# Analysis of Water Use Efficiency Metrics and Benchmarking


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FINAL REPORT

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Prepared For

**Mesa Water District**

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# List of Tables and Figures

# Introduction

In this report, potential Water Efficiency benchmarks are analyzed for Mesa Water. We examine alternative benchmarks, data requirements, and recommended alternatives. A key objective of this report is to analytically assess alternatives and to provide a recommendation on a Water Efficiency benchmark.

This report is the basis for a collaborative process with Mesa Water to propose up to three alternative measures to benchmark performance. Alternative measures to consider include:

1. Aggregate Total System Gallons per Capita per Day (GPCD) measures
2. Disaggregate Customer Class measures
3. Water budget-based benchmarks, including separation of outdoor water use using billing system data

The GPCD benchmark is a natural first choice because it is already a statutory benchmark required by SBx7-7. Whether the statutory GPCD benchmark will "measure what counts," is another question. Possible purposes include regulatory compliance, and program and budgetary performance. Water budget-based benchmarks are the most data intensive, but do constitute one of the four "Compliance Methods" for SBx7-7. Separation of indoor and outdoor end uses is widely noted to be a more informative benchmark. Since outdoor use is not typically measured, benchmarking comparisons are indirect, and, thus, may reflect the varying accuracy of assumptions rather than what is intended.

We will identify benefits and challenges associated with the alternative benchmarks including the following:

- Data availability;
- Suitability to benchmark objective; and
- Analytic resources needed.

## *Definitions: Metrics vs. Benchmarks*

We note standard definitions of metrics and benchmarks as used in the water industry:

"A metric is a unit of measure (or a parameter being measured) that can be used to assess the rate of water use during a given period of time and at a given level of data aggregation (e.g., system-wide, sector-wide, customer level, or end-use level). Another term for a metric is performance indicator. Basically, a metric is a formula. In the context of measuring water use, there are very many possible metrics that can be formulated. Some examples of water usage metrics include: total water use per capita per day; residential indoor water use per dwelling unit per day; or average volume of water being used for flushing toilets."

"A benchmark is a particular (numerical) value of a metric that denotes a specific level of performance, such as a water efficiency target." (AWWA White Paper on Benchmarking 2009).

Thus, the issue of choosing a benchmark can be divided into (1) the choice of a metric and (2) the choice of a benchmark (a particular value of the chosen metric).
The AWWA white paper referenced above also provides a universe of potential metrics of water use and conservation as displayed in Figure 1 which begins below and continues on the next page.

| Category of Metric | Symbol | Description | Selected Advantages | Selected Limitations |
|---|---|---|---|---|
| Aggregate Production Based | $PQ_c$ | Per capita production | Good availability of data on water production | Population served defined differently by water utilities and cannot be measured accurately. |
| | $PQ_a$ | Production per account | Number of billed accounts known for each billing period | Cannot account for differences in the composition of water use among primary sectors. |
| | $PQ_{ea}$ | Production per "equivalent" account | Number of equivalent accounts is more precise than population served | Number of equivalent accounts depends on sectoral water use characteristics |
| Aggregate Metered Sales Based | $SQ_a$ | Retail sales per account | Separates out system losses | Cannot account for differences in the composition of water use among primary sectors. |
| | $SQ_{ea}$ | Retail sales per equivalent account | Number of billed accounts known for each billing period | Number of equivalent accounts depends on sectoral water use characteristics |
| Disaggregate -- Sector Sales Based | $AUM_{a\,F}^{S}$ | Annual single-family usage metric per account | Definition of single-family sector generally consistent | Influenced by seasonal and weather-sensitive components of water use |
| | $AUM_{a\,F}^{M}$ | Annual multifamily usage metric per account | Number of accounts available and more accurate that housing unit counts. | Large variance in number of units served per multifamily account |
| | $AUM_{a\,R}^{N}$ | Annual nonresidential usage metric per account | Number of accounts available and more accurate than employment and other counting variables. | Large variance in types of businesses and corresponding water uses |
| Disaggregate -- Sector and Seasonally Based | $IUM_a^{SF}$ | Indoor (nonseasonal) single family use metric per account | Indoor use is considered relatively homogenous | Difficulty in estimating indoor/outdoor use distinction in areas with year-round outdoor and/or cooling uses. |
| | $IUM_c^{SF}$ | Indoor (nonseasonal) single family use metric per capita | Scales indoor use for average number of people residing in households. | |
| | $OUM_{a\,F}^{S}$ | Outdoor (seasonal) single family use metric per account | Isolates weather-sensitive uses | Classification of irrigation meters can confound estimates. |
| | $IUM_a^{MF}$ | Indoor (nonseasonal) multi-family use metric per account | Indoor use is considered relatively homogenous | Regularly collected data on |

| Category of Metric | Symbol | Description | Selected Advantages | Selected Limitations |
|---|---|---|---|---|
| | $IUM_c^{MF}$ | Indoor (nonseasonal) multi-family use metric per capita | Scales indoor use for average number of people residing in households. | irrigated acreage would improve use of account-level data<br><br>Heterogeneity of customers and class definitions for multifamily and nonresidential categories limits inter-utility comparisons |
| | $OUM_a^{MF}$ | Outdoor (seasonal) multi-family use metric per account | Isolates weather-sensitive uses | |
| | $IUM_a^{NR}$ | Indoor (nonseasonal) nonresi-dential use metric per account | Indoor use perhaps less variable than sector-wide use | |
| | $OUM_c^{NR}$ | Outdoor (seasonal) nonresi-dential use metric per account | Convenient measure of weather-sensitive uses | |
| Leakage and Loss | NRW | Nonrevenue water | Easily computed from commonly available data | Combines real and apparent water losses |
| | CARL | Real resource loss | Focuses on real (physical) losses | Does not provide any allow-ances for unavoidable leaks |
| | ILI | Infrastructure leakage index | Can be used for inter-utility comparisons | Rigid formula for assessing unavoidable leaks |
| Conservation Indices | $ICI^{SF}$ | Indoor single-family conservation index | Ratio benchmarks with 1.0 target/goal value<br><br>Can be tailored to reflect service area end use and weather characteristics<br><br>Can be used for inter-utility comparisons | Indoor use measure may include outdoor uses using minimum month estimation methods<br><br>Requires definition and calculation of benchmark usage rates for indoor and outdoor use<br><br>Outdoor benchmark values require multiple assumptions to reflect service area characteristics |
| | $ICI^{MF}$ | Indoor multifamily conservation index | | |
| | $OCI^{SF}$ | Outdoor single-family conservation index | | |
| | $OCI^{MF}$ | Outdoor multifamily conservation index | | |

**Figure 1 Metrics of Water Use and Conservation (Table 25 in AWWA white paper)**

Assessing this broad universe of measures found in the literature for use in Mesa Water leads us to the following conclusions:

- Using metrics on aggregate data (e.g., aggregate production or consumption) does not allow for accounting for differences in the service area customer base. A large customer–such as a regional airport for example–would make incommensurate comparison between two water retailers.
- Disaggregate measures allow for more comparability between water retailer but may be constrained due to lack of comparable customer class distinctions. For example, there are retailers in Orange County that classify multiple family master meters as "commercial" accounts.
- Indoor-Outdoor performance measures may be desired, but since not all outdoor water use is directly metered, only "estimates" of outdoor water use can be feasibly created. Because of lack of direct measurement, estimated volumes of outdoor water use are of limited applicability for comparisons across water retailers without extensive data analysis.

- Water loss control metrics could be added to a broader "scorecard" of water efficiency metrics.
- Variation in service area characteristics (weather zone, customer base, persons per household, lot size, etc.) can provide hypotheses to explain spatial differences across service areas.
- Variation of water demand drivers (weather, economic cycle, population and business growth, and changes in water use technologies) can explain variation in Mesa Water use through time. Controlling for these factors more directly addresses the "Conservation" performance metrics defined above.

Below, we conceptually describe three types of water efficiency performance metrics that are feasible for Mesa Water.

## *Alternative 1: Daily Use Per Capita (Gallons per Capita per Day, GPCD)*

Following the Governor's goal of achieving a 20% statewide reduction in per capita water use by 2020 ("20x2020"), Senate Bill 7 – the Water Conservation Act of 2009 -- was enacted as part of the Seventh Extraordinary Session (SBx7-7). SBx7-7 requires all urban retail suppliers to develop targets to reduce per capita water use by 20 percent in 2020 (and an interim target of 15 percent in 2015.) This law contains consequences for urban retail suppliers who do not meet the mandated target:

- Conditions eligibility for state water grants and loans on compliance as of January 1, 2016
- Failure to meet targets establishes a violation of law for administrative or judicial proceedings after January 1, 2021

Since a GPCD measure is required for the SBx7-7, we have used calculations summarized in the Mesa Water 2010 Urban Water Management Plan and in the MWDOC 2010 UWMP as a point of departure. According to the 2010 Urban Water Management Plan, Mesa Water has selected "Option 1" which requires 20% reduction by 2020 and 10% by 2015. The UWMP also states, "Mesa Water is a member of the Orange County 20x2020 regional Alliance formed by MWDOC." The Alliance is comprised of 29 retail water suppliers in Orange County. The Regional Alliance weighted 2015 target is 174 GPCD and 2020 target is 157 GPCD. Under Compliance Option 1, the simple 20% reduction from the baseline, Mesa Water's 2015 interim water use target is 161.1 GPCD and the 2020 final water use target is 143.2

Table 1 (built from Table 2-6 and 2-7 from UWMP p. 2-9) summarizes water use and population and provides the base period ranges used to calculate the baseline water use from 1996 to 2008. Because Mesa Water is an OCWD agency, this gross water use includes deductions for indirect potable recycled water use from the Groundwater Replenishment System (GWRS) and Water Factory 21 managed by OCWD.

**Table 1 Water Use and Population**

| Year | Population | Gross Water Use (gpd) | GPCD |
|---|---|---|---|
| 1996 | 99,780 | 19,352,854 | 194 |
| 1997 | 101,003 | 19,382,777 | 192 |
| 1998 | 102,334 | 18,491,975 | 181 |
| 1999 | 103,662 | 18,630,765 | 180 |
| 2000 | 103,957 | 19,122,177 | 184 |
| 2001 | 104,852 | 19,071,338 | 182 |
| 2002 | 105,865 | 18,037,909 | 170 |
| 2003 | 105,779 | 17,927,187 | 169 |
| 2004 | 107,096 | 18,497,925 | 173 |
| 2005 | 107,078 | 17,643,029 | 165 |
| 2006 | 106,964 | 18,167,455 | 170 |
| 2007 | 107,047 | 19,084,557 | 178 |
| 2008 | 107,494 | 17,679,197 | 164 |

Key Points about using SBx7-7 measure of GPCD as a metric for Mesa Water:

- By definition, it is measuring what SBx7-7 requires, so it is good for one of the most important supplier objectives.
- The calculation of gross water use deducts recycled water and thus is a measure of fresh water use not total water use.
- As Mesa Water rolls off Metropolitan, its share of recycled water may change and, thus, the SBx7-7 calculations will need to be modified.
- The measure does not distinguish indoor from outdoor performance.
- When comparing between suppliers, this GPCD might not be measuring how well the supplier is performing at demand management and instead be measuring how close they are to recycled water trunk lines and large customer sites.

## *Alternative 2: Use by Customer Class*

Separation of water use metrics into customer classes is the first step toward more meaningful cross utility comparisons. Although data consistency is imperfect, we have collected data from the MWDOC survey of Orange County retail water suppliers.

## *Alternative 3: Water Budget and Indoor-Outdoor*

Even higher resolution water use metric examines customer water use relative to a technical benchmark—a water budget that defines an efficient level of water use for a given customer. Having written the Water Research Foundation report on water budgets, we are comfortable stating that water budgets are most feasibly constructed for irrigation-only customers—as this is the horticultural origin of the entire concept of water budgets. Water budgets have been constructed for residential customers—where measures of outdoor landscape area are available.

Indeed Mesa Water has conducted just such an analysis for single family customers. We note that water budget estimation for CII customers are not generally successful or even feasible—given the variability of CII water use drivers and lack of consistent customer data.

The most important subset of end uses may be the divide between indoor end uses and outdoor end uses. We noted earlier that these are not directly measured and hence any comparison is not, strictly speaking, empirical. We are experienced with construction of estimates based on applying usage patterns of irrigation-only meters to other customers with mixed uses. We will present this type of analysis for Mesa Water in the last section of this report.

## *Organization of the Report*

The following section will examine aggregate water use metrics first for the following reasons:

- It is a preexisting metric having state mandated benchmark (in GPCD form)
- Comparable data exists for retailers in Orange County

The report begins with an aggregate water use meter and logically changes the metric to show how Mesa Water's ranking against other water retailers will change. Specifically, we will show how narrowing the definition of a performance metric to customer classes–where feasible—can improve comparability.

The report next examines a standardization for one important determinate of an agency's water use—population. By dividing water use by the estimated population served, one can arrive at the SBx7-7 state mandated metric and state specified benchmarks for 2015 and 2020. These will be compared across Orange County retailers for FY2010-11 and through time.

A water budget-based analysis has recently been conducted for Mesa Water single family customers. Interested readers are referred to the board presentation given in Nov. 2012.

Last, the report estimates outdoor water use for Mesa Water based on a more sophisticated method than the "Minimum Month Winter Use" method widely applied in the literature. The minimum month method requires the counter-factual assumption of zero winter outdoor irrigation. We present an alternative—based on observable patterns of seasonal outdoor irrigation consumption from dedicated irrigation meters in the customer billing system—that can be used for inference to mixed use meters (which measure indoor and outdoor use). Note that since outdoor end use estimates are not measurements per se, they cannot readily be considered "performance metrics" for purposes of comparing across water agencies. Comparisons across agencies could reveal differences in the applicability of a common assumption rather than differences in water uses. The intended purpose of estimating outdoor water use in this report is to highlight the importance of considering outdoor use for performance metrics, should such data be available, and also to define the volume of water conservation potential for outdoor WUE alternatives.

# Water Use Performance Metrics for Orange County

First we examine a source of consistent data across Orange County from the MWDOC FY2010-11 Water Rate Survey. [1]

## *Aggregate Use per Meter for Orange County Retailers*

Figure 2 below compares aggregate water use per meter for each retail agency in the county. Mesa Water appears in yellow and exhibits a slightly higher volume of water use per meter than the county average. Lest one leap to incorrect conclusions, it should be noted that total water use in this graph includes agricultural water. These can be subtracted out to form the basis for the next aggregate comparison.

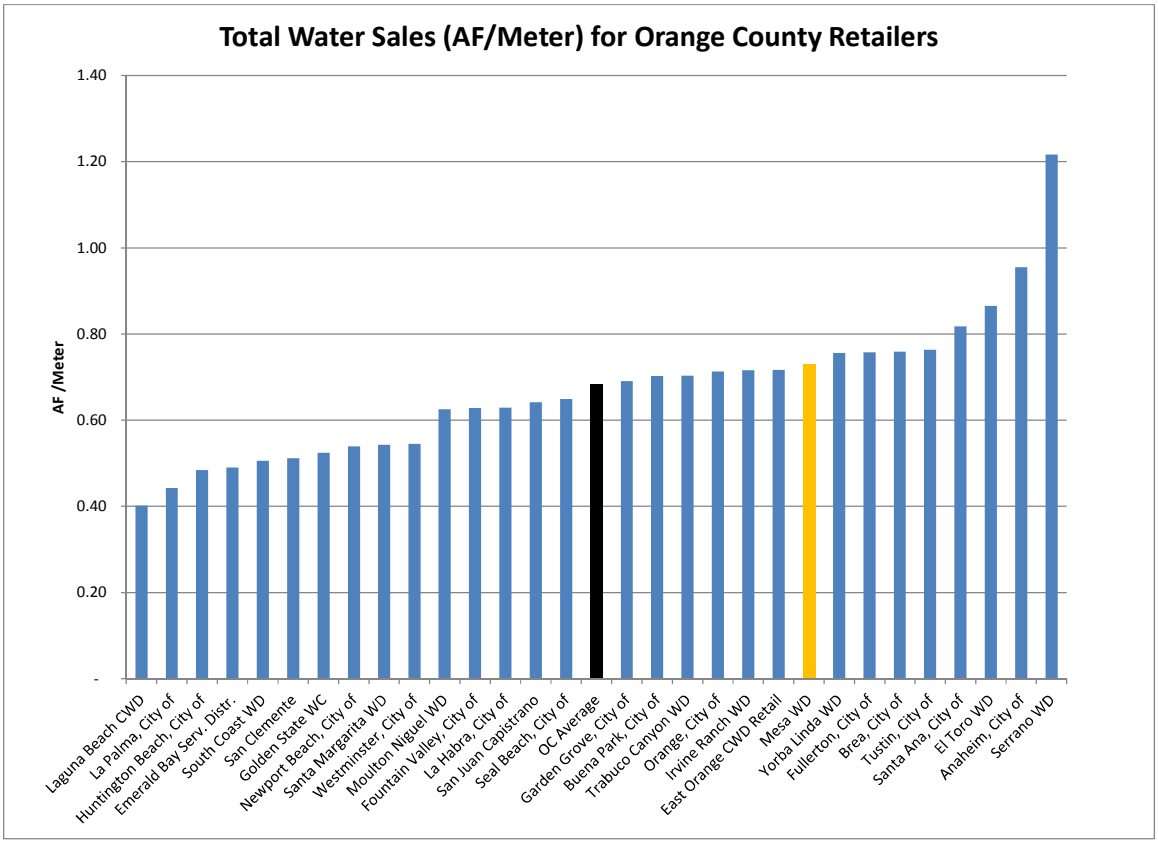


**Figure 2 Aggregate Water Use per Water Meter**

[1] The Survey distinguishes between water "usage" which includes system loss (see Survey Table 10) and water "sales" that does not include system loss (see Survey Table 9). In this section, the text continues to consistently use the term water "use" but the graphs have been labeled with the more specific Survey nomenclature.

## *Aggregate Municipal and Industrial Use per Meter for Orange County Retailers*

Removing agricultural water users, we can compare what is termed "Municipal and Industrial (M&I)" water use. M&I water use is all urban water use except agricultural water uses and power plant water use. Figure 3 compares M&I water use in acre feet per meter. The relative ranking of Mesa Water within the county has changed only slightly. It should be noted that Mesa Water has also made significant investments in recycled water supply that reduce potable water demands. The next aggregate comparison arrives at a more direct measure of potable water use by removing recycled water uses.

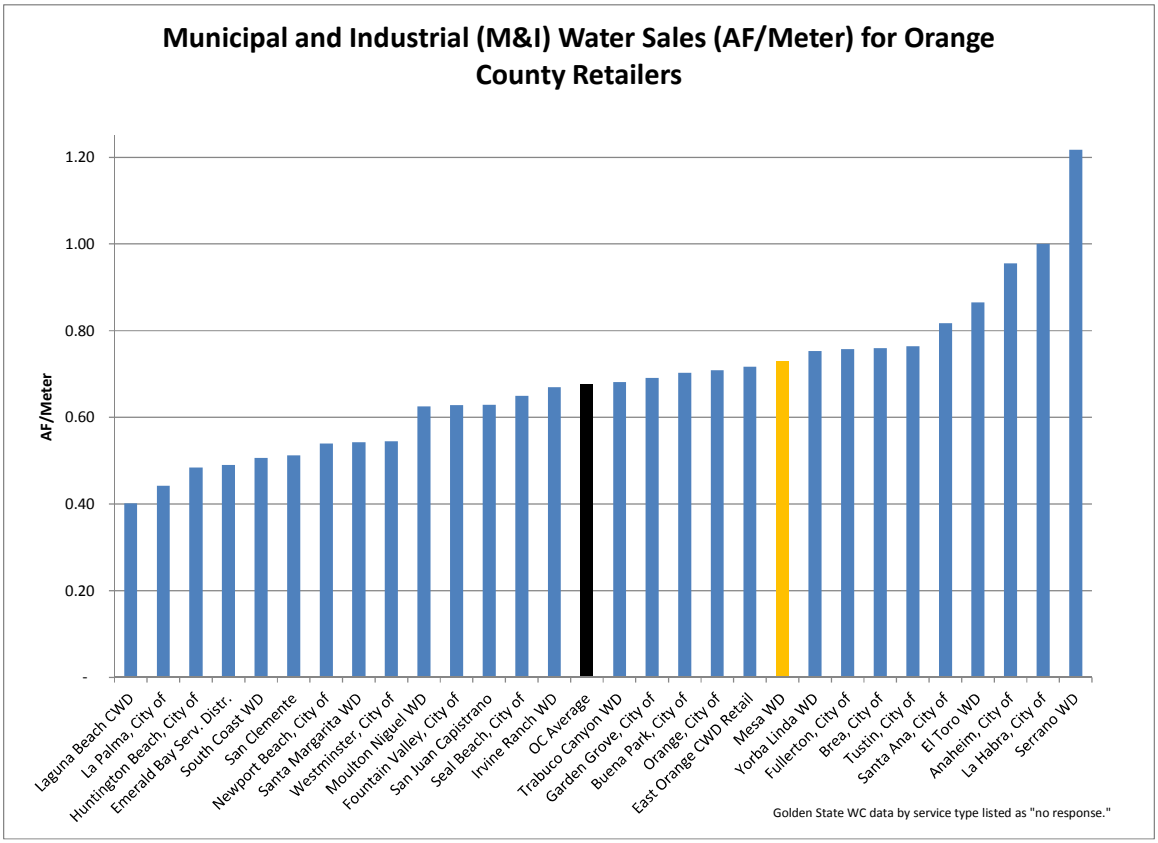


**Figure 3 Municipal and Industrial Water Use per Water Meter**

## *Aggregate Potable Water Use (Municipal and Industrial minus Recycled Water) per Meter for Orange County Retailers*

Removing recycled water use, we can compare potable water use ("M&I minus Recycled) per meter. Figure 4 compares potable water use in acre feet per meter. The relative ranking of Mesa Water within the county is now much closer to the county average. Note that this aggregate comparison does not account for differences in the customer base. Notably, Mesa Water includes major regional facilities such as the John Wayne Orange County Airport, State of California's Fairview Development Center, Segerstrom Center for the Arts, Orange County Fairgrounds, Orange Coast College, and South Coast Plaza shopping complex (UWMP p. 1-5). The next aggregate comparison directly examines single family residential use per meter to see what disaggregation by customer class reveals.

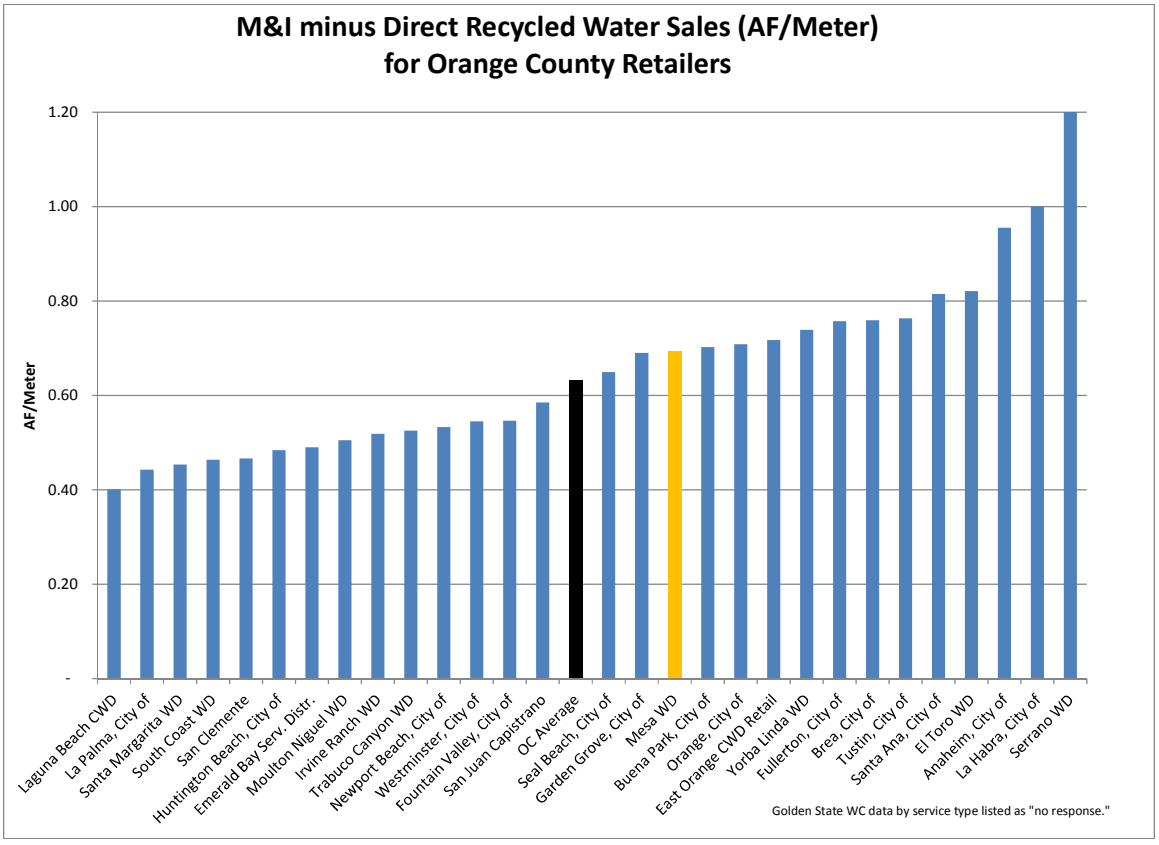


**Figure 4 Potable Water (Municipal and Industrial less Recycled Water) Use per Meter**

## *Single Family Residential Water Use per Meter for Orange County Retailers*

Examining just single family water use per meter across Orange County allows a more focused and consistent comparison. Figure 5 compares single family water use in acre feet per meter. Mesa Water now appears to rank less than the county average of single family use.

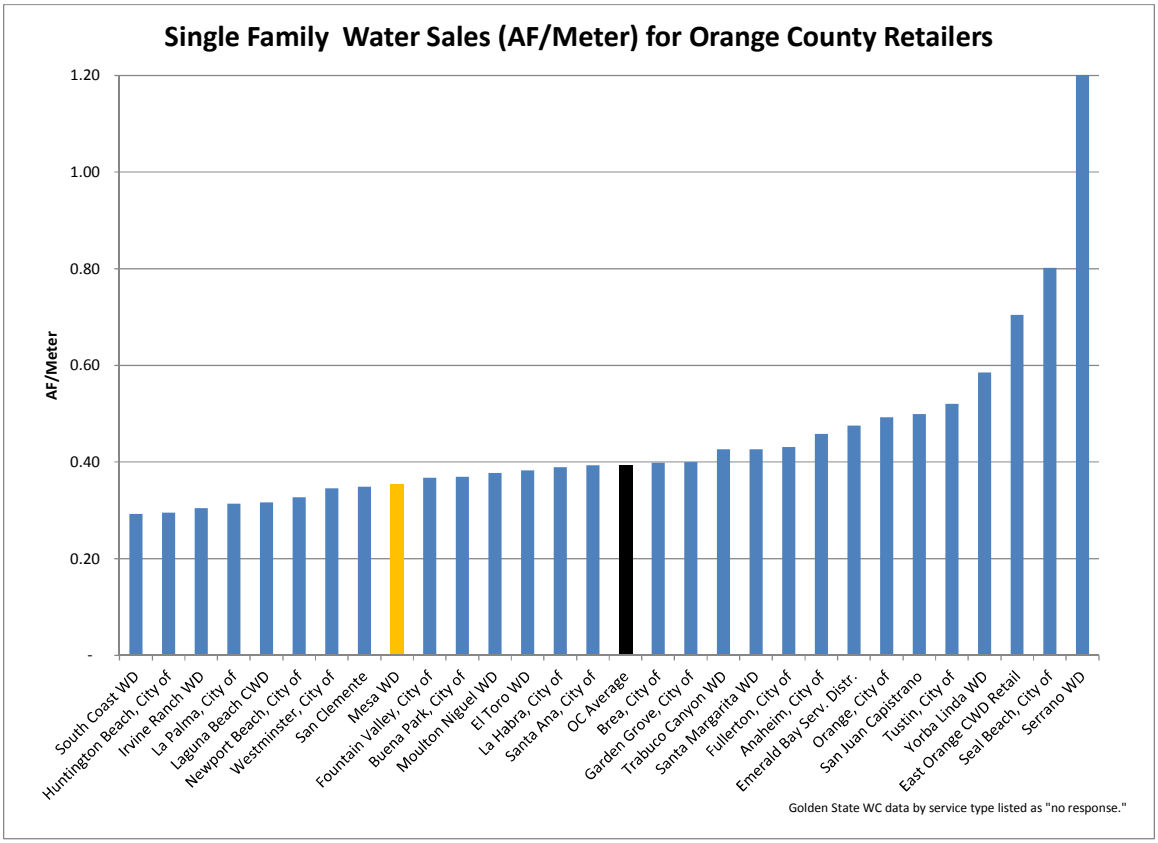


**Figure 5 Single Family Water Use per Meter**

Since the state established benchmarks for aggregate water demand reductions in 2015 and 2020 are standardized by population instead of use per meter, we next turn to water use metrics standardized by population.

## *Aggregate Municipal and Industrial Use per Person for Orange County Retailers*

Figure 6 depicts aggregate M&I per capita water use across Orange County retailers. Note that color differences distinguish North (green) versus South (blue) Orange County retailers. There are fundamental differences in water supply sources between the two halves of the county—access to groundwater supplies is less prevalent in South Orange County.

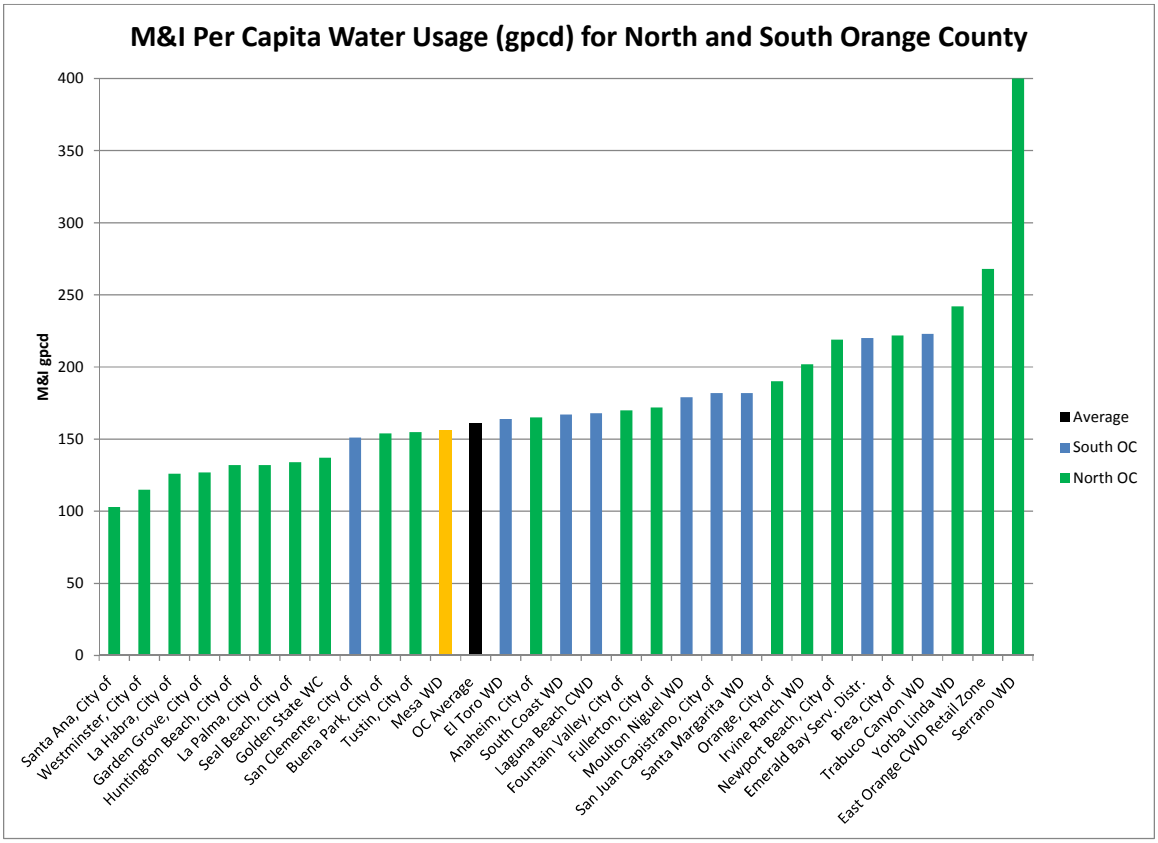


**Figure 6 M&I Per Capita Water Use (GPCD) for North/South Orange Cnty Retailers**

## *Aggregate Direct Potable Water Use per Person for Orange County Retailers*

Figure 7 adjusts the aggregate direct potable use per capita by subtracting out direct recycled water.

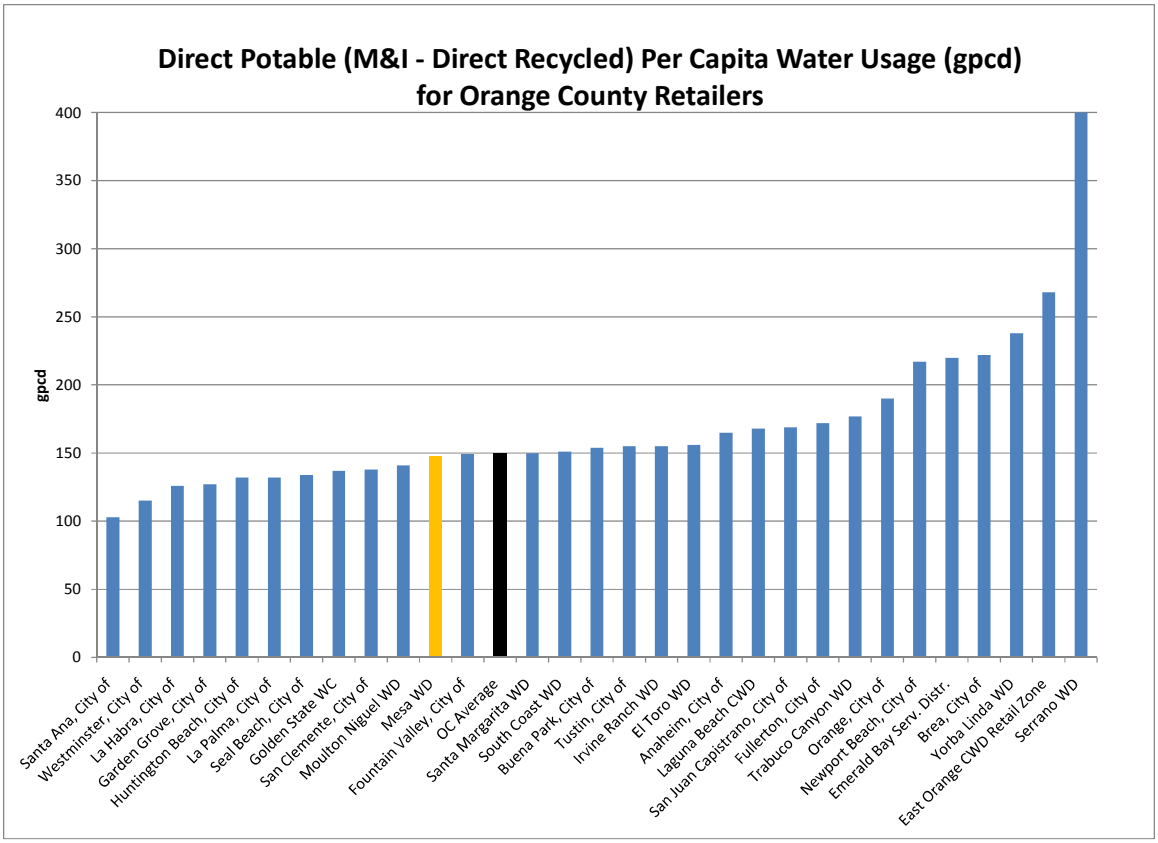


**Figure 7 Aggregate Direct Potable Water Use per Person across Orange Cnty Retailers**

## *Residential Use per Capita (GPCD) Across Orange County*

Last, disaggregation of per capita water use is limited by comparability of customer classification. Figure 8 depicts residential per capita water use for Orange County retailers who make a clean distinction between residential and nonresidential water users. Note that Mesa Water is slightly less than the county average residential use on a per capita basis.

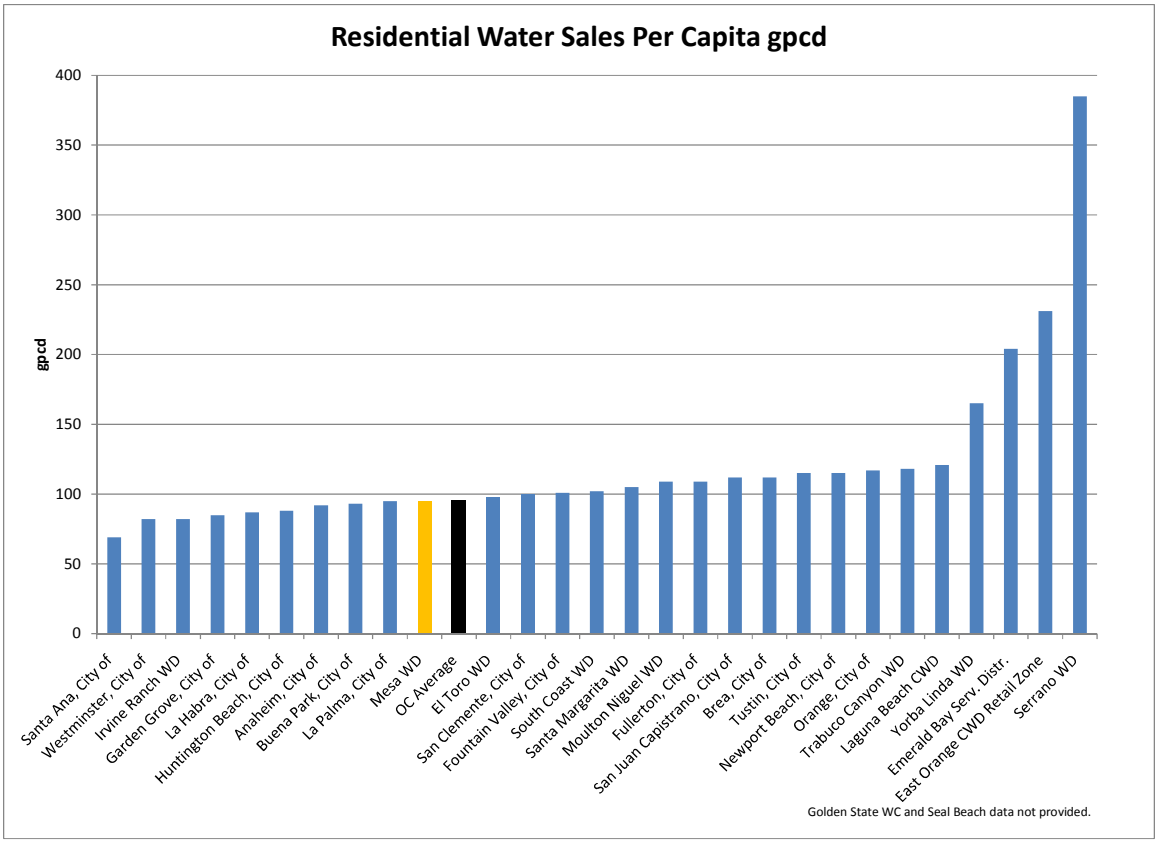


**Figure 8 Residential Water Use per Capita (GPCD) Across Orange County**

## *SBx7-7 Per Capita Benchmarks (M&I –RW, GPCD) Across Orange County*

The state mandated SBx7-7 water use benchmark (referred to as "target") is expressed in per capita terms and allows recycled water (direct and indirect) to be removed from consideration. Figure 9 displays this benchmark across Orange County retailers. The SBx7-7 targets are calculated excluding recycled water.[2]

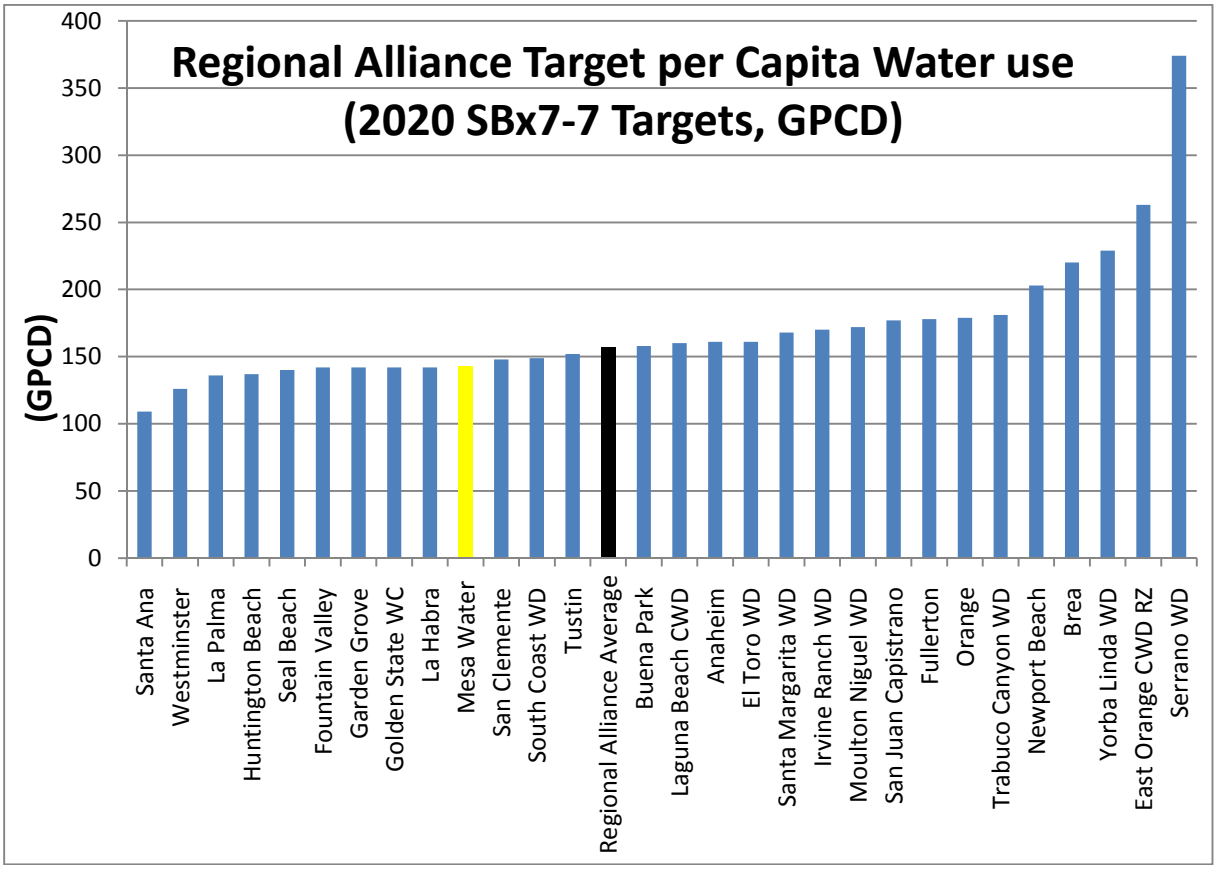


**Figure 9 2020 SBx7-7 Benchmark (gpcd)**

[2] MWDOC provided retailers with data to exclude indirect potable reuse from GWRS for the purpose of calculating their targets if they chose to do so (MWDOC 2010 UWMP p. 2-13). The Regional Alliance Average is the weighted average of the retailer targets (MWDOC 2010 UWMP p. 2-10).

## *Current Use minus Benchmark (M&I –RW, GPCD) Across Orange County*

Figure 10 contrasts the difference between an FY2011 performance measure of per capita use versus the state mandated SBx7-7 2020 benchmark. Mesa Water's FY2010-2011 water use per capita is somewhat higher than the benchmark that needs to be achieved by 2020. Note that this does not include accounting for direct recycled water use or indirect recycled water through the GWRS (indirect potable not subtracted out).

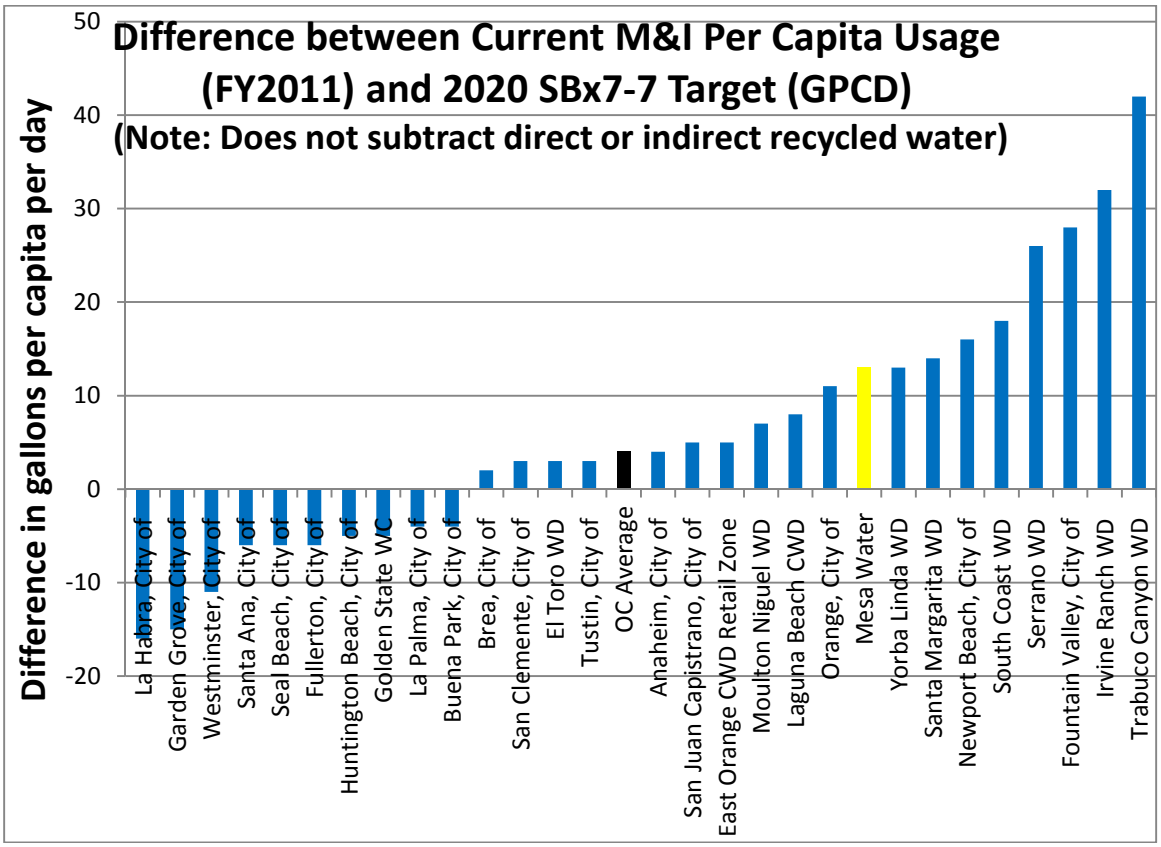


**Figure 10 Difference between Current M&I per Capita Use (FY2011) and 2020 SBx7-7 Benchmark (GPCD)**

## *Comparison over Time: Per Capita Use across Orange County*

The comparison of current retail use to a 2020 benchmark brings into question trends in usage. Figure 11 depicts data compiled from 2010 Urban Water Management Plans on historical per capita use.

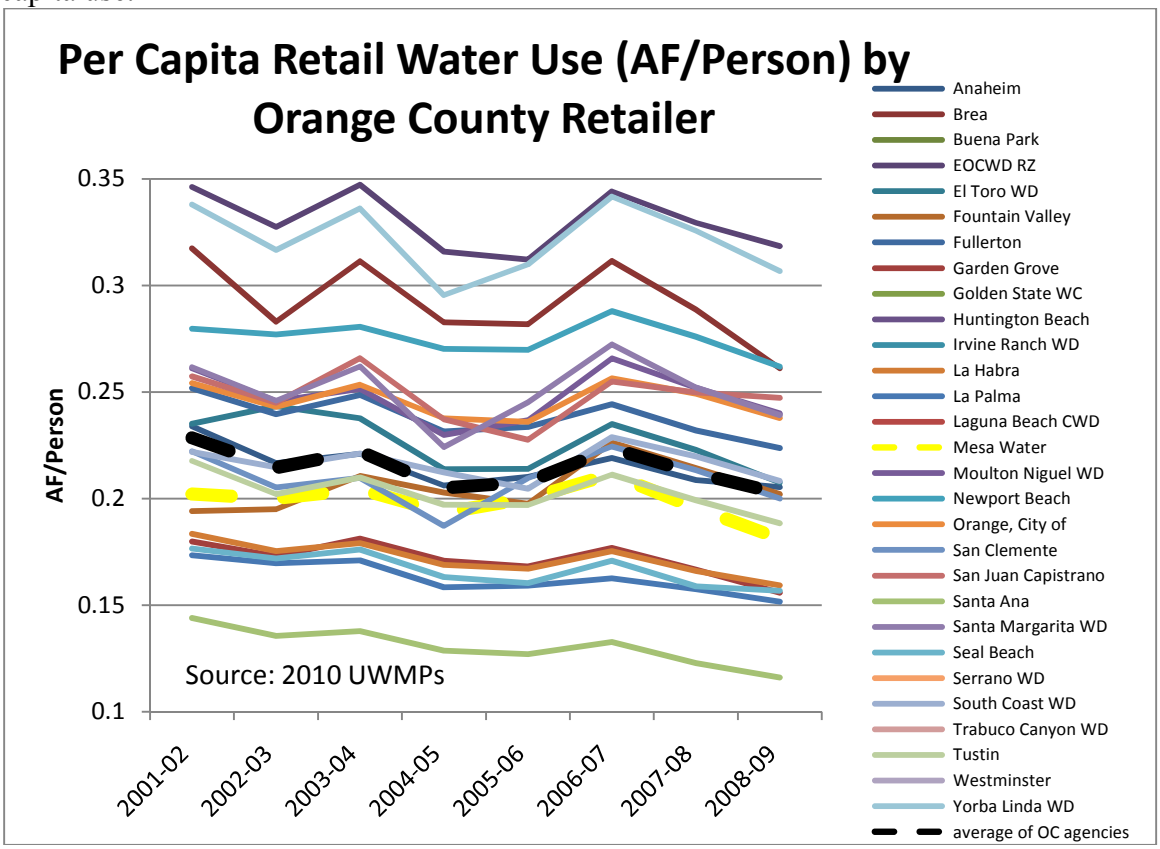


**Figure 11 Historical Per Capita Retail Water Usage by Supplier: 2001-2009**

The effect of cool/wet weather and the beginning of the recent economic recession can be seen toward the end of Figure 11. How much of the use decline in Figure 11 is due to weather and the recession and how much has ongoing water use efficiency improvements (due to higher fixture efficiencies required by the plumbing code and the increasing real price of water)? This is an as yet unanswered empirical question.

# 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. Figure 12 presents results from this study.

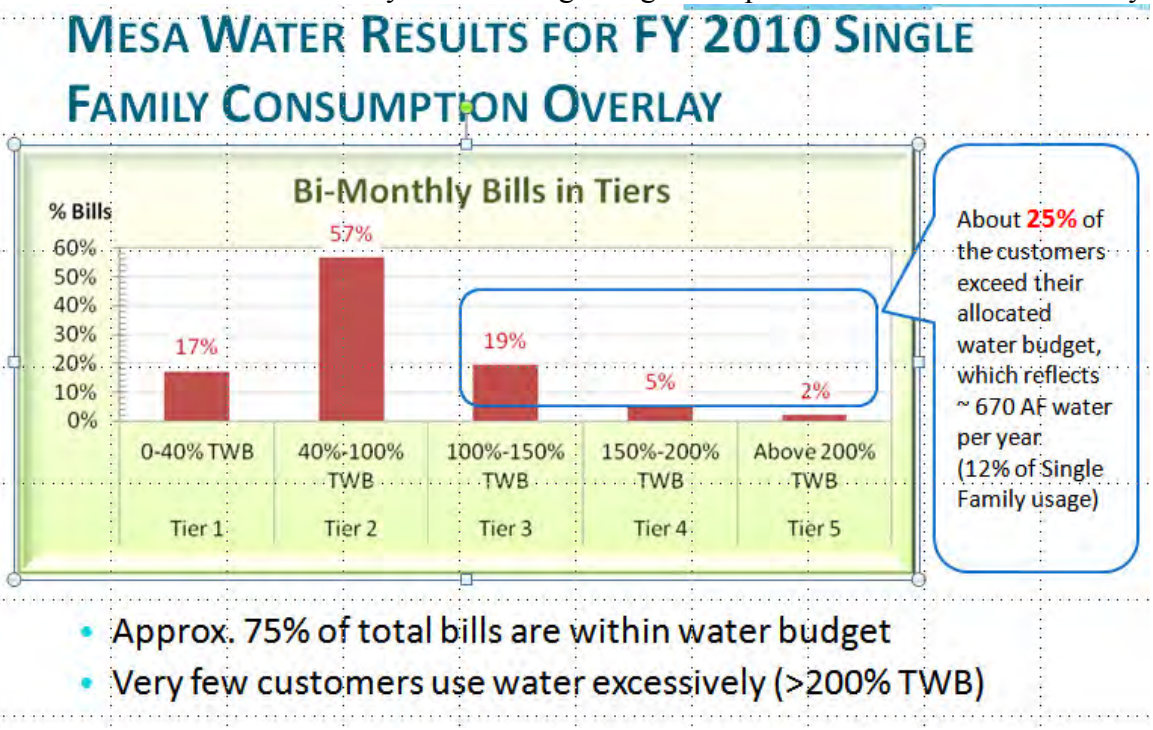


**Figure 12 Mesa Water Budget Comparison for Single Family Customers (November 2012 Board presentation)**

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.

# Estimating Outdoor Water Use at Mesa Water

This chapter 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 2 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 2 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 |

Figure 12 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.

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.

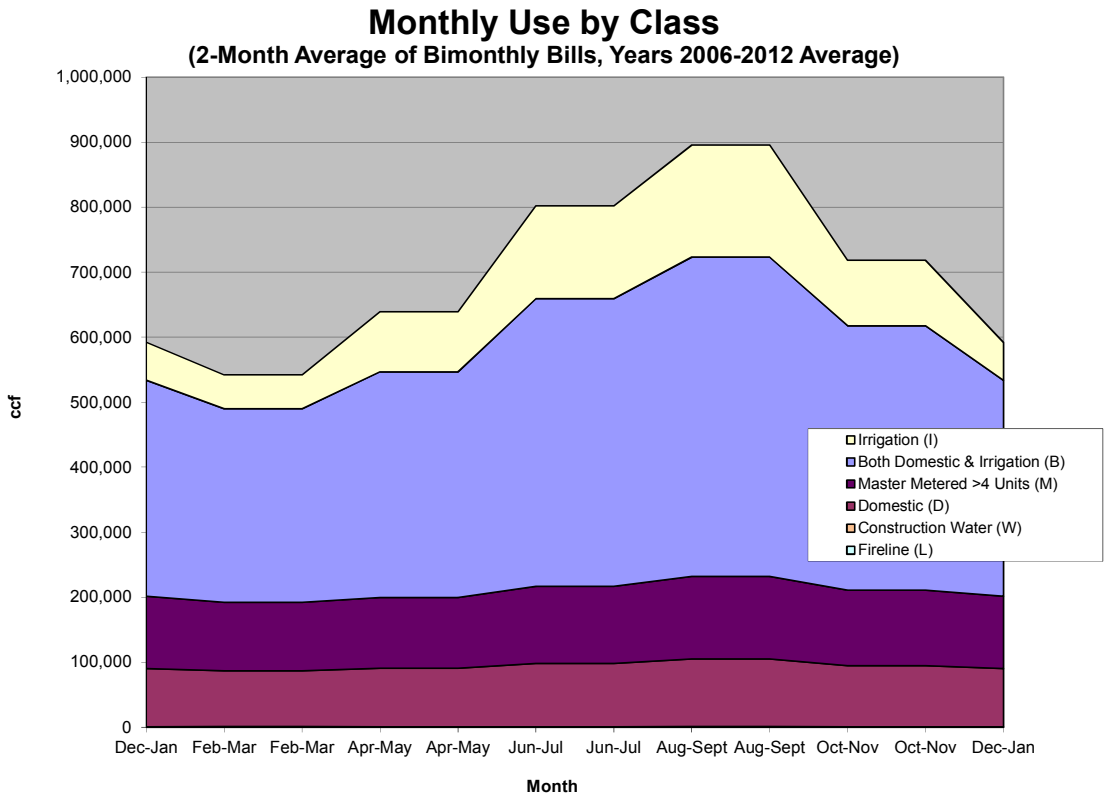


**Figure 13 Average Monthly Use by Customer Class Type**

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. Figure 13 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.

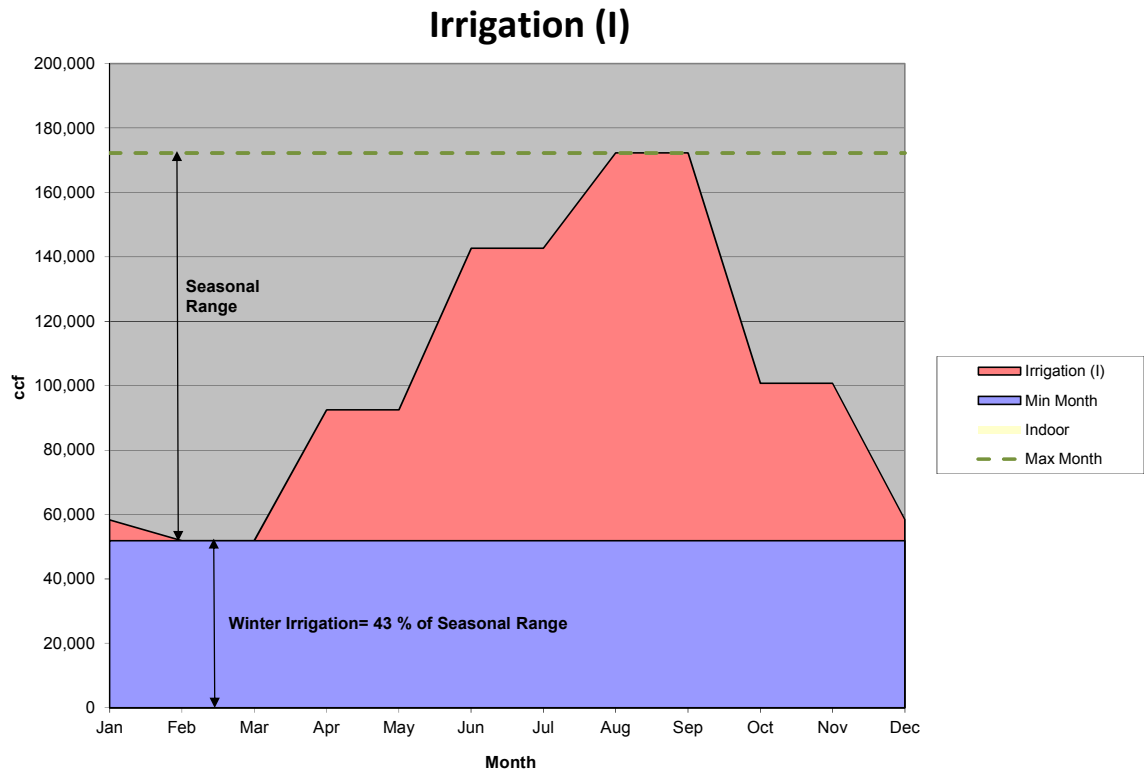


**Figure 14 Average Monthly Use among Dedicated Irrigation-Only Customers**

This relationship of winter irrigation to the seasonal pattern of irrigation use then forms the basis for inferring winter use among all customers. Figure 14 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).

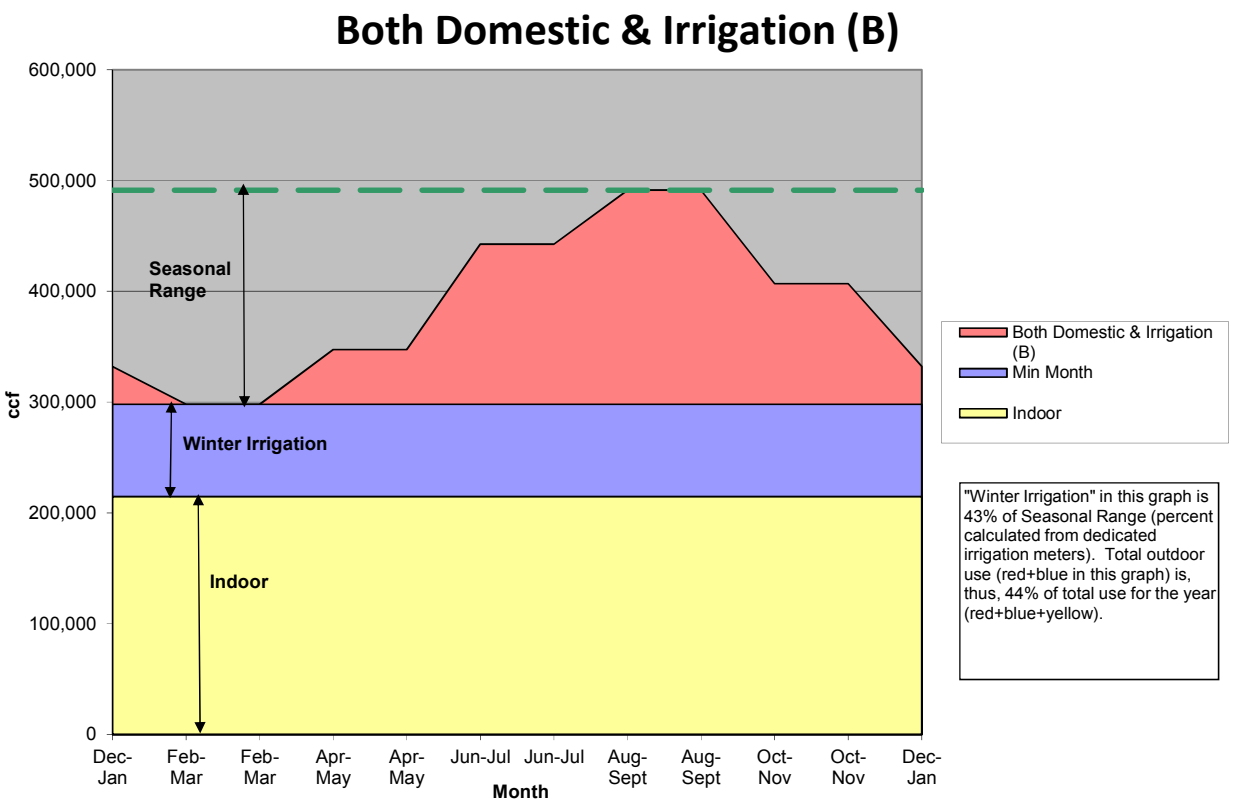


**Figure 15 SF Customer Class B-Both Domestic and Irrigation-Estimation of Outdoor and Indoor Uses**

Table 3 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 3 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% | |

# Findings and Recommendations

## *Findings*

- Using metrics on aggregate data (e.g., aggregate production or consumption) does not allow for accounting for differences in the service area customer base. A large customer– such as a regional airport for example–would make incommensurate comparison between two water retailers.
- Disaggregate measures allow for more comparability between water retailer but may be constrained due to lack of comparable customer class distinctions. For example, there are retailers in Orange County that classify multiple family master meters as "commercial" accounts.
- Indoor-Outdoor performance measures may be desired, but since not all outdoor water use is directly metered, only "estimates" of outdoor water use can be feasibly created. Because of lack of direct measurement, estimated volumes of outdoor water use are of limited applicability for comparisons across water retailers without extensive data analysis.

## *Recommendations*

- Water loss control metrics could be added to a broader "scorecard" of water efficiency metrics.
- Variation in service area characteristics (weather zone, customer base, persons per household, lot size, etc.) can provide hypotheses to explain spatial differences across service areas.
- Variation of water demand drivers (weather, economic cycle, population and business growth, and changes in water use technologies) can explain variation in Mesa Water use through time. Controlling for these factors more directly addresses the "Conservation" performance metrics defined above.