MesaWater
DISTRICT

WATER USE EFFICIENCY PLAN

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

THIS PAGE INTENTIONALLY LEFT BLANK

Water Use Efficiency Plan

FINAL REPORT

October 2013

Prepared For

Mesa Water District

By

A&N Technical Services, Inc.

In Association With

Maureen Erbeznik & Associates
M.Cubed
Gary Fiske & Associates

Funding Provided By

Bureau of Reclamation

Mesa Water District
1965 Placentia Avenue
Costa Mesa, CA 92627
949.631.1200
www.MesaWater.org

Table of Contents

Contents

List of Tables

List of Figures

Section 1 - Executive Summary

Our mission statement is clear and concise…*"to satisfy our community's water needs."* Long-term water supply issues, however, are complex and dynamic because population, drought cycles, and regulatory restrictions affect them. To deliver on our mission, Mesa Water District understands the need to put forth a well-constructed strategic initiative that ensures a safe, abundant, and reliable water supply through cost-effective means.

Overview

Mesa Water District (Mesa Water) currently serves over 110,000 customers in an 18 square mile area including the Cities of Costa Mesa, parts of Newport Beach, unincorporated areas of Orange County and John Wayne Airport. Mesa Water, governed by a five-member Board of Directors, is almost entirely independent of imported water.

Due to infrastructure and transportation costs, imported water has until recently been a costly but necessary expense for Mesa Water. Water efficiency is the primary tactic for achieving independence from imported water. Current imported water costs run $1,318 per acre-foot and imported water was 12 percent of the supply mix as of the 2010 Urban Water Management Plan (UWMP). However, it is expected that additional treatment capacity (MWRF) and recycled water will eliminate the need for imported water, and thus, the avoided supply costs for Mesa Water's 2013 Water Use Efficiency (WUE) Plan is $337 per acre-foot.

Wholesale imported water is purchased from the Metropolitan Water District of Southern California (MWD) through the Municipal Water District of Orange County (MWDOC). This relationship benefits Mesa Water by providing water purchases and ensuring water reliability. Additionally, MWD and MWDOC provide supplemental project and program funding.

This Mesa Water WUE Plan recommends a portfolio of WUE programs that builds on the track record of successful Mesa Water programs and regional funding for new WUE innovations. The program portfolio is designed to cost $198 per acre-foot, considerably less than the expected avoided costs thus meeting a rigorous economic justification. This recommended WUE portfolio can be feasibly implemented with existing staff, coupled with regionally funded outside vendors. Note that alterative portfolios were also constructed so the recommended programs could be scaled up (High Portfolio) or down (Low Portfolio) at roughly similar costs per acre-foot.

Resultant of these projections, Mesa Water seems poised to achieve both its 2015 and 2020 urban water savings mandates by continuing its current path with the recommended WUE programs (Medium portfolio).

Legislative Background

In addition to meeting customer needs, Mesa Water is obligated to meet the requirements of California legislative and regulatory initiatives for water use efficiency. The enacted legislation has raised the criticality of water use planning and implementation in California. The strategies and programs included in this water use efficiency plan are designed to meet:

- Governor's call for 20% per capita water use reduction by 2020
- California Urban Water Conservation Council's Best Management Practices
- Assembly Bill 1420 Statute

On February 28 2008, Governor Schwarzenegger presented a plan to achieve a 20 percent reduction in per capita water use statewide by 2020 (commonly known as 20x2020), with an incremental milestone of 10 percent reduction by year 2015. This initiative was incorporated into law as Senate Bill X 7-7 (SBx7-7).

Additionally, Mesa Water, as a member of the California Urban Water Conservation Council (CUWCC) and signatory to a CUWCC Memorandum of Understanding (MOU), has a commitment to implement Best Management Practices (BMPs) for more efficient use of water. This commitment requires that Mesa Water maintain the staffing, funding, and priority levels necessary to achieve the level of water savings called for by the BMPs and report performance accordingly.

Furthermore, Assembly Bill 1420 became effective in January of 2009 stating that issuance of state loans or grant funding be conditioned on implementation of the Demand Management Measures (DMMs) described in Water Code Section 10631. DWR equates the DMMs with the CUWCC BMPs.

In response to these compliance obligations, Mesa Water devised a strategy to meet these requirements in the most cost-effective manner feasible. Table 1 shows the compliance requirements and associated strategies for each:

Table 1 Compliance Requirements
Compliance Requirements

Regulatory Agency or State Organization	Requirements	Approach
SBx7-7	Reduce per capita water use by 10% by 2015 AND Reduce per capita water use by 20% by 2020	By implementing WUE Programs, Policy Initiatives, and Recycled Water Projects, Mesa Water is projected to be on track to meet per capita water reduction goals for both target years.
CUWCC	Reduce per capita water use by 18% by 2018	Mesa Water will utilize CUWCC's new GPCD option, which offers a per capita methodology to track compliance. This will align with the requirements of 20x2020 as well.
AB 1420	Fulfill BMP commitments	Lines up with actions taken to meet CUWCC BMP compliance.

Mesa Water Goals

Mesa Water is an active stakeholder in Orange County's Regional Alliance, working in partnership with the Alliance to develop plans for achieving water use efficiency goals in the region.

Mesa Water is adopting the following goals that include those mentioned in the 2013 MWDOC Water Use Efficiency Plan:

1. Customer-driven Focus: Provide voluntary water use efficiency programs for customers who desire them.
2. Target WUE Programs for Mesa Water Customers.
3. Maximize Cost Effectiveness of WUE Programs
4. Maximize Regional Funding.
5. Track Results using AWE Tool Customized for Mesa Water
6. Achieve 20% or More Reduction in Per Capita Water Use by 2020.
7. Pursue Innovation in Water Use Efficiency in Orange County.

Of these five regional goals, the most measurable is the state mandate to reduce water use 20% by the year 2020. Table 2 shows the 20x2020 goals for Mesa Water's territory:

Table 2 20x2020 Mesa Water Goals

Mesa Water GPCD Goals 20x2020	*Baseline (Avg annual water sales 1999 – 2008)*	*2015 Target (10% Reduction)*	*2020 Target (20% Reduction)*
Gallons per Capita per Day	173.5	161.1	143.2

As a participant in the regional goal setting effort, Mesa Water expects to meet or exceed the 20x2020 mandate for both the 2015 target and the 2020 targets. However, there are a number of reasons why water use efficiency plays a continual role today and in future planning:

1. The SBx7-7 target dictates the minimum level of water use reduction, not the optimum level of achievement possible.
2. Water use efficiency preserves local resources.
3. Water use efficiency is one of the most cost effective methods to increase water supplies, as is suggested by the rigorous cost effectiveness analyses in this report, MWDOC, and the Metropolitan Water District.
4. Despite today's positive results in per capita water use reduction, it is likely that system demand will rebound as the economy recovers, as drought conditions are less impactful to Mesa Water, and as population grows.
5. Future droughts are an inevitable part of California's hydrologic variability, and water use efficiency planning is part of the overall process of planning to prevent shortages and adapt to them should they occur.
6. Hydrologic variability also potentially impacts the Regional Alliance's ability to meet the 2015 and 2020 targets.
7. Water use efficiency diversifies the water resource portfolio.
8. Water use efficiency brings broader benefits beyond water use reductions.
9. Water use efficiency provides additional benefits such as energy savings, reduced runoff, and non-point source pollution

In addition, as part of the Regional Alliance, MWDOC, and therefore Mesa Water, have committed to meeting their share of the MWD's IRP water usage reduction goals. The regional integrated resource planning effort aims to improve water system reliability with the most cost-effective portfolio of water resources, including water use efficiency and recycled water.

Mesa Water will reach the goal through regional and local actions utilizing:

1. Water Use Efficiency Active Programs– offering customers a program portfolio with cost-effective water efficiency measures.
2. WUE Passive Policy Initiatives– including building codes and landscape ordinances.
3. Recycled Water Program– savings credits accrued from Mesa Water's recycled water program and GWRS.

Water Use Efficiency Active Programs

Mesa Water actively participated in MWDOC's Regional Alliance and the formulation of the regional Water Use Efficiency Master Plan. As such, Mesa Water has placed itself in an ideal scenario for maximizing the partnership opportunities with MWDOC and leveraging funding to achieve more cost effective water use efficiency programs.

Mesa Water will build off of the regional strategy and customize water use efficiency messaging, marketing and outreach programs to best meet Mesa Water customers' needs. As taken directly from MWDOC's WUE Master Plan: *The core goal of marketing, under the WUE Master Plan, is to increase public perception of the value of water. Once customers comprehend its value, they will be much more inclined to take action and increase their level of WUE at their homes and places of business. To accomplish this feat, the value of water will be a message that is threaded through all marketing initiatives.*

MWDOC's marketing and outreach strategies:

- Increase participation in rebate and incentive programs through regional marketing efforts.
- Work collaboratively with MWD and its member agencies to develop regional messages, coordinate outreach tools, and market transformation initiatives.
- Build strategic partnerships with industry organizations, non-profits, and other organizations.

- Utilize water awareness programs to educate the public about the value of water.

Mesa Water will work closely with MWDOC staff to ensure this strategy is employed within its service territory. Through this relationship, Mesa Water will take advantage of funding for incentives through MWDOC and MWD as well as any grant funds obtained my MWDOC.

Mesa Water selected a four part strategy designed to keep its program budget lean, while maximizing water savings. Mesa Water's strategy for Active Programs includes the following:

1. Provide voluntary water use efficiency programs for customers who desire them.
2. Take full advantage of MWD funded programs and additional MWDOC incentive dollars.
3. Pursue grant opportunities to provide increased water efficiency services and measures.
4. Drive response to Active Programs by supplementing MWD and MWDOC program marketing by initiating local targeted outreach.

In order to achieve the WUE active programs' goal, Mesa Water will implement active, quantifiable programs through 2020. The programs will deliver water savings through the 2015 and 2020 target years and beyond due to the long life for several of the measures being offered. It is important to note that the WUE programs will be modified, amended, or replaced as needed over the next seven years as industry technologies and outreach methods yield better alternatives.

Mesa Water will continue to offer the wide range of existing regional programs administered by MWDOC and MWD over the next several years. In addition, Mesa Water will continue to offer residential home water surveys performed by Mesa Water staff.

Mesa Water anticipates that two new programs will kick off in FY 2013/14. The programs will be implemented and administered by Mesa Water staff through funding received from MWD's Member Agency Administered Program. The programs will address market-specific opportunities for water savings within Mesa Water.

The two new programs are:

- **Multi-family High Efficiency Toilet Direct Installation Program.** Mesa Water has a large number of small to medium sized multi-family housing complexes with an

expected lower saturation rate than single family or large multi-family sites. Due to their unique characteristics—specifically, hard to reach owners--these units have not been targeted heavily in past programs. The program will provide free installations of high efficiency toilets.

- **High Efficiency Sprinkler Nozzle Distribution Program.** Mesa Water has numerous large landscape sites including the John Wayne Airport, the Orange County Fairgrounds, Fairview Developmental Center, AAA, as well as City parks and local schools. There are many sites such as strip malls and street medians that are hard to irrigate and would benefit from more efficient sprinklers. Mesa Water staff will provide high efficiency sprinkler nozzles to these sites for free.

Table 3 is an overview of the annual and lifetime water savings for each of the measures to be implemented. Note that programs can contain multiple measures (i.e. SoCal Water$mart includes high efficiency nozzles, smart controllers, etc.).

Table 3 Water Saving by WUE Active Programs

Water Savings by WUE Active Programs

WUE Active Program	Estimated Lifetime Water Savings (AF)	Maximum Year Annual Water Savings (AF)
Commercial High Efficiency Toilets (*SoCal Water$mart)*	593	39
ULF Urinal (SoCal Water$mart)	428	28
Home Owner Association WaterSmart Landscape	515	103
High Efficiency Toilet Direct Installation Program	356	24
High Efficiency Clothes Washer Incentives *(SoCal Water$mart)*	257	25
Residential Surveys	121	24
High Efficiency Nozzle Distribution	63	13
Residential Smart Controller Incentives *(SoCal WaterSmart)*	62	6
Commercial High Efficiency Nozzle Incentives *(SoCal WaterSmart)*	25	5
Residential High Efficiency Nozzle	25	5

WUE Active Program	Estimated Lifetime Water Savings (AF)	Maximum Year Annual Water Savings (AF)
Incentives *(SoCal WaterSmart)*		
Turf Removal Incentives	15	2
Residential High Efficiency Toilet Incentives *(SoCal WaterSmart)*	9	1
Commercial Smart Controller Incentives *(SoCal WaterSmart)*	3	0.3
Total	2,472	273

The Plan is estimated to save 2,472 acre-feet of water over the life of the measures at a cost to Mesa Water of $198 per acre-foot, which is cost competitive with other water resource alternatives. The avoided costs equate to $633,240 over the savings lifetime that exceeds the direct program expenditures of $410,480 over 5 years.

Mesa Water will need to review the success of the High Efficiency Toilet Direct Installation Program and the High Efficiency Nozzle Distribution programs, as well as assess new water use measures available in the market. Based upon results, Mesa Water may elect to modify program plans accordingly.

Table 4 provides the highlights of the selected plan:

Table 4 WUE Plan highlights

Plan Overview	
Cost per Acre-foot*	$198 per acre-foot
Lifetime Water Savings	2,472 acre-feet
Lifetime Avoided Costs	$633,240
5-Year Average Annual Expenses*	$82,096
Five Year Total Budget	$410,480

*Does not include labor.

It should be noted that Mesa Water's contributions to regionally funded water use efficiency is not guaranteed to return to Mesa Water's customers without effectively designed and implemented local water use efficiency programs.

Section 2 – Customer Demand and Market Potential

The Planning Process

With major challenges ahead, Mesa Water recognizes that a sound, fact-based WUE plan is needed as a tool to guide water use efficiency program implementation over the upcoming years. The Plan provides recommended programs (with additional contingency planning for alternative funding scenarios.) The plan was funded through a grant from the United States Bureau of Reclamation and will serve as a foundation for the WUE strategic effort.

The work approach to develop the Plan was conducted in a logical and transparent manner. The Water Use Efficiency Plan was part of a larger project, Mesa's Benchmarking Study and Plan. The initial stages of the planning process yielded an understanding of Mesa Water's demand profile, water use efficiency measure saturation, and historical program participation. Next, available technologies and delivery mechanisms were identified and screened for cost effectiveness as well as water savings and market potential within Mesa Water. Outside funding sources were factored into the analysis to properly rank best potential measures and program formats. Landscape water use measures and programs were earmarked as well.

The activities and deliverables are delineated in the Table 5.

Table 5 Activity and Results

Activity	Deliverable
Gather End Use Data & Organize End Users by Sector	• Customer counts by sector • Summary of demand by sector • Target list of highest demand and largest volume customers
Evaluate Past Water Use Efficiency Programs	• Assessment of past programs • Historical water savings from programs
Identify and Evaluate Potential WUE Program Concepts	• Program concepts list • Economic analysis of potential WUE programs • Non-economic evaluation of potential WUE programs
Selected WUE Programs and Perform Economic Analysis	• Final selection of programs • Economic analysis of several scenarios with budget info, annual and lifetime water savings, potential outside funding
Finalize Water Use Efficiency Plan	• Final Water Use Efficiency Plan

Past Water Use Efficiency Activities

Mesa Water has been managing water use efficiency initiatives for over twenty years. During that time, efficiency efforts have evolved from single measures, such as toilet replacements, to comprehensive water use surveys with multiple indoor and outdoor recommendations.

Table 6 illustrates historical water savings program activity levels. The timeline shown in the table illustrates Mesa Water's increased focus on water use efficiency in recent years. In recent years the landscape sector has been increased to address this savings opportunity.

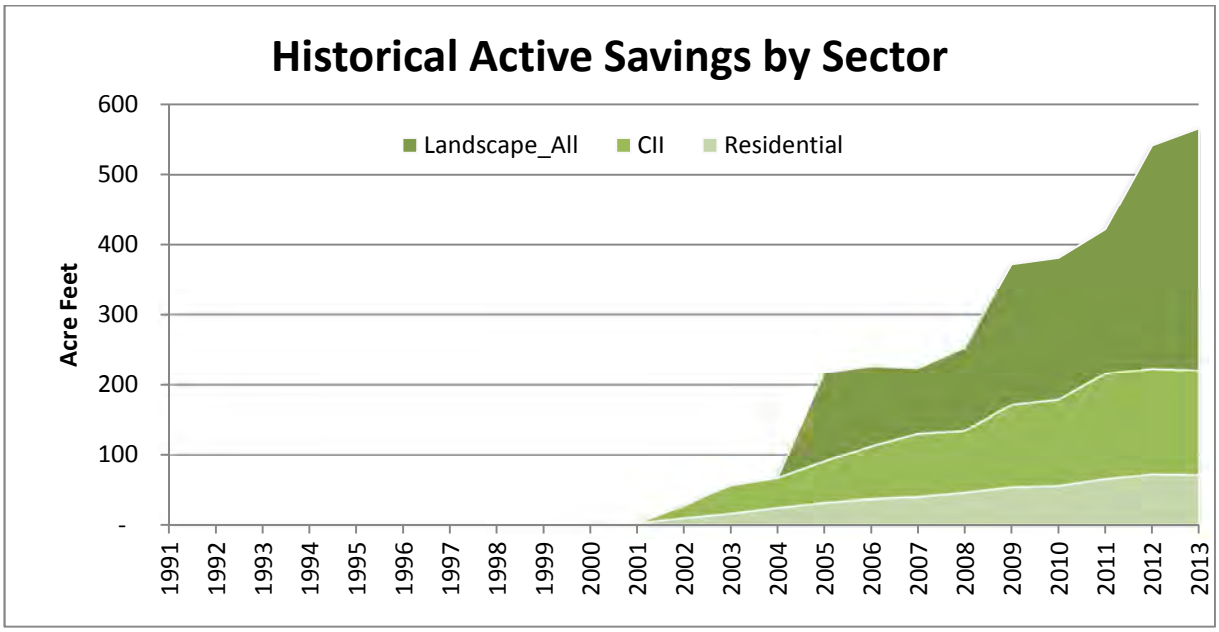
Table 6 Historical Program Activity

Historical Program Activities

	ULF Toilets	Commercial Measures	Clothes Washers	Smart Controllers	Landscape Performance	High Efficiency Toilets	High Efficiency Nozzles	Synthetic Turf	Turf Removal
2000 & Before	11,022								
FY 01/02	1,505	424	24						
FY 02/03	2,387	155	117						
FY03/04	988	22	228						
FY 04/05	192	130	240	5	191				
FY 05/06	124	241	212	40	170				
FY 06/07	56	141	239	20	138	247	83		
FY 07/08	14	141	249	12	165	19	368	4,114	
FY 08/09	-	543	246	13	286	736	198	81,123	
FY 09/10	-	219	73	20	285	131	278	4,106	
FY 10/11	-	669	232	29	288	7	118	2,198	
FY 11/12	-	41	176	21	450	-	574	-	6,777
FY 12/13	-	6	28	3	481	-	1,257	-	6,094
Individual Program Total	16,288	2,732	2,064	163	2,454	1,140	2,876	91,541	12,871

Over the past 12 years, commercial and residential sectors have contributed to growing active water use efficiency savings. Since 2004, the Landscape Sector has significantly outpaced the other two sectors, delivering a growing percentage of acre-feet savings (Figure 1). (Note that "Residential" includes residential indoor savings, and "Landscape" includes all landscape savings including those from the residential sector).

Figure 1 Historical Active Savings by Sector



Water Demand by Sector

Table 7 presents the number and type of accounts for Mesa Water's service territory. Single family comprises the majority of accounts with a notable number of 2, 3, or 4 family attached homes and condo/apartment accounts:

Table 7 Account Classes and number of Accounts per class

Account Class Combined	Number of Accounts
Single Family	13,766
2, 3, or 4 Family Attached	2,134
Trailer Parks	23
Condo/Apt	2,800
Multi-Family >4 units	804
Offices	186
Businesses	1,353
Hotels	58
Commercial	774
Government/Public	136
Industrial	274
Irrigation	975
TOTAL	23,283

Source: Mesa Water Account Breakdown 2012.xlsx

Table 8 presents the projected number of accounts and water demand per water use sector in 2015. Mesa Water account categories have been compiled into more general water use sectors. As shown in the chart, residential use represents the highest use in Mesa Water's service area.

Table 8 Projects Number of Accounts and Demand by Water Use Sector by 2015

Sector	Projected Number of Accounts by Water Use Sector	Projected Water Demand by Water Use Sectors (AFY)
	Year 2015	Year 2015
Single Family	16,585	5,950
Multi-Family	3,480	5,580
Commercial	3,920	4,280
Industrial	302	470
Institutional and Government	352	2,140
Landscape	45	1,280
Total Accounts	24,683	19,700

Source: MW 2010 UWMP, – Tables 2-3 and 2-4

Top Users

Table 9 presents the top 10 users within Mesa Water's territory and their associated annual water use in both hundred cubic feet (CCF) and acre-feet (AF) as well as their percentage of total use.

The top 10 users represent 14.5% of all water demand in Mesa Water. Each of these customers represents a significant opportunity for water use efficiency and many have already received customer outreach from Mesa Water. Since many of these customers have exceptionally large landscape areas--and given recent technology advancements-- it will still be worthwhile to continue examining large water uses for the potential of landscape efficiency upgrades.

Table 9 Mesa Water Top 10 Users

Site Name	FY 2011 Consumption (CCF)	FY 2011 Consumption (AF)	Percent of Total Mesa Water Demand
City of Costa Mesa	181,982	418	2.3%
Mesa Verde (Costa Mesa Golf Course)	173,852	399	2.2%
Newport-Mesa Unified School District	162,413	373	2.1%
County of Orange	119,033	273	1.5%
Fairview Developmental	92,416	212	1.2%
The Irvine Company, LLC	88,936	204	1.1%
United Dominion Realty	86,747	199	1.1%
South Coast Plaza	79,883	183	1.0%
CalTrans	75,199	173	1.0%
Coast Community College	70,599	162	0.9%
Total	1,131,060	2,596	14.5%

Source: MCWD CAFR 6-30-2012.pdf

Landscape Water Use

Water used for landscaping is generally not directly metered (except in those cases where dedicated irrigation meters exist). For this reason, outdoor water demand is estimated based upon two methods.

Method 1

A common method used to infer outdoor use is to assume that all winter use is categorized as indoor consumption. For example, if we calculate winter minimum use over 12 months we have inferred total indoor use for the year. Total use for the year minus indoor use then equals outdoor use.

In Table 10 the "low bound" for outdoor use is calculated with this "minimum winter use is indoor use" method. The method underestimates outdoor use because there is likely to be winter irrigation in dry climates such as Mesa Water's territory.

Method 2

The second method to infer outdoor use consists of employing the pattern of seasonal variation used by dedicated irrigation meters and applying it to other sectors with mixed meters. The reasoning is that with dedicated irrigation meters, winter irrigation is measured. Thus, we can observe the relative water use in winter and summer irrigation seasons, and then calculate the ratio of variables observable for other sectors. This method will result in a higher estimate of outdoor water use. The method relies on the assumption that the seasonal variation of outdoor use is the same for sites with dedicated meters as for the mixed meter sites.

Table 10 also presents the estimated outdoor water use as ***a percentage of each sector's*** total water demand utilizing both Method 1 and 2 to create a low and high estimate range.

The table shows that the combined sectors have a range of 30 – 44% outdoor water usage. With several landscape efficiency products and programs recently introduced, this emerging market offers great opportunity for water use reduction. Indoor measures are generally highly saturated therefore securing further water savings from indoor sectors is more difficult and expensive to obtain.

Table 10 Water use by Indoor, Outdoor and Total Use

Class	Total	Indoor	Outdoor	Percent Outdoor	Percent Outdoor (Low Bound)
Both Domestic & Irrigation (B)	4,636,256	2,575,468	2,060,789	44%	23%
Domestic (D)	1,121,876	936,649	185,227	17%	8%
Irrigation (I)	1,236,595	0	1,236,595	100%	100%
Master Metered >4 Units (M)	1,373,118	1,149,945	223,173	16%	8%
Estimated Total	8,376,924	4,665,856	3,711,069	44%	30%

Market Potential

With an understanding of Mesa Water's customer demand per segment, there needs to be a clear understanding of the market potential for each. There are three primary factors that impact market potential:

- Past program activity and measure saturation
- Water demand by customer sector
- Landscape water use

The market potential for current WUE measures is detailed in Table 11.

Table 11 Potential Savings by Customer Segment

Potential Savings by Customer Segment

Residential Customer Segment	
Toilets	From the saturation analysis, there is an estimated 80 percent saturation of efficient toilets. It is anticipated that smaller multi-family sites may have a lower saturation rate and may provide an opportunity for HET replacements. Direct install programs will ensure replacement of only high volume fixtures and therefore maximize water savings.
Clothes Washers	Since there are approximately 16,000 single family accounts and 3,500 multi-family accounts, and the existing installed stock of clothes washers is far from saturated, there is significant potential left for this measure.
Residential Landscape	The Outdoor Use analysis shows that there is a considerable market share (44%) of outdoor water use. Consequently there is a large opportunity for water savings. Two technologies readily available in the market today with existing regional incentives are smart controllers and high efficiency nozzles. It will be important to target high water use customers to increase the volume of water saved by these measures.
Commercial, Industrial, and Institutional (CII) Customer Segment	
Toilets	Although the rate of natural replacement may not be the same for the CII sector as for residential, there is still an estimated high level of saturation for efficient toilets. Remaining potential is likely to exist in high use, older sites such as restaurants, bars, and entertainment facilities.
Urinals	Urinals are far less saturated than toilets. The greatest opportunity for urinals is within high use sites, as demonstrated by installations completed at John Wayne Airport and the Orange County Fairgrounds. Other high use sites include restaurants, bars and entertainment facilities. Program options include replacement with high efficiency or zero water urinals or valve retrofits.
CII Landscape	Commercial landscape is defined as sites with mixed use meters. As with residential there is significant opportunity for WUE measures and the top measures are smart controllers and nozzles.
Industrial	There are 274 industrial meters in Mesa Water's service area. Reusing process water at these sites provides opportunity for water use reduction. The customer's return on investment for WUE projects appears to be a barrier to implementation.
Large Landscape (dedicated irrigation meters)	The large landscape sector includes sites such as parks, residential common areas, and large commercial sites. There are over 400 meters currently not enrolled in the regional Landscape Performance Program. These sites provide a considerable opportunity for WUE. Enrolling them in the Landscape Program will provide the most effective savings.

Analysis of the customer demand and saturation statistics yields the following conclusions:

- Mesa Water's landscape market is highly unsaturated and offers potential for significant water savings.
- There are a number of reliable and cost effective landscape measures and services available for customers.
- Many top water using customers have substantial landscape areas such as city parks and the school district.
- Some targeted indoor opportunities remain within Mesa Water for high efficiency toilets and washers.
- MWD and MWDOC continue to provide an array of funded programs that meet the needs of Mesa Water's customers. By maximizing participation, Mesa Water can deliver water savings most cost-effectively and with minimal direct budget impact due to regional funding
- Opportunities for outside funding are projected to continue over the next few years.

Section 3 - Water Use Efficiency Strategy and Selected Programs

In order to stretch supply and reduce dependence on potable water over the next seven years, Mesa Water will utilize a two-pronged strategy. First, continue to promote and expand irrigation efficiency of large landscaped areas, and second, further drive down water demand by rolling out additional water use efficiency programs targeting other areas. The programmatic strategy developed for goal achievement is logical and straightforward:

- **Target markets with highest water savings opportunity.** Estimated at nearly 44% of total water demand, landscape usage is the key market to address with dedicated irrigation sites as the prime opportunity for water savings. Additionally, promotion of high efficiency clothes washers remains an area of focus. In spite of excellent market penetration from past initiatives high efficiency toilets in specific locations provide a remaining opportunity.
- **Continue active participation in MWD's Regional Programs.** The MWD SoCal Water$mart Program will be the central incentive delivery mechanism for Mesa Water's WUE programs. Mesa Water will provide enhanced incentives for targeted measures such as high efficiency clothes washers.
- **Implement Comprehensive Landscape Program Offerings.** The landscape market has long remained an "untapped" market opportunity. With the development of new technologies and increased customer awareness, this market segment is beginning to yield positive results and will be a top priority for program implementation and landscape transformation. Currently, high efficiency sprinkler nozzles and smart controllers are the most likely measures to yield water savings in landscape usage.
- **Secure outside funding for programs.** Outside funding will be pursued whenever possible in order to drive down Mesa Water's cost per acre-foot of water saved. There are many funding sources available to Mesa Water including MWD, MWDOC, Federal grants offered through the United States Bureau of Reclamation, and efficiency grants offered through State agencies such as the Department of Water Resources. Mesa Water will leverage all of these funding sources for current and future programs.

Selected Programs

The program selection becomes somewhat complicated when the process moves beyond the individual measures and programs and onto the "mix" of programs to be included in the portfolio. This interactivity requires that all factors be considered and weighed against one another.

During the program selection process it was found that some of the water efficiency possibilities did not meet Mesa Water's criteria for selection, such as the cost per acre-foot, market need, or overall program budget dollars. It was also necessary to consider measures that maximized access to MWD and MWDOC funding and available grant opportunities.

With possible solutions listed, each measure was first run through the economic analysis model to compare against Mesa Water's avoided cost of supply, and to better examine the pros and cons of each.

With an avoided cost of $1,318 in 2013, a number of water use efficiency program possibilities can be identified as cost effective. Although cost effectiveness was not the only consideration in selecting programs, it was a critical evaluation component. The lower the cost per acre-foot, the more attractive the program is for the program portfolio. Potential Programs were compared according to the following economic attributes:

- Low overall costs
- High acre-foot lifetime savings
- Low cost per acre-foot

As stated above, direct program cost was not the only consideration in selecting programs. In order to understand the goals of the WUE plan clearly, it was first necessary to define the elements of "success." Below are the major elements of success for WUE programs.
Major Elements of Success

- **Cost effectiveness.** The program provides economical water savings compared to the avoided cost of water supply.
- **Certainty of water savings.** The program uses "tried and true" measures that have proven savings.
- **Market potential.** The program has an opportunity for large volume of water savings.
- **Market innovation/transformation.** Program helps to forge the way into a specific market (such as landscape) so that vendors offer water use efficiency measures and customers make water use efficiency upgrades on their own.
- **Ease of implementation**. The program is not burdensome for MWDOC to operate.
- **Outside funding potential**. There is a possibility of third-party funding or grant money, which would reduce overall program costs and increase Mesa Water benefit-to-cost ratio.

- **Regulatory compliance.** The program fulfills 20x2020, BMP and other regulatory compliance requirements, AB 1420 Urban Water Management Plans, and Small Municipal Separate Storm Sewer System (MS4) Program.
- **Other benefits.** The program has additional benefits such as reduced runoff, reduced non-point source pollution, reduced wastewater, or improved water quality.
-

Armed with the results of the economic analysis, each potential program was compared against the full list of evaluation criteria. The final step in the process was to assimilate all the findings and create the best portfolio of programs for the future.

Based upon the evaluation results, several programs were eliminated from the list, some were put on hold until MWD began funding or grants were obtained.

Each of the selected programs is described in further detail below.

WaterSmart Landscape Program

Projected Lifetime Water Savings:	515 Acre-feet	Mesa Water 5 Year Expense:	$35,127
Mesa Water Per Unit Costs:	$90 per meter	Mesa Water Cost per Acre-foot	$69
Funding Partners:	MWDOC	Mesa Water Avoided Cost:	$151,672
Program Years:	FY 13/14 – FY 17/18	Projected Response:	75 meters per year

The WaterSmart Landscape Program is a FREE water management tool for homeowner association and other large landscape sites. Mesa Water has 975 dedicated irrigation meter accounts that are targets for this program. The program provides customers--with sites that have dedicated irrigation meters--information on their monthly or bi-monthly usage versus a budget allocation. Each customer is given a water budget allocation based on the size of their irrigated acreage and the local weather. The water budget allocation varies monthly based on seasonal outdoor watering needs.

Customers are sent a report via email with detailed information regarding their site and their monthly budget versus their actual use. The water budget provides information and guidance as to reasonable water usage for a customer's site. The budget is a tool customers can use to make informed choices about their water usage each month. If a customer is over their budgeted amount they could be given a list of recommendations and next steps.

Program Advantages:	Existing program. Ease of operation for Mesa Water because it is administered by MWDOC and its vendor. Targets high water-use market.
Program Design Requirements:	Pull the full list of dedicated irrigation meter accounts. Cross reference list with list of current participants. Verify email addresses for participants. Contact non-participants to educate customers on the program and its value. Follow up with customers over their water budget regarding water use efficiency opportunities and assist them in the process.

Residential Survey Program

Projected Water Savings:	121 Acre-feet	Mesa Water 5 Year Budget:	$40,071
Mesa Water Per Unit Costs:	$110 per survey	Mesa Water Cost per Acre-foot	$343
Funding Partners:	MWD for nozzles	Mesa Water Avoided Cost:	$34,994
Program Years:	FY 13/14 – FY 17/18	Projected Response:	70 surveys per year

This program provides high water-use residential customers with water audits of their homes and landscape. Water audits are an effective tool at educating customers and obtaining behavioral water savings through information sharing. In addition staff provides free installed high efficiency nozzles to interested customers. This program also serves as a gateway for participation in fixture based rebate programs through SoCal Water$mart, such are smart controllers. The program is administered through Mesa Water staff wand will target the top 20% of high water users.

Program Advantages:

Provides good PR and customer contact.
Existing program.
Actively targets top water using residential customers.
Provides community education.
Promotes other WUE programs.

Program Design Requirements:

Follow up with customers to ensure they implement recommendations and participate in regional incentive programs.
Support could include documented next steps, list of local vendors, and web link to rebate programs.

Multi Family HET Direct Installation Program

Projected Water Savings:	356 Acre-feet	Mesa Water 5 Year Budget:	$133,127
Mesa Water Per Unit Costs:	$217.50 per HET	Mesa Water Cost per Acre-foot	$491
Funding Partners:	MWD	Mesa Water Avoided Cost:	$86,192
Program Years:	FY 13/14 – FY 15/16	Projected Response:	200 HETs per year

HET direct installations provide long-term water savings (20 plus years). The Direct install Program will target small multi-family units that would have not been sought in past programs by Mesa Water because the owners are hard to reach. These toilets are not likely to get replaced unless active replacement is sought. Mesa Water would hire a plumbing contractor to implement the program. The contractor would solicit participation as well as purchase and install the product. Only high volume toilets would be replaced ensuring maximum water savings.

Mesa Water may consider partnering with another Orange County water retailer in order to obtain cost efficiencies for product purchasing and installation costs.

Program Advantages:	Targets local Mesa Water opportunity and high density indoor usage. Will leverage outside funding through MWD's Member Agency Funding for locally implemented programs. Long term water savings.
Program Design Requirements:	Obtain outside vendor to conduct installation. Mesa Water staff would contact owners of 2, 3 and 4 unit apartment buildings.

High Efficiency Nozzle Distribution

Projected Water Savings:	63 Acre-feet	Mesa Water 5 Year Budget:	$13,010
Mesa Water Per Unit Costs:	$5 per nozzle	Mesa Water Cost per Acre-foot	$216
Funding Partners:	MWD	Mesa Water Avoided Cost:	$18,088
Program Years:	FY 13/14 – FY 17/18	Projected Response:	500 nozzles per year

High efficiency nozzles can save up to 30% of outdoor water use. The market for high efficiency spray nozzles has only emerged in recent years and has a tremendous potential. Hundreds of thousands of inefficient pop up spray heads are installed in Mesa Water's territory. Virtually any site with irrigation will have pop up spray heads.

The High Efficiency Nozzle Distribution Program provides nozzles for free to large landscape sites as well as hard to irrigate areas. Mesa Water has many large landscape sites including the John Wayne Airport, South Coast Plaza, the Orange County Fairgrounds, as well as City parks and schools. In addition there are numerous sites such as strip malls and street medians that are hard to irrigate and would benefit from more efficient sprinklers. Mesa Water staff will provide high efficiency sprinkler nozzles to these sites for free. Staff would then conduct follow up inspections to verify correct installation.

Program Advantages:

Will leverage outside funding through MWD's Member Agency Funding for locally implemented programs.
Targets high water-use landscape segment.
Employs new technology and subsequent customer education.

Program Design Requirements:

Program will be launched in 2014 utilizing Mesa Water staff.
Staff will generate a list of high potential sites.
Each customer will be contacted to enroll in the program.
The customer along with their landscape contractor will inventory their site.
Based upon the inventory Mesa Water will provide the required nozzles.
The customer will install the nozzles and then Mesa Water will conduct a verification inspection to ensure correct and complete installation.

SoCal Water$mart Incentive Program

Projected Water Savings:	1,402 Acre-feet	Mesa Water 5 Year Budget:	$187,791
Mesa Water Per Unit Costs:	Varies per Measure $1.00 per HET $201.35 per HEW $33.75 per Controller	Mesa Water Cost per Acre-foot	Varies per Measure (see chart below)
Funding Partners:	MWD	Mesa Water Avoided Cost:	$338,057
Program Years:	FY 13/14 – FY 17/18	Projected Response: Commercial HETs = 200 per year ULF Urinals = 50 per year Commercial HE Nozzles = 250 per year Residential HE Nozzles = 250 per year Commercial Smart Controllers = 5 per year Residential Smart Controllers = 30 per year Residential HETs = 15 year one only High Efficiency Washers = 170 per year	

The SoCal Water$mart Program offers residential and commercial customer incentives for a menu of indoor and outdoor devices. The program is operated by EGIA, MWD's regional vendor. Over the last five years, the program has operated in Mesa Water territory being the primary focus of the WUE program effort.

SoCal Water$mart Incentive Program Measures Offered:

Measure	Incentive	Mesa Water Cost per Acre-foot
Residential		
High Efficiency Sprinkler Nozzle	$4	$73
High Efficiency Toilet	$50	$0
High Efficiency Washer	Base Incentive = $85 Mesa Water Added = $200	$811
Smart Controller < 1 acre	$80/controller	$96
Smart Controller > 1 acre	$25/station	NA
Commercial		
Air Cooled Ice Machines	$1,000	NA
Cooling Tower Conductivity Controllers	$625	NA
Cooling Tower ph Controllers	$1,750	NA
Connectionless Food Steamers	$485 per compartment	NA
Dry Vacuum Pumps	$125 per 0.5 HP	NA
High Efficiency Sprinkler Nozzles	$4 per nozzle	$73
High Efficiency Toilets – Commercial	$100	$0
Laminar Flow Restrictors	$10 per restrictor	NA
In-stem Flow Regulators	$1 per regulator	NA
Large Rotary Nozzles	$13 per set	NA
Smart Irrigation Controllers	$25 per station	$309
Ultra Low Volume Urinals	$200	$0

Program Advantages:

Leverages outside funding sources.
Ease of operation for Mesa Water because it is administered by MWD and its vendor.
Targets commercial and residential market.
Takes advantage of regional marketing efforts.
Provides one-stop-shop for customer rebates.

Recommendations:

Market program directly to Mesa Water customers.
Focus on market segments (i.e. restaurants, hotels, medical facilities)

Turf Removal Program

Projected Water Savings:	15 Acre-feet	Mesa Water 5 Year Budget:	$1,260
Mesa Water Per Unit Costs:	$0.11 square foot	Mesa Water Cost per Acre-foot	$95
Funding Partners:	MWD and MWDOC	Mesa Water Avoided Cost:	$4,237
Program Years:	FY 13/14 – FY 17/18	Projected Response:	4,000 sf per year

The Turf Removal Incentive Program encourages customers to remove high water consuming turf and replace it with alternative solutions such as low water using indigenous California friendly plants and surfaces that allow for ground water infiltration and reduce runoff.

Through this Program, residential and commercial customers of participating retail water agencies are eligible to receive an incentive of $0.30 (or more) per square foot of turf removed for qualifying projects. Several retail agencies provide supplementary funds above the $0.30 per square foot.

Customers download a program application and guidelines from the MWDOC website. Customers submit their application and plan designs to MWDOC. Preliminary site inspections are conducted by MWDOC program staff, prior to turf modifications, in order to confirm customer eligibility and verify square footage. Exposed soil, where turf has been removed, must be covered with mulch, rock, synthetic turf, or approved low water use plant material. When the landscape renovation is finished, a final inspection will be conducted by MWDOC staff. Upon final approval a rebate check is generated and sent to the customer.

Funding for the program is provided through MWDOC in partnership with MWD and Mesa Water.

Program Advantages:	Leverages outside funding sources. Ease of operation for Mesa Water because it is administered by MWDOC and MWD. Targets high water-use landscape segment.
Recommendations:	Market the program through regional efforts focusing on long term market transformation.

Program Savings Scenarios

Over the past several years, water use planning and implementation efforts have reached a level of complexity and interconnectivity throughout the water industry, thus making transparent and defensible decision-making critical.

To achieve savings goals, it is necessary to comprehensively analyze program-by-program data, including water savings, budget and cost effectiveness, as well as environmental and societal impacts. The Tracking Tool developed by Alliance for Water Efficiency (AWE), and used for Mesa Water's modeling, is a robust and flexible computer-based program which allows Mesa Water to clearly understand and adapt future water-saving opportunities.

The following is a listing of some of the key features of the Tracking Tool:

- **Flexible Modeling of Water Savings.** Water savings for an activity can be modeled as having a fixed life or as persisting indefinitely. A water use efficiency activity's savings profile can include a decay process or it can be modeled as constant. Savings from water use efficiency activities that interact with existing plumbing/energy codes, such as toilet, showerhead, and clothes washer replacement/rebate programs, can be disaggregated into program-related and code-related savings components.
- **Water Savings Disaggregation.** The tool disaggregates water savings three different ways: (1) by water user classification, (2) between system peak and off-peak periods, (3) and between program-related and code-related water savings. The tool has built-in capability to estimate service area water savings due to national toilet, showerhead, clothes washer and dishwasher water efficiency code requirements.
- **Demand Forecasting**. The tool can modify a baseline water demand forecast to account for both program-related and code-related water savings over time. The tool can also generate a simple baseline demand forecast if the user does not have one. The tool also allows for demand disaggregation for peak/off-peak demand and by customer sector.
- **Avoided Cost Analysis**. Users have the option to use their own forecasts of system avoidable costs, or they can use the tool's avoided cost calculator to estimate avoidable system operating and capital costs due to water use efficiency water savings.
- **Charting & Reporting Capability**. The tool includes dynamic charts and tables that automatically adjust to user settings and water use efficiency program specifications.

Charts are embedded within worksheets, but also can be displayed in their own windows with a click of a button (this feature is not available if you are using Excel 2007). Charts and reports can be easily copied into other documents for report generation.

- **Scenario Management**. Users can easily save scenarios and retrieve them for later use. This makes it easy to see how different program mixes or assumptions about water savings or program costs impact the overall results.
- **Open Source**. Users can examine the tool's internal logic. Users can customize or extend the capabilities of the tool to meet their specific planning needs. Visual basic code used by the tool is transparent and extensively commented to make it easy to follow.

As part of the program evaluation, savings were modeled using three different budget levels and productivity assumptions, designed to deliver varying degrees of water savings. These three levels of planning assumptions have been identified as the Low, Medium and High plans.

Mesa Water's current water use efficiency program offering, as well as future planned programs, falls within the parameters of the Low budget scenario. It is recommended that Mesa Water increase their budget and implement the Medium scenario. This level allows Mesa Water to expand program services in a manageable way while driving down the avoided cost of water. The increase to the current budget is minimal as compared to the benefits derived. Table 12 provides the program benefits, costs and savings for each of the three budget scenarios.

Table 12 Scenario Benefits, Costs and Savings

Program Option	Costs (Program Expenditures)	Benefits (Avoided Costs)	Savings (Lifetime AF)
Low	$307,861	$474,930	1,854
Medium	$410,481	$633,240	2,472
High	$513,101	$791,551	3,090

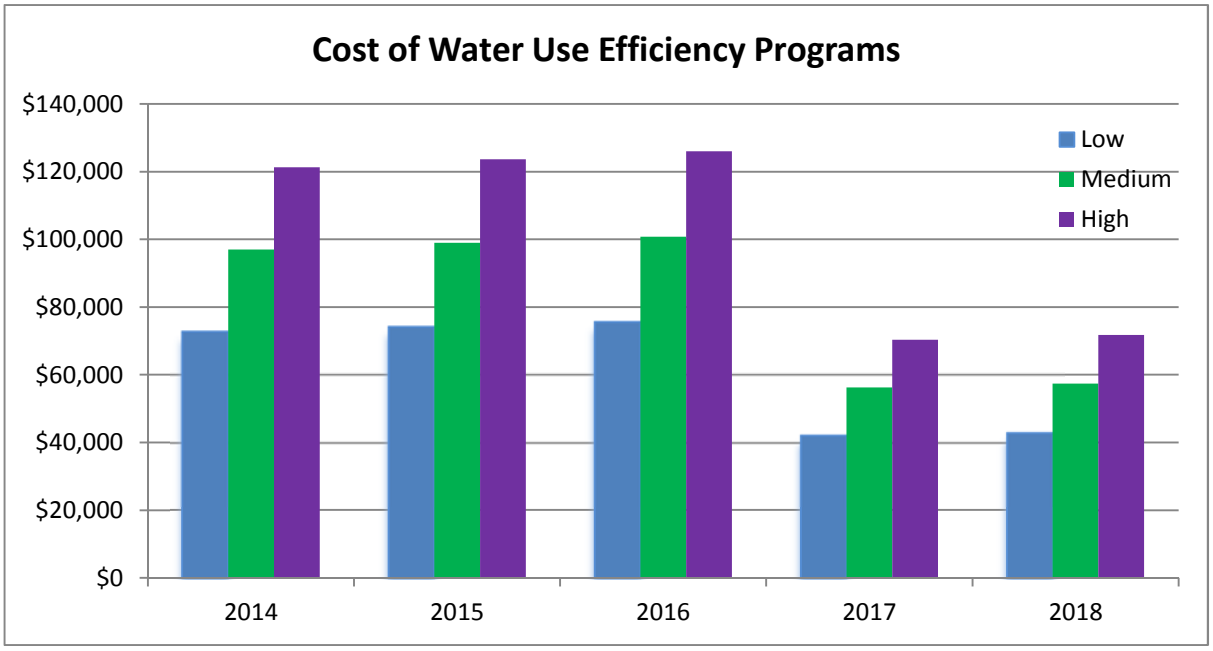
Table 13 outlines the 5-year budget plans utilized in these scenarios.

Table 13 5-Year Budget

	Program Year				
	FY 13/14	FY 14/15	FY 15/16	FY 16/17	FY 17/18
Low	$72,753	$74,208	$75,604	$42,226	$43,070
Medium	$97,004	$98,944	$100,805	$56,301	$57,427
High	$121,254	$123,680	$126,007	$70,376	$71,784

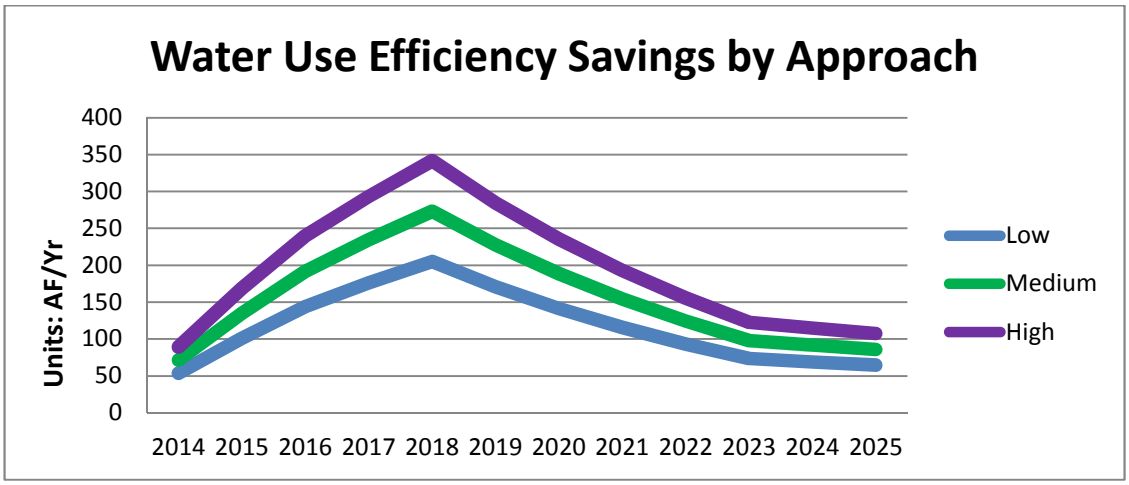
Figure 2 depicts the Medium scenario requires an average annual budget of $100,000 for the next three years lowering in FY 16/17 to approximately $57,000 per year.

Figure 2 Cost of Water Use Efficiency Programs by Year



The three scenarios provide water savings projections in direct correlation with the amount of money dedicated to WUE program efforts. The line graph below shows the savings projections according to each water use efficiency approach. The proposed Mesa Water WUE Plan (the medium green line below) produces a cumulative water savings of 906 AF over the first 5 years, 1,699 AF over the first 10 years, and 2,472 AF over the lifetime of the implemented programs.

Figure 3 Water Use Efficiency Savings by Approach by Year



This Mesa Water WUE Plan recommends a portfolio of WUE programs that builds on the track record of successful Mesa Water programs and regional funding for new WUE innovations. The program portfolio is designed to cost $198 per acre-foot, considerably less than the expected avoided costs thus meeting a rigorous economic justification. This recommended WUE portfolio can be feasibly implemented with existing staff, coupled with regionally funded outside vendors. Note that alterative portfolios were also constructed so the recommended programs could be scaled up (High Portfolio) or down (Low Portfolio) at roughly similar costs per acre foot.

Resultant of these projections, Mesa Water seems poised to achieve both its 2015 and 2020 urban water savings mandates by continuing its current path within the recommended WUE programs (Medium scenarios).

Section 4 - Five Year Action Plan

Mesa Water staff recommends implementation of the Medium Plan scenario. Although the plans focus primarily upon the five-year program selections and implementation strategy, there is also guidance for longer-term program and water savings planning (up to year 2020).

Budget by Year

Mesa Water prepares annual budgets with line items dedicated to water use efficiency activities. The annual budget for each year of the five year planning period is displayed in Table 13. The budget amounts shown reflect the financial commitment only of Mesa Water and are exclusive of MWD, MWDOC or other financial contributions.

Table 14 Annual Budget by Year

Program Year	Annual Program Budget ($/Yr)
FY 13/14	$97,044
FY 14/15	$98,944
FY 15/16	$100,805
FY 16/17	$56,301
FY 17/18	$57,427

Budgets per Program

Table 14 is the projected five year budgets per program. Forty six percent of the five year budget is allocated for SoCal Water$mart incentives. The majority of the SoCal Water$mart budget (95%) is for high efficiency clothes washer incentives. The Multi Family HET Direct Installation Program represents 32% of total budget.

Table 15 Projects 5 Year Budgets by Program

Program	FY 13/14	FY 14/15	FY 15/16	FY 16/17	FY 17/18	5 Year Total
SoCal Water$mart Incentive Program*	$36,104	$36,826	$37,562	$38,313	$39,080	$187,884
Multi Family HET Direct Installations	$43,500	$44,370	$45,257	$0	$0	$133,127
Residential Survey Program	$7,700	$7,854	$8,011	$8,171	$8,335	$40,071
WaterSmart Landscape Program	$6,750	$6,885	$7,023	$7,163	$7,306	$35,127
High Efficiency Nozzle Distribution	$2,500	$2,550	$2,601	$2,653	$2,706	$13,010
Turf Removal Program	$450	$459	$351	$0	$0	$1,260

*Includes budgets for different devices Mesa Water has chosen to offer enhanced incentives on through SoCal WaterSmart.

Implementation Schedule

Budgets are fairly well determined for next year but, as circumstances shift over time, the years beyond are less certain. Program planning will always be a fluid process. On a regular and ongoing cycle, program plans and schedules will need to be revised and updated.

The programmatic schedule for the new 5 fiscal years is listed in Table 15.

Table 16 Program Schedule for Next 5 Fiscal Years

Program	FY 13/14	FY 14/15	FY 15/16	FY 16/17	FY 17/18
SoCal Water$mart Incentive Program*	Program implemented through duration of plan based upon MWD funding				
Multi Family HET Direct Installations		Program implemented for three years			
Residential Survey Program	Program implemented through duration of plan				
WaterSmart Landscape Program	Program implemented until 100% of dedicated irrigation meters are enrolled				
High Efficiency Nozzle Distribution	Program starts in 2014 and increasing production over time				
Turf Removal Program	Program implemented for three years				

Table 16 is the annual activity for each measure. Note that a program can be comprised of multiple activities (i.e. SoCal Water$mart includes HETs, smart controllers, etc.).

Table 17 Annual Activity by Measure

Program	2014	2015	2016	2017	2018	5 Year Total
Turf Removal	4,000 sf	4,000 sf	3,000 sf	0	0	11,000 sf
High Efficiency Nozzle Distribution	500	500	500	500	500	2,500
Commercial High Efficiency Nozzles (SoCal Water$mart)	250	250	250	250	250	1,250
Residential High Efficiency Nozzles (SoCal Water$mart)	250	250	250	250	250	1,250
Residential HE Clothes Washer Incentives (SoCal Water$mart)	170	170	170	170	170	850
CII HET Incentives (SoCal Water$mart)	150	150	150	150	150	750

Multi Family HET Direct Installations	200	200	200	0	0	600
WaterSmart Landscape Program	75	75	75	75	75	375
Residential Survey Program	70	70	70	70	70	350
CII HET Enhanced Incentives (SoCal Water$mart)	50	50	50	50	50	250
CII Ultra Low Volume Urinal Incentives (SoCal Water$mart)	50	50	50	50	50	250
Residential Smart Controllers (SoCal Water$mart)	30	30	30	30	30	150
Commercial Smart Controllers (SoCal Water$mart)	5	5	5	5	5	25
Residential HET Incentives (SoCal Water$mart)	15	0	0	0	0	15

Outside Funding

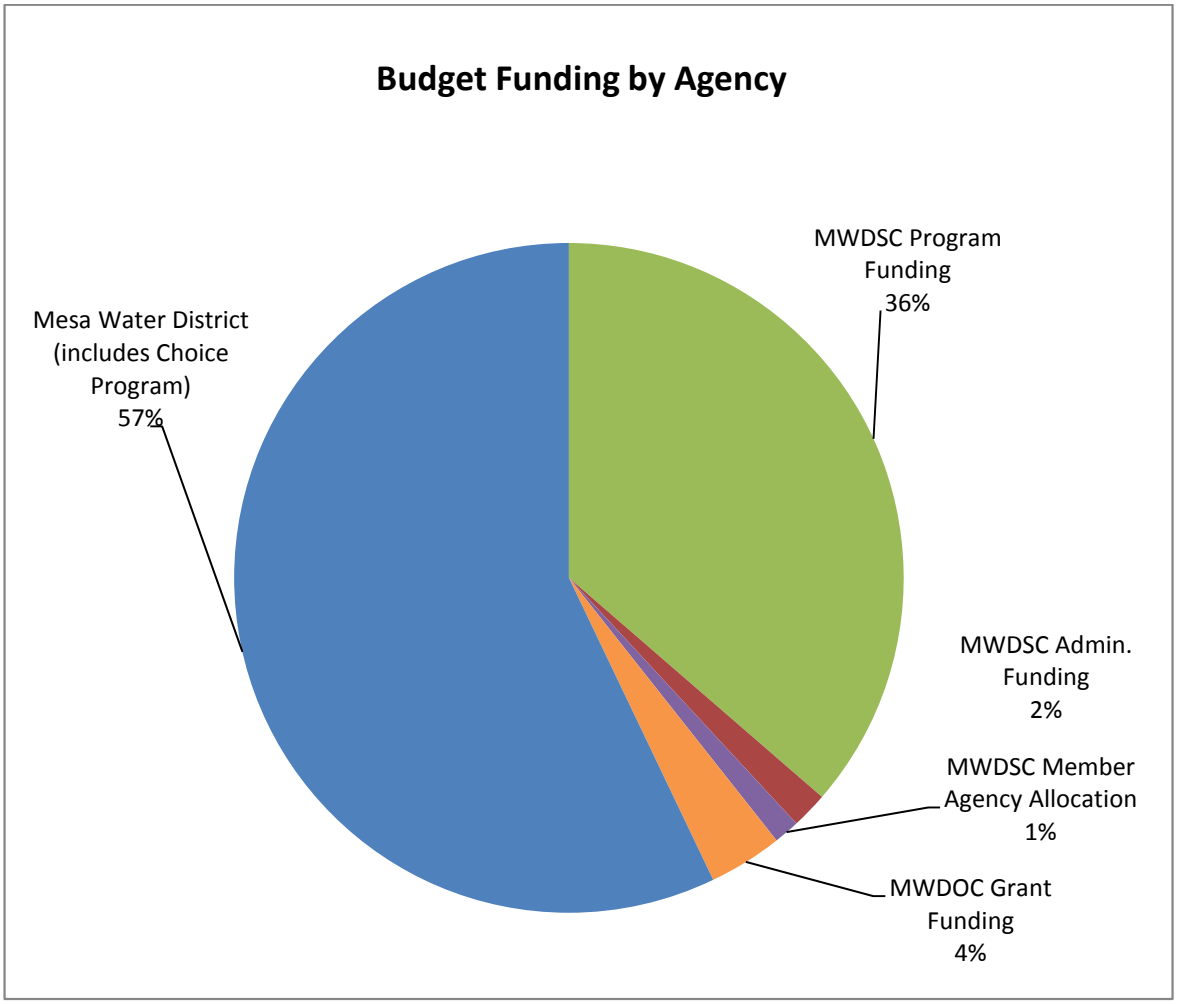
Mesa Water has been extremely successful in leveraging outside funding for its programs. Currently MWD, MWDOC and grantors, including USBR and DWR, fund a significant portion of program costs. MWDOC provides funding through their *Choice Programs*. Mesa Water is billed a portion of MWDOC's shared administrative costs based upon the actual participation. Due to fluctuations in customer participation year-by-year Mesa Water's actual costs cannot be modeled. Below is a chart listing the funding by agency.

Table 18 Program Funding by Agency

Program	MWD Funding	Mesa Water Funding	MWDOC and Grant Funding
High Efficiency Clothes Washer Incentives	$82,342	$178,132	$0
Multi Family HET Direct Installations	$33,511	$133,127	$0
Ultra Low Volume Urinal Incentives	$53,029	$0	$0
Home Water Surveys	$9,107	$40,071	$0
WaterSmart Landscape Program	$9,640	$35,127	$0
CII HET Incentives	$13,258	$92	$26,020
CII Enhanced Incentives	$39,104	$0	$0
Large Landscape Nozzle Distribution	$10,408	$13,010	$0
Residential Smart Controllers Incentives	$13,676	$5,269	$0
Turf Removal Incentives	$9,787	$1,260	$0
CII High Efficiency Nozzle Incentives	$5,224	$1,756	$0
Residential High Efficiency Nozzle Incentives	$5,224	$1,756	$0
CII Smart Controller Incentives	$653	$878	$0
Residential HET Incentives	$821	$0	$0

As depicted in the chart below 57% of the cost are provided by Mesa Water, 40% through MWD including administration and 4% from MWDOC.

Figure 4 Percent of Total Budget by Funding Agency



Mesa Water Costs and Benefits

The Plan is estimated to save 2,472 acre-feet of water over the life of the measures at a cost to Mesa Water of $198 per acre-foot. This falls below Mesa Water's avoided cost of $337 per acre-foot and well below $1,318 per acre-foot of purchased MWD water which was part of the supply mix as of the 2010 UWMP. Mesa Water's avoided costs equate to $633,240 over the lifetime of savings (in present value).

This Plan represents a modest increase in Mesa Water budgeted expenditures for Water Use Efficiency. It should be noted that the justification for the WUE programs is not merely for improved customer service. There is a rigorous economic justification that compares the WUE programmatic expenditures against the direct economic cost savings (the avoided costs of water delivery mentioned above). Thus, the benefit-to-cost ratio for Mesa Water is quite good using conservative assumptions. Moving forward, the landscape market requires more

complex products and services and therefore cost more. Table 18 shows the cost per acre-foot per activity:

Table 19 Cost per Acre-foot per Activity

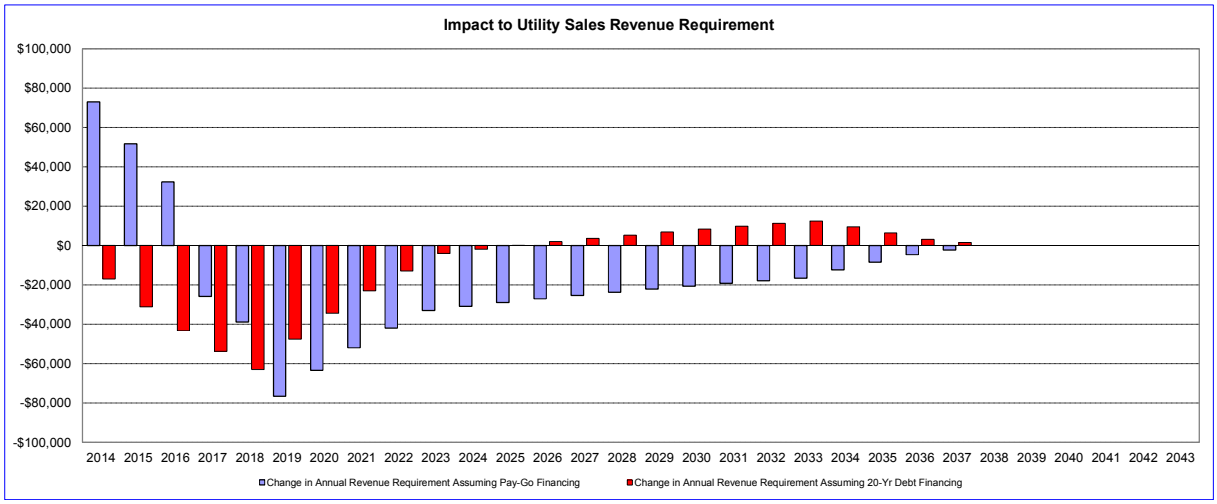
Program	Cost per Acre-foot	Avoided Costs
WaterSmart Landscape Program	$69	$151,672
Turf Removal Program	$95	$4,237
Residential Survey Program	$343	$34,994
Multi Family HET Direct Installations	$491	$86,192
High Efficiency Nozzle Distribution	$216	$18,088
SoCal Water$mart Incentive Program	$73-$811*	$338,057
Total		$633,240

****Dependent upon which device is incentivized through SoCal Water$mart.***

The effect on direct customer bills over time (derived from the expected Revenue Requirement) is negative overtime: customer bills will be lower than they would otherwise be. Figure 5 shows the net effect on Mesa Water Revenue Requirement over time. Assuming that WUE program expenditures come from the operating budget, the effect on Mesa Water cash flow is depicted annually in the blue bars. (The red bars depict the shape of cash flow were WUE program expenditures to be debt financed over a 20 year period.)

This report provides the quantified delta change on water sales attributable to the planned WUE programs. Since this quantity is known it can be incorporated into sales forecasts used in rate setting. Incorporating the planned demand reduction into the sales forecast results in an increase in the needed water rate of $0.0013 per billing unit. (If the recommendation of this plan is ignored, the “lost revenue” would be about one tenth of one cent on each billing unit sold. This WUE Plan emphatically does not recommend the practice of “losing revenue” since revenue neutrality is a required condition for economic desirability.)

Figure 5 Impact of WUE on Mesa Water Revenue Requirements – Lower Customer Bills



Program Implementation Strategy

In line with Mesa Water's strategy, three of the programs will be implemented through regional vendors managed by MWD and MWDOC. Mesa Water staff will continue to implement the residential surveys and the new High Efficiency Nozzle Distribution Program. The High Efficiency Toilet Direct Installation Program will be outsourced to a plumbing contractor.

To ensure success of the regional programs, Mesa Water will vigorously promote the programs including posting programs on Mesa Water website, sending out targeted emails and direct mail pieces and conducting direct outreach to CII and large landscape customers.

Table 20 Program by Implementing Vendor

Program	Implementation Vendor
WaterSmart Landscape	MWDOC's vendor, ConserVision
Turf Removal Program	MWD's SoCal Water$mart vendor, EGIA
Residential Survey Program	Mesa Water
Multi-family HET Direct Installation Program	TBD
High Efficiency Nozzle Distribution Program	Mesa Water
SoCal Water$mart Rebate Program	MWD's SoCal Water$mart vendor, EGIA

Staffing

The current funding and administration relationships with MWDOC and MWD provide Mesa Water with the benefit of program administration capacity beyond its existing resources. Regulatory commitments require that Mesa Water maintain the staffing, funding and priority levels necessary to achieve the level of water savings called for by the BMPs and DWR mandates. Through all of the modeling scenarios Mesa Water will be in compliance with the regulatory requirements.

Mesa Water currently carries a staffing level of 1.2 Full Time Equivalent (FTWE) staff people; one Conservation Specialist and 0.2 full time equivalent of a Customer Service Manager working on water use efficiency tasks. The Conservation Specialist currently administers all of Mesa Water's programs including conducting residential surveys.

In order to add two more locally implemented programs, the HET Direct Installation Program and the High Efficiency Nozzle Distribution Program, it is recommended that Mesa Water add another 0.5 FTE. This staffing increase would be required for the additional field, marketing, admin, reporting and invoicing (for these programs that receive primary funding from regional sources.) If the High Scenario Plan were to be selected it would be necessary to add at least another 0.5 FTE staff person to address the more staff intensive requirements of meeting with customers, explain the program, assisting in inventory counts, coordinating the purchase of nozzles, coordination with multi-family sites, and conduct of follow up inspections as well as the standard administration and reporting.

It is important to note that the additional budget dollars to staff these positions for the Medium and High level plans will be offset by the increased cost effectiveness of the expanded programs.

Major responsibilities for the Conservation Specialist include:

- Day to day program management of the water use efficiency programs.
- Coordination of landscape programs with the Cities of Costa Mesa & Newport Beach.
- Analysis of customer water use & evaluation of water use efficiency measures/practices.
- Interaction with the public, property managers, landscape managers, staff, and outside agencies.

- Participation in planning & presenting landscape workshops; promotion of water use efficiency and runoff reduction through public relations, educational speeches, and private contact.
- Assistance with the implementation, monitoring, and reporting of water use efficiency research projects and grants.
- Representation of the District on water use efficiency issues to committees including CUWCC, AWE, etc.
- Providing backup support to Customer Service manager, and acting as a resource for field customer service staff.

The Customer Service Manager carries the following major responsibilities relating to water use efficiency and assumes management responsibility for all Customer Service Department duties and activities.

- Manages development and implementation of department goals.
- Establishes the appropriate service and staffing levels. Assesses and monitors work load on an ongoing basis.
- Oversees the development and administration of the department budget.
- Analyzes, develops, and implements cost-effective water use efficiency programs consistent with the Best Management Practices, including the identification, evaluation, and implementation of measures essential to the efficient use of the District's water supplies; tracks customer contact and program progress; reports on progress.
- Represents the District on water use efficiency issues to committees, meetings, community groups, etc., including conducting media interviews as needed.
- Plans, develops, implements, evaluates, and promotes landscape water conservation programs consistent with current state/federal laws. Coordinates with the City of Costa Mesa and other public agencies.
- Oversees conservation and water use efficiency functions including water surveys, investigations, and evaluations of customers.
- Serves as liaison between the District and other government agencies including MWD and MWDOC.
- Prepares and oversees the Districts UWMP and BMP reports.

Responsibilities of the Field Customer Service Representative include:

- Conducts detailed water consumption audits for unusually high or low meter readings.

- Conducts in-depth water conservation audits for residential, commercial, and industrial customers.
- Explains water conservation methods to customers.
- Inputs information from surveys into the billing system and tracking databases.

Recommended staffing levels, per plan scenario levels are presented in the following chart:

Table 21 Staffing Levels per Plan

Staffing Levels per Plan

Plan Scenario	Recommended Staffing
Low	1.2 FTEs
Medium	1.7 FTEs
High	2.2-2.5 FTEs

Outside Funding Opportunities

Outside funding sources have provided critical financial support to water use efficiency programs for several decades. Regional, state and federal agencies have a long history of making funds available to local water agencies for the implementation of prioritized programs. In the form of incentives, grants and loans, these financial mechanisms underscore the shared goals of water use efficiency within California's water industry.

As the state and national economies continue in a recovery phase, the availability of outside funding will likely be less consistent and more competitive. Therefore it is important that Mesa Water has a clear understanding of the outside funding possibilities and includes realistic expectations of their availability. This section provides a description of current outside funding sources as well as brief projections as to their availability in the near future.

Metropolitan Water District

MWD has been a consistent source of outside program funding to its member agencies for many years. Their support has come in numerous formats and Mesa Water has consistently utilized these funds for program implementation. For Fiscal Year 13/14, MWD offers the following financial support opportunities to local agencies.

- **SoCalWater$mart:** provides direct rebates to commercial, single family and multi-family residential customers for the installation of high efficiency toilets, high

efficiency clothes washers, smart landscape controllers, high efficiency nozzles and other efficiency devices.

- **Agency Administered Programs**: Each MWD member agency will be allocated a specific budget for locally implemented programs. These funds are distributed to Mesa Water's wholesale supplier.
- **Water Savings Incentive Program**: WSIP is a collaborative effort between Metropolitan, its 26 public member agencies and large volume water customers to improve water use efficiency.

California Department of Water Resources

In recent years, the State's primary funding contribution to water use efficiency programs has come from Proposition 50, the Water Security, Clean Drinking Water, and Coastal & Beach Protection Act of 2002. Given the slow pace of the economic recovery in California, it is unknown whether Prop 50 funds will be available in the foreseeable future. Other State agencies, which focus on water, such as the California State Water Resources Control Board offer grant programs, which focus primarily on water quality and storm water issues and are not directly relevant to water use efficiency. At this time, it is advisable to develop local water use efficiency plans for the next two years absent expectations of any significant state financial contribution.

United States Bureau of Reclamation

Federal financial contributions to local agency water use efficiency programs have come primarily from the United States Bureau of Reclamation (USBR). USBR currently offers two water use efficiency grant opportunities under the WaterSmart program: the Challenge Grant and Water and Energy Efficiency Grants.

Other Federal Sources

The United States Environmental Protection Agency currently offers financial assistance to local agencies for watershed, water quality and water distribution/treatment systems upgrades. At this time, financial support is not available for water use efficiency/efficiency programs.

Appendix A – Task 2 – Evaluate Historical Water Use Efficiency Implementation

Introduction

As part of the Mesa Water Use Efficiency (WUE) Benchmarking Study and Plan in Task 2, A & N Technical Services, Inc. is evaluating level of water use efficiency implementation that has historically occurred at Mesa Water. This evaluation includes:

1. Quantification of the water saved through historical WUE program implementation ,
2. Estimation of the annual level of market activity of programmatic WUE programs (variously referred to as Demand Management Measures or Best Management Practices)
3. Analysis of monthly water consumption records to estimate indoor versus outdoor end uses of water.

This evaluation will inform both the evaluation of future WUE potential (Task 3) and the assessment of compliance with WUE regulations and codes (Task 4).

Data Sources, Reports, and Guidance

In the evaluation of historical WUE Implementation, the project team collected and reviewed literature, reports, and published and unpublished data to develop a complete picture of the state of existing WUE/conservation implementation. Our efforts included:

i. Historical consumption by customer class, including per capita water use from previous SBx7-7 calculations by MWDOC.
ii. Water rates and rate structure
iii. Levels of water conservation staffing
iv. California Urban Water Conservation Council (CUWCC) Best Management Practice (BMP) reports and levels of compliance with the BMPs
v. Compilation of historical local and regional WUE programs. We assembled data on the current and historical level of programs and estimated associated water savings.

Additional documents revived included the following:

- 2010 Urban Water Management Plan (UWMP) from Mesa Water and from MWDOC
- CUWCC BMP Costs and Savings Study
- CUWCC Potential BMP Reports
- Metropolitan's 2010 Long Term Conservation Plan

- AB 1881, the Updated Model Water Efficient Landscape Ordinance and other statutes, ordinances, and regulations related to WUE
- Water Loss Management Assessment, 2007
- EPA Water Sense standards
- US Bureau of Reclamation's guidebook on Achieving Efficient Water Management: a Guidebook for Preparing Municipal Water Conservation Plans

1. Evaluation of Historical WUE Implementation

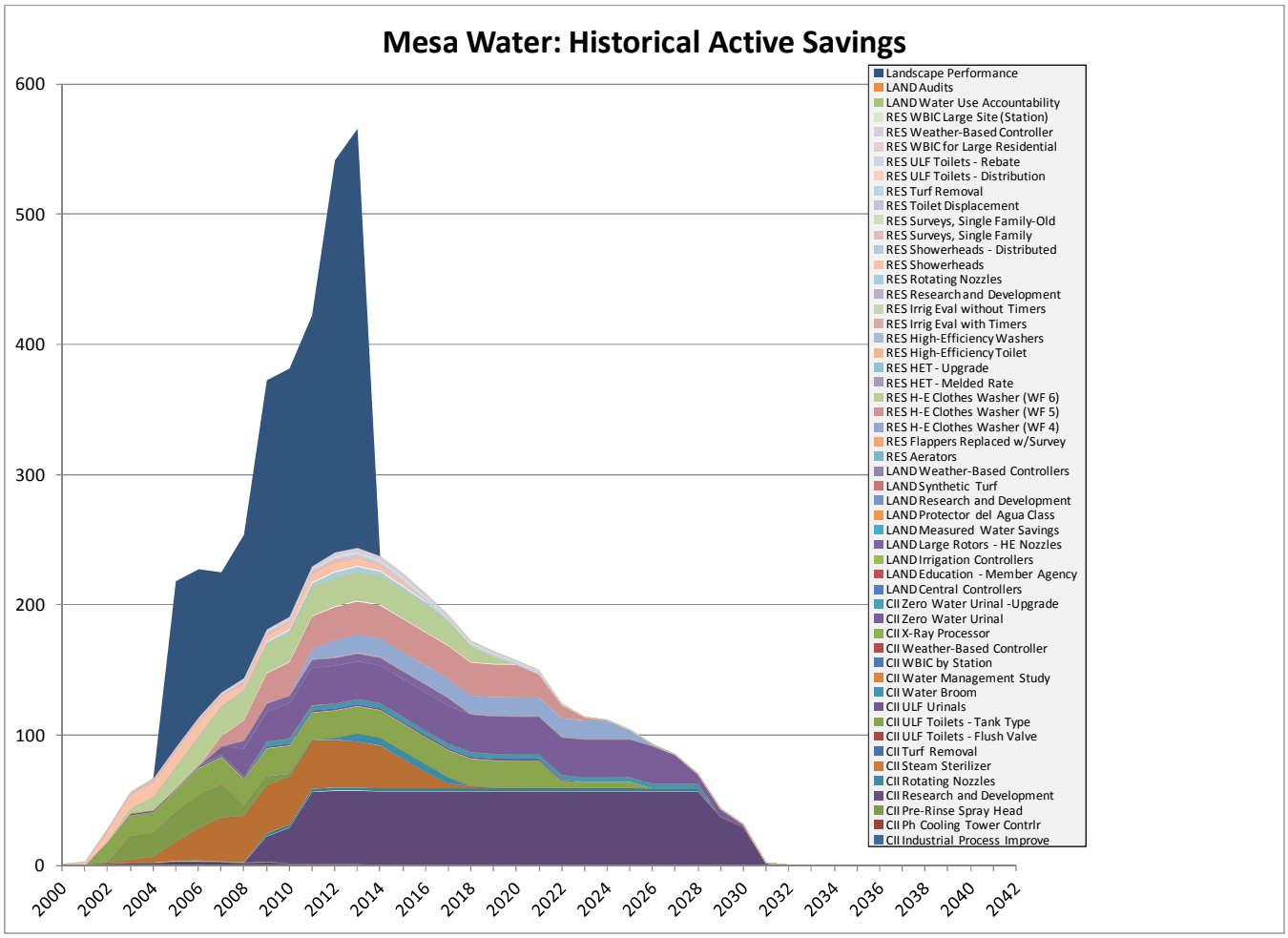
The compiled data on WUE implementation are summarized in two figures:

1. WUE water savings from historical WUE programs, from point of implementation to cessation of water savings
2. WUE water savings by customer segment

The historical Mesa Water WUE implementation activities derived from Metropolitan/MWDOC records of WUE program rebates/activity levels and Mesa Water records of in-house WUE program implementation. The water savings for each implemented WUE program derives from regional water savings assumptions used by Metropolitan/MWDOC. Note that these data will inform the estimation of remaining WUE market potential in Task 3 and will address compliance with WUE regulations and codes in Task 4.

Figure 6 WUE Water Savings from Historical Active WUE Programs, by Program

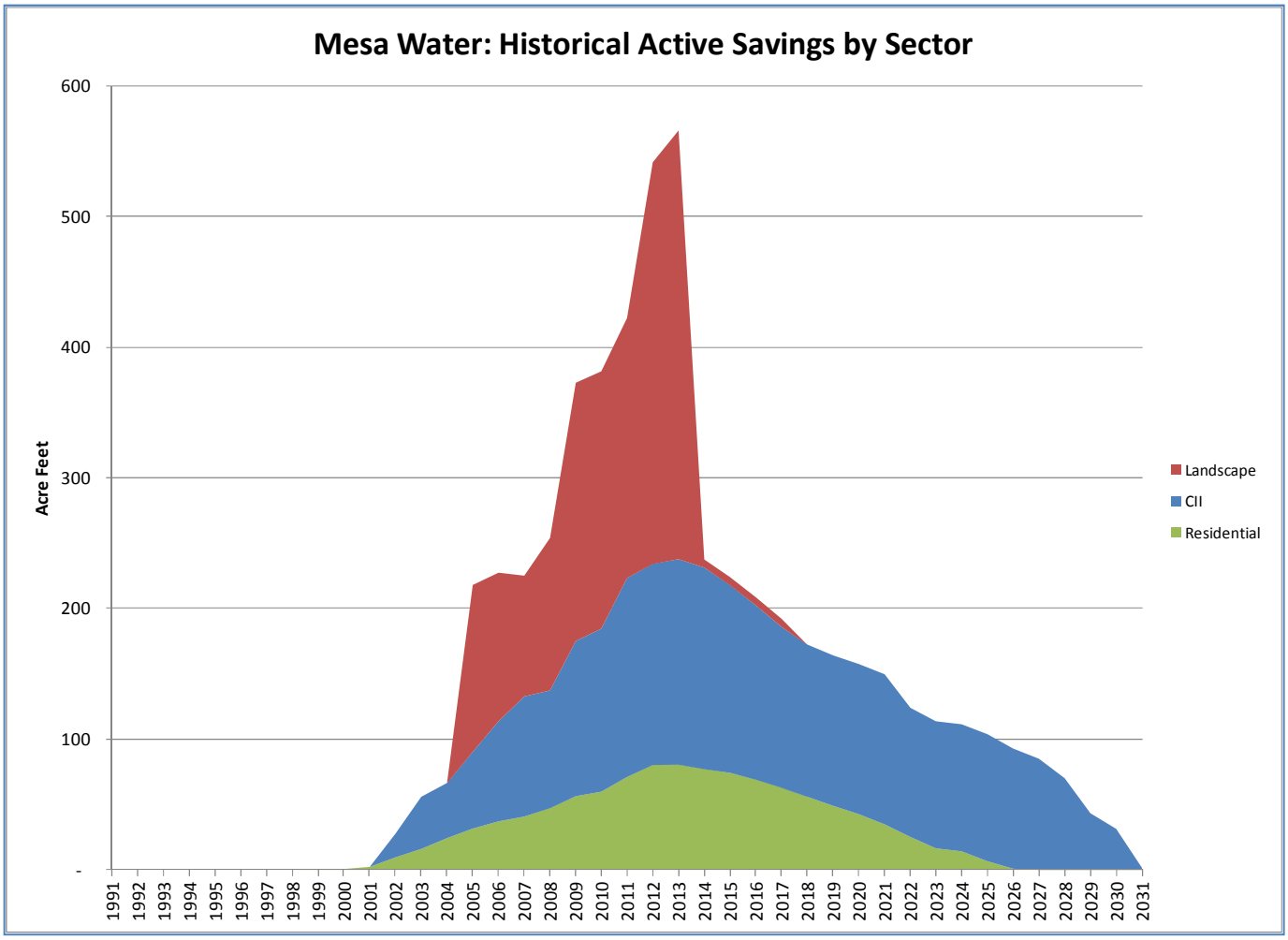
WUE Water Savings from Historical Active WUE Programs, by Program



Note: The figure above embeds no assumption for future Landscape Performance implementation.

Figure 7 WUE Water Savings from Historical Active WUE Programs, by Customer Sector

WUE Water Savings from Historical Active WUE Programs, by Customer Sector



Note: The figure above embeds no assumption for future Landscape Performance implementation.

2. Historical Active WUE Program Implementation, by Specific Program

The data compiled in this project also document historical WUE Program implementation for each year of program activity.

Figure 8 Smart Irrigation Timers Installed

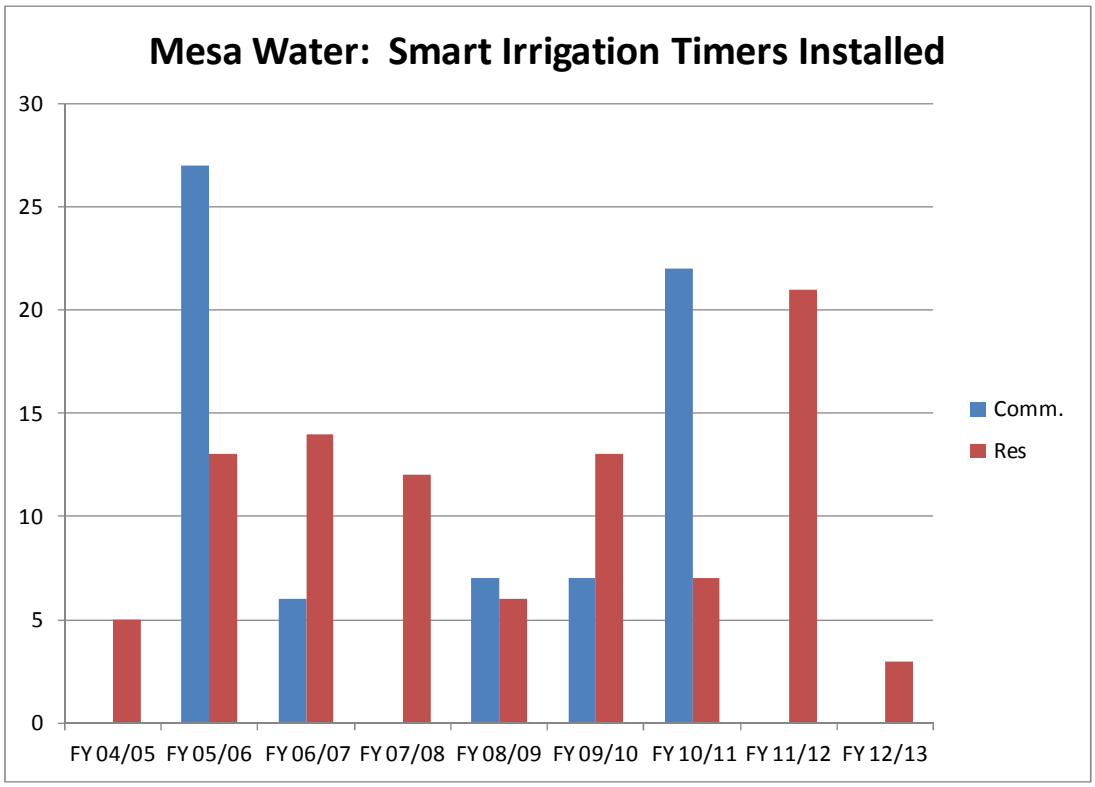


Figure 9 Rotating Nozzles Installed

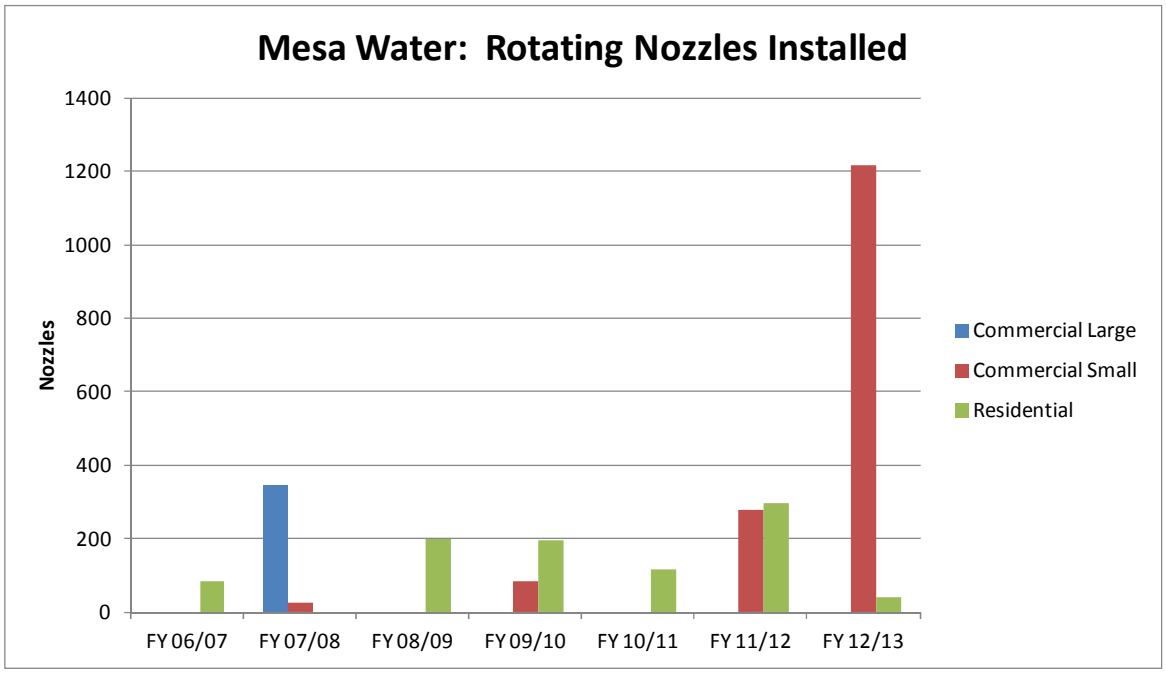


Figure 10 SaveABuck Installations by Type

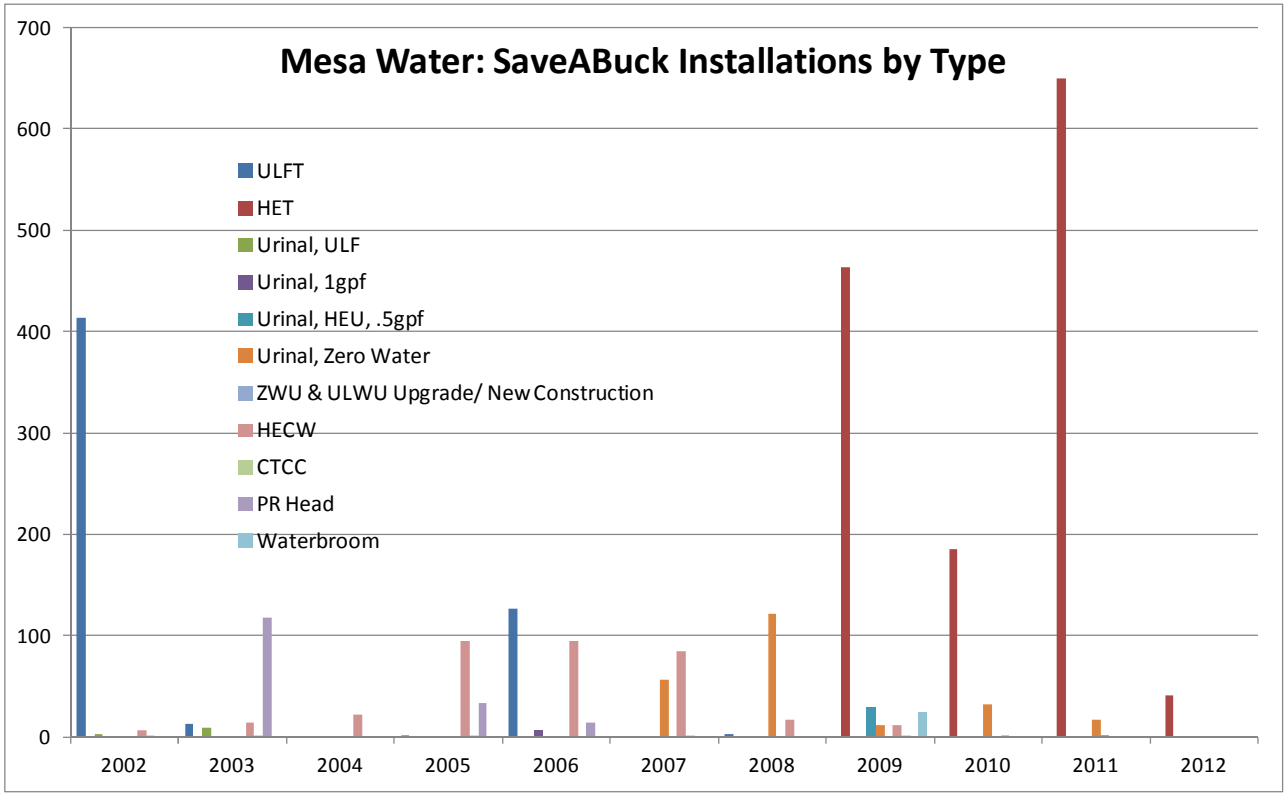


Figure 11 High Efficiency Clothes Washer Rebates Installed

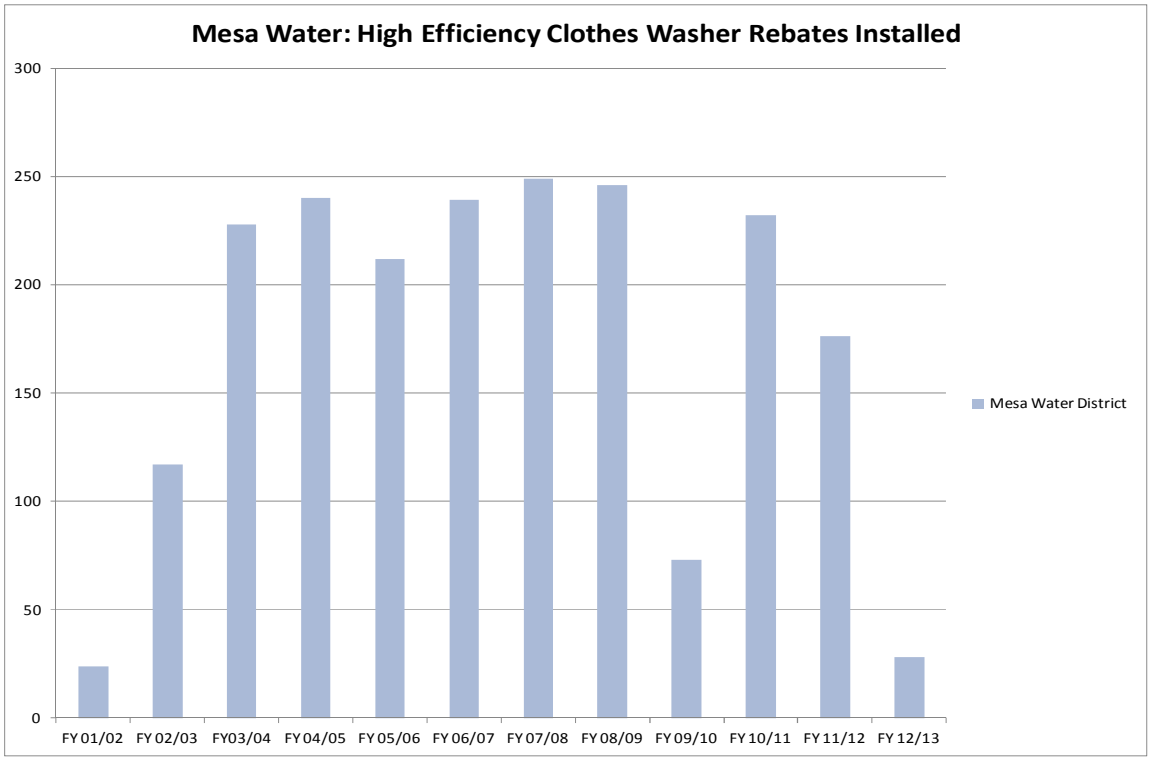


Figure 12 ULF Toilets

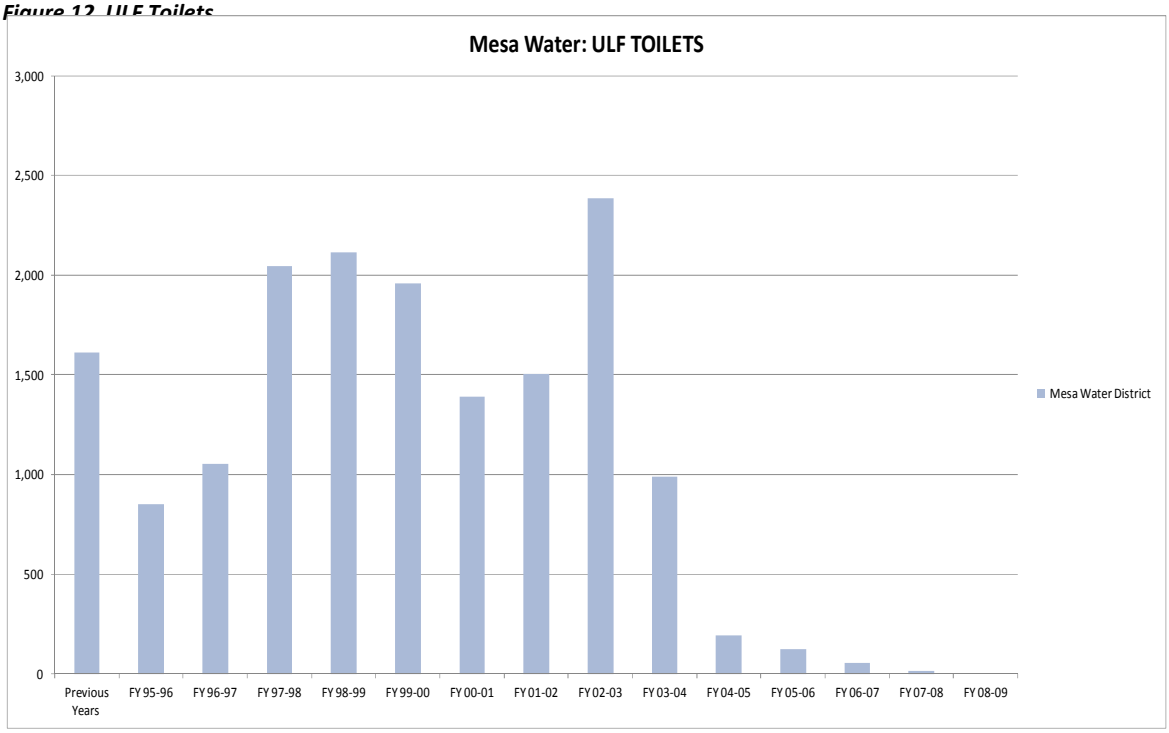


Figure 13 High Efficiency Toilets (HETs)

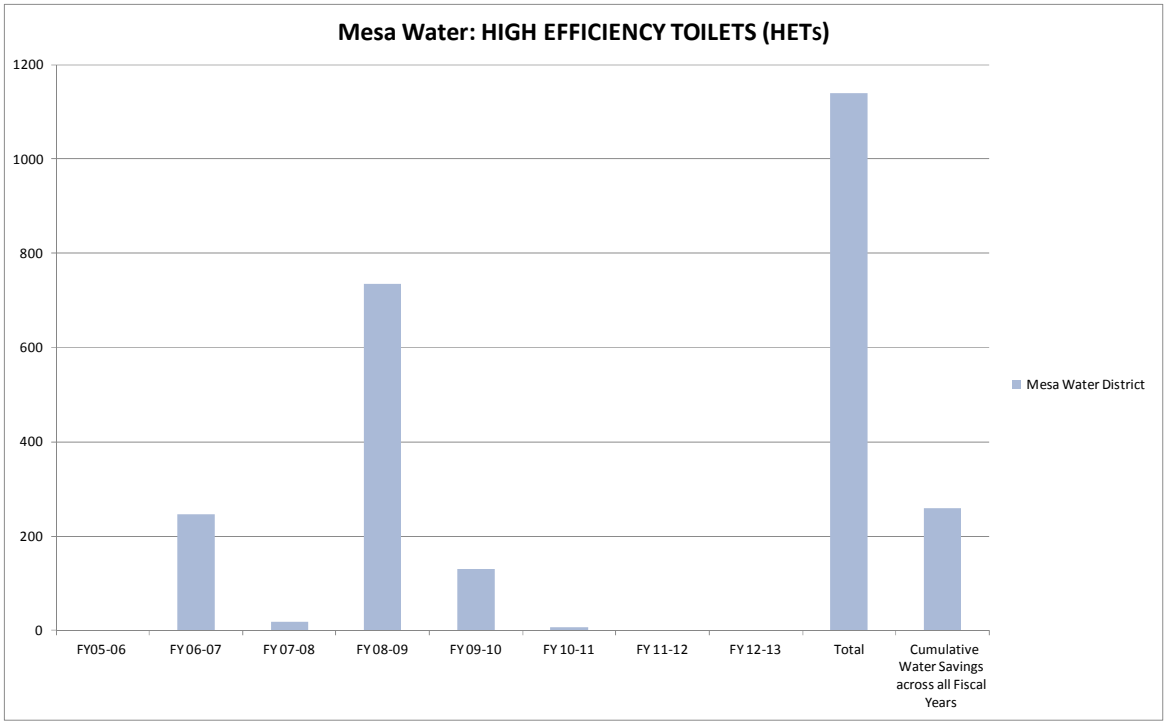


Figure 14 Turf Removal

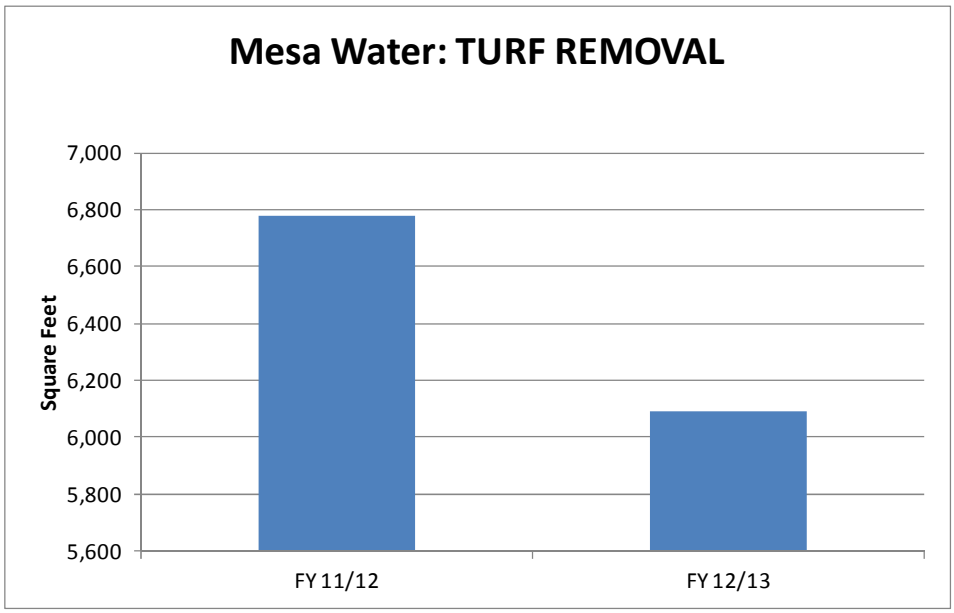


Figure 15 Synthetic Turf

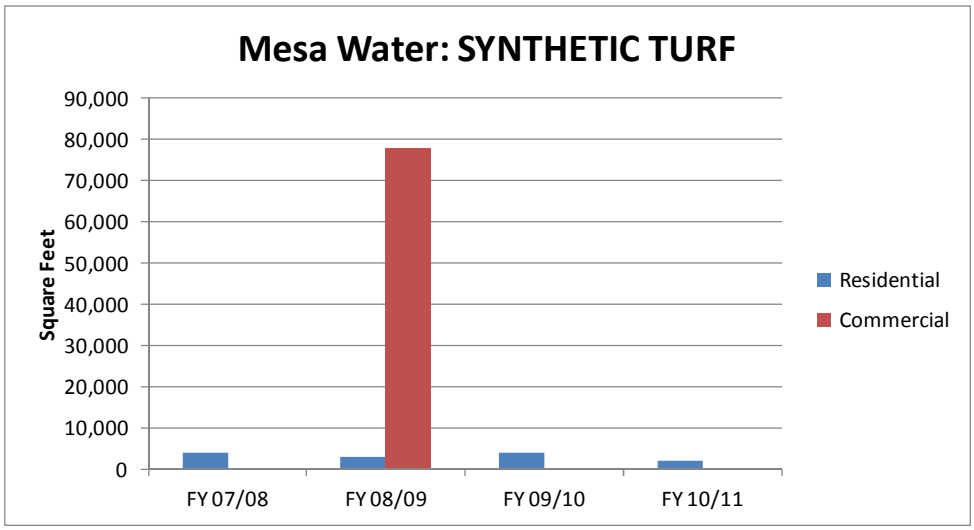
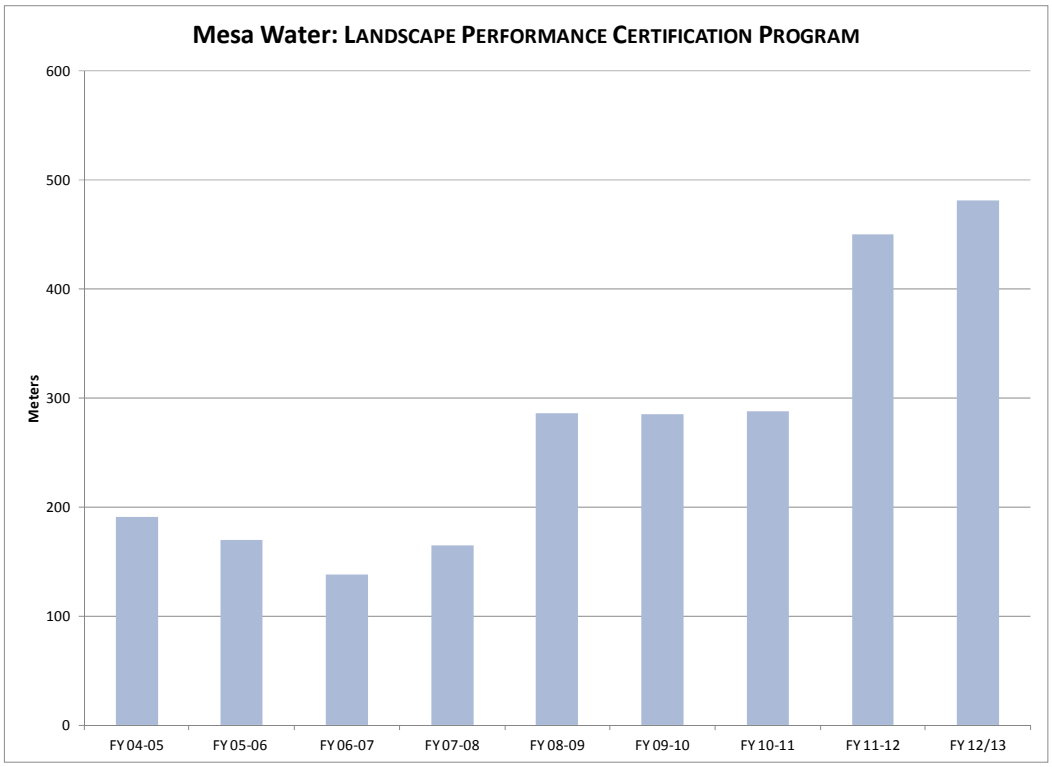


Figure 16 Landscape Performance Certification Program



Estimating Outdoor Water Use at Mesa Water

This section documents the estimation of outdoor water use across Mesa Water customer classes.

- The data set used contains values from 2006 to 2012 (7 years) and it was extracted from the billing system at the account level.
- The customer classes were aggregated such that all irrigation-only meters were lumped together in the category named Irrigation. What remains are the mixed meters and domestic only meters.
- Because billing is bimonthly, two-month averages were created--Dec-Jan, Feb-Mar, etc.—to pool customer readings in odd months with even months.

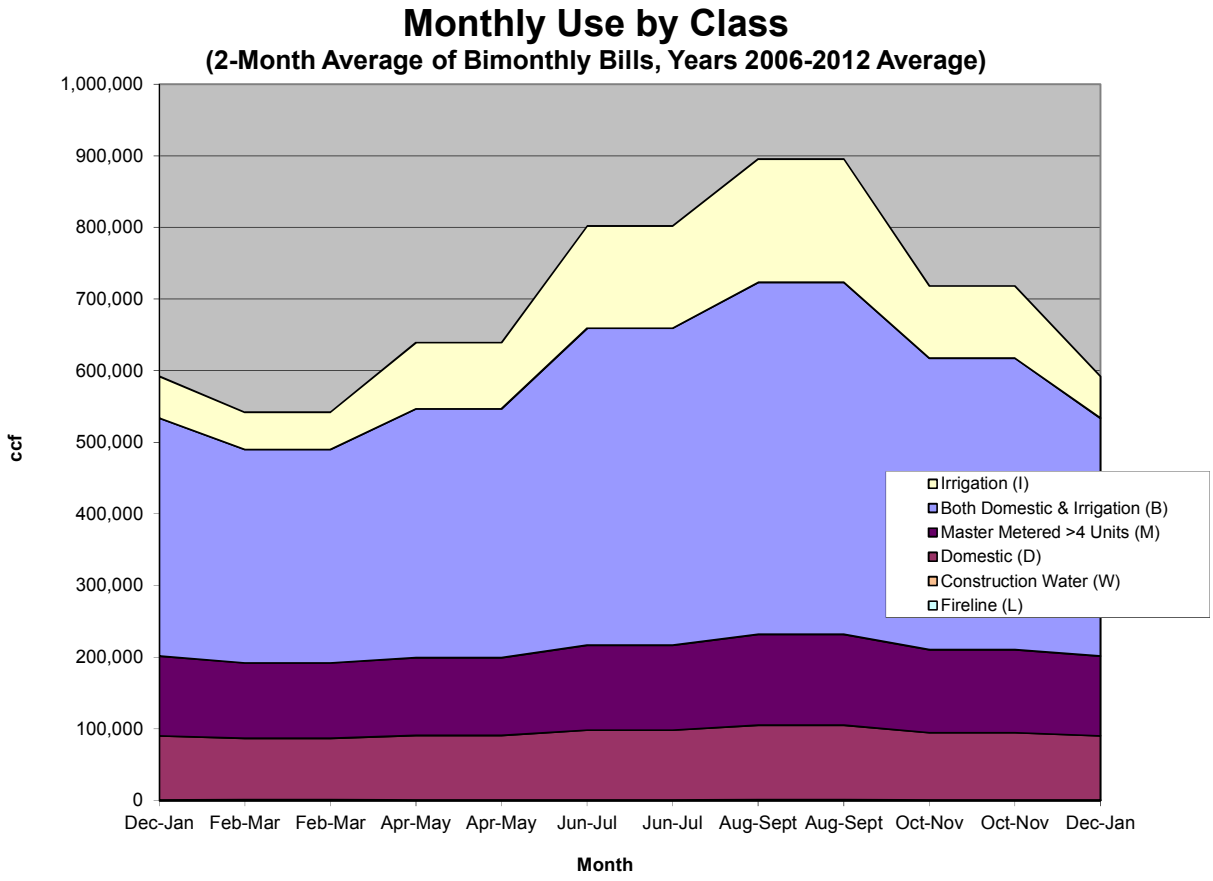
Table 21 reports the number of meter read consumption observations from the compiled billing system data from 2006 to 2012 for each customer class. Non-zero values in the table indicate which of the Mesa Water customer classes (rows) were assigned to the four analytic categories (columns). These data were used as the basis for inferring outdoor water use.

Table 22 Meter Read Consumption Observations

Customer Class	Both Domestic & Irrigation (B)	Domestic (D)	Irrigation (I)	Master Metered >4 Units (M)
Business, Retail-Both	21,435	0	0	0
Business, Retail-Domestic	0	34,355	0	0
Business, Retail-Irrig.	0	0	8,696	0
Commercial, misc-Both	15,116	0	0	0
Commercial, misc-Domestic	0	17,565	0	0
Commercial, misc-Irrig	0	0	4,267	0
Condo-Both	6,314	0	0	0
Condo-Domestic	0	117,650	0	0
Condo-Irrigation	0	0	12,464	0
Gov. Public Auth-Both	5,256	0	0	0
Gov. Public Auth-Domestic	0	2,732	0	0
Gov. Public Auth-Irrig.	0	0	8,717	0
Hotel-Both	1,420	0	0	0
Hotel-Domestic	0	1,307	0	0
Hotel-Irrigation	0	0	691	0
Indus-Both	8,829	0	0	0
Indus-Domestic	0	2,878	0	0
Indus-Irrigation	0	0	769	0
MF >4units-MasterMete	0	0	0	35,842
Office-Both	2,752	0	0	0
Office-Domestic	0	5,810	0	0
Office-Irrigation	0	0	2,450	0
Res2-4units-Both	85,266	0	0	0
Res2-4units-Domestic	0	6,823	0	0
Res2-4units-Irrigatio	0	0	1,960	0
SF-Both	585,162	0	0	0
SF-DomesticOnly	0	10,686	0	0
SF-IrrigationOnly	0	0	1,846	0
Trailer-Both	1,135	0	0	0
Total	732,685	199,806	41,860	35,842

The figure below graphs the compiled water use by month using the 2006 to 2012 account level billing data provided by Mesa Water. The strong seasonal pattern reflects irrigation needs during the characteristic dry summers. Irrigations needs are apparent in all sectors, but less so for Domestic (D) and Master-Metered (M) accounts.

Figure 17 Average Monthly Use by Customer Class Type



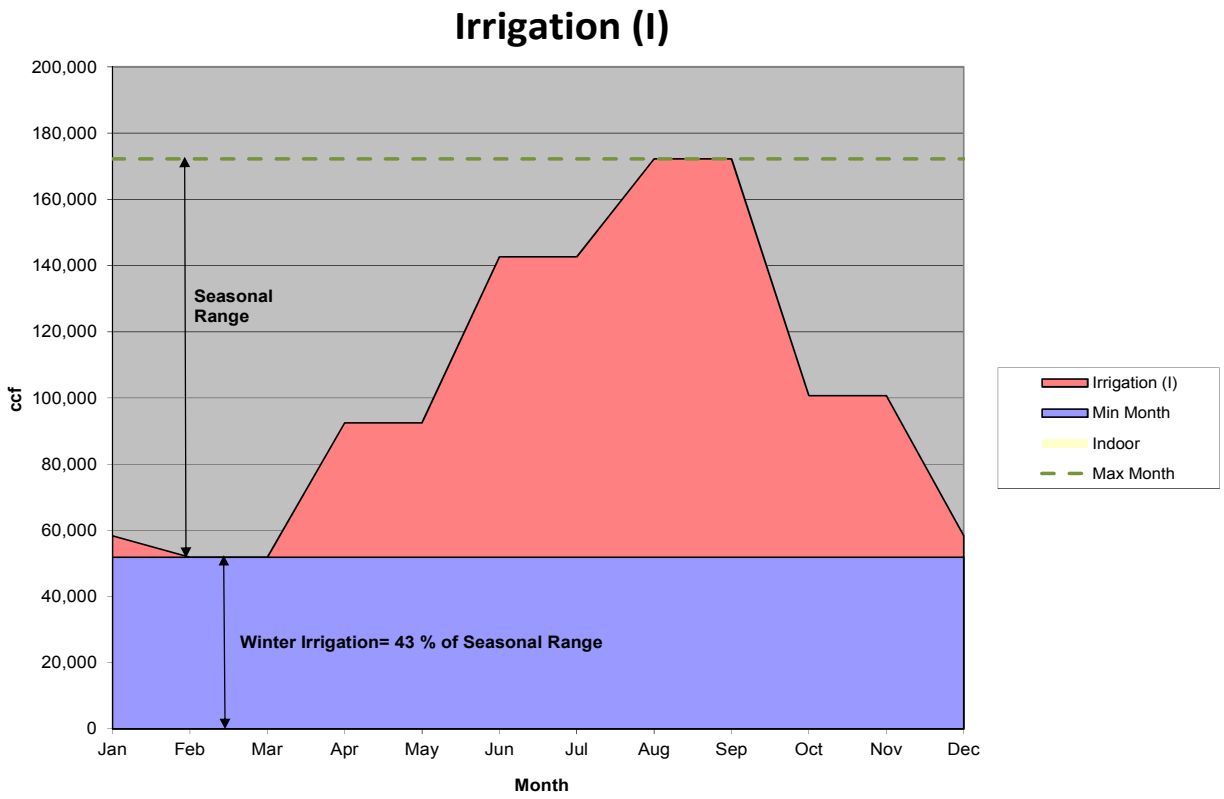
Water used for outdoor irrigation (landscaping) is not always directly metered (except in those cases where dedicated irrigation meters exist). For this reason, outdoor water use needs to be estimated.

A common method used to infer outdoor use is to assume that the minimum winter month of use is only indoor consumption. This "Minimum month" method will underestimate the volume of outdoor use when *any* customers irrigate in the minimum winter month. There is ample evidence of winter irrigation in Southern California. We use consumption data from Mesa Water to develop an empirical estimate of the level of winter irrigation as input toward estimating outdoor use for mixed use meters.

Specifically the pattern of seasonal variation used by dedicated irrigation meters is applied to other sectors with mixed meters. With dedicated irrigation meters, winter irrigation is

directly measured. Thus, we can measure relative water use in winter and summer irrigation seasons and apply this pattern to other sectors. The figure below depicts the reality that within the class of dedicated irrigation meters, the winter minimum is not zero. In fact, the winter minimum for dedicated irrigation-only customers is still 43 percent of the "seasonal range" (difference between peak month and minimum month). This method results in a higher estimate of outdoor water use than the "Minimum Month" method and it assumes that outdoor use patterns are common across sectors.

Figure 18 Average Monthly Use among Dedicated Irrigation-Only Customers



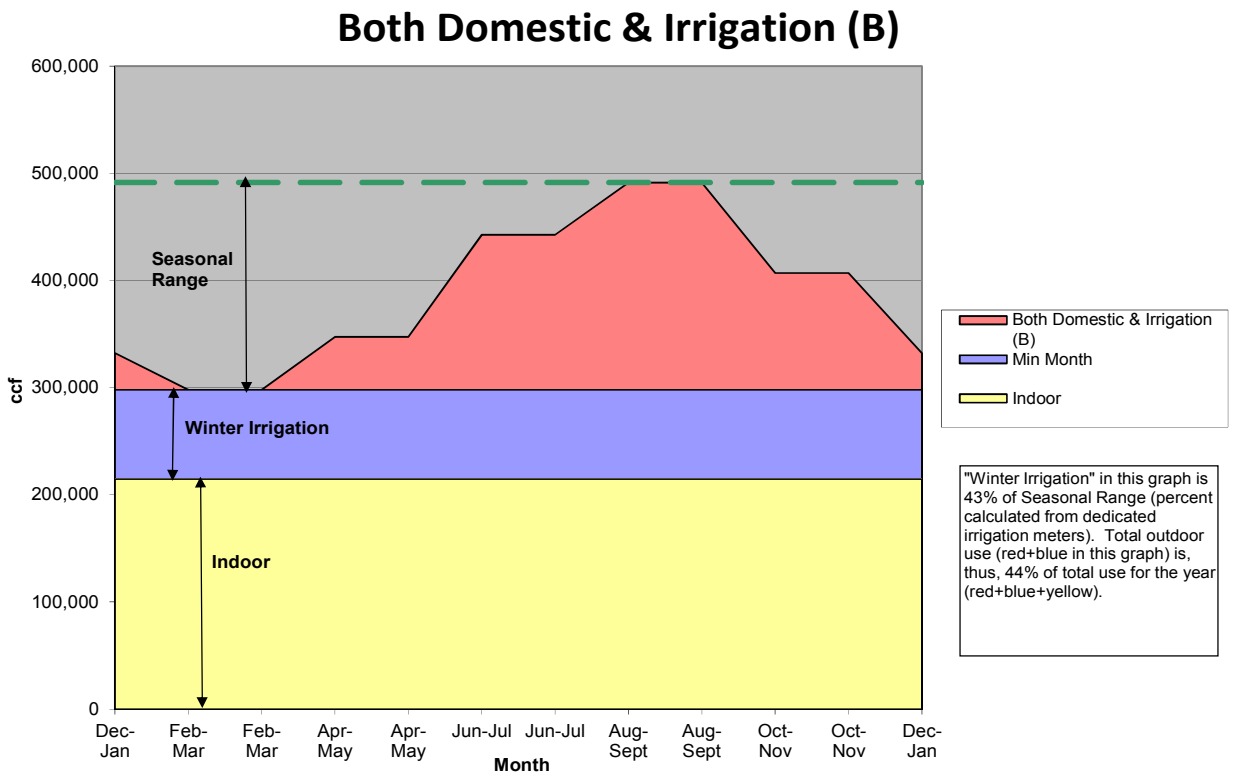


Figure 19 Single Family Customer Class B-Both Domestic and Irrigation-Estimation of Outdoor and Indoor Uses

This relationship of winter irrigation to the seasonal pattern of irrigation use then forms the basis for inferring winter use among all customers. The figure below illustrates this logic for Customer Class **B** whose use represents **B**oth domestic uses and irrigation uses. "Winter Irrigation" in Figure 14 is calculated by multiplying 43 percent (as calculated for irrigation only meters) times the seasonal range. Thus, the estimated total volume of outdoor use for Customer Class B (red+blue areas below) is 44 percent of total use for the year (red+blue+yellow areas).

Table 22 presents the estimated outdoor water use for all major customer class types of Mesa Water—approximately 44 percent of total water use at Mesa Water is estimated to be outdoor water use.

Caveats to this analysis include that the years of water history include some years of drought and some of economic recession. More broadly, the percent outdoor use calculations are sensitive to the years selected for the analysis. The more years included the more confidence in the stability of the results.

Table 23 Estimated Outdoor Water Use

Class	Average Annual Use, 2006-2012 (ccf/yr)	Estimated Indoor Use (ccf/yr)	Estimated Outdoor Use (ccf/yr)	Percent Outdoor Use
Both Domestic & Irrigation (B)	4,636,256	2,575,468	2,060,789	44%
Domestic (D)	1,121,876	936,649	185,227	17%
Irrigation (I)	1,236,595	0	1,236,595	100%
Master Metered >4 Units (M)	1,373,118	1,149,945	223,173	16%
Total	8,376,924	4,665,856	3,711,069	44%
		56%	44%	

Appendix B – Task 3 – Evaluate Future Water Use Efficiency (Conservation) Potential

Introduction

This memo covers the evaluation and identification of potential water savings for the various customer classes within Mesa Water:

- Single Family
- Multi Family
- Irrigation
- CII

This evaluation and identification of potential water savings also presents results from a recent water budget evaluation conducted at Mesa Water as well as other industry standard approaches for determining water conservation potential. We identify existing efficient plumbing device saturation for single and multi family accounts based on the age of housing stock, existing plumbing codes, and prior conservation activities.

Saturation of Efficient Toilets

The Orange County Saturation Study (2002) found the saturation of efficient toilets at 45.8 percent in Orange County in 2000 when the survey was conducted.

Table 24 Toilet Flush Volumes Estimated in the Orange County Saturation Study (2000)

Variable	Single-Family	Multi-Family	Full Sample
	Pre-1992	**Pre-1992**	**Pre-1992**
Toilet flush volume (gallons)			
1.60 or less	48.6%	37.6%	45.8%
3.50	35.4%	47.6%	38.5%
5.00	15.3%	13.9%	14.9%
7.00+	0.6%	1.0%	0.7%

Source: Table 10 of the Orange County Saturation Study (2002)

Comparing the Saturation Study measure efficient toilet saturation level in the 2000 to a very low level of efficient toilet saturation (assumed to be 2 percent) in 1992 the year of Energy Policy Act (EPAct 1992) allows an estimation of the annual rate of efficient toilet

replacement. Since the EPAct 1992 required ULF toilet standards (1.6 gpf) on all toilets available for sale, the annual toilet replacement rate for all toilets in existence in 1992 can be estimated and reasonably assumed to be ULF toilet replacement. Similarly, new post-1992 housing stock can be assumed to solely contain efficient ULF toilets.

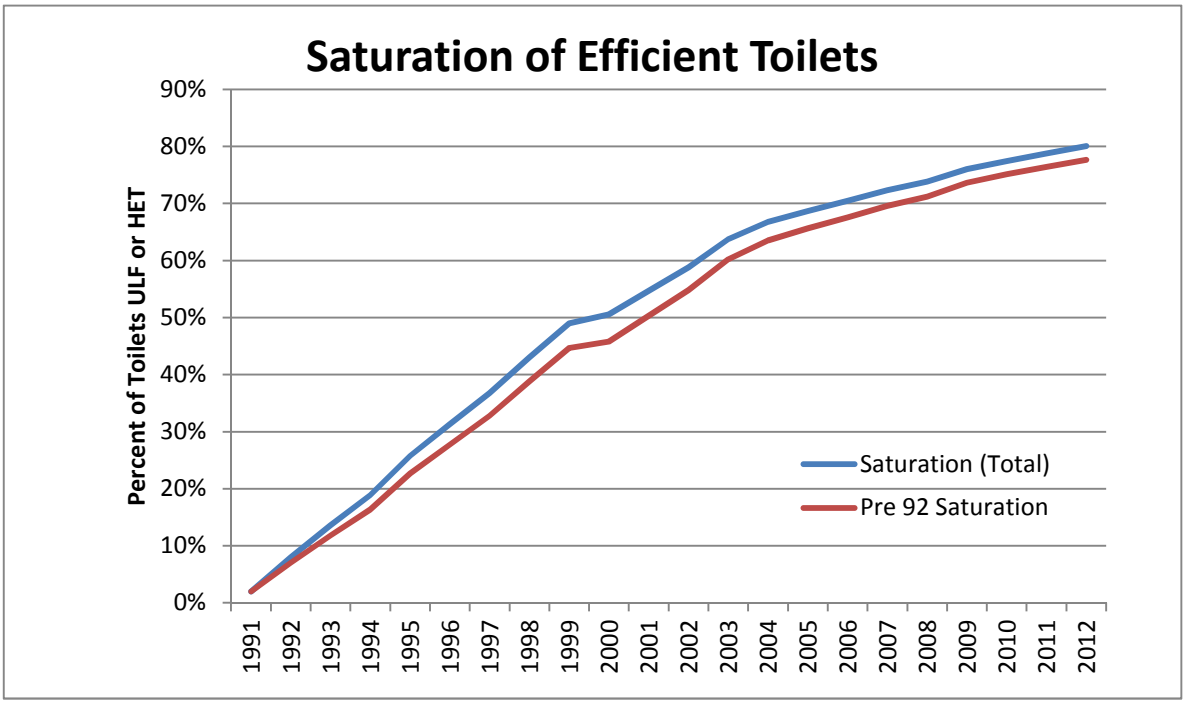
The total annual ULF toilet replacement rate inferred from this exercise can be further subdivided. The number of ULF toilets replaced through rebate or direct install (in active WUE programs in Orange County) is known for the years 1992 to 2000. Please note new housing stock only contains efficient ULF toilets and would not have qualified for these WUE programs.

Focusing on the pre-1992 housing stock that contained non-efficient toilets (those of 3.5 or higher gallons per flush) we can:

- Infer the annual rate of efficient toilet replacement between 1992 and 2000 that cannot be accounted for by known active WUE toilet replacement programs (total replacement minus those replaced by known active WUE programs). The resulting inferred annual rate of toilet replacement is 5.1 percent per year.
- The inferred rate of toilet replacement of 5.1 percent per year is used to define the input parameters for the AWE Water Conservation Tracking Tool to estimate passive conservation over time.

By applying the assumption that the 1992 to 2000 rate of “non-active” or “natural” replacement continues through the year 2012, and accounting for active conservation, the estimated saturation rate for efficient toilets (both ULF toilets and HE toilets) is 80 percent in 2012 as shown in Figure 20.

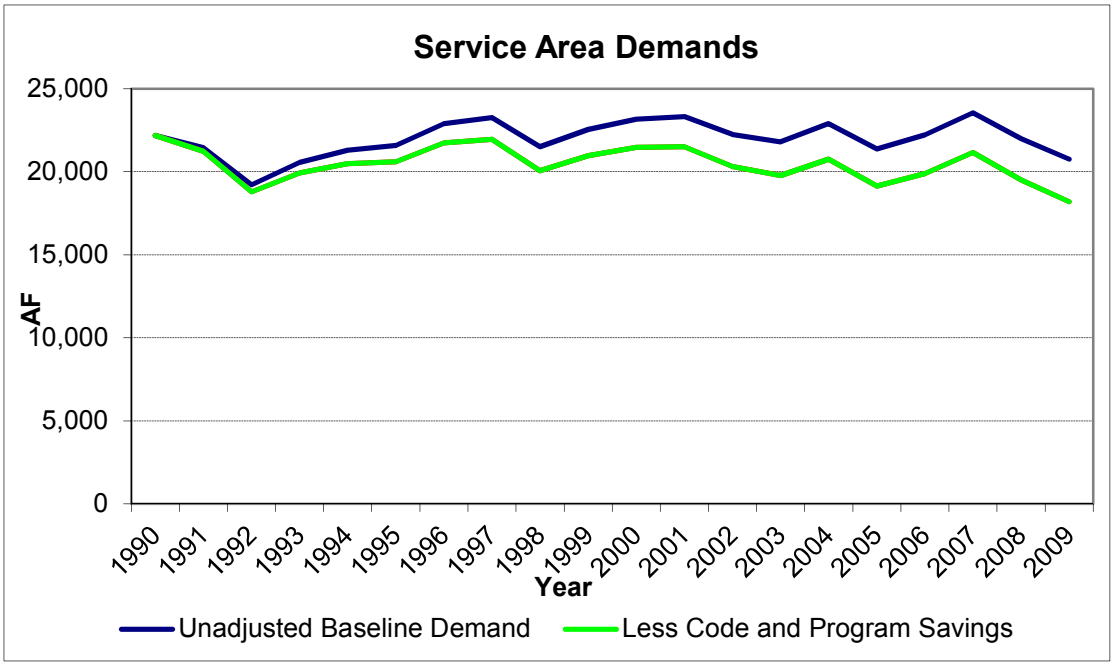
Figure 20 Saturation of Efficient Toilets (ULF and HE)



Passive Conservation

To calculate passive conservation we use the Alliance for Water Efficiency (AWE) Water Conservation Tracking Tool to calculate savings that result from plumbing code changes (Figure 21). The rate of natural replacement estimated, as described above, defines the input parameter required. Other relevant inputs to the Tracking Tool include the number of single and multi-family housing units before the 1992 standards and the number of bathrooms per housing unit.

Figure 21 Demand With and Without Passive Savings



Market Description

To assess market potential, we first describe water demand in total and by sector. Next, we summarize past achieved conservation in the sectors to illustrate what conservation is already "built in" to the current levels of demand. Then we describe remaining market potential.

Table 24 shows demand to be more than half residential with a sizable multifamily sector.

Table 25 Accounts and Use by Sector

	Number of Accounts by Water Use Sector	Water Demand by Water Use Sectors (AFY)
	2015	**2015**
Single Family	16,585	5,950
Multi-Family	3,480	5,580
Commercial	3,920	4,280
Industrial	302	470
Institutional/Gov	352	2,140
Landscape	45	1,280
Total Accounts	**24,683**	**19,700**

Source: MW 2010 UWMP, Customer Class Demand Forecast - Table2-3 &2-4_DP.xlsx

Table 25 shows there is considerable share of water use in

Table 26 Outdoor Use by Class

Class	Total	Indoor	Outdoor	Percent Outdoor	Percent Outdoor (Low Bound)
Both Domestic & Irrigation (B)	4,636,256	2,575,468	2,060,789	44%	23%
Domestic (D)	1,121,876	936,649	185,227	17%	8%
Irrigation (I)	1,236,595	0	1,236,595	100%	100%
Fireline (L)	1,003	544	459	46%	25%
Master Metered >4 Units (M)	1,373,118	1,149,945	223,173	16%	8%
Construction Water (W)	8,075	3,249	4,825	60%	30%
Total	8,376,924	4,665,856	3,711,069	44%	30%
		56%	44%		

Table 26 shows the detail of the residential and commercial sector.

Table 27 Number of Accounts by Class

Account Class Combined	Qty
Single Family	13,766
2, 3, or 4 Family Attached	2,134
Trailer Parks	23
Condo/Apt	2,800
MF >4 units	804
Offices	186
Business	1,353
Hotel	58
Commercial	774
Govt/Public	136
Industrial	274
Irrigation	975
TOTAL	23,283

Source: Mesa Water Account Breakdown 2012.xlsx

Table 27 shows the top 10 customers by consumption volume in fiscal year 2011-12.

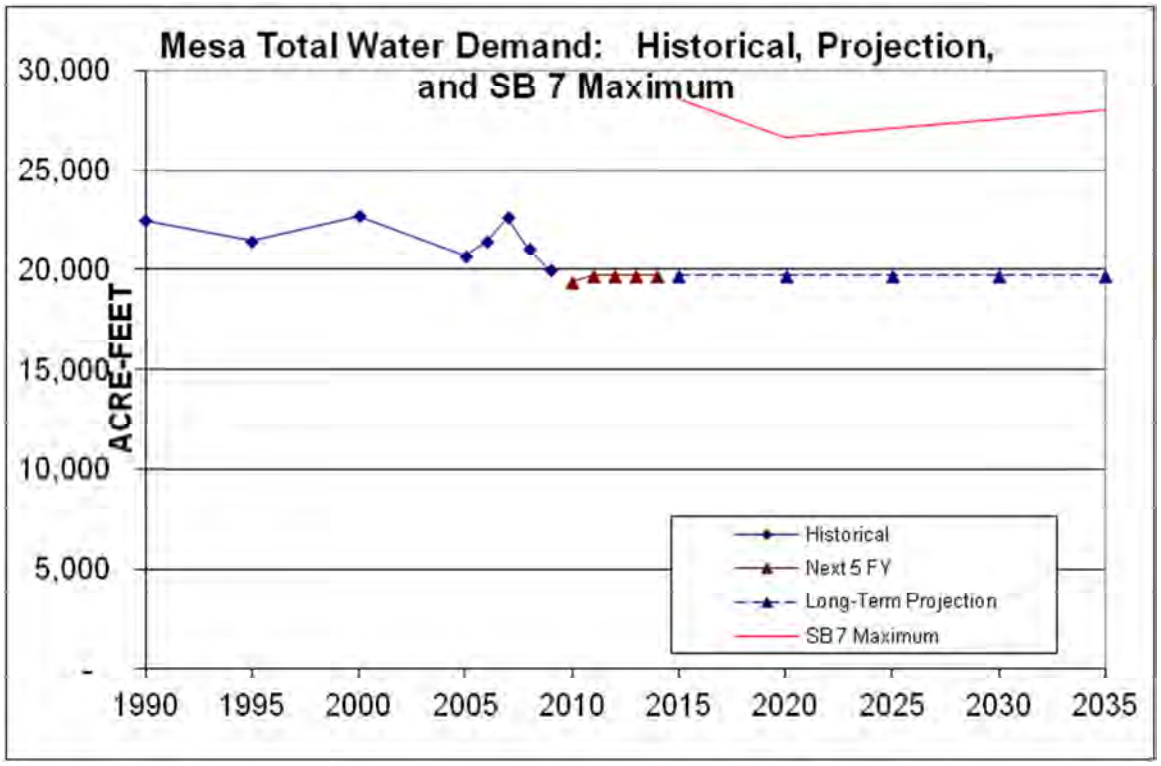
Table 28 Top 10 Water Users by Consumption Volume in Fiscal Year 2011-12

FY 2011/12	Consumption	Acre Feet	Total
City of Costa Mesa	181,982	418	2.3%
Mesa Verde (Costa Mesa Golf	173,852	399	2.2%
Newport-Mesa Unified School	162,413	373	2.1%
County of Orange	119,033	273	1.5%
Fairview Developmental	92,416	212	1.2%
The Irvine Company, LLC	88,936	204	1.1%
United Dominion Realty	86,747	199	1.1%
South Coast Plaza	79,883	183	1.0%
CalTrans	75,199	173	1.0%
Coast Community College	70,599	162	0.9%
Total		2596	14.5%

Source: MCWD CAFR 6-30-2012.pdf

Figure 22 graphs water demand forecasts that are expected to be relatively flat in the near future.

Figure 22 Historic and Projected Water Demand



Source: Water Demand Forecasts - AGNCPRJX 4 UWMP2010.xlsx

Figure 23 graphs per capita consumption (in gallons per capita per day, GPCD) which has declined. Investments in recycled water capacity can be subtracted from per capita potable water requirements. The effects of the recent recession are evident that the has

Figure 23 Per Capita Consumption in gallons per capita per day (GPCD)

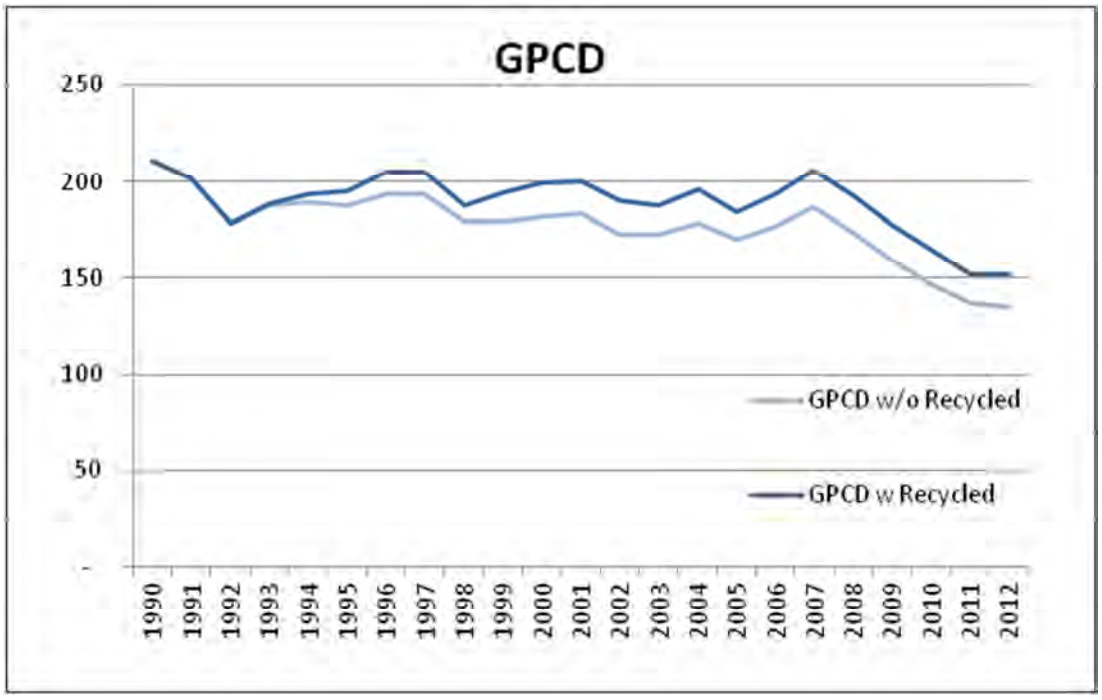
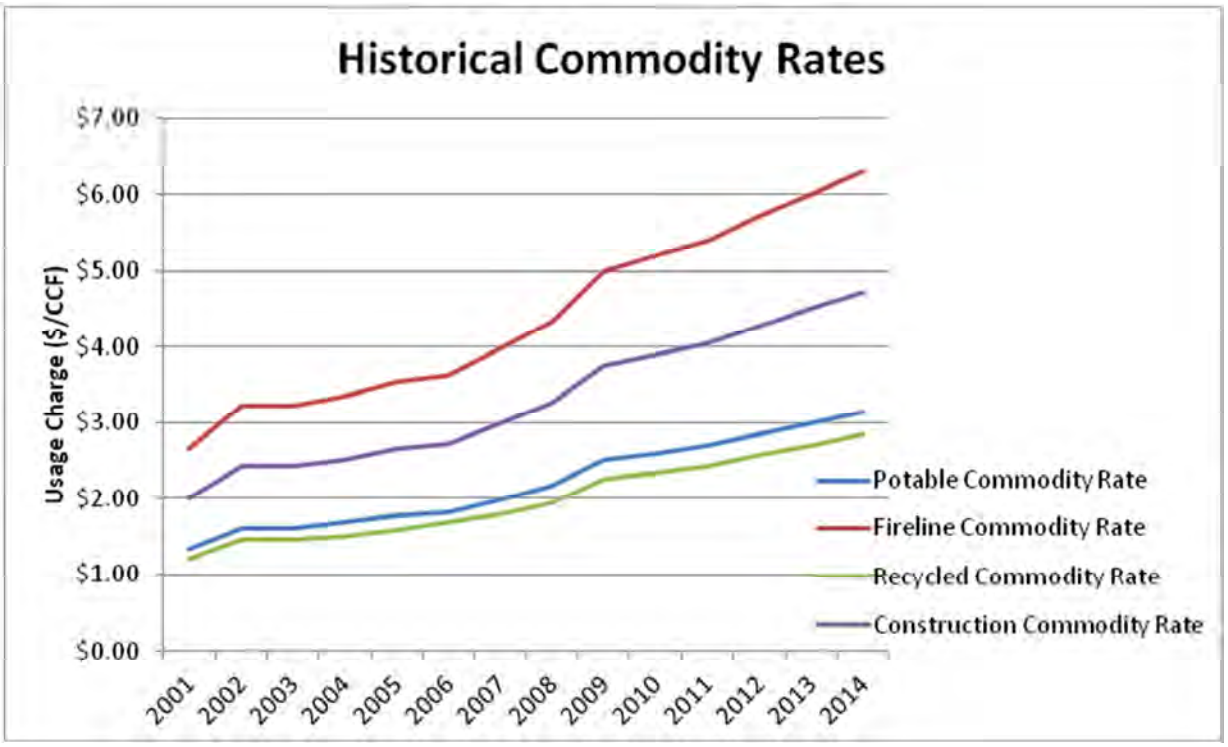


Figure 24 plots commodity water rates over time. This is an essential piece of the puzzle when understanding current market conditions because it clearly shows the increased price signal as reflected in the volumetric rate for water over time.

Figure 24 Historical Commodity Rates



Past Active WUE Accomplishments

Table 28 shows the past active WUE programs as documented with records from MWDSC rebates as well as in-house conservation activity.

Table 29 Past Achieved Conservation

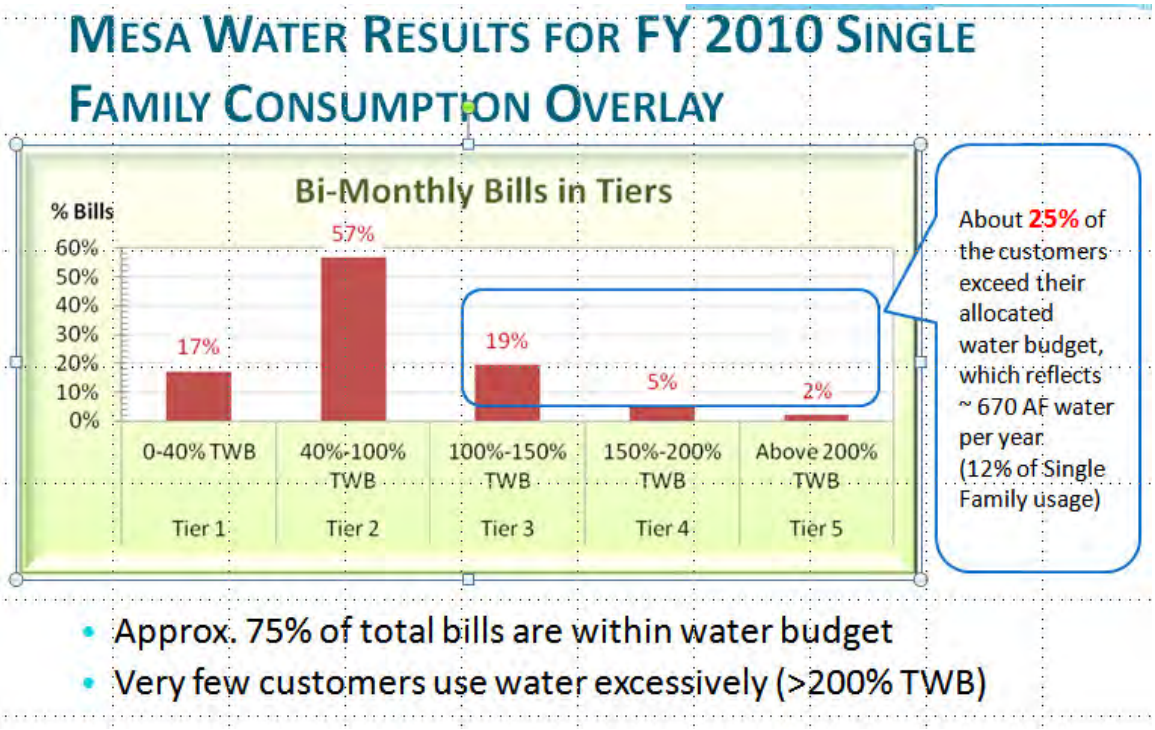
Sector	Program	Units	Lifetime Savings(AF)	AFY:Max	Lifetime Savings/ Unit (AF)
CII	CII High-Efficiency Toilet	1,340	1,139	57	0.85
CII	CII High-Efficiency Washers	345	371	37	1.08
CII	CII Zero Water Urinal	238	584	29	2.45
CII	CII Pre-Rinse Spray Head	165	126	25	0.77
CII	CII ULF Toilets - Tank Type	557	422	21	0.76
CII	CII Water Broom	24	74	4	3.07
CII	CII Cooling Tower Cond Meter	7	23	3	3.22
CII	CII High-Efficiency Urinal	36	44	2	1.23
CII	CII ULF Urinals	12	29	1	2.45
CII	CII Zero Water Urinal -Upgrade	2	1	0	0.61
CII	CII Rotating Nozzles	1,602	32	6	0.02
CII	CII WBIC by Station	33	4	0	0.13
Subtotal			2,850	187	

Landscape	Landscape Performance	2,454	1,641	322	0.67
Landscape	LAND Large Rotors - HE Nozzles	343	62	6	0.18
Subtotal			1,703	328	
Residential	RES Rotating Nozzles	1,142	23	4	0.02
Residential	RES Weather-Based Controller	94	39	4	0.41
Residential	RES Turf Removal	12,871	18	2	0.00
Residential	RES H-E Clothes Washer (WF 5)	807	354	25	0.44
Residential	RES H-E Clothes Washer (WF 6)	821	317	23	0.39
Residential	RES H-E Clothes Washer (WF 4)	436	200	14	0.46
Residential	RES Showerheads	3,289	101	11	0.03
Residential	RES Surveys, Single Family	543	35	3	0.07
Subtotal			1,088	87	
Total			5,641	565	

Single Family Water Use vs. Water Budget at Mesa Water

Results from the recent study that overlaid an estimated water budget on Mesa Water Single Family (SF) consumption provided one technical estimate of water use efficiency—with respect to a volume of water defined by a water budget. The reader should note that the technical definition of water efficiency by the components of a water budget is not without controversy. Figure 25 presents results from this study.

Figure 25 Mesa Water Budget Comparison for Single Family Customers (November 2012 Board presentation)



The 25 percent of SF customers at Mesa Water whose use exceeds the technical benchmark of a water budget control 47 percent of single family water use; were their water use brought within the water budget, water use in the single family sector would be 12 percent less. It should also be noted that Mesa Water's 25 percent of SF customers over water budget is less than that at several Southern California water agencies that have water budget based rate structures that attempt to bring customers within a defined water budget. Thus, though not perfect, Mesa Water's compliance with one technical definition of efficiency is better than nearby agencies.

Market Potential for Water Use Efficiency (WUE)

Note that the existence of WUE potential in different market segments does not equate to the existence of cost-effective WUE potential. It is important to add in the analysis of economics that define efficiency in WUE. By market segment, we note the following observations.

Residential

- Toilets. From the saturation analysis tables above, we see that there is about an 80 percent saturation of efficiency toilets at this point. Market potential in this sector is limited to programs targeted to find the remaining non-conserving toilets. Since Mesa Water has a sizable multi-family sector, as is evident in the table above, this constitutes a remaining sector of conservation potential. Note that the Table above does not delineate between the saturation of ULFTs and HETs; conversion from the former to the latter is another potential source of conservation. Direct install programs of targeted multi-family residence complexes with HET or better have demonstrated proven results in other parts of the state.
- Clothes Washers. Since there are approximately 16,000 single family accounts and 3,500 multifamily accounts, and since the existing installed stock of clothes washers is far from saturated, this is a significant potential source of market potential. Cost-effectiveness of programs will need to be addressed.
- Landscape (nozzles, controllers, turf removal). The Outdoor Use analysis shows that there is a considerable market share of outdoor water use in the residential sector. The design of WUE programs that target outdoor water use is critical for cost-effective implementation. The targeting of high water use customers is one way to increase the volume of water saved by WUE programs in the landscape sector.

Commercial, Industrial, and Institutional (CII)

- Toilets. Although the rate of natural replacement may not be the same for CII sector as for residential, we expect a high level of saturation for efficient toilets. Remaining potential is likely to exist in high volume sites, and by targeting old fixtures.

- Urinals. The market potential includes high volume sites in particular. Program options include replacement with HE urinals, zero-water urinals, or valve retrofits.
- Landscape (nozzles, controllers, turf removal). Commercial sector market potential includes decorative landscape, parkways, and lawns at office buildings, shopping centers, and institutional sites.
- Industrial. At industrial sites, which are a small part of Mesa Water demand, the indoor market potential varies by technology type.
- Large Landscape
- Market potential in the large landscape sector includes sites such as parks, residential common areas, and large commercial sites.

Appendix C – Task 4 – Mesa Water Compliance with Efficiency Regulations

This Appendix provides the results of our evaluation of the compliance status of Mesa Water District with the following three statewide water use efficiency regulations:

- AB 1881 – Updated Model Water Efficient Landscape Ordinance
- SBx7-7 - Water Conservation Bill of 2009
- AB 1420 – DMM/BMP Implementation Compliance

AB 1881

Regulatory Requirements: By January 1, 2010, local agencies must either (a) adopt the state's updated model water efficient landscape ordinance or (b) adopt a different ordinance that is at least as effective as the model ordinance in conserving water. If a local agency takes no action, the updated model ordinance will go into effect as if it were adopted and shall have the same force and effect as if adopted by the local agency. By January 31, 2010, local agencies must notify the California Department of Water Resources (DWR) which ordinance is in place, provide DWR a copy of the ordinance, and provide DWR "Evidence in Record" demonstrating that all requirements have been satisfied. By January 31, 2011, DWR must submit a report to legislature on the status of adopted ordinances by local agencies.

A local agency is defined in AB 1881 to be any city, county, or city and county, including a charter city or charter county. A water supplier that is not also a local agency, as defined in AB 1881, is not directly subject to AB 1881 requirements. Under the act, a local agency may designate another agency (such as a special district water supplier) to assume some or all of the responsibilities of enforcing a water efficient landscape ordinance. Any transfer of implementation responsibility must be agreed-to in advance by all involved parties.

Mesa Water District Compliance Status: Mesa Water District is not a local agency under the requirements of AB 1881. It provides water service within the jurisdictions of two local agencies subject to AB 1881 requirements: City of Costa Mesa and City of Newport Beach. Mesa Water District supports both local agencies in their implementation of AB 1881 by providing bimonthly water use budgets for all new landscape projects, as well as existing sites with dedicated irrigation meters.

Both local agencies have adopted landscape water use ordinances that are at least as effective as the state's updated model water efficient landscape ordinance, and have submitted the required documents and "Evidence in Record" to DWR. DWR's AB 1881

compliance status report to the state legislature reports that both City of Costa Mesa and City of Newport Beach are currently in compliance with AB 1881 requirements.[1]

SBx7-7

Regulatory Requirements: Senate Bill 7 (SBx7-7), which was signed into law in November 2009, amended the State Water Code to require a 20% reduction in urban per capita water use by 2020. Commonly known as the 20x2020 policy, the new requirements apply to every retail urban water supplier subject to the Urban Water Management Planning Act (UWMPA). SBx7-7 requires each urban retail water supplier to develop 2020 urban water use targets in accordance with specific requirements described below. Urban retail water suppliers will not be eligible for state water grants or loans unless they comply with SBx7-7's requirements. Starting in 2021, an urban retail water supplier's failure to meet its target will establish a violation of law for purposes of any state administrative or judicial proceeding.[2]

Under SBx7-7, an urban retail water supplier may adopt one of four different methods for determining the 2020 gpcd target:

1. Set the 2020 target to 80% of average GPCD for any continuous 10-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.[3]
2. Set the 2020 target as the sum of the following:
    a. 55 GPCD for indoor residential water use
    b. 90% of baseline CII water uses, where baseline CII GPCD equals the average for any contiguous 10-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.
    c. Estimated per capita landscape water use for landscape irrigated through residential and dedicated irrigation meters assuming water use efficiency equivalent to the standards of the Model Water Efficient Landscape Ordinance set forth in Section 2.7 of Division 2 of Title 23 of the California Code of Regulations.[4]

[1] http://www.water.ca.gov/wateruseefficiency/docs/Appendix.pdf

[2] Water Code Section 10608.8.(a)(2). For example, starting in 2021 the State Water Resources Control Board could cite non-compliance as evidence of waste and unreasonable use.

[3] If the supplier meets at least 10% of its retail demand with recycled water, it may extend the period for calculating average baseline GPCD by up to an additional five years.

[4] This method requires the use of satellite imagery, site visits, or other best available technology to develop an accurate estimate of landscaped areas served by residential and dedicated irrigation meters.

3. Set the 2020 target to 95% of the applicable state hydrologic region[5] target, as set forth in the state's 20x2020 Water Conservation Plan (California Department of Water Resources 2010).
4. Set the target using a method based on implementation of indoor residential BMPs plus specified reductions in outdoor residential and commercial and industrial water use.[6]

Additionally, if baseline GPCD is greater than 100 gallons, the 2020 GPCD target can be no greater than 95% of average GPCD calculated over a continuous 5-year period ending no earlier than December 31, 2007 and no later than December 31, 2010, irrespective of the target method adopted.

SBx7-7 allows water suppliers to form regional alliances and set regional targets for purposes of compliance. The regional target is calculated as the population-weighted average target for the water suppliers comprising the regional alliance. Importantly, being part of a regional alliance does not preclude a water supplier from complying with SBx7-7 by meeting its individual target. A water supplier that is part of a regional alliance will not comply with SBx7-7 only if the regional alliance fails to meet the regional target and the water supplier fails to meet its individual target. This provision of SBx7-7 effectively gives a water supplier that is part of a regional alliance two ways to comply.

Beginning with the 2010 UWMPs, SBX7-7 (CWC §10608 (e)) requires each urban retail water supplier to include the following in its UWMP.

- Baseline daily per capita water use — how much water is used within an urban water supplier's distribution system area on a per capita basis. It is determined using water use and population estimates from a defined range of years.
- Urban water use target — the target daily per capita water use in 2020, as determined by one of the four target determination methods.
- Interim urban water use target — the planned daily per capita water use in 2015, a value halfway between the baseline daily per capita water use and the urban water use target.

In 2015 and 2020, each water supplier will also determine compliance daily per capita water use to assess progress toward meeting interim and 2020 urban water use targets.

[5] California is divided into 10 hydrologic regions. A map of these regions can be viewed at: www.water.ca.gov/floodmgmt/hafoo/csc/.

[6] DWR has developed Provisional Target Method 4 in accordance with Water Code Section 10608.20(b)(4). The specific requirements for this method are described in DWR's 2010 UWMP guidelines (California Department of Water Resources 2011).

Mesa Water District Compliance Status: Mesa Water District selected target method 1 – simple 20% reduction from baseline GPCD. Mesa's baseline GPCD is 178.9 GPCD and its 2015 and 2020 targets are161.1 and 143.2 GPCD, respectively.

Mesa is also a member of the Orange County 20x2020 Regional Alliance formed by MWDOC. This regional alliance consists of 29 retail agencies in Orange County as described in MWDOC's 2010 RUWMP. The Regional Alliance Weighted 2015 target is 174 GPCD and 2020 target is 157 GPCD.

Mesa included the above information in its 2010 UWMP, per SBx7-7 requirements. At this point in time Mesa has satisfied all SBx7-7 requirements. The next compliance check is in 2015. Mesa will be in compliance in 2015 if either its district-level GPCD is less than or equal to 161.1 GPCD or the regional alliance's average GPCD is less than or equal to 174 GPCD. If neither of these conditions is met in 2015, Mesa can still achieve compliance if Mesa submits and DWR approves a compliance plan for bringing 2020 GPCD in line with its 2020 target.

AB 1420

Regulatory Requirements: AB 1420 requires DWR and other state agencies to condition water management grants and loans to urban water suppliers on implementation of the Demand Management Measures (DMMs), effective January 1, 2009. DMMs will be equated with the BMPs as described in the CUWCC MOU for loan and grant funding eligibility purposes.

To demonstrate compliance, a water supplier must submit a signed AB 1420 Self-Certification Statement Table 29. This statement documents which BMPs have been implemented and at what level. If some BMPs have not yet been implemented, the water supplier must also submit AB 1420 Self-Certification Statement Table 30. The water supplier uses Table 30 to document its budget, schedule, and implementation plan to come into compliance with BMPs it has not implemented.

A water supplier can also satisfy the BMP implementation requirements by selecting either the Flex Track or GPCD compliance options specified in the MOU. The water supplier must submit Tables 29 and 30 regardless of which MOU compliance option it has selected.

DWR uses its discretionary authority to determine whether an urban water supplier is eligible for a water management grant or loan. The eligibility determination will be based on information provided in Tables 29 and 30. DWR will inform the water supplier of its funding

eligibility determination within 60 days of receiving the water supplier's compliance information.

Supporting documents are subject to audit by DWR. DWR may also recommend that Tables 29 and 30 be included in the grant or loan funding agreement and a schedule for submittal of progress reports to the Funding Agency to ensure continued compliance.

By signing Tables 29 and 30, the authorized representative certifies under penalty of perjury that all information and claims regarding compliance, implementation of the BMPs, and financing plans are true and accurate. Falsification or inaccuracies in either table or in any supporting documents may, at the discretion of the Funding Agency, result in loss of all grant or loan funds to the applicant. Additionally, the Funding Agency may take legal action to recover any disbursed funds and refer the matter to the Attorney General's Office.

Mesa Water District Compliance Status: Mesa Water District has adopted the GPCD compliance option for the MOU. This option requires Mesa to implement the Foundational BMPs and to maintain GPCD within the limits specified in the MOU.

Foundational BMPs are grouped into two categories: (1) Utility Operations and (2) Education Programs. Within the Utility Operations category there are five BMPs that must be implemented. Within the Education category there are two BMPs that must be implemented. The Foundational BMPs are listed in Table 29. CUWCC's 2009-10 BMP reports (the most recent set of reports available), show that Mesa is "On Track" with all applicable Foundational BMPs listed in Table 29.

Table 30 Foundational BMPs Coverage Status

	Old BMP Number	BMP Name	2010 BMP Coverage Status
Utility Operations			
	BMP 12	Conservation Coordinator	On Track
	BMP 13	Water Waste Prohibition	On Track
	BMP 10	Wholesaler Assistance	Not Applicable
	BMP 3	System Water Audit/Leak Detection/Leak Repair	On Track
	BMP 4	Metering with Commodity Rates	On Track
	BMP 11	Conservation Pricing	On Track
Education Programs			
	BMP 7	Public Information	On Track
	BMP 8	School Education	On Track

Mesa's GPCD limits required for MOU compliance are shown in Table 30. The second to last column in Table 30 shows the highest acceptable GPCD in each BMP reporting cycle year for Mesa to be in compliance with the GPCD compliance option. The last column shows Mesa's actual GPCD. Mesa is currently within the highest acceptable GPCD and therefore "On Track" with the MOU's GPCD compliance schedule.

A completed draft of AB 1420 Self-Certification Table 29 is included as an attachment to this TM. Because Mesa is currently "On Track" for its Foundational BMPs and its GPCD, it is not required to complete AB 1420 Self-Certification Table 30.

Table 31 GPCD Limits for MOW Compliance

Year	BMP Report Cycle	MOU Target GPCD	Highest Acceptable GPCD	Actual GPCD
2010	1	171	178	145
2012	2	165	171	135
2014	3	159	165	TBD
2016	4	152	159	TBD
2018	5	146	146	TBD

Appendix D – Statistical Analysis of Mesa Water Demand: Empirical Estimates of Demand Trends and Demand Hardening

Introduction

For purposes of quantifying trends in Mesa Water Demand, one must estimate how water demand responds to predictable variations. There are numerous forces that drive demand growth in the long-term. These include changes in land use patterns, changes in household size, growth in personal income and employment, and price and conservation. Weather conditions tend to make water demand go up or down in a given year.

For use in the Water Use Efficiency master Plan and Benchmarking, the Mesa Water needs depiction of the predictable forces that cause demand to vary in the short-term to clarify remaining long-term trends. This memorandum describes an empirical model developed to predict daily demand fluctuations. By their nature, these models cannot replace long-term predictive models of water demand. However, by providing a better understanding of short-term demand variations, these models can clarify the direction of long term trends. The explanatory variables in this short-term model include:

- Deterministic functions of calendar time, including
    - The seasonal shape of demand
- Weather conditions
    - measures of evapotranspiration, contemporaneous and time of year
    - measures of rainfall, contemporaneous, time of year, and lagged
- Measures to control for long-term growth in demand
    - Trend
    - Employment growth different than trend

The model documented here is then used to create high resolution depictions of how variations in weather and the business cycle affect water demand over a wide range of conditions. These model-estimated weather and employment effects can then be used to (1) normalize observed demand and (2) serve as the basis for defining near term variability of demand and, importantly, any revenue dependent upon demand.

Data and Methods

Data

Customer water demand, due to meter reads conducted on a continuous basis, is not typically measured in discrete monthly increments. As a result, this modeling effort used consistent system-wide monthly data—that is monthly water production adjusted for

changes in storage. The reader is urged to keep in mind that though these models maybe described as “demand” models, the data on which the models are estimates would be better described as “supply” measures. To the extent that storage issues can be accounted for, the difference between these two constructs should be made small. Nonetheless, the issue remains.

The second major issue with using production data is the level and magnitude of noise in the data. The data generating mechanism for recording production can change over time as flow meters age or are replaced. Constructing a consistent time series requires matching two different and possibly, inconsistent time-series. The records of flow can also embed non-ignorable meter miss-measurement. To keep data inconsistencies from corrupting statistical estimates of model parameters, this modeling effort employed a sophisticated range of outlier-detection methods and models.

Specification

A Model of Per Capita Water Demand

The model for Mesa Water per capita water demand seeks to separate several important driving forces. In the short run, changes in weather can make demand increase or decrease in a given year. In the long run, population trends can drive demand higher. Strong regional economic growth can increase water demand through additional commercial or industrial water use. In addition, a rising economic tide can broadly increase personal income levels and economic activity can encourage or discourage additional population growth. Changes in water rates will change the relative attractiveness of water conservation.

These models are estimated at an aggregate level and, as such, should be interpreted as a condensation of many types of relationships — meteorological, physical, behavioral, managerial, legal, and chronological. Nonetheless, these models depict key short-run and long-run relationships and should serve as a solid point of departure for improved quantification of these linkages.

Systematic Effects

This section specifies a water demand function that has several unique features. First, it models seasonal and climatic effects as continuous (as opposed to discrete monthly, semi-annual, or annual) function of time. Thus, the seasonal component in the water demand model can be specified on a continuous basis, then aggregated to a level comparable to measured water use (e.g. monthly). Second, the climatic component is specified in difference form as a similar continuous function of time. The climate measures are thereby

made independent of the seasonal component. Third, the model permits interactions of the seasonal component and the climatic component. Thus, the season-specific response of water use can be specific to the season of the year.

The general form of the model is:

Equation 1

$$PerCapitaWaterUse_t[GPCD] = \frac{Use_t}{Pop_t} = f(S_t + C_t + T_t)$$

Where ***Use*** is the volumetric quantity of retail water use within time *t*, S_t is a seasonal component, C_t is a climatic component, and T_t is the trend component of GPCD Demand. The function *f* is the functional form of the connection between per capita water use and its explanatory components. Each of these components is described below.

Seasonal Component: A monthly seasonal component could be formed using monthly dummy variables to represent a seasonal step function. Equivalently, one may form a combination of sine and cosine terms in a Fourier series to define the seasonal component as a continuous function of time.[1] The following harmonics are defined for a given day *T*, ignoring the slight complication of leap years:

Equation 2

$$S_t \equiv \sum_{1}^{6}\left[\beta_{i,j}\cdot\sin\left(\frac{2\pi\cdot jT}{365}\right)+\beta_{i,j}\cdot\cos\left(\frac{2\pi\cdot jT}{365}\right)\right] = Z\cdot\beta_S$$

Where *T* = (1,...365) and *j* represents the frequency of each harmonic. Because the lower frequencies tend to explain most of the seasonal fluctuation, the higher frequencies can often be omitted with little predictive loss.

The percentage effect of the seasonal component on normal demand is given by:

[1] The use of a harmonic representation for a seasonal component in a regression context dates back to *Hannan* [1960]. *Jorgenson* [1964] extended these results to include least squares estimation of both trend and seasonal components.

Equation 3

$$S_t\% = \left[\frac{\exp(\widehat{Y}_t - T_t) - \exp(\widehat{Y}_t - T_t - S_t)}{\exp(\widehat{Y}_t - T_t - S_t)} \right]$$

Where $\widehat{Y}$ is the predicted demand.

Climatic Component: The model incorporates two types of climate measures into the climatic component–evapotranspiration and rainfall.[3] The measures of evapotranspiration and rainfall are then logarithmically transformed to yield:

Portland Equation 4

$$R_t \equiv \ln\left[1 + \sum_{t=T}^{T_d} Rain_t\right], E_t \equiv \ln\left[\sum_{t=T}^{T_d} \frac{ETo_t}{d}\right]$$

Though this model extends to monthly measures while for daily measures, *d* takes on the value of one. Because weather exhibits strong seasonal patterns, climatic measures are strongly correlated with the seasonal measures. In addition, the occurrence of rainfall can reduce expected evapotranspiration. To obtain valid estimates of a constant seasonal effect, the seasonal component is removed from the climatic measures by construction.

Specifically, climatic measures are constructed as a departure from their "normal" or expected value at a given time of the year. The expected value for rainfall during the year, for example, is derived from regression against the seasonal harmonics. The expected value of the climatic measures ($\hat{\boldsymbol{E}}=\boldsymbol{Z}\cdot\beta_E$) is subtracted from the original climatic measures:

Equation 5

$$C_t \equiv (R_t - \widehat{R}_t)\cdot\beta_R + (E_t - \widehat{E}_t)\cdot\beta_E$$

The climatic measures in this deviation-from-mean form are thereby separated from the constant seasonal effect.[4] Thus, the seasonal component of the model captures all constant

[3] Specifically it uses the daily evapotranspiration and the total daily precipitation at the CIMIS Station No. 75 in Orange County summarized to a monthly level.

[4] The logarithmic transformation of the original climate variable implies that the seasonal mean climate effect is a geometric mean. Because the model is estimated

seasonal effects, as it should, even if these constant effects are due to normal climatic conditions. The remaining climate measures capture the effect of climate departing from its normal pattern.

The model can also specify a richer texture in the temporal effect of climate than the usual fixed contemporaneous effect. Seasonally varying climatic effects can be created by interacting the climatic measures with the harmonic terms. In addition, the measures can be constructed to detect lagged effects of climate, such as the effect of rainfall a month ago on today's water demand.

The percentage effect of the climate on normal demand is given by:

Equation 5

$$C_t\% = \left[\frac{\exp(\hat{Y}_t - T_t) - \exp(\hat{Y}_t - T_t - C_t)}{\exp(\hat{Y}_t - T_t - C_t)} \right]$$

Where $\hat{Y}$ is the predicted demand.

Trend Component: For the Mesa Water Demand model, a deterministic annual trend term was used as the primary determinant of trends in per capita water demand in the long term. Specifically, the trend component for Mesa Water Retail Use was allowed to take on a different slope coefficient before and after 2000:

Equation 6

$$\mathbf{T}_t \equiv AnnualTrend_t \cdot \beta_T + (\text{ln Employment-Trend\_lnEmployment}) \cdot \beta_E$$

Thus the annual trend in Mesa Water Demand from 1992-2011 on is captured by β_T while the effect of employment different than trend (a proxy for the business cycle) is captured by β_E.

---

on the logarithmic scale the departure-from-mean climatic effects would be more accurately termed departure-from-median. See *Goldberger* [1968].

Stochastic Effects

To complete the model, we must account for the fact that not every data point will lie on the plane defined by Equation **(1)**. This fundamental characteristic of all systematic models can impose large inferential costs if ignored. Misspecification of this "error component" can lead to inefficient estimation of the coefficients defining the systematic forces, incorrect estimates of coefficient standard errors, and an invalid basis for inference about forecast uncertainty. The specification of the error component involves defining what departures from pure randomness are allowed. What is the functional form of model error? Just as the model of systematic forces can be thought of as an estimate of a function for the "mean" or expected value, so too can a model be developed to explain departures from the mean—i.e., a "variance function" If the vertical distance from any observation to the plane defined by **(1)** is the quantity ***ε***, then the error component is added to Equation **(1)**:

Equation 7

$$\ln \frac{Use}{Pop} = \mathbf{f}(\mathbf{S}_t, \mathbf{C}_t, \mathbf{T}_t) + \varepsilon$$

In an Ordinary Least Squares (OLS) Regression, the error term is assumed to be distributed normally with a constant variance.

$$\varepsilon \sim N(\mu_\varepsilon, \sigma_\varepsilon)$$

In the estimated retail demand model below, the variance is allowed to be nonconstant and separately modeled as an empirical variance (or link) function.

$$\sigma_\varepsilon = g(\mathbf{S}_t, \mathbf{C}_t, \mathbf{T}_t)$$

A variance function was estimated using the methods of Carroll and Ruppert as a two stage weighted least squares regression[7]. Briefly described, the first stage uses an OLS regression of the mean function (Equation 7) to derive a consistent estimate of the estimated error. The absolute value of the estimated error is used to estimate the variance function. The inverse of the predicted variance is used to weight the regression of the mean function in the second stage.

[7] See Carroll, R. J. and Ruppert, D. (1988). *Transformation and Weighting in Regression*. Chapman and Hall, London.

Estimated Per Capita Demand Model for Mesa Water

Table 31 presents the estimation results for the model of mean retail monthly production in Mesa Water. The independent variables 1 to 8—made up of the sines and cosines of the Fourier series described in Equation 2—are used to depict the seasonal shape of daily retail water demand (that is, $Z \cdot \widehat{\beta}_S$); this is the shape of demand in a normal weather year. This seasonal shape is important in that it represents the point of departure for the estimated climate effects (expressed as departure from what is expected in an average month).

The estimated weather effect is specified in "departure-from-normal" form. Variable 9 is the departure of monthly precipitation from the average precipitation for that month in the season. (Average seasonal precipitation is derived from a regression of monthly precipitation on the seasonal harmonics—exactly equal to monthly precipitation averaged over all years in the record.) Lagged precipitation deviations are also included in the model (Variable 10). Evapotranspiration is treated in an analogous fashion (Variables 13). The contemporaneous weather effect is interacted with the harmonics (Variables 11-12 and 14) to produce a seasonal shape to both the rainfall and the temperature elasticities. Thus, departures of temperature from normal produce the largest percentage effect in the spring. Similarly, departures from normal rainfall produce a larger effect upon daily demand in the summer than in the winter. The lagged effect of temperature can also be detected further in time than rainfall—a detectable effect one month long.

The trend term (variable 15) and departure of employment growth from trend (16) comprise the long term determinants of demand.[8] The constant term (17) describes the intercept for this equation.

Table 32: Estimated Mesa Water Per Capita Demand Model (Mean Function)

Estimated Mesa Water Demand Model (Mean Function) Ln Mesa Water Per Capita Use GPCD (Gl. Per Capita Per Day)		
Independent Variable	**Coefficient**	**Std. Error**
1. First Sine harmonic, 12 month (annual) frequency	-0.09482	0.00410
2. First Cosine harmonic, 12 month (annual) frequency	-0.21820	0.00411
3. Second Sine harmonic, 6 month (biannual) frequency	0.00293	0.00409
4. Second Cosine harmonic, 6 month (biannual) frequency	-0.00770	0.00409

[8] A variation of the model was used to test for a detectable trend in the seasonal shape of demand by including an interaction of the trend term and the annual harmonic

5. Third Sine harmonic, 4/12 frequency	0.00253	0.00410
6. Third Cosine, 4/12 frequency	0.01164	0.00409
7. Fourth Sine harmonic, 3 month (quarterly) frequency	0.00384	0.00407
8. Fourth Cosine, 3 month (quarterly) frequency	-0.00104	0.00410
9. Contemporaneous Rainfall Deviation [(ln (Rain+1)) – Monthly mean]	-0.05373	0.01118
10. One month lag of rain deviation	-0.03679	0.00671
11. Interaction of contemporaneous rain with annual sine harmonic	-0.00769	0.01138
12. Interaction of contemporaneous rain with annual cosine harmonic	0.00772	0.01397
13. Contemporaneous deviation from mean ln (ETo) in the month	0.19824	0.02396
14. Interaction of contemporaneous ETo deviation with annual sine harmonic	0.06280	0.03666
15. Overall Annual Trend 1992-2012	-0.01071	0.00051
16. Deviation of ln(Employment in City of Costa Mesa) from Trend	0.72327	0.07669
17. Intercept	5.17624	0.00309
Obs	250	
R^2	0.9464	
Root Mean Squared Error	0.04562	
Time period	1992-2012	

Figure s 26 and 27 plot Actual Mesa Water Per Capita Use against the model predictions ($\hat{Y}$) and reveals a very tight fit of predictions to actual.

Figure 26 Mesa Water Per Capita Use (GPCD): Actual vs. Model Prediction , 1992-10/2012

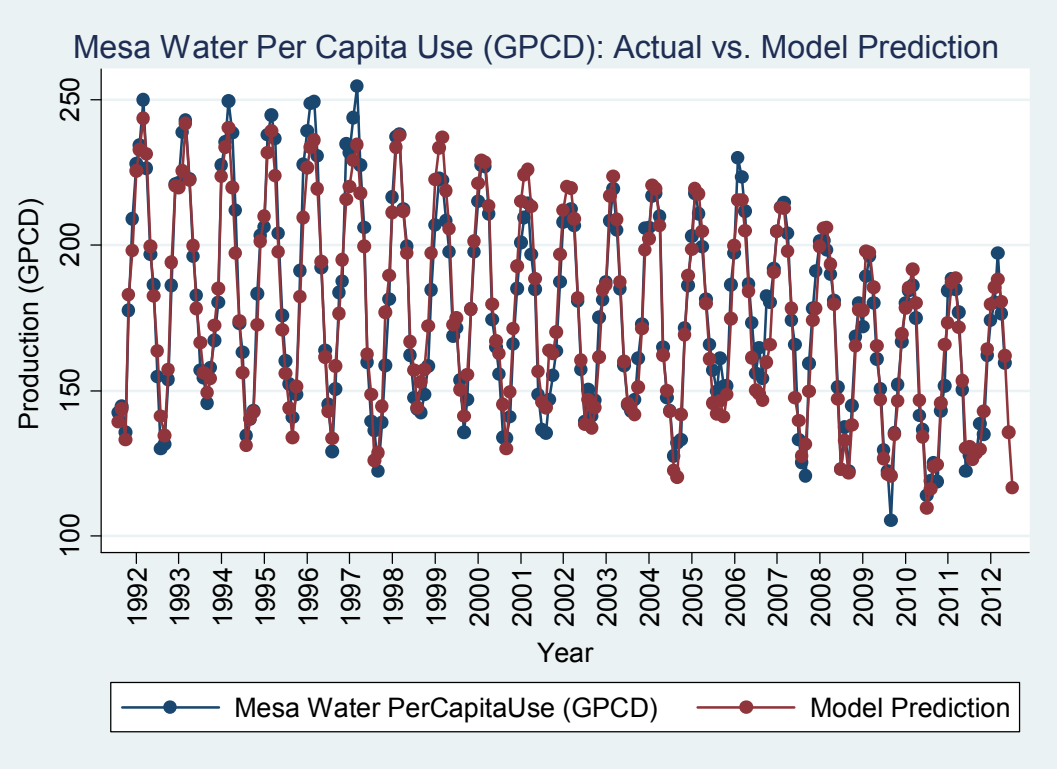
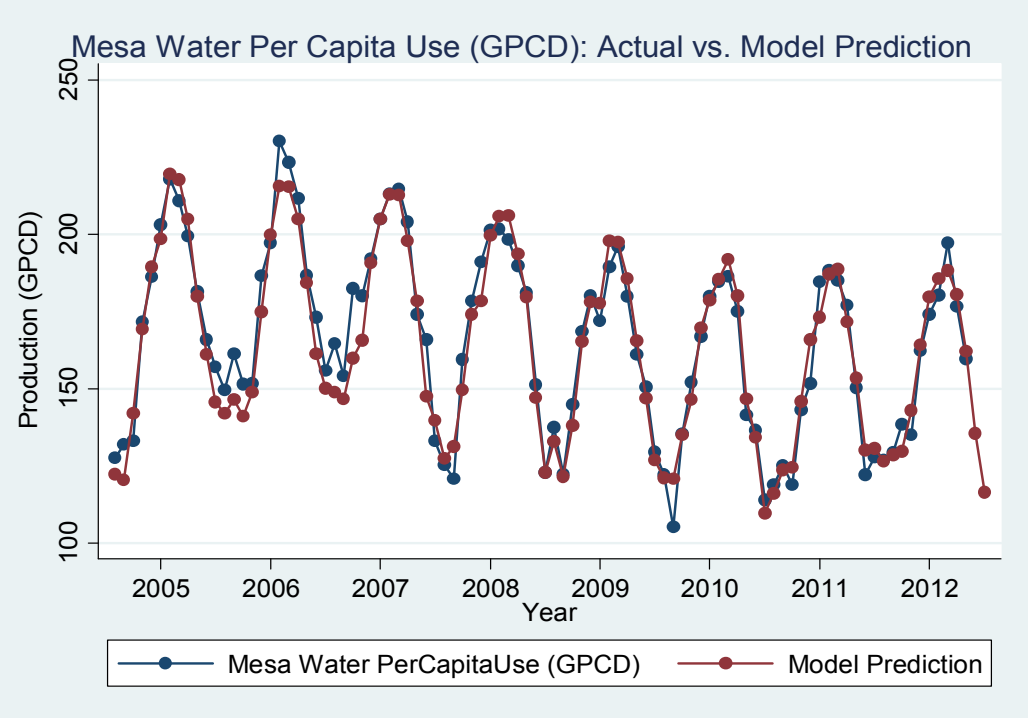


Figure** 27 **Mesa Water Per Capita Use (GPCD): Actual vs. Model Prediction , 2005-10/2012



Application to Demand Trends and Demand Hardening

From the statistically estimated model documented above, one can calculate the effect of weather on per capita water demand as the difference between two predictions: a prediction of demand conditional on actual weather and a prediction of demand "as if" weather were normal. Equation 5 specifies this relationship in percentage terms. Table 32 presents the summation of the estimated effect of weather for each year.

Table 33 Effect of Weather on Mesa Water Per Capita Demand (GPCD)

Effect of Weather on Mesa Water Per Capita Demand (GPCD)				
	Mesa Water			
Year	**Effect of Weather on Water Demand (Change in GPCD)**	**Effect of Weather on Water Demand (Percent)**	**Precipitation (inches)**	**Max Temperature (F)**
1992	-6.318	-3.3%	24.42	74.54
1993	0.199	0.1%	14.77	73.24
1994	-0.883	-0.5%	7.5	73.15
1995	-2.008	-1.1%	14.41	73.82
1996	0.777	0.4%	17.69	73.63
1997	4.568	2.4%	15.48	74.48
1998	-4.770	-2.6%	23.89	71.56
1999	4.605	2.4%	4.41	72.06
2000	1.869	1.0%	8.34	73.12
2001	-2.678	-1.5%	12.85	71.51
2002	2.257	1.2%	5.75	72.25
2003	-2.961	-1.7%	11.8	73.34
2004	-1.139	-0.6%	17.15	72.95
2005	-2.946	-1.7%	20.08	72.85
2006	0.135	0.1%	8.79	73.73
2007	5.356	3.1%	4.12	73.54
2008	2.088	1.2%	10.75	74.21
2009	5.088	3.2%	5	77.18
2010	-1.027	-0.7%	19.59	72.28
2011	-0.620	-0.4%	9.28	72.58
2012	2.445	1.6%	7.39	73.97
Long Term Avg	1992-2012		12.55	73.3
Weather Station	CIMIS Irvine Station 75			

Finally, these estimated effects of non-normal weather and employment different from trend are next used to estimate what per capita water demand would have been if weather had been normal and if employment had not differed from its historical trend (that is, if the recession had not occurred.) Actual demand with weather and employment effects removed will be referred to as “normalized” per capita water demand.

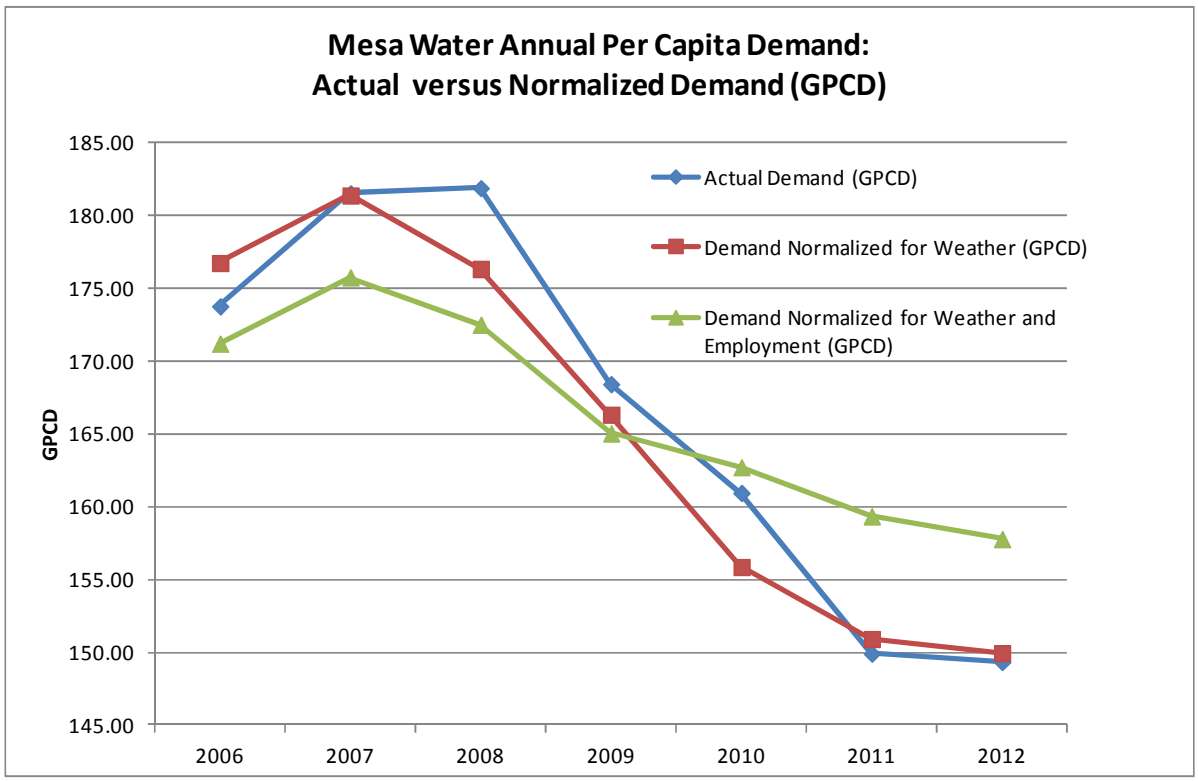
Table 33 presents the derivation of normalized Mesa Water per capita water demand. The first column of raw demand data (“Actual Demand”) is processed using robust statistical methods to screen for measurement and data quality issues. Next, Demand is normalized for weather. The estimated percentage effect of weather different from normal (“Effect of Weather on Water Demand (Percent)”) explains how weather affected actual demand and is used to estimate the third column of retail demand (“Demand Normalized for Weather (GPCD)”). A similar estimate for the effect of employment different than trend is used to estimate the last column of retail demand (“Demand Normalized for Weather and Employment”).

Note that the variation of the percentage annual effect of weather and employment is summarized at the bottom of the table and is useful for risk analysis--Weather could knock per capita demand 3.4 percent either way in any year. The effect of the business cycle—as captured by the effect of employment swings-can be more pronounced, depending where you are in the cycle. The effect on the trend in per capita demand is easier to discern in Figure 28, that plots actual and normalized demand. The near four percent decline (3.8 percent) between 2006 and 2011 in actual per capita demand is reduced in magnitude to a 2 percent decline after normalizing for weather and employment.

Table 34 Mesa Water Per Capita Use (GPCD): Actual and Normalized

	Mesa Water Per Capita Use (GPCD): Actual and Normalized				
Year	Actual Demand (GPCD)	Effect of Weather on Water Demand (Percent)	Demand Normalized for Weather (GPCD)	Effect of Employment on Water Demand (Percent)	Demand Normalized for Weather and Employment (GPCD)
1992	190.53	-3.3%	196.9	0.3%	196.25
1993	190.32	0.1%	190.1	-0.9%	191.81
1994	192.04	-0.5%	192.9	-1.0%	194.87
1995	189.16	-1.1%	191.2	-1.3%	193.68
1996	194.15	0.4%	193.3	-0.9%	195.07
1997	195.73	2.4%	191.0	0.6%	189.88
1998	179.27	-2.6%	184.0	1.8%	180.64
1999	181.36	2.4%	177.0	2.6%	172.33
2000	182.27	1.0%	180.4	2.4%	176.07
2001	170.92	-1.5%	173.5	2.8%	168.63
2002	175.08	1.2%	172.9	2.1%	169.25
2003	175.29	-1.7%	178.2	2.6%	173.69
2004	178.03	-0.6%	179.2	2.9%	173.91
2005	173.77	-1.7%	176.7	3.1%	171.20
2006	181.53	0.1%	181.4	3.1%	175.76
2007	181.89	3.1%	176.3	2.2%	172.51
2008	168.43	1.2%	166.3	0.8%	165.04
2009	160.95	3.2%	155.9	-4.4%	162.72
2010	149.91	-0.7%	150.9	-5.6%	159.35
2011	149.34	-0.4%	150.0	-5.2%	157.78
2012	157.92	1.6%	155.4	-4.6%	162.50
	Standard Deviation of % Effects	**+/- 1.72%**		**+/- 3.07%**	
	95% Confidence Interval	**+/- 3.4%**		**+/- 6.0%**	
Percentage Annual Trend, 1992-2005	-0.7%		-0.8%		-1.0%
Percentage Annual Trend, 2006-2011	-3.8%		-3.7%		-2.1%

Figure 28 Mesa Water Annual Per Capita Demand: Actual versus Normalized Demand (GPCD)


Mesa Water Annual Per Capita Demand:
Actual versus Normalized Demand (GPCD)
185.00
180.00
175.00
170.00
165.00
160.00
155.00
150.00
145.00
GPCD
2006
2007
2008
2009
2010
2011
2012
Actual Demand (GPCD)
Demand Normalized for Weather (GPCD)
Demand Normalized for Weather and Employment (GPCD)