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Metropolitan Water District and its Local Resources Program: Implications for Regional Water Supply and Infrastructure Equity

Authors: Ethan Choi, Steven Hong, Katerina Jowid, Malia Michelsen, Sally Min, Shirleya Williams, and Julia Wu

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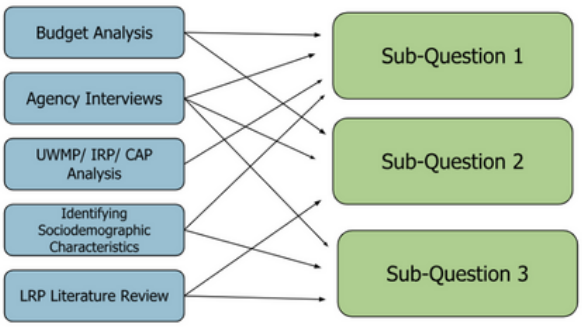
EXECUTIVE SUMMARY

The Metropolitan Water District (MWD) serves local member agencies which in turn supply water to nearly half of California's population. The MWD's Local Resources Program (LRP) helps fund projects designed and proposed by its member agencies to produce more locally-sourced water in Southern California, to bolster the region's self-resiliency and reduce reliance on imported water sources. As of 2022, MWD states that its LRP supports close to half of the recycled water and groundwater recovery production in the district's service area (MWD CAP, 2022).

Southern California has been in a state of water crisis since patterns of record-breaking drought began in the early 1990s.Southern California's reliance upon imported water supplied from the State Water Project (SWP) and the Colorado River has come under threat. Faced with expanding cuts in water supplies delivered via the SWP, the region has needed to draw more and more water from the Colorado River to meet residential needs, putting water sources at risk of drying up or being unable to produce hydroelectric power. Hence, programs like the LRP which stand to help reduce water demand from member agencies have only grown in importance.

Before our study, an independent, public analysis of LRP funding distribution and an in-depth survey concerning the perspectives of receiving member agencies had not yet been conducted. Accordingly, in this study, in cooperation with MWD and many of its member agencies, our research team assessed existing documents, conducted interviews, and performed statistical analyses on funding trends from the program's inception in 1984 to today. In our evaluation of the LRP, the overarching question we are aiming to address is: "What has been the effectiveness of MWD's Local Resources Program in terms of water resilience and equity, and can it be improved?" This research seeks to inform how the LRP fits into a comprehensive vision for Southern California of a long-term transition to local water resources.

Study Methodology process



UWMP: Urban Water Management Plan, IRP: Integrated Resources Plan, CAP: Climate Action Plan
Sub-Question 1: How has LRP funding been distributed temporally and spatially, and for what types of local water? What types of communities have benefited the most?
Sub-Question 2: How is member agencies' reliance on local water resources related to the LRP?
Sub-Question 3: What are member agencies' perspectives on the past, present and future of the LRP?

Through our research, we found a cumulative $1.4 billion, adjusted for 2023 dollars, has been invested by the LRP over time in member agency projects, benefiting twenty-one of the twenty-six member agencies. However, the amount of funding has decreased over the years. Since 2020, only five projects have been approved and received an average funding of around $1.2 million, compared to thirty-seven projects in the years 1990-1999 which received an average of $3 million per project. This is in addition to a significant decrease in the average funding received at around $1.2 million per project, compared to $3 million per project the decade prior.

The distribution of projects and funding per agency was also found to be uneven over time, with the Metropolitan Water District of Orange County (MWDOC), the San Diego County Water Authority (SDCWA), and the city of Los Angeles having the most LRP projects. MWDOC received the most funds, approximately $394 million, adjusted for inflation. Comparing socio-demographic census data against LRP project allocation revealed that less LRP funding has been awarded to member agencies with lower incomes and higher minority populations.

We also analyzed member agencies' Urban Water Management Plans (UWMPs) and MWD's Integrated Resource Plan (IRP) to assess the relationship between the LRP and local water supply attainment. We found that the agencies that did not receive LRP funding had a higher average local water percentage (76.6%) compared to the agencies that did receive LRP funding (53.0%).

Based on the interviews we conducted, unsurprisingly, agencies that received higher LRP funding overall and per capita seemed to be more amenable to participate in the interview process and discussion of the future of the LRP. Overall, member agencies expressed a relatively positive view of the LRP. All participants (n=17 of 26) indicated that the program has been historically vital for the development of local water infrastructure as well as generally perceived as cost-effective for regional water security. However, over a third of interviewed agencies believed that the program needs improvement, and a couple further noted that the LRP is no longer very functional and will require significant improvements to be so again. Major concerns articulated included the fear of MWD possibly ending the LRP entirely; a need for an increase in LRP funds, at both the project and program levels; as well as doubts about the sustainability of the program's business model. Some member agencies indicated an interest in the program facilitating projects that allow for the sharing of benefits on a regional scale, perhaps encouraging more efficient inter-agency collaboration on LRP projects, especially for disadvantaged communities.

Interest in including stormwater capture projects in the LRP was generally high, with two-thirds of agencies expressing interest in the possibility of developing such a program to facilitate the transition to local water. The average self-reported local water use goal was around 50% but ranged dramatically from as low as 20% to as high as 80%, perhaps reflecting the diversity of resource availability of the agencies. Most agencies indicated that it will not be possible in the foreseeable future to reach 100% local supply, emphasizing persistent current and future reliance upon MWD for imported water supplies and financial support from programs like the LRP.

In light of these findings, we provide nine key recommendations.

Recommendations

1. Continue the LRP in some form. The program has been of clear value to member agencies and a significant benefit to the development of local water resources in the region, the need for which has only increased.
2. Clarify the funding process for applicants to the LRP to ensure it follows a clear and transparent logic.
3. Clarify project selection criteria, indicating what causes projects to be approved or rejected.
4. Make robust, non-proprietary data about the attributes of funded projects publicly available for transparency, to enhance public understanding and enable further research on the program's success.
5. Report on whether the planned target investment of 170 thousand AFY of local water resources is met over time to evaluate regional impact and success of the program.
6. Increase the funding pool for the LRP. Proactively help member agencies directly apply to new state and federal funding opportunities for water supply that can contribute to overall LRP funding.
7. New funding can go towards:
    a. The inclusion of a stormwater capture project type into the current LRP model.
    b. The inclusion of water quality projects, potentially projects targeting PFAS contamination.
    c. The revival of inactive projects that have failed or have been neglected, such as the Tapo Canyon Water Treatment Plant.
8. Focus on modifications to better enable the funding for smaller agencies as well as agencies with large portions of disadvantaged communities that cannot otherwise match a sufficiently large portion of funding.
    a. Consider adopting either higher incentive amounts grants or very low interest loans in lieu of a pay for performance model to ensure a more equitable distribution of funds through the LRP.
    b. Consider establishing a parallel, more equity-focused program rather than modifying the existing LRP.
9. Consider a designated, privileged inter-agency collaboration pathway under the LRP to encourage participation by smaller agencies and disadvantaged communities that may require more assistance and partnership in order to apply.

Lastly, future research will be required to determine the causal role and its magnitude, or lack thereof, of the LRP in incentivizing MWD's member agencies to increase investments in local water generation. Moreover, future efforts to ensure continuous improvement within the LRP could consist of the inclusion of some consideration of equity in a future reviewed version of MWD's Integrated Resources Plan (IRP) process. The revision and editing of the IRP's current form will be published in 2025 with additional regulations and structural adjustments. The data and conclusions of such a potentially reviewed version of the IRP would be valuable to regularly assess trends and improvements in agencies' willingness to participate in and benefit from the LRP.

INTRODUCTION

Water supply management has been a battleground in California since at least the mid-20th century. The topic's relevance has only grown in significance given the consequences of human-induced climate change. The golden state presents many complexities when it comes to water supply patterns, as its most populated areas (Southern California and the Bay Area) notably lack adequate local supplies to reliably provide for residential, industrial, and agricultural demands. To continue economic and population growth, California has transformed into "the most hydrologically altered landmass on the planet" as its most densely populated areas have been and will continue to be reliant upon water imported from the north and east of the state (Water Education Foundation, n.d.). As imported sources are increasingly threatened by climate change and over-allocation, a reduction in residential consumption has the potential to reduce water demand. Community education on water sources and availability has encouraged users to implement water-efficient practices, including repairing leaks, planting drought-tolerant landscaping, and supporting WaterSense-certified products (EPA, 2022b). The biggest users, farmers, also have the potential to switch to more efficient drip irrigation systems with the help of government-funded campaigns and subsidies (CDFA, 2022). While such demand shifts will contribute significantly to local resilience in the form of conservation, efforts to continue the momentum toward supply-demand balance will prove to be the responsibility of water management agencies.

Water supply management has become intertwined with climate change prevention policy, as many water utilities and wholesale retailers are predominantly dependent on imported sources, many of which have already felt the negative effects of climate change on water quality. The management of Southern California's imported water supplies will require even greater coordinated efforts on behalf of water agencies and residents of their respective service areas. Southern California residents have heavily relied on the Metropolitan Water District (MWD) to import, manage and deliver the necessary supplies vital to maintain current standards of quality of life in the region. It is difficult to overstate MWD's influence on Southern California's development as "the largest single contractor of the State Water Project and a major supporter of Southern California water conservation and water recycling programs, along with other local water management activities" (MWD, n.d.).

The MWD serves as a wholesale agency providing water to twenty-six retail "member" water agencies, which serve 19 million people in fourteen cities and six counties across Southern California (MWD, n.d.). The region obtains 55% of its water from two imported sources, 25% from the Colorado River, and 30% from California's State Water Project in northern California, both sources which MWD distributes. Along with imported supply, MWD estimates that the region currently obtains about 45% of its water from local stormwater, recycled water, groundwater, and desalination efforts (MWD, n.d.).

In addition to securing locally sourced water supplies, MWD has developed a Climate Action Plan (CAP) as a strategic framework to reduce climate impacts of and on MWD's operations. The CAP "sets targets for reducing GHG emissions from Metropolitan's operations, including conveyance, storage, treatment, and delivery of water to its 26 member water agencies." More importantly, perhaps, the CAP would efficiently "complement Metropolitan's existing long-range planning efforts, including the Integrated Water Resources Plan, Energy Sustainability Plan, and Capital Investment Plan," meaning that water conservation efforts associated with programs like the LRP, as well as additional efforts including turf removal, fixture replacement, and weather controllers, are thoroughly monitored and reported upon in CAP progress reports (MWD, 2022).

Over time, the MWD has implemented several programs to promote a more sustainable water future, including on-site retrofitting and water savings incentive programs. One unique long-term intervention is its Local Resources Program (LRP), through which the MWD invests in local projects which support its own regional water supply reliability targets. The LRP's goal is to accelerate local development by "incentivizing agencies within MWD's service area to construct recycled water, groundwater recovery and seawater desalination projects" (MWD, 2022). As of 2022, MWD states that the LRP supports nearly half of the recycled water, and groundwater recovery production in the district's service area (MWD CAP, 2022). The program has encouraged local water usage through methods of recycling and recovery and would appear to be a potentially vital instrument in the implementation of various goals outlined in MWD's CAP. Moving quickly from large amounts of imported water to more local water supply is not only essential to combat the climate crisis, but also to create a more sustainable water supply network for consumers within the area supplied by MWD's member agencies.

In our evaluation of the LRP, the overarching question we aim to address is: What has been the effectiveness of MWD's Local Resources Program in terms of water resilience and equity, and can it be improved? This research seeks to inform how the LRP fits into a comprehensive vision for the region of a long-term transition to local resources in Southern California. We provide evidence as answers to the following sub-questions:

01 How has LRP funding been distributed temporally and spatially, and for what types of local water? What types of communities have most benefited?

02 How is member agencies' reliance on local water resources related to the LRP?

03 What are member agencies' perspectives on the past, present and future of the LRP?

BACKGROUND

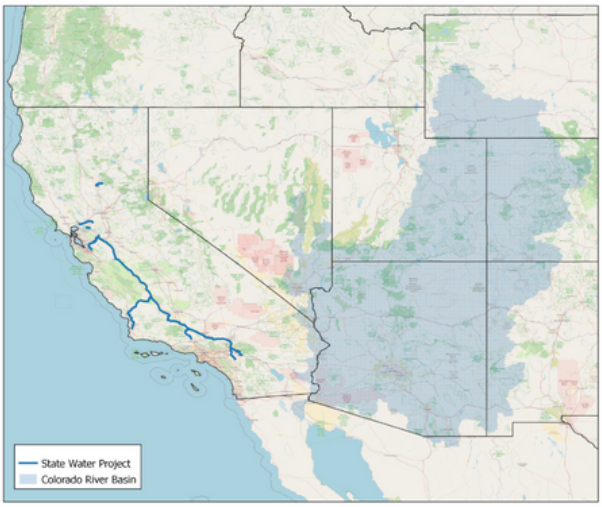
3.1 Southern California's Water Landscape

As stated above, Southern California has largely relied on imported water to enable the demand of its general urban residential needs and the associated agricultural industry. The population and economic growth of the arid region is attributed to the Colorado River and the State Water Project. Water from the Colorado River heavily supplements Southern California's local water supplies. However, the 1922 Colorado River Compact, which apportioned the use of water from the Colorado River to participating states (the Upper Basin includes Colorado, Utah, Wyoming, New Mexico, and Arizona; the Lower Basin includes California, Arizona, and Nevada), was based on an unusually wet season in which the annual river flow measured approximately 16.4 MAF per year compared to more recent flow estimates from the United States Geological Survey (USGS) indicating a three-century average flow of about 13.4 MAF along with highly erratic flows ranging from 4.4 MAF to over 22 MAF. (Megdal, 1997). Lake Powell and Lake Mead, the two largest reservoirs on the Colorado River and its tributaries, are also considered the most visible examples of the consequences associated with the river's overallocation and overuse. Lake Powell has fallen to about 25% of its full capacity as of 2022 (Budryk, 2022). With roughly 6 million people and about 5.8 million households and businesses across the U.S. Southwest states rely on Lake Powell for power (since the lake power generates directly and is a major source of grid resilience when full), the water supply of Lake Powell has a multitude of important uses. Accounting for the current loss rate and the fact that Lake Powell stood at a depth of 3621.41 feet just ten years ago, Lake Powell is very close to this point of no return and jeopardizing millions of people that rely on the reservoir for power. Lake Mead has also seen an "unprecedented drop in its water level" in the past twenty years or so and is operating at less than 40% of its capacity (Achami et al., 2018). This drop in water levels is credited to the recent droughts caused at least in part by climate change, resulting in "warmer winter temperature in the Southwest [and] less snowpack in the Rocky Mountains resulting in less snow melt" (Achami et al., 2018). Additionally, the current guidelines for managing the Colorado River expire in 2026. Despite known overallocation and overuse, and current negotiations, there is yet to be a final revision of the Compact. As of May 2023, California is entitled to receive an average of 58.7% of the 7.5 MAF of water reserved for the Lower Basin each year but consistently consumes more water than its allocated share by the Law of the River because some states within the compact do not use their full allocated supply, like Nevada and Colorado (United States Bureau of Reclamation [USBR], 1922).

The threat of "dead pool" in two of the river's largest reservoirs– Lake Mead and Lake Powell– has appeared in the news recently, with the Interior Department and the Biden Administration calling for the seven states receiving water from the Colorado River to come to a voluntary agreement of reduced allocations in water supply that serves as many as 40 million Americans (Flavelle, April 2023). As a result, "the Biden administration on Tuesday [April 11, 2023] proposed to put aside legal precedent and save what's left of the river by evenly cutting water allotments, reducing the water delivered to California, Arizona, and Nevada by as much as one-quarter" (Flavelle, April 2023). However, a new deal between the states was reached on May 22, 2023, before the deadline of May 30 imposed by the Biden administration. The Lower Division States (California, Arizona, and Nevada) agreed to a 13% reduction in their water use from the Colorado River, one of the most aggressive measures taken yet. The deal states the intent to "conserve at least an additional 3 million acre-feet (MAF) of Colorado River Water in the Lower Basin by the end of the calendar year 2026, with at least 1.5 MAF of that total conserved by the end of the calendar year 2024 (Lower Basin Plan)" (U.S. Department of the Interior [DOI], 2023). The deal also seeks $1.2 billion in payments to irrigation districts, cities, and Native American tribes that agree to temporarily use less water (Flavelle, May 2023). However, this deal has not yet been formally adopted by the U.S. federal government.

In addition to supplies received from the Colorado River, one of the largest sources of water for the region of Southern California is the State Water Project (SWP). The SWP was constructed in the latter half of the twentieth century to alleviate demand for insufficient water supplies sourced from the Colorado River. The SWP is a manmade network of aqueducts and pump systems that transport water from the Feather River watershed northeast of Sacramento and meltwater from the snowpack of the Sierra Nevada Mountains. The storage capabilities of the Sierra Nevada snowpack are immensely valuable, as "60 percent of California's total annual precipitation – in the form of rain and snow – falls in the Sierra Nevada and a portion of the southern Cascades" (Water Education Foundation, n.d.). California receives most of its precipitation in the winter months, most of which falls as snow; the cooler temperatures of the mountain range allow it to act as a natural repository for water to accumulate until the snowpack begins to melt in the spring when demand for water begins to peak as we transition to warmer summer months (National Resources Defense Council [NRDC], 2022). This historic movement of water is a great benefit for water utilities and supply agencies to process, treat, and distribute large volumes of water over an extended period of time. This naturally prevents water processing facilities from becoming overwhelmed by large instantaneous flows as a result of the slow melting of the snowpack. However, as climate change has resulted in increasing ambient air temperatures, the size of the snowpack has decreased, and it is predicted that 60-80% of the average annual Sierra snowpack will be lost by the end of the century (Cayan, et al., 2008). This has several negative consequences that deplete water sources for Californians. A study conducted by the UCLA Institute of the Environment concerning the impact of climate change on the Sierra Nevada Mountains predicted a 10° F increase in temperatures at elevations of 5,000-8,000 feet under a "business as usual" scenario in which nothing is done to prevent climate change, and there will be a predicted 64% drop in the average spring-time snowfall (Reich, et al., 2018). This will cause the snowpack to begin melting earlier in the year,releasing meltwater stores before it is needed. It is estimated that this release of meltwater could occur 10 to 30 days earlier than past average years (Halofsky, 2021). Decreased water supplies in drier months would be a significant challenge for water management facilities, retail agencies and wholesalers.

Figure 1: *MWD's primary sources of imported water to supply its service area include the California State Water Project and the Colorado River.*



The SWP has recently been faced with severe cuts in water supply. In March of 2022, the Department of Water Resources (DWR) issued a reduction in SWP allocation to just 5% of requested supplies for its receiving entities. Climactic whiplash has called for increased storage in the SWP's principal reservoir, Lake Oroville, and residential conservation efforts. In response, MWD had ordered its member agencies to reduce their water use by 30%. However, an unusually wet winter season with record precipitation– January alone had the wettest ten-day period in almost twenty-five years of intense drought– provided desperate relief for the American West, nourishing the Colorado River and the SWP in 2023. Any specific cuts and reductions in allocations from the SWP were removed as a result of the rainfall and have allowed for additional bargaining time to reach a deal between the River states to keep the Colorado River from running dry. Despite a lucky break in California's historic drought, there is still much to consider to prevent a dramatic reduction in water supplies from occurring once again.

3.2 The Metropolitan Water District and Its Significance

The Metropolitan Water District of Southern California was created 95 years ago in 1928 to secure more water supply in the region. MWD is a regional wholesaler and the largest supplier of treated water in the United States. It was primarily built to operate the resources of the Colorado River Aqueduct (CRA) and became the first contractor of the State Water Project in 1960. Met brings together 14 cities, 11 municipal water districts, and one county water authority, communally providing safe water supplies to 19 million people across the large region of Southern California.

These member agencies elect a board of 38 directors to govern MWD, whose powers and functions are specified in its 1927 authorization act. The board was initially charged with issuing bonds and financing their repayment by selling water to member agencies, ensuring the financial structure of the District. Each member agency is represented by one or more directors based on the assessed property valuation of its jurisdiction. Currently, the board is responsible for establishing and administering MWD's policies and upholding the articles of the MWD Act.

MWD oversees the maintenance of Met's three major water reservoirs– Lake Mathews, Lake Skinner, and Diamond Valley Lake– with an overall capacity of over one MAF of water, as well as Met's extensive water purification and treatment processes. MWD contracts about two MAF/ year from the SWP and 1.35 MAF/ year from the CRA, but actual delivery allotments are rarely met, due to environmental restrictions on the amount of water that can be pumped. To increase its supply and continue to provide reliable resources to its growing customer population, most recently MWD has been working on enhancing the local water supplies of its twenty-six members, through various conservation, recycling, groundwater replenishment, and desalination efforts.

3.3 Local Water Supply Targets

As stated previously, MWD is looking toward local sources to supplement the region's supply and to increase its water supply resiliency to address an uncertain future with unpredictable impacts on our water sources due to dramatic climatic whiplash. MWD set the target of "20 by 2020" for water use efficiency targets, aiming for a 20% reduction in potable water use by the year 2020. To do this, bolstering recycled water was deemed necessary and various programs emerged as a direct result. For recycled water, MWD is partnering with the Los Angeles County Sanitation Districts to develop Pure Water Southern California (PWSC), a recycled water project that will produce up to 150 million gallons of water daily (MWD, 2023). Currently, water produced under PWSC is coming from a demonstration plant being used to facilitate regulatory approval of the purification technology used. Should the technology be approved and expanded upon, the fully realized project is expected to be a source of potable water for up to 15 million people. Additionally, Metropolitan's board has allocated $3 million within its annual budget for its "On-site Retrofit Program." This program provides financial incentives for a wide range of project types from design to construction costs, and has funded 436 projects to date.

MWD also explores a wide variety of different local water options and undertakes many projects. For stormwater, MWD has committed $12.5 million to various pilot programs that aim to capture additional stormwater for groundwater discharge (MWD, 2023). Another program of note is the "Future Supply Actions Funding Program." This program aims to co-fund member agency pilot projects and technical studies to increase the potential of various local water resources such as recycled water, stormwater, groundwater, and seawater desalination. With over $6.5 million invested into more than two dozen studies, MWD aims to continue addressing the dwindling and uncertain water supplies looming over Southern California. While MWD does not explicitly give hard baselines and targets, the programs and incentives MWD offer for agencies willing to pursue local water help advance and encourage development on local water attainment.

While MWD has taken many steps to strengthen its ties to local water, many member agencies have set their own ambitious targets (independent of MWD) to reduce reliance on imported water and increase local water supplies. For example, the City of Los Angeles has a goal of sourcing 50% of its water locally by 2035. Long Beach aims to meet 100% of its water demand through local sources by 2025. Additionally, the City of Santa Monica stands out as an example of sustainability in both the water and energy sectors; Santa Monica aims to achieve water self-sufficiency by 2030 through measures such as expanded use of recycled water, increased stormwater capture, and water conservation. If these projects achieve success,

it is estimated that there will be an additional 3200 acre-feet per year of water restored and will be a great step forwards towards the City of Santa Monica's goal of becoming completely "water self-sufficient by 2030" (Gaddy, 2022).

Other member agencies are also undertaking large, primarily self-financed local water supply projects to advance their local water targets. Orange County Water District (OCWD) manages the expansive groundwater basin in Orange County and has implemented projects like the Groundwater Replenishment System (GWRS) to reduce reliance on imported water. The San Diego County Water Authority (SDCWA) is diversifying water sources by implementing the Pure Water San Diego program, aiming to produce one-third of the region's water supply locally by 2035 through advanced water purification systems and recycling. The Inland Empire Utilities Agency (IEUA) serves parts of San Bernardino and Riverside County and has initiatives like the Regional Recharge and Recovery program to capture stormwater for groundwater recharge, and has also begun to invest in recycled water infrastructure.

However, not all local water agencies have clear goals and corresponding timelines regarding local water development. Many face uncertainties of how much local water is available to supplement imported water; and many agencies will not have the environmental conditions and geological formations to support their residents with locally-sourced water. One such instance of this phenomenon occurs in the region of Las Virgenes, which has a limited local water supply due to the limited availability of groundwater. Las Virgenes MWD has set their local water target to a range of 20-50% local water with an uncertain timetable. Currently, Las Virgenes MWD is working on a "Pure Water Project," which is a full-scale water treatment system. It is currently slated to be completed in the next five years and would bolster local water attainment by an estimated 20%.

The goal of achieving 100% local water reliance and setting targets for member agencies within Metropolitan Water District presents a critical discussion. Unlike the electricity sector– which has benefited from a standardized framework like SB100 to guide the transition towards renewable energy– the path to 100% local water lacks a similar comprehensive framework and viable pathways in many local cases. However, it is important to recognize the significance of increasing reliance on local water sources and promoting sustainable water management practices. While each member agency should set individualized targets based on their circumstances, the development of a comprehensive but more customized framework for local water supply targets, similar to SB100, could provide more guidance and clarity to facilitate collective efforts towards sustainable water practices and reduced reliance on imported water.

LRP OVERVIEW

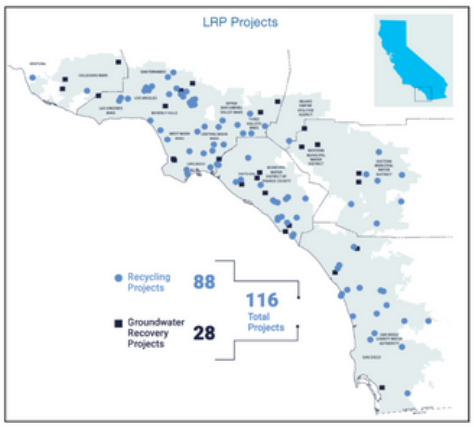
4.1 Background and History

In light of climate change and decreasing supply of imported water, the Metropolitan Water District originally developed the Local Resources Program (LRP) in 1982 to reduce its reliance upon imported water sources like those of the Colorado River and the State Water Project. Locally sourced water will have to become increasingly prominent in future efforts to maintain adequate supplies for the region's needs, especially as imported resources face severe cuts. It is important to note that increasing investments in local water supplies could theoretically undermine the agency's core business model. As member agencies become increasingly self-supporting through development, implementation, and effective management of their local water supplies, their reliance on MWD decreases. While MWD is a special district and cannot operate as a "for-profit" entity, it is still reliant upon revenue to maintain its operating costs and fund programs and projects like the LRP.

However, it appears that in MWD's view, any potential concern regarding revenue impacts is not as important as "help[ing] to increase regional water supply reliability, reduce demands for imported water supplies, decrease the burden on the district's infrastructure and reduce system costs, and free up conveyance capacity to the benefit of all system users" (MWD 2016). California Senate Bill (SB) 60 was passed in 1999 to "place increased emphasis on sustainable, environmentally sound, and cost-effective water conservation, recycling, and groundwater storage and replenishment measures," thus enacting a state law that authorized and further incentivized the existence of the LRP (MWD, 2021). In addition to meeting newer policy standards, the LRP has the potential to increase climate change resiliency for MWD's general service area and lead to a great reduction in the "environmental constraints and uncertainties of a long-term solution to conveyance in the Sacramento-San Joaquin Delta [and the over-allocated Colorado River that] make it difficult to predict the availability of MWD's future water supplies" (IRWD, 2020). Accordingly, the LRP has operated for over 40 years despite a potential decrease in future revenues as well as the MWD's overall influence on water supply (IRWD, 2020).

MWD's efforts to encourage the development of local water supplies date back to 1982, beginning with the Local Projects Program (LPP). As Figure 3 shows, the approach for the program– and even its name– continues to evolve, responsive to both MWD's own and member agency preferences.

Figure 2: *Distribution of projects within the Local Resources Program as of May 2022; reproduced with permission from MWD.*



The LPP was intended to "provide up-front capital (i.e. co-ownership or equity partnership) up to one-half of the project construction, not to exceed a subsidy of about $300/acre-feet to a participating agency for equal ownership in project water," but this funding approach was later found to be suboptimal due to high costs of required infrastructure which would be provided by MWD (MWD, 2016). As a result, MWD turned toward a method of "pay-for-performance" for the implementation of the LPP, meaning "an agency is responsible for construction and operation of the project, and MWD pays the agency for project water deliveries" (2016). Until this point, the LPP was primarily focused on incentivizing recycled water programs, and it was not until 1991 that the Groundwater Recovery Program (GRP) was established to further supplement imported water supplies with local resources in the face of heightened drought conditions. The original rate of $154 per acre-foot was set by the first iteration of locally sourced water programs to match the incentivized rate of the GRP. In 1995, member agencies were provided a more generous monetary incentive by MWD to continue efforts to establish recycled water projects at a new rate of $250 per acre-foot. This was done to combat the high initial costs associated with the first years of project operations, additionally boosting motivation for a member agency to consider decreasing its reliance on MWD for its water needs.

Figure 3: *LRP Funding structure evolution, demonstrating the progression of funding structures for the LRP beginning in 1982. Both nominal and real prices are indicated for reference.*

Type	Year	Nominal Financial Support for Local Projects	Adjusted for Inflation to 2023 Dollars
Capital Funding	1982 LPP	Variable (not to exceed a subsidy of about $300/acre-feet in adjusted 2023 value)	
	1986 LPP	Variable ($75-$113/AF)	Variable ($206-$311/AF)
	1990 LPP	Fixed ($154/AF)	Fixed ($356/AF)
	1991 GRP	Variable (up to $250/AF)	Variable (up to $555/AF)
Pay for Performance Incentives	1995 LRP Conversions	Variable (up to $250/AF)	Variable (up to $495/AF)
	1998 Competitive LRP	Scheduled (avg. $115/AF)	Scheduled (avg. $213/AF)
	2007 LRP	Variable (up to $250/AF)	Variable (up to $365/AF)
	2014 LRP Three Payment Options	A sliding scale incentive of up to $340/AF over a 25-year project term.	
		A sliding scale incentive of up to $475/AF over a 15-year project term.	
		A fixed incentive for up to $305/AF over a 25-year project term. This fixed incentive rate is not dependent on MWD's water rate and provides agencies with a more stable source of funds.	

In 1998, the LPP and GRP combined to form the first iteration of what is now known as the Local Resources Program (LRP). This version of the LRP was designed to be a competitive process to encourage innovation in recycling methods and groundwater recovery while also prioritizing cost-effectiveness for MWD. Under the 1998 LRP, member agencies would compete for funding under the scoring criteria established by the board at MWD, but member agencies critiqued this methodology for favoring proposals requesting lower financial support. Due to such complaints between 1998 and 2003, MWD revised its program requirements to allow for "an open application process and eliminate the competitive process" (MWD, 2016). This is the current application process MWD uses today.

4.2 Agency and Program Funding Structure

MWD had an annual budget of almost $2.14 billion in FY 2022-2023, and has averaged around $2 billion in the past years. Almost $675 million (nominal dollars) accounted for in investments into member agency recycled water and groundwater recovery programs; this value was acquired from an LRP funding spreadsheet provided by a contact at MWD. Thus, LRP funding accounts for approximately 0.3375% of MWD's annual budget.

Overall, MWD receives the majority (71%) of its funds from water rates and charges. Other notable contributions include fund withdrawals (9%), taxes (7%), and hydroelectric sales and miscellaneous income (3%). The Local Resources Program currently falls under MWD's Demand Management budget and is funded by the Water Stewardship Fund (Fund No. 1009 established 2005) at $21.7 million for FY 2023-2024, down $0.5 million from FY 2022-2023. Projects funded through MWD's Demand Management budget support compliance with Senate Bill (SB) 60 (Hayden), AB 1668, and SB 606, which work towards water conservation and drought tolerance (MWD, 2022).

Since the inception of the LRP in 1982, performance incentives have evolved through variable, fixed, and scheduled options, and uptake of the program has also varied substantially. For instance, under the LRP's competitive application process from 1998 to 2007, MWD approved only two projects for funding at an average scheduled payment rate of $115 per acre-foot (MWD, 2016). MWD's internal funding for the LRP until very recently came from what was known as the Water Stewardship Rate, which charged on a per unit basis for water delivered from MWD. Prior to FY 2020-2021 the LRP Effective Rate also included the Water Stewardship Rate. However on November 23, 2021, the Board at MWD incorporated all demand management costs into Metropolitan's supply rate elements for future rates and charges proposals, eliminating the Water Stewardship Rate element (MWD, 2022).

As of the writing of this report, MWD provides financial incentives via the LRP "based on the difference between the LRP Effective Rate (referenced in the LRP agreements as MWD's "full service treated water rate" or "Treated Non-Interruptible Water Rate") and the project's per unit ($ per acre-foot) cost" (MWD, 2022). Funds may cover both upfront construction and long-term maintenance costs, including operations and replacement. The reimbursement strategy of the LRP means that member agencies with less financing capabilities are likely to have a more difficult time taking advantage of the program and its incentives; the opposite is true of agencies with available upfront capital and financing capabilities. To determine the sliding scale incentive, MWD determines a preliminary rate estimate at the beginning of each fiscal year, which is cemented at the end of the year based on actual costs and project production

outcomes. Gaps between the preliminary and final rate are reconciled by MWD, and the member agency is expected to decrease in future years as water rates and project yields increase (Alonso, 2021). The 2023 preliminary LRP Effective Rate is $1,231 per acre-foot (MWD, 2022). The current funding structure for member agency incentives was established in 2014 and consists of three incentive payment structures member agencies may choose from at the time of application:

01 A SLIDING SCALE INCENTIVE OF UP TO $340 PER ACRE-FOOT OVER A 25-YEAR PROJECT TERM.

02 A SLIDING SCALE INCENTIVE OF UP TO $475 PER ACRE-FOOT OVER A 15-YEAR PROJECT TERM.

03 A FIXED INCENTIVE FOR UP TO $305 PER ACRE-FOOT OVER A 25-YEAR PROJECT TERM. THIS FIXED INCENTIVE RATE IS NOT DEPENDENT ON MWD'S WATER RATE AND PROVIDES AGENCIES WITH A MORE STABLE SOURCE OF FUNDS.

By comparison, if member agencies were to rely instead on imported water, MWD's 2023 Tier 1 Full Service Treated Volumetric Cost is $1,209 per acre-foot. Once a member agency reaches their Tier 1 supply limit they must rely on Tier 2 water, which is currently $1,418 per acre-foot (MWD). In reality, additional water is not necessarily available to member agencies at these prices at a given time. To obtain secured LRP funding Options 1 and 2, member agencies must submit annual data on recovered and delivered water, as well as information on costs, financing, and external contributions.

In an even broader comparison, investments in new local water supply independent of the LRP tend to be much more expensive on a per acre-foot basis. For example, MWD's Pure Water Southern California (previously known as the Regional Recycled Water Program) is a partnership with the Sanitation Districts of Los Angeles County with the goal of "purify[ing] wastewater to produce high quality water that can be used again" at a rate of $1,826/AF, and desalination tends to be much more expensive. The relatively high cost of other new local water supply investments underlines that transition to local supplies will be expensive. Yet, it remains necessary as the supply of imported water will continue to be under threat and the cost of existing imported supplies will rise due to the effects of climate change and policy restrictions.

4.3 LRP Application Process

Public and private water utilities within MWD's service area are eligible to apply for LRP funding through their, or as, member agencies. Projects may not begin construction prior to applying, and member agencies are financially responsible for any progress made before the confirmation of LRP funds. Projects with near-term timelines are prioritized, and those expected to be completed in the long-term are required to apply for funding at each project

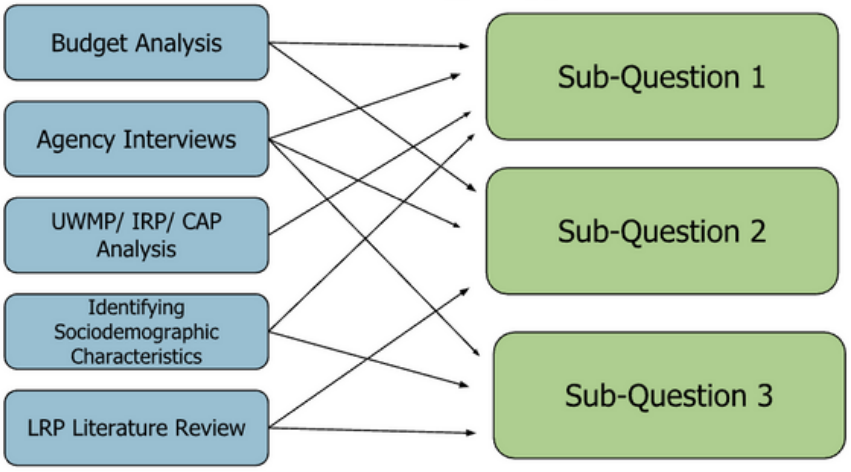
phase. Member agencies may acquire funding for water recycling, groundwater recovery, and seawater desalination development projects through an application and interview process, which requires information on funding, benefits, environmental documentation, permits, and implementation plans. Projects are evaluated on a rolling basis and are considered each year until MWD achieves its interim target of supporting 170,000 acre-feet per year of additional local water resources set in 2015 (Alonso, 2021). It is unclear if this goal is consistently met, but MWD's Annual Achievement Scorecard concerning its investment in recycled water and groundwater recovery projects state that 115,000 acre-feet of water was produced from projects receiving MWD funding in FY 2021-2022 (MWD, 2023). This demonstrates that MWD is unable to meet the interim target through the LRP alone.

An example of an approved but not yet completed LRP-subsidized project is East San Diego County's Advanced Water Purification Program, which was awarded up to $86 million in 2020 with a total projected cost of $383 million for indirect potable reuse and is projected to generate up to 17,400 acre-feet per year (Mackie, 2021). An example of a recently completed LRP-subsidized project is Santa Monica's Sustainable Water Supply Project, finished in November 2022, which received $19 million of the total $96 million cost from LRP and can provide up to 1,600 acre-feet per year of purified water (Mackie, 2021; City of Santa Monica, 2022).

METHODOLOGY

The data collection process undertaken in this study required the identification and collection of information from several different sources (figure 4). We relied upon MWD's website for basic information about MWD and its LRP. To address the distribution of LRP funding, we conducted a literature review and analysis of MWD's Biennial Budget for FY 2022-2023 and 2023-2024, Rate Handbook, and Annual Achievement Scorecards. In addition, MWD staff provided a spreadsheet containing LRP funding and project allocation by agency. Coupled with this information, GIS analysis of member agencies' residential customer sociodemographic characteristics followed in order to determine the spatial and social distribution of LRP funding receipts. We gathered further qualitative evidence from interviews of member agency representatives to provide the perspective of local water utilities regarding the effectiveness of the LRP. We coded interview responses were coded by common themes to assess relative reliance upon local resources relative to the LRP, and allow for individual perspectives to reflect on the benefits and drawbacks of the program.

Figure 4: *Methodology Study process*



UWMP: Urban Water Management Plan, IRP: Integrated Resources Plan, CAP: Climate Action Plan
Sub-Question 1: How has LRP funding been distributed temporally and spatially, and for what types of local water? What types of communities have benefited the most?
Sub-Question 2: How is member agencies' reliance on local water resources related to the LRP?
Sub-Question 3: What are member agencies' perspectives on the past, present and future of the LRP?

5.1 LRP Historical Funding Data Acquisition

We first looked online for a complete and public list of historical project-level funding from the LRP by MWD. After reviewing MWD's website, LRP factsheets, and updated fiscal year reports, we needed further analysis on which member agencies have received awards under the LRP, for how much, and for what projects or objectives the awarded funds went toward. We contacted a member of the agency's Water Resources Management department via email to obtain records of LRP-specific funding receipts. We then used descriptive analyses to examine the different local water projects that have received support from the LRP. We re-coded the projects listed within the spreadsheet from MWD into five categories to distinguish the specific project type. Of the categories of project types, there were:

01

GROUNDWATER TREATMENTS/ DESALTERS (N = 32)

These projects consisted of desalination projects, demineralization projects, and other treatment of contaminated groundwater. These projects were designed to improve the quality of groundwater through the extraction of minerals as well as any other undesired constituents.

02

WATER RECLAMATION/ PURIFICATION (N = 52)

These projects focused on producing recycled water through sewage and wastewater treatments. These projects were responsible for the production of recycled water to be used for drinking as well as agriculture, landscaping, etc.

03

EXPANSION PROJECTS (N = 20)

These projects were responsible for upgrading existing facility treatment equipment, such as constructing additional pumping stations. These projects also expanded existing plant pipelines and created additional ones for quicker and more efficient water transport.

04

DISTRIBUTION PROJECTS (N = 28)

These projects were designed to deliver and supply water, specifically recycled water, to different locations for various purposes.

05

OTHER (N = 4)

These projects did not fall into any of the previously mentioned categories. These projects were specific to location and consisted of barrier projects and replenishment efforts.

Over the course of different versions of the program, of the 136 projects initially provided by MWD for the LRP, 34 either ended before or shortly after initial funding or were accepted but never funded, with 16 closed before receiving any funding. The total amount awarded across the remaining 120 projects, $729,392,594, generally coheres with MWD's 2023 LRP Achievement Scorecard for FY 2021-2022, which accounts for around $724 million (MWD, 2023).[1]

We present project-level funding amounts in both unadjusted and adjusted dollar amounts using the Bureau of Labor Statistics CPI Inflation Calculator. We adjust dollar amounts by inputting funding amount and award date to calculate values in 2023 (present-day) dollars.

5.2 GIS Data Acquisition and Manipulation

We used GIS analysis to explore the relationship between the locations where LRP projects are funded and the socioeconomic trends within those areas. We joined LRP location data with census data to provide insight into the socioeconomic demographics of areas served by LRP projects. We requested access to GIS data on MWD's member agency boundaries through MWD's Public Records Administration. The Public Records Administration redirected us to a GIS Professional in the Geodetics & Mapping Team, who provided us with the necessary GIS layer files to create our own maps for analysis. After obtaining service area boundaries from MWD, a basemap and an inset map were created to represent the boundaries of the member agencies and MWD's service area. We obtained shapefiles for the Colorado River Basin from the Colorado River Basin Open Data Portal to show MWD's imported water sources and the State Water Project shapefiles from the California Open Data Portal. We created a separate map for this data as well as included on the main map as an inset map (right). We created a second inset map (left) to better geographically represent MWD's jurisdiction lines within California. The maps generated for the purpose of this study are presented in Appendices B and C.

We also joined U.S. Census data at the census tract scale from American Community Survey (5-year estimate) for the year 2017-2021, obtained from Social Explorer to identify socioeconomic characteristics such as race/ethnicity, median income, and the percentage of the population below the poverty line within the populations of the member agencies (Social Explorer). The main socioeconomic attributes utilized by the project were: median household income, race, the portion of the population that identifies as Latino or Hispanic, poverty level (below 200% of the poverty level). We used income data to identify California State Water Code's definition of disadvantaged communities; those with an annual median household income less than 80 percent of the statewide annual median household income, making our annual median household income threshold $67,277.

Initially, we tried examining the percentage of disadvantaged communities (DACs) at the member agency scale and found that only the Compton Member Agency falls under this category. However, using member agencies as a scale for comparing DACs is not ideal since using whole member agencies is too large for more detailed analysis. Accordingly, we also tried employing a smaller unit of measurement, the census tract, to identify tracts with a median household income below $67,277. Unfortunately, we were unable to properly analyze these tracts due to time constraints, and have set this as a recommendation for future research.

[1] The additional $5 million in our records may be due to additional funding allocated after FY 2021-2022, and discrepancies in internal MWD accounting.

5.3 Urban Water Management Plans and MWD's Integrated Resources Plan

The Metropolitan Water District's member agencies are responsible for providing water to millions of residents and businesses throughout Southern California. Nearly all of these agencies have developed urban water management plans (UWMPs), per a mandate by the Department of Water Resources, that outline their goals for water supply reliability and sustainability. UWMPs are documents the California Department of Water Resources requires large urban water suppliers to create every five years. The UWMPs are to support a water supplier's long term water resource planning by including points of consideration such as the reliability of resources over a 20 year projected period, demand measurement and water contingency plans, and the use and planned use of recycled and local water sources.[1]

The Local Resources Program (LRP) offered by MWD serves as a critical tool for member agencies to achieve these goals by funding projects that increase the use of recycled water, stormwater capture, and groundwater recharge. Through the LRP, some member agencies can further invest in their local water resources and reduce their dependence on imported water.

To look further into levels of local water reliance we compared the urban water management plans (UWMP) of twenty-six member agencies, where available. Initially, we aimed to see which agencies had publicly available UWMPs, how much they self-reported relying on local versus imported water volumes, and what they anticipated to be their projected (local) water supply in the following years.

While initially unable to locate all the agencies and their UWMPs, we later were able to locate more of the UWMPs through the California Department of Water Resources website, which provided a document with helpful links to UWMPs as well as consolidated spreadsheets comparing different water agencies on a variety of categories such as total water usage (DWR, 2020). For agencies whose UWMPs were not found, we used MWD's Integrated Resources Plan (IRP) spreadsheets (MWD, 2022). The Integrated Resources Plan contains a collection of files that outline the imported and local water usage from the past decade up to 2020. In this context, understanding the impact of funding on water resource management is of particular interest and can shed light on potential strategies for promoting sustainability.

We obtained a complete dataset as the files contain the imported and local water use for all 26 agencies. Additionally, while most UWMP and IRP data were identical, there seem to be some discrepancies for some agencies between the UWMP and IRP data. We collected data from the UWMPs in an Excel spreadsheet depicting the percentages of local and imported water from the time the UWMPs were written (2020) and projections that extended to 2050. We compared local and imported water use by percentage rather than numerical value in the standard acre-foot per year to standardize the data across the various agency sizes. All member agencies had the same time scale for projected water use being five years apart between 2025 and 2045. We compared each agency's IRP LRP funding receipts to determine the relationship between the LRP and broader local water reliance and resilience planning by member agencies.

5.4 Member Agency Interviews

In addition to the quantitative data collected, we wanted to further investigate answers to our research questions via an interview-based qualitative analysis. For this purpose, we developed a questionnaire to understand the past, present, and future of the LRP through the eyes of its direct benefactors – MWD's member agencies. The results of these interviews shaped a deeper understanding of how MWD can support its member agencies and LRP participating agencies, as well as broader local water resiliency efforts.

We contacted all member agencies one to three times via e-mail based on response rate. Although we did not interview all twenty-six member agencies, all were successfully contacted. Of the twenty-six member agencies contacted, fifteen interviews were scheduled and conducted. The missing responses weren't necessarily due to a lack of desirability to participate, as no agencies explicitly declined our invitation, but rather due to an inability to find the correct representatives to contact. Nevertheless, the interviews we were able to conduct provided the perspective of more than half of partner agencies within MWD's service area. Most of the responses received and thus interviewed were from water wholesale agencies; city-owned water providers had a lower response rate – only 3 out of the 12 wholesale agencies didn't respond (75% response rate) versus 6 out of the 14 cities contacted (57% response rate).

We assessed opinions and quotes collected during the interview process anonymously to protect the privacy of respondents and participants and encourage more open dialogue. A set of interview questions was drafted in advance by our team, found in Appendix A of this report. We conducted twenty-to-thirty-minute interviews via Zoom with responsive agencies.

We coded the interview results with a prioritization of trends (consensus or divergence) in responses to individual questions. Opinions supported by a majority of respondents received the highest amount of focus in our writing. We included opinions supported by only one or a few agencies but did not focus on them. Additionally, when the interpretation of a response was unclear, it was excluded from the analysis to avoid bias or inaccuracy.

FINDINGS

6.1 LRP Financing

According to an Annual Achievement Scorecard from MWD, a cumulative $729 million ($1.4 billion when adjusted for 2023 dollars) has been invested by the LRP over time in member agency projects (2023). Across the program's lifetime, twenty-one of the twenty-six member agencies have undertaken some form of LRP project. Regarding specific project types, the funding breakdown differs; however, the funding contribution suggests that recycled water programs are much more commonly applied for by member agencies, perhaps due to their slightly higher average cost.

It is important to note that MWD and its Board do not award funding on the basis of project type; the LRP funding is awarded on a first-come-first-serve basis for all eligible project types and therefore based on projects proposed by MWD's member agencies. Water reclamation and purification projects fall under the general category of recycled water projects and received a total contribution of about $430 million with a total of fifty-two projects. For groundwater treatment and purification projects, the total contribution received was about $180 million with a total of thirty-two projects. Both water distribution and expansion projects also fall under the general category of recycled water programs with each receiving about $91 million and $20 million respectively. Water distribution was featured in twenty-eight projects while there were twenty expansion projects.

While around 80% of the twenty-six member agencies received some funding, not all member agencies have applied for a project under the LRP. Moreover, the number of projects and funding level per agency was unevenly distributed. The Metropolitan Water District of Orange County (MWDOC), the San Diego County Water Authority (SDCWA) and the city of Los Angeles have the most LRP projects. MWDOC has the highest number of projects at twenty-three, SDWCA has twenty-two, and Los Angeles has a total of fifteen projects. MWDOC has the most funds awarded at $394 million, adjusted for inflation. West Basin MWD received $341 million from MWD despite only having three projects. SDCWA is the next closest at $167 million awarded. Figure 6 lists the amount of financial assistance received by each member agency in unadjusted and adjusted 2023 dollars, shown cumulatively and by per-capita.

Figure 5: *Coding of Specific Project Types with Respective Funding Contribution*

	Groundwater Treatment	Water Reclamation	Water Distribution	Expansion Projects	Other	Total
Active	15	24	10	9	4	62
Completed	5	22	8	5	0	40
Not Completed [2]	12	6	10	6	0	34
Total Projects	32	52	28	20	4	136
Total Funding Contribution ($)	$183,682,898.77	$429,468,278.55	$91,146,539.05	$20,247,225.60	$5,718,050.60	$730,262,992.57
Average Funding Contribution ($)	$5,740,090.59	$8,259,005.36	$3,255,233.54	$1,012,361.28	$1,429,512.65	$3,939,240.684

Figure 6a: *Table of LRP Funding Receipt by Agency*

Member Agency	LRP Funding Receipt (Not Adjusted for Inflation)	LRP Funding Receipt per Capita (Not Adjusted for Inflation)	LRP Funding Receipt (Adjusted for Inflation)	LRP Funding Receipt per Capita (Adjusted for Inflation)
MWD of Orange County	$223,099,900	$42,822	$393,980,894	$75,621
West Basin MWD	$172,319,621	$42,465	$341,095,121	$84,056
San Diego County Water Authority	$85,990,843	$18,994	$167,286,466	$36,952
Western MWD	$68,621,846	$13,360	$122,833,760	$23,914
Inland Empire Utilities Agency	$56,148,214	$10,908	$92,893,985	$18,046
Central Basin MWD	$31,004,636	$6,859	$61,812,901	$13,675
Eastern MWD	$27,797,567	$5,473	$49,549,648	$9,755
City of Los Angeles	$11,183,059	$3,066	$17,550,679	$4,811
Las Virgenes MWD	$9,943,009	$2,481	$27,809,771	$6,940
City of Torrance	$8,580,540	$1,915	$13,492,592	$3,012
Calleguas MWD	$8,054,222	$1,815	$13,499,338	$3,043
City of Glendale	$5,923,579	$1,266	$11,218,898	$2,398
City of Long Beach	$5,243,521	$1,203	$12,701,685	$2,915
City of Burbank	$4,925,639	$1,191	$8,921,855	$2,158
City of Beverly Hills	$3,297,275	$942	$3,396,193	$970
Three Valleys MWD	$2,945,724	$634	$4,313,591	$929
Upper San Gabriel Valley MWD	$2,011,183	$449	$2,969,234	$663
City of Santa Ana	$1,205,577	$207	$2,519,656	$432
Foothill MWD	$855,994	$181	$1,789,027	$377
City of Santa Monica	$216,045	$50	$334,870	$77
City of Anaheim	$24,600	$4	$31,242	$5

[2] The Not Completed category includes both terminated projects that were ended before funding or shortly after initial funding, as well as projects that were accepted but where funding never went through.

Figure 6b: *Map of LRP Funding Receipt by Agency*

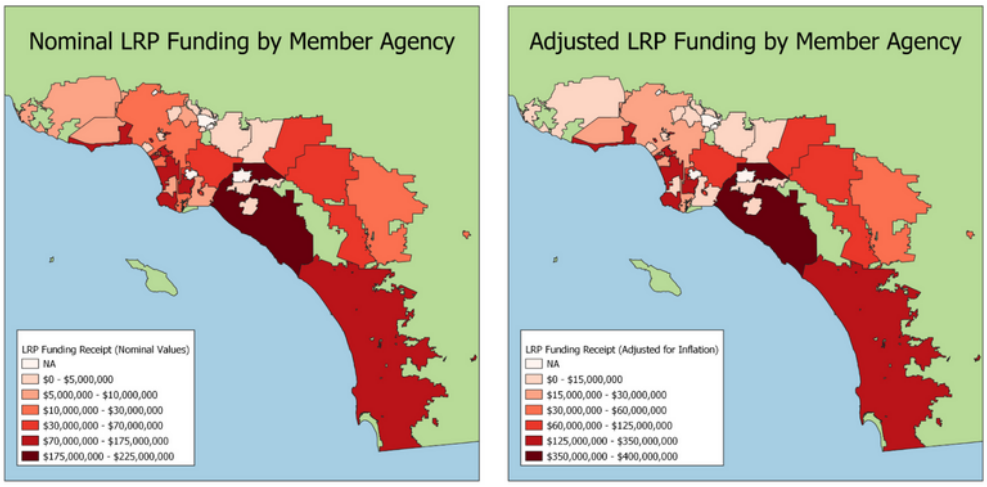


Figure 7 provides a breakdown of the projects begun and funding awarded as the LRP has evolved. At the inception of the LRP in 1984, seven projects were approved and began operating by the end of the decade– a modest start for the program. The 1990s and 2000s saw a significant jump in the number of projects and the funding received. From 1990-1999, thirty-seven projects were approved and awarded approximately $739 million adjusted for inflation. 2000-2009 saw thirty-eight projects awarded around $392 million, cutting the average funding in this decade from $20 million in 1990-1999 to $10 million in 2000-2009.

Since 2020, only five projects have been approved and implemented thus far, in addition to a significant decrease in the average funding received at around $1.2 million per project, compared to $3 million per project the decade prior. Further detail regarding contribution per year and per agency is provided in Figure 7 below. As observed, LRP contributions have been substantially lower since the 2010s. There may have been a decline in the number of projects in the current decade due to the impact of the COVID-19 pandemic on construction and facility operations. This decrease in project funding over the past two decades may also be due to more obvious funding decisions for projects considered "low-hanging fruit" at the program's outset.

Figure 7: *LRP Funding by Decade* [4]

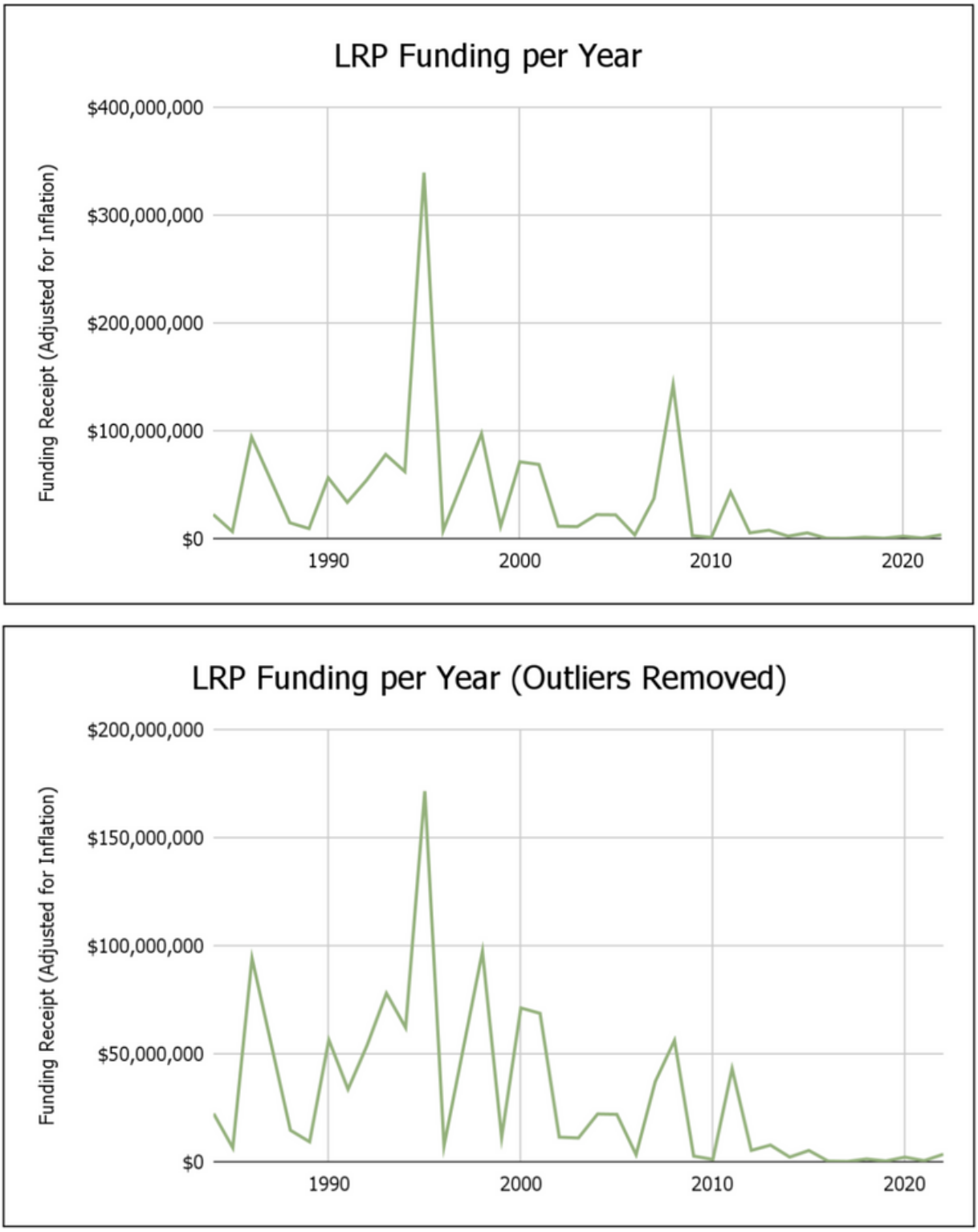
Year	Total Projects [5]	Total Funding (Adjusted for Inflation)	Average Funding (Adjusted for Inflation)
1984-1989	7	$146,708,850	$20,958,407
1990-1999	37	$739,244,945	$19,979,593
2000-2009	38	$391,557,159	$10,304,136
2010-2019	22	$66,432,867	$3,019,676
2020-Present	5	$6,057,583	$1,211,517

[3] Eleven projects not in or no longer in operation were not adjusted for inflation because the date was not provided in the LRP spreadsheet provided by a contact at MWD, and two additional projects did not report funding amount and were also omitted.

[4] There is a disparity in the number of projects and their subsequent funding between Figures 5 and 7. A concerted effort was made to determine the cause of the unaligned data. It is recommended that MWD first resolve these discrepancies within their data and then make said data accessible for public viewership.

[5] The eleven projects considered to be NIO, or "not in operation," would have received a total of $229,200,575.15 (nominal dollars) from MWD. There are an additional two projects with funding years for 2010 and 2019 that reportedly received $0 and are also not included.

Figure 8: *LRP Funding Over Time, total (top) and with outliers removed (bottom). Outliers include the West Basin Water Reclamation Program and Groundwater Replenishment System Project, which received $168m and $86m in 1995 and 2008.*



6.2 Sociodemographics of LRP Receipt

We further compared census data on poverty percentage, median income, and race and ethnicity of member agency populations to LRP project allocation and funding levels for agencies. Figure 9a visualizes the number of LRP projects funded per member agency by median income. The color scale indicates member agencies with lower median incomes with darker reds. Figure 9b similarly visualizes the percentage of people 200% below the poverty line. Darker reds indicate a greater proportion of those living in poverty. These two figures demonstrate similar spatial patterns, with Los Angeles, Central Basin MWD, Long Beach, Central Basin MWD, and other surrounding member agencies having lower median incomes and a greater proportion of their population 200% below the poverty line.

Statistical tests between LRP funding for all member agencies and median income and percent local water indicate a significantly positive relationship, and tests between LRP funding and Hispanic population percentage indicate a significantly negative relationship - all at a 98% confidence level. These results indicate that less LRP funding has been awarded to member agencies with lower incomes and a greater proportion of Hispanic populations. These results also indicate that member agencies who have received more LRP funding also have a greater percentage of local water dependence. These correlations indicate that the LRP may have an impact on local water supply in member agencies, but historical funding has not been distributed equitably.

Figure 9a: *Median Income and Corresponding Number of LRP Projects by Member Agencies*

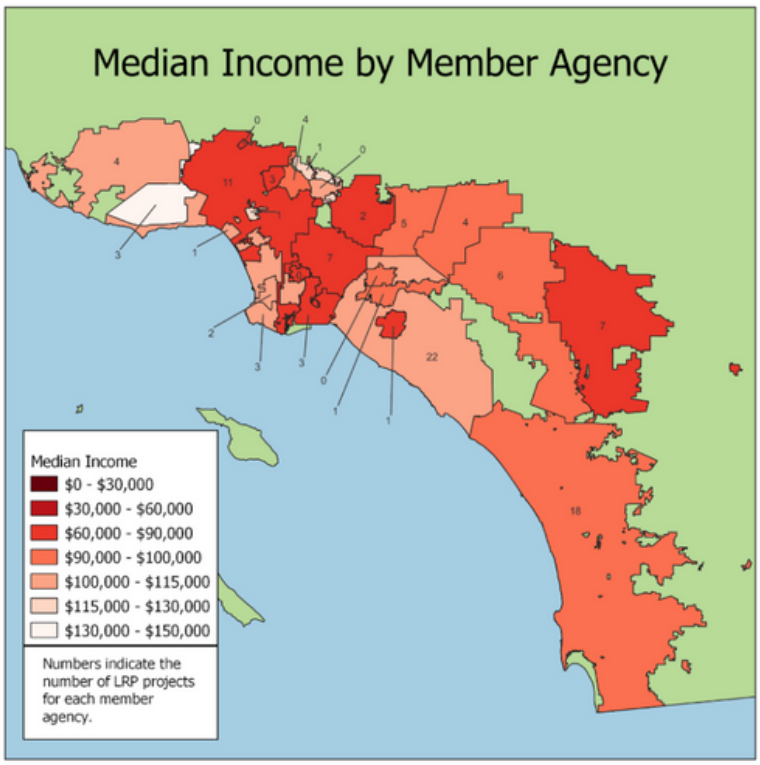


Figure 9b: *Percentage of Population 200% Below Poverty by Member Agencies*

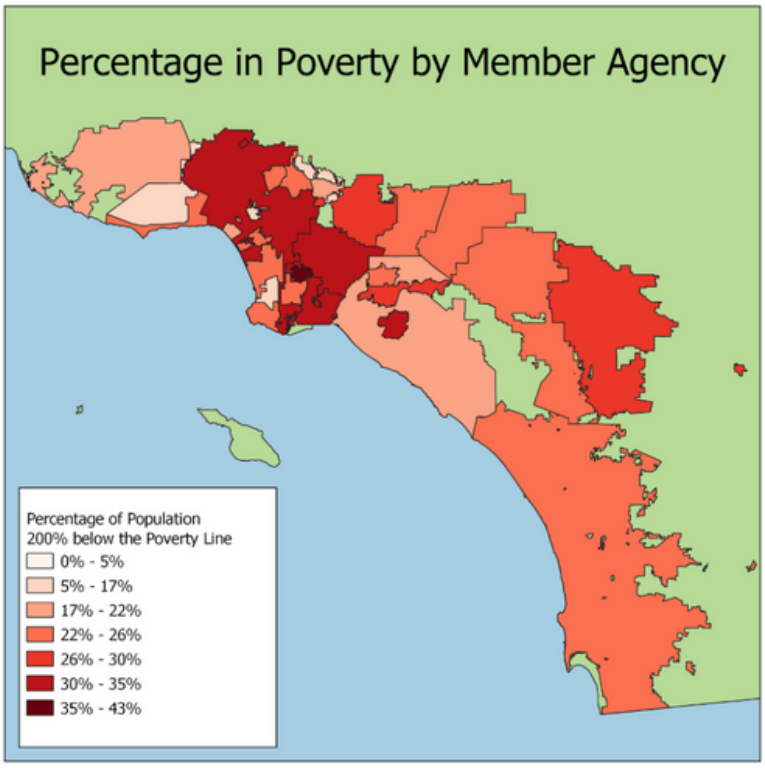


Figure 5c: *LRP Funding per Capita (Adjusted for Inflation)*

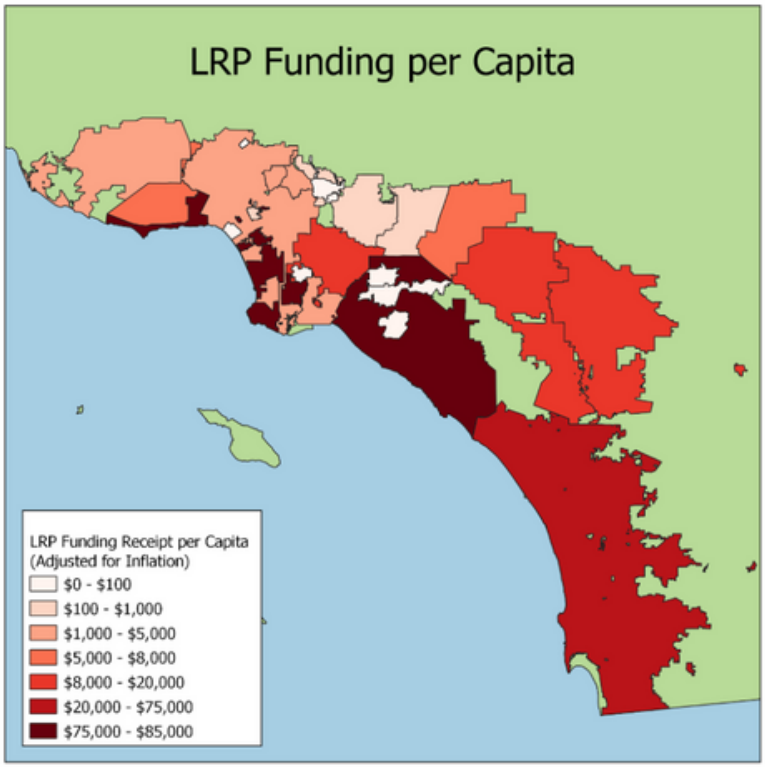
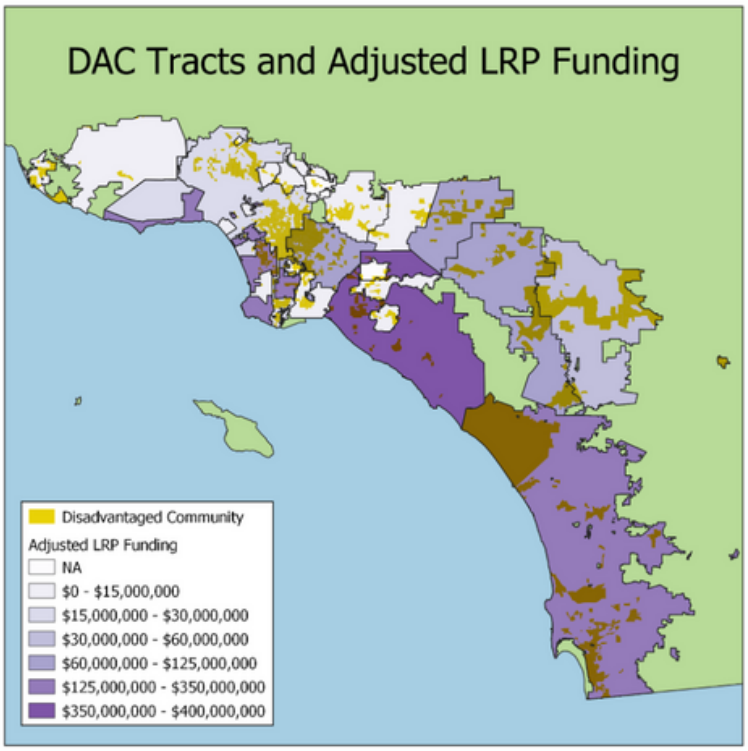


Figure 5d: *Disadvantaged Communities as defined by the California State Water Code by Census Tract vs. LRP Funding by Member Agency (Adjusted for Inflation)*



6.3 Urban Water Management Plan and the Integrated Resource Plan Analysis

Water resource management is a critical aspect of ensuring the long-term sustainability of urban areas, particularly in the face of evolving climate patterns and growing water demand. To address these challenges, UWMPs have emerged as valuable tools for cities and municipalities to develop comprehensive strategies for effective water utilization. However, the availability of published UWMPs varies among agencies, which necessitates the exploration of alternative data sources such as Integrated Resource Plans (IRPs). Understanding the influence of funding on water resource management becomes crucial in this context, as it can offer valuable insight into potential strategies for promoting sustainable practices and resilience. We found that the IRPs only had current local and imported water data, and future projections were absent. Member agencies were first categorized by whether they received LRP funding, how much funding they received (in U.S. dollars), and how many projects the LRP assisted in funding (Figure 10). Additional categories of analysis show how many people member agencies serve, what percent of the member agency relies on local water (in percent), and imported water.

Figure 10: *Member agencies LRP funding status; Percentage local and imported water statistics*

Agency	Received LRP Funding	Funding (Nominal)	Projects	People Served (website estimate)	Local water (%)	Imported water (%)
MWD of Orange County	Yes	$223,000,000	22	3,200,000	71.5	28.5
West Basin MWD	Yes	$172,000,000	3	1,000,000	29.1	70.9
San Diego County Water Authority	Yes	$85,990,843	18	3,300,000	33.5	66.5
Western MWD	Yes	$68,621,846	6	1,000,000	74.9	25.1
Inland Empire Utilities Agency	Yes	$56,148,214	4	935,000	73.2	26.8
Central Basin MWD	Yes	$31,004,636	7	1,600,000	93.1	6.9
Eastern MWD	Yes	$27,797,567	7	1,000,000	53.6	46.4
City of Los Angeles	Yes	$11,183,059	11	4,000,000	78.9	21.1
Las Virgenes MWD	Yes	$9,943,009	3	75,000	12.5	87.5
City of Torrance	Yes	$8,580,540	2	143,600	41.1	58.9
Calleguas MWD	Yes	$8,054,222	4	645,000	34.2	65.8
City of Glendale	Yes	$5,923,579	4	192,366	42.1	57.9
City of Long Beach	Yes	$5,243,521	3	456,062	55.1	44.9
City of Burbank	Yes	$4,925,639	3	105,401	41.4	58.6
City of Beverly Hills	Yes	$3,297,275	1	31,896	0	100
Three Valleys MWD	Yes	$2,945,724	5	500,000	39.9	60.1
Upper San Gabriel Valley MWD	Yes	$2,011,183	2	1,000,000	55.1	44.9
Santa Ana	Yes	$1,205,577	1	309,441	77.9	22.1
Foothill MWD	Yes	$855,994	1	80,000	52.7	47.3
City of Santa Monica	Yes	$216,045	1	91,105	77	23
City of Anaheim	Yes	$24,600	1	345,940	76.7	23.3
Compton	No	$0	0	93,597	99.5	0.5
Fullerton	No	$0	0	141,648	78.5	21.5
Pasadena	No	$0	0	135,732	27.8	72.2
San Fernando	No	$0	0	23,726	100	0
San Marino	No	$0	0	33,745	77.4	22.6

Then, we created a separate table with the calculated average local and imported water percentages for member agencies that did and did not receive LRP funding (Figure 11). We found that the agencies that did not receive LRP funding had a higher average local water percentage (76.6%) compared to agencies that did receive LRP funding (53.0%). While the relationship did not yield a statistically significant t-score (0.51) due to small sample size, there is a numeric mean difference of 23.6%. Several factors could explain this gap. One reason could be that the funding participating member agencies receive from the LRP is relatively new and takes time for the infrastructure to be built and in turn begin showing local water returns. Another explanation could be that agencies that did not apply for funding already have established local water supplies and simply had no need or desire to apply for the funding. There is, however, a significant relationship (confidence level of 98%) between percent local water and LRP funding per capita, indicating that the funding amount has a larger contribution to percent local water than a binary distinction regarding whether or not a member agency received funding.

Figure 11: *Average local and imported water for member agencies that did or did not receive funding*

Received LRP Funding	Number of Member Agencies	Average local water (%)	Average imported water (%)
Yes	21	53.0	47.0
No	5	76.6	23.4

6.4 Member Agency Interview Analysis

6.4.1 Response Rate

The following results are based on the seventeen interviews conducted with MWD's member agencies completed by our research team. A higher amount of funding received was correlated with a greater response rate; only one of the thirteen agencies that received more than $5 million did not respond. Eight of the other thirteen agencies with a funding of less than $5 million did not respond to e-mail communication to participate in an interview. This could be attributed to differences in system sizes, as smaller agencies are often equipped with less funding, meaning there may be fewer staff available to respond to e-mail correspondence within the timeframe required for this project. Comparing response to per capita funding instead, the correlation still holds that agencies with higher funding tended to respond more. Only two agencies receiving more than $25 in LRP funding per person did not respond to our inquiry; agencies that received more than $25 in LRP funding per person had an 83% response rate. Seven agencies receiving less than $25 in LRP funding per person did not respond to our inquiry; agencies that received less than $25 in LRP funding per person had a 50% response rate. Hence, agencies that receive higher funding overall, as well as per capita, seem more amenable to discussing the future of the LRP.

6.4.2. Summary member agency opinions on the LRP

While it is worth noting that member agencies were aware of our contact with MWD, and that this knowledge could have influenced the response of interviews, overall, member agencies expressed a relatively positive view on the LRP. All participants (n=17 of 26) indicated that the program has been historically vital for the development of local water infrastructure, as well as generally cost-effective. Three of the non-responsive members, whom we were unable to interview had not received any LRP funding– a possible cause for their lack of interest in participating. Of those interviewed, these agencies report that the program has helped and continues to help create regional water resiliency, decrease operational, managerial, and capital costs paid by the agencies, as well as increase local hydrological supplies over the years. However, as seen in Figure 12, over a third of interviewed agencies believed that the program needs improvement. A couple of members further noted that while it has been very useful in the past, the LRP is no longer very functional and will require major improvements to be so again.

Figure 12: *Member Agency Opinions of the LRP compared to received funding.*

		Perspective: LRP is "Good As Is"	Perspective: LRP "Needs Improvement"
Based on funding received	Over $10 million received	50%	50%
	Under $10 million received	70%	30%
Based on projects approved	Over 5 projects approved	42%	58%
	Under 5 projects approved	73%	27%
	Total	**62%**	**38%**

Interestingly, the majority of agencies that received funding for five or more projects were more likely to hold an opinion of concern; between two and three (accounting for partial or mixed opinions expressed in the interviews) of the six agencies with five or more LRP projects expressed this sentiment. However, the majority of agencies that had below five funded projects had a higher rate of positive views on the program; eight of eleven with under five LRP funded projects believed that the LRP is currently functioning well. This correlation could be attributed to relative experience with the program and subsequent support from MWD, whether positive or negative.

As for the clarity of the application process, thirteen of the sixteen participants indicated that the terms and conditions of the program are clear, with only three commenting on the difficulty qualifying for the program funding and the lack of clarity in terms of how unit costs are calculated; this may also reflect which agencies responded to interview requests given smaller agencies have less capacity to and experience in navigating funding application processes. All member agency representatives said they were made aware of MWD's Climate Action Plan (CAP) in addition to the development of individual climate action projects currently underway. Despite this, few related local water investment plans to MWD CAP objectives with any detail.

Major Interview Takeaways:

6.4.3. Against the possibility of ending the program

A major concern we observed was the fear of MWD possibly ending the LRP entirely. According to one interviewee, ending the program would be shortsighted thinking. The interviewee expressed that MWD should concentrate on ensuring the program fulfills its intended role to the greatest extent possible. Since there is a need, MWD was instead encouraged by nearly all participants to either leave the LRP as is, or adapt thorough yet incremental changes over time. Mostly, agencies asked that MWD not let short-term financial obstacles dominate any potential discussion, and focus instead on meeting long-term supply needs.

6.4.4. Overall need for increase of funds

Alongside the concern regarding losing LRP funding, the majority of agencies expressed a need for an increase in LRP funds, at both the project and program level. Agency representatives indicated that it would be better to have an even higher incentive (either financial or otherwise) to encourage local agencies to increase innovation and reach beyond the lowest threshold of the LRP. Additionally, many agencies want a larger focus on upfront capital funds, instead of purely operational funds. Lastly, a couple of members suggested MWD further secure funds for addressing quality contamination (groundwater PFAS contamination, TDS exceedance, etc.), which can in turn free up a higher quantity of supply. In short, if a water system can't afford the needed water treatment for contaminated groundwater, MWD could provide aid or assistance so that their groundwater may become usable, further removing additional and unnecessary reliance upon imported resources. Also, funding could be given for the reconstruction of damaged or seized projects, ensuring the sustainability of funded projects. A good example of this would be rebuilding the Tapo Canyon Water Treatment Plant (TCWTP), damaged by the Northridge Earthquake in January of 1994 and is no longer functional.

6.4.5. Ensuring that the LRP has a sustainable business model within MWD

Another concern that repeatedly arose was the long-term sustainability of the program. Because MWD pays its members to reduce their use of imported water supplies, it has less revenue— which seemed counterintuitive to many agencies and represented a concern for the sustainability of the LRP and how it fits in MWD's business model. In order to ensure that they can keep their LRP funding and be subject to needed increases in the future, agencies were interested in a clear indication of the LRP's financial sustainability. Interviewees suggested MWD establish a more stable revenue stream for the LRP's to ensure its long-term viability, perhaps a fixed charge or a simple rate tax. A few members even indicated their willingness to approve such a tax. Additionally, another idea was such that MWD could provide greater financial support for the LRP in return for a percent ownership of the water generated from the program. This would provide MWD ownership as well as a sustainable model in which revenue is generated through the partial ownership and sale of every acre foot of water sold to the end consumer.

6.4.6. Sharing of benefits on a regional scale

The discussion of possible futures for the LRP generated a robust and diverse set of responses. At the end of each interview, participants were asked to come up with possible ideas that our research had not included, but could be considered in aiding local water production. One proposition provided by three of the interviewees was to facilitate projects that allow for the sharing of benefits on a regional scale, perhaps encouraging more efficient inter-agency collaboration on LRP projects. Additionally, one interviewee mentioned that this concept could be applied on a broader scale, ensuring that a larger region (not just a single municipality) maximizes the benefits from each project. The participant suggested different wholesalers and/or multiple city agencies with overlapping regions of distribution, or regions in close proximity, co-create projects. In this way, smaller agencies that do not have and are unlikely to be able to apply for a local water generation project under the LRP alone can still benefit from the program.

6.4.7. Local water use and goals

Another major theme of the interviews was the proportion of local water resources agencies use and plan to develop to reduce reliance on imported water. The average, self-reported local water resources use goal was around 50% but ranged dramatically from as low as 20% to as high as 80%, perhaps reflecting the diversity of resource availability of the agencies. Most agencies indicated that it will not be possible in the foreseeable future to reach 100% local supply, emphasizing persisting current and future reliance upon MWD for imported water supplies and financial support from programs like the LRP.

6.4.8. Interest in the inclusion of a stormwater capture component

According to MWD estimates, around 450,000 acre-feet of stormwater is lost to the ocean annually within its service area (Crosson, 2023). If captured, this water can significantly help reduce imported water sources in the region. Stormwater capture (SWC) projects, however, could be very expensive, ranging from $400 per acre-foot to over $10,000 per acre-foot. Therefore, to achieve local stormwater goals, significant regional investments are needed. MWD is considering adding an SWC component under the LRP. To better understand the perspectives of member agencies on that particular initiative, we added a question concerning the desire for SWC inclusion in the LRP to the interview. We found that interest in including stormwater capture projects in the LRP was generally high, with two-thirds of agencies expressing interest in developing such a program similar to LA County's Safe Clean Water Program. The Safe Clean Water Program was voted to implement in 2018 and levies a tax on all non-exempt parcels in Los Angeles County. The tax revenue– paid for by property owners– goes to a mix of local and regional projects, infrastructure, and programs to capture, treat, and recycle rainwater. All supportive agencies indicated they would apply for such project funding. The rest of the agencies, or about a third of the interviewed participants, had concerns over the feasibility of SWC. Concerns mentioned were: the unreliability of stormwater due to the seasonality of precipitation, the land limitations given the needed infrastructure, and the lack of feasibility to meaningfully impact supply on small scales.

6.4.9. Engagement in LRP's future

Concerning future engagement in the LRP, member agencies were equally divided between currently: a) being engaged; b) not engaged; and c) not engaged enough, indicating that MWD can work harder on including its members in future decision-making processes. Many comments were made about the need for increased interaction between MWD and its members, emphasizing a more holistic dialogue concerning the future of MWD's water supply investments and funding programs. One member agency proposed additional planning workshops, and thus agencies were generally pleased with the current IRP and LRP planning and engagement processes that the MWD is already undertaking.

6.4.10. Reconciling projected and actual costs and benefits

Certain agencies also desired an improvement in reconciling "paper water" versus actual water. Paper water refers to the water a project expects to produce, as projected in planning stages. This doesn't, however, always align with what a project is able to produce post-implementation, given fluctuations in flow, issues in operations and management, delays in funding, etc.

6.4.11. Equal benefits for underserved communities

Several interviewees indicated that some underserved communities and small water systems pay MWD through property taxes for LRP projects yet have no direct connection to and thus no benefit from water from LRP projects. More needs to be done to ensure equal benefit for these communities. More broadly, there have been some complaints regarding the program's equity as some member agencies are in locations and situations that stand to benefit much more from the LRP than other member agencies. This pattern can be observed in the LRP funding map (figure 9c). One interviewed agency representative suggested creating a separate program that considers equity as a high-priority consideration to ensure lower income agencies are able to access the necessary funding with greater ease.

6.4.12. Climate change prioritization

Lastly, certain agencies were concerned about whether project funding approval is meaningfully related to climate change. Some participants recommended MWD set aside higher amounts for projects with a higher environmental benefit. More information is needed to ensure that these projects are benefiting MWD's CAP, as well as the CAP of any member agency within its service area. MWD might be able to account for fluctuations in funding where additional projects can be incentivized in periods of increasingly extreme drought conditions, and then balanced with lower funding in wetter years when rainfall is a sufficient supplement. However, it's important to note that not all agencies expressed this interest.

NEXT STEPS

Based on our findings, including the LRP distributional analysis, impact assessment of local water supply investments, and qualitative evaluation of past and future LRP implementation based on member agency interviews, our team has developed the following set of recommendations:

7.1. Program and Policy Recommendations

1. Continue the LRP in some form. The program has been of clear value to member agencies and a significant benefit to the development of local water resources in the region, the need for which has only increased.
2. Clarify the funding process for applicants to the LRP to ensure it follows a clear and transparent logic.
3. Clarify project selection criteria, indicating what causes projects to be approved or rejected.
4. Make robust, non-proprietary data about the attributes of funded projects publicly available for transparency, to enhance public understanding and enable further research on the program's success.
5. Report on whether the planned target investment of 170 thousand AFY of local water resources is met over time to evaluate regional impact and success of the program.
6. Increase the funding pool for the LRP. Proactively help member agencies directly apply to new state and federal funding opportunities for water supply that can contribute to overall LRP funding.
7. New funding can go towards:
    a. The inclusion of a stormwater capture project type into the current LRP model.
    b. The inclusion of water quality projects, potentially projects targeting PFAS contamination.
    c. The revival of inactive projects that have failed or have been neglected, such as the Tapo Canyon Water Treatment Plant.
8. Focus on modifications to better enable the funding for smaller agencies as well as agencies with large portions of disadvantaged communities that cannot otherwise match a sufficiently large portion of funding.
    a. Consider adopting either higher incentive amounts grants or very low interest loans in lieu of a pay for performance model to ensure a more equitable distribution of funds through the LRP.
    b. Consider establishing a parallel, more equity-focused program rather than modifying the existing LRP.
9. Consider a designated, privileged inter-agency collaboration pathway under the LRP to encourage participation by smaller agencies and disadvantaged communities that may require more assistance and partnership in order to apply.

7.2 Suggested future research

In this study, we aimed to assess a small but important part of the climate adaptation efforts of MWD member agencies through the analysis of MWD's LRP. Additional future research will be required to determine the causal role and its magnitude, or lack thereof, of the LRP in incentivizing MWD's member agencies to increase investments in local water generation. Moreover, future efforts to ensure continued improvement within the LRP could include some consideration of equity in a future reviewed version of the IRP, such as a more focused look at DACs. The revision and editing of its current form will be published in 2025; the document is reviewed and edited every five years with additional regulations and structural adjustments. The data and conclusions of such a potentially reviewed version of the IRP would be valuable to regularly assess trends and improvements in agencies' willingness to participate in the LRP.

CONCLUSION

Water scarcity in Southern California is a complex and multifaceted challenge driven by geography, climate, population growth, and unsustainable water management practices. Conservation efforts, water resource diversification, and long-term planning are necessary to ensure a reliable and sustainable water supply for the region's future. MWD's Local Resources Program (LRP) has emerged as a unique and forward-thinking approach to address the challenges associated with water supply within its service area in Southern California. Through its emphasis on diversifying water sources and promoting sustainable practices, this program aims to reduce reliance on imported water and foster the development of local resources.

Our study aimed to understand how the LRP has supported the long-term transition from imported water to local resources in Southern California. Our analysis shows that not all agencies have benefited equally from the LRP funding; six of the twenty-six agencies have received no funding at all, meaning that these agencies did not apply to the LRP, and funding is awarded on a first-come-first-serve basis. Moreover, due to the specific application mechanisms of the program, poorer and smaller communities have had fewer practical opportunities to receive funding.

Overall, the LRP has been influential in developing local water resources in the region and a great resource according to most interviewed agencies. Many existing recycling, groundwater, and desalination projects would not have been possible or would have been much harder to develop the LRP. Nevertheless, as the impacts of climate change become more significant in the region and as the population served by the MWD rises, more needs to be done to support local communities with existing and future water supply challenges. This will require a significant restructuring of policy in California combined with the cooperation and input of highly influential state entities like MWD to advocate for current and future member agency needs.

In addition to the LRP and other various endeavors to bolster local supplies, we found that interest in including stormwater capture (SWC) projects within the LRP was generally high, with two-thirds of agencies expressing an interest in the possibility of developing such a program. SWC efforts may be one of the keys to maximizing local water supplies as MWD moves toward a regional future less subject to the unpredictable nature of water supply beyond Southern California's backyard.

References

Achievements in conservation, recycling & groundwater recharge. (2023, February) .https://www.mwdh2o.com/media/3vah4zvt/2023-annual-achievement-report-final-metropolitan-water-district.pdf
Achhami, A., Kalra, A., & Ahmad, S. (2018). Dynamic simulation of Lake Mead water levels in response to climate change and varying demands. World Environmental and Water Resources Congress 2018. https://doi.org/10.1061/9780784481400.023
Alonso, K. (2021, February 12). 2018 Local Resources Program: Application Guidelines. The
Metropolitan Water District of Southern California. https://www.mwdh2o.com/media/11919/2018-lrp-application-guidelines_rev4.pdf
A new source of water for Southern California - mwdh2o.com. (2021, January). https://www.mwdh2o.com/media/16859/program-brochure-2021.pdf
Bennett, G., & Hastings, D. (2022, June 2). Megadrought causes perilously low water levels at Lake Mead. PBS. Retrieved November 29,2022, from https://www.pbs.org/newshour/show/persistent-drought-causes-perilously-low-water-levels-at-lake-mead
Budryk, Z. (2022, October 4). What happens if Lake Powell runs out of water? . The Hill. Retrieved November 29, 2022, from https://thehill.com/policy/energy-environment/3671785-what-happens-if-lake-powell-runs-out-of-water/
Buschatzke, T., Hamby, J. B., & Entsminger, J. J. (2023, May 22). The Colorado River Basin States Representatives of Arizona, California, and Nevada: Lower Basin Plan May 2023.
California Department of Food and Agriculture (2022). State water efficiency & enhancement program. https://www.cdfa.ca.gov/oefi/sweep/
California Natural Resources Agency. Bound accountability. https://bondaccountability.resources.ca.gov/Project.aspx?ProjectPK=48133&PropositionPK=48
California Open Data Portal https://data.ca.gov/dataset/i17-statewaterproject-centerline/resource/4b40946d-1b73-439f-b6e1-c4173757cdbe
California Water Boards (2020, August 25). The MCL review process. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLReview.html
Cayan, Daniel & Luers, Amy & Franco, Guido & Hanemann, Michael & Croes, Bart & Vine, Edward. (2008). Overview of the California climate change scenarios project. Climatic Change. 87. 1-6. 10.1007/s10584-007-9352-2.
Center for U.S. Climate and Energy solutions (2022) https://www.c2es.org/document/climate-action-plans/
Chou, B. (2022, March 21). California Snowpack and the Drought. NRDC. https://www.nrdc.org/resources/california-snowpack-and-drought
City of Santa Monica (2022, October 24). Sustainable water infrastructure project opens with community celebration November 17. https://www.santamonica.gov/press/2022/10/24/sustainable-water-infrastructure-project-opens-with-community-celebration-november-17
Climate Action Plan, MWD (2022) https://www.mwdh2o.com/media/12469/final-cap.pdf
Colorado River Basin Lincoln Institute. https://coloradoriverbasin-lincolninstitute.hub.arcgis.com/datasets/lincolninstitute::colorado-river-water-allocation/explore?location=36.485158%2C-107.744573%2C5.79
Costa-Cabral, Mariza & Roy, Sujoy & Maurer, Edwin & Mills, W. & Chen, Limin. (2011). Climate Change Impacts on the Los Angeles Aqueducts Water Sources: 21st Century Hydrologic Projections for Owens Valley and Mono Lake Watershed. AGU Fall Meeting Abstracts. 1235-. Owens (Dry) Lake, California. (n.d.). A Human-Induced Dust Problem. https://geochange.er.usgs.gov/sw/impacts/geology/owens/ 12.
Crosson, Liz. (2023). Building Regional Water Resilience in a Changing Climate
DWR WUEdata - 2020 Urban Water Management Plans. (2020) https://wuedata.water.ca.gov/uwmp_plans.asp?cmd=2020
East County Advanced Water Purification (2020). East County Advanced Water Purification Program receives $86 million in funding. https://eastcountyawp.com/CivicAlerts.aspx?AID=18&ARC=23
East County Advanced Water Purification (2023, February 9a). $2.4 million funding approved. https://eastcountyawp.com/CivicAlerts.aspx?AID=71
East County Advanced Water Purification (2023b). Phase 1B work approved for package B. https://eastcountyawp.com/CivicAlerts.aspx?AID=72
Environmental Protection Agency (2020, May 4). National primary drinking water regulations: Public notifications rule. http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2000_register&docid=fr04my00-13.pdf
Environmental Protection Agency (2022a, November 15). Information about public water systems. https://www.epa.gov/dwreginfo/information-about-public-water-systems#:~:text=EPA%20classifies%20these%20water%20systems,or%20on%20an%20occasional%20basis.
Environmental Protection Agency (2022b, September 23). WaterSense. https://www.epa.gov/watersense/start-saving
Environmental Protection Agency (2023) https://www3.epa.gov/region1/airquality/pm-what-is.html
Flavelle, C. (2023, April 11). Biden administration proposes evenly cutting water allotments from Colorado River. The New York Times. Retrieved April 20, 2023, from https://www.nytimes.com/2023/04/11/climate/colorado-river-water-cuts-drought.html
Flavelle, C., & Rojanasakul, M. (2023, January 27). As the Colorado River shrinks, Washington prepares to spread the pain. The New York Times. Retrieved April 20, 2023, from https://www.nytimes.com/2023/01/27/climate/colorado-river-biden-cuts.html
Gaddy, D. (2022, April 6). Santa Monica's journey to water self-sufficiency | waterworld. https://www.waterworld.com/water-utility-management/asset-management/article/14235527/santa-monicas-journey-to-water-selfsufficiency
Hagekhalil, A. (2022). Annual drinking water quality report. The Metropolitan Water District of Southern California. https://www.mwdh2o.com/media/hv3lufvm/wqr22_final_711-screen.pdf
Halofsky, J. E. (2021). Chapter 2: Climate Change Effects in the Sierra Nevada. In Climate Change Vulnerability and Adaptation for Infrastructure and Recreation in the Sierra Nevada. essay, U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.
Hickey, E. H. (2008). Water supply systems and evaluation methods. U.S. Fire Administration. https://www.usfa.fema.gov/downloads/pdf/publications/Water_Supply_Systems_Volume_I.pdf
Irvine Ranch Water District (2020). Irvine Ranch Water District policy position. https://www.irwd.com/images/pdf/about-us/public-policy/policy-papers/irwd_irp_lrp_policy_paper.pdf
Kanakoudis, V. & Gonelas, K. (2016). Non-revenue water reduction through pressure management in Kozani's water distribution network: from theory to practice. Desalination and Water Treatment, 57(25), pp. 11436-11446. https://doi.org/10.1080/19443994.2015.1049967
Mackie, A. (2021, June 25). Santa Monica, MWD jointly fund water recycling project to produce 750M gallons per year. California Water Environment Association. Retrieved February 17, 2023, from https://www.cwea.org/news/santa-monicamwd-jointly-fund-750m-gallon-per-year-water-recycling/
Megdal, S. B. (1997, August 1). Sharing Colorado River Water: History, Public Policy and the Colorado River Compact. The University of Arizona. https://wrrc.arizona.edu/publications/arroyo-newsletter/sharing-colorado-river-water-hist ory-public policy-and-colorado-river
Metropolitan Water District (2018). Local Resources Program Board Letters. https://www.mwdh2o.com/media/20238/local-resources-program-board-letters.pdf
Metropolitan Water District (2020a). Frequently asked questions about PFAS, PFOA and PFOS. https://www.mwdh2o.com/media/18595/pfas_faqs.pdf
Metropolitan Water District (2020b). Overview of metropolitan's efforts to encourage local resources development. https://www.mwdh20.org/media/20103/2794_001.pdf
Metropolitan Water District (2021). A new source of water for Southern California. https://www.mwdh2o.com/media/16859/program-brochure-2021.pdf
Metropolitan Water District (2022). Biennial Budget Book FY 2022/23 - 2023/24. https://www.mwdh2o.com/media/apajoynz/fy-2022_23-fy2023_24-biennial-budget-book-final-approved.pdf
Metropolitan Water District. Budget & finance. https://www.mwdh2o.com/budget-finance/
Metropolitan Water District. Building local supplies. https://www.mwdh2o.com/building-local-supplies/
Metropolitan Water District. Securing Our imported supplies. https://www.mwdh2o.com/securing-our-imported-supplies/#:~:text=We%20bring%20this%20water%20to,via%20the%20Colorado%20River%20Aqueduct
Metropolitan Water District. The Metropolitan Water District of Southern California. https://www.mwdh2o.com/
MWD The Integrated Water Resources Plan (2022). https://www.mwdh2o.com/how-we-plan/integrated-resource-plan/
Metropolitan Water District. Overview of Metropolitan's Efforts to Encourage Local Resources Development https://www.mwdh2o.com/media/20103/2794_001.pdf
National Geographic Society. How climate change impacts water access. https://education.nationalgeographic.org/resource/how-climate-change-impacts-water-access
Reich, K.D., Berg, N., Walton, D. B., Schwartz, M., Sun, F., Huang, X., & Hall, A. (2018). "Climate Change in the Sierra Nevada: California's Water Future." UCLA Center for Climate Science.
Seawater Barrier Projects. Swed: Seawater barrier projects page. (n.d.). from https://dpw.lacounty.gov/wrd/Projects/WCBUnit13/index.cfm
Social Explorer https://www.socialexplorer.com/tables/ACS2021_5yr/R13321772
State Water Resources Control Board (2008). Overview of California water quality law. https://www.waterboards.ca.gov/board_reference/docs/wq_law.pdf
United States Bureau of Reclamation. (n.d). Colorado River Compact, 1922. https://usbr.gov/lc/region/pao/pdfiles/crcompct.pdf
Water agencies unite and commit to reducing demands on Colorado River. MWD. (n.d.). https://www.mwdh2o.com/press-releases/water-agencies-unite-and-commit-to-reducing-demands-on-colorado-river/
Water Education Foundation. California Water 101. https://www.watereducation.org/photo-gallery/california-water-101#:~:text=Southern%20California%20imports%20more%20than,the%20city%20of%20Los%20Angeles
White House office of Press Secretary (2013). https://obamawhitehouse.archives.gov/the-press-office/2013/06/25/fact-sheet-president-obama-s-climate-action-plan

Appendix A

Member Interview Questions

1. Has your agency participated in the LRP, or considered it?
2. What is your agency's experience with or broad perspective on the present LRP?
    a. Do you have a view on whether it has supported or displaced member agency initiated local water investments?
3. Are the terms and conditions of the present LRP clear and/or presented effectively?
    a. Are there any questions you have to understand this program better?
4. Do you have opinions on how the future of the LRP should look?
    a. Has MWD engaged member agencies on the future of the LRP?
5. What do you think about the future incorporation of stormwater capture incentives in the LRP?
    a. Is this something your agency would be interested in?
6. What is your agency's local water resources attainment and goals?
    a. How has this amount/goals changed over time? Do you see LRP as supporting this goal?
7. Are you aware of MWD's Climate Action Plan (CAP)?
    a. Have you taken any precautionary measures to adapt to/or mitigate climate change? If so, can you give an example?
8. Are there any current issues you are facing within the LRP?
    a. What do you think would be the best way to solve these issues?
9. What do you think is the best part of the LRP?
    a. Why do you think this works so well?

Appendix B

B-1. Member agency boundaries

Appendix B

B-2. Number of LRP projects funded per member agency

Agency	Projects
MWD of Orange County	22
West Basin MWD	3
San Diego County Water Authority	22
Western MWD	4
Eastern MWD	7
Central Basin MWD	6
Inland Empire Utilities Agency	1
City of Los Angeles	14
Las Virgenes MWD	4
City of Torrance	2
Calleguas MWD	6
City of Glendale	2
City of Long Beach	3
City of Burbank	3
City of Beverly Hills	1
Three Valleys MWD	5
Upper San Gabriel Valley MWD	3
Foothill MWD	1
City of Santa Monica	2
City of Anaheim	1
Compton	0
Fullerton	0
Pasadena	0
San Fernando	0
San Marino	0
Santa Ana	0

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Authors: Ethan Choi, Steven Hong, Katerina Jowid, Malia Michelsen, Sally Min, Shirleya Williams, and Julia Wu

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