MADDAUS WATER MANAGEMENT

# CONSERVATION TECHNICAL ANALYSIS

Date: May 29, 2009

To: Daniel Carney, Marin Municipal Water District

From: William Maddaus and Michelle Maddaus, Maddaus Water Management

Subject: ***FINAL Additional Conservation Program Evaluation - Summary of Data Inputs, Assumptions and Results. Addendum to May 8, 2007 Conservation Technical Analysis***

## EXECUTIVE SUMMARY

### Introduction

A conservation technical analysis was conducted by Maddaus Water Management (MWM) for Marin Municipal Water District (MMWD). The purpose of the analysis was to:

1. Research and investigate, with the help of MMWD staff, 4 specific items that could be implemented by MMWD to reduce future water demand. The new measures requested by MMWD for analysis were the following:
    1. Influence of new future plumbing requirements, taking effect in 2014
    2. Leak detection and repair with Automated Metering System (AMS)
    3. AMS Meter installations
    4. Drought Ordinance review

2. Review MMWD Conservation Savings Goals, revise the parameters used with the existing 30 measures in the 2007 MMWD Conservation Master Plan based on staff input. MMWD was responsible for providing a list of revisions to MWM through a list of changes on Attachment 1 in the May 8, 2007 Conservation Technical Analysis Memorandum.

3. Estimate the costs, water savings and cost-effectiveness of the four new measures and revised Master Plan measures.

4. Combine the measures listed above into a more aggressive program (called herein Program E) and evaluate the costs, water savings and cost-effectiveness of the program. Program E also includes the measures in Program D, as described in the May 8, 2007 Technical memorandum.

In addition the prior drought conservation technical analysis was extended, the purpose of which was to:

1. Evaluate the effectiveness of the existing MMWD drought ordinance on a possible future drought, if Program E was in effect.
2. Quantify the combined water savings from the long-term conservation program working together with the drought ordinance to help meet supply shortages.
3. Determine how much demand hardening would occur in the future due to long-term conservation generated demand reductions (that may reduce the effectiveness of the drought ordinance).

This report was intended to be an Addendum to our May 8, 2007 Conservation Technical Analysis. The original 2007 study can be found in the Marin Municipal Water Conservation Master Plan Appendix A, currently available on the MMWD website. At the request of MMWD, items that remained unchanged in the 2007 Memorandum were not included in this 2009 Addendum. Additional background on the methodologies and assumptions for the DSS Model used in both projects can be found in the 2007 MWM report.

**Key Findings**

Based on the Conservation Technical analysis completed in 2009, Maddaus Water Management can offer the following 9 key findings.

1. As requested by MMWD, Maddaus Water Management researched adding an additional crew for Leak Repair and separately the installation and implementation of an Automated Metering System (AMS). One of the goals of the AMS system would be to find leaks and assist with residential and commercial water audits. Both of these items appear to be good ideas that MMWD can consider in the future to create additional water savings. According to this study results, adding an additional crew dedicated to Leak Repair can save an additional 200 AF/yr (when compared to Program D that has two leak detection crews). After the installation of an AMS system the Leak detection notification (Tier 2 – 10) will save an additional 100 AF/yr.

2. The change in California plumbing code requiring 1.28 gallon per flush High Efficiency Toilets (HETs) and 0.5 gallon per flush urinals by the year 2014 increases savings 306 AF/yr in 2025 (367 AF in 2030). The new legislation was signed by the Governor in October 2007 and therefore was not included in the May 8, 2007 Conservation Technical Analysis.

3. Program E saves 1,057 AF/Yr more water than Program D in the year 2025 (1,168 AF/Yr more in the year 2030). Water savings estimates assume the installation of the AMS system is complete by the end of the year 2014.

4. The cost of Program E has a cost of water saved of $437 / AF (without the cost of the installation of the AMS). The present value utility cost of the entire program is $44 Million. This total cost does include some historical costs back to the year 2006 and concludes at the end of the study period in the year 2030. These costs do not include the installation of the AMS system as the cost, timing, and other parameters have not been decided by MMWD at this time. Additionally, the AMS is not planned to be entirely funded out of the MMWD conservation budget.

5. MMWD has not yet made a decision on the AMS system, specifically the exact installation date and cost of the system that would be assigned to the conservation department. Therefore, the exact cost was excluded from this conservation technical analysis except to run a few hypothetical scenarios to determine approximate cost / benefit ratio and cost of water saved. At the request of MMWD, two scenarios were considered, a 20% and a 40% cost sharing for the conservation department (For example, the conservation department would fund 20% of the entire cost of the AMS system). For these two scenarios it was assumed there would be a 3 year installation in the years 2012, 2013 and 2014. The total cost of the AMS system provided by MMWD was approximately $19.6 Million. Using these parameters, Program E with a 20% cost share of AMS would have a utility cost of water saved of $467 / AF. The present value utility cost of the entire program would be $47 Million. Similarly using these assumed parameters, Program E with a 40% cost of AMS would have a utility cost of water saved of $498 / AF. The present value utility cost of the entire program would be $50 Million.

6. Program D measure assumptions (program length and market penetration rates) were reviewed with the MMWD Staff. Adjustments were made to each measure such that MMWD staff is comfortable with the targeted number of activities at this time. Rain water catchments and gray water systems were added as eligible items under existing Tier 2 – 6 Financial Incentives for Irrigation Upgrades program. Apart from the measure savings listed in Key Finding No. 1, the revisions to the other existing measures and use of the AMS system saves a total of approximately 750 AF/yr in 2025 and 850 AF/yr in 2030.

7. MMWD has made great progress in building a strong foundation for a large conservation program (hiring staff, creating new programs, etc.) in a relatively short amount of time. However, Program D is not yet fully operational at this time. Not all of the projected budget and staff has been committed as of April 2009. Based on this fact, it is too soon to tell whether water savings goals for Program D will be reached. Several years of monitoring Program D including the number of actual program participants and their actual water savings would increase confidence in the ability to forecast higher savings from increased efforts.

8. An update on the assessment of the drought ordinance effectiveness if Program E is implemented was made. The combined savings (average year) from Program D and E from a simulated drought in 2025 are 36 and 39 percent reduction respectively.

9. If a simulated drought occurs in 2025 the drought ordinance will save not 25% but rather 4 to 4.3 percent less. Said in other terms, the ordinance would only save from 21 to 20.7 percent if the drought ordinance works in conjunction with Program D or E instead of on its own with no conservation program. This occurs because some of the end uses have been reduced by the conservation program and there is less water available for a temporary demand reduction during a drought. In our opinion this estimated demand hardening should not be a key factor in deciding whether to pursue Program D or E. It is cost-effective to save this water over time, rather than leave the "waste" in the system so it can be saved during a future drought. The District should consider revising its expectations of the effectiveness or the drought ordinance. If it wants to save say 25 percent on top Program D or E savings then it should ask customers for about 30% reductions so it will net about 25 percent on top of savings from Program D or E.

**Long-Term Program E Conservation Program Analysis Overview**

Thirty one conservation measures were analyzed and combined into two alternative programs of increasingly higher water savings and costs. Figure ES-1 shows the projected savings from these programs, labeled Program D (the current approved Master Plan), and E (more aggressive). The programs are defined and water savings tabulated for 2025 and 2030 in Table ES-1. Water savings in 2025 and 2030 for Program E, including the future effects of the plumbing codes, is approximately 6,047 acre-feet/year in 2025 and 6,553 acre-feet/year (AF/Yr) in 2030. The incremental savings of Program E over D, as shown in Table ES-1 are 1,057 AF/Yr and 1,168 AF/Yr in 2025 and 2030 respectively.

**Figure ES-1**
**Long Term Conservation Program Savings**

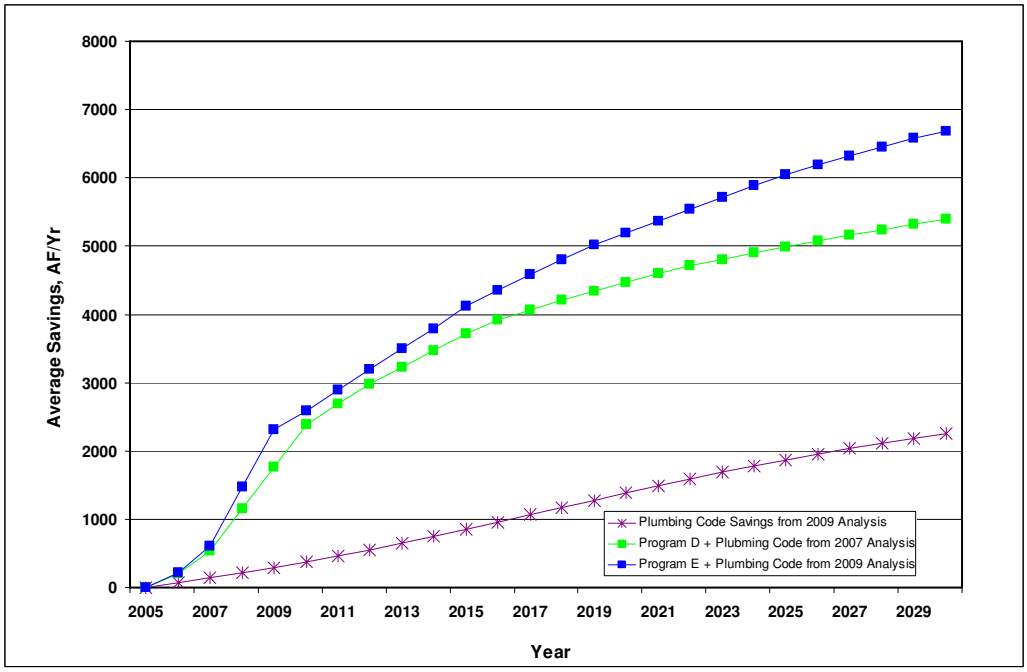



**Table ES-1**
**Conservation Program Description and Future Water Savings**

| Program | Description | 2025 Water Savings with Plumbing Code, AF/Yr | 2030 Water Savings with Plumbing Code, AF/Yr |
|---|---|---|---|
| Plumbing Code Only | No Conservation beyond Plumbing Code (Revised to include new California Legislation requiring High Efficiency Toilets and Urinals in the year 2014. Plumbing code water savings increased when compared to the May 8, 2007 Technical Analysis) | 1,871 | 2,251 |
| D | Program D is the same as described in May 8, 2007 Conservation Technical Analysis. The water savings for Program D + Plumbing Code remained unchanged from the May 8, 2007 Technical Analysis. | 4,990 | 5,385 |
| E | New Program E includes a total of 31 measures (includes AMS, Leak Repair, and revisions to 30 measures in Program D) + Plumbing Code | 6,047 | 6,553 |
| Difference Between Program D and E | Comparison between Program D and Program E | 1,057 | 1,168 |

Table ES-2 shows the relative cost-effectiveness of Program E. Additional resources are required to reach the higher level of water savings. The plumbing code is included for reference and represents the amount MMWD would save if there were no long-term conservation program. Note that all Program E programs are cost-effective (benefit-cost ratio greater than 1.0) from the utility perspective and also from the community perspective (which includes both the utility and the customer costs and benefits). The cost of water saved for MMWD is $437 per acre-foot excluding the cost of installation of AMS to $498 per acre-foot with a 40% AMS installation cost allocation to the conservation department. Programs E would save enough water to more than meet the needs of projected future customers in the District through 2030 during normal water years.

**Table ES-2**
**Cost Effectiveness of Alternative Programs**

| Conservation Program | Water Utility Benefit-Cost Ratio | Community Benefit-Cost Ratio | Total Water Savings as a % of Total Production in 2030** | Present Value of Water Utility Costs ($1,000s) | Present Value of Customer Costs ($1,000s) | Present Value of Community Costs ($1,000s)* | Five Year Utility Cost 2009-2013 ($1,000s) | Utility Cost of Water Saved ($/AF) | % of Water Needed for New Development (2005 to 2030) |
|---|---|---|---|---|---|---|---|---|---|
| Plumbing Code | NA | NA | 7.04% | NA | NA | NA | NA | NA | 68.7% |
| Program E | 2.22 | 1.10 | 13.45% | $ 43,655 | $ 72,463 | $ 116,117 | $ 15,526 | $ 437 | 131.4% |
| Plumbing Code + Program E, No Cost of AMS | 2.22 | 1.10 | 20.49% | $ 43,655 | $ 72,463 | $ 116,117 | $ 15,526 | $ 437 | 200.1% |
| Plumbing Code + Program E, 20% Cost of AMS | 2.09 | 1.08 | 20.49% | $ 46,871 | $ 72,463 | $ 119,334 | $ 18,277 | $ 467 | 200.1% |
| Plumbing Code + Program E, 40% Cost of AMS | 1.96 | 1.05 | 20.49% | $ 49,972 | $ 72,463 | $ 122,435 | $ 20,898 | $ 498 | 200.1% |

*Includes customer energy savings at 2009 PG&E retail gas and electric rates, *plus customer costs as well as utility costs and benefits*
**Percent of water saved for programs refer to demand with plumbing code

### Drought Measure Water Savings

The analysis of the drought ordinance effectiveness and demand hardening made in the 2007 Conservation Technical Analysis was extended to include the Revised Plumbing Code and Program E. Key results from evaluating a simulated drought in 2025 are the following:

- Plumbing Code (no additional conservation program) + 25% Drought Ordinance can reduce total demand 30.5 percent
- Program D + 25% Drought Ordinance can reduce demand 36 percent
- Program E + 25% Drought Ordinance can reduce demand 39 percent
- Savings are diminished a small amount from the sum of Program Savings and the Drought Ordinance Savings if acting alone. In other words program savings from Table ES-1 above cannot be added to the drought ordinance (25%) directly. Combined savings are less.
- The drought ordinance acting with Program D or E will result in an additional drought reduction of about 21 percent, rather than the planned 25 percent due to demand hardening. If MMWD desires to achieve a 25 percent reduction during a future drought and Program D or E is in place, then it should revise its ordinance and ask for about a 30 percent reduction so it will net about 25 percent (or be satisfied with 21 percent net savings).

These demand reductions should not be confused with reductions assumed in the MMWD Supply model, computed as necessary to balance supply and demand. No inferences should be drawn about whether these simulated droughts would ever occur or whether the temporary demand reductions used in the MWM analysis would be adequate to balance supply and demand in such a future shortage.

In summary long-term conservation from Program E can save significant amounts of water and is cost-effective for MMWD. However, this program is very aggressive and since Program D has not yet been fully implemented, expansion of additional conservation should be considered carefully and done over a reasonable time period.

## INTRODUCTION AND PURPOSE

The purpose of this report is to present an overview of the conservation evaluation process which has been completed for Marin Municipal Water District (MMWD). The evaluation was performed on a total of 31 individual measures and an updated plumbing code. The 2009 Conservation Technical Analysis includes new technology and methods (such as Automatic Meter System/Infrastructure (AMS), Leak Detection) plus a review and revision of the 30 measures evaluated for the 2007 MMWD Master Plan (10 Tier One measures, 9 Tier Two measures and 11 New Development measures). Specifically the report includes an analysis of the following as requested by MMWD:

1. Influence of new future plumbing requirements, taking effect in 2014
2. AMS Meter and infrastructure installations
3. System and customer leak detection (notification) and repair with Automated Metering System (AMS)
4. Use AMS to enhance planned residential and commercial water surveys and tracking landscape water budgets
5. Drought Ordinance review
6. Review of 30 measures analyzed in the 2007 MMWD Conservation Master Plan

The Tier One measures correspond to the 2006 California Urban Water Conservation Best Management Practices (CUWCC BMPs). The conservation measures, where quantification is possible (BMP 1, 2, 3, 5, 6, 7, 9, and 14), were analyzed using the Least Cost Planning Decision Support System (DSS) Model. The remaining BMPs (4, 8, 10, 11, 12, and 13) are of a qualitative nature or not applicable to MMWD and were not included in this analysis. The evaluation was also performed using the Least Cost Planning Decision Support System (DSS) Model on the Tier Two measures and potential New Development measures to make new single family homes, apartments, and businesses more water efficient. These conservation measures were then organized into programs showing benefits, costs, and water savings. The conservation savings are based on a 10% to 50% market penetration for existing accounts and 100% for new development ordinances (account participation). Only the new Program E will be discussed in detail in this report. Programs B, C, and D were described in the 2007 report.

It is possible to achieve lower or higher conservation savings than those stated in this report. For example, the savings could be increased if (a) program length and/or resources are increased or decreased, or (b) different programs, other than those analyzed in the report(s), with higher savings are implemented (if new technology becomes available), or (c) if programs are redesigned to offer higher or reduced incentives (direct installation or higher rebate amounts can often increase participation, and lower incentive amounts often leads to a lower participation rate).

## CONTENTS

This technical report provides a general overview for the methodology, assumptions, and results for the conservation analysis. The following ten pieces of information are included in this report:

1. Overview of Evaluation Process
2. Revised Baseline Water Demands with and without the new plumbing fixture requirements (2014)
3. Leak Detection and Repair with Automated Metering System (AMS)
4. AMS Meter installations
5. Comparison of Individual Conservation Measures
6. Results of Conservation Program Evaluation
7. Update on Drought Analysis and Demand Hardening
8. Conclusions
9. Attachment 1: Assumptions for the Conservation Measures Evaluated
10. Attachment 2: Program E Annual Costs 2009 - 2030

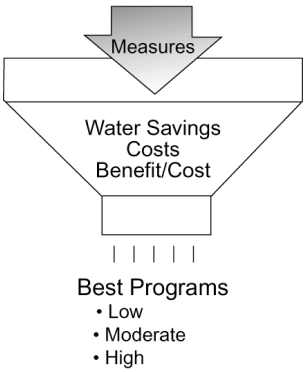
Each of these will be discussed in individual sections below.

## 1. OVERVIEW OF EVALUATION PROCESS

### Long Term Conservation Evaluation Process

Using the same evaluation process in 2009 as in 2007 water savings were estimated and costs for the measures were developed. To review, benefits and costs were compared in a formal present value analysis and conclusions were drawn about which measures produce cost-effective water savings. This process can be thought of as an economic screening process, shown in Figure 1. Packaging the best measures into alternative programs allows MMWD to consider what level of conservation is appropriate.

**Figure 1**
**Evaluation Process**




Benefit-cost analysis has been used by many water agencies to evaluate and help select a water conservation measure best suited to local conditions. This analysis requires a locale-specific set of data, such as historical water consumption patterns by customer class, population projections, age of housing stock, and prior conservation efforts.

The following nine steps were used to implement the methodology by expanding upon the same DSS model used to prepare the demand projections.

1. Develop baseline water use projections without the national plumbing code. Projections cover each key customer category and are broken down into indoor end uses and outdoor end uses. Note, the plumbing code refers to savings from the 1992 Energy Act; it is not the same as savings from BMP conservation. The baseline water use projections (demand projections) for this project were matched to the 2005 Urban Water Management Plan (UWMP) forecasts created by MMWD, found in the Water Use Provisions section of the UWMP on Page 32. The projections used in the DSS Model are shown in Table 2.
2. Identify possible water conservation measures and screen the measures qualitatively to identify those that are applicable to the service area. Develop appropriate unit water savings and cost factors for each measure.
3. Estimate the affected customers (or number of accounts) for each conservation measure by dividing the measure's projected customers (or accounts) that implements the measure by the total service area customers (accounts). This factor is called the market penetration or installation rate. For this analysis 10% to 100% is assumed as shown in Attachment 1. These individual penetration rates could be higher if more time and/or resources were dedicated to the program.
4. Estimate total annual average and peak day water savings. The water savings are computed by multiplying unit water savings, per measure, by the market penetration or installation rate (10% to 100% of accounts), and then multiplying by the number of units in a particular service area (such as dwelling units) targeted by a particular measure.
5. Identify benefits to Marin Municipal Water District including potential reduction in imported water
6. Quantify total benefits for each year in the planning period by multiplying average water savings for each measure by the computed value of the benefits.
7. Determine initial and annual costs to implement the measures based upon pilot projects, local experience, and the costs of goods, services, and labor in the community. This is multiplied by the number of units participating each year and then added to overall administration and promotion costs to arrive at a total measure cost, which may be spread over a number of years.
8. Compare benefits and costs of measures by computing the present value of costs and benefits over the planning period.
9. Compile and compare packages containing various new measures (for example, benefit-cost ratios greater than 1.0 and significant water savings).

## 2. BASELINE WATER DEMANDS WITH AND WITHOUT PLUMBING CODE

Water demand projections were developed out to the year 2030 using the Least Cost Planning Water Demand Management Decision Support System (DSS) model. This model incorporates information from the:

- 2005 MMWD Urban Water Management Plan.
- 2006 Water Management Report.

- 2000 and 2005-7 Census data and estimates.
- 2007 MMWD Conservation Master Plan
- 2007 Maddaus Water Management Conservation Technical Analysis
- Data provided by MMWD staff including estimates for value of water saved, historical water use, past conservation efforts, and water system facilities.

**National Plumbing Code**

National law requires that for new construction after January 1, 1992 only fixtures meeting the following standards can be installed in *new buildings*:

- Toilet – 1.6 gal/flush maximum
- Urinals – 1.0 gal/flush maximum
- Showerhead - 2.5 gal/min at 80 psi
- Residential Faucets – 2.2 gal/min at 60 psi
- Public Restroom Faucets - 0.5 gal/min at 60 psi

Replacement of fixtures in *existing buildings* is also governed by the Federal Energy Policy Act that requires only devices with the specified level of efficiency (shown above) can be sold after January 1, 1994 for residential use and January 1, 1997 for commercial toilets. Only efficient models can be legally sold by manufacturers to be placed in new structures or used as replacement parts for existing fixtures. Natural replacement rates for toilets, urinals and showerheads used in this analysis were 3 to 4 percent per year (varying by fixture type). The net result of the plumbing code is that new buildings will be more efficient and old inefficient fixtures will slowly be replaced with new more efficient models. The national plumbing code is an important piece of legislation and carefully taken into consideration when analyzing the overall water efficiency of a service area.

In addition to the plumbing code the US Department of Energy regulates appliances such as residential clothes washers. Regulations to make these appliances more energy efficient has driven manufactures to dramatically reduce the amount of water these efficient machines use. Generally horizontal axis washing machines use 30-50 percent less water than conventional models (which are still sold). We forecast a gradual transition to efficient clothes washers so that by 2020 this will be the only type of machines sold. Given that machines last about 15 years eventually all machines in the MMWD area will be of this type.

In October 2007, the California legislature passed a new requirement AB715, which mandates that by 2014 all toilets sold by manufacturers be High Efficiency Toilets (flushing at 1.28 gallons per flush or less) and all urinals be High Efficiency Urinals (flushing at 0.5 gallons per flush or less). This new regulation was included in the plumbing code analysis for MMWD. Shown below in Table 1 are the current requirements and possible future fixture requirements that may apply to MMWD.

**Table 1 - Plumbing Fixture Legislation and Regulations**

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| Plumbing Fixture | Required by Plumbing Legislation and Regulations | Possible Future Fixture Requirements |
|---|---|---|
| Urinals | 0.5 gpf by 2014 in California | 1 pint per flush |
| Residential Lavatory Faucets | 2.5 gpm | 0.5 gpm |
| High Efficiency Toilets | 1.28 gpf by 2014 in California | 1.28 gpf |

gpf = gallons per flush; gpm = gallons per minute

## Demand Forecasts without the Plumbing Code

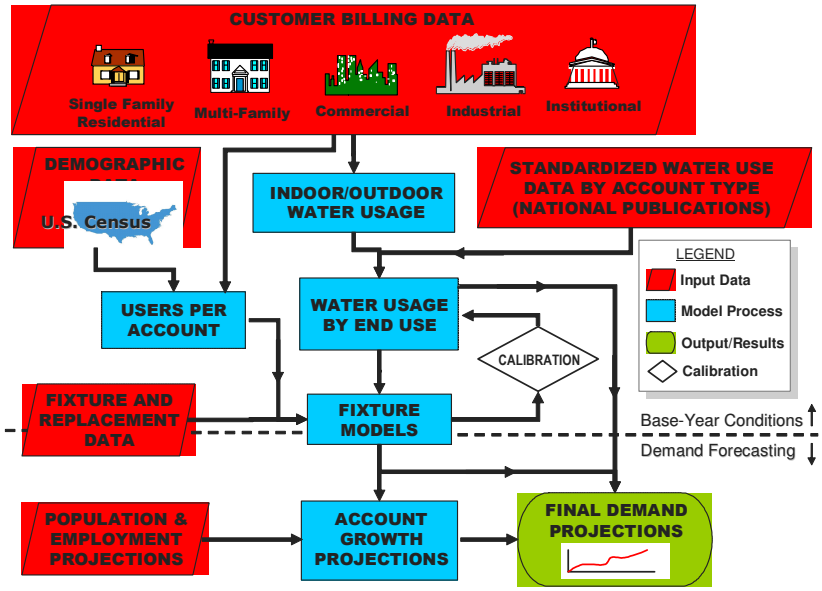
As mentioned previously, we matched the demand projections generated by MMWD in their Urban Water Management Plan for the years 2010 through 2025. The projection in the UWMP was equated to our "without the plumbing/appliance code" projection.

## Demand Forecasts with the Plumbing Code

We then used the DSS model as outlined by the Figure 2 to generate an additional projection "with the plumbing code" to take into account the plumbing fixture changes and appliance changes that are taking place since the enactment of the 1992 Energy Act and subsequent plumbing fixture legislation and regulations. It is important to generate a demand projection "with the plumbing code" to currently determine the level of efficient fixtures in the service area. For example, the "with the plumbing code" demand takes into account all of the toilets that have been changed from high flush volumes to the more efficient 1.28 gallons per flush model. In addition new homes built since 1992 have these low flow fixtures in them and are added into the housing mix in the model. This is a very important step that is taken to make sure that any water conservation measures undertaken by MMWD that overlap with the effects of the plumbing code are properly accounted for.

Figure 2 below describes how the above listed items are incorporated into the flow of information in the DSS Model.

**Figure 2**
**DSS Model Overview**



**Graph of Revised Projected Baseline Demands**

Figure 3 shows the projection at five-year increments. The graph shows projections for demand with and without the plumbing code through 2030. The upper demand curve closely match those in the Urban Water Management Plan "Past, Current and Projected Water Use" shown in the Water Use Provisions section on page 32. The lower curve reflects the 2014 plumbing code changes described above and is lower than the baseline curve presented in the 2007 report.

**Table of Water Demand Projections**

Table 2 presents the water demands projection which includes the following:

1. The water demand projections are based on the future population projections.
2. The water demands in 2030 without plumbing code are the same as in the 2005 Urban Water Management Plan.
3. Projections were made *with and without* the plumbing codes.
4. Projections shown in the below table are for potable water only.

The plumbing codes and appliance standards will reduce 2030 demands 2,251 AF/Yr or approximately 6.5 percent (this is an increase of one percent from the 2007 analysis). We include these savings in the overall savings projected for MMWD. Further reductions in demand due to conservation measures are calculated from an end use version of the demands "with plumbing code".

**Figure 3**
**Revised Baseline Average Day Water Use Projections for MMWD Potable System**

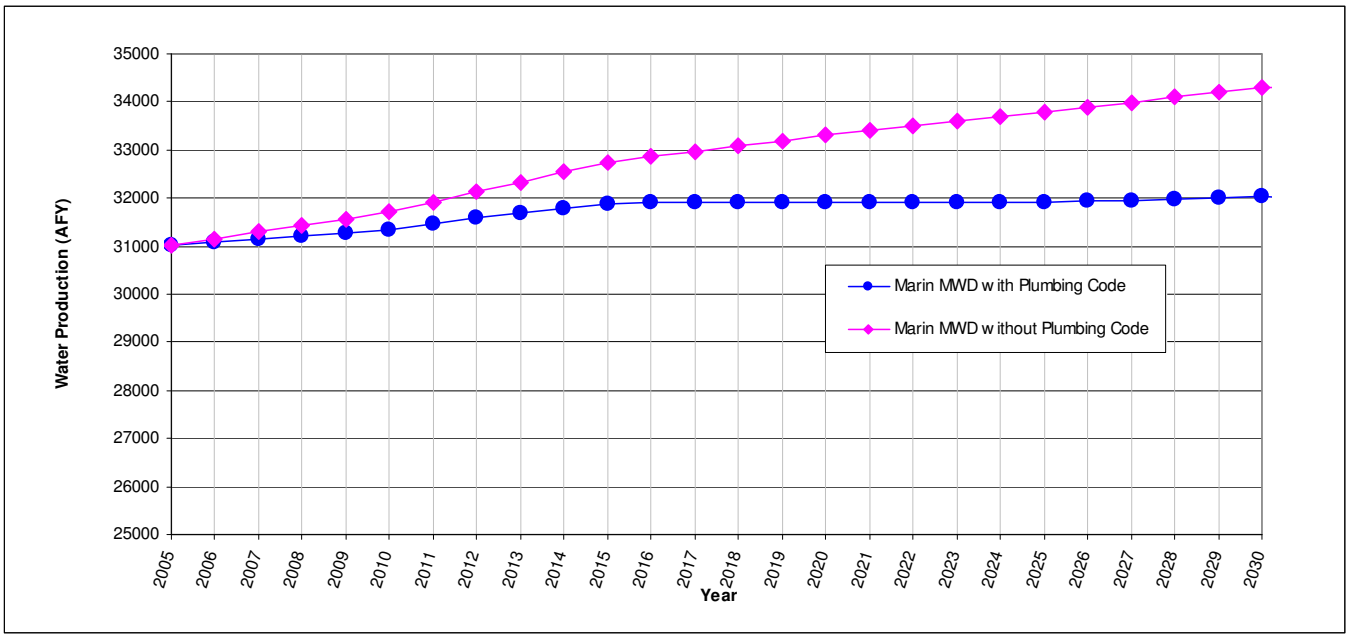



**Table 2**
**Baseline Water Use Projections for MMWD Potable System**

| Data Source for Projection | | Plumbing Code | Water Production, (AF/Yr)* | | | | | |
|---|---|---|---|---|---|---|---|---|
| Residential | Non-Residential | | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 |
| 2005 Urban Water Management Plan | 2005 Urban Water Management Plan | Not Included | 31,018 | 31,715 | 32,752 | 33,302 | 33,792 | 34,293 |
| 2005 Urban Water Management Plan | 2005 Urban Water Management Plan | Included | 31,018 | 31,341 | 31,894 | 31,917 | 31,920 | 32,042 |

*Total Water Production is potable only. Demand without plumbing code; closely match demands in Urban Water Management Plan. Plumbing code included values revised from 2007 report.

## 3. LEAK DETECTION AND REPAIR WITH AUTOMATED METERING SYSTEM

Maddaus Water Management interviewed MMWD Operations department staff to understand the current leak detection program and learn of any remaining conservation savings potential. MMWD staff provided data and an explanation of the current positions and responsibility of each leak detection crew. During the summer of 2008, there were up to 20 identified leaks that were unable to be repaired due to the lack of staff availability. The service crews are responsible for not only leak repairs but also installation of new services, service up sizing, hydrant installation and repairs.

Figure 5 and Table 4 quantify the past ten year history of unaccounted for water (UFW) at MMWD. UFW is the difference between water produced and water sold, expressed as a percentage of water produced. The low points on the graph of 7.2% and 8.9% were during the

two years MMWD had a proactive leak detection program (meaning that MMWD looked for leaks rather than just repair leaks that were reported). The leak detection program was recently reinstated in the year 2008 following the adoption of the 2007 Marin Municipal Water Conservation Master Plan. In 2008, the two crews have been very successful at identifying and repairing over 700 leaks on the MMWD system saving an estimated 375,000 gallons per day (0.375 mgd). The typical stated industry goal is to have a UFW under 10%. The goal of the MMWD aggressive program will be to reduce UFW below this 10% industry recommended goal.

**Figure 5**
**MMWD 10 year History of Unnaccounted for Water (UFW)**

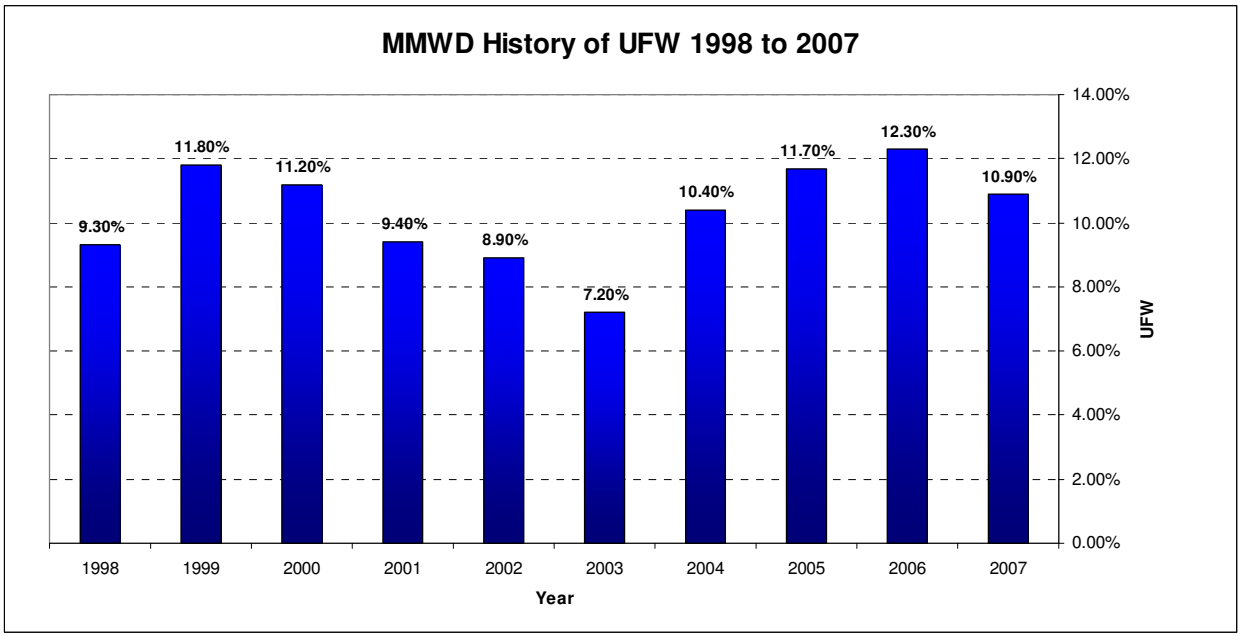



**Table 4**
**MMWD 10 year History of Unnaccounted for Water (UFW)**

| Year | MMWD UFW |
|---|---|
| 1998 | 9.30% |
| 1999 | 11.80% |
| 2000 | 11.20% |
| 2001 | 9.40% |
| 2002 | 8.90% |
| 2003 | 7.20% |
| 2004 | 10.40% |
| 2005 | 11.70% |
| 2006 | 12.30% |
| 2007 | 10.90% |
| **Average** | **10.3%** |

Following multiple discussions and data analysis on UFW as shown above, MMWD staff agreed there is remaining potential water savings if a third crew was hired. This third crew would be dedicated to repair only (rather than sharing their time amongst other activities other than leak repair). The additional staff would allow the repair of leaks in a timely fashion. Currently, with existing crews, leaks are scheduled for repair by severity of the leak and additional work load. At times there can be 5 to 10 leaks waiting for repair, occasionally that number can rise to as high as 15 to 20. With the assistance of the MMWD staff, the following assumptions were created for Program E:

- The savings goal from Program E would be to reduce unaccounted for water from 10.7% as reported in the 2005 MMWD Urban Water Management Plan down to 7.0%. The 7.0% value was just under the actual UFW of 7.2% shown in Table 4 during the year 2003 when MMWD last had a leak detection program.
- Cost of a "dedicated leak repair crew" was provided to MWM and incorporated into the DSS model as Tier 1 - 3 (BMP 3 UFW Reduction). The cost for the additional crew was added to the existing program budget to arrive at a total cost to run the leak detection program with a total of 3 crews. The incremental cost for a leak detection crew was provided by MMWD staff at approximately $145,000 per year. The annual cost includes a crew leader, heavy equipment operator, utility worker, labor worker, small service truck, small dump truck, and small excavator.
- The Leak Detection program would be greatly assisted using the Automated Metering Systems (AMS) described in the next section. The AMS system would enable the detection of more leaks and make it possible to efficiently maintain the 7.0% UFW goal.

## 4. AUTOMATED METERING SYSTEM (AMS)

Maddaus Water Management interviewed MMWD Operations department staff to understand the feasibility of installing an automated metering system (AMS) for the MMWD service area. An AMS system includes both the meters and the communication hardware and data management software that creates a 2-way "fixed" network between advanced water meter and utility business system. AMS allows the automated collection and distribution of information to both customers and the utility.

A previous study on automatic metering systems was completed on September 5, 2007. The study reviewed the 57,300 meters in service (report quoted number of meters in 2007, current meter total in 2009 is closer to 62,000 to 65,000) and concluded the meter accuracy of the system was between 93.88% and 96.66%. This meter inaccuracy may cost MMWD between $1.2 million and $2.2 million per year in lost revenue. However, the AMS system is very expensive and according to the 2007 estimate will cost MMWD approximately $19.6[1] million dollars.

MMWD has not yet made a decision on the AMS system, specifically the exact installation date and cost of the system that would be assigned to the conservation department. Therefore, the exact direct cost was excluded from this conservation technical analysis except to run a few hypothetical

[1] $19.6 Million cost for the AMS system was provide by MMWD and generated in 2007 by Mountain States Pipe and Supply, representing U.S. Metering and Technology. Cost elements include MMWD staff time, overhead and indirect costs, CEQA, reporting, etc.

scenarios to determine approximate cost / benefit ratios and cost of water saved. At the request of MMWD, two scenarios were considered, a 20% and a 40% cost sharing for the conservation department (For example, the conservation department would fund 20% of the entire cost of the AMS system). These scenarios are examples only, and not the actual costs of AMS assigned to conservation department.

For these two scenarios it was assumed there would be a 3 year installation period starting in the year 2012 and concluding at the end of the year 2014. The total cost of the AMS system provided by MMWD was approximately $19.6 Million as discussed earlier in this section. As shown in Table 10, using the assumed parameters, the cost of Program E with a 20% cost share of AMS would have a cost of water saved of $467 / AF. The present value cost of the entire program would be $47 Million. Similarly using these assumed parameters, the cost of Program E with a 40% cost of AMS would have a cost of water saved of $498 / AF. The present value cost of the entire program would be $50 Million.

A few of the key benefits of the AMS system (that pertain to water conservation) listed in the MMWD study are the following:

1. Real-time usage and monthly billing: Current billing on 30-60 day cycles do not allow for customers to judge their individual water conservation efforts until after the billing cycle (60 days later). In-home remote meter readouts would allow consumers to see their actual usage. By providing multiple reads per day and posting the reads to the web on a daily basis, both the consumer and MMWD would be able to track conservation efforts such as a repair of a customer leak, or a change out to efficient equipment in real-time.
2. Customer Large Water Leaks Written Off / Forgiven: With an AMS system, thresholds for unusual usage can be individually set, and will alert MMWD immediately. MMWD can be proactive in notifying the customers or dispatching a crew to avoid having to write off revenue as a result of the water leak. The faster response at catching leaks early will help to reduce the UFW as discussed above in Section 3.
3. Enhanced residential, commercial and landscape surveys and water budgets: The AMS system will enable staff to target customers for surveys that appear to have leaks on their property and/or use excessive amounts of water for irrigation or other purposes that could be reduced by better water management. The surveys will show customers how they can save money on their water bill, enhancing their participation over conventional surveys without AMS.

The 2007 AMS Study authors and MMWD Operations department staff recommended a pilot project to determine if the system is feasible for the service area. It was recommended to do a residential area distant from MMWD headquarters (possibly Fairfax or Woodacre) that could be monitored closely. This small system could be tested to ensure customer satisfaction, accuracy in data collection, and integrity with hilly terrain (MMWD service area has approximately 40% of its service area in hilly areas). If it is concluded the pilot test is successful, then MMWD staff would recommend a three year meter and infrastructure installation program.

MWM was directed by MMWD staff to incorporate this system into Program E measures starting in the year 2015, to allow system tests and ensure the system is fully functional. Thus implementation of Program E requires an AMS system to be fully functional by 2015. The

individual conservation measures in Program E that benefit from the AMS system are BMP 1a and BMP 1b, Residential surveys (allows the conservation staff to target homes with existing leaks for surveys, BMP 3 Leak Detection as described above, BMP 5a water budgets can help with the aid of increased meter accuracy, BMP 9 commercial surveys (again allows conservation to target businesses that already appear to have a leak for a water survey), and Tier 2-10 AMS installation and customer leak notification.

## 5. COMPARISON OF INDIVIDUAL CONSERVATION MEASURES

### Perspectives on Benefits and Costs

The determination of the economic feasibility of water conservation programs depends on comparing the costs of the programs to the benefits provided. The analysis was performed using the DSS model. The DSS model calculates savings at the end-use level; for example, the model determines the amount of water a toilet rebate program saves in daily toilet use for each single family account. For this evaluation, benefits are based the avoided costs of developing new sources of imported water for Marin Municipal Water District estimated to cost about $1,631 per acre-foot[2]. At the request of MMWD, this cost of water was not changed for the 2009 Conservation Technical Analysis. The following text is included from the 2007 report to help the reader recall the methods used in the previous study. Similar methods were used for in 2009 analysis.

Present value analysis is used to discount costs and benefits to the base year. From this analysis benefit-cost ratios of each measure are computed. When measures are put together in programs the interactions are accounted for by multiplying water use reduction factors together at the end use level. A water use reduction factor is 1.0 minus the water savings, expressed as a decimal. This avoids double counting when more than one measure acts to reduce the same end use of water.

Benefit-cost analysis can be performed from several different perspectives, based on who is affected. For planning water conservation programs for utilities, the perspectives most commonly used for benefit-cost analyses include the utility and the community. The "utility" benefit-cost analysis is based on the benefits and costs to the water provider. The "community" benefit-cost analysis includes the utility benefit and costs together with account owner/customer benefits and costs. These include customer energy benefits and costs of implementing the measure, beyond what the utility pays.

The utility perspective offers two advantages for this analysis. First, it considers only the program costs that will be directly borne by the utility. This enables the utility to fairly compare potential investments for saving and supplying water. Second, because revenue shifts are treated as transfer payments, the analysis is not complicated with uncertainties associated with long-term rate projections and retail rate design assumptions. Revenue reductions, as a result of reduced water sales due conservation will be predictable and can be accommodated by adjusting utility water rates over time, as is current MMWD practice. Because it is the water provider's role in developing a conservation plan that is paramount in this study, the utility perspective was primarily used to evaluate elements of the plan.

[2] Daniel Carney, Marin Municipal Water District, December 2006

No evaluation perspectives are without shortcomings. The principal weakness of the utility perspective is that it does not count the benefits accrued or costs incurred outside of the utility. Therefore another perspective is also used – the community perspective. The community perspective is defined to include the utility costs and benefits and the customer costs and benefits. Costs incurred by customers striving to save water while participating in conservation programs are considered, as well as the benefits received in terms of reduced energy bills (from water heating costs). Other factors external to the utility, such as environmental effects, are not included in the benefit-cost analysis. Because these external factors are often difficult to quantify, they are frequently excluded from economic analyses, including this one.

**Present Value Parameters**

The time value of money is explicitly considered. The value of all future costs and benefits is discounted to 2005 (the base year) at the real interest rate of 3.0%. The DSS model calculates this real interest rate, adjusting the current nominal interest rate (assumed to be approximately 6.1%) by the assumed rate of inflation (3.0%). Cash flows discounted at 3 percent are herein referred to as "Present Value" sums.

**Assumptions about Costs**

Costs were determined for each of the measures based on industry knowledge, past experience and data provided by MMWD. Costs may include incentive costs, usually determined on a per-participant basis; fixed costs, such as marketing; variable costs, such as the costs to staff the measures and to obtain and maintain equipment; and a one-time set-up cost. The set-up cost is for measure design by staff or consultants, any required pilot testing, and preparation of materials that will be used in marketing the measure. Measure costs were estimated for each year between 2005 and 2030. Costs were spread over the time period depending on the length of the implementation period for the measure.

Lost revenue due to reduced water sales is not included as a cost because the conservation measures evaluated herein generally take effect over a span of time that is sufficient to enable timely rate adjustments, if necessary, to meet fixed cost obligations.

**Water Savings**

Data necessary to forecast water savings of measures include specific data on water use, demographics, market penetration, and unit water savings. Savings normally develop at a measured and predetermined pace, reaching full maturity after the target market penetration is achieved. This may occur three to ten years after the start of implementation, depending upon the implementation schedule.

**Conservation Measures Evaluated with the DSS Model**

Upon inspection of the overall list of new measures it became apparent that some measures could be combined and others could be separated into two categories as follows:

- Measures that were voluntary and incentive based
- Measures that were regulatory and applied to new development only

This division was used to create two lists of measures that could be evaluated separately. Tier Two targets various types of customers and offers a range of incentives to enhance participation. New Development measures were targeted at single family homes (including town homes and

condos), apartments and non-residential accounts as this category represents the largest category of new development with the most water savings potential.

Table 5 summarizes the 10 Tier One measures, 10 Tier Two measures, and 11 New Development measures evaluated in the DSS Model for Program E. The measure package was specifically designed to illustrate an increasing level of water savings for MMWD.

The program is not intended to be rigid programs but rather to demonstrate the range in saving that could be generated if selected measures were run together. In this step we account for the overlap in water savings (and benefits) and estimate combined savings and benefits from programs or packages of measures.

**Program E**

Program E builds on Program D and contains all Program D measures plus a revised unaccounted for water program and enhanced measures using AMS. Program E includes all 31 analyzed conservation measures at high market penetrations of 30 to 50 percent range except for the New Development measures which are at 100% market penetration as they are ordinances for all new development. Note that some measures are listed in two parts due the addition of AMS; the market penetration range of 30 to 50 percent is obtained by adding the two measures together (for example Tier 1a with and without AMS). Measures without AMS would be implemented until about 2015 when the AMS system is planned to be available and then these measures would be replaced by measures using AMS. Also note that measures that either saved a small amount of water or were not cost-effective (Benefit-Cost ratio less than 1.0 and a high cost of water saved) were included here so as to represent the highest water savings based on the all measures analyzed. Some of the Tier Two measures are small programs in that the target number of accounts is very small. Even though they appear to be relatively expensive from a measure point of view, their impact on the overall program costs and savings is relatively minor.

**Table 5**
**Conservation Measures Included in Program E, Descriptions and Changes Made to Measures for Program E Only**

| Description of Conservation Activity | Measure Number | Target Customer Category | Measure Description |
|---|---|---|---|
| BMP 1a - Residential Water Surveys-Indoor | Tier 1 - 1 | SF, CONDO, MF | This is the indoor component of indoor and outdoor water surveys for existing single-family and multifamily residential customers. Normally those with high water use are targeted and a customized report is provided to homeowner. Assumes program will switch to using the AMS system in the year 2015. |
| BMP 1b - Residential Water Surveys-Outdoor | Tier 1 - 2 | SF, CONDO, MF | This is the outdoor component of indoor and outdoor water surveys for existing single-family and multifamily residential customers. Normally those with high water use are targeted and a customized report is provided to homeowner. Assumes program will switch to using the AMS system in the year 2015. |

| Description of Conservation Activity | Measure Number | Target Customer Category | Measure Description |
|---|---|---|---|
| BMP 3 - UFW Reduction 3.7% | Tier 1 - 3 | SYSTEM | MMWD will hire a 3rd Leak detection and repair crew to increase efforts to find and repair leaks in the distribution system and take other actions (such as meter replacement) to reduce water losses. A ten year program to reduce unaccounted for water from 10.7 to as low as 7.0 percent (variable) is proposed for this measure. (This effort is greater than Program D which had a 3.0% UFW reduction down to 7.7 percent) |
| BMP 5a - Landscape Water Budgets | Tier 1 - 4 | IRR | 90% - 100% of all irrigators of landscapes with separate irrigation accounts would receive a monthly or bi-monthly irrigation water use budget. Assumes program will switch to using the AMS system in the year 2015. |
| BMP 5b – Large Landscape Conservation Audits | Tier 1 - 5 | COM, INS | All public and private irrigators of landscapes larger than one acre would be eligible for free landscape water audits upon request. |
| BMP 6 - Washing Machine Rebate | Tier 1 - 6 | SF, CONDO | Homeowners would be eligible to receive a rebate on a new water efficient clothes washer. Water savings have been increased to account for more efficient machines available on the market. Assume MMWD will rebate highest efficiency machines. Program E extends washer rebates to the year 2015 with a goal of 1,400 washers per year. (Program D concludes the washer rebate program in the year 2010). |
| BMP 7 – Public Information | Tier 1 - 7 | SF, CONDO | Public education would be used to raise awareness of conservation measures available to customers. Programs could include poster contests, speakers to community groups, radio and television time, and printed educational material such as bill inserts, etc. |
| BMP 9 - Commercial Water Audits | Tier 1- 8 | COM, INS | High water use accounts would be offered a free water audit that would evaluate ways for the business to save water and money. Assumes program will switch to using the AMS system in the year 2015. |
| BMP 14 – ULF Toilet Ordinance- Single Family | Tier 1- 9 | SF | Homeowners would be required to replace an existing high volume toilet with a 1.6 gallon per flush efficient toilet when the name on the water account changes. Program concluded in the year 2007 and was replaced with a HET rebate program (See measure Tier 2-3), but savings continue from toilets replaced due to the ordinance for the life of the toilet. DSS Model only has program active for the years 2006 and 2007. |
| BMP 14 – ULF Toilet Ordinance- Multifamily | Tier 1- 10 | MF | Homeowners would be required to replace an existing high volume toilet with a 1.6 gallon per flush efficient toilet the when name on water account changes. Program concluded in the year 2007 and was replaced with an HET direct install program for RMF customers (See measure Tier 2-3), but savings continue from toilets replaced due to the ordinance for the life of the toilet. |

| Description of Conservation Activity | Measure Number | Target Customer Category | Measure Description |
|---|---|---|---|
| | | | DSS Model only has program active for the years 2006 and 2007. |
| Rain Sensor Retrofit | Tier 2 - 1 | SF, Condo | Agency pays for the $40 rain sensor; homeowner has the option to pay for installation ($35). Program start date changed to 2009 (was originally 2008) and extended 3 years to the year 2015 (Program D concluded in the year 2012). |
| San Quentin Toilets | Tier 2 - 2 | Existing Customers CII | Toilet replacement at San Quentin. Replace a total of 1,000 toilets over 5 years. Entire program cost and administration was provided by the prison. Current completion date is sooner than planned and will finish in the year 2009 (Program D concluded in the year 2017). |
| Residential High Efficiency Toilet Rebates | Tier 2 - 3a | SF, CONDO | Provide an average of a $200 rebate or voucher for the installation of a high efficiency toilet (HET). Program will start with a rebate of $250, and then decrease to $150 per toilet by the end of the program. HETs are defined as any toilet to flush 20% less than ULFTs and include dual flush technology. Rebate amounts would reflect the incremental purchase cost. Program was extended three years to conclude in the year 2019. |
| CII High Efficiency Toilets Rebates and Direct Install | Tier 2 - 3b | Existing Customers: MF & COM, INS | Provide a $200 rebate or $300 direct installation of a high efficiency toilet (HET). Costs assume MMWD will use a contractor for this particular program. HETs are defined as any toilet to flush 20% less than ULFTs and include dual flush technology. Rebate amounts would reflect the incremental purchase cost. Program began in the year 2008 and planned to continue until the year 2018. |
| Homeowner Landscape Classes Intensive | Tier 2 - 4 | Existing Customers: SF & CONDO | Sponsor classes at stores where irrigation equipment is sold or other suitable venues on selection and installation of efficient plant material and irrigation equipment (drip irrigation, smart controllers, low volume sprinklers, etc.). This program began in 2008 and is currently known as the Bay Friendly Landscape Program. |
| Coin-Op Washer Rebate | Tier 2 - 5 | Existing Customers: MF | Provide a $400 rebate for efficient coin-op washing machines to existing apartment complexes over a certain size with a common laundry room. |
| Financial Incentives/ Rebates for Irrigation Upgrades | Tier 2 - 6 | Existing Customers SF, CONDO, MF, CII, IRR | For SF, CONDO, MF, CII, and IRR customers with landscape, provide for rebates towards the purchase and installation of selected types of irrigation equipment upgrade including low volume sprinkler heads, check valves, smart irrigation controllers, low water use plants, food producing plants, gray water and rain catchment systems. Rebate is up to $350 for residential accounts and up to $650 for mixed use accounts and up to $3,500 for dedicated irrigation accounts. Assume average rebate claimed equates to $1,500 for non-Residential accounts. |

| Description of Conservation Activity | Measure Number | Target Customer Category | Measure Description |
|---|---|---|---|
| Hotel Retrofit 60% Market Penetration | Tier 2 - 7 | Existing Customers: COM | Following a free water audit, offer the hotel a rebate for equipment identified that would save water. Provide a rebate schedule for certain efficient equipment such as air-cooled ice machines, steamers, washers, cooling towers, and spray rinse valves. |
| CII Rebates to Replace Inefficient Equipment | Tier 2 - 8 | Existing Customers: CII | Provide a rebate for a standard list of water efficient equipment. Included would be x-ray machines, icemakers, air-cooled ice machines, steamers, washers, spray valves, efficient dishwashers, replace once through cooling, and add conductivity meters on cooling. |
| Existing Commercial Urinals Intensive | Tier 2 - 9 | Existing Customers: COM | Rebate increased to $400 for existing buildings to encourage installation of 0.5 gal/flush urinals rather than the current standard of 1.0 gal/flush models. The $400 cost assumes some drain line height changes are required. |
| Customer notification through AMS System | Tier 2 - 10 | ALL | Install AMS system throughout the entire service area by 2015. Use the system to automatically and electronically notify customers of the presence of a leak on their property. Assign one MMWD full-time staff person equivalent to perform email and telephone follow-up until leaks are repaired. |
| Require Rain Sensors | ND-1 | New Customers: SF, CONDO, MF, COM, INS | Require-sensor or rain shut off devices with all new automatic irrigation system installations on new homes and buildings. Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| Smart Irrigation Controller | ND-2 | New Customers: SF, CONDO, MF, COM, INS | Require developers to provide the latest state of the art SMART irrigation controllers. These SMART controllers have on-site temperature sensors or rely on a signal from a central weather station that modifies irrigation times at least weekly. Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| High Efficiency Toilets | ND-3 | New Customers: SF, CONDO, MF, COM, INS | Require developers to install a high efficiency toilet (HET). HET are defined as any toilet to flush 20% less than an ULFT and include dual flush technology. Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| Dishwasher New Efficient | ND-4 | New Customers: SF, CONDO, MF, COM, INS | Require developers to install an efficient dishwasher (meeting certain water efficiency standards, such as gallons/load). Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| Clothes Washing Machine Requirement | ND-5 | New Customers: SF, CONDO, MF, COM, INS | Building departments would be responsible to ensure that an efficient washer was installed before new home or building occupancy. Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |

| Description of Conservation Activity | Measure Number | Target Customer Category | Measure Description |
|---|---|---|---|
| Hot Water on Demand | ND-6 | New Customers: SF, CONDO, MF, COM, INS | Require developers to equip new homes or buildings with a hot water on demand system such as those made by Metland Systems and others. These systems use a pump placed under the sink to recycle water sitting in the hot water pipes to the water heater. Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| High Efficiency Faucets and Showerheads | ND-7 | New Customers: SF, CONDO, RMF, COM, INS | Require developers to install lavatory faucets that flow at no more than 1.5 gpm, kitchen faucets at 2.2 gpm, showerheads at 2.0 gpm Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| Landscape and Irrigation Requirements | ND-8 | New Customers: SF, CONDO, MF, COM, INS | Enforce a regulation that specifies that new homes or buildings be landscaped according to Bay Friendly Landscape principals, with appropriate irrigation systems. (Combines with Smart Controller listed above). Goal is overall 25% in irrigation water use (measure ND-2 and ND-9 combined). Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| MultiFamily Submetering | ND-9 | New Customers: MF | Require all new multi-family units to provide sub-meters on individual units. To help reduce financial impacts on tenants, regulations would be adopted that specify acceptable methods of metering and billing. Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| New CII Equipment | ND-10 | New Customers: CII | Offer reduced water and sewer connection fees to new facilities to install water efficient equipment in new facilities that goes above and beyond the building code requirements. Model program after Santa Rosa's BAT program. Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |
| 0.5 gal/flush Urinals in New Buildings | ND-11 | New Customers: CII | Require that new buildings be fitted with 0.5 gpf urinals rather than the current standard of 1.0-gal/flush models. Ordinance start year changed from 2008 to 2009. Ordinance assumed to be initiated on July 1, 2009. |

*Measures BMP 1a, 1b, 5a, 5b, 14, and Tier 2 3a and 3b, 5a and 5b are all counted as individual measures. These measures were split for more accurate evaluation.

Notes: ND = New Development.
T1 = Tier One
T2 = Tier Two
SF = Residential Single Family
MF = Residential Multi Family greater than 5 units
CONDO = Residential Duplexes and 3 or 4 units
CII = Commercial/Industrial/Institutional
IRR = Dedicated irrigation meters

**Measure Assumptions, Unit Costs, Market Penetration**

Attachment 1 summarizes all the water savings and cost assumptions for each measure in Program E for MMWD. Do note that the unit costs vary according to the type of account being addressed. For example, a measure might cost a different amount for a residential single family account, than a residential multifamily account.

**Comparison of Individual Measures**

Tables 6 through 8 present results of conservation measure evaluation for Marin Municipal Water District. Table 6 presents results for Tier One, Table 7 presents results for Tier Two and Table 8 presents results of New Development measures going forward from 2009.

These tables show how much water the measures would save on a 30-year average basis, how much they would cost and what the benefit-cost ratios are *if the measures were run on a stand-alone basis, i.e. without interaction or overlap from other measures that might address the same end use(s).* Note that measures with benefit-cost ratios less than 1.0 are defined to be "not cost-effective". Water savings are shown for 2025. Other key statistics are the cost of water saved in dollars per acre foot ($/AF), and the benefit-cost ratios. Benefits and costs are defined below:

- *Utility benefits and costs:* those benefits and costs that the utility would receive or spend.
- *Community benefits and costs:* community benefits equal utility benefits plus customer energy (cost to heat water) benefits. It is assumed hot water is heated 71 percent by natural gas and 20 percent by electricity and 9 percent by other means. PG&E 2009 residential retail rates are used to compute benefits of customer hot water savings. Community costs include utility and customer costs to implement measures.
- *Water Benefits:* based on the cost of not providing additional water for MMWD.
- *Costs for the utility:* include measure set-up, annual administration, and payment of rebates or purchase of devices or services as specified in the measure design.
- *Customer costs:* include costs of implementing the measure and maintaining its effectiveness over the life of the measure.
- *2025 water savings:* measure average water savings achieved by 2025. It is useful in comparing the relative water savings of the various measures.
- *First 5-year utility cost is the total money needed by MMWD to sponsor the program for the first 5 years.* Included would be the cost of incentives, contracts, materials and utility staff. Annual costs may be approximated by dividing the numbers by five.

NOTE: Individual measure water savings are not additive in Tables 6 through 8 due to measure overlap.

The column headings in Tables 6 through 8 are defined as follows:

- *Water Utility Benefit-Cost Ratio = NPV of Utility of Benefits (based on reduced imported water) divided by NPV of Utility Costs (see above)*
- *Total Community Benefit-Cost Ratio = NPV of Utility Benefits plus Customer Benefits (see above) divided by NPV of Utility plus Customer Costs (see above) where NPV = 30 year present value of annual costs discounted at 3 percent*

- *2025 Water Savings (AFY) = measure average water savings (AF/Yr) where AF/Yr =acre feet per year*
- *Cost of Savings per Unit Volume ($/AF) = NPV of Utility Costs divided by 30-year Average Water Savings * 365 where AF = acre feet*
- *Five Years of Utility Costs (2009-2013) = sum of annual costs for period shown, undiscounted. Note some programs do not start until 2015.*
- *Five Years of Community Costs (2009-2013) = sum of annual costs for period shown, undiscounted. Note some programs do not start until 2015.*

From Tables 6 through 8 the following observations can be made:

- The most cost-effective Tier One measure is the landscape water budgets.
- The most cost-effective Tier Two measure is the San Quentin Toilets, from the utility perspective as there was not direct cost for the program (the entire program was financed and managed by the prison). When the customer costs are considered, as with the community benefit-cost ratio the measure still remains attractive.
- The most cost-effective New Development measures are the High Efficiency Toilets for all new buildings, from the utility perspective.
- For Tier Two conservation the high efficiency toilets, urinals, and landscape and irrigation requirements have low community benefit-cost ratios (which is less than one). This is due to the fact that the rebates for hardware are expensive compared to other programs.
- Eight out of ten Tier One measures, Eight out of ten Tier Two measures, and all eleven of the New Development measures are cost effective from the utility perspective. In total, 27 of the 31 measures evaluated are cost-effective from the total community perspective.
- Eight out of ten of the Tier One measures, six out of ten of the Tier Two measures and six out of eleven of the New Development measures are cost effective from the community perspective, indicating that all other measures have relatively high customer costs. In total, 20 of the 31 measures evaluated are cost-effective from the total community perspective.

**Table 6**
**Tier One Conservation Measure Costs and Savings**

| Tier One Conservation Measure | | Water Utility Benefit-Cost Ratio | Total Commun-ity Benefit-Cost Ratio | 2025 Water Savings (AF/Yr) | Cost of Savings per Unit Volume ($/AF) | Five Year Utility Cost 2009 - 2013 Utility Cost ($) | Five Year Utility Cost 2009 - 2013 Total Community Cost ($) |
|---|---|---|---|---|---|---|---|
| T1-1 | BMP 1a Residential Water Surveys-Indoor without AMS | 0.79 | 1.44 | NA | $1,648 | $451,114 | $481,188 |
| | BMP 1a Residential Water Surveys-Indoor with AMS | 1.22 | 2.22 | 89.1 | $710 | Program begins in year 2015 | Program begins in year 2015 |
| T1-2 | BMP 1b Residential Water Surveys-Outdoor without AMS | 0.84 | 0.81 | 0.0 | $1,542 | $439,147 | $453,786 |
| | BMP 1b Residential Water Surveys-Outdoor with AMS | 1.27 | 1.23 | 92.8 | $678 | Program begins in year 2015 | Program begins in year 2015 |
| T1-3 | BMP 3 UFW Reduction 3.7% | 4.16 | 4.16 | 1147.0 | $244 | $2,191,147 | $2,191,147 |
| T1-4 | BMP 5a Landscape Water Budgets without AMS | 6.79 | 6.79 | NA | $182 | $272,997 | $272,997 |
| | BMP 5a Landscape Water Budgets with AMS | 9.72 | 9.72 | 395.9 | $88 | Program begins in year 2015 | Program begins in year 2015 |
| T1-5 | BMP 5b Large Landscape Conservation Audits | 0.57 | 0.17 | 2.4 | $1,766 | $27,208 | $89,995 |
| T1-6 | BMP 6 Washing Machine Rebate | 5.93 | 8.31 | 214.6 | $172 | $431,656 | $962,924 |
| T1-7 | BMP 7 Public Information | 1.58 | 2.52 | 155.0 | $672 | $798,180 | $798,180 |
| T1-8 | BMP 9 Commercial Water Audits Without AMS | 1.95 | 0.91 | 90.6 | $511 | $784,459 | $2,353,377 |
| | BMP 9 Commercial Water Audits With AMS | 1.44 | 0.65 | 190.1 | $572 | Program begins in year 2015 | Program begins in year 2015 |
| T1-9 | BMP 14 ULF Toilet Ordinance-Single Family | 76.56 | 38.28 | 58.0 | $15 | Program ended in year 2007 | Program ended in year 2007 |
| T1-10 | BMP 14 ULF Toilet Ordinance-Multifamily | 204.52 | 102.26 | 19.9 | $5 | Program ended in year 2007 | Program ended in year 2007 |

**Table 7**
**Tier Two Conservation Measure Costs and Savings**

| Tier Two Conservation Measure | | Water Utility Benefit-Cost Ratio | Total Commun-ity Benefit-Cost Ratio | 2025 Water Savings (AF/Yr) | Cost of Savings per Unit Volume ($/AF) | Five Year Utility Cost 2009 - 2013 Utility Cost ($) | Five Year Utility Cost 2009 - 2013 Total Community Cost ($) |
|---|---|---|---|---|---|---|---|
| T2-1 | Rain Sensor Retrofit | 2.82 | 1.54 | No savings in 2025 due to measur e life of 10 years | $413 | $227,618 | $417,300 |
| T2-2 | San Quentin Toilets | No Utility Cost | 7.21 | 72.9 | No Utility Cost | No Utility Cost | $250,000 |
| T2-3a | Residential High Efficiency Toilet Rebates | 0.83 | 0.45 | 263.4 | $1,188 | $3,608,402 | $6,629,808 |
| T2-3b | CII High Efficiency Toilets Rebates and Direct Install | 1.91 | 1.91 | 227.3 | $507 | $1,399,277 | $1,399,277 |
| T2-4 | Homeowner Landscape Classes Intensive | 4.89 | 0.16 | 29.6 | $197 | $85,139 | $2,639,316 |
| T2-5 | Coin-Op Washer Rebate | 3.54 | 5.54 | 43.8 | $278 | $184,595 | $369,190 |
| T2-6 | Financial Incentives/ Rebates for Irrigation Upgrades | 0.59 | 0.25 | 489.5 | $1,563 | $4,687,613 | $12,013,551 |
| T2-7 | Hotel Retrofit 60% Market Penetration | 10.95 | 7.28 | 56.5 | $85 | $43,892 | $114,120 |
| T2-8 | CII Rebates to Replace Inefficient Equipment | 3.29 | 1.30 | 29.4 | $283 | $76,080 | $193,126 |
| T2-9 | Existing Commercial Urinals Intensive | 0.65 | 0.53 | 22.5 | $1,484 | $240,128 | $292,903 |
| T2-10 | Customer notification through AMS System | 1.43 | 0.14 | 103.6 | $611 | Program begins in year 2015 | Program begins in year 2015 |

**Table 8**
**New Development Conservation Measure Costs and Savings**

| New Development Conservation Measure | | Water Utility Benefit-Cost Ratio | Total Commun-ity Benefit-Cost Ratio | 2025 Water Savings (AF/Yr) | Cost of Savings per Unit Volume ($/AF) | Five Year Utility Cost 2009 - 2013 Utility Cost ($) | Five Year Utility Cost 2009 - 2013 Total Community Cost ($) |
|---|---|---|---|---|---|---|---|
| ND-1 | Rain-sensor shut off device on irrigation controllers | 17.00 | 3.40 | 41.9 | $53 | $22,331 | $111,654 |
| ND-2 | Smart Irrigation Controller | 25.14 | 0.67 | 69.9 | $36 | $25,170 | $940,459 |
| ND-3 | High Efficiency Toilet (HET) | 51.83 | 0.94 | 65.8 | $19 | $25,170 | $1,390,822 |
| ND-4 | Dishwasher New Efficient | 4.56 | 0.81 | 12.7 | $200 | $25,170 | $757,402 |
| ND-5 | Clothes washing machines requirement for new residential | 32.62 | 2.73 | 89.6 | $28 | $25,061 | $936,371 |
| ND-6 | Hot Water on Demand | 27.40 | 1.13 | 69.6 | $33 | $23,005 | $1,194,153 |
| ND-7 | High efficiency faucets and showerheads | 22.55 | 7.62 | 62.6 | $40 | $25,170 | $179,397 |
| ND-8 | Landscape and irrigation requirements | 17.59 | 0.08 | 48.9 | $52 | $25,170 | $5,516,904 |
| ND-9 | MultiFamily Submetering | 43.42 | 10.00 | 26.2 | $21 | $5,534 | $49,810 |
| ND-10 | New CII Equipment | 24.86 | 5.02 | 36.3 | $37 | $13,241 | $119,172 |
| ND-11 | 0.5 gal/flush urinals in new buildings | 4.33 | 0.59 | 6.0 | $217 | $13,186 | $97,573 |

## 6. RESULTS OF CONSERVATION PROGRAM EVALUATION

Figure 6 shows annual average water savings for the revised plumbing code and Programs D and Program E for the years 2005 to 2030.

**Figure 6**
**Conservation Measure Programs - Annual Water Conservation Savings**

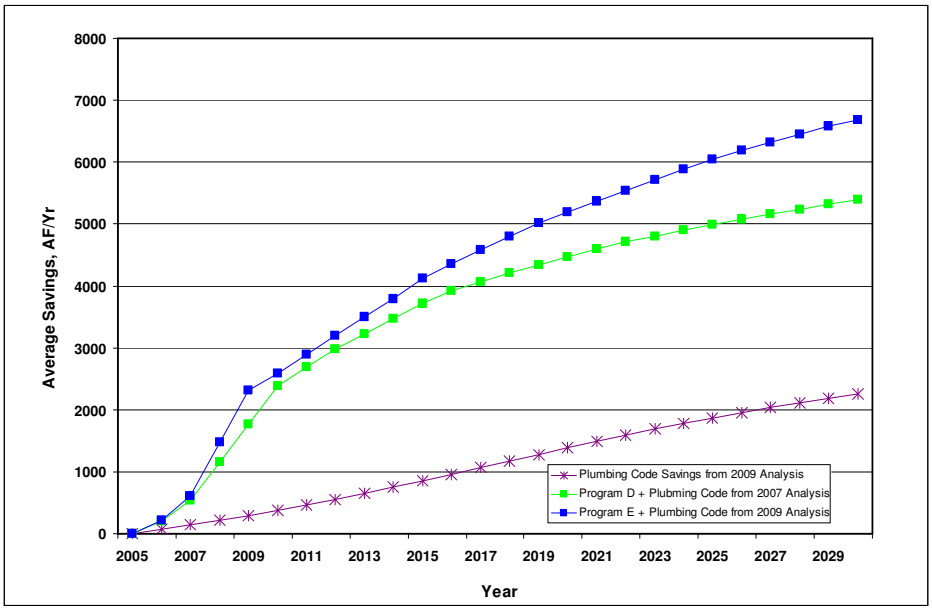



Table 9 and 10 present key evaluation statistics compiled from the DSS model. Assuming all measures are successfully implemented, projected water savings for 2015 and 2030 in acre-feet are shown, as are the costs of achieving this reduction. Table 9 excludes the $19.6 Million cost of installing AMS. Table 10 shows two hypothetical scenarios of a 20% and 40% cost share allocated to the conservation department of installing AMS.

The costs are expressed three ways.

1. Total present value over the 30-year period,
2. The money utilities would need to budget in the first five years (2009-2013) to get new programs underway,
3. The cost of water saved. These costs include costs to complete Tier One measures, as needed. Cost of water saved is presented two ways, just for the utility and for the community (customer plus utility).

These cost parameters are derived from the annual time stream of utility, customer and community costs. The annual costs for Program E are shown in Attachment 2 for three scenarios, without the cost of the AMS system, 20% cost share of the AMS system, and 40% cost share of the AMS system by the conservation department.

The water savings are expressed as a percentage of the projected 2030 demand. The last column indicates the percentage of the new water demand for 2030 that each program could fill. The new water needed by new customers over the next 25 years is the difference between 2005 demand of 31,018 AF/Yr and 2030 demand 32,042 AF/Yr with the plumbing code. The new water needed for MMWD by 2030 is 1,024 AF/Yr (Water needed for new development is for the years 2005 to 2030 which covered the entire study period).

## Table 9
## Comparison of Long-Term Conservation Programs - Costs and Savings
## Without the Cost of the Installation of the AMS System

| Conservation Program | Water Utility Benefit-Cost Ratio | 2015 Water Savings (AF/Yr) | 2025 Water Savings (AF/Yr) | 2030 Water Savings (AF/Yr) | 2030 Indoor Water Savings (AF/Yr) | 2030 Outdoor Water Savings (AF/Yr) | Total Water Savings as a % of Total Production in 2030* | Present Value of Water Utility Costs ($1,000s) | Present Value of Customer Costs ($1,000s) | Present Value of Community Costs ($1,000s) | Five Year Utility Cost 2009-2013 ($1,000s) | Utility Cost of Water Saved ($/AF) | Community Cost of Water Saved ($/AF) | % of Water Needed for New Development (2005 to 2030) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plumbing Code | NA | 858 | 1,872 | 2,251 | 2,251 | NA | 7.0% | NA | NA | NA | NA | NA | NA | 68.7% |
| Program E | 2.22 | 3,389 | 4,175 | 4,302 | 2,940 | 1,362 | 13.5% | $ 43,655 | $ 72,463 | $ 116,117 | $ 15,526 | $ 437 | $ 1,163 | 131.4% |
| Plumbing Code + Program E | 2.22 | 4,247 | 6,047 | 6,553 | 5,191 | 1,362 | 20.5% | $ 43,655 | $ 72,463 | $ 116,117 | $ 15,526 | $ 437 | $ 1,163 | 200.1% |

Notes:

- Present Value is determined using an interest rate of 3%
- Cost of water saved is present value of water utility cost divided by total 30-year water savings.
- Five Year Cost for all above programs is 2009 to 2013
- * % of water saved refers to the demand with the plumbing code
- Community Cost = Customer Cost plus Utility Cost

## Table 10
## Comparison of Program E Long-Term Conservation Programs
## AMS with Cost share of 20% and 40%

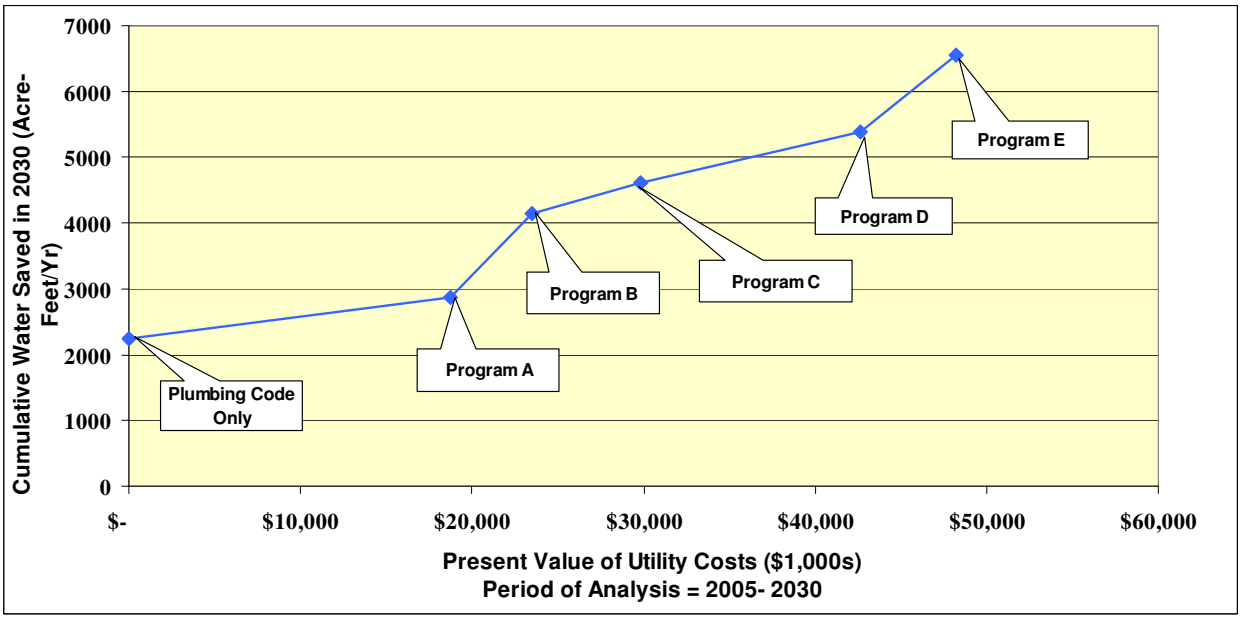
| Conservation Program | Water Utility Benefit-Cost Ratio | Present Value of Water Utility Costs ($1,000s) | Present Value of Customer Costs ($1,000s) | Present Value of Community Costs ($1,000s) | Utility Cost of Water Saved ($/AF) | Community Cost of Water Saved ($/AF) |
|---|---|---|---|---|---|---|
| Plumbing Code + Program E, No Cost of AMS | 2.22 | $ 43,655 | $ 72,463 | $ 116,117 | $ 437 | $ 1,163 |
| Plumbing Code + Program E, 20% Cost of AMS | 2.09 | $ 46,871 | $ 72,463 | $ 119,334 | $ 467 | $ 1,189 |
| Plumbing Code + Program E, 40% Cost of AMS | 1.96 | $ 49,972 | $ 72,463 | $ 122,435 | $ 498 | $ 1,220 |

Notes:

- Present Value is determined using an interest rate of 3%
- Cost of water saved is present value of water utility cost divided by total 30-year water savings.
- Community Cost = Customer Cost plus Utility Cost

Figure 7 shows how marginal returns change as more money is spent to achieve higher water savings. As the figure shows the cost versus saving curve is starting to decline after Program B. This means that the added cost of going from that Program C and D will save less water per unit expenditure. In other words there are diminishing returns when the curve starts to flatten out as Tier Two measures are added to the program. Then going from Program D to Program E the curve increases, showing that the savings increment Program E provides is more cost effective than other increments, with the exception of the increment from Program A to B. The attractiveness of Program E is of course related to the use of an AMS system. The cost of the AMS system is not included in Figure 7 for Program E at the request of MMWD. It was assumed the AMS system would be funded by departments other than conservation. The exact dollar figure for AMS system for the conservation department is unknown at this time, and therefore was not included.

**Figure 7**
**Present Value of Utility Costs versus Cumulative Water Saved in 2030**




## 8. DROUGHT ANALYSIS AND DEMAND HARDENING

The goal of this section is to update the evaluation made in the 2007 Technical Memorandum of the effectiveness of MMWD's existing drought ordinance in a future year, after the implementation of a long-term conservation program. In the prior memorandum Programs B and D were evaluated. In this memorandum Program E is added and Program D is retained for comparison. In addition to the drought analysis, the demand hardening phenomenon was evaluated. The assumed end use reductions were not changed from those shown in Table 9 of the prior 2007 memorandum.

### Background

MMWD's existing drought ordinance is a two-stage reduction program. Stages are triggered as water supply (reservoir storage) declines to certain specified threshold levels. For example, when storage falls below 50,000 AF on April 1st a 10 percent rationing is initiated. If storage falls below 40,000 AF on April 1st then a 25 percent rationing is initiated. In the past water use

reductions in drought periods have been achieved by effective public information programs combined with water rate increases. MMWD customers have an excellent record of achieving even more water savings than had been requested or targeted.

**Drought Measure Analysis**

Figure 8 shows the estimated impact of a simulated two-year drought occurring in 2025, rebounding gradually by 2028, on projected annual average demand through 2030. The graph of demand without plumbing code is included for reference and matches the demand projection found in the 2005 MMWD Urban Water Management Plan. If the drought ordinance is triggered in 2025 and the public is requested to make a 25 percent demand reduction, demand is projected to drop close to 25 percent. Our forecast of this reduction was made with an end use model and assumed customer reductions, considering the customer's ability to reduce water use. It will drop more if a long-term conservation program is in place at the time the drought occurs. The combined reduction of Program D and the drought ordinance is forecasted to be about 36 percent. The more aggressive Program E would cause a demand reduction of about 39 percent under these conditions. These simulated reductions in this report were made to study the impact of demand hardening only. They should not to be confused with demand reductions computed by the MMWD Supply model to balance supply and demand during a repeat of past droughts.

Table 11 shows the combined water savings of the long-term and drought program operating together. If a simulated drought occurs in 2025 the drought ordinance will save not 25% but rather 4 to 4.3 percent less. Said in other terms, the ordinance would only save from 21 to 20.7 percent if the drought ordinance works in conjunction with Program D or E instead of on its own with no conservation program. This occurs because some of the end uses have been reduced by the conservation program and there is less water available for a temporary demand reduction during a drought. In our opinion this estimated demand hardening should not be a key factor in deciding whether to pursue Program D or E. It is cost-effective to save this water over time, rather than leave the "waste" in the system so it can be saved during a future drought. MMWD should consider revising its expectations of the effectiveness or the drought ordinance. If it wants to save say 25 percent on top Program D or E savings then it should ask customers for about 30% reductions so it will net about 25 percent on top of savings from Program D or E.

**Figure 8**
**Simulated Drought Water Savings**

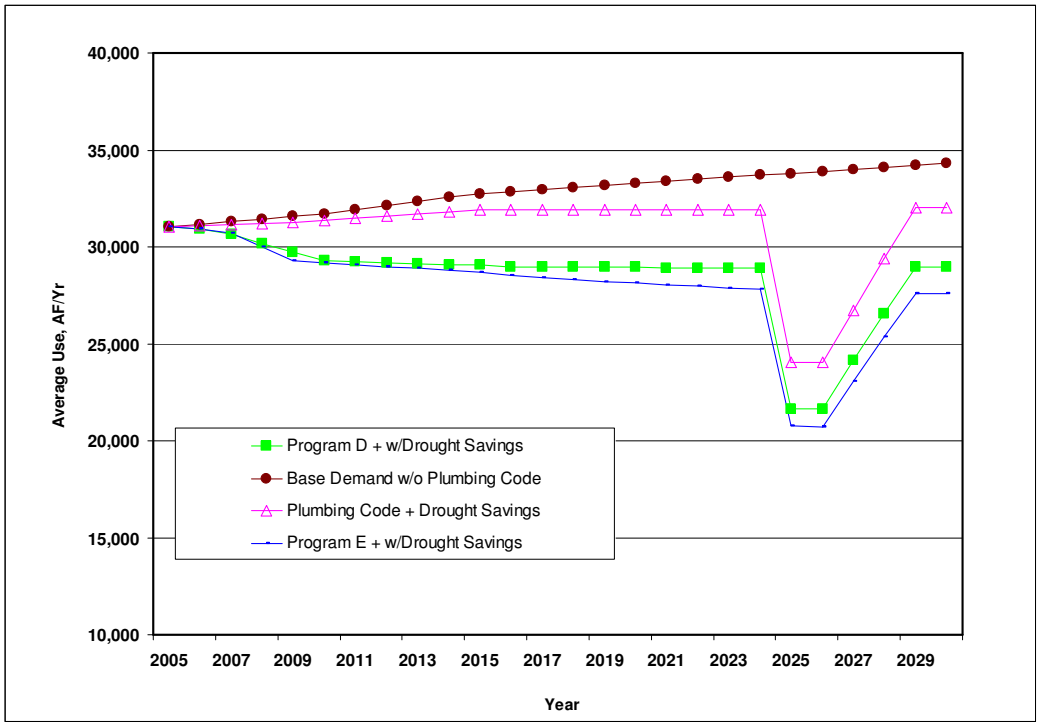



**Table 11**
**Drought Water Savings with Long-Term Program in Place and Amount of Demand Hardening**

| Scenario | Program Savings Only in 2025, (AF/Yr) | Program + Drought Ordinance Savings in 2025, (AF/Yr) | Percentage Reduction in 2025 Relative to Demand w/o Plumbing Code (%) | Demand Hardening, (Value in Bold Type) (%) |
|---|---|---|---|---|
| Demand without Plumbing Code + Drought Ordinance | 0 | 8,447 | 25% | 0 |
| Baseline Demand + Plumbing Code | 1,872 | --- | 5.5% | --- |
| Baseline Demand + Drought Ordinance | --- | 9,739 | 30.5% | 25+5.5=30.5 minus 30.5 = **0.0** |
| Program D | 5,035 | --- | 14.9% | --- |
| Program D + Drought Ordinance | --- | 12,136 | 35.9% | 25+14.9=39.9 minus 35.9= **4.0** |
| Program E | 6,046 | --- | 17.9% | --- |
| Program E + Drought Ordinance | --- | 13,036 | 38.6% | 25+17.9=42.9 minus 38.6=**4.3** |

## 9. CONCLUSIONS

### Relative Savings and Cost-Effectiveness of Programs

Marin Municipal Water District's service area has relatively high portion of residential water use and a significant amount of outdoor water use. Consequently, residential conservation programs produce the most savings. MMWD's service area is not a heavy manufacturing sector so the conservation potential in the nonresidential sector is relatively low. The amount of new growth forecasted for MMWD's area is relatively low so measures directed at new development produce relatively small savings. Because of the high avoided cost of new water, water conservation programs are very cost-effective. Overall conclusions are:

1. As requested by MMWD, Maddaus Water Management researched adding an additional crew for Leak Repair and separately the installation and implementation of an Automated Metering System (AMS). One of the goals of the AMS system would be to find leaks and assist with residential and commercial water audits. Both of these items appear to be good ideas that MMWD can consider in the future to create additional water savings. According to this study results, adding an additional crew dedicated to Leak Repair can save an additional 200 AF/yr (when compared to Program D that has two leak detection crews). After the installation of an AMS system the Leak detection notification (Tier 2 – 10) will save an additional 100 AF/yr.

2. The change in California plumbing code requiring 1.28 gallon per flush High Efficiency Toilets (HETs) and 0.5 gallon per flush urinals by the year 2014 increases savings 306 AF/yr in 2025 (367 AF in 2030). The new legislation was signed by the Governor in October 2007 and therefore was not included in the May 8, 2007 Conservation Technical Analysis.

3. Program E saves 1,057 AF/Yr more water than Program D in the year 2025 (1,168 AF/Yr more in the year 2030). Water savings estimates assume the installation of the AMS system is complete by the end of the year 2014.

4. The cost of Program E has a cost of water saved of $437 / AF (without the cost of the installation of the AMS). The present value utility cost of the entire program is $44 Million. This total cost does include some historical costs back to the year 2006 and concludes at the end of the study period in the year 2030. These costs do not include the installation of the AMS system as the cost, timing, and other parameters have not been decided by MMWD at this time. Additionally, the AMS is not planned to be entirely funded out of the MMWD conservation budget.

5. MMWD has not yet made a decision on the AMS system, specifically the exact installation date and cost of the system that would be assigned to the conservation department. Therefore, the exact cost was excluded from this conservation technical analysis except to run a few hypothetical scenarios to determine approximate cost / benefit ratio and cost of water saved. At the request of MMWD, two scenarios were considered, a 20% and a 40% cost sharing for the conservation department (For example, the conservation department would fund 20% of the entire cost of the AMS system). For these two scenarios it was assumed there would be a 3 year installation in the years 2012, 2013 and 2014. The total cost of the AMS system provided by MMWD was approximately $19.6 Million. Using these parameters, Program E with a 20% cost share of AMS would have a utility cost of water saved of $467 / AF. The present value utility cost of the entire program would be $47

Million. Similarly using these assumed parameters, Program E with a 40% cost of AMS would have a utility cost of water saved of $498 / AF. The present value utility cost of the entire program would be $50 Million.

6. Program D measure assumptions (program length and market penetration rates) were reviewed with the MMWD Staff. Adjustments were made to each measure such that MMWD staff is comfortable with the targeted number of activities at this time. Rain water catchments and gray water systems were added as eligible items under existing Tier 2 – 6 Financial Incentives for Irrigation Upgrades program. Apart from the measure savings listed in Key Finding No. 1, the revisions to the other existing measures and use of the AMS system saves a total of approximately 750 AF/yr in 2025 and 850 AF/yr in 2030.

7. MMWD has made great progress in building a strong foundation for a large conservation program (hiring staff, creating new programs, etc.) in a relatively short amount of time. However, Program D is not yet fully operational at this time. Not all of the projected budget and staff has been committed as of April 2009. Based on this fact, it is too soon to tell whether water savings goals for Program D will be reached. Several years of monitoring Program D including the number of actual program participants and their actual water savings would increase confidence in the ability to forecast higher savings from increased efforts.

8. An update on the assessment of the drought ordinance effectiveness if Program E is implemented was made. The combined savings (average year) from Program D and E from a simulated drought in 2025 are 36 and 39 percent reduction respectively.

9. If a simulated drought occurs in 2025 the drought ordinance will save not 25% but rather 4 to 4.3 percent less. Said in other terms, the ordinance would only save from 21 to 20.7 percent if the drought ordinance works in conjunction with Program D or E instead of on its own with no conservation program. This occurs because some of the end uses have been reduced by the conservation program and there is less water available for a temporary demand reduction during a drought. In our opinion this estimated demand hardening should not be a key factor in deciding whether to pursue Program D or E. It is cost-effective to save this water over time, rather than leave the "waste" in the system so it can be saved during a future drought. The District should consider revising its expectations of the effectiveness or the drought ordinance. If it wants to save say 25 percent on top Program D or E savings then it should ask customers for about 30% reductions so it will net about 25 percent on top of savings from Program D or E.

**ATTACHMENTS**

Attachment 1 Assumptions for the Measures Evaluated in the DSS Model.
All of Attachment 1 assumptions do not include the hypothetical 20% and 40% cost share of AMS.
Attachment 2 Annual Costs for Programs E for years 2009 to 2030

# Attachment 1
# Assumptions for Tier One Measures Evaluated for Program E in the DSS Model

| | BMP 1a Residential Audits without AMS | BMP 1a Residential Audits with AMS | BMP 1b Residential Audits without AMS | BMP 1b Residential Audits with AMS | BMP 3 Leak Detection and Repair Dedicated 3rd Crew | BMP 5a Water Budgets without AMS | BMP 5a Water Budgets w/AMS |
|---|---|---|---|---|---|---|---|
| Applicable Customer Classes | SF/CONDO/MF | SF/CONDO/MF | SF/CONDO/MF | SF/CONDO/RMF | System | IRR | IRR |
| Included in Program Package (Program E) | E | E | E | E | E | E | E |
| Applicable End Uses | Indoor | Indoor | Outdoor | Outdoor | UFW | Irrigation | Irrigation |
| Water Use Reductions For Targeted End Uses | 5% | 7% | 10% | 12% Outdoor, 35% Leakage | 3.7% | 15% | 20% |
| Evaluation Start Year | 2006 | 2015 | 2006 | 2015 | 2009 | 2006 | 2015 |
| Evaluation End Year | 2014 | 2035 | 2014 | 2035 | 2035 | 2014 | 2035 |
| Average Annual Interventions for Years Progam is Running | 553 SF, 34 CONDO, 16 RMF | 554 SF, 36 CONDO, 17 RMF | 553 SF, 34 CONDO, 16 RMF | 554 SF, 36 CONDO, 17 RMF | NA | 118 IRR | 124 IRR |
| Planned Interventions By End of Program (Accounts) | 4,967 SF, 301 CONDO, 143 RMF | 11,590 SF, 748 CONDO, 355 MF | 4,967 SF, 301 CONDO, 143 RMF | 11,590 SF, 748 CONDO, 355 MF | NA | 1,063 | 2,154 |
| Participating Accounts % (Market Penetration Goal,%)* | 10% | 22% | 10% | 22% | See comment | 81% | 154%* |
| Measure Life (years) | 7 | 10 | 7 | 10 | Permanent | 10 | 15 |
| Utility Unit Cost for SF/CONDO accounts, $/unit | $ 120.00 | $ 120.00 | $ 120.00 | $ 120.00 | NA | - | - |
| Utility Unit Cost for MF accounts, $/unit | $ 120.00 | $ 120.00 | $ 120.00 | $ 120.00 | NA | - | - |
| Utility Cost | - | - | - | - | $510,600 Per Year 2009 to 2011, $420,144 Per Year 2011 to 2035 | $150/account | $50/account |
| Customer Unit Cost. $/unit | $ 10.00 | $ 10.00 | $ 5.00 | $ 5.00 | - | $ - | $ - |
| Annual Utility Admin & Marketing Cost, % of total annual cost | 25% | 25% | 25% | 25% | NA | 15% | 10% |
| Affected Units | accounts | accounts | accounts | accounts | NA | Irrigation accounts | Irrigation accounts |
| Comments | BMP complete for RMF, but MWD has elected to continue to offer surveys to RMF customers. | MMWD currently plans to run RMF surveys in the future. $10 customer cost assumed because all major items inspected during surveys have a rebate or offer in other programs. $120 cost is a mixture of in house and contracted out audits | MMWD currently plans to run RMF surveys in the future. $120 utility cost is a mixture of in house and contracted out audits. The $5 customer cost is assumed because all major items inspected during surveys have a rebate or offer in other programs. If during the survey, MMWD recommend a irrigation system upgrade, the customer costs would be covered under the Financial Incentives for Irrigation Upgrades, please see measure Tier 2-6. | MMWD currently plans to run RMF surveys in the future. $120 utility cost is a mixture of in house and contracted out audits. The $5 customer cost is assumed because all major items inspected during surveys have a rebate or offer in other programs. If during the survey, MMWD recommend a irrigation system upgrade, the customer costs would be covered under the Financial Incentives for Irrigation Upgrades, please see measure Tier 2-6. | 10-year program to reduce UFW to **7.0%**, then annual maintenance | Budgets without the assistance of AMS System using the current plan review process to create budgets. MMWD staff changed cost to $150 per account based on actual cost using current methods | Budgets with assitance of AMS System. The market penetration of 154% is due to the measure life. MMWD must repeat account budgets to keep them current. Based on using fully automated processes to produce and distribute budgets. Please change to $50 based on future methods using automated budget calculation and transfer methods. |

SF = Residential Single Family
MF = Residential Multi Family 5 or more unites
IRR = Dedicated irrigation meters
NRSF = New Single Family Homes
COM / BUS= Commercial
INS = Public, buildings / grounds owned by the Water Utility or City
CONDO = Duplexes and 3 or 4 units
IND = Industrial

# Attachment 1
# Assumptions for Tier One Measures Evaluated for Program E in the DSS Model

| | BMP 5b Water Audits | BMP 6 Washer Rebates | BMP 7 Public Education | BMP 9 CII Audits without AMS | BMP 9 CII Audits w/AMS | BMP 14 Toilet Ordinance |
|---|---|---|---|---|---|---|
| Applicable Customer Classes | COM/INS | SF/CONDO | SF/CONDO | COM/INS | COM/INS | SF/MF |
| Included in Program Package (Program E) | E | E | E | E | E | E |
| Applicable End Uses | Irrigation | Laundry | All | All | All | Toilet |
| Water Use Reductions For Targeted End Uses | 15% | 51% | 15% | 12% | 15% all uses, and 35% on external leaks | 60% |
| Evaluation Start Year | 2006 | 2006 | 2006 | 2006 | 2015 | 2006 |
| Evaluation End Year | 2035 | 2015 | 2035 | 2014 | 2035 | 2007 |
| Average Annual Interventions for Years Progam is Running | 15 COM, 2 INS | 1,328 SF, 81 CONDO | 50% of all customers each year. 25,542 SF, 1,678 CONDO | 70 COM, 5 INS | 74 COM, 6 INS | NA |
| Planned Interventions By End of Program (Accounts) | 261 COM, 37 INS | 1,410 rebates per year for 10 years. 14,100 rebates by end of the program | 766,253 SF, 48,540 CONDO | 560 COM, 42 INS | 1,562 COM, 118 INS | 5,250 SF, 204 MF |
| Market Penetration Goal, % | 7.2% COM, 13.5% INS | 25% | 100% | 16% | 42% | Equals service change rate |
| Measure Life (years) | 10 | Permanent | 2 | Permanent | Permanent | Permanent |
| Utility Unit Cost for SF/CONDO accounts, $/unit | - | $ 125.00 | $ 5.00 | - | - | - |
| Utility Unit Cost for MF accounts, $/unit | - | - | - | - | - | - |
| Utility Cost | $300/account | - | - | $ 1,000.00 | $ 1,000.00 | - |
| Customer Unit Cost. $/unit | $ 1,500.00 | $ 200.00 | - | $ 2,000.00 | $ 2,000.00 | $ 125.00 |
| Annual Utility Admin & Marketing Cost, % of total annual cost | 30% | 30% | 25% | 50% | 50% | $15,600 per year SF, $2,000 per year MF |
| Affected Units | Assume applies to large landscape accounts | per dwelling unit | per dwelling unit | CII accounts | CII accounts | per toilet |
| Comments | Audits focus on educating contractors in basic irrigation scheduling and management practices. Renew audits in 2016 and 2026 due to 10 year measure life | BMP 6 complete, but continue to 2015. Lowered penetration rate to 1,400 per year based on current MMWD program goals, but increased length of program to 2015 | On-going public education effort including billing notices, advertising and marketing, press releases, and other public outreach methods. | Program ends in 2014, to allow a switch toconducting CII Audits with the help of information from AMS in year 2015. | Start in 2015 after installation of AMS. Assume internal MMWD audit costs. | Ordinance was changed to be a HET rebate program in the year 2007. |

SF = Residential Single Family
NRSF = New Single Family Homes
CONDO = Duplexes and 3 or 4 units
MF = Residential Multi Family 5 or more unites
COM / BUS= Commercial
IND = Industrial
IRR = Dedicated irrigation meters
INS = Public, buildings / grounds owned by the Water Utility or City

# Attachment 1
# Assumptions for Tier Two Measures Evaluated for Program E in the DSS Model

| Measure | T2 - 1 | T2 - 2 | T2 - 3a | T2 - 3b | T2 - 4 | T2-5 |
|---|---|---|---|---|---|---|
| | **Rain Sensor Retrofit** | **San Quentin Toilets** | **Residential High Efficiency Toilet Rebates** | **CII High Efficiency Toilet Direct Install + Rebates** | **Homeowner Landscape Class** | **Coin-Op Washers Rebate** |
| Applicable Customer Classes | SF, CONDO | CII Existing | SF, CONDO | MF, COM, INS | SF, CONDO | MF (5 or more units) |
| Included in Program Package (Program E) | E | E | E | E | E | E |
| Applicable End Uses | Irrigation | Toilets | Toilet End Use | Toilet End Use | External | Laundry |
| Water Use Reductions For Targeted End Uses | 9% | 54% | 54% | 54% | 5% | 51% |
| Evaluation Start Year | 2009 | 2008 | 2007 | 2008 | 2008 | 2008 |
| Evaluation End Year | 2015 | 2009 | 2019 | 2019 | 2017 | 2017 |
| Average Annual Interventions for Years Progam is Running | 1,022 SF, 63 CONDO | 333 toilets per year for 3 years | 1,175 SF, 72 CONDO | 79 MF, 46 COM and 4 GOV | 17 classes per year, 30 attendees per class | 37 accounts, 75 washers |
| Planned Interventions By End of Program (Accounts) | 7,152 SF, 439 CONDO | 1,000 toilets total | 15,274 SF, 941 CONDO | 944 MF, 556 COM and 48 GOV | 170 classes over 10 years starting in 2009 | 373 accounts, 745 washers (assumes an average of 2 washers per account) |
| Market Penetration Goal By End of Program, % | 14% | NA | 30% | 63% RMF, 16% COM, 18% INS | 5% | 25% |
| Measure Life, years | 10 | Permanent | Permanent | Permanent | Permanent | Permanent |
| Utility Unit Cost for SF/CONDO accounts, $/unit | $ 40.00 | -- | $ 200.00 | $ - | $ 1,000.00 | $ - |
| Utility Unit Cost for MF accounts, $/unit | -- | -- | $ - | $ 300.00 | $ - | $ 400.00 |
| Utility Unit Cost for non-Res accounts, $/unit | -- | $ - | $ - | $ 300.00 | $ - | $ - |
| Customer Unit Cost. $/unit | $ 35.00 | $ 250.00 | $ 150.00 | $ - | $500 Condo, $1,000 SF' | $ 500.00 |
| Annual Utility Admin & Marketing Cost, % of total annual cost | 10% | 0% | 25% | 15% | 10% | 25% |
| Affected Units | dwelling unit | NA | dwelling unit | account | account | account |
| Comments | Admin and Marketing cost decreased to 10% as MMWD plans to combine the Rain Sensors with Program BMP 1b (External Water Surveys). Extended program to 2015. Cost of regular unit is $14, cost of wireless unit is $43. Assume average cost of $40. | No cost to MMWD, toilets were purchased and program entirely run by San Quentin. $250 is for labor of installation of the toilet. The toilets have been purchased already. | Added Commerical and Institutional categories in year 2009. Start a rebate for $250 then decrease to $150 by end of program. Assume rebate average of $200. | Direct Install program Added Commerical and Institutional categories in year 2009. Cost is $315 per toilet for direct install. Rebate cost is $200. Drop from admin cost from 25% to 15% MMWD Contract out. | Assume $1,000 per class for 30 students per class. Bay Friendly Landscape Progam. Administrative costs include staff time to coordinate with teaching contractors. | Higher efficiency machines save an average of 51% more water than conventional top loading machines |

SF = Residential Single Family
NRSF = New Single Family Homes
CONDO = Duplexes and 3 or 4 units
MF = Residential Multi Family 5 or more unites
COM / BUS= Commercial
IND = Industrial
IRR = Dedicated irrigation meters
INS = Public, buildings / grounds owned by the Water Utility or City

# Attachment 1
# Assumptions for Tier Two Measures Evaluated for Program E in the DSS Model

| Measure | T2 - 6 | T2 - 7 | T2-8 | T2 - 9 | T2 - 10 |
|---|---|---|---|---|---|
| | **Financial Incentives for Irrigation Upgrades** | **Hotel Retrofit** | **CII Rebates to Replace Inefficient Equipment** | **Existing High Efficiency Urinal Replacement** | **Install AMS and Leak Detection Customer Notification** |
| Applicable Customer Classes | SF, CONDO, MF, CII, IRR | COM Existing | COM Existing, INS | COM Existing | SF, CONDO, MF, COM, INS |
| Included in Program Package (Program E) | E | E | E | E | E |
| Applicable End Uses | Irrigation | Indoor uses | Process End Use | COM Urinal | Internal and External Leakage |
| Water Use Reductions For Targeted End Uses | 15% | 20% | 35% | 77% | 25% |
| Evaluation Start Year | 2007 | 2008 | 2008 | 2007 | 2015 |
| Evaluation End Year | 2025 | 2022 | 2022 | 2025 | 2030 |
| Average Annual Interventions for Years Progam is Running | 681 SF, 115 Condo, 130 MF, 10 COM, 49 IRR, 54INS | 72 rooms per year | 24 COM, 2 INS | 54 COM, (or 108 urinals) | 769 SF, 24 MF, 50 CONDO, 57 COM, 4 INS |
| Planned Interventions By End of Program (Accounts) | 12,941 SF, 2,812 Condo, 1,035 MF, 2,462 COM, 929 IRR, 186 INS | 1076 rooms (60% of total of 1,802 rooms in MMWD Service Area) | 358 COM, 27 INS | 1,025 Accounts. Assume average of 2 unrinals per account, total of 2056 urnial replacements by end of program | 12,306 SF, 375 MF, 789 CONDO, 891 COM, 67 INS |
| Market Penetration Goal By End of Program, % | SF 25%, Non-SF 65% | 60% | 10% | 20% | |
| Measure Life, years | Permanent | 0 | permanent | 0 | 10 |
| Utility Unit Cost for SF/CONDO accounts, $/unit | $ 350.00 | $ - | $ - | $ - | $ 50.00 |
| Utility Unit Cost for MF accounts, $/unit | $ 1,500.00 | $ - | $ - | $ - | $ 200.00 |
| Utility Unit Cost for non-Res accounts, $/unit | $ 1,500.00 | $ 100.00 | $ 500.00 | $ 400.00 | $ 200.00 |
| Customer Unit Cost. $/unit | $ 1,500.00 | $ 200.00 | $ 1,000.00 | $ 100.00 | $ 500.00 |
| Annual Utility Admin & Marketing Cost, % of total annual cost | 25% | 25% | 25% | 10% | 10% |
| Affected Units | account | per room | per account | Assume 2 unrinals per CII Account. Assume urinals make up 25% of the total CII toilet fixtures (Koeller & Company, July 2005). | per account |
| Comments | Measure expanded to include gray water and rain catchment systems, low water use plants and food producing plants. Program length extended to the year 2025 | Approximately 1802 rooms in MMWD service area. Assume the $100 average cost per room can replace various pieces of equipment. The cost is only an average to arrive at resonable budget per hotel. Small 2 bedroom hotel, budget would be $200. Large 50 room hotel, budget would be $5,000. | Added institutional category | Increased due to Plumbing code change. Marketing done by manufacturers who do installations. Customer cost assumes some drain line height change. | Cost is to call or e-mail customers if there is a leak. Will be as automated as possible by a computer program, use 1 full time staff person. Cost will be approximately $100,000 per year. |

SF = Residential Single Family
MF = Residential Multi Family 5 or more unites
IRR = Dedicated irrigation meters
NRSF = New Single Family Homes
COM / BUS= Commercial
INS = Public, buildings / grounds owned by the Water Utility or City
CONDO = Duplexes and 3 or 4 units
IND = Industrial

# Attachment 1
# Assumptions for New Development Measures Evaluated for Program E in the DSS Model

| Measure | ND 1 | ND 2 | ND 3 | ND 4 | ND 5 | ND 6 |
|---|---|---|---|---|---|---|
| | **Require Rain Sensors** | **Require Smart Irrigation Controllers** | **Require High Efficiency Toilets** | **Require Efficient Dishwashers** | **Require Clothes Washers** | **Require Hot Water on Demand** |
| Applicable Customer Classes | New SF, New Condo, New MF, New CII | New SF, New Condo, New MF, New CII | New SF, New Condo, New MF, New CII | New SF, New Condo, New MF, New CII | New SF, New Condo, New MF, New CII | New SF, New Condo, New MF, New CII |
| Included in Program Package (Program E) | E | E | E | E | E | E |
| Applicable End Uses | Irrigation | Irrigation | Toilet end use | Diswasher end use | Clothes Washer end use | Faucet and shower end use |
| Water Use Reductions For Targeted End Uses | 9% | 15% | 50 to 55% | 34% | 50% | 14.2 gpd per house |
| Evaluation Start Year | 2009 | 2009 | 2009 | 2009 | 2009 | 2009 |
| Evaluation End Year | 2030 | 2030 | 2030 | 2030 | 2030 | 2030 |
| Planned Interventions By End of Program (Accounts) | 100% of new | 100% of new | 100% of new | 100% of new | 100% of new | 100% of new |
| Market Penetration Goal By End of Program, % | 100% of new | 100% of new | 100% of new | 100% of new | 100% of new | 100% of new |
| Measure Life, years | permanent | permanent | permanent | permanent | permanent | permanent |
| Utility Unit Cost for SF/CONDO accounts, $/unit | $ 12.50 | $ 12.50 | $ 12.50 | $ 12.50 | $ 12.50 | $ 12.50 |
| Utility Unit Cost for MF accounts, $/unit | $ - | $ - | $ - | $ - | $ - | $ - |
| Utility Unit Cost for non-Res accounts, $/unit | $ - | $ - | $ - | $ - | $ - | $ - |
| Customer Unit Cost. $/unit | $ 55.00 | $ 500.00 | $ 300.00 | $ 400.00 | $ 500.00 | $ 700.00 |
| Annual Utility Admin & Marketing Cost, % of total annual cost | 10% | 10% | 10% | 10% | 10% | 10% |
| Affected Units | account | account | account | account | account | account |
| Comments | | | | | | |

SF = Residential Single Family
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CONDO = Duplexes and 3 or 4 units
MF = Residential Multi Family 5 or more unites
COM / BUS= Commercial
IND = Industrial
IRR = Dedicated irrigation meters
INS = Public, buildings / grounds owned by the Water Utility or City

## Attachment 1
## Assumptions for New Development Measures Evaluated for Program E in the DSS Model

| Measure | ND 7 | ND 8 | ND - 9 | ND - 10 | ND - 11 |
|---|---|---|---|---|---|
| | **Require High Effiency Faucets & Showerheads** | **Require Landscape and Irrigation Requirements** | **Require Multi Family Submetering on New Accounts** | **Reqire Install New CII Equipment for Reduced Connection Fee** | **Require 0.5 Gal/flush Urinals in Bldgs.** |
| Applicable Customer Classes | New SF, New Condo, New MF, New CII | New SF, New Condo, New MF, New CII | Apartments (5 or more units) | New CII | New CII |
| Included in Program Package (Program E) | E | E | E | E | E |
| Applicable End Uses | Faucet and shower end use | Irrigation | Indoor | Com Process | Com Urinal |
| Water Use Reductions For Targeted End Uses | 15% | 10% | 0% | 25% | 65 to 75% |
| Evaluation Start Year | 2009 | 2009 | 2009 | 2009 | 2009 |
| Evaluation End Year | 2030 | 2030 | 2030 | 2030 | 2030 |
| Planned Interventions By End of Program (Accounts) | 100% of new | 100% of new | 100% of new | 100% of new | 100% of new |
| Market Penetration Goal By End of Program, % | 100% of new | 100% of new | 100% of new | 100% of new | 100% of new |
| Measure Life, years | Permanent | Permanent | Permanent | Permanent | Permanent |
| Utility Unit Cost for SF/CONDO accounts, $/unit | $ 12.50 | $ 12.50 | -- | $ - | $ - |
| Utility Unit Cost for MF accounts, $/unit | $ - | $ - | $ - | $ - | $ - |
| Utility Unit Cost for non-Res accounts, $/unit | $ - | $ - | $ 100.00 | $ 100.00 | $ 50.00 |
| Customer Unit Cost. $/unit | $ 50.00 | $ 3,000.00 | $ 1,000.00 | $ 1,000.00 | $ 400.00 |
| Annual Utility Admin & Marketing Cost, % of total annual cost | 10% | 10% | 25% | 25% | 25% |
| Affected Units | account | account | account | account | account |
| Comments | | | $100 inspection fee | $100 inspection fee | $50 inspection fee |

SF = Residential Single Family
MF = Residential Multi Family 5 or more unites
IRR = Dedicated irrigation meters
NRSF = New Single Family Homes
COM / BUS= Commercial
INS = Public, buildings / grounds owned by the Water Utility or City
CONDO = Duplexes and 3 or 4 units
IND = Industrial

**Attachment 2**
**Program E Annual Costs 2009-2030,**
**No Installation of AMS System Cost**

| | Program E by Cost Category ($1,000s) | | |
|---|---|---|---|
| **Year** | **Utility** | **Customer** | **Community** |
| **2009** | $3,293 | $5,096 | $8,389 |
| **2010** | $3,298 | $5,100 | $8,433 |
| **2011** | $3,108 | $5,678 | $8,820 |
| **2012** | $3,020 | $5,579 | $8,721 |
| **2013** | $3,028 | $5,586 | $8,736 |
| **2014** | $3,036 | $5,592 | $8,750 |
| **2015** | $3,126 | $6,499 | $9,763 |
| **2016** | $3,063 | $5,122 | $8,326 |
| **2017** | $2,906 | $4,805 | $7,852 |
| **2018** | $3,074 | $4,696 | $7,911 |
| **2019** | $3,078 | $4,700 | $7,919 |
| **2020** | $2,064 | $4,092 | $6,298 |
| **2021** | $2,064 | $3,963 | $6,169 |
| **2022** | $2,061 | $3,944 | $7,036 |
| **2023** | $2,038 | $3,907 | $6,977 |
| **2024** | $2,041 | $3,910 | $6,982 |
| **2025** | $2,043 | $3,912 | $6,987 |
| **2026** | $1,107 | $2,457 | $3,627 |
| **2027** | $1,106 | $2,459 | $3,628 |
| **2028** | $1,106 | $2,460 | $3,630 |
| **2029** | $1,107 | $2,461 | $3,632 |
| **2030** | $1,114 | $2,462 | $3,634 |

**Attachment 2**
**Program E Annual Costs 2009-2030,**
**20% AMS System Installation Cost**

| | Program E by Cost Category ($1,000s) | | |
|---|---|---|---|
| **Year** | **Utility** | **Customer** | **Community** |
| **2009** | $3,293 | $5,096 | $8,389 |
| **2010** | $3,298 | $5,100 | $8,399 |
| **2011** | $3,018 | $5,678 | $8,695 |
| **2012** | $4,330 | $5,579 | $9,910 |
| **2013** | $4,338 | $5,586 | $9,924 |
| **2014** | $4,346 | $5,592 | $9,938 |
| **2015** | $3,126 | $6,499 | $9,626 |
| **2016** | $3,063 | $5,122 | $8,185 |
| **2017** | $2,906 | $4,805 | $7,711 |
| **2018** | $3,074 | $4,696 | $7,770 |
| **2019** | $3,078 | $4,700 | $7,778 |
| **2020** | $2,064 | $4,092 | $6,157 |
| **2021** | $2,064 | $3,963 | $6,027 |
| **2022** | $2,061 | $3,944 | $6,004 |
| **2023** | $2,038 | $3,907 | $5,945 |
| **2024** | $2,041 | $3,910 | $5,950 |
| **2025** | $2,043 | $3,912 | $5,955 |
| **2026** | $1,107 | $2,457 | $3,565 |
| **2027** | $1,106 | $2,459 | $3,564 |
| **2028** | $1,106 | $2,460 | $3,566 |
| **2029** | $1,107 | $2,461 | $3,568 |
| **2030** | $1,114 | $2,462 | $3,576 |

**Attachment 2**
**Program E Annual Costs 2009-2030,**
**40% AMS System Installation Cost**

| | Program E by Cost Category ($1,000s) | | |
|---|---|---|---|
| **Year** | **Utility** | **Customer** | **Community** |
| **2009** | $3,293 | $5,096 | $8,389 |
| **2010** | $3,298 | $5,100 | $8,399 |
| **2011** | $3,018 | $5,678 | $8,695 |
| **2012** | $5,640 | $5,579 | $11,220 |
| **2013** | $5,648 | $5,586 | $11,234 |
| **2014** | $5,656 | $5,592 | $11,248 |
| **2015** | $3,126 | $6,499 | $9,626 |
| **2016** | $3,063 | $5,122 | $8,185 |
| **2017** | $2,906 | $4,805 | $7,711 |
| **2018** | $3,074 | $4,696 | $7,770 |
| **2019** | $3,078 | $4,700 | $7,778 |
| **2020** | $2,064 | $4,092 | $6,157 |
| **2021** | $2,064 | $3,963 | $6,027 |
| **2022** | $2,061 | $3,944 | $6,004 |
| **2023** | $2,038 | $3,907 | $5,945 |
| **2024** | $2,041 | $3,910 | $5,950 |
| **2025** | $2,043 | $3,912 | $5,955 |
| **2026** | $1,107 | $2,457 | $3,565 |
| **2027** | $1,106 | $2,459 | $3,564 |
| **2028** | $1,106 | $2,460 | $3,566 |
| **2029** | $1,107 | $2,461 | $3,568 |
| **2030** | $1,114 | $2,462 | $3,576 |