Best Management Practices for Improving Efficiency in Commercial, Industrial, and Institutional Water Use: Key Successes and Challenges in California

A Technical White Paper Prepared by Maddaus Water Management Inc.

Prepared for the California Department of Water Resources

March 31, 2022

Lisa Maddaus, P.E.

Michelle Maddaus, P.E.

Nicki Powell

MADDAUS WATER MANAGEMENT INC.

This report is included in the Recommendation Package of Department of Water Resources to the State Water Resources Control Board as a supporting document with a sequence number of WUES-DWR-2021-16.T1.

Acknowledgments

This technical white paper is the culmination of more than four decades of effort by William (Bill) Maddaus, the founder of Maddaus Water Management Inc. (MWM) and the MWM Team. Based on Bill's extensive field experience at commercial, industrial, and institutional (CII) properties, he compiled an original list of CII Water Use Efficiency Best Management Practices (BMPs) and developed a survey site review process to directly assist utilities and customers with improving water efficiency. Over the past 20 years, Bill initially trained and then continued to collaborate with Lisa Maddaus, Michelle Maddaus and Chris Matyas to perform CII Water Use Assessments and design Water Conservation Master Plans that incorporate CII BMPs. Incorporated in 2013, MWM has now expanded to include more industry specialists, including those who contributed to this publication: Nicki Powell, Sierra Orr, Andrea Pacheco, and Tess Kretschmann.

The technical white paper was made possible through the efforts of the Water Use Efficiency Branch in the California Department of Water Resources (DWR) and Stantec Consulting Services Inc. (Stantec). The authors would like to specifically acknowledge Sabrina Cook and Shem Stygar from DWR for their leadership and input, and Yung-Hsin Sun from Stantec for his dedicated support on the development of this publication through extensive review and feedback. In addition, the valuable insights gained from the DWR-led stakeholder process would not have been possible without the facilitation skills of Orit Kalman from the Center for Collaborative Policy, California State University, Sacramento. This paper would not have come into existence without Peter Brostrom, who originally requested the effort as the former DWR Water Use Efficiency Branch Chief. Peter deserves full credit for his vision in its creation. The DWR and our industry lost a magnificent resource and presence with his sudden passing in 2021.

The comprehensive nature of this publication would not have been possible without the contributions of industry professionals from utilities around the world who have provided invaluable experience and lessons learned to the MWM team when planning and implementing water use efficiency in the CII Water Use Sector. The comments from more than 150 California-based conservation professionals, who shared insights from their own experiences working with California's CII industry at each DWR working group meeting and stakeholder session, provided the authors with key information that is presented in this technical white paper.

The authors would like to express their deepest appreciation to the following case study contributors for their support, as their efforts greatly supported and enhanced the quality of this white paper:

- Ariel Flores, Los Angeles Department of Water and Power
- Madeline Wood and Cathie Paré, City of Santa Barbara
- Deb Lane, and Claire Nordlie, City of Santa Rosa
- Fiona Sanchez and Amy McNulty, Irvine Ranch Water District
- Anonymous, Supplier A

Executive Summary

Climate changes in California are stressing the state's water management system, requiring adaptation and cooperation from all sectors in order to cope with the variability (Mount et al., 2021). Climate projections also show that California's severe, multi-year droughts are likely to become the norm and will continue to test the vulnerabilities of the state's water supply system (Mount et al., 2021). As a result, California's water supplies are more threatened than ever when it comes to reliability for our community, hastening our need to act and work together to increase resilience for our communities.

One specific outcome of the last drought was the historic "Making Water Conservation a California Way of Life" legislation (Department of Water Resources [DWR] and State Water Resources Control Board [State Water Board], 2018) that provides foundational changes in our approach to water conservation and drought planning. Improving urban water use efficiency is a significant part of the 2018 legislation requirements, including the development and adoption of water use efficiency standards, variances, and performance measures for commercial, industrial, and institutional (CII) water use.

This technical white paper focuses on the best management practices (BMPs) for CII water use, presenting an overview of what current BMP implementation is like in the CII sector and identifying opportunities for urban water suppliers to assist their CII customers with water efficiency improvements. This paper incorporates stakeholder input, a literature review, and MWM's own technical experience to address the status, challenges and successes surrounding BMP implementation. Based on the water industry's collective experience over the past several decades, the following actions will maximize the benefits of water efficiency in the CII sector:

- **Raise Awareness that Water Resilience Leads to Economic Resilience**. Water is the cornerstone of California's $3.3 trillion economy, driving the need to be more efficient with available water supplies. According to the *California Water Plan Update 2018,* CII customer demands comprise an estimated 30% of the state's urban water demand. To increase our water resiliency, larger water users need to lead by example, given that the business sector water use is concentrated with more than 80% of the demand coming from the top 20% of CII customers in the community (Water Research Foundation, 2019).
- **Support State and Federal Efficiency Codes and Standards by Staying Current and Flexible.** While decades of water and energy efficiency standards and green building codes have resulted in billions of gallons of water saved every year in California, more upgrades are still needed to increase saturation of higher efficiency appliances and fixtures. In one 2019 study, the Plumbing Manufacturers Institute, in conjunction with the US EPA, found that the California saturation rate in the US EPA's WaterSense-labeled water efficient urinal and toilet products is only 1.2% and 16.8%, respectively (GMP Research, 2019). More studies on market penetration are necessary to help confirm where enhanced efficiency standards are warranted, including more irrigation

equipment. One recommendation includes continued enhancement of the California Green Building Standards Code (Part 11, Title 24, California Code of Regulations), known as CALGreen, which is the first-in-the-nation mandatory green building standards code. Additional recommendations for improvements include continued improvement of Title 20 Appliance Efficiency Standards, the Model Water Efficient Landscape Ordinance, and other policy standards to support local higher efficiency practices regarding purchases of new equipment for building or renovating properties.

- **Hasten the Business Sector to Engage and Invest More.** All businesses have a responsibility to embrace the need to be more water efficient. Being water wise is being business wise for all CII users. Some businesses have already invested in sustainability practices, products, and services. Some have even become "green business" certified which includes verification of water efficient practices. Continued technology advancement provides additional opportunities for business owners to implement measures with shorter payback periods. This is important as only limited progress can be made by water suppliers without the participation of business owners.
- **Leverage Urban Water Suppliers' Experience to Strengthen Their Commitments and Investments**. For decades, CII water use efficiency BMPs through partnerships between urban water suppliers and businessowners have been voluntarily implemented with varying levels of success. Given the diversity of businesses and utilities and the variability in CII customer water use, achieving cost-effective CII Water Use Efficiency (WUE) programs have often proven challenging and time intensive for water suppliers and customers. Pragmatic efforts at implementation need to continue to press forward using water industry CII BMPs where cost-effective for local ratepayers or supported by external funding. Where justified, suppliers may seek to hire more staff and promote the expansion of specialized training programs to sufficiently motivate cost-sharing investments with business owners.
- **Take Advantage of Multi-benefit Funding Opportunities.** Beyond the water sector, there are multiple benefits to investing in water efficiency. These include, but are not limited to, greenhouse gas emissions savings that meet energy sector mandates, wastewater and stormwater volume dry weather flow reductions that have water quality benefits, and savings on peak demand (cooling and irrigation) to optimize infrastructure investments. More examples are needed of successful funding partnerships that document the multi-benefit opportunities in the CII sector. This would also highlight where additional external funding would be most supportive to implementing more CII water use efficiency BMPs.

Most successful CII water use efficiency BMP implementation in California is due to urban retail water suppliers taking one or more of the following actions: (1) offering a customized program to their service area; (2) offering group incentives; (3) leveraging

wholesaler or regional program funding sources; (4) engaging in programs that directly install devices; and (5) developing successful partnerships with other organizations and agencies to help implement BMPs. Especially during dry year and drought conditions, there has been more documented public support of encouraging water use efficiency, which along with increasing saturation rates of new appliances and fixtures installed is evidence that CII customers are more aware of the need to conserve water. This is most notable in the case studies provided within this technical white paper.

Why Does It Really Matter to Increase CII WUE?

Since the first CII BMP activities were voluntarily committed to by the Signatories of the 1991 Memorandum of Understanding Regarding Urban Water Conservation in California (CUWCC, 1991), industry experience of challenges and successes has shown us the many reasons why it is so important to increase CII water use efficiency.

DWR hosted workshops and meetings through early 2022 with more than 150 workgroup members and stakeholders to help identify the key challenges and successes to implementing CII WUE performance measures called for in the "Making Water Conservation a California Way of Life" legislation (DWR & State Water Board, 2018). Taking into consideration the progress of the CII sector thus far and coupled with more than 25 years of the authors' planning and field implementation experience of CII BMPs across the state of California, the following are key insights to maximizing CII WUE water savings:

- *Top challenges for CII customer and BMP implementation*: Businesses have competing interests and property/business management often do not prioritize water efficiency investments. Common disconnects occur between the water supplier and business owners due to issues such as staff turnover, lack of interest or buy-in to invest, receiving management approval, and inadequate execution at the staff operations level.
- *Top challenges for water supplier and BMP implementation*: Minimal to no enforcement authority, coupled with lack of skilled labor with specialized staff training and adequate funding, make it difficult for water suppliers to facilitate water efficiency upgrades of CII customers/facilities operating on private properties. Right now, California also does not have a standardized CII classification system nor well-defined baseline metrics to help monitor future key successes and challenges in urban water supplier BMP implementation. Once overcome, a standardized statewide CII classification will lead to better understanding of CII customers' water use patterns, and best practices will help direct funds to meaningful investments to obtain water savings.
- *Top successes achieved by CII customers*: Sustainability-minded communities with green business certification programs collaborate and leverage funding to cost share with business owners. Cost and public perception are top drivers for many CII customers. Water Management Plans, developed and implemented by CII customers, are practical but are also expensive, complex, and only warranted

in select situations. Standardization is needed for what constitutes a holistic water assessment (also known as water audit, evaluation, or survey[1]) and Water Management Plans, while allowing for adaptability and flexibility to apply to the diverse types of businesses.

- *Top successes achieved by water suppliers*: Locally adapted and customized programs are most successful. BMPs, including a list of 46 potential ideas, have become increasingly robust, developed over decades mainly by larger water suppliers. This most particularly includes water assessments. Staff training to implement BMPs combined with adequately funded incentives and partnering with committed customers is a winning combination. This is most often seen in communities with higher water costs or scarcity of water supplies, driving more cost-effective ratepayer-based investments. Overall flexibility is necessary. Pilot studies lead to stronger implementation strategies by confirming cost-effectiveness and market saturation in the design phase.
- *Top critical needs and/or recommendations from stakeholders*: Regulations, such as building codes and appliance and fixture efficiency standards along with local ordinances, have resulted in real water savings. These regulations help create "passive" savings as upgrades to more efficient equipment are required when less efficient equipment needs repair or replacement. Water suppliers need more support from the state and federal agencies for water supplier staff training and funding along with flexibility to design programs that fit their unique CII customers. Partnerships and collaborations are key to implementation with buy-in from multiple agencies, leading to larger projects including pay-for-performance type approaches. These approaches deliver lasting water savings, as illustrated in the case studies in Appendix C. Leveraging various funding sources and developing key account relationships, especially with CII customers that use the majority of water, are vital to achieve long-term sustainable water savings.

Fundamentally, the CII sector has and continues to improve water use efficiency, yet there are significant opportunities for customers and urban water suppliers to further water savings in this sector. Investments in training, funding and technological improvements over time are needed to strengthen the implementation of best management practices within this sector and encourage greater water use efficiency. As the CII sector achieves more water savings, California's water supplies will become more reliable, benefitting all businesses, institutions, and their customer base residents.

[1] The term "water audit" has developed a negative connotation for customers which has impacted urban water supplier outreach efforts. As a result, industry trends have moved toward the use of different terminology, most notably water "assessment" rather than "audit." Therefore, for the purposes of this paper, the terms assessment, audit, evaluation, and survey may be used interchangeably throughout this white paper to maintain the integrity of original citations and to honor individual agency preferences in stakeholder surveys and case studies. A detailed definition of "assessment" is provided in Section 5.1.2 and Appendix E.

Table of Contents

Acronyms and Abbreviations

AB	Assembly Bill
ACWA	Association of California Water Agencies
AMI	Advanced Metering Infrastructure
APN	Assessor's Parcel Number
AWE	Alliance for Water Efficiency
AWWA	American Water Works Association
BAWSCA	Bay Area Water Supply and Conservation Agency
BMP	Best Management Practice
CalWEP	California Water Efficiency Partnership
CCWD	Contra Costa Water District
CEC	California Energy Commission
CII	Commercial, Industrial, and Institutional
CIMIS	California Irrigation Management Information System
CPUC	California Public Utilities Commission
CUWA	California Urban Water Agencies
CUWCC	California Urban Water Conservation Council
CWA	California Water Association
CWC	California Water Code
DOE	United States Department of Energy
DMM	Demand Management Measure
DSS Model	Least Cost Planning Decision Support System Model
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
GPCD	Gallons Per Capita Per Day
gpf	gallons per flush
gpm	gallons per minute
gpy	gallons per year
HEW	High Efficiency Washer
IRWD	Irvine Ranch Water District
LADWP	Los Angeles Department of Water and Power
Legislature	California State Legislature

maf	million acre-feet
MWDOC	Municipal Water District of Orange County
MWELO	Model Water Efficient Landscape Ordinance
MWM	Maddaus Water Management Inc.
NAICS	North American Industry Classification System
NPDES	Non-Point Discharge Elimination System
PPIC	Public Policy Institute of California
psi	pounds per square inch
SB	Senate Bill
SMPM	Standards, Methodologies, and Performance Measures
State Water Board	State Water Resources Control Board
ULFT	Ultra-Low Flush Toilet
US EPA	United States Environmental Protection Agency
UWMP	Urban Water Management Plan
UWUO	Urban Water Use Objective
WMP	Water Management Plan
WSCP	Water Shortage Contingency Plan
WUE	Water Use Efficiency
WUS	Water Use Studies

1 Introduction

This technical white paper provides an overview of the water use in the commercial, industrial, and institutional (CII) sector. This includes a review of historical and current implementation of best management practices (BMPs) by urban water suppliers (including urban retail water suppliers and urban wholesale water suppliers) to improve water use efficiency (WUE) in California.

A BMP is defined as a set of practices, measures, or procedures that is beneficial, empirically proven, cost effective, and widely accepted by the professional community (Maddaus et al., 2017). BMPs are classified as the actions available that lead to increased conservation ethic in the CII water use sector by CII customer facility managers, urban water suppliers, regulators, legislators, and voluntary organizations.

A multifaceted approach is needed to build the conservation ethic in the CII sector. Key elements that have been found to influence CII sector water use efficiency BMP implementation strategies include:

- **CII Customer Outreach and Relations:** Connecting with CII customers requires a unique approach when it comes to outreach and can be a time-intensive effort. Water supplier relations need to be tailored and robust one-on-one contacts made by knowledgeable staff with key business facility decision-makers and operations staff. Testimonials from recent CII customers' successful upgrades in WUE technologies can lead to more effective outreach strategies to all CII customers by building on the knowledge and trust in the benefits of those investments for their businesses. The energy sector takes a "key account" manager approach to help with points of contact and outreach to large users for supply reliability and security as well as to include opportunities such as rebates or site assessments to improve efficiency.
- **Federal, State, and Local Funding Resources:** Funding is always a critical concern, especially for urban retailer water suppliers looking to combine sources to fund BMP implementation support while cost-sharing with businessowners who are focused on their bottom-line and customer service. Businessowners want to know the payback on BMP implementation, and many times anything with a payback from a few months to two years is not considered financially feasible. Urban retail water suppliers are tasked with developing BMPs focused on rebate incentives or even "pay for performance" programs to buy back water savings where water scarcity makes such programs more financially viable. Often this involves a focus on larger users that consume most of the water in the CII sector.
- **Policies and Regulations:** These include the suite of local, state, and federal codes and standards that govern installation of water efficient fixtures and appliances. They have been a useful tool, especially in the case of plumbing

efficiency standards that have resulted in and continue to lead to billions of gallons of water saved every year. This is largely due to CII customers being required to replace fixtures and appliances with higher efficiency models for new construction installations, fixture repairs, or in select situations when account or property ownership changes. Beyond the higher efficiency of indoor equipment, appliances, and fixtures, local ordinances (including landscape BMPs) continue to produce on-going, additional water savings in the non-residential sector.

- **Education and resources:** There are a suite of opportunities to educate CII customers, staff, management, and other supporting or partnering non-governmental organizations (e.g., California Water Efficiency Partnership, or CalWEP). To be useful, these resources need to cover the broad range of CII water uses and technologies and explain the unique benefits to different types of CII customer audiences. One example of a useful resource is the Alliance for Water Efficiency's (AWE) *Commercial Kitchens Guide* (AWE, 2018).
- **Water Supplier Staffing and Contractors:** The manpower needed to execute installation, or support and collaborate with onsite CII facility staff in the BMP. Staff and contractors need to learn and carefully plan for WUE BMP implementation that minimizes or eliminates impacts to business operations. Water utility staff need tools, resources, and thorough training on WUE opportunities in order to know how to research, design and implement projects to achieve water savings successfully, such that the CII customers continue to thrive in their businesses.

The findings presented in this paper are organized by the key elements in Figure 1 as a framework. They provide a roadmap for holistic CII BMP implementation strategy.

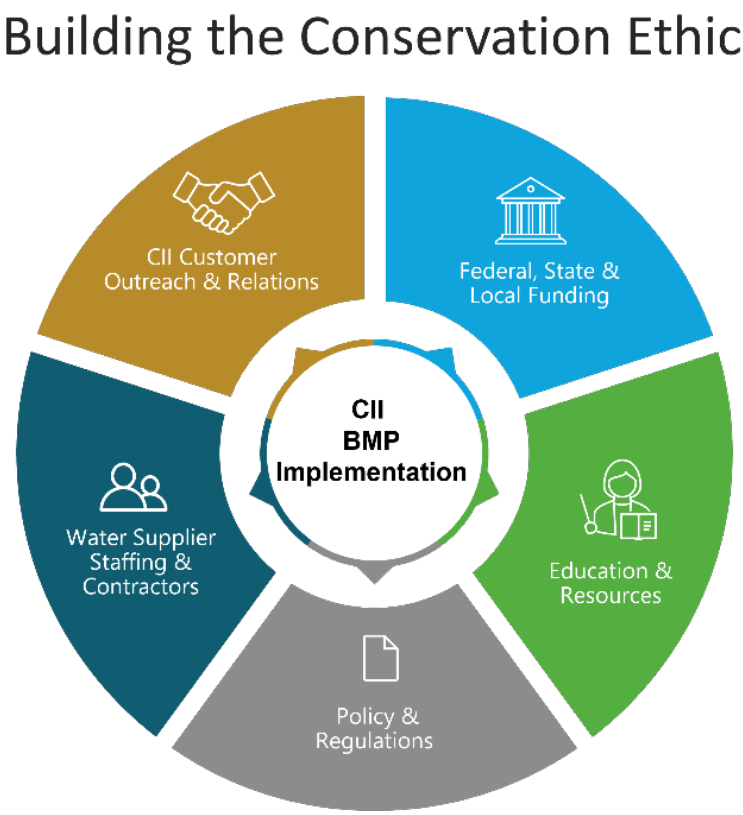


Figure 1: Key Elements to CII WUE BMP Implementation

This CII BMP implementation approach has been adapted from the comprehensive conservation program planning approach for all urban water use sectors described in the American Water Works Association (AWWA) *Manual M52 Water Conservation Programs – A Planning Manual, 2nd Edition* (Maddaus et al., 2017). The goal is to offer a simplified framework to understand CII BMP Implementation efforts. Sections 4 and 5 frame the key challenges and successes in CII BMP implementation into a context that leads to maximizing our collective efforts in WUE improvements in this sector.

1.1 Purpose

This white paper is intended to provide CII BMP recommendations for industry-wide consideration, based on MWM experience with CII BMP conservation programs, stakeholder input, and industry research. MWM's experience includes program design, training more than 400 utility staff, and the direct field implementation by MWM staff of water assessments[2] with reports on behalf of urban water suppliers. Industry research

[2] The term "water audit" has developed a negative connotation for customers which has impacted urban water supplier outreach efforts. As a result, industry trends have moved toward the use of different terminology, most notably water "assessment" rather than "audit." Therefore, for the purposes of this paper, the terms assessment, audit, evaluation, and survey may be used interchangeably throughout this white paper to maintain the integrity of original citations and to honor individual agency preferences in surveys and case studies. A detailed definition of "assessment" is provided in Section 5.1.2 and Appendix E.

and stakeholder feedback related to BMP feasibility are also significant contributors to this paper's evaluation of CII BMPs.

DWR is developing recommendations for water use efficiency standards and performance measures per the 2018 Legislation for Water Conservation and Drought Planning (SB 606 and AB 1668). As part of the legislative requirements, DWR is to develop recommendations on CII water use efficiency performance measures for consideration by the State Water Resources Control Board (State Water Board) per California Water Code (CWC) 10609.10(a). To inform the development of the CII water use efficiency performance measures, DWR funded MWM to develop a comprehensive overview of the current implementation of CII BMPs, including key successes and challenges. The resulting white paper can also be a reference for urban water suppliers and CII customers.

1.2 Document Development

This white paper builds upon the 2013 CII Task Force Water Use Best Management Practices Report to supplement the report's customer-centric BMP list with supplier-side BMPs and incorporates updated information from other technical documents based on a literature review. MWM also based the technical perspectives in this white paper on more than 25 years of its own experience working with urban water suppliers in the CII water use sector and field water assessments at CII customers facilities, citing lessons learned from consulting and coordinating with both suppliers and CII facilities on the implementation of CII BMPs. To strengthen the document further, MWM solicited stakeholder input through leveraging DWR's stakeholder engagement process, including workshops, meetings, online surveys, and case studies. The result is an assessment of the successes and challenges of implementing CII Water Use Efficiency (WUE) BMPs and recommendations for urban water suppliers, legislative agencies, and other stakeholders on encouraging and supporting CII BMP implementation.

1.3 Document Organization

This white paper is organized into the following sections:

- Section 1 – Introduction. This section provides the purpose of this white paper and its development process.
- Section 2 – Overview of CII Water Use in the Water-Fueled California Economy. This section focuses on CII water use characteristics, types of facilities and users as well as classifications and benchmarking methods.
- Section 3 – History and Guidance on CII Water Use Efficiency Best Management Practices. Through a historical perspective we briefly review the laws and organizations that have shaped CII water use and BMPS as well as publications that may be referenced for further understanding.

- Section 4 – CII BMP Implementation Experience. Through stakeholder surveys, case studies and extensive field experience we get a first look into the experience of running CII programs.
- Section 5 – Key Findings on CII BMPs. First, we explain the eight most implemented CII BMP's. We then return to the BMP implementation strategies as described in the Introduction and Figure 1 as a framework to discuss challenges, successes, and recommendations.
- Section 6 – Comprehensive List of Current CII WUE BMPs. This section includes a comprehensive table of CII measures including their type, focus, whether they are voluntary, an incentive or mandated, as well as short descriptions of each.
- Section 7 – Conclusion. This section provides a summary of salient points found throughout the research.
- Appendices – the appendices include six case studies prepared by urban water suppliers for an in-depth review of current CII programs in their service areas, along with report templates, survey results, and definitions.

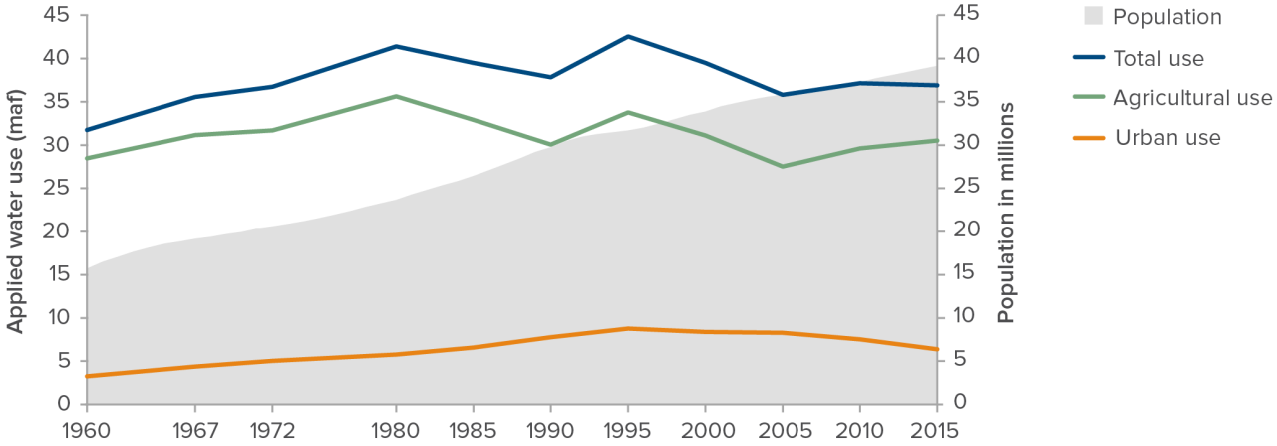
2 Overview of CII Water Use in the Water-Fueled California Economy

Water is essential to California's $3.3 trillion economy, fueling businesses and households, supporting the production of agricultural and industrial products, and sustaining healthy ecosystems and watersheds whose services Californians rely on (Bureau of Economic Analysis, 2021). However, due to its subjection to numerous and competing demands, water has become a scare resource, prompting innovations to improve California's water resilience (Hanak et al., 2021). Furthermore, climate changes in California are stressing the state's water management system, requiring adaptation and cooperation from all sectors in order to cope with the variability (Mount et al., 2021). Climate projections also show that California's severe, multi-year droughts are likely to become the norm and will continue to test the vulnerabilities of the state's water supply system (Mount et al., 2021).

Over the past 160 years, California's water supply system has evolved to meet these challenges, including an increased emphasis on water use efficiency. In urban areas in particular, water conservation can play an important role in adapting to reduced supplies, as it did in the drought of 2012-16 (Mount et al., 2021). Increasing water use efficiency will continue to be critical to growing and protecting the state's economy and to reducing pressures on California's water resources and environmental health. (DWR Vol. 1, 2013).

2.1 CII Sector Water Use

The CII sector employs the state's residents, provides goods and services, and maintains the state's position as a center for technology and innovation (DWR, Vol. 1, 2013). Though California's economy and population have grown, water use in the state has remained generally consistent (Figure 2).



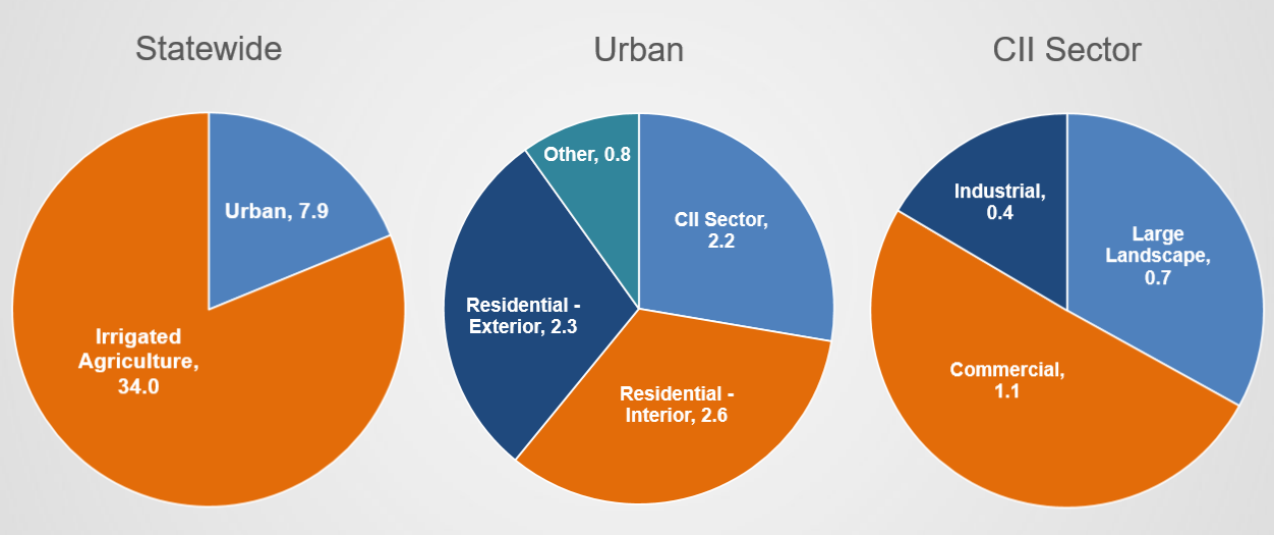
Notes:

1. *Except for 2015 (a severe drought year), the figure reports the estimates for normal rainfall years.*
2. *Pre-2000 estimates are adjusted to levels that would have been used in a year of normal rainfall.*
3. *Estimates are for water years (October 1 to September 30).*

Source: Water Use in California *(PPIC, 2019).*

Figure 2: California Consumptive Water Use (1960-2015)

Considering a total consumptive water use of nearly 42 million acre-feet (maf) as documented in the 2018 *California Water Plan Update* (DWR, 2018), CII use at 2.2 maf does not represent a large portion of the overall water use in California (Figure 3). Volumetrically, DWR estimates that the CII sector accounts for about 5% of statewide consumptive water use. However, looking specifically at urban water use, DWR estimates that approximately 28% of total urban water use in California is from the CII sector (Figure 3), and on average, the CII sector accounts for between 30 to 50% of municipal water demand within community water service area boundaries nationally (Kiefer et al., 2015). Thus, CII water use is significant at the municipal level.



Notes:

1. *Data based on 2011-2015 California Water Plan averages.*
2. *Volumes shown are in million acre-feet (maf) per year.*

Source: California Water Plan Update *(DWR, 2018).*

Figure 3: Volumetric breakdown of California Non-Environmental Developed Water Use

2.2 Increasing Focus on Urban Water Use Efficiency in the CII Sector

Due to being a vital ingredient in California's economy and a significant portion of California's urban water deliveries going to CII customers, understanding the water use and drought response within the CII sector is important for long-term state water resiliency (M.Cubed, 2017). Increasing drought and social awareness of water issues has also put pressure on the CII sector to manage its water resources efficiently. The CII sector is one of the foci for urban water use for the "Making Water Conservation a California Way of Life" legislation (DWR & State Water Board, 2018).

Addressing water use efficiency in the CII sector is, however, uniquely challenging for multiple reasons, many due to the sector's distinguishing characteristics. It is also important to note that the presence of CII customers within their service areas varies widely among California urban water suppliers, ranging from 27 total CII accounts (0.6% of accounts) in the case of the City of Hillsborough to more than 84,000 total CII accounts (11% of accounts) in the case of Los Angeles Department of Water and Power. This difference is important when addressing water use efficiency on both the state and local levels, as the make-up of each urban area will dictate which sectors and groups should be targeted to reduce water use most effectively.

2.3 Important CII Water Use Characteristics

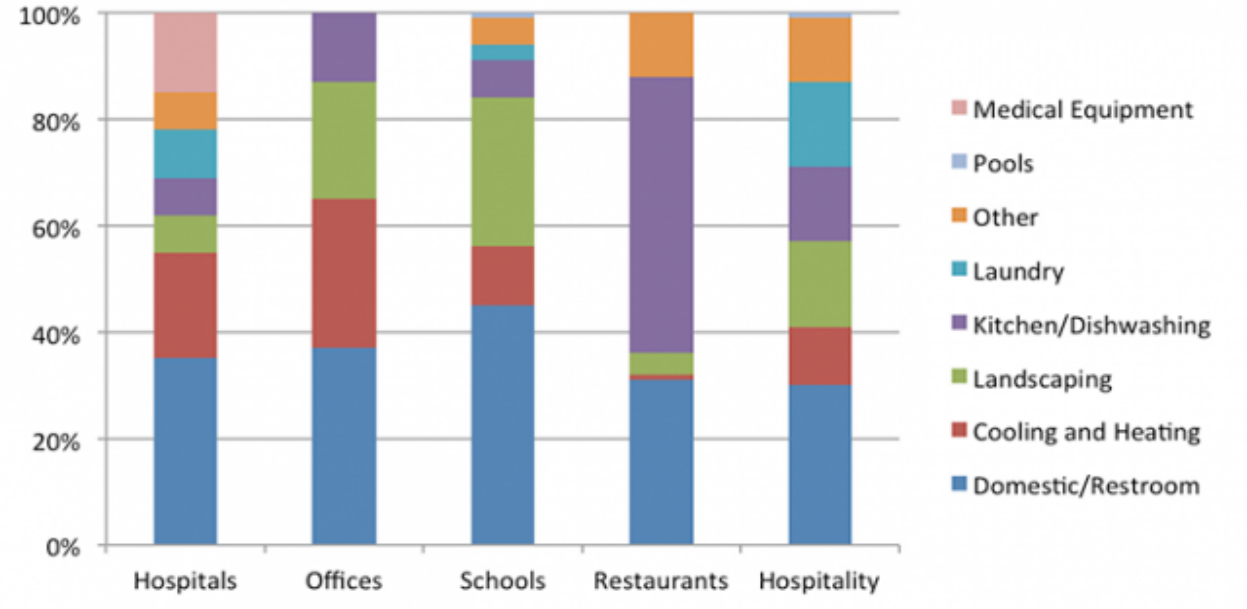
Unlike residential customers, where water use patterns are relatively consistent, CII uses are highly variable (M.Cubed, 2017). Numerous characteristics described in this

section provide background to the complexities of CII sector water use, which require specialized knowledge by water supplier staff and CII facility managers as well as unique BMP implementation strategies.

2.3.1 Diverse Types of CII Water Facilities

The broad diversity in CII facility types and sizes, equipment types, facility age, quantity and rate of operations, and number of fixtures can make addressing water use efficiency challenging in the CII sector. For example, a hospital has a very different water use profile than a hotel, and a small restaurant has very different water use attributes than a large manufacturing facility (Figure 4). Therefore, CII customer characteristics and end uses are not necessarily comparable across CII types or even within the same CII category. Understanding these end uses is crucial for determining water efficiency and conservation opportunities (Grinshpun, Ashmore, & Benzaoui, 2019).

Suppliers serve a very diverse range of CII customer types, and often each customer type has its own individualized business needs. Therefore, suppliers would need to recognize the differences in water use among CII customers in order to effectively assist customers with BMP implementation. Performing water assessments is one universal BMP that can help a customer and/or water supplier understand how much water savings potential exists for the customer's business facility and determine where the areas for efficiency improvements exist (Hoffman, et al., 2019). Because of their site-specificity, water assessments can be effective in determining what other BMPs may be effective for a particular site. The goal is to leverage CII BMPs to meet the diverse and unique needs of CII customers, which will be discussed further in the next chapter.



Source: EPA WaterSense, N.D. *accessed September 20, 2021.*

Figure 4: End Uses of Water in Various Types of Commercial and Institutional Facilities

2.3.2 Large Users

The impact of large water users within the CII sector cannot be overstated. Previous research has shown that as much as 80% of CII water use is consumed by 20% of CII users (Dziegielewski et al., 2000). Because top consuming accounts make up a large portion of total water use, they have potential for large efficiency gains (Grinshpun et al., 2019). This skewed distribution of CII water use also indicates that average consumption is not a good measure of central tendency because it is influenced by a few very large users (M.Cubed, 2017).

This impact is evident across water agencies of all sizes. An example from a smaller urban retail water supplier is the City of Santa Cruz whose top 100 CII water users represent 87% of CII water demand and 30% of total water demand (City of Santa Cruz, 2017). The top 1% of CII water users in another small city, New Braunfels in Texas, use 27% of the total water demand (Grinshpun et al., 2019). In a 2013 AWWA study, researchers found that the top 15 CII customers at a mid-size urban retail water supplier were responsible for 84% of industrial demand (Vickers, 2013). As an example, from a large urban retail water supplier, 20% of the City of Albuquerque's total CII customers are responsible for 80% of the City's CII water use (Dziegielewski et al., 2000). All of these examples demonstrate that a small portion of CII customers have the greatest impact on water use within the sector, therefore illustrating the influence of a small group of CII users on total water demand.

Even though large CII customers use more water, it does not necessarily mean these large CII customers are *wasting* water. Distinguishing between high use and inefficient use is necessary to achieve water use efficiency goals and often needs to be done at the facility (Maddaus et al., 2017). Dependent on the assessment of water efficiency potential, targeting a few CII high users could prove to be cost effective for water suppliers to reduce water use, due to fewer site visits and outreach efforts.

2.3.3 Varied Classification and Benchmarking Methods

California has not standardized the classification of CII water customers, prompting the Legislature to require DWR to provide a recommendation to the State Water Board on a standardized CII water use classification system as part of the 2018 legislation [CWC 10609.10 (b)(1)].

Currently, some suppliers categorize CII customers only by meter size, while other suppliers may only distinguish between residential and non-residential customers. Other suppliers may classify CII sites according to the North American Industry Classification System (NAICS) codes, a system developed to analyze data related to the business economy, grouping CII sites by activity such as various types of manufacturing businesses, educational institutions, and food stores. However, these codes have not been adopted as general practice within the water industry. Furthermore, the amount of water used at each site with the same NAICS code differs depending on variables such

as number of employees and customers, product output, hours of operation, etc. (Vickers, 2001). This variance in classification systems used by urban water suppliers, with some lacking any classification at all, could impede the evaluation of water use efficiency for CII customers (M.Cubed, 2017).

The wide variance in CII customer categories among urban water suppliers also inhibits CII water use metrics, such as total volume or gallons per capita per day (GPCD), from accurately informing trends within the CII sector (DWR Vol. 1, 2013). Due to the inability to establish common benchmarks of water use in the CII sector, data on baseline water use within this sector is limited. It is very unlikely that meaningful CII water use benchmarks can be determined without real observations on the metric of interest (e.g., gallons per square foot in office buildings, gallons per beds in hospitality, gallons per table in restaurants) and characteristics associated with individual CII businesses or facilities (Kiefer et al., 2015).

3 History and Guidance on CII Water Use Efficiency Best Management Practices

Creating Water Use Efficiency Programs and associated BMPs for the CII sector is not new. Continuing efforts and tremendous progress have been made over the last fifty years, much of that stemming from the California Urban Water Conservation Council (CUWCC). State and federal laws, including plumbing codes, are to be credited with much of the savings the CII sector has already achieved. Understanding the history of legislation in the state, along with the efforts already made toward crafting a set of CII BMPs, provides a better perspective on where there is room for additional growth and exploration in the CII conservation terrain.

3.1 History of CII BMP Development

Building the conservation ethic in the CII sector is an idea that began decades ago. It started in response to the drought of 1976-77 and continued into the 1980s with inclusion in the CWC for the urban water resources and conservation planning requirements for implementing demand management measures. Since then, CII BMPs have been conceptualized and implemented in California as well as at the national level.

3.1.1 CUWCC Voluntary BMPs

Many key BMPs directed at CII sector water use originated in the Memorandum of Understanding Regarding Urban Water Conservation in California (CUWCC, 1991), which was voluntarily signed by hundreds of California urban wholesaler and retail water suppliers. The CUWCC continued to define and refine the voluntary BMPs through amendments to the Memorandum of Understanding (MOU) in 1994, 1997, 1999, 2004, and 2007 (CUWCC). See Appendix A for details on the MOU updates.

Then, as directed in the Water Conservation Act of 2009 (Senate Bill X7-7), DWR and the CUWCC formed the CII task force (consisting of academic experts; urban retail water suppliers; environmental organizations; and commercial, industrial, and institutional water users) to better define CII BMPs, metrics, and recommendations to the Legislature specific to the CII water sector.

The BMPs defined in the MOU were implemented voluntarily by many urban retail water suppliers. There were more than 350 dues-paying, water utility members on average across the past two decades. Many of these members voluntarily reported activities through March 2018. Following through on BMP implementation was important to many water suppliers, especially those that faced local water supply reliability challenges. The Central Valley Project Improvement Act (CVPIA) also directed the US Department of the Interior, Bureau of Reclamation (USBR) to impose requirements on its Central Valley Project contractors to use the same CUWCC BMP voluntary reporting database. This database was monitored by USBR, and USBR would send enforcement letters if reporting was incomplete.

3.1.2 2013 CII Task Force Report

After the initial meeting in March 2011, the CII Task Force developed a wide range of BMPs published in the 2013 CII task report that focused on technical advancements and improved management practices for CII customers to increase water use efficiency in their facilities (DWR Vol. 2, 2013). The report included recommendations from the task force on facilitating BMP implementation and defined several key terms that the industry uses to this day. The recommended BMPs were grouped into the following categories: (1) Commercial and Institutional sectors; (2) Industrial sectors; and (3) BMPs for common devices, processes, and practices applicable to the CII sectors.

The task report's customer centric BMP list and MWM field experience is the basis for the CII BMP list that was developed for this white paper. However, since the publication of this task force report, many urban water suppliers have accrued valuable insight into the feasibility and potential water savings of the recommended CII BMPs, which is also included in this white paper's recommendations.

3.1.3 2018 Transformation from CUWCC Voluntary BMPs to New Legislation

With increased pressure from a changing climate leading to more severe droughts and water uncertainty, the state of California passed new legislation in 2018 on water conservation and drought planning, including requirements for water use efficiency standards, variances, and CII performance measures (DWR, 2018). The same year, the CUWCC membership voted to allow the organization to sunset, replacing it with a new one: the California Water Efficiency Partnership (CalWEP). CalWEP was launched as an innovative leader, voice, and expert on water efficiency in California. CalWEP carries forward the expertise and collaboration that was a CUWCC hallmark, but with a new name and new affiliation with AWE. This new framework allows CalWEP to better serve

members and more quickly adapt to California's changing regulatory, political, social, economic, and environmental climate. CalWEP is committed to providing cutting-edge expertise on California water issues, challenges, and opportunities within a broad collaborative framework (CalWEP, n.d.).

3.2 Primary Publications on CII BMP Guidance

The included list of BMPs and recommended approaches contained herein are in no way meant to be the most exhaustive library for consideration. When looking for additional resources, there are a number of trusted sources that offer further specificity into a particular category, such as AWE's 2018 *Commercial Kitchens Guide*.[3] The East Bay Municipal Utility District (EBMUD) offers the *Watersmart Guidebook: A Water-Use Efficiency Plan and Review Guide for New Businesses* (EBMUD, 2002).[4] Similarly, the South Florida Water Management District produced a second edition of its guide for facility managers: *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities* (2013).[5] These guides are especially useful for any agency or department embarking on, or expanding, a CII water conservation and outreach program in their community or for those simply looking to educate and inform by sharing resources. Guidance from beyond the United States border may also be helpful. Sydney Water in Australia offers numerous BMPs including *Best practice guidelines for water conservation in commercial office buildings and shopping centers* (parts 1, 2, and 3; 2007, n.d., and n.d., respectively) and other guides on aquatic centers, clubs, and sports fields.[6] Many of these resources list different businesses and technologies and offer typical water footprints by type along with calculations, audit basics, and more.

3.3 Water Savings from State Laws, Codes, and Standards

Passive water savings are water savings that require no behavior change by the water user and are the basis of water use efficiency from which more active conservation measures are undertaken by facility maintenance staff or water utility staff. For example, the installation of more efficient fixtures in new construction and the natural replacement of existing equipment over time are both sources of passive water savings since the upgrades to higher efficiency equipment enact water savings without direct intervention of customers or urban water suppliers.

California appliance regulations, combined with federal standards, set minimum efficiency levels for water and energy consumption in products such as plumbing and irrigation equipment. These state and federal efficiency standards help drive water efficiency technology uptake in CII facilities. California regulations for appliances and

[3] https://www.allianceforwaterefficiency.org/impact/our-work/commercial-kitchens-guide
[4] https://www.ebmud.com/water/conservation-and-rebates/commercial/watersmart-guidebook/
[5] https://issuu.com/southfloridawatermanagement/docs/water_efficiency_improvement_guide?mode=window&proSidebarEnabled=true&backgroundColor=%23222222
[6] https://www.sydneywater.com.au/your-business/managing-your-water-use/programs-resources.html

fixtures in many cases require higher efficiency than national codes and standards.[7] In 2017, California received a Grade A- according to *The Water Efficiency and Conservation State Scorecard: An Assessment of Laws,* written by AWE and the Environmental Law Institute, for its coverage of water use efficiency codes and policies within state regulations (i.e., CALGreen building codes and standards). The scorecard report is updated every five years and the next update is expected in 2022.

Following is a summary of various plumbing codes at the state and local levels that have encouraged water conservation for the past several decades.

3.3.1 California State Plumbing Code and CII-Related Water Use Efficiency Laws

3.3.1.1 CALGreen and Title 20 Appliance Efficiency Regulations

Effectively, all new construction in California, including permited new buildings and renovations, are subject to the California Green Building Code (CALGreen) and have been since 2011 when it first went into effect after adoption by the California Building Standards Commission in 2010. As a result, newly contructed buildings have an element of higher water use efficiency compared to older buildings. CALGreen references the California Code of Regulations Title 20 Appliance Efficiency Standards that were first adopted in 1977 during a drought period and were most recently updated and adopted in 2019 (effective on October 1, 2020) by the California Energy Commission (CEC) with inclusion of sprinkler spray bodies. Both CALGreen and the Title 20 codes are updated every three years, with the most recent 2019 versions effective as of January 1, 2020.

Energy efficiency is regulated by the California Energy Code (California Code of Regulations, 2021), which are codes targeted to also reduced embedded energy within water use. The current CEC appliance efficiency standards apply to the following new appliances, whether sold in or shipped to California:

- Showerheads –1.8 gallons per minute (gpm) at 80 pounds per square inch (psi)
- Toilets – 1.28 gallons per flush (gpf)
- Wall Mounted Urinals – 0.125 gpf
- Floor Mounted Urinals – 0.5 gpf
- Lavatory Faucets and Aerators – 1.2 gpm at 60 psi
- Kitchen Faucets and Aerators – 1.8 gpm at 60 psi with optional temporary flow of 2.2 gpm
- Public Lavatory Faucets – 0.5 gpm at 60 psi

[7] A compilation is maintained online of state and national standards called the Appliance Standards Awareness Project: https://appliance-standards.org/.

- Metering Faucets – 0.20 gallons per cycle
- Commercial Pre-Rinse Spray Valves – CALGreen 1.0-1.28 gpm depending on product spray force rating and 2019 California Plumbing Code 1.6 gpm.
- Food Waste Disposers – must either modulate the use of water to no more than 1 gpm when the disposer is not in use (not actively grinding food waste or no load) or must automatically shut off after no more than 10 minutes of inactivity. Disposers must use no more than 8 gpm of water.

Additionally, separate submeters or metering devices must be installed for new buildings or additions in excess of 50,000 square feet, or in the case of excess consumption (e.g., any tenant in a new building or building addition who is projected to use more than 1,000 gallons per day).

The following regulation governing outdoor water efficiency appliances took effect on October 1, 2020:

- Spray sprinkler bodies sold or offered for sale in California are required to use the WaterSense test procedure (Version 1.0, September 21, 2017) and must meet state standards (California Code of Regulations, Title 20, Section 1605.3(x)(1)(A)).
- Spray sprinkler bodies must contain an internal pressure regulator to restrict water flow to 30 psi. They will also need to be marked per Section 1607 and certified to the California Energy Commission (CEC) per Section 1606 of the California Code of Regulations.

3.3.1.2 California State Law – AB 715

California adopted plumbing codes for toilets, urinals, showerheads, and faucets in 1991, mandating the sale and use of ultra-low flush toilets (ULFTs) using 1.6 gpf, urinals using 1 gpf, and high efficiency showerheads and faucets. AB 715 (2007) led to an update to California Code of Regulations Title 20 mandating that all toilets and urinals sold and installed in California as of January 1, 2014, must be high efficiency versions with flush ratings not to exceed 1.28 gpf (toilets) and 0.5 gpf (urinals).

3.3.1.3 California State Laws – SB 407 and SB 837

SB 407 (2009) required that multifamily and commercial properties built prior to 1994 be fully retrofitted with water conserving fixtures by 2019. SB 407 program length is variable and continues until all the older high flush toilets have been replaced in the service area. Additionally, SB 407 conditions issuance of building permits for major improvements and renovations upon retrofit of non-compliant plumbing fixtures. SB 837 (2011) requires that sellers of real estate property disclose on their Real Estate Transfer Disclosure Statement whether their property complies with these requirements. Both laws are intended to accelerate the replacement of older, low efficiency plumbing

fixtures by ensuring that only high efficiency fixtures are installed in new commercial and multifamily buildings.

3.3.1.4 Model Water Efficient Landscape Ordinance

Model Water Efficient Landscape Ordinance (MWELO), a state regulation designed to prevent water from being wasted on irrigated landscapes, was originally created in 1993 and more rigorously updated throughout the 2000s. In 2015, at the height of the California drought during 2014-16, then Governor Edmund "Jerry" Brown Jr. issued Executive Order B-29-15. The order directed the California Department of Water Resources to update the MWELO[8] since about half of the water directed to urban areas is used on irrigated landscapes (DWR, n.d.).

Executive Order B-29-15 directs land use authorities (cities and counties) to ensure MWELO compliance on new or renovated landscaped areas of 500 square feet or more. This applies to residential, commercial, industrial, and institutional projects that require a permit, plan check, or design review. Land use authorities are responsible for enforcing the ordinance, with technical assistance by DWR. By January 31 of each year, cities and counties are required to submit an annual report documenting MWELO implementation and enforcement measures (Executive Order No. B-29-15, 2015).

3.3.2 National Plumbing Code and Standards for Commercial and Industrial Products Not Covered by California Codes and Standards

In addition to the California code on fixture replacement in existing buildings mentioned above, the Federal Energy Policy Act of 1992, as amended in 2005, mandates that only devices with the specified level of efficiency can be sold as of 2006. Fixtures not covered by the California code are captured by the Energy Policy Act of 2005. The net result of the plumbing code is that since 2006 CII buildings across the United States (including California) with older, inefficient fixtures are slowly replacing those fixtures with newer, more efficient models.

The United States Department of Energy has federal code of regulations for minimum efficiency specifications pertaining to water use for the following commercial and industrial equipment, including commercial ice makers, clothes washers, air conditioners, heat pumps, and boilers. Information about these standards can be found on the Department of Energy website[9].

In addition to national codes and standards, both the US EPA WaterSense Program and joint Department of Energy and US EPA Energy Star Programs have voluntary efficiency labeling specification programs. For decades, significant progress in CII

[8] More information is available online at: https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance
[9] https://www.energy.gov/eere/buildings/appliance-and-equipment-standards-program

customers identifying and voluntarily installing water efficient equipment, fixtures, and appliances has occurred.

3.3.3 Local Building Codes and Ordinances

Some cities and counties have implemented local codes and standards related to water conservation. All local cities and counties with land use approval and permitting authority are required to review plan specifications and inspect for the installation of Title 20 Appliance Efficiency Standard compliant water and energy efficient products per the California Green Building Code Standards, Title 24 Part 11.

Some local cities and counties progress further with more aggressive requirements. For example, the City of Santa Cruz has a locally mandated ordinance in place for Plumbing Fixture Retrofit Regulations that goes beyond the AB 715 state codes by establishing stricter requirements (City of Santa Cruz, n.d.). Also, some cities have progressive green building codes, such as the City of Santa Monica's Climate Friendly Buildings Policies, which help strengthen water and energy efficiency requirements for residential and nonresidential buildings beyond national code (City of Santa Monica, n.d.). In general, consistency of equipment specifications for higher water efficiency appliances and fixtures according to national and California statewide codes and standards has been most effective in achieving higher installation rates. Note that local ordinances are not feasible for all urban water suppliers, such as special districts or investor-owned utilities that are regulated instead by the California Public Utilities Commission, since they do not have the authority to create local regulations.

4 CII BMP Implementation Experience

Through the experience and stakeholder surveys outlined in this section, and as found in the key findings presented in Section 5, many larger urban water suppliers and MWM bring extensive experience into planning, training, and implementing CII sector water use efficiency projects and site surveys, most occurring in California. Key observations from this experience are essential to learning pragmatic solutions presented on ways to leverage more successful CII WUE BMP implementation.

4.1 Field Experience

Through conducting the onsite surveys and by providing a detailed report of findings and recommendations, MWM for the past two decades has collected a myriad of industry specific findings. As of December 2021, MWM has trained more than 1,000 attendees in conducting water assessments and completed more than 300 water assessments themselves in the field. MWM has a wide range of experience with CII assessments, including manufacturing facilities, large university campuses, food service, hotels, hospitals, agricultural facilities, and more.

MWM also offers a comprehensive CII Water Assessment Training Workshop that provides a technical overview of the most common commercial water uses and equipment, payback calculations, and report writing, as well as advanced workshops for in-depth evaluation of individual topic areas, such as cooling towers, irrigation management, and industrial processes. MWM also develops and uses an Excel-based Water Assessment Tool. This software stores data during a water assessment that can later be analyzed and used in project reports, evaluations, and payback calculations to customize project design. MWM has conducted more than 50 workshops with participants from 11 states and Canada in the past 20 years using a basic version of the Water Assessment Tool.

4.2 Stakeholder Process

Through a DWR-led process, MWM acted as an expert consultant to engage more than 150 stakeholders for preparation of this white paper, including:

- Four presentations at four separate CII stakeholder meetings (March-June 2021) to discuss the development of the CII BMPs and solicit feedback from the group through discussions and interactive breakout sessions.
    - Following DWR's process, stakeholders who were present included two workgroups: the Water Use Studies (WUS) Working Group and the Standards, Methodologies, and Performance Measures (SMPM) Working Group. General public comments were also received through additional open meeting designated for discussion time among all stakeholders
- Conducting two stakeholder surveys distributed through workgroup channels to gather information from California urban water suppliers on what BMP measures have worked well, which ones have not, and suggestions for measures that could work for other suppliers and CII customers themselves.
    - CII BMP Implementation Survey via WUS and SMPM workgroups – see Section 4.3.1 and Appendix B for survey results
    - State-run CII Programs Survey via CalWEP members – see Section 4.3.2 for survey results
- Submitting a formal draft white paper outline to stakeholders and DWR and incorporating feedback into this final version.

Stakeholder comments and feedback were essential to the development of this paper to provide a true and comprehensive evaluation of the feasibility of implementing CII BMPs.

4.3 Stakeholder Surveys

Stakeholder surveys are an important tool. They are both a quantitative and qualitative method to collect current data across a broad range of organizations in a relatively short amount of time. These surveys provided a window into the utility experience, perspectives, preferences, and expectations when it comes to CII BMP Implementation. Not only do they impart a baseline of data, but they often serve as a catalyst for further discussions and topics of research.

4.3.1 CII BMP Implementation Survey, March – June 2021

MWM's stakeholder survey provided during DWR-led stakeholder process on BMP implementation asked participants to assess the feasibility of 45 different water use efficiency measures within their service area. The basis for the 45 BMPs is as published in the American Water Works Association (AWWA), *Manual M52 Water Conservation Programs – A Planning Manual, 2nd Edition* (Maddaus et al., 2017), assembled based on MWM planning experience when working with California urban retail water suppliers as well as a review of common measures noted on utility websites and conservation plans.

The survey response options for rating each of the 45 measures were: "implemented as high priority," "implemented as lower priority," "feasible for future implementation," "not useful for my service area," and "suggest removing from list." The summarized supplier survey results below represent input from 30 California urban water suppliers on the status of CII BMPs in their service areas based on the open response period from March to June 2021. Additional independent surveys would be beneficial to further confirm these observations by boarder groups of stakeholders.

Comprehensive results for each group of measures are in Appendix B.

- There were no measures that were unanimously selected to remove from the list, nor were any unanimously selected as feasible for future implementation.
- *Water Management Plans* had the most votes for "feasible for future implementation", followed by *Incentives for Large Stormwater Catchment Systems*. However, some more experienced urban water suppliers commented that Water Management Plans were very challenging to have CII customers act upon and follow through on water savings recommendations, and as a result the value of implementing them remains debatable.
- *Require Fixture Replacement by a Deadline* had the most votes for "suggest removing from the list."
- *Financial Incentives for Irrigation Upgrades* was voted as the highest priority for implementation.

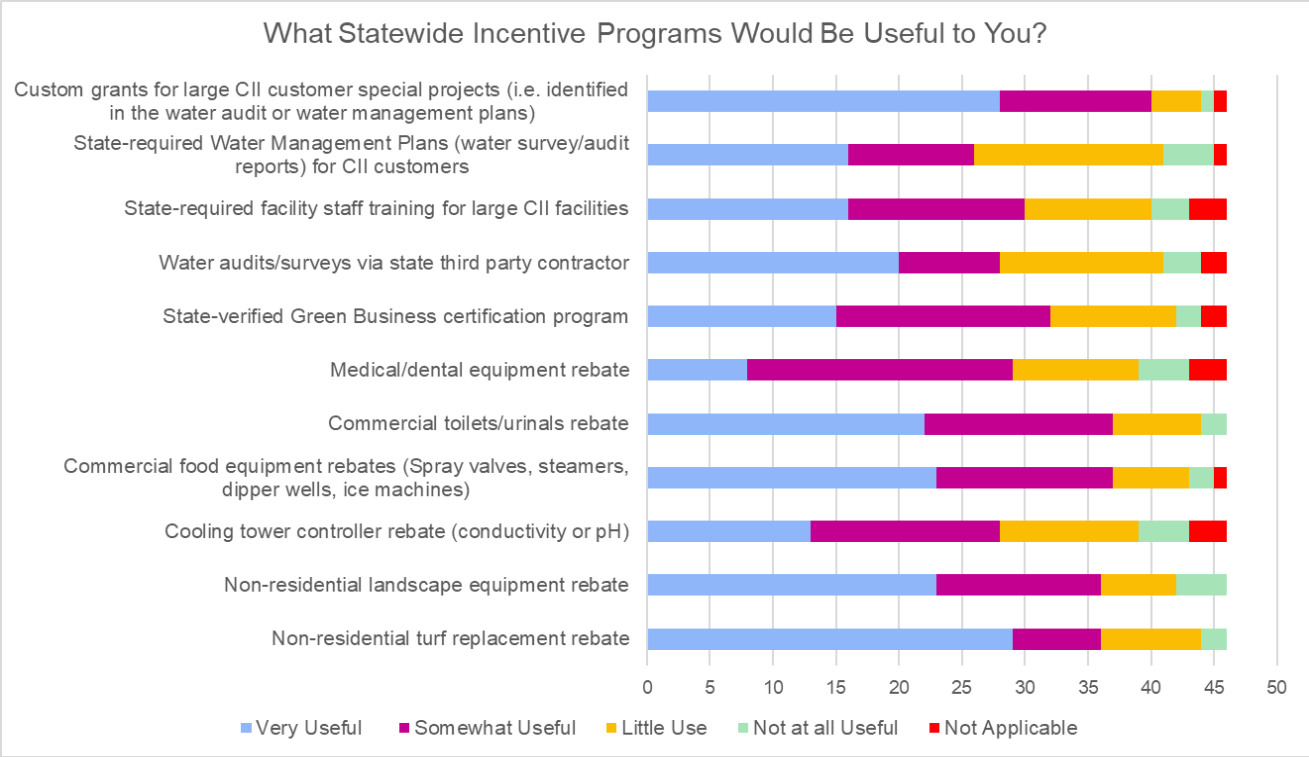
- *Rebates for Submeters on Cooling Towers* and *Alternate Onsite Sources of Non-Potable Water* were tied for the least useful for participants' service areas.

The survey also collected comments from participating water suppliers, whose input is included in the key findings section.

4.3.2 Statewide CII Programs Survey, September 2021

MWM surveyed CalWEP members in September 2021 to gauge water supplier interest in potential statewide incentive programs. Note that none of the programs listed in the survey are currently run by a state agency. The survey asked participants to select the usefulness to their urban water supplier of eleven different CII programs, from very useful to not applicable (Figure 5). The responses from survey results showed the following:

- The most useful incentive program selected for statewide implementation was a non-residential turf replacement rebate, followed closely by customer grants for large CII customer special projects.
- The least applicable incentive programs selected for statewide implementation were a cooling tower controller rebate and medical/dental equipment rebates.



Source: CalWEP Statewide Survey – Would State-Wide CII Water Use Efficiency Programs Help You? (46 Responses, conducted by MWM, September 2021).

Figure 5: Stakeholder Survey on Statewide Incentive Program Interest

4.4 Urban Water Supplier Case Studies

All California urban water suppliers participating in the DWR-led stakeholder process and the ACWA and CalWEP memberships were all notified and thus were provided the opportunity to submit case studies on their experiences designing and implementing CII programs. The following cases studies, located in Appendix C, were voluntarily submitted by five California urban water suppliers for inclusion in this paper. Note that not all utility sizes and regional locations are represented.

Table 1: List of Case Studies

Case Study No.	Supplier Name	Supplier Size	Program Name	Case Study Submittal Date	Program Type
1	Los Angeles Department of Water and Power	Extra Large (>500,000 water customers)	Cedars-Sinai Water Reuse Project	October 8, 2021	Custom Rebate Program
2	City of Santa Barbara	Medium (about 26,000 water customers)	CII Survey and Incentive Program	September 24, 2021	Incentive Program
3	City of Santa Rosa	Medium (about 50,000 water customers)	CII Survey and Incentive Programs	September 29, 2021	Incentive Program
4	Los Angeles Department of Water and Power	Extra Large (>500,000 water customers)	City Hall East Technology Project	October 8, 2021	Custom Rebate Program
5	Irvine Ranch Water District	Large (about 100,000 water customers)	Effectiveness of CII Customer Water Budgets in Achieving Efficient Water Use for Mixed Use Meters	July 16, 2021	Water Budget Program
6	Supplier A	Large (about 200,000 water customers)	CII Survey and Incentive Programs	October 6, 2021	Incentive Program

5 Key Findings on CII BMPs

Through the assessment of CII BMP implementation experience from past to present, a multitude of takeaways were revealed that can help urban water suppliers, CII water users, state agencies, and other stakeholders to support and implement successful BMPs. The information in this section is synthesized to help these water industry peers as they seek to collaborate in tackling some of the challenges faced when working in the CII sector and enabling greater success with CII water use efficiency BMPs.

5.1 Commonly Implemented BMPs Based on Urban Water Supplier Input

There are a few trending BMPs that were, or currently are, the focus of larger urban water suppliers' CII programs, per the stakeholder survey results. These BMPs were repeatedly brought up during stakeholder discussion and are known to be focus areas of conservation program plans. A closer look offers key insights into the current status of BMP implementation.

5.1.1 Education and Outreach Programs

Nearly all urban water suppliers have some form of an education and outreach program, whereby information is provided for CII customers on available water efficient technologies, appliances, and fixtures, and/or a call to action is made for CII customers to improve water efficiency in their daily operations. These programs often include printed and/or electronic information shared out by urban water suppliers' staff and can also include targeted outreach methods including direct contact phone calls and mailing contact letters or other advertisements. Other industry stakeholder outreach programs are also often leveraged for educational purposes, including national programs such as the US EPA's WaterSense Program.[10]

5.1.2 Water Audits, Assessments, and Surveys

A water audit – also called a water assessment, evaluation, or survey – is a comprehensive analysis of the current water use of a facility and subsequent development of a strategy to increase water use efficiency (Nevada Governor's Office of Energy, n.d.). Over the past decade, the term "audit" has become less preferred in the minds of several industry stakeholders and has thus brought about the transition towards more updated terms, the primary one being "assessment." This is due to many factors. Based on MWM experience and direct feedback from more than 100 water agencies across the West Coast during conferences and meetings, the most recurrent factor has been that the term "audit" is off-putting to customers, negatively impacting

[10] For more information on the US EPA WaterSense labelling program success, reference the 2019 U.S. WaterSense Market Penetration Study by GMP Research Inc. Accessed online: https://www.safeplumbing.org/files/safeplumbing.org/documents/misc/2019-WaterSense-market-penetration-study.pdf.

water supplier outreach efforts when offering a water "audit" to a CII customer. The energy sector uses the term "assessment" for their energy "audits," which has informed the transition to "assessment" in the water sector in the interest of aligning the terminology in both sectors. Los Angeles Department of Water and Power also states that "assessment" is the term that seemed the most beneficial and effective in their long-standing water and energy efficiency programs. Additionally, US EPA WaterSense provides a comprehensive CII Water Assessment Checklist and has formally transitioned to using the phrase "water assessments," in other publications. Thus, the industry continues to be moving in this direction.

The goals of a water assessment are to: (1) quantify how water is being used, (2) identify what opportunities exist for reducing water use, and (3) calculate the potential payback for each opportunity identified (Hoffman, et al., 2019). However, water assessments can vary in detail and purpose, from a brief facility survey to identify possible savings and costs for water efficiency improvements to a more detailed analysis with complete savings and cost calculations including estimates of the return on investment (ROI). The City Energy Project's Water Audit Guidance Manual has a structured breakdown of the variety of water assessment levels, exemplifying the range of involvement that can occur within an assessment (see Figures 6a and 6b).

LEVEL 1	
Focus of Audit	• Brief on-site survey • Approximate estimate of savings and costs • Identify no- and low-cost measures • Identify priorities for Level 2 and 3 audits
Inputs	• Building use and square footage • Demographics • Utility bills • Submeter data • Site drawings and building floor plans • Aerial imaging • Phone interviews
Outputs	• Summary of water-using equipment and systems • Building water use intensity as compared to similar buildings • Summary of specific issues or needs • Specific water conservation measures identified • Estimate of savings and costs for water conservation measures

Figure 6a: Water Efficiency Audit Levels
Source: Water Audit Guidance for Commercial Buildings *(Hoffman et al., 2019).*

LEVEL 2	
Focus of Audit	• Water consumption by end use breakdown • More detailed estimate of savings potential • Practical water efficiency measures based on owner's economic criteria • Proposed changes to operations and maintenance
Inputs	• Level 1 items • Identification and description of water-using equipment models, age, condition, operational procedures, settings, and water-using characteristics • Measurement of flow rates, use estimates for all water-using equipment and systems
Outputs	• Level 1 items • Breakdown of water use by use area • Calculations for savings and costs for all water conservation measures • Benefit and cost analysis estimates including water, wastewater, water/ wastewater treatment, and all associated energy costs such as heating, pumping, and treatment • List of potential capital-intensive improvements
LEVEL 3	
Focus of Audit	• Detailed analysis and monitoring to evaluate water use by subsystem • Investment-grade estimates of savings potential • Evaluation of capital-intensive measures
Inputs	• Level 2 items • Measurement of all HVAC and other non-plumbing water-using equipment Includes an as-built listing of all water-using equipment and systems
Outputs	• Level 2 items • Financial evaluation of capital investment and projected savings • Water-using equipment list and system descriptions with manufacturers' product specifications • Detailed summary report including water-using system interactions and the value of combining measures

Figure 6b: Water Efficiency Audit Levels
Source: Water Audit Guidance for Commercial Buildings *(Hoffman, et al., 2019).*

The assessment process generally consists of four stages:

1. Data collection
2. Site walk-through
3. Analysis including payback calculations
4. Report generation including quantified water efficient project recommendations

The site walk-through is the primary component that determines the status of water end uses and identifies potential water saving measures. After all necessary data has been collected through the combination of the data collection and site visits, the assessor reviews each water use measurement to determine if that volume of use is within the range of normal parameters and whether additional measurements or discussion with facility personnel is needed (Hoffman, et al., 2019). Each identified end use should include a description of the use as it exists, a description of the potential water conservation measure(s) for that use, and potential water savings expressed in flow rate or another common metric depending on the measure. Then, the assessor would be able to determine both the savings and cost to implement the conservation measure(s).

While assessments are a great way to determine water savings potential, it should be noted that, in order to produce actual water savings, water assessment program should be carefully designed with components to maximize water savings such as:

1. Targeted to certain customers (such as large users or an industry like restaurants, schools, or hotels)
2. Offering incentives
3. Post-assessment follow-through
4. Focused marketing outreach using technology such as Advanced Metering Infrastructure (AMI) data, water budgets or flow sensors to identify customers

These components are important to improving the cost-effectiveness of a water assessment for the water utility, who has invested time and/or money in performing the assessment, because simply performing a water assessment report does not ensure that any of the recommended water efficient measures will be implemented. However, assessments can be used as an effective tool for facility managers to clearly understand where the opportunities are in increasing efficiency within their facilities, and more pointedly, where they can lower their operating costs, which is in many cases a necessary practice before implementing additional BMPs.

Performing water assessments is also a key skill for many urban water suppliers to use if assisting CII customers with locating medium to large leaks at their CII property, as identifying leaks can save water and potentially prevent significant infrastructure damage. For example, both the City of Santa Rosa and City of Santa Barbara have an emphasis on leak detection and repair, and for many years, the City of Beverly Hills has been using a combination of AMI data and water assessments for their top 100 residential and CII customers (Appendix C). For more information on Beverly Hills' approach to audits, the Water Waste Technology using AMI to Big Fat Data (BFD)

presentation from the October 2021 WaterSmart Innovations conference is available online.

In addition, assessments can help to build trust and a relationship with customers. As noted in Irvine Ranch Water District case study, water efficiency assessments provide IRWD the opportunity to engage with customers about their water use, explain IRWD's rate structure, and identify water efficiency improvements and incentive programs that may help the customer reduce water use. Aside from leaks or over watering, unusual increases or changes in usage may be caused by changes in staffing or changes in business practices, including increased production. To evaluate these changes, IRWD performs a free water efficiency survey (assessment). During the survey, all end uses of water are examined, and customer input is sought to determine if the increase in usage is legitimate. If leaks and excessive irrigation are ruled out, the water budget may be adjusted to accommodate the new uses. Customers are also provided with information on water efficiency programs and incentives. The IRWD survey program is successful in maintaining customer water use within budget.

The information gathered in an assessment also can be used to develop a Water Management Plan (WMP). See Appendix D for an example report template from one urban retail water supplier, the City of Santa Rosa. EPA WaterSense also provides a comprehensive CII Water Assessment Checklist[11].

5.1.2.1 Opportunities for Onsite Reuse and Potential for Process Water Improvements

Onsite reuse or reclaimed water use is often leveraged where feasible, primarily for medium and large CII customers since both cost-effectiveness and feasibility of recycled water systems often rely on large CII customers using the treated wastewater as an alternative source of supply. There also has been some success with stormwater capture and reuse projects on some larger properties. The State Water Board, US Water Alliance, and others have been very active in promoting onsite reuse and optimizing non-potable supplies (US Water Alliance, n.d.).

Process water is water used by industrial water users for producing a product or product content or water used for research and development (CWC §10608.12(p)). It is highly specialized and carefully engineered for use in manufacturing facilities or unique, costly equipment operation. When new CII development is being engineered, opportunities for efficient potable and non-potable water use and onsite reuse are often considered for cost savings and to maximize efficient use of local water supplies. For existing properties, assessing industrial facilities with process water requires onsite entry to review equipment, information, and processes that are often considered proprietary by these companies; this generally requires both parties signing off on a non-disclosure agreement prior to entry. Select opportunities for assessing process water within a small number of CII customers may exist, evaluated on a case-by-case basis. Larger CII

[11] https://www.epa.gov/sites/production/files/2017-01/documents/ws-commercial-water-assessment-checklist.pdf

customers may be operating on a scale where water efficiency rebate programs are available, or the customer may qualify for a custom-designed pay-for-performance type incentive. These are large scale investments by both the CII customer and urban water supplier that are perceived as high risk regarding the impact to business operations and productivity. From experience, many large facilities have already taken the step to optimize water use on site and/or have incorporated recycled water. Additionally, many large companies are analyzing and comparing water use at different facilities in their organization and developing goals or benchmarks. Recently, MWM has seen more and more opportunities emerging to engage with these companies and offer support and/or guidance on the industry specific benchmarks to help reduce their water footprint and increase their resource utilization. More studies or information on key industry benchmarks could help facilitate the engagement and improvement on process water use across our state.

5.1.3 Device/Equipment Rebate Programs

Providing rebates to replace inefficient equipment is a direct way urban water suppliers can increase water efficiency in the CII sector. Rebates may cover the cost of the device, installation, and/or permitting fees. Commonly rebated devices for the CII sector include indoor plumbing fixtures such as high-efficiency toilets, urinals, and faucet aerators; irrigation equipment such as weather-based irrigation controllers and rotating sprinkler nozzles; food service equipment such food steamers, dishwashers, and spray valves; and other large equipment such as ice machines, commercial washing machines, and dry vacuum pumps.

An example of a comprehensive commercial device rebate program is the Municipal Water District of Orange County (MWDOC), which combines rebates administered through the Metropolitan Water District of Southern California's (MWD) regional SoCal Water$mart rebate program with additional, locally administered commercial equipment rebates (MWDOC, 2021). Additionally, one common suggestion from suppliers is to collaborate with energy utilities to improve the cost-effectiveness of this measure, as pooling resources and providing dual-incentives between water and energy suppliers provides opportunities for increased water savings and cross-promotion (e.g., ice machines, pre-rinse spray valves, etc.). For additional BMP examples, see the list of primarily incentive-based measures in Section 6.

5.1.4 Water Management Plans

A WMP provides a framework for CII facilities to document water use (historical and current water use data), identify opportunities for improved water efficiency, and define an implementation strategy for improving water efficiency. An effective WMP is one that fully outlines not just how much water is being used on annual, monthly, and even daily basis, but also how it is used and by whom or what. WMPs enable setting goals for water use reduction that are as specific and measurable as possible (AMWUA, 2008). A

WMP is primarily customer-driven, and therefore will depend on the CII customer characteristics and capabilities. The goal is to make the WMP practical and useful for the facility owner. Feedback in the form of a technical review from water suppliers is important in this process so that customers can understand what works. In the case of new development, this review for water efficiency can occur during plan check review by city or county land use authorities, typically in coordination with the water supplier.

The scale of these plans varies greatly dependent on the facility. Water assessment reports, discussed above in Section 5.1.2, are an abridged form of water management plans. Through experience, MWM has found that shorter technical reports focused on payback calculations tend to be the most successful at convincing facility managers to adopt water efficiency measures. WMPs can be generated by either the urban water supplier or the customer, and large businesses may already have plans from industry guidelines. A well-designed WMP sets the stage for successful implementation of measures to avoid water waste and to manage demand for effective water resource management (EPA, 2016a).

5.1.5 Business Recognition/Certification Programs

Business certification programs administered by a variety of entities that are often in partnership (water suppliers, County economic development departments and/or non-profits, etc.). For example, the Sacramento Business Environmental Commission[12], recognize commercial customers for their work towards achieving improved water efficiency. This BMP measure combines outreach, onsite assessments, and education with incentives to encourage adoption of water efficient devices and practices by the business community.

Another example is East Bay Municipal Utility District's WaterSmart Certification program, which has certified 180 businesses since initiation in 2010 (EBMUD, n.d.). In this program, EBMUD staff provides all program participants, open to all CII customers, with a water use assessment, recommendations on cost-effective water saving measures, and resources for water efficiency upgrades. A business must meet specified water efficiency fixtures and behaviors criteria to receive certification. The district's certification provides opportunities for the business' reputation and brand, including advertisement by EMBUD for their business's accomplishment. Participation also helps in the drought mitigation response, as EBMUD already knows which businesses to target for additional savings and those that have already been verified as having reduced demands.

Water efficiency recognition programs also can incorporate other sustainability measures (i.e., energy efficiency, solid waste recycling, etc.) in collaboration with outside organizations and/or agencies, such as integrating with a regional or city-wide

[12] For more information online: https://sacberc.saccounty.net/SASB/Pages/default.aspx.

Green Business program. This method is recommended to help decrease the burden on water suppliers and streamline local programs.

5.1.6 Landscape Conversion

As the most public-facing component of a business' water use, outdoor landscaping is a common target for improving water use efficiency. There is great potential for water savings within large CII landscape areas, through turf removal or landscape conversion. This BMP is typically incentive based, providing a fixed or per square foot rebate for removing turf and replacing it with low water use plants or hardscape. It can also include irrigation system upgrades. Based on MWM experience with conservation program BMP modeling for urban retail water suppliers, this BMP is rarely cost effective for utilities to implement without some external funding, such as grants. The cost drivers are often due to extensive staff time and order of magnitude of the expense of the incentives relative to the estimated water savings.

Some urban water suppliers also offer reimbursement for design consultations and installation assistance, such as Contra Costa Water District's (CCWD) *Lawn to Garden Rebate and Landscape Design Assistance Programs* (CCWD, n.d.). For more examples and guidance on landscape transformation programs, AWE also has a great publication entitled *Sustainable Landscapes: A Utility Program Guide* (AWE, 2019). More resources are also available from the California Water Efficiency Partnership, available online primarily to urban water supplier members.[13]

5.1.7 Advanced Metering Infrastructure (AMI) Strategies

Several urban water suppliers selected AMI metering as a high-priority measure for identifying leaks, which can be a huge asset to improving CII water efficiency. Some commenters remarked that the investment cost of a meter system retrofit may not be feasible for small utilities, while others mentioned pilot programs targeting specific customer categories as a way to make this measure cost effective. Overall, this measure sees better results when applied to individually metered properties, so it is suggested to target larger CII customers for pilots since many smaller businesses are grouped on the same meter. This measure is often combined with a customer-facing portal where customers can access and self-manage their usage, facilitating water use reduction further while enhancing customer service.

5.1.8 Pay-for-Performance Programs

Pay-for-performance programs, or water savings performance programs, are also highlighted by several urban water suppliers as an effective incentive for CII customers to improve water efficiency. These programs are customized, providing a varied level of incentives based on the amount of water each customer saves. Many pay for

[13] https://calwep.org/all-resources/

performance programs address using cost-share methods to fund expensive projects that may not otherwise get CII business management staff approval unless additional funding support was received from the urban water supplier. These projects are expensive but can achieve high water savings. Projects can vary by industry including specific process water use from large users.

One successful pay-for-performance program is MWD's *Water Savings Incentive Program*, which provides financial assistance for customers who implement projects that save at least 10 million gallons of water over the total project lifespan (SoCal Water$mart, n.d.). MWD monitors the project's water savings and customers receive an incentive based on the measure's water savings and eligible costs. This encourages customer projects designed for specific water-saving needs, helping to address the reality of diversity and complexity within the CII sector. A challenge to suppliers with this program is that it requires highly specialized knowledge and the ability to stay current with rapidly evolving technologies, which can be staff-intensive to administer since customer water savings must be verified. A challenge for the customer is the business risk of not achieving enough water savings to receive the reimbursement.

The City of Santa Rosa's Sustained Reduction Program is another customizable program for commercial customers, who can choose to implement a water saving technology not already incentivized, receiving a rebate of up to $200 per 1,000 gallons saved as of fall 2021 (City of Santa Rosa, n.d.).

Another pay-for-performance program model is Irvine Ranch Water District's (IRWD) *Custom Water Budgets*, recently implemented for CII accounts for the district. This effort implemented custom water budgets for all CII customers, tailored to the unique needs of each customer (IRWD, 2021). Consisting of both indoor and outdoor components, each budget is calculated to minimize water waste and incentivize installation of water efficient devices and technologies. IRWD's budget-based rate structure motivates customers to promptly address water waste. With just 3% of accounts continuously over budget between 2018-2020, it proves the effectiveness of the program and rate structure combination in promoting efficient water use for mixed-use CII customers.

For more details about the programs referenced above, see Appendix C: California CII Urban Water Supplier Program Case Studies.

5.2 Challenges, Successes, and Recommendations

There is no single approach to implementing CII BMPs due to the wide variability in CII customer and water supplier characteristics; what works for some does not necessarily work for all suppliers across California. The following key findings, based on the source material and experience noted above, are organized by key CII conservation program elements presented in Section 1 (see Figure 1) and include recommendations on BMP implementation based on the identified successes and challenges.

5.2.1 Universal Challenges and Successes

There are a few key challenges, on both the water supplier side and the CII customer side, that affect all aspects of BMP implementation and therefore should be considered when designing and implementing CII programs. Additionally, there are some key successes that apply universally and are worth noting up front.

Key Challenge – CII Customer Investment: Oftentimes business owners and other commercial customers have higher priorities and/or may not want to invest more funding or time into learning how to improve their water efficiency. Without sufficiently motivated commercial customers, it becomes very difficult for urban water suppliers to implement CII water efficiency programs. For instance, the CII BMP survey found that water assessments were rarely cost effective for water suppliers to implement without the customer's buy-in, and changes were rarely seen at assessed facilities that did not have buy-in from the start.

Key Challenge – Urban Water Supplier Staff Time/Experience: Urban water supplier staff time was one of the most recurrent themes as far as challenges to CII BMP implementation on the water supplier side. Several urban water suppliers stated that they do not have the expertise to perform water assessments, for example, in the varied and complex commercial sector. They also remarked that even if they were trained, they do not have the time or budget to perform the site visits themselves. Some urban water suppliers noted the impracticality of requiring water management plans, particularly considering the burden on urban water suppliers and especially when they have no means of enforcement with their commercial customers. Time and experience constraints on the utility side extend to all types of BMPS, and without the capacity, utilities may be very limited on the number and types of BMPs that they can implement.

Key Challenge – Lack of Consistent Studies Due to Heterogeneity in Water Use and Inconsistent Customer Classification Systems: CII water use is highly variable and hard to quantify onsite water savings. It is very difficult to identify customers who have made changes without onsite verification of water use and upgrades in water efficient technologies since some have just increased or decreased productivity that mask quantified savings in AMI or water billing data. It is often unknown if a CII facility made changes outside of a water supplier BMP program. In addition, customer types are very diverse and classification systems are inconsistent. The combination of these factors makes it difficult to scope and complete useful studies, including industry benchmarking, market saturation (i.e., how many water efficient fixtures are already out there), or water savings estimates by devices.

Key Challenge – Lack of Proper Authority for Enforcement Actions: Currently, CII water efficiency programs across California are voluntary. One area of potential study is to verify that CII customers who have voluntarily participated in CII incentive programs have long-term resilience in their achieved water savings. Nevertheless, urban water suppliers can offer a variety of CII conservation programs, but they cannot require

implementation or participation and have no authority over water and wastewater services that are fully permitted and paid for through customer water rates.

Key Success – Long Track Record with Experience: Many large water suppliers were past members of the CUWCC and have been voluntarily designing and implementing active CII programs for more than two decades. The United States Bureau of Reclamation Central Valley Project Improvement Act also historically required contractors to implement the CUWCC list of BMPs. Urban retail water suppliers who have already implemented several BMPs for their CII customers have experience that can be leveraged to further success.

Key Success – Data Driven Decisions: Education strategies that include hard data, such as cost-effectiveness and payback period values, tend to be more successful with implementation of the recommendations by CII customers and are a key component of successful BMP programs.

Key Success – Collaboration Among Partners: Numerous programs exist in urban metropolitan areas where regional or wholesale water suppliers have partnered with retailers. With more funding and support they may be able to further capitalize on economies of scale. For example, San Diego County Water Authority, Metropolitan Water District of Southern California, Bay Area Water Supply and Conservation Agency, Regional Water Authority, Sonoma-Marin Saving Water Partnership, and Zone 7 water agencies partner with their urban water suppliers to reduce administrative burden while providing the service area with water efficiency opportunities. Past partnering with non-profits or contractors for CII customer direct install programs has also proven successful, such as DWR grant projects for customer leak repair and efficient equipment upgrades.

5.2.2 CII Customer Outreach and Relations

5.2.2.1 Challenges

Facility and Business Management: It can be hard to obtain successful BMP adoption if the urban water supplier is only interfacing with an owner or manager rather than staff (i.e., the commercial customer's primary point of contact with the supplier is not necessarily the person who is using water at the facility). Water efficiency measures may not be as effective if information does not "trickle down" to staff. Additionally, property owners can be very cautious about releasing proprietary information and may require a non-disclosure agreement before an assessor can review property water-using equipment on site. For example, revenue and product sales data is highly sensitive information for competing hotels and thus challenging to acquire. This is especially concerning for CII customers given the public records request rights that are required of urban water suppliers.

Service Area Diversity: Differences in how service areas classify their various CII users as well as differences regionally can make CII customer outreach and relations

complex. For example, even if two CII sites are a similar size and type, such as a mid-size restaurant, a mid-size restaurant in rural Northern California could have different operations, approval processes, and equipment needs than a mid-size restaurant in the high-tourism coastal area of Southern California. This would instigate very different water assessments, cost-effectiveness of incentives, education and resources materials and thus, generally impact the types of BMP recommendations. As another example, some areas classify agriculture as CII while others do not, which would affect how each of the water suppliers in those areas targets its CII customer base.

5.2.2.2 Successes

Offer Customized CII Programs: CII customers should select and design BMPs that make sense for them (including pay-for-performance programs). Ideally, a water supplier would design a locally adapted and operated CII WUE program to address unique community concerns and customize WUE programs for different types of CII customers. For example, CII indoor water assessments are not effective for many water suppliers whose indoor water demand makes up less than 5% of total service area demand. As a result, water assessments should not be a high priority BMP for that supplier's service area customers who would most likely lack voluntary participation. Instead, the focus should be on other BMPs such as incentive-based BMP recommendations if found to be cost effective,

Combine Conservation Measures: CII customers can increase cost-effectiveness by grouping incentives, education, and/or policy programs rather than administering multiple stand-alone programs (e.g., equipment upgrades and rebates as part of landscape or indoor survey). In addition, these measures can be leveraged at the regional level. During DWR led meetings, stakeholders mentioned examples where cost-effectiveness at the retailer level was substantial enough to justify changes at the wholesale level. Wholesalers were amenable to increasing funding for incentives where the combined cost effectiveness and funding levels would be more likely to attract CII customer cost-sharing participation. For example, IRWD provided background on its CII WUE program funding that was subsequently added to MWD-funded programs.

Build Relationships: Relationship building with business and CII organizations (e.g., chamber of commerce, hotel business associations, rotary clubs, etc.) has been effective in building trust in water supplier programs among businessowners, generating higher CII participation in WUE programs. Building and maintaining relationships with large water users is very beneficial to increasing both long-term water efficiency and drought response. For example, Contra Costa Water District has worked with a number of large refineries to support water efficiency and curtail demand in times of water shortage. Additionally, these relationships can help expand outreach efforts as the organization or business engages with other CII customers.

Positive Reinforcement: Recognition for CII water users is vital to program success. Numerous urban wholesaler and urban retail water suppliers participate in the statewide Green Business Network to provide CII customers with a Green Business certification

and promote the water efficiency efforts of the businesses. Many large corporations have sustainability goals that are central to their operations and are provided to the public on their websites (e.g., Hilton's environmental impact webpage). The high-tech firms, such as Bay Area Water Conservation and Reuse Awards (bawcra.org), and the hotel industry, such as members of the Green Hotel Association® (greenhotels.com) are leaders in water efficiency. Water suppliers have stated that DWR should provide consideration and credit of these past efforts in its formal recommendations related to any future regulations or policies affecting CII customers.

5.2.3 Education And Resources

5.2.3.1 Challenges

Payback Analyses: In the majority of stakeholder survey comments, water suppliers indicated that cost burden is a primary indicator of whether CII customers will implement a water efficiency BMP. Due to high operational costs at CII facilities and businesses, low risk tolerance to impact operations, and customer experience, many businessowners are hesitant to make investments in water efficiency measures that would have an additional financial burden. The businesses often operate on a low profit margin, and cash flow is an issue.

CII customers operate on the premise of “payback period” which is defined as how long before the cost savings exceed the initial upfront cost to install the device (Hoffman et al., 2019). The lower the payback period, the quicker the device will be paid off and savings will start accumulating into profit. Thus, the benefit-cost ratio should be considered when promoting water efficiency measures. Cost-effectiveness calculations can be performed from both the urban water supplier and the customer perspectives and include an evaluation of all associated costs for implementing the measure using data from other past similar projects or research. The higher the payback, the more cost effective the measure is. As noted earlier, Water Audit Guidance for Commercial Buildings publication outlines how to conduct a payback calculation. Additionally, urban water suppliers can consider sending conservation staff to trainings and workshops, such as the Pacific Gas and Electric Small and Medium Businesses workshop. This workshop is free and has been offered annually for the past eight years. The American Water Works Association also provides annual training opportunities that teach payback analysis, including Conservation Practitioner Classes Level 1 and 2 and the Sustainable Water Management Conference Benefit-Cost Analysis Workshop. In-person trainings or online webinars can support increased staff experience to benefit CII education and outreach.

Low Installation Success Rates: Low uptake in BMP recommendations, once provided, is a significant barrier for achieving water savings and wider CII BMP implementation. Lack of CII customer buy-in may play a large role in this challenge. Programs are also not cost effective if customers do not follow up and implement water efficiency recommendations. Since businessowners are more inclined to achieve cost

savings through retrofitting or repairing equipment rather than full replacement, education should focus on the benefits to the customer. Additionally, although suppliers can encourage participation through outreach and education, they cannot be expected to meet a specific water savings or participation threshold; this type of requirement is dependent on customer willingness to participate due to the challenge of authority discussed previously. It is also challenging to follow-up and confirm installation and quantify water savings.

Market Saturation: Without a saturation study, water suppliers may implement programs and dedicate funding to conservation measures with little room for market uptake. Both water suppliers and CII customers should consider market saturation before doing outreach on or implementing BMPs, as practices often are not cost effective if the activity or incentive for a particular service area is already saturated (i.e., if all the CII toilets in a region have already been replaced with more efficient models).

5.2.3.2 Successes

Target Top Users: As discussed in Section 4, targeting efficiency improvements within the top 10-20% of CII customers is an effective approach to improving water efficiency within the CII sector. By targeting the top CII users to reduce water use, agencies can more efficiently and effectively achieve a significant total water use reduction than, for instance, targeting thousands of residential customers or a random sample of CII users of all sizes. Target key accounts with staff assigned as “managers” and facilitate frequent communications with large CII customers. As discussed above, similar key account manager approach has been used successfully by energy utilities seeking to find performance-based energy savings.

Water Management Plans: Custom plans can be helpful resources for customers of complex sites who are interested in more robust projects to improve water efficiency. However, urban retail water supplier staff should be aware that there are some liability issues with regard to personnel safety when conducting assessments for WMPs for complex properties (such as roof access to cooling towers). In addition, onsite water and wastewater treatment systems are complex; any plans need to be assessed carefully and may require professional design and construction services. Plans are only valuable if water efficient recommendations are implemented which often requires funding support (as noted below) and if the customer has buy-in (as discussed previously).

5.2.4 Federal, State, and Local Funding

5.2.4.1 Challenges

Prop 218 Restrictions: Urban water efficiency programs are funded through operations budgets from rate revenue collected by CII customers. This rate revenue needs to be invested equitably and in a fiscally responsible manner that serves all customers. California’s Proposition 218 governs the parameters surrounding cost of service (Voter

Approval for Local Government Taxes. Limitations on Fees, Assessments, and Charges. Initiative Constitutional Amendment, 1996). All WUE programs, including CII incentives, need to be justified through cost-effectiveness analysis, including those for private investor-owned utilities regulated by the California Public Utilities Commission.

Lack of Local Funding: CII water use efficiency education, outreach, and program development can be financially and staff time intensive. The benefits due to saved water may not outweigh the costs. Local utilities often lack funding justification to conduct the high level of engagement often required for successful CII outreach and participation in programs.

5.2.4.2 Successes

Statewide Programs: State- and federal-sponsored funding for CII water efficiency programs along with associated training for water, energy utility, and CII facility managers is another tool in the effort to reduce water waste in the face of continuing droughts. California could potentially leverage conservation or temporary drought funding support from state and federal grants to support businesses' water efficiency activities. Utilities may take advantage of statewide programs to streamline program administration and limit the burden on suppliers who have limited staff time to run programs on their own. During stakeholder meetings, several urban water suppliers stated that they would greatly value and encourage state-funded and state-run programs, especially in anticipation of upcoming legislative requirements. Offering statewide incentive programs would provide organization and funding opportunities. This would allow for consistency throughout the state for water customers and encourage participation in the particular program. It also would allow for maximizing water savings and support small and medium utilities that do not have the resources to develop, staff, or fund conservation programs.

Funding for Required Water Supplier BMPs: If a particular BMP, such as water management plan, is mandated of an urban water supplier or its customers by the Legislature or other authority, the authority should also provide adequate funding for an urban water supplier to produce the plan.

5.2.5 Policy and Regulations

5.2.5.1 Challenges

Classifying Large Users and Water Waste: Clear distinction needs to be made between wasteful water use and CII customers with legitimate high-water use. Large CII customers ideally already have water efficiency included in their operations. These customers often have high volume wastewater discharges or process energy inputs that are under special permits with flow restrictions. Furthermore, these customers have additional cost drivers to operate systems that do not waste water. For example, larger users could leverage ancillary benefits of conservation including decreased water bills

and wastewater treatment costs, as well as reduced energy costs from not having to heat water that is ultimately wasted.

Enforcement: Since urban water suppliers do not have the authority to require water efficiency BMPs to be implemented by customers operating on private property, enforcement of these practices is out of the water supplier's jurisdiction. If BMPs are to be required by CII customers, they could be more effective if the regulations come directly from the Legislature to CII customers, rather than requested by individual urban water suppliers. However, financial incentives can be achieved through water supplier rate policies, as demonstrated by IRWD's water budget-based rate program (Appendix C).

5.2.5.2 Successes

Consider Flexibility: Many water suppliers and water professionals support local flexibility, or customizations, on compliance with legislative requirements as this is perceived as achieving better results with longer lasting water savings. This is also necessary due to the diversity in urban water supplier service areas and CII customer base, as discussed previously. Legislative requirements should either be broad enough to fit the majority of urban water suppliers and allow for exceptions, or should have requirements segmented based on various variables that can be filtered by location, service area size, etc.

5.2.6 Urban Water Supplier Staffing and Contractors

5.2.6.1 Challenges

Staffing and Contracting: Urban water suppliers, especially municipalities, often have lengthy and difficult hiring processes for new staff and/or outsourcing work with contractors. As a result, lack of adequate resources can impede progress on CII BMP implementation due to additional staff time and field equipment resource needs as well as delays in contracting that can affect CII customer program uptake. Additionally, some contractors have limited services and therefore will not be able to provide turn-key program support.

5.2.6.2 Successes

Collaboration: Urban water suppliers should consider working with other existing programs in your service area, for example, energy efficiency and green business programs. Many successful programs involve outside stakeholders when creating and marketing programs such as non-profits or other community organizations. If applicable to your service area, taking advantage of regional programs to minimize administrative burden while providing the service area with water efficiency opportunities (e.g., San Diego County Water Authority, Metropolitan Water District of Southern California, Bay Area Water Supply and Conservation Agency, Regional Water Authority, Sonoma-Marin Saving Water Partnership, and Zone 7 water agencies). Past partnering with contractors for CII customer direct install programs has proven successful, such as the statewide

pre-rinse spray valve installation program run by the CUWCC (Koeller, 2004). Based on this study, and following the nearly 50% saturation of valve replacement, the Title 20 Appliance Efficiency Regulations were changed to help complete the installation of this new high efficiency technology. It is also recommended to consider engaging with water- and energy-related organizations who may have programs and resources that are useful for collaboration. In addition, seek other non-governmental programs to support/expand on the voluntary implementation of CII water use efficiency in the business community.

Training: Stakeholders and urban water suppliers should recognize the need to hire additional staff and to train for more specialized expertise in CII water use and water efficient technologies. Standardization of water assessment training for utilities and CII properties across the state could help to simplify and make implementation more feasible for non-technical staff. Regional and statewide industry organizations could expand training, such as within AWWA's Water Use Efficiency Practitioner Exam material, to include more CII water use customer water efficiency practices and equipment and more detailed instruction on how to estimate water savings beyond basic calculations.

6 Comprehensive List of Current CII WUE BMPs

After assessing the abovementioned sources and experience, a comprehensive list of CII BMPs was developed (Table 2). This BMP list is intended to be a full menu of options from which urban water suppliers can choose a focused selection of common measures based on their local service area needs. Some BMPs are for urban water suppliers to coordinate and/or implement with CII customers, while others may be more applicable for CII customers to implement directly. The BMPs are categorized into three comprehensive groups based on the type and focus of the practice:

- Education – Education generates public awareness and knowledge of how to conserve water and can provide the backbone for any conservation program. While effectiveness of many education programs is difficult to directly measure, education increases awareness and improves effectiveness of incentive programs.
- Incentive- Incentives offer financial encouragement to adopt efficient fixtures, appliances, landscaping, etc. Incentives can be targeted at high water users or at low-income customers and can help speed up adoption of water saving practices. Typically, the costs and effects of incentives are quantifiable (for example, a $100 rebate for a toilet nets a 60% reduction in gallons per flush).
- Policy – Policies are actions adopted by a government, business, or institution, and have significant impact on conservation by affecting many customers at once. For example, water-efficient landscaping standards reduce water use significantly, so policies requiring efficient landscaping for new homes can have a large impact on water use for areas experiencing high growth.

Table 2: Current CII WUE BMP Measures

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Education/ Incentives	Focused Indoor Water Assessments	CII Indoor	Incentive	Provide free water assessments to hotels and motels. Standardize on the types of services offered to reduce costs. Included would be bathrooms, kitchens, ice machines, laundry, cooling towers, landscaping, and irrigation systems and schedules.
Education/ Incentives	Irrigation Assessment	CII Outdoor	Incentive	Free irrigation water assessment provided to CII properties. Maybe included with indoor surveys.
Education	Top CII Water Users in Service Area Program	CII Indoor/ Outdoor	Incentive	Screen for largest CII water customers to be offered a free water survey that would evaluate ways for the business to save water and money.
Education/ Incentives	Water Management Plan	Both	Voluntary	Provide CII water customers with a water management plan based on results of the survey.
Education	Business Recognition Programs	CII Indoor/ Outdoor	Voluntary	Sponsor a recognition program for businesses that significantly reduce water use. They would receive a plaque/recognition.
Education	Efficient Outdoor Use Education and Training Programs	SF/MF/CII Outdoor	Voluntary	Urban retail water supplier would offer, organize, and sponsor a series of educational workshops or other means for educating landscapers and contractors in efficient landscaping and irrigation principals.

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Education	Promote Green Buildings	ALL	Voluntary	Assign staff a position to work with local Green Building associations, developers, designers, vendors to promote incorporating water efficiency into building design. Possibly work with other partner utilities or agencies energy/wastewater/storm water. Co-sponsor award program. Partner with green real estate initiatives and/or local developers to promote EPA WaterSense Certified Homes program. More information here: https://www.epa.gov/watersense/watersense-labeled-homes
Education	Large Landscape Water Budget Program (non-regulatory)	CII Outdoor	Incentive	Large landscape water budget program provides incremental report of expected water use compared to actual water use. Primary goal is to serve as a communication tool between stakeholders (i.e., property operator, irrigation technician, etc.). Common example is Waterfluence but can be performed in-house.
Incentives	Indoor Plumbing Fixture Upgrades	CII Indoor	Incentive	Support installation of high efficiency indoor plumbing fixtures including showerheads, faucets, aerators, high efficiency urinals, high efficiency toilets. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Install High Efficiency Fixtures in Government Buildings	CII Indoor	Incentive	Install high efficiency faucets, toilets, urinals and showerheads in City or Utility facilities. Could also offer incentives for similar installations in other government buildings (such as utility pays for all or part of fixture cost, and building owner provides installation.)
Incentives	High Efficiency Washer Rebate	CII Indoor	Incentive	Provide a rebate or incentive for the installation of a high efficiency commercial washer (HEW).

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Incentives	Financial Incentives for Landscape Upgrades	CII Outdoor	Incentive	Support a Smart Landscape Rebate Program with incentives for substantive landscape retrofits or installation of water efficient upgrades including purchase and installation of water-wise plants, compost, and mulch. Landscape upgrades might include conversion of turf to lower-water-using turf varieties.
Incentives	Financial Incentives for Irrigation Upgrades	CII Outdoor	Incentive	Irrigation equipment upgrades may include, but not limited to, soil moisture sensors, flow sensors, in-stem flow regulators, plumbing flow control valve, Split Service Incentive (splits mixed use meters into indoor and outdoor), laminar flow restrictors, rain shut-off sensors, conversion to drip systems, large rotary spray nozzle installation, etc.
Incentives	Landscape Conversion or Turf Removal	CII Outdoor	Incentive	Provide a per square foot incentive to remove turf and replace with low water use plants or hardscape. Landscape conversion could include conversion of turf to lower-water-using turf varieties. Rebate based on price per square foot removed and capped at an upper limit for multifamily or commercial residence.
Incentives	Weather-Based Irrigation Controller Rebates	CII Outdoor	Incentive	Support installation of a weather-based irrigation controller. These controllers have onsite weather sensors or rely on a signal from a central weather station that modifies irrigation times at least weekly. Requires local irrigation contractors who are competent with these products, so may require sponsoring a training program in association with this measure. This may include rebate, incentive, giveaway, direct installation, or similar program.

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Incentives	Rotating Sprinkler Nozzle Rebates	CII Outdoor	Incentive	Support replacement of standard spray sprinkler nozzles with rotating nozzles that have lower application rates. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Pressure Regulation	Both	Incentive	Support installation of pressure regulators or automated control valves. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Provide Incentive for Large Rainwater Catchment Systems	CII Outdoor	Incentive	Provide incentive for installation of large rainwater catchment systems. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Provide Incentive for Large Stormwater Catchment Systems	CII Outdoor	Incentive	Support installation of large stormwater catchment systems. Stormwater catchment refers to surface water from rainfall events, not roof water. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Customized Top Users Incentive Program	Both	Incentive	Water supplier to provide customer financial incentives based on water survey findings. Incentives are tailored to each individual site as each site has varying water savings potentials.

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Incentives	CII Rebates to Replace Inefficient Equipment	Both	Incentive	Support upgrading to water efficient technology from a standard list of water efficient equipment. Included would be x-ray machines, icemakers, air-cooled ice machines, steamers/steam cookers, washers, spray valves, dishwashers, garbage disposal, washing and sanitation, combination ovens, steam kettles, laundry operations, medical and lab equipment, vivarium and aquariums, fabric cleaning and washing equipment, industrial equipment, etc. Also includes replacing once-through cooling and adding conductivity meters to cooling towers. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Water Savings Performance Program	Both	Incentive	Water supplier-sponsored Water Savings Performance program provides financial incentive per gallons saved to sites within the urban retail water supplier service area.
Incentives	Restaurant Spray Nozzles	CII Indoor	Service	Support installation of 1.15 gallons per minute (or lower) spray nozzles and possibly free installation for the rinse and clean operation in restaurants and other commercial kitchens.
Incentives	Dipper Wells	CII Indoor	Incentive	Provide a dipper well device incentive for relevant food service accounts. Devices save water and money using less than 600 gallons of water per year.
Incentives	School Building Retrofit	Both	Incentive	School retrofit program wherein school receives a grant to replace fixtures and upgrade irrigation systems. Might target university and college campuses.

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Incentives	Hotels/Motels Retrofit with Financial Assistance	Both	Incentive	Following a free water assessment, offer motels a rebate for equipment identified that would save water. Or provide a rebate schedule for certain efficient equipment such as air-cooled ice machines that motels could apply for without an assessment.
Incentives	Rebates for Submeters on Cooling Towers	Both/cooling	Incentive	Support installation of submeters to measure the make-up and bleed-off water of the facility cooling towers. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Rebates for Conductivity Controllers on Cooling Towers	Both/cooling	Incentive	Support installation of advanced cooling tower controllers to reduce bleed-off water of the facility cooling towers. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Dry Vacuum Pump	CII Indoor	Incentive	Support installation of dry vacuum pumps. This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Dry Heat Sterilization in the Pharmaceutical Industry	CII Indoor	Incentive	Support installation of dry heat sterilization (versus steam). This may include rebate, incentive, giveaway, direct installation, or similar program.
Incentives	Alternate Onsite Sources of Non-Potable Water	Both	Incentive	Alternate onsite sources are different from recycled water. Many factors have converged to encourage the use of the alternate onsite non-potable sources of water. Commercial and institutional facilities also have significant opportunities to capture and reuse a variety of alternate onsite sources for non-potable applications.

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Incentives	Building Meters, Submeters, and Management Systems	Both	Incentive	Tracking total property water use as well as specific uses within the building(s) is a key component of facility management efforts and essential to managing water costs and maintaining systems and processes on the property.
Incentives	Replace Single-Pass Cooling Equipment	Both/cooling	Incentive	Types of equipment that often use single-pass cooling include chillers or other refrigeration systems, condensers, air compressors, hydraulic equipment, CAT scanners, degreasers, welding machines, vacuum pumps, x-ray equipment, ice machines, wok stoves, etc.
Incentives	Alternate Sources of Water and Recirculated Water Use	Both	Incentive	Use of alternative sources and recirculated water is a best management practice for all industries. This may include condensate, RO water, water reuse systems, grey water, stormwater, etc.
Policy	Fixture Retrofit on Resale or Name Change on Water Account	ALL	Ordinance	Work with the real estate industry to require that a certificate of compliance be submitted to the urban retail water supplier that verifies that a plumber has inspected the property and efficient fixtures were either already there or were installed before close of escrow.
Policy	Pressure Regulation at Individual Properties	ALL	Incentive/ Ordinance	Water suppliers can ensure installation of pressure regulators at CII properties where pressure is above a certain level and pressure regulation is found to be lacking or inadequate.

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Policy	Install AMI	ALL	Service	Retrofit system with AMI meters and associated network capable of providing continuous consumption data to urban retail water supplier offices. Features may include online customer access to their usage and leak alerts.
Policy	Install AMI New Development	ALL	Requirement	Require that new customers install AMI meters as described above. The AMI system would, on demand, indicate to the customer and urban retail water supplier where and how their water is used, facilitating water use reduction and prompting leak identification.
Policy	Targeted AMI Data to Specified Customer Categories	ALL	Service	Establish a real-time data collection and communication protocol with Top 1-10% Users.
Policy	Require Fixture Replacement by a Deadline	ALL	Ordinance	Utility would pass an ordinance that requires CII facilities to bring fixtures up to efficient standard by a fixed date at their own expense.
Policy	Require Weather Adjusting Smart Irrigation Controllers and/or Rain Sensors in New Development	ALL	Ordinance	Require developers for all commercial development to install the weather-based irrigation controllers. Some utilities offer rebates for rain sensors. For example, see CALGreen building code that requires this on all new buildings with an irrigation system.

Equipment or Program Type	Specific Program	Focus of Program	Voluntary, Incentive or Required of Customers?	Measure Description
Policy	Prohibit Water Waste and Practices	All Outdoor	Ordinance	Adopt or modify ordinance that prohibits the waste of water defined as gutter flooding and failure to repair leaks in a timely manner.
Policy	Require Plan Review for New CII	CII Indoor/ Outdoor	Ordinance	Require plan reviews for water use efficiency for all new business customers.
Policy	Hotels/Motels Retrofit	CII Indoor	Mandatory	Require schedule for certain efficient plumbing fixtures be replaced by a deadline.
Policy	Prohibit Once-Through Cooling, Non-Recycling Fountains, Water Wasting Fixtures and Practices	CII	Ordinance	Prohibit certain obvious wastes of water in new facilities, such as those listed. Consider requiring retrofits of existing situations, allowing reasonable time for compliance.

7 Conclusion

As we have learned, CII BMP implementation varies widely across California, but is key to continuing to improve urban water use efficiency. As almost 30% of urban water use is attributed to CII users, it is important to include this sector in urban water use efficiency efforts. The diversity in CII customer type and varied classification and benchmarking methods have shown that there is no single suitable approach to improving water use efficiency in the CII sector, and these complexities have made it challenging for urban water suppliers to effectively address the sector's water use. However, we have also seen the emphasis of CII BMPs grow tremendously in the past couple of decades, as drought and water reliability concerns in the state have prompted new regulations and changed industry efficiency appliance standards.

Combining the experiences and observations from stakeholders with the available information and studies on CII BMPs has led to key findings which provide the industry with lessons to learn from and grow upon. The commonly implemented BMPs exemplify where efforts have been focused within the industry thus far and provide example approaches for urban water suppliers and CII customers that may be initiating their water use efficiency efforts. The universal successes and challenges also help to lay out foundational industry knowledge of implementing CII BMPs, and their application may be useful for all program elements. Overall, the recommendations for CII BMP implementation will help to push the industry towards greater implementation success and higher water efficiency. All stakeholders, from customers and water suppliers to non-governmental organizations and state agencies, have a role to play in improving CII water use efficiency and can support BMP implementation within the industry in order to strengthen the state's water reliability amidst the rapidly changing climate.

8 References

All links were accessed on January 14, 2021, unless otherwise indicated.

Alliance for Water Efficiency (AWE). (2018). *Commercial Kitchens Guide*. Available at: https://www.allianceforwaterefficiency.org/impact/our-work/commercial-kitchens-guide

Ibid. (2019). *Sustainable Landscapes: A Utility Program Guide*. Available at: https://www.allianceforwaterefficiency.org/impact/our-work/sustainable-landscapes-utility-program-guide

Alliance for Water Efficiency and Environmental Law Institute. (2017). *The Water Efficiency and Conservation State Scorecard: An Assessment of Laws.* Available at: https://www.allianceforwaterefficiency.org/sites/www.allianceforwaterefficiency.org/files/highlight_documents/AWE-2017-State-Scorecard.pdf

Arizona Municipal Water Users Association (AMWUA). (2008). *Facility Manager's Guide to Water Management*. Available at: http://www.amwua.org/pdfs/facility_managers_guide.pdf

Bay Area Water Supply & Conservation Agency (BAWSCA). (2018). *Bay Area Water Supply & Conservation Agency's "Making Conservation a Way of Life" Strategic Plan – Phase 1.* Available at: https://bawsca.org/uploads/userfiles/files/BAWSCA_Conservation%20Strategic%20Plan%20Phase%201_Final_9-17-18_cx.pdf

Bureau of Economic Analysis (BEA). (2021). *Data Tools: GDP and Personal Income.* Retrieved January 11, 2022. Available at: https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1&acrdn=1.

California Department of Water Resources (DWR). (2016). *Chapter 16A Non-Potable Water Reuse Systems.* Available at: https://up.codes/viewer/california/ca-plumbing-code-2016/chapter/16A/non-potable-water-reuse-systems#16A

Ibid. (2013). *Commercial, Industrial, and Institutional Task Force Best Management Practices Report to the Legislature Volume I*. Available at: http://toolbox.calwep.org/w/images/4/4b/CII_Volume-I_July_2014.pdf

Ibid. (2013). *Commercial, Industrial, and Institutional Task Force Best Management Practices Report to the Legislature Volume II.* Available at: http://toolbox.calwep.org/w/images/1/10/CII_Volume-II_July_2014.pdf

Ibid. (2018a) *California Water Plan Update 2018.* Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2018/Final/California-Water-Plan-Update-2018.pdf

Ibid. (2015). *Model Water Efficient Landscape Ordinance*. Available at: https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance

California Department of Water Resources (DWR) and State Water Resources Control Board (State Water Board). (2018b). *California Primer on Making Water Conservation a California Way of Life.* Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Make-Water-Conservation-A-California-Way-of-Life/Files/PDFs/Final-WCL-Primer.pdf

California Energy Commission. (2021). *Appliance Efficiency Regulations – Title 20*. Available at: https://www.energy.ca.gov/rules-and-regulations/appliance-efficiency-regulations-title-20

California State Legislature. Assembly Bill 715 (Laird), October 11, 2007. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200720080AB715

Ibid. Assembly Bill 1668 (Friedman), May 31, 2018. Available at: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB1668

Ibid. Senate Bill 407 (Padilla), October 11, 2009. Available at: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100SB407

Ibid. Senate Bill 606 (Hertzberg), May 31, 2018. Available at: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB606

Ibid. Senate Bill 837 (Blakeslee), July 1, 2011. Available at: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB837

California Urban Water Conservation Council (CUWCC). (1991). *Memorandum of Understanding Regarding Urban Water Conservation in California.* Available at: http://toolbox.calwep.org/wiki/Memorandum_of_Understanding_Regarding_Urban_Water_Conservation_in_California

California Water Efficiency Partnership. (n.d.). *Resources, Articles and Events.* https://calwep.org/all-resources/

City of Santa Barbara. (2021). *Santa Barbara – Rebates*. Retrieved July 28, 2021. Available at: https://www.santabarbaraca.gov/gov/depts/pw/resources/conservation/rebates/default.asp

City of Santa Cruz. (2017). *Water Conservation Master Plan.* Available at: https://www.cityofsantacruz.com/home/showpublisheddocument?id=58962

Ibid. (n.d.). *Plumbing Fixture Retrofit Regulations.* Retrieved September 22, 2021, Available at: https://www.cityofsantacruz.com/government/city-departments/water/conservation/regulations/plumbing-fixture-retrofit-regulations

City of Santa Monica. (n.d.). *Green Building*. Santa Monica Office of Sustainability and the Environment. Retrieved September 22, 2021, Available at: https://www.smgov.net/Departments/OSE/categories/buildGreen.aspx

City of Santa Rosa. (n.d.). *Rebates & Free Services*. City of Santa Rosa Water. Retrieved September 17, 2021, Available at: https://srcity.org/834/Rebates-Free-Services#Commercial%20Rebates. See Case Study Appendix C.

Contra Costa Water District (CCWD). (n.d.). *Landscape Design Assistance Program*. Retrieved September 17, 2021, Available at: https://www.ccwater.com/274/Landscape-Design-Assistance-Program

Dziegielewski, B., J. C. Kiefer, W. DeOreo, P. Mayer, E. M. Opitz, G. A. Porter, G. L. Lantz, and J. O. Nelson. (2000). *Commercial and Institutional End Uses of Water*. Denver, Colorado: AWWA, Research Foundation and American Water Works Association with Cooperation of the US Bureau of Reclamation. Catalog No.90806. 264

pp. ISBN 1-58321-035-0. Available at: https://www.waterrf.org/resource/commercial-and-institutional-end-uses-water

East Bay Municipal Utility District (EBMUD). (n.d.). *WaterSmart Certification*. Retrieved September 17, 2021, Available at: https://www.ebmud.com/water/conservation-and-rebates/commercial/watersmart-business-certification-program/

Ibid. (2008). *Watersmart Guidebook: A Water-Use Efficiency Plan-Review Guide for New Businesses.* Available at: https://www.ebmud.com/water/conservation-and-rebates/commercial/watersmart-guidebook/

GMP Research Inc. (2019). *US WaterSense Market Penetration Study.* Plumbing Manufacturers Institute. Available at: https://www.safeplumbing.org/files/safeplumbing.org/documents/misc/2019-WaterSense-market-penetration-study.pdf

Governor of California, Jerry Brown, Executive Order No. B-29-15. (2015). https://www.ca.gov/archive/gov39/wp-content/uploads/2017/09/4.1.15_Executive_Order.pdf

Grinshpun, M., Ashmore, J., and Benzaoui, J. (2019). *Water Utility of the Future: A Case Study of Conservation as a Service.* Boston University Institute for Sustainable Energy. Available at: http://www.bu.edu/ise/files/2019/10/Water-Utility-of-the-Future-A-Case-Study-of-Conservation-as-a-Service_FINAL.pdf

Hanak, Lund, Howitt, Gray, Thompson, and Azuara. (2021). *Water and the California Economy*. Public Policy Institute of California. Retrieved January 11, 2022. Available at: https://www.ppic.org/publication/water-and-the-california-economy/

Hoffman, H.W., Antonoff, J., Apicella, J., Betz, F., Buso, S., Carlile, J., Casamassima, B., Cheslak, K., Cox, M., David, C., DeMarco, P., Firestone, H., Golin, C., Herman, K., Horner., R., Mason, D., Maddaus, M., Murer, M., Nguyen, K., O'Neil, M. … Zullo, L. (2019). *Water Audit Guidance for Commercial Buildings.* City Energy Project. Available at: https://www.cityenergyproject.org/wp-content/uploads/2019/05/City_Energy_Project_Resource_Library_Water_Audit_Guidance_For_Commercial_Buildings.pdf

Irvine Ranch Water District. (2021). *Effectiveness of Commercial, Industrial and Institutional Customer Water Budgets in Achieving Efficient Water Use for Mixed Use Meters.* See Appendix C.

Kiefer, J. C., L. Krentz, and B. Dziegielewski. (2015). *Methodology for Evaluating Water Use in the Commercial, Institutional, and Industrial Sectors.* Project #4375. Available at: https://www.waterrf.org/resource/methodology-evaluating-water-use-commercial-institutional-and-industrial-sectors

Koeller, J. (2004). *Evaluation of Potential Best Management Practices – Pre-Rinse Spray Valves for the Food Service Industry.* Prepared for the CUWCC. Available at:

http://toolbox.calwep.org/w/images/9/94/Pre-Rinse_Spary_Valves_for_the_Food_Service_Industry-PBMP-2004.pdf

M.Cubed and A&N Technical Services, Inc. (2017). *CII Water Use and Drought Response: Case Study of California Water Service.* Prepared for California Water Service.

Maddaus, M., Maddaus, W., and Maddaus, L. (2017). *M52 Water Conservation Programs – A Planning Manual, 2nd Edition.* Available at: https://www.awwa.org/Store/Product-Details/productId/61841578

Maddaus Water Management Inc. (MWM). (2021). CalWEP Statewide Survey – Would State-Wide CII Water Use Efficiency Programs Help You?

Mount, Hanak, Baerenklau, Butsic, and Chapelle. (2021). *Managing Drought in a Changing Climate: Four Essential Reforms*. Public Policy Institute of California. Retrieved January 11, 2022. Available at: https://www.ppic.org/publication/managing-drought-in-a-changing-climate-four-essential-reforms/

Municipal Water District of Orange County (MWDOC). (n.d.) *Commercial Rebates*. Retrieved September 4, 2021. Available at: https://www.mwdoc.com/save-water/rebates/commercial-rebates/

Nevada Governor's Office of Energy. (n.d.). *Public Building Water Auditing Best Practices.* Available at: *http://energy.nv.gov/uploadedFiles/energynvgov/content/Programs/Public%20Building%20Water%20Auditing%20Best%20Practices.pdf*

Public Policy Institute of California (PPIC). (2021). *Water Use in California*. Available at: https://www.ppic.org/publication/water-use-in-california/

SoCal Water$mart. (n.d.). *Water Savings Incentive Program*. SoCal Water$mart Commercial Rebates. Retrieved September 17, 2021, Available at: https://socalwatersmart.com/en/commercial/water-savings-incentive-program/

South Florida Water Management District, Water Supply Development Section. (2013). *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities*. South Florida Water Management District Water Supply Development Section. Available at: https://issuu.com/southfloridawatermanagement/docs/water_efficiency_improvement_guide?mode=window&proSidebarEnabled=true&backgroundColor=%23222222

Sydney Water. (2007). *Best Practice Guidelines.* Retrieved September 20, 2021. Available at: https://www.sydneywater.com.au/your-business/managing-your-water-use/programs-resources.html

United States Department of Energy (DOE). *Appliance and Equipment Standards Program*. Available at: https://www.energy.gov/eere/buildings/appliance-and-equipment-standards-program

United States Environmental Protection Agency (US EPA). (2016a). *Best Practices to Consider When Evaluating Water Conservation and Efficiency as an Alternative for Water Supply Expansion*. Available at: https://www.epa.gov/sites/default/files/2016-12/documents/wc_best_practices_to_avoid_supply_expansion_2016_508.pdf

Ibid. (n.d.). *WaterSense® Commercial Buildings: Types of Facilities.* Retrieved September 20, 2021, Available at: https://www.epa.gov/watersense/types-facilities

Ibid. (2016b). *WaterSense® Simple Water Assessment Checklist for Commercial and Institutional Facilities.* Retrieved September 20, 2021, Available at: https://www.epa.gov/sites/production/files/2017-01/documents/ws-commercial-water-assessment-checklist.pdf

US Water Alliance. (n.d.). *Resources for Onsite Non-Potable Water Programs.* Retrieved January 14, 2022. Available at: http://www.uswateralliance.org/initiatives/commission/resources

Vickers, A. (2001). *Handbook of Water Use and Conservation.* Amherst, Massachusetts: WaterPlow Press.

Vickers, A., Tiger, M., and Eskaf, S. (2013). *A Guide to Customer Water-Use Indicators for Conservation and Financial Planning A Guide to Customer Water-Use Indicators for Conservation and Financial Planning*. American Water Works Association. Available at: https://www.researchgate.net/publication/277477322_A_Guide_to_Customer_Water-Use_Indicators_for_Conservation_and_Financial_Planning

Voter Approval for Local Government Taxes. Limitations on Fees, Assessments, and Charges. Initiative Constitutional Amendment. Calif. Constitution. Article XIII C and Article XIII D. Available at: https://leginfo.legislature.ca.gov/faces/codesTOCSelected.xhtml?tocCode=CONS&tocTitle=+California+Constitution+-+CONS

Water Research Foundation. (2019). *Water Use Analysis Guide for Commercial and Institutional Efficiency.* Available at: https://www.waterrf.org/resource/water-use-analysis-guide-commercial-and-institutional-efficiency

Appendices

Appendix A: CUWCC MOU Amendments on BMPs

CALIFORNIA URBAN WATER CONSERVATION COUNCIL

BMPs

1994 MOU

1. Interior and Exterior Water Audits and Incentive Programs for Single Family Residential, Multi-Family Residential, Government/Institutional Customers
2. Plumbing, New and Retrofit
3. Distribution System Water Audits, Leak Detection and Repair
4. Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections
5. Large Landscape Water Audits and Incentives
6. Landscape Water Conservation Requirements for New and Existing Commercial, Industrial, Institutional, Governmental, and Multi-Family Developments
7. Public Information
8. School Education
9. Commercial and Industrial Water Conservation
10. New Commercial and Industrial Water Use Review
11. Conservation Pricing
12. Landscape Water Conservation for New and Existing Single-Family Homes
13. Water Waste Prohibition
14. Water Conservation Coordinator
15. Financial Incentives
16. Ultra-Low Flush Toilet Replacement

1997 MOU

1. Water Survey Programs for Single-Family Residential and Multi-Family Customers
2. Residential Plumbing Retrofit
3. System Water Audits, Leak Detection and Repair
4. Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections
5. Large Landscape Conservation Programs and Incentives
6. High-Efficiency Washing Machine Rebate Programs
7. Public Information Programs
8. School Education Programs
9. Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts
10. Wholesale Agency Assistance Programs

11. Conservation Pricing
12. Conservation Coordinator
13. Water Waste Prohibition
14. Residential ULFT Replacement Programs

1999 MOU

The 1999 MOU amended:

- BMP 9 - CII

2004 MOU

The 2004 MOU amended:

- BMP 6– High-Efficiency Washing Machine Financial Incentive Programs
- BMP 10 - Wholesale Agency Assistance Programs

2007 MOU

The 2007 MOU amended:

- BMP 4 – Metering
- BMP 6 – High Efficiency Washing Machines

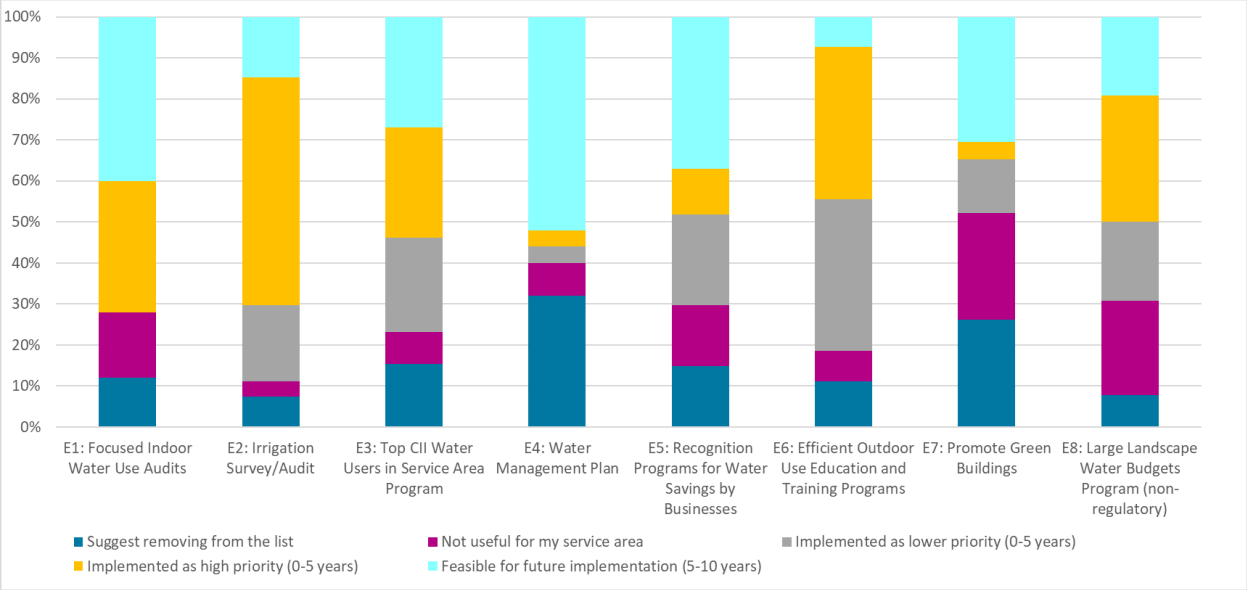
2016 MOU

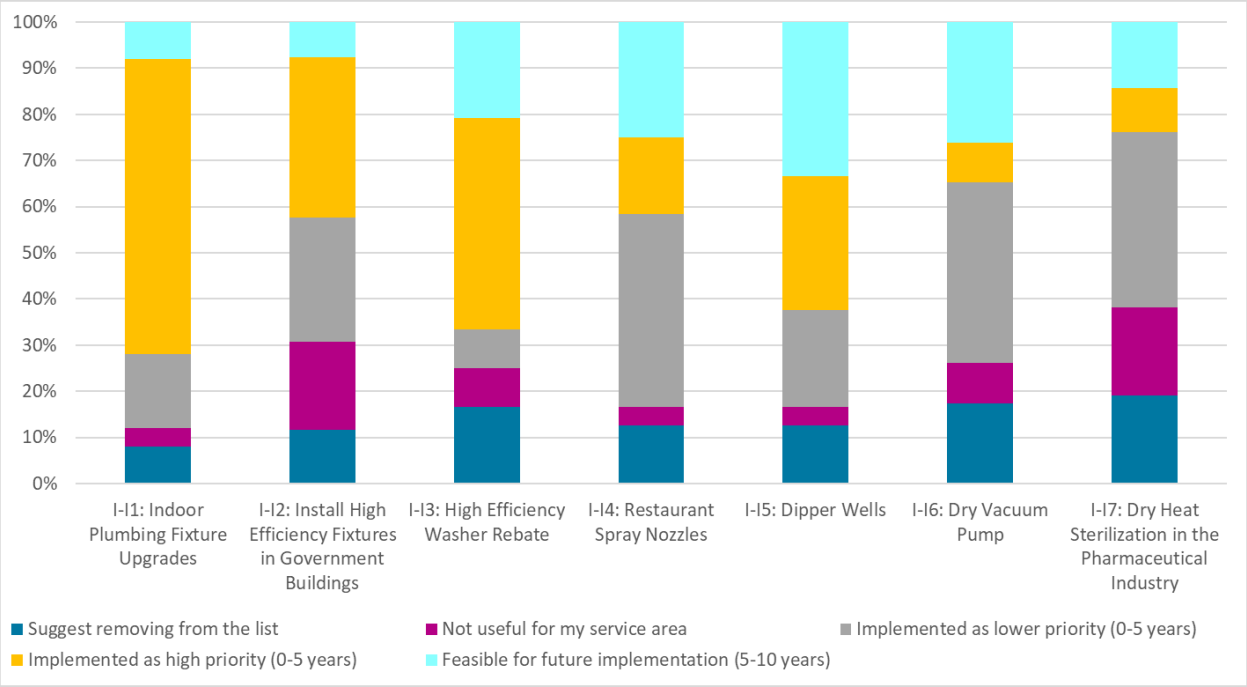
In 2015 the BMPs were organized as follows:

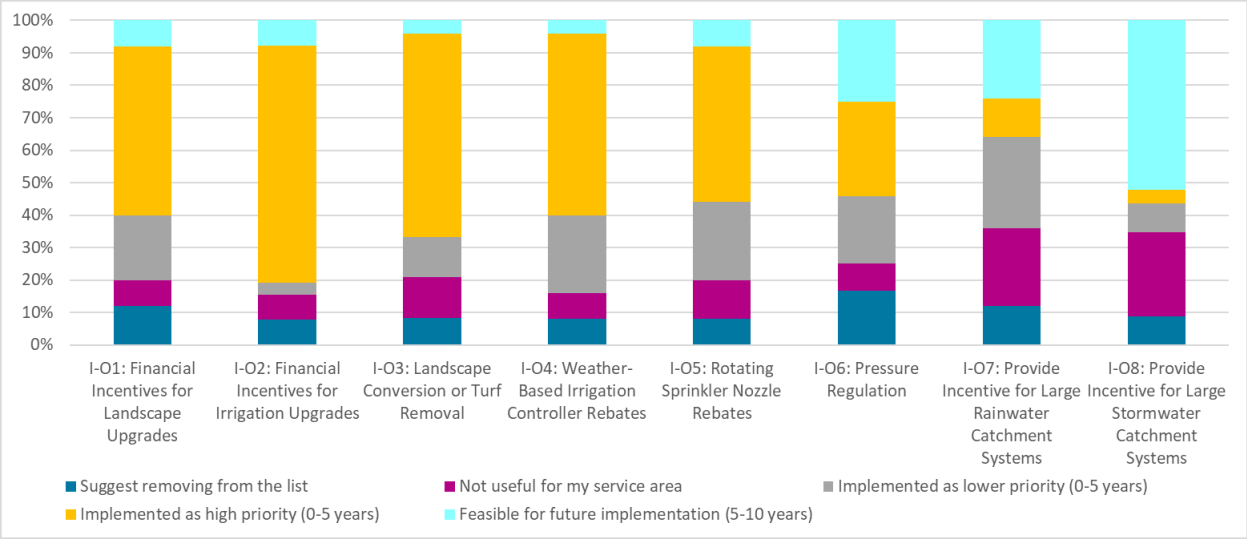
- *Foundational BMPs*
    1. Utility Operations
    2. Education
- *Programmatic BMPs*
    3. Residential
    4. Commercial, Industrial, and Institutional
    5. Landscape

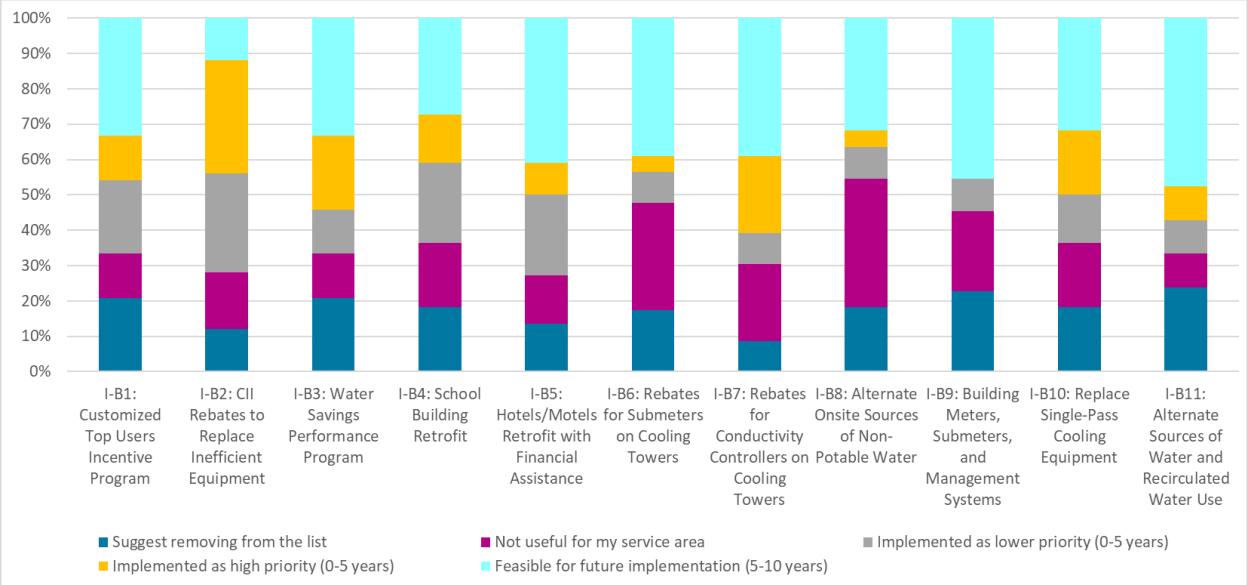
Appendix B: CII BMP Stakeholder Survey Results

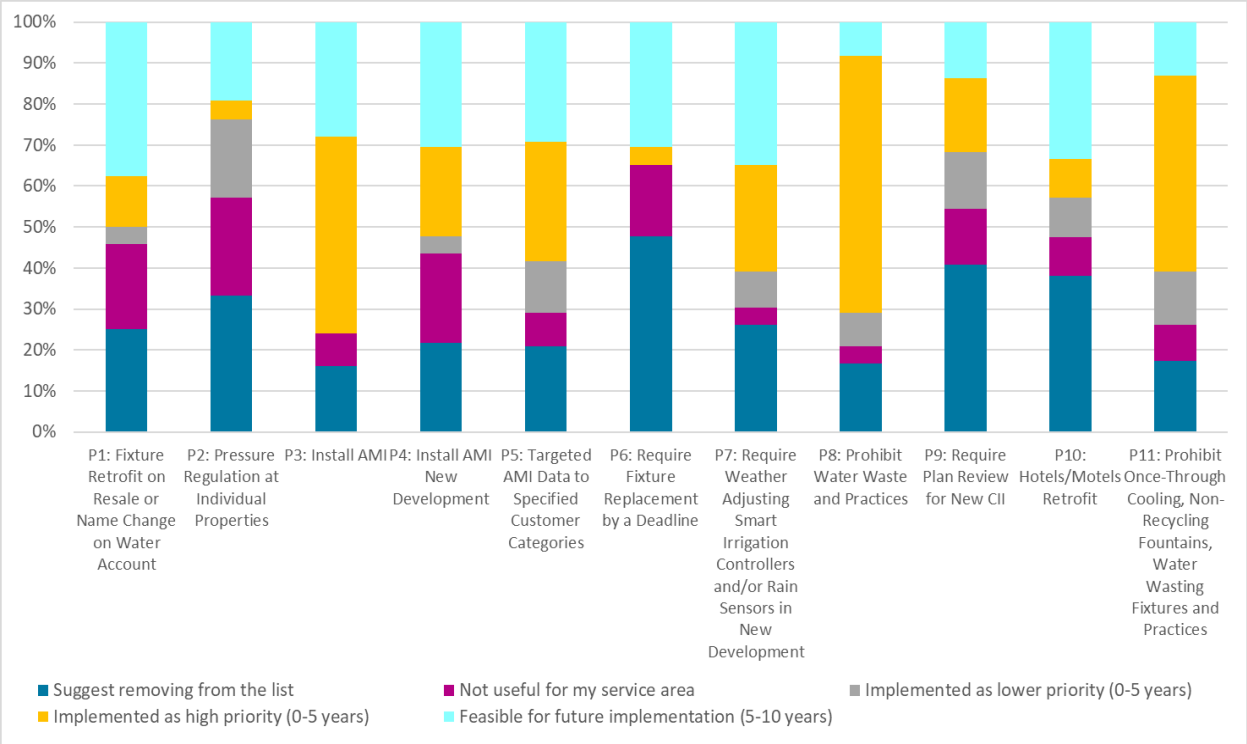
The figures below display input from 30 California urban water suppliers on the status of CII BMPs in their service areas, received during on the CII BMP stakeholder survey response period from March to June 2021, as introduced in Section 4.3.1.






100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
I-O1: Financial Incentives for Landscape Upgrades
I-O2: Financial Incentives for Irrigation Upgrades
I-O3: Landscape Conversion or Turf Removal
I-O4: Weather-Based Irrigation Controller Rebates
I-O5: Rotating Sprinkler Nozzle Rebates
I-O6: Pressure Regulation
I-O7: Provide Incentive for Large Rainwater Catchment Systems
I-O8: Provide Incentive for Large Stormwater Catchment Systems
Suggest removing from the list
Not useful for my service area
Implemented as lower priority (0-5 years)
Implemented as high priority (0-5 years)
Feasible for future implementation (5-10 years)


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
I-B1: Customized Top Users Incentive Program
I-B2: CII Rebates to Replace Inefficient Equipment
I-B3: Water Savings Performance Program
I-B4: School Building Retrofit
I-B5: Hotels/Motels Retrofit with Financial Assistance
I-B6: Rebates for Submeters on Cooling Towers
I-B7: Rebates for Conductivity Controllers on Cooling Towers
I-B8: Alternate Onsite Sources of Non-Potable Water
I-B9: Building Meters, Submeters, and Management Systems
I-B10: Replace Single-Pass Cooling Equipment
I-B11: Alternate Sources of Water and Recirculated Water Use
Suggest removing from the list
Not useful for my service area
Implemented as lower priority (0-5 years)
Implemented as high priority (0-5 years)
Feasible for future implementation (5-10 years)


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
P1: Fixture Retrofit on Resale or Name Change on Water Account
P2: Pressure Regulation at Individual Properties
P3: Install AMI
P4: Install AMI New Development
P5: Targeted AMI Data to Specified Customer Categories
P6: Require Fixture Replacement by a Deadline
P7: Require Weather Adjusting Smart Irrigation Controllers and/or Rain Sensors in New Development
P8: Prohibit Water Waste and Practices
P9: Require Plan Review for New CII
P10: Hotels/Motels Retrofit
P11: Prohibit Once-Through Cooling, Non-Recycling Fountains, Water Wasting Fixtures and Practices
Suggest removing from the list
Not useful for my service area
Implemented as lower priority (0-5 years)
Implemented as high priority (0-5 years)
Feasible for future implementation (5-10 years)

Appendix C: California CII Urban Retail Water Supplier Program Case Studies

Note: The case studies provided below are written by the agency listed. Edits, besides minimal edits to grammar, spelling and syntax, were not made to the agency's submitted text. Also, due to industry standard terminology changes, the words "assessment," "audit," "evaluation," and "survey" are used interchangeably throughout this white paper, including in this case studies section.[14]

Cedars-Sinai Water Reuse Project, Los Angeles Department of Water and Power (LADWP), Los Angeles, CA

To lessen reliance on imported water, LADWP is researching novel ways to preserve water and use local water sources. Groundwater, which is created by aquifer dewatering, is a promising local water supply.

The Cedars-Sinai Medical Center (Cedars-Sinai) in West Hollywood implemented a novel groundwater treatment system to utilize local groundwater, which dramatically reduced the hospital's potable water demand and corresponding water bill. Cedars-Sinai is situated above an active groundwater aquifer, which requires water to be periodically pumped and diverted from the base of the building to maintain the structural stability of the hospital. Before the installation of the new groundwater treatment system, Cedars-Sinai pumped and treated the groundwater to adhere to local and federal discharge limits before releasing it to the storm drain, as required by their industrial waste permit. Roughly 42 million gallons of groundwater were treated and discharged each year, which accumulated costly storm drain discharge and permitting fees.

Recognizing an opportunity to utilize the discharged groundwater, Cedars-Sinai partnered with Rethink H2O, an outside contractor, to install a groundwater treatment system to treat the groundwater for use in the building's air conditioning cooling towers. A five-step treatment prepares the pumped water for use in the hospital's cooling towers. A pumping system then delivers the treated water to the cooling towers, which provide cooling for the building's air conditioning system.

LADWP provided funding on the project through its Technical Assistance Program (TAP) at an amount of $155,355, which helped to offset the total project cost of $1.2 million dollars.

[14] The term "water audit" has developed a negative connotation for customers which has impacted urban water supplier outreach efforts. As a result, industry trends have moved toward the use of different terminology, most notably water "assessment" rather than "audit." Therefore, for the purposes of this paper, the terms assessment, audit, evaluation, and survey may be used interchangeably throughout this white paper to maintain the integrity of original citations and to honor individual agency preferences in surveys and case studies. A detailed definition of "assessment" is provided in Section 5.1.2 and Appendix E.

The project has a short return on investment of less than 5 years due to annual water bill savings, LADWP's TAP rebate, and additional funding of $168,000 provided through Metropolitan Water District's Water Savings Incentive Program.

The treated groundwater now provides 50-80 percent of the water used in the building's cooling towers, saving an estimated 80 thousand gallons per day or 29.3 million gallons (90 acre-feet) of LADWP-supplied potable drinking water every year. This is equivalent to the amount of water used by 360 single-family homes in one day. This project also reduces Cedar-Sinai's average annual water bill by $263,000.

This groundwater treatment system has resulted in dramatic water savings for Cedars-Sinai. This case study serves as a successful example of a business investing in water efficiency and utilizing a previously overlooked water resource. Cedars-Sinai, with the assistance of LADWP's TAP program and MWD's Water Savings Incentive Program, greatly improved their water efficiency and reduced the amount of water discharged into the storm drain.

CII Survey and Incentive Program, City of Santa Barbara, Santa Barbara, CA

Water use in the City of Santa Barbara service area is predominantly residential; about 22% of water demand is from commercial, industrial, and institutional (CII) accounts. However, 85% of the top 20 highest potable water use accounts are CII accounts. The focus of most of the City's past and current water use efficiency programs has been on landscaping and residential programs, however, the City decided to expand and focus efforts on high water use CII accounts to determine additional savings opportunities.

The City's Commercial, Industrial and Institutional Incentive Program (CII Program) began in 2013. The purpose of the CII Program was to provide water-intensive CII accounts (over 100 HCF per month on average) with a detailed summary of the water uses on their site and recommendations for retrofits or equipment replacements based upon the return on investment for the projects.

City staff perform a comprehensive water survey including the flow rate of individual fixtures, the make and model of equipment, and data on frequency of use provided by the facility staff. A detailed report is created with efficiency recommendations with estimated savings in gallons as well as annual water, sewer, and energy cost reductions. Only projects with an estimated return on investment of four years or less are recommended.

The City offers a maximum rebate of $15,000 per customer, and budgets for two rebates per year ($30,000). Invoices with specific details of replaced equipment are necessary to calculate the final amount of the incentive.

Incentive amounts are calculated for each proposed project based on:

- Estimated water savings
- City's avoided cost of water

- Estimated project life expectancy
- Maximum 50% of equipment cost
- Maximum total incentive per site is $15,000

The top water users in the CII classification are solicited to participate using a variety of outreach methods: letters, postcards, and phone calls to the decision makers in the company including facility management, finance/accounts payable staff, and owners/presidents.

49 sites have been inspected to date over the course of eight years, while only four properties completed the rebate process and received rebate funding. Seventeen school campuses were surveyed and accepted free aerators and showerheads. Multiple sites self-funded efficiency retrofits or were required to meet efficiency standards during remodels.

Barriers to program participation include:

- Contacting the right person at the facility that can influence the decision makers or has a seat at the budget table to follow up and make the recommendations come to fruition.
- Completion of projects requires coordination of the facility management, the in-house maintenance staff, hired contractors, and third-party distributors.
- Getting buy-in for the project when the in-house plumbing staff is expected to complete the installations, but the labor and material expense was not in their annual budget and the incentive goes to the general fund.
- City staff time to dedicate to outreach, audits, reporting, and following up with participants. A high level of training is required to be able to perform the detailed and lengthy surveys, understand the technology, and communicate the best practices and/or opportunities for replacement. Once the survey is done, the data analysis and reporting take additional staff time and research for available upgrades, incentive calculations, and time to meet with and present the recommendations and incentives. The last hurdle is a commitment from the customer to do the projects that qualify for the rebate, this is where we have had the least success. They do not have the budget to contribute the cost share, it requires more work than what the incentive covers, lack of priority, etc.

We have found that focusing outreach to specific business categories has been helpful, currently that is coin-operated laundromats. We have inspected all the coin-operated laundries in our area and currently have two properties that have completed the process and one who is in-process. Word of mouth is a great promotional tool. One laundromat replaced more machines than our incentive could cover, their estimate of water savings of 9% was actually 13% savings after the project was completed.

We have been pleased to see a reduction in water use from sites that we surveyed even if they did not proceed with an incentivized project. We found an average annual reduction in water use of 10% for the properties we surveyed; often there were leaks or

small fixture changes that could be repaired and implemented without a large capital expense from the facility. We have often seen that considerable water savings often comes from the smallest, easiest, and least expensive projects. Toilets with a flush cycle too long, 2.0 gallons per minute aerators in public lavatory faucets, and basic maintenance that is not reported are the top issues at every property.

CII Survey and Incentive Programs, City of Santa Rosa Water Department, Santa Rosa, CA

City of Santa Rosa Water Department (Santa Rosa Water) has implemented water conservation programs since the 1976-1977 drought. Since the early 1990s an established program to target and support the City's 4,000+ Commercial, Industrial, and Institutional (CII) customers has been in place.

Santa Rosa Water offers free WaterSmart Surveys to CII customers, which includes a review of all water uses (e.g., plumbing, irrigation, process, and cooling water) and provides recommendations for efficiency improvements. Audit report templates are created for both indoor and outdoor Surveys using companion field data sheets that are used to gather data during the Survey. These Surveys allow Santa Rosa Water to develop a relationship with the customer, which can lead to rebate program participation and prompt repair of water waste issues.

Santa Rosa Water also offers rebates and incentive programs for CII accounts, including a High-Efficiency Urinal Rebate, Sustained Reduction Rebate, High-Efficiency Clothes Washer Rebate, Service Split Incentive, Commercial Kitchen Rebate, Green Exchange Rebate, and Rainwater Harvesting Rebate. All rebate program requirements are available at srcity.org/Rebates

The table below provides the number and value of rebates offered to Santa Rosa's CII customers between 1999 and August 2021.

Table 3: Number and Value of Rebates Offered to City of Santa Rosa CII Customers, 1999 to Aug. 2021

Program	Number of Rebates Issued	Total Rebate Value Provided
CII WaterSmart Audit: Indoor	654	Free service to CII customers
CII WaterSmart Audit, including rebate pre-inspections: Landscape	821	Free service to CII customers
Best Available Technology Incentive	5	N/A
High-efficiency Clothes Washer	155	$205,000
Toilet Rebate and Toilet Direct Install	17,700	$306,000 (rebate value only)
High Efficiency Urinal Rebate	27	$11,000

Green Exchange: Cash for Grass Rebate	227	$506,000
Green Exchange: Irrigation Efficiency Rebate	224	$244,000
Sustained Reduction Rebate	22	$733,000
Service Split Incentive	5	N/A

Santa Rosa Water's Communications Team employs various outreach strategies to target the entire service area. This includes the "WaterSmart Center" website, bill inserts, radio ads, digital ads, newsletters, social media posts, etc. In 2021, due to the drought emergency, Santa Rosa Water directly targeted business groups and organizations and developed drought resources for commercial customers, including signage with the tagline, "Drought is Here. Save Water", and a tip card specific to commercial customers. Santa Rosa Water also sent out over 700 letters to lodging establishments, restaurants, and miscellaneous service providers. The letters informed commercial customers about the June 29, 2021, City Council emergency drought declaration and the adoption of a mandatory 20 percent community-wide reduction in water use along with specific prohibitions. For the business sector this included serving water only upon request in restaurants, mandatory messaging about reusing towel and linens in hospitality establishments, and eliminating any power washing of buildings or other hard surfaces unless required for public health and safety.

Despite these efforts, it continues to be difficult to engage CII customers. This is especially true for the hospitality and restaurant sectors. For example, Santa Rosa Water offers a grant funded Commercial Kitchen Rebate that reimburses 100% of the purchase price for qualifying water and energy saving appliances. Santa Rosa Water staff have done extensive outreach targeting this sector to attract participation, including the creation of a postcard that was sent to over 900 account holders, as well as door-to-door outreach in the City's restaurant-dense downtown area. Two responses were received via the postcards and while restaurant owners expressed interest during the door-to-door meetings, neither of these efforts led to significant participation. From customer feedback, one barrier to CII customer uptake of this opportunity is the large upfront cost to the business despite the reimbursement once the rebate is approved. Another barrier was the lack of time the business owner has to navigate the process of purchasing new equipment, applying for the rebate, and training the staff on the new equipment. Ultimately customer participation for this grant has occurred via word of mouth and much of the grant funding remains unused.

The CII sector is complex. For example, the capital costs for retrofitting existing CII facilities for water use efficiency improvements is often challenging and expensive for the customer due to unknown underground water and wastewater piping paths along with the obstruction of existing hardscape. Santa Rosa Water has retained the consulting services of a civil engineering firm for assistance on complex CII facilities. These services have resulted in providing complex water balance studies and data

analysis for some of Santa Rosa Water's largest water customers. While expensive, and not feasible for some utilities, having this level of expertise on hand allows Santa Rosa Water staff the ability to offer audits and water use studies to any customer regardless of complexity.

To address the complexity of the commercial customer, the Santa Rosa Water offers a Sustained Reduction Rebate. This rebate pays $400 for every 1,000 gallons of average monthly sustained reduction in consumption resulting from water use efficiency improvements. The rebate was designed for water use efficiency improvements or technologies that Santa Rosa Water does not have a rebate for and, as the CII sector and potable water offset technologies have become more complex, the flexibility of this rebate program structure is proving to be helpful.

One key success of Santa Rosa Water's CII program is pairing AMI hourly data with the City Council adopted Water Waste Ordinance (Ordinance). Santa Rosa Water completed the installation of the upgraded metering system in January 2021. This was an expensive investment and has proven to be an extremely valuable resource for not only departmental operation efficiencies, but also a valuable tool for generating individualized customer data to accelerate system-wide water savings. Santa Rosa Water's Water Billing and Water Use Efficiency teams collaborate closely to use the newly available hourly usage data to target messaging to customers with continuous use. This targeted outreach along with more granular usage data has resulted in enhanced leak detection, more customer engagement, and increased participation in audits and programs. The AMI data provides documentation necessary for the enforcement of the Ordinance and allows the Water Use Efficiency team to detect a leak, follow-up with a customer, offer customized and specialized assistance, and, if necessary, enforce shutoffs for customers that violate the Ordinance. The Ordinance and AMI data together motivate the customer to act by providing documentation of leaks or wasteful water use practices, which in turn drives customer participation in Water Use Efficiency programs.

City Hall East Technology Project, LADWP, Los Angeles, CA

With help from TAP (Technical Assistance Program) funding, the City of Los Angeles implemented a new and advanced water treatment technology in the cooling towers of one of its main buildings, City Hall East. This bold step on behalf of the City, dramatically reduced the amount of water used by City Hall East and created a precedent for future cooling tower retrofits of public buildings.

City Hall East is an 18-story building housing approximately 530,000 square feet of City administrative office space. Four large cooling towers reside on the roof of the building: two 500-ton towers and two 800-ton towers.

Each cooling tower has two fans and two water retention basins that work together to achieve the necessary evaporative cooling for the building's air conditioning system. This evaporative mechanism consumes vast amounts of water and also concentrates

naturally occurring minerals and substances in the cooling tower basin water. This basin water was previously managed through the addition of acids, chemical dispersants, scaling inhibitors, and biocides to prolong the usability of the water and prevent equipment damage. These traditional chemical methods proved to be expensive, inefficient, and caused a buildup of minerals (scaling) in the appliances.

The General Services Department (GSD) utilized LADWP TAP funding to replace the original water treatment regimen with a state-of-the-art water treatment mechanism created by the company Dynamic Water Technologies and Universal Environmental Technologies (DWT-UET). The DWT-UET system operates externally to the cooling tower basin by pumping the cooling tower water through a reactor which treats the water using an automated process. This automated process treats the basin water through electrolysis, whereby electricity is used to change the chemical make-up of the water. This process lowers the pH, accelerates the precipitation/removal of scalants within the reactor, and reacts with chloride to produce chlorine, a natural biocide. The reactor also dynamically manages the pH of the water to avoid potential corrosion. This technology drastically reduced water use, minimized water released into the sewer, and completely eliminated the use of harsh and dangerous chemicals in the process.

The system saves approximately 1.16 million gallons of water a year, which is a 20% reduction in water use. The reduction in blowdown water (water released to the sewer) is equal to the amount of water saved, which is approximately 1 million gallons per year.

Aside from saving water, the program's "annual monetary savings due to reduced system maintenance, decreased water purchases, and lowered sewer service costs amount to approximately $34,105 per year with a total cost of $188,674 (including TAP funding), the system's simple payback period is approximately 5.5 years.

The system also precisely maintains conditions in the cooling tower water to prevent scaling and corrosion. Furthermore, during the first two months of operation, the system removed 507 pounds of scale from the cooling tower piping, which will improve the operational efficiency and extend the life of the equipment.

The Effectiveness of Commercial, Industrial, and Institutional Customer Water Budgets in Achieving Efficient Water Use for Mixed Use Meters, Irvine Ranch Water District, Irvine, CA

Water use within the Commercial, Industrial, Institutional (CII) customer sector is complex, business specific, dynamic and can fluctuate throughout the year. These variables can make evaluating water use efficiency a challenge. Since 1991, the Irvine Ranch Water District (IRWD) has addressed these challenges with the implementation of custom water budgets for all CII customers. The water budgets are tailored to the unique needs of each customer. The water budgets are developed based on the indoor water use needs plus an outdoor component. The outdoor budget is calculated the same way as a water budget is set for dedicated irrigation meters, based on real time evapotranspiration and horticultural principles. IRWD uses its budget-based rate

structure to effectively communicate water use efficiency performance to customers on the bill and through targeted customer outreach. As a result, IRWD's mixed use CII customers are motivated to stay within a water-efficiency budget, minimize water waste and are incentivized to install water efficient devices and technologies. Because the outdoor portion of the water budget is calculated in exactly the same way as a dedicated irrigation meter, this approach provides an alternative pathway for water suppliers to promote efficient water use to CII customers in lieu of requiring separate dedicated meters for the outdoor use.

For the purposes of water budgeting, IRWD classifies CII accounts as Indoor-only or Mixed-use accounts. Dedicated irrigation meters also have water budgets but are considered a separate customer class and are handled separately.

Indoor-only budgets are determined for each month of the year since business needs can vary significantly over the course of a year. Water use may change throughout the year to reflect fluctuations in business practices or the seasonal nature of water use. Examples include schools with no classes held during summer months or cooling towers which use more water during summer months. For these types of accounts, the budgets for the summer months would be adjusted up or downward. The water budgets adhere to the principle of being high enough to meet the unique and sometimes fluctuating water needs of the business but low enough to detect water waste.

Mixed-use accounts include the indoor budget as described above plus an outdoor budget. The outdoor budget uses the same water budget formula and approach as is applied to IRWD's dedicated irrigation meters. Outdoor budgets are calculated using real-time evapotranspiration (ET) data from one of IRWD's three weather stations and the irrigated landscape area associated with the mixed-use meter. The indoor and outdoor budgets are added together for each bill period and change each month.

CII water budgets provide an efficiency standard at the account level against which the customer's monthly water use can be measured. This efficiency performance metric is used by IRWD for targeted outreach and IRWD's budget-based rate structure sends a strong price signal to the customer if water use exceeds the budget.

High-cost bills are more attention-getting than a spike in water use alone. IRWD's budget-based rate structure has just two tiers for CII customers. Accounts are either within budget or over-budget. Usage within budget is currently billed at the Base rate of $2.00 per hundred cubic feet (CCF. Note that One CCF = 748 gallons). Usage that exceeds the budget is billed at the Wasteful rate of $13.63 per CCF. The difference between the Base and the Wasteful tier rate is almost 700%. These costs are based on cost of service and specifically named to get the customer's attention. It gives customers a financial incentive to share their time and sometimes confidential business information to ensure appropriate water budget calculations. Typical causes of over-budget usage include leaks and excessive irrigation. Once the customer makes repairs or adjustments and the water use returns to normal, IRWD policy allows for the

adjustment of over-budget charges on previous bills. The strong price signal provides the impetus for customers to address the cause of water waste. Customers who are unable to identify the cause for high use on their own can request a free water efficiency site survey from IRWD.

Water efficiency surveys provide IRWD the opportunity to engage with customers about their water use, explain IRWD's rate structure, and identify water efficiency improvements and incentive programs that may help the customer reduce water use. Aside from leaks or over watering, unusual increases or changes in usage may be caused by changes in staffing or changes in business practices, including increased production. To evaluate these changes, IRWD performs a free water efficiency survey. During the survey all end uses of water are assessed and customer input sought to determine if the increase in usage is legitimate. If leaks and excessive irrigation are ruled out, the water budget may be adjusted to accommodate the new uses. Customers are also provided with information on water efficiency programs and incentives. The IRWD survey program is successful in maintaining customer water use within budget.

IRWD reviews all water budgets for CII accounts every three years or more frequently as the need arises. IRWD also monitors CII accounts on a monthly basis for performance against the water budget. Underperforming accounts are targeted for outreach and offered a water efficiency survey. The strong price signal and potential to reduce the cost of bills motivates customers to address water waste promptly.

IRWD's water budgets that are tied to a rate structure with a strong price signal have proven to be highly effective at minimizing water waste and promoting efficient water use for mixed use CII customers. An analysis of the three-year average usage (2018-2020) for 724 mixed-use accounts shows the following results:

- 86% of the bills during the three-year study period were at or below budget.
- 54% of accounts are under budget for all 12 months of the year.
- Of the remaining 46% of accounts with over-budget usage, 30% are back within budget after just one month of over budget use. The performance of this group indicates the responsiveness of the customers to the rate structure and this group typically did not require a survey.
- An additional 40% of accounts were back in budget after two to four months of overbudget use.
- Only 3% of accounts were always over their budget and would be targeted for direct outreach by IRWD.

IRWD's water budget data is used to target customers for water efficiency outreach and incentive programs. IRWD reviews actual customer water use compared with budget on a monthly basis and proactively contacts customers not meeting their budget. Customer water use analysis is also used to target customers for onsite surveys and to identify other water savings opportunities. Customers are motivated to install water efficient devices to help them remain within their water budget and also due to the availability of

cost-effective financial incentives. Since 2000, IRWD has provided incentives in the amount of $1.95 million to CII customers and has leveraged other incentive funding from regional wholesalers (Metropolitan Water District of Southern California and the Municipal Water District of Orange County) in the amount of $4.4 million. Projects and devices include, but are not limited to, water efficient plumbing fixtures, weather-based irrigation controllers, cooling tower controllers and custom pay-for-performance process improvements. Over 62,000 devices and/or projects have been installed or completed, resulting in estimated annual savings of 3,930 acre-feet and over 41,000 acre-feet in estimated lifetime savings.

Water budgets provide an incentive for all customers, including mixed use CII, to take responsibility for their water use and have proven for the last 30 years to be a highly effective water use efficiency tool for IRWD. Indoor budgets are based on business requirements. The outdoor portion of the mixed-use budgets are based on irrigated area and set and managed in the same way as a water budget for a dedicated landscape meter. Since there is no difference in how the outdoor portion of the mixed-use meters and dedicated irrigation meters are handled, this approach is as effective as a separate dedicated irrigation meter. There would be no additional water efficiency benefit to separating the meter or requiring the use of equivalent technology. The mixed-use water budget in effect is the in-lieu technology. When combined with a strong price signal, CII water budgets incentivize customers to participate in water efficiency programs, reduce water waste and improve overall water efficiency.

CII Rebate and Survey Programs, Supplier A, CA

Supplier A started its water conservation program approximately three decades ago primarily due to the “Memorandum of Understanding Regarding Urban Water Conservation in California” and agreed to implement the sixteen BMPs. Supplier A had tank style toilet rebate/voucher programs for both single and multi-family customers for over 20 years and direct installation programs historically too. Supplier A ended the tank-style rebates several years ago after a significant market transformation had occurred and only 1.28 gallons per flush (gpf) toilets could be sold in CA. There seemed to be many CII facilities that still had old flushometer toilets and urinals, providing opportunity for water savings by retrofitting flushometers and urinals. So, Supplier A developed a program offering the highest toilet rebate amount in the region. Supplier A also updated their commercial and multifamily clothes washer rebate to substantially increase the rebate amount and restructured the program.

Supplier A also has a CII survey program to primarily help customers, promote their incentive programs, and save water through customer implemented CII BMPs. They also have commercial irrigation equipment rebates and a lawn conversion rebate focused on outdoor water savings. Below are the CII programs offered by Supplier A:

- Commercial and Multi-Family Irrigation Equipment Rebate: Commercial, multi-family, and homeowners association customers can be reimbursed a portion of the cost to upgrade selected irrigation equipment.
- Commercial and Multi-Family Lawn Conversion Rebate: Replace lawn with water-wise landscape and get up to $20,000 per site for commercial, multi-family, and municipal customers.
- Commercial and Multi-Family Clothes Washer Rebate: Multi-family and commercial customers can get up to $450 back for purchasing or leasing qualified Energy Star certified commercial grade clothes washers.
- Commercial Flushometer Toilet and Urinal Rebate: Commercial, industrial, and institutional customers can get up to $400 back for replacing their toilets and urinals with high-efficiency models.
- Water Use Evaluations for Commercial Customers: To help identify potential water saving opportunities and efficiency improvements, Supplier A offers free professional water use evaluations to all CII customers.

Supplier A's rebate funding comes from ratepayer funds and various grants. They try and make sure their rebate programs are cost effective and select rebates that are near or below the "avoided cost" of water plus the added cost to procure additional water from a new alternate source. The avoided cost is based on the costs to procure water, pump it, move it, and treat it. The rebate amount is determined based on the projected water savings over the life of the product while keeping rebate amounts at or near the avoided cost or "avoided cost + new water supply procurement costs." By not having to process or procure the additional water supply through water efficiency improvements, Supplier A is able to offset the costs of the rebate. This is the general idea when developing their programs.

There are many different marketing strategies attempted for these programs, however, response has been negligible for the amount of effort and labor spent marketing. Some of the strategies tried for various CII rebates include: Outreach to commercial plumbers; Developing marketing flyers; contacting commercial property management companies and associations; Sending direct mailings to customers; Calling and visiting plumbing distributors and stores to promote the program; Contacting schools and universities, city government, and county government; Mailings and emails to commercial dedicated irrigation customers, landscapers, and irrigation supply stores; Contacting laundry service providers/route operators to help promote rebates; Marketing to property management and apartment associations; Calling laundromats.

Supplier A even developed a document to have the property owner/account holder sign over the rebate to a third-party installer. The idea was to get the rebate program to be closer to a direct install program without being one and to give plumbing installers an incentive to "sell" and promote the program. A large commercial direct installer did

promotions and cold calling/walk-ins to Supplier A's largest CII customers without any success.

CII surveys/reports take a lot of time and very few customers implement the savings recommendations even if they are free or cost effective. Even with multiple routine follow-ups to move customers to action, it is hard to get any traction. Supplier A's CII survey program is primarily about providing help to customers and providing excellent customer service with the hope that customers will take action on BMPs and recommendations.

In Supplier A's experience, a higher percentage of multi-family properties take management action than commercial properties and often reduce water use significantly after finding all their toilet leaks. Notably this is done through management performing toilet leak detection dye tablet testing rather than a rebate. Even so, on average 15-20% of existing multi-family units have toilet leaks based on survey results. In this instance, getting the customer to incorporate toilet leak detection testing into their SOPs and annual inspections is the "Program". Unfortunately, in Supplier A's experience, CII does not have the same water savings potential from finding and fixing leaks as the multi-family sector for many reasons (except in hotels/motels). However, there are plenty of water savings to be had in both multi-family and CII landscapes, generally to do with proper irrigation management.

The biggest barrier to CII water efficiency improvements being implemented is business' staff time. CII customers, apart from large corporations, just do not have the staff or time. In many instances no action is taken since there is no water/energy/sustainability manager to execute projects and implement recommendations. Without anyone responsible or specifically assigned the duties to improve water efficiency, it just drops off business' radar, even when water savings would offset any associated staff time and labor costs.

Other barriers include upfront costs and funding which can take years to secure. Not being able to pay or cover upfront costs for a project is a real barrier. Generally, projects are more expensive than the rebate amount Supplier A can offer. However, money is not the only determining factor in participation as many customers with no or low-cost upgrades with paybacks of less than a couple years do not get upgrades and projects completed. Again, time is the big barrier.

Other barriers include the low cost of water and the fact that wastewater is billed separately and hidden on a property tax bill. Being able to demonstrate these costs on customer treated water bills would be helpful. The fact that billing may often be done by a contracted third party also further separates the customer from their water consumption and associated costs. There is even greater disconnect in communication between the business owner to the property management company and then to the landscaper. This often results in nobody having any real responsibility for landscape water use.

Barriers from the utility perspective include the significant time burden to complete surveys and reports and “sell” and convince customers to improve their water efficiency. Marketing will consume far more time than processing actual rebates. Marketing avenues for CII programs are limited and CII does not have many of the marketing opportunities that SF rebates have. Letters and/or emails only go so far, and CII rebates do not make it to social media, bill inserts, newsletters which are mostly tailored to SF. Having better and less laborious ways to market would be helpful. Other barriers include not being able to directly recommend commercial plumbing installers/companies due to being a public agency.

CII is so complex there are always new things to learn and ways of doing things differently. Supplier A plans to look into direct install programs to see if they might remove barriers to participation and streamline the process for businesses. Direct install programs seem to get more participation at other local urban water suppliers. A list of recommended plumbing contractors might help contractors to encourage businesses to move forward with upgrades, however recommending contractors as a public agency is not allowed. Finding a way to streamline surveys and survey reports through software programs or CII survey templates could be very helpful however, staff have not had the time to complete such a project and existing CII template programs require far too many inputs. Changes may also be implemented upon learning about other successful programs to either revamp or fine-tune existing programs. New technologies are also always being evaluated and monitored.

In summary, Supplier A’s CII incentive programs have had very low participation and it has been very difficult to acquire participants or interest in the programs. Even though rebate amounts are quite high, and paybacks are often less than two years, customers still do not take action. Once getting an interested customer, many either never follow through or it takes years to complete the upgrades. When a big rebate comes through it can save a lot of water, (one customer saved approximately 48,000 gpd or 17,520,000 gpy or 53 acre-feet/year) but it can also take a great deal of staff time.

In spite of the challenges, Supplier A’s CII programs provide a valuable benefit to participating CII customers who are needing help managing their water use. The programs provide excellent customer service to help businesses (especially small businesses), industrial customers, and institutional customers. Customers who participate can potentially save on water, wastewater, and sometimes even energy. CII surveys provide commercial property management and owners with knowledge of BMPs and are an important and helpful service to our customers. There are also environmental benefits particularly with landscape rebates and BMPs.

Supplier A has not had the opportunity or resources to complete a recent, thorough, and statistically valid study/analysis of CII customer water use and water savings. However, preliminary analysis does indicate water savings of 20-25% for sites that had a CII survey and of 20% for sites that completed the Commercial Flushometer Toilet and Urinal Rebate program. More extensive analysis is needed as the preliminary savings

are not compared to a control and could be influenced by other factors including water use changes during Covid-19.

To create a successful program, Supplier A provides the following tips:

- Be sure to network with other CII water efficiency professionals to gain wisdom and experience, obtain basis for water savings, and to get ideas for program design and terms and conditions. Review other urban water supplier websites.
- Attempt to offer the largest rebate possible based on conservative yet reasonable water savings assumptions and by utilizing data from savings studies. Make sure the rebate is near to your avoided cost of water. Be realistic with product longevity and ask industry professionals about their products.
- Market water savings by including wastewater costs to catch customers' interest.
- Be sure to break down all water costs and include wastewater fees in your analyses and reports.
- Try and make implementation of recommendations, BMPs, and water efficiency upgrades as easy for customer as possible. Make sure to give concrete recommendations and actions.
- Check in with your customers after a survey and after they have applied for rebates, to keep things on track.
- Try to get the private marketplace to do your marketing for you whenever possible.
- Realize that the barriers and low participation of CII water use efficiency will wear your staff down. Have staff do more than just CII to keep them encouraged, hopeful, and motivated.
- Set realistic goals as it is CII after all.

CII programs are extremely time consuming, complex, have very low participation, and the overall water savings is limited due to program reach. There are extensive barriers to implementation of CII water efficiency upgrades and towards adoption of BMPs. At the end of the day, if an urban water supplier does not already have a CII program, it may be advisable to find more effective and lower cost water efficiency programs particularly if the program is solely focused on achieving water savings. Targeting other customer classes will likely lead to more cost-effective water savings.

Appendix D: Example Water Survey Report from City of Santa Rosa

CII Water-Use Efficiency Survey Results

DATE:
TO:

CC:
ACCOUNT NUMBER:
METER NUMBER:
FROM:

FACILITY NAME:
FACILITY ADDRESS:

This survey was conducted on [DATE] by City of Santa Rosa staff. We met with [CONTACT NAME] to investigate ways to improve the water use-efficiency and determine any potential water savings at [FACILITY NAME]. The chart below shows the historical indoor consumption for this facility:

[COPY/PASTE CHART FROM AUDIT SPREADSHEET]

City of Santa Rosa Indoor Commercial Water-Use Efficiency Fixture Ratings*

Fixture	High Efficient	Efficient	Inefficient
Tank Toilet in gallons per flush (gpf)	< 1.28 gpf	1.28 gpf	> 1.6 gpf
Flushometer Valve Toilet	< 1.28 gpf	1.28 gpf	> 1.28 gpf
Floor Mount Urinal in gallons per flush (gpf)	< 0.5 gpf	0.5 gpf	> 0.5 gpf
Wall Mount Urinal in gallons per flush (gpf)	< 0.125 gpf	0.125 gpf	> 0.125 gpf
Lavatory (bathroom) faucet in gallons per minute (gpm)	< 0.5 gpm	0.5 gpm	> 0.5 gpm
Kitchen faucet in gallons per minute (gpm)	≤ 1.5 gpm	1.8 gpm**	> 1.8 gpm
Shower in gallons per minute (gpm)	≤ 1.5 gpm	2.0 gpm	> 2.0 gpm
Pre-rinse spray valve in gallons per minute (gpm)	≤ 1.28 gpm	1.6 gpm	> 1.6 gpm
Service sinks (janitor, pot fill, laundry, bar, clinical, etc.)	Production sink should be ≥4.0 gpm		

Sources: IAPMO Green Plumbing code, EPA WaterSense

SUMMARY FINDINGS

[ENTER SUMMARY OF AUDIT FINDINGS]

GENERAL FIXTURE EFFICIENCIES: [CHOOSE AS APPROPRIATE]

Toilets:

- All restrooms have high-efficiency toilets that use 1.28 gpf, or less. Well done, these are amongst the most water efficient toilets available!
- All restrooms have toilets that use 1.6 gpf. These toilets could be replaced with high-efficiency toilets that use 1.28 gpf or less. This would result in a 20% or greater reduction in consumption per toilet.
- Some restrooms have toilets that use 1.6 gpf. These toilets could be replaced with high-efficiency toilets that use 1.28 gpf or less. This would result in a 20% or greater reduction in consumption per toilet. See inventory list for details.
- Some restrooms have high flow toilets that use 3.5 gpf, or greater. Replacing these toilets with high-efficiency toilets that use 1.28 gpf or less, would reduce water consumption by over 60% per toilet. See inventory list for details.
- One or more toilets were found to have a leak. Leaking toilets can waste from 10-200 gallons of water per day. Typically, the water drains from the tank into the bowl, eventually causing the refill valve to temporarily turn on and refill the tank. It is important to address this leak now, because the leak will continue to get worse causing greater water loss. See inventory list for details.
- One or more toilets were found to have the water level set too high which is causing wasted water to drain into the overflow tube. The water level should be set at 1-inch below the topof the overflow tube. See inventory list for details.

Urinals:

- All restrooms have urinals that use 0.125 gpf, or less. Well done, these are amongst themost water efficient urinals available!
- Some restrooms have urinals that use 0.5 gpf or greater. Replacing these urinals with high-efficiency models that use 0.125 gpf or a waterless model would reduce water consumption from 50%-100% per urinal. Any urinal with a flow rate of 1.0 gpf or more is eligible for the City's High Efficiency Urinal rebate. See program details below.
- All restrooms have urinals that use 0.5 gpf. However, replacing these urinals with high-efficiency models that use 0.125 gpf or a waterless model would reduce water consumption from 50%-100% per urinal.
- All restrooms have urinals that use 1.0 gpf. Replacing these urinals with high-efficiency models that use 0.125 gpf or a waterless model would reduce water consumption from 50%-100% per urinal. Any urinal with a flow rate of 1.0 gpf or greater is eligible for the City's High Efficiency Urinal rebate. See program details below.
- Some restrooms have urinals that use 1.0 gpf, or greater. Replacing these urinals with high-efficiency models that use 0.125 gpf or a waterless model would reduce water consumption from 50%-100% per urinal. Any urinal with a flow rate of 1.0 gpf or more is eligible for the City's High Efficiency Urinal rebate. See program details below.
- All restrooms have urinals that use 1.0 gpf, or greater. Replacing these urinals with high-efficiency models that use 0.125 gpf or a waterless model would reduce water consumption from 50%-100% per urinal. Any urinal with a flow rate of 1.0 gpf or more is eligible for the City's High Efficiency Urinal rebate. See program details below.

- The City of Santa Rosa offers rebates of up to $450 for each inefficient urinal replaced with a high-efficiency urinal that uses 1 pint (0.125 gallons) of water per flush or a waterless urinal. More details are provided below.

Lavatory Faucets:

- All faucets have efficient flow rates.
- Some lavatory faucets have flow rates above 0.5 gpm. The City of Santa Rosa will supply free 0.5 gpm faucet aerators. If the faucet thread is not compatible with the City's free faucet aerators, it is recommended to order a compatible 0.5 gpm aerator through a local plumbing supply company or through your plumber. It may be necessary to replace the entire fixture in order to meet efficiency standards.
- All faucets have flow rates above 0.5 gpm. The City of Santa Rosa will supply free 0.5gpm faucet aerators. If the faucet thread is not compatible with the City's free faucet aerators, it is recommended to order a compatible 0.5gpm aerator through a local plumbing supply company or through your plumber. It may be necessary to replace the entire fixture in order to meet efficiency standards.
- One or more faucets were found to have a leak. Dripping faucets can waste thousands of gallons of water over time. It is recommended to repair or replace immediately.

Kitchen Faucets:

- All faucets have efficient flow rates.
- Some faucets have flow rates above 1.5 gpm. The City of Santa Rosa will supply free sink aerators that flow at 1.5 gpm. If the faucet thread is not compatible with the City's free faucet aerators, it is recommended to order a compatible 1.5 gpm aerator through a localplumbing supply company or through your plumber. It may be necessary to replace the entire fixture in order to meet efficiency standards.
- All faucets have flow rates above 1.5 gpm. The City of Santa Rosa will supply free sink aerators that flow at 1.5 gpm. If the faucet thread is not compatible with the City's free faucet aerators, it is recommended to order a compatible 1.5 gpm aerator through a local plumbing supply company or through your plumber. It may be necessary to replace the entire fixture in order to meet efficiency standards.
- One or more faucets were found to have a leak. Dripping faucets can waste thousands ofgallons of water over time.

Showers:

- All showers have efficient flow rates.
- Some showers have flow rates above 1.5 gpm. The City of Santa Rosa will supply freeshower heads that flow at 1.5 gpm.
- All showers have flow rates above 1.5 gpm. The City of Santa Rosa will supply free showerheads that flow at 1.5 gpm.
- One or more shower heads / diverter valves were found to have a leak. Dripping shower heads and diverter valves can waste thousands of gallons of water over time.

Pre-Rinse Spray Valve (PRSV):

- The PRSV has an efficient flow rate.
- The PRSV has a flow rate above 1.28 gpm. It is recommended that the PRSV be replacedwith one with a flow rate of 1.28 gpm or lower.
- The PRSV was found to have a leak. Leaking fixtures can waste thousands of gallons ofwater over time

EMBEDDED ENERGY IN WATER

Given that water systems are the single greatest users of energy in the State of California, programs that focus on water-use efficiency stand to have significant impacts on overall energy savings; and implementation of these programs will result in sustainable reductions of greenhouse gas (GHG) emissions.

The California Energy Commission states that 19% of the electricity and 30% of the natural gas consumed in the State are used to acquire, purify, distribute, and treat the waste of California's water. The electricity demands for the supply of water amount to approximately 56,000 gigawatt hours (GWh) per year, which corresponds to 204.4 million tons of greenhouse gas emissions each year. This is due to electricity related to water systems alone. Most of the natural gas used is for end-uses of water like heating or ultra-purification, which dramatically increases the embedded energy in water. Most of this natural gas is used to heat water for commercial and residential uses.These statistics verify that increased water efficiency will need to be a significant part of the solution to curbing GHG emissions.

Specifically, in the City of Santa Rosa, indoor water use requires an average of 7.45 kilo watt hours (kWh) per 1,000 gallons of water used. This covers the energy needed to pump the water from the ground, deliver it throughout the city, and treat the waste water after the water has been used.

CITY OF SANTA ROSA REBATE PROGRAMS

Sustained Reduction Rebate

The Sustained Reduction Rebate pays up to $400 for every 1,000 gallons of sustainable reduction in water use that is achieved through improving the efficiency of water using fixtures and/or other water using processes that are not covered through other existing rebate programs. Per the terms of the contract, the City will pay $400 per 1,000 gallons of average monthly water savings or the

cost of equipment minus labor costs, whichever is less. A list of qualifying toilets that can be used in conjunction with the Sustained Reduction Rebate can be found on the EPA Water Sense website[1].

High-Efficiency Urinal Rebate

The High-Efficiency Urinal Rebate Program is a program that pays up to $450 per urinal replaced with a high-efficiency urinal that uses 1 pint of water (0.125 gallons) per flush or a waterless urinal. A list of qualifying urinals can be found on the EPA Water Sense website[2]. The high-efficiency urinalrebate cannot be used in conjunction with the sustained reduction rebate.

Below is a detailed inventory of the fixtures assessed during the audit.

Please contact me if you would like more information about the Water-Use Efficiency Program, or if you have additional questions. Please feel free to use me as a resource to help you more closely monitor the water consumption at [TEXT].

Sincerely,

Deb Lane
Water Resources Analyst
(707) 543-4506 | dlane@srcity.org

[Facility name]

[COPY/PASTE DETAILED INVENTORY TABLE FROM AUDIT SPREADSHEET]

Appendix E: Definitions

assessment (also called audit, evaluation, or survey) – comprehensive analysis of the current water use of a facility, and subsequent development of a strategy to increase water use efficiency (Nevada Governor's Office of Energy, n.d).

audit (also called assessment, evaluation, or survey) – comprehensive analysis of the current water use of a facility, and subsequent development of a strategy to increase water use efficiency (Nevada Governor's Office of Energy, n.d).

best management practice (BMP) – a set of practices, measures, or procedures that are beneficial, empirically proven, cost effective, and widely accepted by the professional community.

CII performance measures – actions to be taken by urban retail water suppliers that will result in increased water use efficiency by CII water users. Performance measures may include, but are not limited to, educating CII water users on BMPs, conducting water use audits, and preparing water management plans. Performance measures do not apply to process water, as defined in CWC §10608.12(n).

CII sector – a group of businesses, schools, municipal buildings, and other facilities that comprise the user classifications and water use characteristics of non-residential properties.

demand management measures – measures listed in the CWC that are used by water suppliers for managing water demand. The DMMs were historically identical to the BMPs found in the CUWCC Memorandum of Understanding, but revisions to both the DMMs and the BMPs have now made them different sets of practices.

efficiency – a level of water use performance that minimizes water waste.

evaluation (also called assessment, audit, or survey) – comprehensive analysis of the current water use of a facility, and subsequent development of a strategy to increase water use efficiency (Nevada Governor's Office of Energy, n.d).

high-efficiency device – a device that achieves a specific function at a lower water use based on being below an identified threshold (i.e., US EPA WaterSense labelled product).

measure – a device plus a distribution method and possibly an incentive, such as a rebate targeted at a particular type of end user that, when implemented, will save water.

process water – water used by industrial water users for producing a product or product content or water used for research and development, as defined in CWC §10608.12(p).

program – a set of one or more water efficiency measures targeted at one or more customer classes that would be managed by the urban retail water supplier as a separate project.

standard – a performance specification for a water-using device or fixture.

survey (also called assessment, audit, or evaluation) – comprehensive analysis of the current water use of a facility, and subsequent development of a strategy to increase water use efficiency (Nevada Governor's Office of Energy, n.d).

urban retail water supplier – a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes, as defined in CWC §10608.12(t).

urban water supplier – either an urban retail or wholesale water suppliers, defined by CWC §10608.12(t) and §10608.12(w), respectively; the term is also defined by CWC §10617.

urban water use efficiency standards – the standards effective through CWC §10609.4 (indoor residential use) or adopted by the State Water Board (outdoor residential, water loss, and CII outdoor irrigation of landscape areas with dedicated meters) pursuant to CWC §10609.2.

urban water use objective – an estimate of aggregate efficient water use for the previous year based on adopted water use efficiency standards and local service area characteristics for that year, as described in CWC §10609.20 and defined in CWC §10608.12(u).

urban wholesale water supplier – a water supplier, either publicly or privately owned, that provides more than 3,000 acre-feet of water annually at wholesale for potable municipal purposes, as defined CWC §10608.12(w).

water conservation incentive – an effort designed to promote customer awareness of reducing water use and motivate customers to adopt specific conservation measures.

water efficiency – the accomplishment of a function, task, process, or result with the minimal amount of water feasible; an indicator of the relationship between the amount of water required for a particular purpose and the quantity of water used or delivered.

water efficiency measure – a specific tool or practice that results in more efficient water use and thus reduces water demand.

water efficiency standard – criterion creating maximum or acceptable levels of water use.

water efficient landscape – a landscape that minimizes water demand through design, installation, and management.

water use efficiency – employing water-saving practices to reduce costs and to slow the depletion of the water supply to ensure future water availability (Maddaus et al., 2017).