources and conservation play a critical and growing role in the region's water portfolio. For effective implementation, managers and policy-makers should be aware of the latest information on the development of these local resources and conservation efforts. This paper seeks to help inform future water resource discussions by identifying current and potential resource issues, opportunities, and actions in the following areas:

- Conservation
- Groundwater (including stormwater and other recharge)
- Recycled Water
- Seawater Desalination
- Stormwater Direct Use
- Graywater
- Resource Interrelations

The information provided in this paper does not obligate future policy or implementation for any agency, but instead aims to help advance the regional discussion on water resource issues.

OVERVIEW

The 2010 IRP included the development of six individual Issue Papers[1] based on each of the different resource areas, which summarized the findings of in-depth workgroup discussions, the status of local supplies and programs, and recommendations for future opportunities. The 2015 IRP Technical Update Issue Paper Addendum builds on the previous Issue Papers, providing a discussion on the current challenges and opportunities of each resource, lessons learned since 2010, and updated recommendations.

Process

This Issue Paper Addendum is a product of an overall process of regional collaboration with input from the IRP Member Agency Technical Workgroup, the Water Use Efficiency Meetings, other resource experts, and stakeholders.

[1] The 2010 IRP Update Issue Papers can be found in the Technical Appendix: http://mwdh2o.com/PDF_About_Your_Water/2.1.2_IRP_Appendix.pdf

3. Conservation

Overview

Conservation is a major part of Metropolitan's regional resource strategy and was identified in the 2010 IRP as one of the core resources to meet projected levels of demand. Metropolitan and its member agencies support numerous water conservation programs in the region that involve incentives, research and development, and efforts to change consumer behavior.

California has experienced major drought conditions since the 2010 IRP. Immediately following Governor Jerry Brown's Emergency Drought Declaration in January 2014, Metropolitan took a series of actions to address drought conditions. In February 2014, Metropolitan declared a "Condition 2 – Water Supply Alert" to increase public awareness and urge local water agencies within the Metropolitan service area to adopt and enact water saving ordinances. In December 2014, recognizing the importance of indoor and outdoor conservation in managing the ongoing drought, Metropolitan's Board of Directors authorized an additional $40 million for conservation incentives to keep up with turf removal rebate demand, raising the two-year conservation budget to $100 million (fiscal years 2014/15 – 15/16). In addition, Metropolitan conducted an enhanced $5.5 million public outreach program including an extensive radio and television advertising campaign that greatly increased public awareness of the drought and encouraged increased conservation efforts.

The following winter of 2014/15 was the driest on record for the northern Sierra, where snowpack is extremely important for Metropolitan's imported water supplies. In 2015, California entered a fourth consecutive drought year and the seventh dry year out of the previous eight years. In March 2015, the Board authorized a second regional public outreach campaign asking the public to conserve even more. On April 1, 2015, Governor Brown issued an Executive Order (EO B-29-15) that, among other things, directed the State Water Resources Control Board (SWRCB) to implement mandatory water reductions in urban areas to reduce potable urban water usage by 25 percent statewide. On April 14, 2015, Metropolitan's Board voted to implement the Water Supply Allocation Plan, which places limits on the amount of water member agencies can purchase without facing a surcharge. On May 5, 2015, the SCWRCB adopted an emergency conservation regulation in accordance with the governor's directive. The provisions of the emergency regulation went into effect on May 18, 2015. As a result of this activity at the state and local level, Metropolitan experienced a 20-fold increase in application requests for water-saving devices rebates. In May 2015, Metropolitan's Board further increased the two-year conservation budget to an unprecedented $450 million, with $340 million committed to turf removal incentives.

The Governor's April 1, 2015 Executive Order also directed the California Department of Water Resources (DWR) to update the state's Model Water Efficient Landscape Ordinance through expedited regulation. The California Water Commission approved the revised ordinance on July 15, 2015. Under the rules of this newly adopted ordinance, new California yards and commercial landscaping installed after December 1, 2015, will use up to a third less water on average.[2]

Throughout the region, consumers have shown heightened interest in the use of Metropolitan's incentives to help move toward more efficient water use practices. While overall interest in incentives for water efficiency increased, the most significant increase occurred in Metropolitan's turf removal program. With water conservation activity reaching an all-time high in summer/fall 2015, the challenge will be to encourage and sustain water-saving behavior and to optimize the resources available to achieve the highest amount of water savings into the future.

Challenges

Varying Commitment to Conservation

Resources committed toward water conservation efforts tend to vary significantly depending on the water supply situation. Unlike energy providers that maintain energy efficiency media campaigns on a continuous basis, conservation messaging from water utilities is often only highly-visible during periods of drought. A main challenge is coordination of consistent messaging across the region and maintaining long-term conservation efforts. Whereas energy providers are comprised of a relatively few public utilities and investor-owned utilities, water agencies are numerous and differ greatly in size, demographic profiles, and microclimates. In Metropolitan's service area for example, there are 26 member agencies that supply water to about 250 retail agencies that deal directly with customers.

Conflicting Institutional Objectives

Water retailers throughout California are working hard to comply with the mandatory use reduction targets set by the SWRCB. However, in some communities, the water retailer is a municipality with a wide range of responsibilities besides delivering water to local residents and businesses. In some cases, municipal goals and objectives may conflict with long-term water conservation. One example is landscaping. Although Assembly Bill 1 (Asm. Cheryl Brown), signed into law in July 2015, prevents cities and counties from imposing fines for brown lawns when the governor has declared a state of emergency due to drought conditions, they may revert to existing landscape standards once the drought ends and again require landscapes with higher water demand. Assembly Bill 1164 (Asm. Mike Gatto), signed into law on October 9, 2015, prohibits local governments from banning water-conscious landscaping at private residences while allowing cities and counties to set aesthetic and environmental standards.

Communicating Water Use to End Use Customers

Some water bills can be confusing and do not use user-friendly terms or billing units. This makes it difficult for customers to know how efficiently they use their water or how their use compares with their neighbors. Additionally, water utilities that lump costs into fixed charges rather than volumetric charges in order to ensure more steady revenue flows can inadvertently diminish the financial incentive for their consumers to reduce water usage. It also can be particularly difficult to engage commercial and

[2] California Department of Water Resources. July 15, 2015. "Water Commission Adopts Model Water Efficient Landscape Ordinance; Public Comment Helped Shape Revisions". Available at http://www.water.ca.gov/news/newsreleases/2015/071515b.pdf

property tenants and those who live in multi-family housing where there are disconnections between those who use water and those who pay the water bills.

Demand Hardening

Due to significant conservation investments over the past 25 years, the region is continually challenged with finding innovative and cost-effective ways to save more water. Obtaining additional conservation savings is becoming increasingly difficult and expensive as easier-to-achieve opportunities in the region are exhausted, particularly as residential indoor water-saving devices approach market saturation in some areas. Future long-term savings potential will be increasingly derived from customized commercial, industrial, and landscape programs and may ultimately result in lifestyle changes. However, the region is highly diverse and different communities have different levels of market saturation for indoor devices and program implementation. Areas with older housing may obtain more savings from indoor retrofits than areas with newer construction.

Compliance with Proposition 218 Requirements for Water Rate Structures

Proposition 218, enacted in 1996, imposes certain procedures, requirements, and voter approval mechanisms for local government assessments, fees, and charges. In April 2015, the Fourth District Court of Appeal issued a key Prop. 218-related decision in *Capistrano Taxpayers Association Inc. v. City of San Juan Capistrano*. The court ruled that tiered rate structures designed to encourage water conservation, where higher users pay progressively higher rates, violate Proposition 218 if they are not tied to costs of service. This decision may impact retail water suppliers attempting to use water rate structures as a measure to comply with the mandatory water use reduction requirements from the SWRCB.

Availability of Water Savings Data

A continuing challenge with any water conservation program is availability of reliable water savings data. Water savings estimates are instrumental for calculating incentive amounts and planning water demand reduction analyses. However, documented water savings studies have inherent component variables that could lead to different results under changed conditions. Because of the wide range of factors that can affect performance, water agencies must work in general savings terms or modify their savings estimates based on their observed results. In addition to the challenge to obtain representative data, the amount of water savings for many water efficient devices can vary greatly depending on user behavior, which is difficult to measure. For example, low-flow showerheads would seemingly generate consistent water savings, but residential end use studies have shown that shower usage times vary considerably and in some circumstances the average usage time increased to the point where no savings actually occurred. Other approaches such as turf removal are relatively new to Southern California and water savings data will need to be analyzed.

Opportunities

Drought Has Created Momentum

The drought has heightened water awareness throughout the state and created new regulatory pathways to advance water conservation. For example, brown lawns and medians have spurred significant interest in creating alternative landscapes that require less water. This heightened awareness has led to unprecedented activity in Metropolitan's conservation incentive programs. The challenge in the future will be in maintaining this level of interest during wetter years or in the face of limited funding for incentives.

The Governor's April 2015 Executive Order called for revising the state's Model Water Efficient Landscaping Ordinance to increase water efficiency standards for new and retrofitted landscapes through more efficient irrigation systems, graywater usage, onsite stormwater capture, and by limiting the portion of landscapes that can be covered in turf. It also requires reporting on the implementation and enforcement of local ordinances, with required reports due by December 31, 2015. State law requires all land-use agencies to adopt a water-efficient landscape ordinance that is at least as efficient as the model ordinance prepared by DWR. DWR's model ordinance takes effect in those cities and counties that do not adopt their own. Land-use agencies also will be required to report on ordinance adoption and enforcement each year.

Technological Advances

Advances in technology also offer opportunities to increase conservation. These technological advances can vary from consumer smartphone applications to advanced meters that allow consumers to monitor their water use in real time. Technology allows water agencies can create conservation programs that better suit their customers based on customer use data. Additionally, on the consumer level, technological advances can simplify and encourage water conservation through smarter appliances that modify operations based on load and irrigation controllers that can be programmed through a smartphone. Metropolitan frequently revises its list of devices eligible for rebates together with the member agencies through the Program Advisory Committee (PAC).

Behavioral Changes and Market Transformation

To meet the State's current mandate and future regional demands, conservation needs to put a greater focus on consumer behavior and how to encourage people to use water more efficiently. The primary methods used to affect behavioral change include advertising, media reporting, tiered water billing rates, water agency outreach, and social norm messaging programs. The current drought has received significant attention through the news media, water conservation advertising, and water agency outreach programs. In an effort to spur market transformation, Metropolitan created a turf removal program in 2008 with an incentive of 30 cents per square foot of turf removed. However, there was little interest in this program at that incentive level. Grants from the U.S. Bureau of Reclamation and the California Department of Water Resources enabled Metropolitan to increase the incentive to $1 per square foot. As interest grew and member agencies began to contribute extra funding, popularity in this program soared. Metropolitan, in order to make this program equitable for all of its agencies, increased its incentive to $2 per square foot to match the top performing agencies. Shortly thereafter, demand for turf removal rebates increased beyond expectations and quickly consumed the available conservation budget. Rather than closing the program, Metropolitan decided to increase funding for the program to $340 million to encourage development of a new regional conservation mindset due to the high-visibility of turf removal. The underlying premise of a highly visible turf removal program is that additional water savings benefits will occur from neighbors removing their grass for a more sustainable landscape, investing in other water savings fixtures, or reexamining their own water use behavior. Sustainable landscapes can be both showcases for natural beauty and statements that people understand the need for addressing water scarcity in the region and that they are contributing to the solution.

Lessons Learned

Mandatory Reporting Has a Powerful Effect on Conservation

In July 2014, the SWRCB adopted an emergency water conservation regulation which required mandatory monthly water use reports by urban water suppliers. In July 2015, the SWRCB assigned individual conservation targets for each retail urban water supplier. Urban water suppliers are expected to meet or exceed their individual conservation standard starting in June 2015 and continuing through February 2016. These water use reports have been highly effective at encouraging conservation. The format of these reports also suggests that reporting does not have to be complicated to be effective. Enforcement and compliance statistics indicate that water suppliers are following up on water waste reporting and issuing formal warnings and penalties against alleged violators. Waste reporting is an important tool for identifying leaks and overwatering that could go undetected for weeks resulting in millions of gallons of wasted water.[3] In addition, under the revised Model Water Efficient Landscape Ordinance adopted in July 2015, all local agencies are now required to report to DWR on the implementation and enforcement of their landscape ordinances by December 31, 2015, with additional annual reporting requirements.

Water Pricing Can Reduce Demand

Water pricing can reduce demand by providing an economic incentive for consumers to conserve water by altering their behavior. Many water suppliers have established rate structures to incentivize water conservation and have seen significant savings as a result. A recent study by researchers at the University of California, Riverside, School of Public Policy found that between July 2011 and April 2014, household usage was 10 to 15 percent lower under a tiered structure than it would have been under uniform rates.[4] However, the previously-noted court ruling for the city of San Juan Capistrano determined that the city's tiered water rate structure, designed to encourage conservation, violated the provisions of Proposition 218 and therefore was unconstitutional. This decision has discouraged water agencies that were contemplating adopting a tiered rate structure, and it forced agencies with conservation rate structures to go back and review their rates to ensure they are in compliance with Proposition 218.

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[3] State Water Resources Control Board. July 1, 2015. "State Reduces Water Use by Nearly 29 Percent in Advance of June Conservation Mandate". Available at http://www.waterboards.ca.gov/press_room/press_releases/2015/pr070115_may_conservation.pdf

[4] UC Riverside School of Public Policy, *Policy Matters*, Vol. 6, Issue 1, Fall 2014. Schwabe, Kurt, Barenklau, Ken, and Dinar, Ariel. "Coping with Water Scarcity: The Effectiveness of Allocation-Based Pricing and Conservation Rebate Programs in California's Urban Sector." Available at http://policymatters.ucr.edu/wp-content/uploads/2014/10/pmatters-vol6-1-water-incentives.pdf

Non-Price Measures are Also Effective

In recent years the energy utilities have incorporated non-price interventions using behavioral economics to successfully lead consumers to conserve more. A similar strategy is now taking place in the water industry, where customers are being exposed to a variety of social marketing tools to motivate and engage them to affect behavioral changes that lead to water savings. These social norms messaging programs seem to offer promising ways to affect and reduce resource use among consumers, especially when customers are shown their water use is out of alignment with their perceptions, and more importantly, similar households. In 2014, the California Water Foundation, East Bay Municipal Utility District, and WaterSmart Software announced results of an independent study on a yearlong social norms pilot project. The program utilized WaterSmart Software's Home Water Reports service to provide customers personalized reports on their water use and how they compared to their neighbors. Findings showed that residential homeowners reduced their consumption by about 5 percent from the previous year.[5]

Legislation Can Help Change Marketplace and Prioritize Conservation

Recent years have shown conservation-related legislation can be highly effective when it involves changes to the marketplace rather than forcing changes upon residents and businesses. One example of productive legislation is AB 715, signed into law in 2007. AB 715 requires that all toilets and urinals sold in California after January 1, 2014 are to have a flush rate of 1.28 gallons per flush (gpf) for toilets and 0.5 gpf for urinals. The water savings attributed from this law is about 20 percent for each toilet sold and about 50 percent for each urinal compared to what the national standards require.

State legislation like AB 1881 (Water Conservation in Landscaping Act of 2006) and Senate Bill 407 (2009, Water Conservation: Plumbing Fixtures Replacement), were less effective than intended due to their complexity and lack of funding for training or enforcement for officials required to enforce the provisions of the law. Lessons learned from the outcome of these bills are now applied to improving the language on existing bills circulating through the legislature. The July 2015 update to the Model Water Efficient Landscape Ordinance further advances the objectives of AB 1881.

Recent legislation has prioritized and protected water efficient behavior against conflicting rules that penalize conservation. Examples include AB 2100, SB 992, and AB 1. AB 2100 was an urgency bill that went into effect immediately upon the governor's signature. For the period it was effective (July 21, 2014 through September 18, 2014), AB 2100 prohibited homeowner associations from imposing a fine or assessment against a unit or lot owner for reducing or eliminating watering of vegetation or lawns during any period for which the governor or a local agency has declared a state or local emergency due to drought. SB 992 went into immediate effect on September 18, 2014, superseding AB 2100 because it amended the same section of law, Civil Code Section 4735. SB 992 is nearly identical to AB 2100 except for two additional features on recycled water and pressure washing.

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[5] Mitchell, David L. and Chesnutt, Thomas, W. *Evaluation of East Bay Municipal Utility District's Pilot of WaterSmart Home Water Reports.* Prepared for California Water Foundation and East Bay Municipal Utility District. Available at http://californiawaterfoundation.org/uploads/1389391749-Watersmart_evaluation_report_FINAL_12-12-13(00238356).pdf

For recycled water, it provided exception to the ban on fining or penalizing owners who fail to irrigate their landscaping if the association has access to recycled water for landscape irrigation. For pressure washing, SB 992 homeowner associations from requiring pressure washing exterior surfaces during a state or local drought emergency. As previously mentioned, AB 1 prevents cities and counties from imposing fines for brown lawns when the governor has declared a state of emergency due to drought conditions.

Recommendations

Programs

- Evaluate existing programs for effectiveness and areas of improvement
- Explore new programs and devices
- Expand partnerships with governments and utilities to increase funding and gain greater access to customers

Measures

- Continue to assist with model ordinances

Communication

- Explore ways to communicate water use to the end user, such as through user-friendly water bills, social media, and technology (smartphone apps, etc.)
- Provide targeted outreach and conservation education to city and regional planners who develop zoning and ordinances

Retail Water Pricing

- Study successes in retail water pricing structures that have effectively reduced water use and are in compliance with Proposition 218 requirements

Overall

- Explore research opportunities and technology development
- Develop opportunities for information sharing and program integration
- Explore strategies to help incentivize additional water conservation

4. Groundwater (including stormwater and other recharge)

Overview

Groundwater basins within Metropolitan's service area provide an average of 1.4 million acre-feet per year (MAFY) within the Metropolitan service area. Groundwater production is used to offset peak seasonal water demands on the imported water treatment and distribution systems. Further, surplus water supplies available during wet years are stored in groundwater basins for later use during dry, drought, or emergency periods. Metropolitan's 2005 Groundwater Assessment Study (referred herein as the Groundwater Report)[6] provides a description of the groundwater basins within the Metropolitan service area.

Active groundwater recharge in the service area started more than 100 years ago with the capture of stormwater. Basins began being recharged with imported water in the 1930s and with recycled water in the 1960s. Today, groundwater recharge through spreading basins and injection wells supports an average of about 50 percent of the total groundwater production in region. During the most recent drought, groundwater basin managers responded with a suite of actions to removing institutional barriers to increased stormwater capture or use of recycled water for groundwater recharge.[7]

Challenges

The 2010 IRP Groundwater Issue Paper identified challenges for the potential use of available storage. These challenges include:

- Institutional issues for storage and recovery of stored water
- Funding needed for capital infrastructure and O&M costs
- Remediation of contaminated groundwater
- Lack of water to store

Additional challenges have been identified during workshop discussions for the 2015 IRP Update. These identified challenges are discussed below.

Potential Threats to Sustainable Groundwater Resources

Identification of the sustainable levels of groundwater production and strategies for maintenance of these levels is important to regional water supply reliability. As a result, this paper focuses more attention on groundwater sustainability and potential threats to reliability.

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[6] Groundwater Assessment Study. Available at http://www.mwdh2o.com/AboutYourWater/Sources%20Of%20Supply/Local-Supplies/Ground-Water-Sources

[7] Metropolitan Water District of Southern California. Board Report: Status of In-Regional Groundwater, February 2015. Available at http://edmsidm.mwdh2o.com/idmweb/cache/MWD%20EDMS/003735550-1.pdf

Groundwater Levels at Historical Lows

As basins experience a major decline in groundwater and storage, there is a potential risk for loss of groundwater production capacity in the region. The 2005 Groundwater Report estimated that there was approximately 3.8 million AF of usable space in groundwater basins (considered to be a healthy storage level) in 2005. Recent consecutive multiple dry years have significantly reduced recharge of the groundwater basins, and water levels throughout the region have reached historic lows. By December 2014, groundwater basin storage levels had declined by more than 1 million AF. For example, the key well elevation in the Main San Gabriel Basin as of June 2015 was 177.5 feet mean sea level (MSL), 22.5 feet below the established operating range and a historic low for the basin. Metropolitan estimates that within its service area, unused groundwater storage space increased to nearly 5 MAF in 2015. If this trend continues, the risk of being unable to sustain a reliable source of supply increases.

Urbanization Reduces Groundwater Recharge and Increases Flood Risk

Groundwater basins in the region were adjudicated many decades ago. For example, the adjudication of the Raymond Basin, in the Pasadena/Foothill area, dates to 1943. Other adjudications date from the 1960s, 1970s, and 1980s. Data used to determine the basin safe yield predates these adjudications. Since then, urbanization has increased impervious coverage of basin areas and channelization of streambeds, impeding the outflow of stormwater and reducing infiltration that recharges groundwater aquifers.

Recent water use efficiency measures to reduce outdoor water use for landscape irrigation and to reduce leakage from water distribution pipelines may further reduce incidental recharge of groundwater aquifers. Development of sewer systems to replace septic systems has also reduced incidental recharge of groundwater. Several groundwater basin managers have revised basin safe yield quantities or initiated measures to sustainably use and preserve groundwater supplies. Simultaneously, water managers in these areas have identified projects to replace lost sources of recharge in order to maintain safe yields or to minimize reduction of the basin safe yield.

Climate Change May Alter Precipitation Patterns

Climate studies have suggested that climate change may alter historic precipitation patterns in Southern California. These studies indicate that total average precipitation over the long term may remain constant, but that the pattern of this precipitation may change to include longer periods of very dry weather with precipitation occurring less often and with greater intensity. Climate warming is predicted to reduce snow pack in local mountains which would also contribute to peak runoff and increasing challenges for capture and infiltration of stormwater. A warmer climate may also cause a longer growing season and increased evapotranspiration by vegetation. These changes in precipitation patterns may alter both passive and active stormwater recharge of groundwater basins.

Costs/Funding Issues

Groundwater

Funding for capital infrastructure continues to be a significant challenge. State propositions are a sporadic source of grant funds. Remediation of groundwater contamination presents a significant, on-going cost for operations and maintenance (O&M) that presents barriers to implementation.

Stormwater

Cost may also be a barrier for implementation of new stormwater projects. The more costly projects tend to be distributed projects located in areas where infiltration is poor. Less costly projects tended to be modifications to existing centralized facilities. It is also important to note that the range of costs does not consider the suitability for recharge for the project – a basin may not be suitable for recharge due to factors such as soils and geology or groundwater contamination. Although some potential stormwater projects may appear to have relatively low cost on a per AF basis, issues other than costs can impede their implementation, such as environmental issues associated with sediment removal and funding availability. Certain grant funding may only be available for upfront capital costs without covering ongoing operation and maintenance costs.

It also may be difficult to calculate the benefits versus costs. Not all areas within the Metropolitan service area are conducive to groundwater recharge, and the areas that do have a productive groundwater resource have varying basin characteristics. In addition, an increase in groundwater basin storage does not necessarily result in an equal increase in potential production yield. More than 90 percent of the groundwater resources within the Metropolitan service area are adjudicated or formally managed pursuant to statute or adopted groundwater management plans. Within adjudicated or formally managed basins, the legal rights to extract groundwater are often defined by the determined safe yield, which is calculated differently for each basin. Water right issues must be addressed on a site-by-site basis when stormwater is captured in the upper part of watersheds, since stormwater capture diverts runoff that would have otherwise flowed to downstream users. Stormwater capture may also complicate the accounting of groundwater pumping rights.

Recycled Water

Using recycled water for groundwater recharge is an important part of groundwater sustainability. For more than 50 years, tertiary treated recycled water has been recharged in spreading basins throughout the Metropolitan service area. In recent years, the trend has been toward more advanced levels of treatment to manage salt buildup, blend water requirements, and changing regulations. Advanced levels of treatment can dramatically increase the cost of replenishment supplies. Balancing cost versus treatment and blending requirements is an ongoing issue for increased use of recycled water for recharge.

Institutional Challenges

Unique Requirements for Each Basin

Each basin in the region has specific physical and institutional conditions that can complicate groundwater management. Physical conditions may include contaminant plumes, seawater intrusion, areas of high groundwater, or discharge of poor quality water. An approach to groundwater management that fails to address the unique nature of different groundwater basins will not be effective.

In recent years, storage policies in the Central, West Coast, and Main San Gabriel groundwater basins have been addressed with amendments to the existing adjudication agreements. The Central and West Coast basin judgments were amended in 2013 and 2014 to provide a new management structure for use of the storage space in the basins. The Main San Gabriel Basin judgment was amended to facilitate storage of water in advance of overproduction.

Broadening the Agencies' Mission

Multi-benefit approaches to groundwater storage projects may enable a new wave of projects. Single purpose may be too costly to provide cost-effective benefits. If a project can be modified to provide multiple benefits, two or more agencies may be able to collaborate and share costs. Stormwater capture may provide water supply, flood protection, and surface water quality management. Partnering agencies involved in such a project may need to revise policies or adjust operating procedures to realize these additional benefits.

Groundwater Quality

Remediation of Groundwater Contamination

Groundwater quality issues are a common concern throughout the region. Increased conjunctive use of surface and groundwater is hampered by groundwater quality problems. Increased storage of surface water may spread contaminant plumes or mix with existing contamination. Funding may not be available for capital facilities and for ongoing operation and maintenance of the treatment facilities. Further, some constituents present technical feasibility challenges for their removal. Waste disposal can be a challenge if brine lines are not available or if capacity is limited. Regeneration or replacement of treatment media can also be costly and present hazardous waste disposal problems.

Recycled Water Recharge Regulatory Constraints

Recycled water has been used for groundwater recharge since the 1960s. However, expanded use of this resource has potential implications to groundwater quality. Recycled water, depending upon the level of treatment, can have a higher concentration of salts and nutrient loading. Regulatory constraints for recharge of recycled water include: treatment, blend water, retention time, and Basin Plan Objectives established by the applicable Regional Water Quality Control Board (RWQCB). These constraints are in place to help protect water quality, but may limit how much recycled water can feasibly be recharged into the groundwater basins. In addition, advanced levels of treatment may be required to meet the regulatory constraints.

Basin Salt Loading

Conjunctive use of surface and groundwater supplies may face hurdles when native groundwater is of better quality than imported or recycled recharge water. Constituents such as total dissolved solids (TDS), chloride, sulfate, and nitrate are common problems. Basin Plans adopted by RWQCBs are required to protect existing high quality waters from degradation. The Basin Plans also set out quantified water quality objectives for protection of existing or potential future beneficial uses of water. Increasing levels of recycled water or Colorado River water may contribute to basin salt loading.

Operational and Environmental Issues

Endangered Species

Endangered species associated with aquatic habitats affect the operations of stormwater reservoirs and stream courses for storage, conveyance, and recharge of stormwater, imported water, and recycled water. Water managers will need to develop approaches that provide a balance between water supply and ecological benefits as species decline and receive protection afforded by the state and/or federal endangered species acts, including the designation of critical habitat. Water flow velocity and duration may be affected as operational purposes are broadened to better accommodate ecological values. Establishment and maintenance of vegetation and suitable substrates may be objectives of these revised operations.

Operational

Groundwater recharge operations are complicated by differing objectives that apply to flood control and stormwater capture. In Southern California, many groundwater recharge facilities are located within or adjacent to flood control facilities. Stormwater recharge is reliant upon the capture and slow release of stormwater to downstream spreading facilities. Flood control reservoirs often have a primary purpose for flood control, which traditionally has involved moving large quantities rapidly downstream, before they rise and possible flood nearby areas. This approach tends to work against retaining stormwater for slow release for groundwater recharge. In some cases, a small water conservation pool is allowed to be held during the storm season with a somewhat larger pool allowed late in the season when flood risk is reduced.

Imported water is an important source of supply for supplemental recharge of groundwater basins. Treated drinking water may be recharged indirectly through the in-lieu method. In-lieu recharge of imported water is accomplished when additional imported water is used for municipal and industrial purposes in place of groundwater that was planned to be pumped and used. Treated imported water is also used for recharge through injection to the groundwater aquifer. This is most often done at seawater barriers. Imported water is increasingly being replaced by recycled water.

Challenges associated with spreading untreated imported water include access to recharge areas, water quality characteristics of the imported water as compared to the groundwater, and the potential for quagga mussels to be transmitted via untreated Colorado River water. The presence and spawning of quagga mussels in the Colorado River and downstream facilities, if unchecked, would adversely affect the capacity and operation of Metropolitan's conveyance, storage, and distribution systems, as well as any further downstream facility that might receive such water. Access to recharge areas requires that the imported water spreading deliveries be scheduled for times when spreading grounds are not being used for recharge of stormwater or recycled water. Additionally, imported water spreading deliveries need to be scheduled around maintenance of stormwater channels used for conveyance and maintenance of spreading grounds.

Specific requirements for groundwater recharge may impact which water sources can be used in a specific basin. The TDS, chloride, and sulfate concentrations in imported water used for spreading is of concern to groundwater basin managers trying to comply with RWQCB Basin Plan water quality objectives. In many basins, water from the State Water Project is preferred for groundwater recharge due to lower TDS levels. Further, in recent years, the potential for presence of quagga mussels in untreated Colorado River water places substantial requirements for desiccation (drying) of conveyance and spreading areas to kill quagga mussels and avoid further spread of this invasive species. These requirements greatly limit where and when Colorado River water may be used for groundwater recharge.

Sediment Removal

Stormwater reservoirs lose storage capacity as sediments in runoff settle out and accumulate. Sediment must be removed if capacity is to be maintained for flood control and stormwater capture for recharge. Sediment production greatly increases in years following forest fires, and significant challenges restrict agencies' ability to remove large amounts of sediment from the reservoirs. Challenges include addressing impacts to riparian habitat and species and impacts to nearby neighborhoods from truck traffic, noise, and dust. Finding suitable sediment disposal locations must also be accomplished. Removal of sediment for maintenance of reservoir capacity can be very expensive due to the large quantity of material that must be moved. Spreading basins are also affected by fine sediments and algae growths that clog the spreading facilities. Removal is necessary in order to maintain percolation rates.

Opportunities

Adjudication Amendments Increased Flexibility for Groundwater Management

Recent amendments to groundwater basin adjudications have increased the potential to store water supplies in advance of dry years. This advanced storage will ease the impact on basin water levels when dry years reduce availability of storm and imported water supplies for groundwater recharge. By formally recognizing storage in these basins, the adjudication amendments will encourage better conjunctive management of imported, recycled, and stormwater supplies.

Regulatory Changes Maximize Recycled Water Recharge

In June 2014, the Department of Drinking Water (DDW) modified the regulations regarding the use of recycled water for groundwater recharge. Changes such as modifications of the blend water period from 60 months to 120 months may provide opportunities for enhanced recycled water recharge – increasing the time period allows agencies to better take advantage of hydrologic conditions. Additionally, the percentage of water required to dilute the recycled water has been decreased, increasing the maximum recycled water contribution. Many seawater barriers are moving toward 100 percent use of highly treated recycled water and no longer be required to use non-recycled water for blending over time. These measures allow recycled water recharge to continue during dry periods, and for groundwater managers to maximize the use of recycled water.

New technologies for treatment and disposal

Several agencies are researching alternative treatment technologies through Metropolitan's Foundational Actions Funding Program[8]. For example, new treatment and brine disposal technologies may provide additional opportunities for groundwater recovery and recycled water recharge.

Multi-benefit approaches

Multi-benefit approaches may provide opportunities to increase stormwater capture for water supply. Additionally, with the recent changes in the Central, West Coast, and Main San Gabriel Basins, partnerships for utilization of available supplies and groundwater storage space create additional opportunities.

Lessons Learned

Groundwater Production Maintained During Dry Years

Dry years have shown that groundwater basins are able to continue groundwater production with historically low water levels. While significant overdrafting of groundwater is not to be encouraged, it is reassuring that basins can be successfully drawn down in response to extreme extended drought conditions. To avoid long-term subsidence, overdraft, or other impacts, the basins will need to be recharged as soon as the drought ends.

Dry years have also demonstrated the ingenuity of local water managers. When imported water supplies are limited, system operational changes have helped to ensure that all areas continue to have access to drinking water supplies. Metropolitan was able to radically re-operate its system to address a severe shortage of State Water Project supplies. Other agencies implemented interconnections between systems, repaired wells or lowered well bowls and installed treatment to allow recovery and use of contaminated groundwater. Additional recycled water projects have come online to meet certain water supply demands (landscape irrigation, industrial applications, and groundwater recharge), freeing up potable water for other purposes. The U.S. Army Corps of Engineers allowed temporary deviations from its flood control operations manuals to allow increased capture and recharge of stormwater.

Groundwater management planning within a watershed context is more effective than individual projects planned outside this context. Pilot and demonstration projects provide valuable data, allowing technical, operational, and institutional problems to be identified and addressed prior to major capital infrastructure commitments.

Cost is a Significant Factor in the Development of Stormwater Projects

Many agencies are faced with limited available funding to help with capital and O&M costs for the development of stormwater projects. These agencies often seek outside Federal and State funding through grants and loans. Often, such grants and loans only fun the upfront capital portion of the total costs and the agency and/or the property owner is responsible for funding the ongoing O&M. With an increasing population, the region must further manage increased water demands as well as increased

[8] Information on Metropolitan's Foundational Actions Funding Program can be found at: http://mwdh2o.com/AboutYourWater/Planning/Funding-Programs/Innovative-Supplies-Funding/Pages/default.aspx

stormwater runoff and related stormwater quality issues, which may eventually require facility upgrades to increase capacity and treatment.

Distributed stormwater capture projects are typically more expensive than centralized projects. However, distributed projects may produce addition benefits and bring additional partners to the table. For example, green streets can bring together agencies responsible for street repairs, water supply, and flood control together with property owners to develop projects that benefit all the stakeholders.

Land acquisition is an important part of the success of any recharge project. Often, the effective recharge areas are already used for other projects or have become urbanized, making it difficult to develop new recharge projects. Modification of existing recharge areas, such as deepening spreading basins or developing ongoing sediment removal programs may be the primary way to increase recharge.

Public Outreach is Critical for Stormwater Projects

It is important to begin outreach early to increase public support and education. The Elmer Street Neighborhood Retrofit is an example of a successful stormwater project because of ongoing public outreach and education of homeowners, through the coordinated efforts of the City of Los Angeles and the Los Angeles County Department of Public Works, which designed the project, and the Council for Watershed Health, which administered the project.

Expected Groundwater Yield in the Region Reduced in the Long-Term

The recent drought and subsequent historical low groundwater levels have highlighted groundwater sustainability issues in the region. Despite groundwater levels dropping, groundwater production in the region has been relatively stable for the past several years. The loss of recharge while maintaining production has resulted in a loss in storage of more than 1 million acre-feet. In the past, groundwater basin producers and managers had an optimistic view of future conditions and expected to be able to maintain higher levels of production. However, in many basins, pumpers are not using their full adjudicated rights because of groundwater quality issues, inability to perform well maintenance, distribution system issues, or management actions that reduce allowable pumping. In consideration of these conditions, the current outlook of expected future groundwater production in the region is lower than previously anticipated.

Recommendations

Explore Opportunities to Address Ongoing Threats to Sustainability

- Evaluate performance of existing storage programs
- Review storage and transfer strategies
- Explore options to facilitate more effective utilization of groundwater and increased recharge
- Study long-term impacts of drought on groundwater management
- Evaluate the potential of improvements in storm forecasting to increase stormwater capture in reservoirs without adverse effects to flood protection

Explore Innovative Project and Partnership Development

- Continue to explore opportunities for partnerships between water and wastewater agencies

- Look for opportunities to develop multi-benefit approaches with different agencies
- Evaluate funding opportunities (e.g., Metropolitan's Local Resources Program) to assist projects that increase groundwater recharge or improve groundwater quality
- Evaluate a business case analysis and an accurate cost/benefit analysis for providing regional incentives/rebates based on the study of various stormwater pilot projects. It is important that the business case analysis include calculations of regional benefit and dry-year yield

Continue to provide an avenue for open regional discussion on stormwater

- Encourage information sharing of 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
  - Operations and maintenance
- Seek opportunities to seek partnerships, joint funding, or other multi-benefit projects

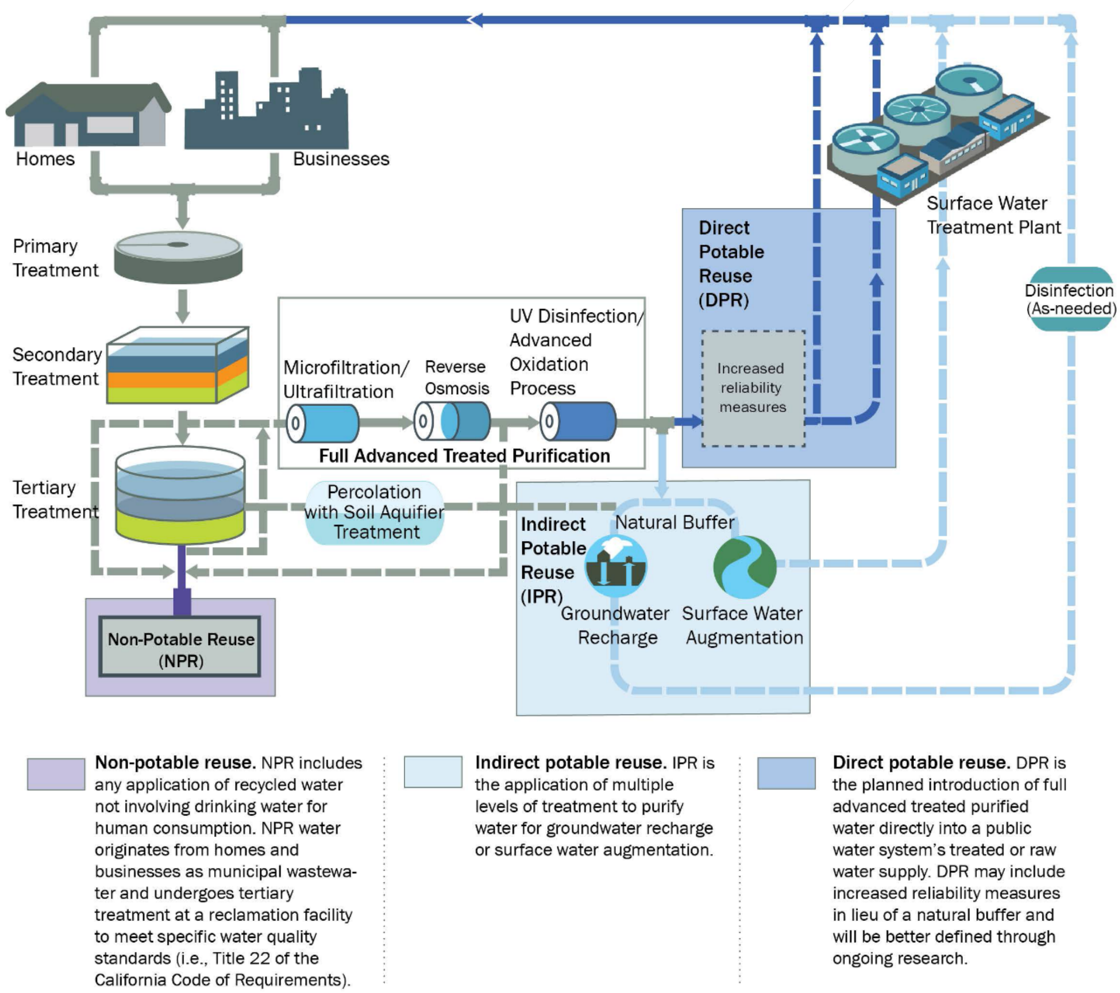
5. Recycled Water

Overview

Recycled water use categories include non-potable reuse, indirect potable reuse for groundwater recharge and surface water augmentation, and direct potable reuse. **Figure 5-1** shows a general schematic of treatment processes for non-potable reuse, indirect potable reuse, and direct potable reuse.

The 2010 IRP Update identified challenges and opportunities to the development of recycled water projects. Some of those challenges have since been addressed as agencies move forward to facilitate increased use of recycled water. This section will cover additional challenges, opportunities, lessons learned, and recommendations to enhance the development of recycled water.

Figure 5-1: General Schematic of Recycled Water Use



Source: California Urban Water Agencies

Challenges

Challenges to enhanced recycled water development include permitting, public acceptance, cost, water quality, operational, and institutional barriers.

Lengthy and Variable Permitting Process

The State Water Resources Control Board (SWRCB) established the Recycled Water Policy (Policy). This Policy requires the SWRCB and the nine Regional Water Quality Control Boards (RWQCB) to encourage the use of recycled water, consistent with state and federal water quality laws. The Policy provides additional directions to the RWQCBs on appropriate criteria to be used in regulating recycled water projects. The Division of Drinking Water (DDW) of SWRCB and the nine RWQCBs are responsible for setting the rules and permitting for recycled water projects. The timeline and roadmap for getting a permit is challenging and inconsistently implemented in different regions of the state. Limited history and technical information (e.g., on direct potable reuse) to inform regulations and limited staffing at DDW and other agencies has challenged the ability to propose, revise, and adopt new regulations in a timely manner. Agencies planning and designing direct potable reuse and indirect potable reuse projects face delays because of regulatory uncertainty. In addition, many project proponents hoping for grant or loan funding have identified lengthy CEQA review as a challenge.

Indirect potable reuse projects face regulatory constraints such as treatment, blend water, retention time, and Basin Plan Objectives, which may limit how much recycled water can feasibly be recharged into the groundwater basins. For example, the Basin Plan Objective for TDS of a particular basin may be lower than the quality of the tertiary water effluent available, resulting in the need for more blend water or advanced levels of treatment. These treatment requirements impact the economic feasibility of a project.

Public Perception/Conflicting Messaging

Conflicting messaging confuses the public about the safety of recycled water. There is not a clear understanding by the public of the difference between non-potable reuse, indirect potable reuse and direct potable reuse uses. The public is most familiar with non-potable reuse as they see recycled water in use at parks, golf courses, schools, and other large landscapes. However, public perception and acceptance of drinking recycled water (indirect potable reuse and direct potable reuse) is a much bigger challenge. Signage for non-potable reuse projects at parks, schools, and golf courses that read, “Using recycled water; do not drink” can adversely affect the public’s acceptance of direct potable reuse and indirect potable reuse. In addition, negative labelling such as “toilet to tap” also affects public perception. Although public acceptance of recycled drinking water has improved, effective education and public outreach is still needed. There is a need for new messaging to reduce the confusion.

Cost

Cost, including up-front capital and ongoing operation and maintenance, remains a barrier to recycled water development. Most low-cost projects have been built. The price tag for expanding the recycled water distribution systems remains a barrier to full implementation of non-potable reuse projects – these projects require pipelines connecting the treatment plants and the individual users. Some agencies may also be considering indirect potable reuse and direct potable reuse projects to reduce the need to have extensive recycled water distribution systems because of the cost. Some non-potable reuse and indirect potable reuse projects and all direct potable reuse projects require advanced treatment facilities, which are comparatively expensive. Advanced treatment may also require additional brine concentrate disposal facilities (e.g., a brine line) and extensive infrastructure for injection wells/spreading facilities, or for delivery of the product water to a spreading ground, surface reservoir, or water treatment plant for potable uses. End users play a very important role for recycled water advancement. Site conversion costs (borne by the customer) and additional conveyance infrastructure for new customers can also be a barrier to reaching full non-potable reuse project capacity. Some agencies may be challenged with cash flow issues or cannot secure the funding needed to implement projects.

In addition, with the increasing prospect of statewide regulations for indirect potable reuse and direct potable reuse, some agencies pursuing indirect potable reuse are hesitant to extend their existing distribution system for non-potable reuse projects for fear of stranded facilities. Similarly, some agencies pursuing direct potable reuse may delay their planed indirect potable reuse project to prevent stranded distribution facilities[9].

Source Control and Effluent Water Quality Needs

Source water quality and flow control is essential to help safeguard the water recycling treatment process and the end use of the water by placing controls on the type, timing, and amount of wastewater that comes into the plant, a good source control program limits treatment plant disruptions and ensures treatment processes are capable of handling spikes in volume, industrial influent, and high salinity influent. When it comes to the treatment process, recycled water policy requires that the effluent meets certain water quality standards. Salt and nutrient management plans protect groundwater beneficial uses and prevent excess degradation, which may limit expanded indirect potable reuse applications if the agency does not have funds for advanced treatment to remove salts to meet the Basin Plan Objectives. In some cases, existing source control plans may need to be updated to deal with constituents of emerging concern and with more stringent needs of the users.

Water use efficiency helps conserve water, but also incidentally reduces wastewater volume resulting in an increase in the concentration of wastewater. As a result, additional treatment is needed, which increases operation and maintenance costs of the system. Source water quality is especially important for implementing indirect potable reuse and direct potable reuse projects to protect potable water systems.

Operational Issues

While each agency is different, it is important to recognize the possible operational issues that may occur with the use of recycled water, including:

- Reduction in wastewater flows due to ongoing conservation and drought

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[9] Indirect potable reuse projects usually require injection wells or a distribution system to a surface reservoir or recharge basin, and may also require improvements to a surface reservoir, recharge basin, or treatment facility.

- Lack of seasonal storage to address diurnal and seasonal demands; construction of storage facilities may be needed for flow equalization
- Brine disposal needs
- Environmental flow or stream discharge requirements may limit the ability to deliver recycled water during high demand periods
- Regulatory issues such as blend requirements and water quality objectives may impact the effectiveness of indirect potable reuse
- Lack of regional GIS data to optimize recycled water deliveries
- Need for multiple barriers to ensure recycled water quality and for monitoring techniques that provide feedback in real-time to respond to plant disruptions, especially with direct potable reuse projects
- Need for additional operator training and certification

Conflicting Institutional Objectives

Institutional coordination among drinking water, wastewater, and groundwater management agencies may be challenging and the agencies may face barriers due to the difficulty in aligning varying institutional objectives. The main objective of a wastewater agency is to collect, treat, and safely dispose of wastewater based on a set of established standards. This may conflict with the objectives of a groundwater agency that is legally tasked to protect the quality of groundwater. At the same time, water agencies developing recycled water projects are usually seeking a consistent, higher quality treated wastewater for a successful recycling program – though the wastewater agency may not be treating the wastewater to such higher quality for its normal disposal, and the groundwater agency may still be concerned about the quality of the return flows of this recycled water to the groundwater basin.

Opportunities

Progress Towards New Regulatory Process

The state of California has made some progress in developing permit standards that provide opportunities to expand recycled water use.

Non-potable reuse: The SWRCB developed a general permit for non-potable uses of recycled water in June 2014 that provides an opportunity for new projects to come online sooner with more standardized monitoring requirements. Further, revisions are being considered to attract additional users and further streamline recycled water projects.

Indirect and direct potable reuse: The SWRCB is facing a December 2016 deadline under SB 918 to develop regulations for surface water augmentation and to investigate and report to the legislature the feasibility of direct potable reuse.

New Funding Opportunities

On January 17, 2014, as part of the governor's emergency drought declaration, the SWRCB, under the Clean Water State Revolving Fund, will provide up to $800 million in low interest loans for water recycling projects that offset or augment state water supplies and can be completed within three years.

Projects must apply for the funding through the SWRCB by December 2, 2015. As of May 27, 2015, over 30 projects had applied requesting more than $1.6 billion in funding.

Proposition 1 (Assembly Bill 1471, Rendon) authorized $7.545 billion in general obligation bonds for water projects with $725 million for water recycling and desalination projects. Another $625 million will be administered through SWRCB's Water Recycling Funding Program (WRFP) for water recycling and $100 million through DWR for desalination.

In 2014, Metropolitan increased the financial incentives under its Local Resources Program (LRP) for agencies to develop recycled water. Metropolitan also established the On-site Retrofit Pilot Program to provide rebates to customers that convert their irrigation and industrial system from potable water to recycled water. In addition, Metropolitan established the Reimbursable Services Program to provide technical and construction assistance to its member agencies for local project development. Metropolitan advances funds and is reimbursed by the agency.

Improving Public Perception

The drought has heightened water awareness in the region and has provided momentum for water conservation and reuse. The public is more willing to accept alternative supplies such as recycled water. Public outreach and education have also helped improve the public's perception of recycled water. Public sharing of information, open door stakeholder meetings, and focus groups have been very effective at distributing information and addressing public concerns. Case studies and demonstration projects are used to educate and improve public perception on recycled water.

Ample opportunities exist for cooperation among agencies to address the issue of conflicting and confusing messaging by branding or the use of alternative terminologies. A regional workgroup could explore and encourage outreach partnerships among agencies.

New Technologies, Research, and Information Sharing

New technologies, research, and information sharing greatly enhance the development of recycled water. Programs such as Metropolitan's Foundational Actions Funding (FAF) Program focus on technical studies and pilot projects that reduce barriers to future local production. Projects under this program include optimizing new treatment techniques for recycled water, exploring new monitoring methodologies, and testing innovative brine concentration technology. In addition to the technical portions of this program, the FAF Program supports collaboration between agencies and regional sharing of information.

Research is especially critical in advancing new water supply options, such as direct potable reuse. WateReuse in partnership with other agencies (including Metropolitan) is leading the California Direct Potable Reuse Initiative[10] to advance direct potable reuse as a water supply option in California and

[10] https://www.watereuse.org/foundation/research/direct potable reuse-Initiative

address regulatory, utility, and community concerns. The Foundation's report *Direct Potable Reuse: A Path Forward*[11] provides an overview of direct potable reuse and identifies research needs.

Regional studies can also examine the needs of multi-jurisdictional areas and foster communication among agencies to promote the use of recycled water. For example, sharing regional information such as GIS data can identify areas of recycled water surpluses and needs.

In addition, a clearing house could be developed to collect and disseminate information on research and technology developments and studies

Partnerships

Drinking water, wastewater, and groundwater management agencies share some common objectives, including access to source water, cost minimization, and protection of the environment. Many agencies are successfully cooperating and developing recycled water projects. These partnerships can allow sanitation districts to reduce the cost of disposing treated wastewater to the ocean, reduce impacts to the marine environment, and provide a source of reclaimed water to water agencies for recycling. At the same time, groundwater basin management agencies could be the recipients of final recycled water, helping maintain or increase groundwater levels.

Lessons Learned

There have been many success stories on recycled water development. Focusing on public outreach and education has improved public perception. Partnerships and joint efforts among water and wastewater agencies proved to be an effective way to remove barriers and make progress. Numerous studies and research funded by federal, state, and local agencies are benefitting local and regional effort.

Public Outreach is Important

Public outreach and education have helped improve the public's perception of recycled water. When the public is informed and takes part in the decision making process, they will likely be more accepting of a project.

Water shortages raise awareness for alternate ways to conserve. As a result, the public is more willing to accept alternative supplies such as recycled water, support the more expensive projects, and tolerate rate increases. Some residential property owners are interested in using recycled water for watering plants to help with the drought. For example, residents have access to recycled water from "residential recycled water fill stations" in the Irvine Ranch Water District. Developing similar programs throughout Southern California would help increase recycled water use and conservation of potable supplies.

Additional Funding Needed

LRP incentives and onsite retrofit program funding have increased use of recycled water in the region by almost 200 percent. However, incentives alone may not be enough to spur project development - capital funding is also necessary because the LRP only provides funding after a project begins operation. As an example, even though Metropolitan recently increased its LRP incentive rates, there are only a few

[11] https://www.watereuse.org/product/direct-potable-reuse-path-forward

applications for new projects because agencies lack capital funding to construct the project in the first place. Although available construction funding for recycled water projects has recently increased under the recently passed Proposition 1, projects generally still require a 50 percent local match. One source of funding is typically not enough to fund a recycled water project.

Funding is also needed for studies, pilot projects, and research. Metropolitan's FAF Program provided funding for studies and pilot projects to help advance the development of local supplies.

Partnerships can be Successful

History shows us that partnerships among agencies helps advance use of recycled water and provide tangible benefits to each participating agency. A good example of partnerships working well is the agreement between Orange County Water District (OCWD) and the Orange County Sanitation District (OCSD). This partnership began in the 1970s, when OCWD built the Water Factory 21 to produce recycled water to mitigate seawater intrusion in the Orange County Groundwater Basin. Twenty years later, the two agencies decided to jointly build the Groundwater Replenishment System (GWRS) recycled water project. GWRS is the largest planned indirect potable reuse facility in the world with a current capacity of 100,000 AFY and future expansion to 130,000 AFY.

Other examples of cooperation between agencies to further recycled water use include partnerships between the city of Los Angeles and West Basin Municipal Water District (West Basin Water Recycling Program), the city of Los Angeles and the city of Burbank (North Hollywood Water Recycling Project), city of Long Beach and the Water Replenishment District (Alamitos Barrier Water Recycling Project), the Sanitation Districts of Los Angeles County and Central Basin Municipal Water District (Century and Rio Hondo Water Recycling Project).

Water Industry Organizations and Regional Collaboration Help Advance Recycled Water

Recent advancements to recycled water development are due, in large part, to cooperation and collaboration among water and sanitation districts as well as other water industry organizations. Historically, the WateReuse Association was one of the main advocates for recycled water development in the state. Their activities initially focused on permitting issues, public outreach/education, conferences for information sharing, and research related to recycled water. As recycled water became a core resource for water and wastewater agencies, they started to ramp up their activities to help advance recycled water and utilized partnerships with academia along with other trade organizations such as the Association of California Water Agencies (ACWA), California Urban Water Agencies (CUWA), WateReuse Association, and California Associations of Sanitation Agencies (CASA). Professional organizations such as American Water Works Association (AWWA) are another vehicle to promote recycled water through research, technical seminars, and operator training and certification. These organizations have proven to be effective in promoting regional collaboration on research and leveraging resources.

Recommendations

The 2010 Issue Paper included a set of recommendations, many of which are still valid today. The following include additional recommendations for consideration.

Explore Opportunities to Improve Permitting Process

- Streamline and simplify water recycling regulations with uniform administration consistent with operations, public health, and the environment
- Support legislation and regulation that expands the types of recycled water uses consistent with the protection of public health and help achieve the state's recycled water goal (an additional 1 million acre-feet by 2020)
- Convene a forum to discuss projects, permitting, and treatment technologies

Improve Public Education and Awareness of Water Recycling

- Pursue unified, consistent messaging
- Consider expanding residential fill stations to further advance public acceptance of recycle water

Explore various investment strategies, such as incentives, ownership, and partnerships

- Promote collaboration among stakeholders and agencies to facilitate implementation of recycled water projects in California
- Promote development of new financing to increase water recycling, advance research in science and technology, assess health effects, develop additional regional planning, and study innovative technologies
- Explore a business case for further development of recycled water partnerships or ownership
- Consider additional end user programs to replace potable water systems with recycled water
- Collaborate on pursuing grant funding

Consider joint technical studies and projects

- Explore a collaborative regional effort to develop a regional GIS data set
- Explore integration approaches
- Investigate programs for the development of new technologies, such as comprehensive real-time monitoring devices and techniques that improve water quality and ensure public health, and maintain public confidence
- Study opportunities to protect or improve the quality of wastewater source supplies
- Explore development of a regional study to help identify opportunities for seasonal storage

6. Seawater Desalination

Overview

Metropolitan's 2010 IRP Update included an issue paper that provided a broad overview of seawater desalination's benefits and barriers to development. The purpose of this addendum is to highlight changed conditions since 2010 and describe key factors shaping the development of seawater desalination within Metropolitan's service area.

Metropolitan and its member agencies have been considering seawater desalination as a potential new supply source since the 1960s. The 2010 IRP Update included seawater desalination as one of the resources that could be developed to meet a core local supply goal of 102,000 AFY by 2025. Several member agencies have made significant progress in developing seawater desalination projects since the 2010 IRP. The following table provides a summary for projects in Metropolitan's service area**.**

Table 6-1
Summary of Existing and Proposed Seawater Desalination Projects within Metropolitan's Service Area

Status	Agency	Location	Capacity (AF)
Existing	San Diego County Water Authority	Carlsbad	56,000
Permitting	Orange County Water District/MWDOC	Huntington Beach	56,000
Planning	West Basin MWD	TBD	20,000 – 60,000
Planning	South Coast Water District / MWDOC	Doheny Beach	5,000 – 16,000
Planning	San Diego County Water Authority	Camp Pendleton	56,000 – 168,000
Planning	Calleguas MWD	TBD	20,000 – 80,000
On-hold	Long Beach (City of)	TBD	10,000
		Total	223,000 – 446,000

In addition, there is a privately-developed project under consideration in Rosarito Beach, Mexico, which could supply Metropolitan's service area through direct delivery across the border, or alternatively through exchange agreements via the Colorado River.

The constant availability of ocean water is one of the key benefits of seawater desalination. Seawater desalination can provide critical supply reliability during droughts, and increase Southern California's resilience against the possibility of longer and more intense dry periods resulting from climate change.

With the exception of certain types of subsurface intakes, seawater desalination projects do not impact upstream or downstream water supplies. As a result, seawater desalination supplies are not constrained by California's complex system of water rights and are not subject to statutory court ordered or drought-related curtailments.

Seawater desalination produces high quality potable supplies that after post-treatment and stabilization can be integrated into existing drinking water systems and delivered directly to consumers. For example, in the Middle East, seawater desalination is the principal water supply for many urban areas. Also, water managers in Israel have found that high quality seawater desalination supplies benefit its expansive water recycling program for agriculture by improving the quality of the source wastewater.[12]

Seawater desalination's unique properties – independence from hydrological variability and California's water rights system – make it a valuable resource that can help increase the reliability of Southern California's supply mix

Challenges

Although water agencies in Southern California have included seawater desalination in their resource portfolios since the 2000s, they have also encountered several interrelated barriers to development along the way. Changes since the 2010 IRP include the environmental context, new state regulations, updated cost estimates, and a growing awareness of the water-energy nexus.

Protecting California's Marine Environment

California's iconic marine and coastal environments are essential, unrivaled resources. Over 73 percent of Californians live in coastal-adjacent counties. Economically, ocean and coastal activities support 472,000 jobs and contribute 39.1 billion to the state's gross domestic product.[13] Coastal-adjacent tourism and recreation alone account for $17 billion in commercial activity.

Seawater desalination is poised to contribute to this coastal economy, but must do so in the context of numerous challenges facing the Southern California's fragile marine environment. These threats include: [14]

- Marine debris and pollution
- Overfishing
- Endangered species
- Invasive species
- Sea level rise
- Ocean acidification
- Habitat loss

The Ocean Protection Council, which develops state policy recommendations regarding marine resources, considers seawater desalination an emerging issue along with marine renewable energy and

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[13] Coastal and Ocean Economic Summaries of the Coastal States; National Ocean Economics Program, 2014
[14] http://ocean.nationalgeographic.com/ocean/protect/

offshore aquaculture.[15] Understanding the environmental challenges facing the marine environment is an important consideration as water agencies add seawater desalination to water supply portfolios.

New Regulations Affect Future Development

In the past five years, state agencies have implemented new regulations that will affect the future development of seawater desalination. This includes amendments to the State Water Resources Control Board's (SWRCB) Ocean Plan and Once Through Cooling regulations, as well as the establishment of Marine Life Protected Areas (MLPAs) in Southern California.

Ocean Plan Regulations

In May 2015, after more than five years of development, the SWRCB updated California's Ocean Plan with regulations targeting seawater desalination projects. The new regulations include unprecedented requirements for intakes, outfalls, brine discharges and environment mitigation provisions. The regulations give Regional Water Quality Control Boards (RWQCBs) broad powers to determine project design elements of potential projects and to request unlimited studies. The new regulations will increase the costs of permitting, construction, operation, and mitigation for most projects, and could affect the ability to develop regional-scale projects.

Once Through Cooling Regulations

Prior to the revised Ocean Plan regulations, in 2010 the SWRCB adopted regulations requiring coastal power plants to phase out the use of once-through-cooling over the next 15 years. Once-through-cooling is the use of seawater to cool power plant generators in a single-pass system. In response, owners of coastal power plants are decommissioning generators that rely on once through cooling, and in many cases repowering using alternative technologies such as air-cooled systems. The phase-out of once-through-cooling diminishes the environmental and operational benefits of co-locating seawater desalination projects with power plants. However, coastal power plants will remain attractive sites for development due to the presence of coastal-dependent industrial zoned land, electrical infrastructure, and the potential to repurpose existing intake and outfall infrastructure. Projects affected in Metropolitan's service area include the Carlsbad, Huntington Beach, and West Basin projects.

[15] http://www.opc.ca.gov/webmaster/ftp/pdf/2012-strategic-plan/OPC_042412_final_opt.pdf

Marine Life Protected Areas

In 2011, the then California Department of Fish and Game created a system of 50 MLPAs covering approximately 15 percent of Southern California's coastline.[16] MLPAs are defined zones along the Channel Island and mainland coast where certain types of commercial and recreational activities are restricted (see **Figure 6-1**). The MLPA network includes areas near planned seawater desalination projects, and there is a cluster of MLPAs located near the planned desalination project at Doheny Beach.

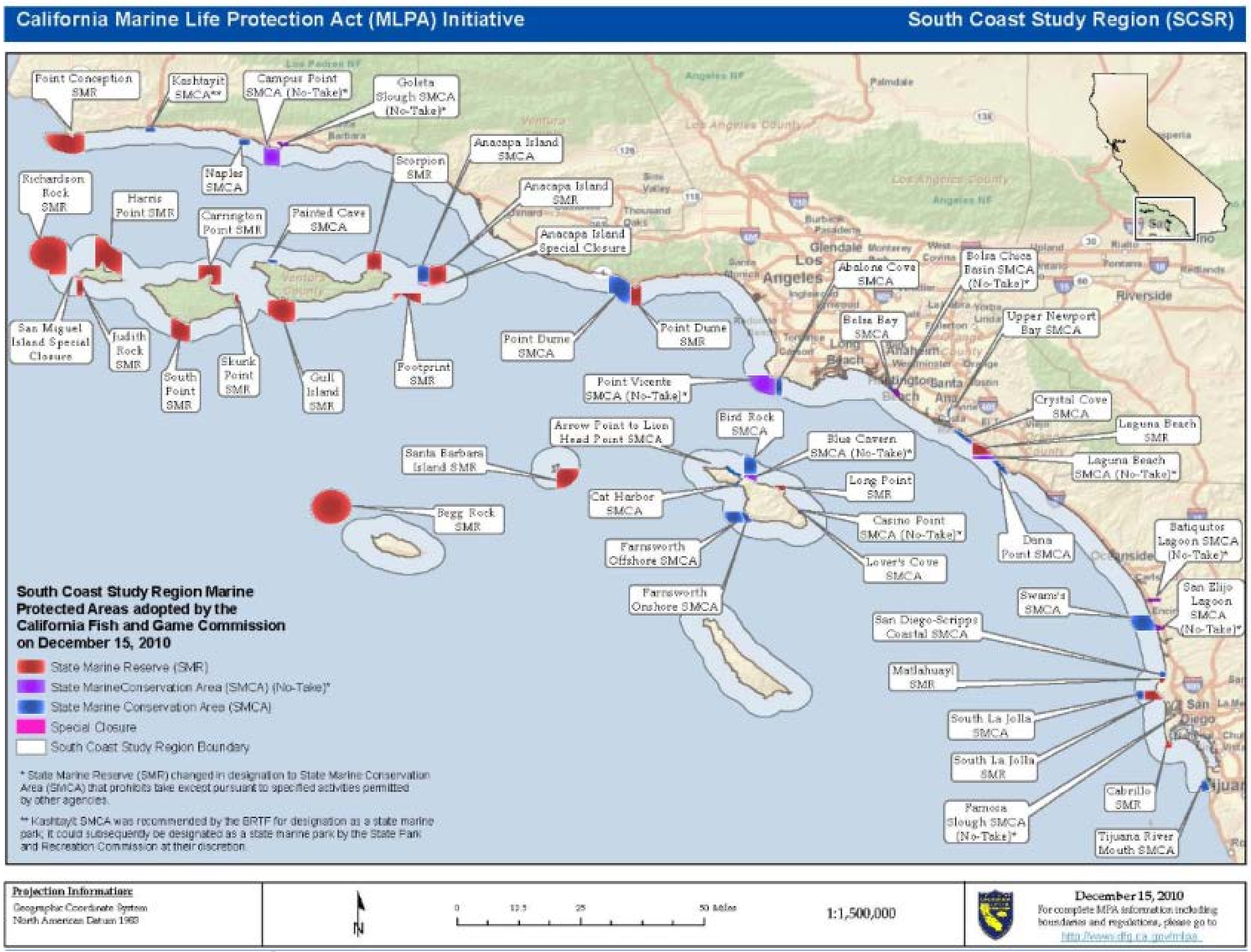

Figure 6-1: Marine Protected Areas in Southern California

Most construction and operational activities associated with seawater desalination are prohibited in MLPAs with the exception of certain types of subsurface intakes. Additionally, the SWRCB's Ocean Plan regulations require locating screened seawater intakes as far away from MPLAs as feasible. MLPAs could benefit desalination projects as potential opportunities to mitigate marine life impacts.

[16] http://www.dfg.ca.gov/marine/mpa/scmpas_list.asp

Costs

The 2010 IRP identified planning, capital, and operating costs as implementation barriers for seawater desalination projects and cost continues to be a limitation to development. Capital costs and unit costs can vary significantly based on site and project-specific factors. These include design capacity, utilization factor, land availability, intake/outfall infrastructure. Other factors affecting cost include the types of processes needed to meet water quality goals as well as the length of pipeline and pumping requirements for integrating desalinated seawater into the distribution system. As a result, cross-comparisons between projects can be misleading.

Energy Use

Despite continued advancements in energy efficiency and process design since 2000, seawater desalination remains more energy intensive than most alternative new supplies. The reverse osmosis process uses the majority of energy in most plants, but product water and seawater intake pumping requirements can also affect overall energy use. Electric power can range from 28 percent to 50 percent of a project's total unit costs.[17]

Conflicting Messaging

Public education and acceptance is key factor in the successful implementation of seawater desalination projects. Currently, there are conflicting messages on seawater desalination. The conveyance of a uniform public message and further stakeholder education is needed.

Opportunities

There are several opportunities for accelerating the development of seawater desalination in Southern California, including improved approaches to permitting, funding, technology, collaboration, and communication of benefits.

Streamlined Permitting Process

Although permitting is a challenge, several actions since the 2010 IRP have improved the permitting process. For example, CalDesal, a consortium of water utilities and other stakeholders with an interest in desalination and salinity control, promoted legislation in 2011 to streamline the permitting process for seawater desalination. The legislation ultimately led to a coordination agreement among the Coastal Commission, State Lands Commission, SWRCB, Regional Water Quality Control Boards and other state agencies with related permitting authority. These agencies will collaborate with each other and the project developer early in the permitting process to avoid redundancy and provide clarity on the permitting requirements. The process, which is facilitated by the Ocean Protection Council and known as the Seawater Desalination State Interagency Working Group, represents an opportunity to reduce both the cost and time required to obtain permits, while ensuring appropriate review by the state agencies.[18]

[17] WateReuse; Seawater Desalination Power Consumption White Paper; 2011
[18] http://www.opc.ca.gov/desal/

Additional opportunities for improving the permitting process include the Governor's 2014 Water Action Plan (WAP) and a Memorandum of Understanding (MOU) between the SWRCB and the Coastal Commission regarding implementation of the Ocean Plan regulations. The governor's plan calls for streamlining permitting for local projects, including seawater desalination.[19] The MOU between SWRCB and other state agencies will clarify implementation of the Ocean Plan regulations when there are overlapping permitting authorities between agencies. The MOU should help provide consistent application of the Ocean Plan regulations and avoid conflicting requirements placed on seawater desalination projects.

Funding Opportunities

Since the 2010 IRP, opportunities have increased for regional, state, and federal funding. This includes funding for projects as well as for research and development.

Regional Funding

Metropolitan has provided regional project funding for seawater desalination since 2001. Metropolitan programs include:

- **Seawater Desalination Program (SDP).** The SDP provides up to $250 per AF on a sliding scale for a term of 25 years or until 2040, whichever comes first. Projects with signed SDP agreements include: city of Long Beach, Municipal Water District of Orange County, and West Basin Municipal Water District.
- **2014 Update Local Resources Program (LRP).** Under the LRP, seawater desalination projects are eligible for an incentive of $340 per AF for up to 25 years.
- **Foundational Actions Funding Program (FAF)**. Metropolitan also supports applied seawater desalination research and development by member agencies. The current round of Program funding includes: a study related to slant well subsurface intakes and an evaluation of corrosion resistance of various materials for use in wedge-wire screens.

State and Federal Funding

State funding opportunities for seawater desalination and other local supplies have increased since 2010. This includes funding under Proposition 1 as well as funding made available to respond to California's ongoing drought. A summary of state funding is provided below:

- **Water Bond.** The $7.5 billion Water Bond included $725 million for recycling and other advanced treatment projects such as desalination. DWR expects to issue a $49 million round of funding for desalination in 2016[20]
- **Proposition 50.** DWR also awarded $8.75 million in grants out of Proposition 50 for brackish and seawater desalination projects ranging from research to project construction, including two projects in the Metropolitan service area: SDCWA: received $2.6 million for a system integration study for

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[19] http://resources.ca.gov/docs/california_water_action_plan/Final_California_Water_Action_Plan.pdf
[20] http://www.water.ca.gov/desalination/2016Cycle4.cfm

the Carlsbad Project and received $1.0 million for intake pilot testing for the Camp Pendleton Project[21]

- **The California Energy Commission (CEC).** RFP for up to $3 million for renewably-powered desalination projects as part of a $30 million solicitation that includes a focus on new agricultural and urban conservation technology.

Federal funding for seawater desalination has come primarily through the U.S. Bureau of Reclamation (USBR)'s Desalination and Water Purification Research Program:

- **USBR**. In 2015, USBR funded $350,000 in seawater desalination research projects[22] in Metropolitan's service area, including: $150,000 for West Basin's subsurface intake study and $200,000 for SDCWA's pilot study for Camp Pendleton
- **USBR**. USBR supports research and provides funding for pilot testing new technologies as well as the Brackish Groundwater National Desalination Research Facility (BGNDRF) in New Mexico.[23]

Technological Advances

Southern California is one of the birthplaces of reverse osmosis (RO) technology, and remains a leading center for innovation. Membrane manufacturers, chemical suppliers, and desalination design firms comprise a strong desalination technology industrial cluster in the region.

Innovation in the seawater desalination industry is accelerating on a number of fronts. Research into energy efficiency has the potential to further reduce the energy requirements for seawater desalination. However, the new Ocean Plan regulations have created an urgent need for additional research into intakes, outfalls, marine life entrainment, and salinity impacts.

Examples of promising energy-related technologies include forward osmosis, biomimetic membranes, graphene-based membranes, and desalination on a micro-chip. These technologies, as well as many others, are in the research phase of development. Innovative process designs can also reduce RO energy consumption, and renewably-powered desalination is also an area of active research.

Partnerships Can Help Manage Risk

For large, capital intensive water projects, managing project risks is important for successful implementation. Risks associated with seawater desalination projects include development, operational, and demand risks. Innovative partnerships have the potential to address these risks for water agencies and other project developers. The Carlsbad project is an example of how a partnership with a private developer can help mitigate risk for public agencies. The Water Purchase Agreement between the SDCWA and Poseidon Water, the project developer, explicitly defines how different risks

[21] http://www.water.ca.gov/desalination/2014Cycle3.cfm
[22] http://www.usbr.gov/research/AWT/DWPR/2015_DWPR.html
[23] http://www.usbr.gov/research/AWT/BGNDRF/

are allocated to each party. The risk allocation affects the cost of the water but assigns risks to the party best able to manage them.[24]

Partnerships can also be used to manage demand risk. Demand risk refers to a situation where a water project is underutilized or stranded due to a lack of demand for project water. Many different types of water projects are subject to demand risk, including recycled water projects,[25] pipelines, fresh water treatment plants, and other types of water supply infrastructure.

Partnership approaches to seawater desalination can mitigate these risks by coordinating the use of project water to maximize efficiencies. The approach was originally considered by the City of Santa Cruz – Soquel Creek Water District project, (SC^2). The City of Santa Cruz needed water additional supplies to address reliability during dry years. The Soquel Creek Water District needed additional water supplies to recharge its coastal groundwater basin which was at risk for seawater intrusion. The partnership agreement would have allowed Santa Cruz to take project water in dry years and in summer months to manage peak demands, while Soquel Creek took project supplies in normal to wet years and in the winter.[26] While the project is no longer under development, this approach could be applied to manage demand risks, either locally or with regional partners. Project phasing can also help manage demand risk.

Communication of Benefits

Another opportunity centers on improving the communication of the benefits of seawater desalination. Seawater desalination can diversify local and regional resource portfolios while providing supply benefits uniquely suited for managing short-term and long-term uncertainties. Often the desalination's unique benefits are overwhelmed by negative information put forth by groups opposed to desalination projects. The member agencies pursuing desalination project in Metropolitan's service area have featured extensive public outreach as part of their develop process. However, more outreach is needed to counteract persistent negative messaging occurring at both the state and local levels.

Lessons Learned

Case Studies

Experienced gained in developing seawater desalination projects in California and overseas can provide guidance for addressing many of the implementation challenges discussed above. **Table 6-2** provides project summaries that highlight lessons learned from various projects in California and overseas.

System Integration Study

Distribution system integration is an important but sometimes over looked element of seawater desalination design and operations. How desalinated supplies are integrated with existing potable water distribution systems can affect existing distribution system and project operations, and can be a

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[24] San Diego County Water Authority; Special Board Report, September 20th, 2012; http://www.sdcwa.org/sites/default/files/files/board/2012_presentations/2012_09_20_presentations.pdf
[25] http://awa.asn.au/uploadedfiles/Water_Recycling_Fact_Sheet.pdf
[26] http://www.scwd2desal.org/index.php

determining factor for avoiding stranding water supply infrastructure. In 2011, Metropolitan completed a survey of international integration practices and associated lessons learned for ten large projects. **Table 6-3** summarizes the key study findings regarding operations and water quality.

Table 6-2
Summary of Seawater Desalination Case Studies

Case Study	Lessons Learned
Carlsbad	• Large desalination plants are possible in California • Cost estimates change over time • Benefits of public-private partnerships • Complexity of California's permitting process
Santa Cruz-Soquel Creek	• Partnerships can help manage demand risks • Community opposition can derail carefully planned projects
Australia[27]	• Turned to seawater desalination during historic drought • Four plants on the east coast were put on standby mode when the drought ended • Two plants on the west coast are running at 100% capacity where the drought has not ended • Renewable energy can offset GHG emissions but can increase cost • Streamlined permitting process with a single master permit covering all regulatory agencies • Seawater desalination can be an important emergency supply during floods
Spain[28]	• Constructed 26 small and large scale plants as part of State sponsored "AGUA" program along Mediterranean coast[29] • Avoided cost and environmental impacts of expensive large-scale conveyance project • Agricultural customers reluctant to purchase higher priced supplies, leading to low utilization factors • Implemented innovative subsurface intakes at several facilities
Israel	• Rapidly developed five large projects representing 580,000 AFY in response to long-term crisis[30] • Low salinity of the product water benefits Israel's extensive recycling program for agricultural use

[27] "A tale of two cities: Desalination and Drought in Perth and Melbourne" NCEDA, 2013
[28] http://www.nytimes.com/2013/10/10/business/energy-environment/spains-desalination-ambitions-unravel.html?_r=0
[29] Presentation by J. Zorilla to the Multi-States Salinity Coalition, February, 2011.
[30] Source: Water Desalination Report, June 2013.

Table 6-3
Summary of Lessons Learned - Seawater Desalination System Integration

Topic	Reported Strategies
Inter-tie Location	• Upstream intertie: operational flexibility, blending potential, larger demands • Nearby intertie: shorter conveyance pipelines, less pumping
Reported Blending Practices	• Projects reported blending in reservoirs, storage tanks, and pipelines • Blending varied based on availability of alternative supplies
Operations	• Base-loaded where seawater desalination is a high percentage of supply
Corrosion – System integrity – Lead and copper – Aesthetics	• Blending • Meet corrosion indices • Post-treatment conditioning to match existing supplies
Bromide – Disinfection by-products – Chloramine residual decay	• Blending • Two-pass RO process • Modify chloramine residual formation process
Boron – Potential impacts to landscapes and agriculture	• Blending • Two-pass RO process
Other	• Modeling can help ensure successful integration • Consider end users when developing quality goals • Engage public in all stages of development • Integration costs are site specific and can be a major component of the project

Recommendations

Regional actions may be able to address some of the current barriers to development. These include research and studies, regulation and legislation, and technical capacity building. The following summarizes high-level recommendations for moving forward.

- **Consider investing in new research and studies**
  - Subsurface and screened intakes
  - Entrainment and brine discharge impacts
  - Siting and integration studies
  - Mitigation approaches
  - Renewable energy and energy efficiency
- **Explore legislative, regulatory, and communications opportunities**
  - Continue support for CalDesal, the Southern California Salinity Coalition, the Multi-States Salinity Coalition, and related stakeholder groups
  - Consider new public outreach and messaging efforts
  - Educate decision makers and key stakeholders
  - Support permit coordination among state agencies

- **Evaluate options for capacity building**
  - Promote technical training on seawater desalination technologies and planning
  - Leverage knowledge base and support capabilities of the local desalination industrial sector
  - Preserve coastal sites for future project development
  - Explore opportunities to minimize demand risks and stranded investments

7. Stormwater Direct Use

Direct use of stormwater/urban runoff (stormwater) was not directly identified as a water supply component in the 2010 IRP Update. Over the past few years, the movement to capture and use stormwater in multi-beneficial ways has developed significantly.

Overview

Although the majority of the future stormwater capture projects are infiltration projects rather than direct use projects, direct use Best Management Practices (BMPs), such as cisterns, rain barrels, or public restroom projects are increasingly promoted, especially with smaller-sized parcels and in areas where infiltration is not a feasible option. These types of BMPs commonly are used to supplement irrigation or meet non-potable demands. As such, the effect of direct use BMP projects on the water supply portfolio differs from that of large infiltration projects. Instead of increasing the groundwater production yield (supply), direct use projects reduce potable demands. This benefit can be viewed in a similar manner to water conservation.

Challenges

The following section includes a discussion of the major challenges of implementing direct use stormwater projects, including availability of supplies, operation and maintenance costs, and grant funding.

Rainfall Patterns

Rainfall is hard to predict and a lack of rainfall can limit the applicability of direct use. In addition, during heavy rains, the collection systems may not be able to hold all the available water. During the rainy season, when there is limited need for irrigation water, stored water can become stagnant. In addition, due to the seasonal nature of rainfall in Southern California, there is limited impact to summer peaking. Most of the demand reduction is in the winter and is largely dependent on fill-release cycles and the intensity of rain events.

Operation and Maintenance

Direct use systems require regular maintenance as they may be prone to stagnant water and algae growth, and attract rodents, mosquitoes, insects and lizards. They can become breeding grounds for many animals if they are not properly maintained. Proper vector control and ongoing maintenance is important for these projects.

Many agencies are faced with limited available funding to help with O&M costs. Grants often only fund the up-front capital portion of the total costs of a rainwater harvesting system and the agency and/or the homeowner is responsible for the ongoing O&M.

Groundwater Impacts

The following section addresses groundwater impacts which potentially include reduced recharge and water quality issues.

Reduction in recharge
In some areas, direct stormwater capture may reduce groundwater recharge. Water that would normally be diverted to downstream recharge area is captured for irrigation and largely consumed.

Water Quality
Urbanization also generally degrades the water quality of stormwater. Water that is captured and used for irrigation may impact soil quality (and ultimately groundwater quality). For example, when stormwater drips from roofs, the roof material itself may have dangerous chemicals and debris that can be harmful. It is generally good practice to bypass the containment system during the first rainfall.

Opportunities
Since the 2010 IRP Update, Governor Brown signed the "Rainwater Capture Act of 2012" (AB 1750) prior to enactment of the Act, the SWRCB required all potential appropriators obtain a permit to appropriate water from any source, including water falling in the form of precipitation. Since enactment, the use of rainwater is not subject to the California Water Code's SWRCB permit requirement. AB 1750 exempts the capture and use of rainwater from rooftops from the SWRCB’s permitting authority over appropriations of water. AB 1750 also allows residential users and other agencies to capture and use stormwater.

Non-potable use
Project examples include: onsite cisterns and the collection of rainwater for use in cooling towers, truck washes, drip irrigation, toilet flushing, and other non-potable uses such as:

- Restrooms
- Onsite irrigation
- Subregional/regional storage

Metropolitan currently offers a rebate of up to $75 per rain barrel. Agencies such as the Los Angeles Department of Water and Power offer an additional $25 per rain barrel. Other agencies offer rain barrel distribution events to encourage outdoor conservation.

Public Outreach
Stormwater direct use projects can increase public awareness of water issues. In addition they can provide educational opportunities by public participation in the stormwater projects.

Lessons Learned
The following section outlines lessons learned since the 2010 IRP regarding stormwater direct use.

Additional Operation and Maintenance Required
As noted above, rainwater harvesting systems require regular maintenance. The responsibility for maintenance often falls to the homeowner so it is important to provide proper training to homeowners in the operation of the facilities. For municipal projects, maintenance is provided by the project proponent but this is often difficult to maintain beyond initial construction due to lack of available funding.

Projects Take More Time

It is more challenging for an agency to build a direct use stormwater project because it is a new concept for Southern California. Initial findings from recent projects are that they take additional time for permitting and overall construction.

Recommendations

- Evaluate a business case analysis and an accurate cost/benefit analysis for providing regional incentives/rebates based on the study of various pilot projects. It is important that the business case analysis include calculations of regional benefit and dry-year yield
- Continue to provide an avenue for open regional discussion on the direct use of stormwater
- 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
    - Operations and maintenance

8. Graywater

Overview

Graywater was identified as a potential resource in the 2010 IRP Update. At the time, the 2010 IRP Update Graywater Technical Workgroup Issue Paper recommended that Metropolitan should not take an active role in providing financial incentives for installing graywater systems because of high costs, lack of data, and uncertainty in the regulatory environment.[31] The purpose of this issue paper is to discuss changes and remaining issues since the 2010 IRP Update.

Graywater Defined

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

Graywater in California

At the time of the 2010 IRP Update, California had some of the most restrictive standards in the country which were documented in the 2010 IRP Graywater Technical Workgroup Issue Paper. Since 2009, California has significantly reduced institutional barriers. Revised regulations have made graywater more accessible for residents. Currently, there is no longer a requirement for costly 9-inch subsurface irrigation systems, and basic clothes washer systems ("laundry-to-landscape") no longer require a permit. On a practical level, legal graywater use in California is still largely limited to outdoor reuse because indoor reuse requires disinfection and treatment to tertiary recycled water standards.[32]

Challenges

Permitting and Regulations

Graywater systems other than basic laundry-to-landscape systems involve permitting processes with local jurisdictions that can be confusing, time-consuming, and costly. By their nature, graywater systems are distributed projects and are usually customized retrofits. Because of barriers involved with permitting, many graywater users install graywater systems without obtaining permits or inspections. This makes it difficult to track graywater usage and obtain systematic data.

[31] Metropolitan Water District of Southern California, 2010 IRP Update Technical Appendix, A.8 Graywater Technical Workgroup Issue Paper. Available at http://www.mwdh2o.com/PDF_About_Your_Water/2.1.2_IRP_Appendix.pdf

[32] 2013 California Plumbing Code, Chapter 16, 1601.7.2. Available at http://www.iapmo.org/2013%20California%20Plumbing%20Code/Chapter%2016.pdf

While current technologies around the world support a range of sources and uses, not all are legal in California. There are few packaged systems that meet California requirements, are easy to install, and easy to maintain.

Costs

Graywater users may not be aware of long-term commitment in terms of time and monetary costs needed to maintain their systems prior to installation. Graywater systems need regular maintenance, and monetary benefits alone may not justify costs to the owners.

Potential Health Impacts

Improper use or storage can potentially lead to pathogens or vectors. Because of this, human contact and storage are still prohibited. However, there have been no reported cases of illness related to graywater systems.

Potential Soil Impacts

Compared with potable water, graywater typically has higher concentrations of dissolved salts and other constituents which, if too high, can be detrimental for irrigated soils and plants. Without regular rainfall or soil flushing, salts can accumulate in the soil. With excessive rain, additional minerals and nutrients can runoff into natural waterways and increase risk of algal blooms. In particular, water that has been softened tends to have high sodium content. Therefore, it is advisable for graywater users to take precautions such as switching to potassium-based water softeners and using environmentally-friendly detergents.

Drain-Line Impacts

A concern related to the proper operation of plumbing fixtures is drain line carry (i.e., what a toilet is able to flush down the drain line). High-efficiency retrofits for toilets, urinals and showerheads already reduce the amount of water that is going down the drain. Graywater diversions could have the unintended consequence of further reducing the volume of wastewater, causing insufficient volume to carry waste down the drain line under certain conditions with older plumbing systems.

Potential Conflict with Other Resources

Groundwater

Graywater used for irrigation can potentially add unwanted salts or other contaminants to groundwater. When a construction permit is required, the permit may require identification of the groundwater level and soil absorption qualities. Graywater systems are not allowed where percolation tests show the absorption capacity of the soil to be insufficient to accommodate the maximum discharge. Graywater disposal fields are not allowed to be within three feet vertical of the highest known seasonal groundwater level.[33]

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[33] 2013 California Plumbing Code, Chapter 16, 1
http://www.iapmo.org/2013%20California%20Plumbing%20Code/Chapter%2016.pdf

Sewer Systems

Large-scale implementation of graywater could create low-flow conditions in sewers. When graywater is diverted before it reaches the drain line, it no longer is being blended with blackwater that is discharged into a sewer. This reduced flow has consequences to the biological and chemical composition of the sewerage and places additional stress on sewage treatment mechanisms that must handle increasing concentrations of chemicals, pathogens, and nutrients. Moreover, less water in the sewer line means that there is less flow to push along solids, also called scouring action. Diminished scouring action may lead to more blockages in sewer pipes, especially in coastal communities that tend to have gentler slopes with less gravity flow.

Recycled Water

Graywater diversions, especially to outdoor applications, may reduce the wastewater available for treatment plants to reclaim as recycled water. Recycled water is a significant source of local water supply in the region and a major component of Metropolitan's IRP.

Conservation

Graywater volume decreases as water-use efficiency increases. Graywater may have unintended effects on overall water use. For example, a consumer who uses graywater may decide to delay replacement of an old clothes washing machine with a more efficient model and has less incentive to change existing landscaping to more water-saving alternatives. As buildings and homes become more water efficient, the potential to save water through graywater systems will be reduced, making graywater systems less cost effective.

Opportunities

Policy

California Plumbing Code since 2009

California's graywater code is found in Chapter 16 of the 2013 California Plumbing Code. In 2009, the California Plumbing Code introduced three-tier permitting standards that include basic laundry-to-landscape systems that no long require permits or inspections as long as the installer follows the guidelines in the code. Other types of systems require a permit from the local jurisdiction. Under the current code, graywater systems must:[34]

- have a way to direct flow back to the sewer/septic system, with a clearly-labeled valve
- send the water to irrigate landscape
- keep the water on the same property where it is produced and follow set-backs listed in the code
- have a maintenance manual
- discharge graywater under a two-inch cover of mulch, plastic shield, or stones

[34] Greywater Action website. "California Greywater Regulations." Available at http://greywateraction.org/?p=11128 Accessed July 6, 2015.

Graywater systems must not:

- contain diaper water
- contain hazardous chemicals
- have pooling graywater or runoff
- make graywater accessible to people or pets (such as in an open tub)
- include a pump (except the clothes washing machine's internal pump)
- connect to the potable water supply
- affect other parts of the building, such as the electrical or structural components

Graywater No Longer Prohibited by Local Governments

AB 849, passed in 2011, removed the authority of a city, county, or local agency to prohibit the use of graywater. Local jurisdictions may only adopt standards that are more restrictive than state requirements, and such ordinances must indicate local conditions that necessitate the more restrictive requirements.

Governor's Executive Order B-29-15

On April 1, 2015, Governor Brown issued Executive Order B-29-15. Among other provisions, it directed enforcement of statewide mandatory urban water reduction by 25 percent compared with 2013 use, and it directed the California Energy Commission, jointly with the DWR and the State Water Resources Control Board, to implement a Water Energy Technology (WET) program to deploy innovative water management technologies.

Revised Model Water Efficient Landscape Ordinance

Executive Order B-29-15 also directed DWR to revise the state's existing model landscape ordinance through expedited regulation. The California Water Commissioned adopted a revised Model Water Efficient Landscape Ordinance on July 15, 2015. To encourage graywater use, the model ordinance allows landscapes under 2,500 square feet that are irrigated only with graywater or captured rainwater to meet a simple irrigation checklist and not be subject to the entire ordinance.

Administrative

Consolidation of Authority

SB 518 requires that the California Building Standards Commission, as part of its triennial review, adopt building standards for graywater in nonresidential occupancies, and it also terminated DWR's authority on standards for nonresidential graywater. This consolidates authority for graywater standards under the CBSC.

Streamlining Permit Processes

Some local jurisdictions are streamlining their permit processes. For example, in 2012, the City of Los Angeles revised its permitting application for simple graywater systems to improve the customer experience, providing a straightforward checklist and sample system drawing that homeowners can easily print and include in their application.

Education and Acceptance

Public awareness and interest in graywater has increased since the 2010 IRP, largely due to drought conditions, mandatory water use restrictions, and the new opportunities for laundry-to-landscape systems that are now legal and simple to implement. There are ongoing educational efforts by organizations such as Greywater Action and local agencies. For example, West Basin Municipal Water District is currently researching the ability to provide free graywater workshops in its service area.

Lessons Learned

Costs and Limitations

Customers need to be made aware of potentially prohibitive costs and technical limitations. Of the six permitted graywater systems in the city of Santa Monica that were discussed in the 2010 IRP Issue Paper on graywater, only one remains. The others were removed or abandoned because maintenance was more than expected. An unintended consequence was that users had less motivation to use water-efficient clothes washers, or to wash clothes efficiently, in order to produce enough graywater for irrigation.

Permitting

Customers can be intimidated by permitting requirements, even with the revisions made to the California Plumbing Code since 2009. Administrative burden on customers can be eased and still be in compliance with regulations. Many local jurisdictions can further streamline their permit processes.

Recommendations

Research

Continue to encourage research on graywater potential and impacts. Through Metropolitan's Innovative Conservation Program, Metropolitan supported a 2009 field study of the water-use efficiency potential for in-home graywater in California with the AQUS® system that captured the untreated graywater from the bathroom lavatory sink, filtered and disinfected it, and used it to flush a tank-type gravity-fed toilet, thereby conserving the potable water normally used for flushing.[35]

Education

Complementing the need for technical research, public information efforts are needed to increase consumer awareness of current graywater opportunities as well as understanding of overall benefits and costs.

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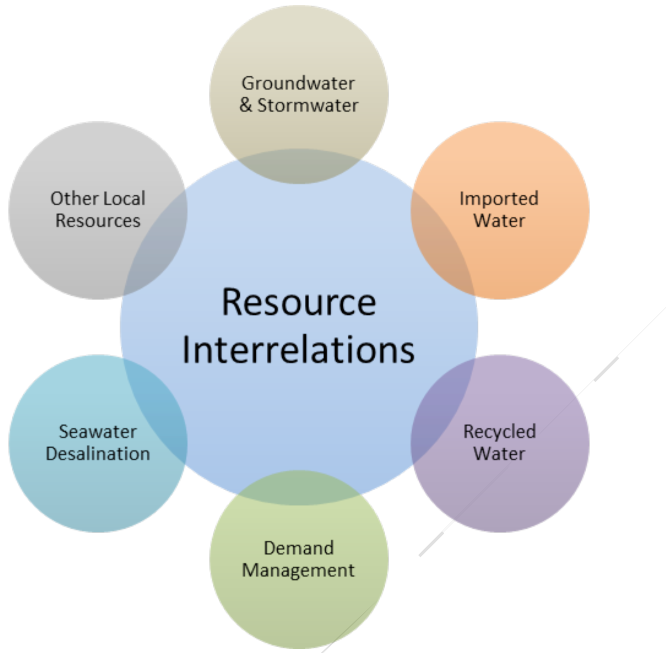
[35] Koeller and Company. January 2010. Field Study of the AQUS® Water Saving Device: Report to the Metropolitan Water District of Southern California in support of the Innovative Conservation Program Grant. Available at http://www.bewaterwise.com/icp/AQUS-Report.pdf

9. Resource Interrelations

The purpose of this section is to discuss common issues and opportunities that may relate to multiple resources. A similar section was referred to as “Synergy” in the 2010 IRP.



Background

During the 2010 IRP technical workgroup process, several of the workgroups identified similar recommendations with respect to Metropolitan’s participation in legislative affairs, increased public education, and coordinating funding efforts. To streamline these ideas, a Synergy Workshop was held on April 20, 2009, which included participants from the groundwater, stormwater, and recycled water IRP technical workgroups. Synergy Workshop participants identified opportunities to work together to optimize the use of groundwater, recycled water, and stormwater in Metropolitan’s service area.

The 2015 IRP Issue Paper Addendum combines all the resources into one comprehensive document, which allows for easier identification of common elements and resource interconnections.

Shared Challenges

The common challenges in developing additional local water supplies and demand management include:

- Water quality issues
- Regulatory constraints
- Prohibitive costs and limited funding
- Lack of public support and negative perceptions

Water Quality

Water quality is clearly an issue across many resources, and the effluent for one resource can be the influent for another. Conjunctive use of surface and groundwater supplies may face hurdles when the native groundwater quality differs (e.g., more contaminated or more pristine) from imported or recycled recharge water. Recharged water may move contaminant plumes or mix with existing contamination. Recharge constituents such as total dissolved solids, chloride, sulfate, and nitrate are common problems. Basin Plans adopted by Regional Water Quality Control Boards are required to protect existing high quality waters from degradation, but may limit the use of recycled water and/or imported water supplies. With increasing levels of recycled water, basin salt loading becomes more of an issue. Stormwater recharge may additionally impact groundwater quality.

Also, demand management strategies may incidentally impact source water quality and quantity for recycled water. Seawater desalination subsurface intakes may impact the nearby groundwater basin.

Regulatory Challenges

Regulatory challenges are common across all resources. The regulatory path to a successful project can be a lengthy and costly one regardless of the resource. With the constantly changing regulatory environment, projects are often delayed.

Prohibitive Costs and Limited Funding

One of the key barriers to implementing local resource projects is cost. In some areas (e.g., stormwater), upfront capital can be provided via grants or agency capital improvement programs, but funding for operations and maintenance may not be fully funded. In other areas (e.g., recycled water), efforts such as Metropolitan's Local Resources Program provide incentives upon production, but upfront capital costs may be difficult to secure. Overall, projects tend to cost more as regulations become more stringent (e.g., for seawater desalination) and as the lower-cost projects have already been implemented.

Difficulty in quantifying/measuring benefits versus costs also poses a challenge to selecting investment options. For stormwater and recycled water projects, project scale is an important aspect— whether to invest limited resources into large regional projects or smaller distributed projects. Distributed projects may play a role in demand reduction, but can be very expensive to implement and may have little contribution to groundwater infiltration. For recycled water, regulatory uncertainty increases the potential for stranded facilities and makes it difficult to determine whether to invest in non-potable reuse, indirect potable reuse, or direct potable reuse.

Lack of Public Support and Negative Perceptions

Public acceptance and engagement are critical to all resource and demand management options. Ongoing drought conditions, public outreach, and ongoing success of local projects have helped to gradually increase the public's awareness of water conservation and acceptance of alternative supply sources. However, these projects may continue to lack public support due to negative perception of these types of projects.

Opportunities

Multi-benefit Approaches

It is important to recognize opportunities for the development of multi-benefit projects. These types of projects and partnerships improve collaboration and maximize water supply development in the region. An example is a green street project that incorporates various stormwater best management practices and brings together multiple agencies to address the multiple needs of flooding, groundwater recharge, and street services.

Funding

Grant funding and cost sharing may also provide an opportunity for agencies to collaborate.

Technology, Research, and Information Sharing

New technology in one resource area may often benefit another area. For example, brine concentration technology for groundwater recovery projects can also benefit recycled water projects. There is opportunity for combining research and sharing information to streamline the development of local resources in the future. An example of a regional approach to research in partnership with local agencies is Metropolitan's Foundational Actions Funding Program.

Drought Conditions Facilitate Regulatory Reforms

The recent drought conditions have opened up regulatory pathways and heightened awareness of water issues. For example, Governor Brown's Executive Order (April 1, 2015, Executive Order B-29-15) calls for "prioritized review by state agencies for permitting for projects that increase water supplies." In addition, the drought has also improved the public perception of alternative water supplies.

Optimizing Resource Interactions

Each water resource is connected with the others, and there are opportunities to optimize these resource interactions. Areas of potential optimization include:

- Interactions between stormwater, recycled water, imported water, seawater desalination, and groundwater
- Storage: groundwater, surface water, in-region, out-of-region

There is also an opportunity to develop regional plans that analyze integrating and optimizing resources.

Recommendations

- Explore partnership opportunities for multi-benefit approaches
- Explore research and technology development opportunities and programs
- Investigate integrating regulatory, public outreach, and education efforts
- Explore integrating resource, program, and planning opportunities
- Explore funding strategies that improve economic feasibility of multi-benefit projects

10. Conclusion

This Issue Paper Addendum provides an understanding of the local water resource obstacles facing the region in order to determine potential pathways to overcome them. There has been significant progress made in each resource area and more can be done, as identified through the recommendations in this report.

One of the major themes observed in each resource area is that the region is in a critical time of heightened public awareness of water and increased public engagement due to the current drought. There is great opportunity for shifting public behavior/perception, institutional reform, regulatory enhancements, and partnerships. Another major theme observed is that new technologies, research, and information sharing could significantly address the issues through technological developments and by providing the data needed to inform regulations.

NEXT STEPS

Overall, agencies must decide where and how to focus resources. As stated previously, this paper aims to help advance that regional discussion on water resource issues, policy, and implementation programs. For Metropolitan, that discussion with its Board of Directors will follow the completion of the 2015 IRP Technical Update.

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- IRP Member Agency Technical Workgroup
- Member Agency Water Use Efficiency Meetings
- LRP Coordinators Meeting