

# **Tap-Smart:** The Conservation Master Plan

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**Denver Water**

**Submitted to Colorado Water Conservation Board  
April 30, 2007**

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# Tap-Smart: Denver Water's Conservation Master Plan

## Executive Summary: Water for Tomorrow

As the Denver Metro area continues to grow, planning for its water future is an important challenge to Denver Water. Successful stewardship of this precious resource is critical to Colorado's prosperity and welfare. The Denver Water Board's long history of water management and planning will enable it to meet this challenge.

No single water resource is sufficient to meeting this challenge. In its 1997 Integrated Resource Plan (IRP) the Board recognized the need to invest in and manage a diverse portfolio of resources to meet its future needs and minimize risks. The Board is pursuing opportunities that increase supply through **conservation, recycled water, and water supply development**. Each of these resources is an essential piece to our future.

### Conservation

In the 2002 IRP the Board set a goal to reduce water use by 29,000 acre-feet by 2050. This goal was in addition to the 30,000 acre-feet of reductions Denver Water users have achieved since 1980.

The 2002 drought increased the focus on conservation. The competing uses of water around the state between the environment, agriculture, recreation, municipal and industrial, make it increasingly clear that water waste is unacceptable in Colorado today. Consequently, the Board in 2005 reaffirmed its commitment to conservation by accelerating its 50-year conservation goal.

### Recycled Water

Denver Water opened its Recycled Water Plant in 2004. The plant receives water from the Metro Wastewater facility after its treatment process, treats the water to nonpotable standards, and delivers the recycled water to industrial and irrigation users. Over the next 15 years, the recycled water distribution system will be expanded to serve more users, delivering 17,000 acre-feet per year.

### Water Supply Development

Denver Water is pursuing numerous options for increasing water supply. Some examples include purchasing and constructing storage from previously mined gravel pits north of Denver, implementing small scale system refinements to manage the system for greater productivity, and developing new water supply in the Moffat Collection System.

The combination of conservation, recycled water, and new water supply development is the foundation of the diverse portfolio of resources that will enable Denver Water to meet future water needs and minimize risks.

## Tap-Smart: Denver Water's Conservation Master Plan

The Tap-Smart Plan is a key strategic undertaking. Only through fostering a conservation culture in this semi-arid region can we truly ensure a sustainable water resource. The Tap-Smart Plan asks all of Denver's water users to eliminate water waste and share fairly the responsibility of water conservation.

That level of conservation will create positive benefits for some time:

- Reservoir levels are higher, helping us through future droughts;
- More water remains in streams and rivers, supporting agriculture, the environment, and water-based recreation.

Conservation measures in this Tap-Smart Plan are grouped into seven categories, specifically:

- City and County of Denver government programs
- Education and Outreach
- Diagnostics
- Rebates and Incentives
- Rules
- Research, Monitoring and Evaluation
- General Administration of all the measures.

### **Government Takes the Lead**

Mayor John Hickenlooper has rightly concluded that Denver's city government must lead the way by being a role model for water conservation. The Mayor's sustainability initiative, called Greenprint Denver, will include water conservation as one of the major components.

Within the next year in the City and County of Denver government properties:

- Indoor water diagnostics (audits) will be done on city buildings;
- 100 urinals and toilets in high-use areas will be retrofitted for efficiency;
- A plan to improve irrigation efficiency throughout Denver will be launched;
- Plans will be initiated to build conservation into all of city government's property management.

### **Denver Water Gears Up Its Own Conservation Efforts**

Continuing an effort that began over 25 years ago, Denver Water will ensure that the water collection, treatment and delivery system is as leak-free as possible.

In addition, Denver Water is evaluating, improving and accelerating its conservation programs to make sure they achieve the needed level of customer response, while helping customers maintain the lifestyle they desire.

### **Businesses and Citizens Do Their Part**

As government steps up and begins reducing its water usage, Denver businesses and citizens will be asked to adopt a conservation culture, maintaining savings they achieved during the drought or stepping up to conservation.

The model selected to involve these customers and create a conservation culture is Community-based Social Marketing (CBSM) as defined by Dr. Douglas McKenzie-Mohr.

The direct cost to Denver Water of the Tap-Smart Plan is estimated at \$143,000,000 for the next ten years. This investment will save an estimated 29,000 acre-feet of water per year by the end of the ten-year Conservation Master Plan horizon, if all goes as planned.

Conservation programs will continue to include rebates, incentives, educational programs and practical help for citizens to help them use only the water they need.

By implementing the water conservation programs, the supply initiatives, and fully using all the allocations for recycling water, Denver Water intends to meet the needs of its customers for tomorrow and the foreseeable future.

# **Tap-Smart: the Conservation Master Plan**

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## **Introduction to Tap-Smart**

In September, 2005, the Denver Water Board requested from staff a plan that would accelerate the accomplishment of its 2050 conservation goal to 2016. Appendix A contains the text of the Board's Resolution. On March 22, 2006, staff presented its first draft of the updated Conservation Plan to the Board. There were several questions and issues raised by the Board at that meeting. Staff did further research, revised estimates, and presented a new plan On May 24, 2006. Over the months since then, even more revisions have been made, including naming this plan "Tap-Smart." This document describes the new Tap-Smart Plan.

The relevant sections of the March 2006 draft Plan submitted to the Board are attached to this document as Appendices B, C, and D. Those pages describe the two-year process of researching the universe of conservation methods, filtering the 480 possible measures down to the most predictably effective ones, estimating costs for labor and materials, and comparing those to the goal stated by the Board.

In addition to answering many of the Board's questions, staff uncovered even more issues and concerns. Current events such as the probability of recurring drought, climate change, population growth, and changing economic events will raise even more questions in the future. Therefore, this master Plan will be updated at least every five years, and the annual plan and budget will be scrutinized by the Board and staff very carefully to make sure everything is on track to achieve the goal.

## **What This Plan is NOT**

The Tap-Smart Plan is not a full Integrated Resource Plan (IRP) although items in the 2002 IRP form the basis of goals and measures in this Tap-Smart Plan. Neither is this document a Drought Response Plan. Both of those documents already exist and are related to this Plan but not part of it. Denver Water Board and staff fully understand that the only reasonable model for preparing for the future is to look at all the options (the IRP and its revisions) and prepare for water shortage emergencies (the Drought Response Plan of 2004). These documents are available on request from Denver Water.

There is also a separate plan for dealing with non-drought emergencies and none of that Plan is included here. The Crisis Communications Plan is handled by the Manager of Community Relations. If demand-reduction measures are needed during a crisis, Conservation Section staff will be assigned to assist as needed, but those crisis-response measures are not addressed here.

There is an overall Communications Plan which includes issues such as water quality, recycled water, customer services and other issues only indirectly related to water conservation and efficiency. The only portion of the Communications Plan included in this Tap-Smart Plan is the part about conservation.

## **Audience for the Tap-Smart Plan**

This Plan is written for several diverse audiences, the most important of which is the Denver Board of Water Commissioners in fulfillment of their September 2005 directive. Additionally, the Plan is for use by Denver Water employees, Distributors, and stakeholders. In this current form with revised Tables and Appendices, this plan is intended to fulfill the requirement of Colorado HB-1365, also called C.R.S. 37-60-126. This law states that all entities which serve more than 2,000 acre-feet of water per year must file a Conservation Plan with the Colorado Water Conservation Board and then update the Plan at least every seven years. Therefore, this Tap-Smart Conservation Master Plan is submitted to the Office of Water Conservation and Drought Planning of the Colorado Water Conservation Board as required by law.

## **Tap-Smart Conservation Goal**

In its 2002 Integrated Resource Plan, the Board set an overall system conservation goal of 165 gallons per capita per day (GCD) for all uses of treated water<sup>1</sup>. This goal was to be achieved by build-out of Denver Water's Service Area, or by 2050. In 2005, the Board requested that staff develop an accelerated conservation plan for its consideration that would achieve the 165 GCD goal by 2016.

To achieve the goal of 165 GCD, Denver Water's existing customers must reduce their use by a total of 39,000 acre-feet (AF) by 2016. Figure 1 shows one scenario to achieve 165 GCD. Staff assumed that 10,000 AF of permanent demand reductions was achieved during the drought through hardware and behavioral changes in water use. This Tap-Smart Plan can achieve up to 25,000 AF of demand reductions, which leaves 4,400 AF to be gained through other means such as conservation-oriented rates.

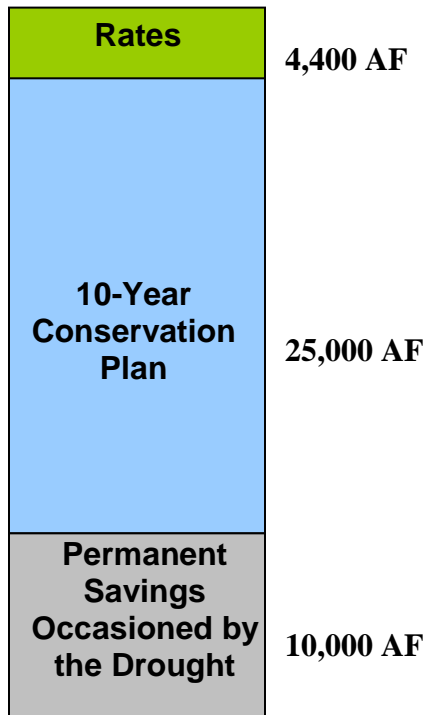
The Tap-Smart Plan is flexible in that water reductions can be shifted to water rates and away from active conservation measures, thereby reducing the cost of the plan. That is, excessively costly or otherwise less appealing conservation measures can be cut from the Tap-Smart Plan. This is discussed further in this document.

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<sup>1</sup> Per capita, system-wide water use is simply a measurement of treated water deliveries made by Denver Water, divided by the population served. These figures take all uses of water into account including: residential, commercial, industrial, institutional and unaccounted for water. A separate calculation of single family per capita use (SFGCD) will be discussed later.



**Figure 1 – Conservation Goal**  
**39,400 AF Goal**



The Board of Water Commissioners approved a new inclining block rate structure which became effective January, 1, 2007. The blocks are more steeply inclining than previous blocks at Denver Water. The goal for implementing this rate structure was to help eliminate water waste and encourage more conservation. The Board will evaluate the effects of the 2007 rate structure and make adjustments in the years ahead as they deem necessary.

## Impacts of Drought on Future Savings

Beginning in 2002, water use has been substantially reduced from historic levels by drought conditions and Denver Water’s drought response measures. Those measures included mandatory water use restrictions and drought surcharges.

The average use between 1993 and 2001 was 211 GCD. The average use between 2002 and 2004 was 169 GCD, which is a 20 percent decrease from the pre-drought levels. In 2005, Denver Water’s reservoirs began to recover from the drought and mandatory drought restrictions were lifted. Water use in 2005 increased 12 percent to 163 GCD compared to 2004 water use of 150 GCD due to the removal of mandatory restrictions and a hotter and drier summer.

Staff cannot fully determine what level of water use reductions achieved during the drought is durable. Two recent studies suggest there may be at least a partial return to pre-drought use without additional measures taken by the Board. Denver Water polled other water providers in the West during the drought. The results showed other utilities had seen a rebound in use in the years after a

drought had eased. The Drought Shadow theory predicts that water use will increase to levels 5 or 10 percent lower than pre-drought levels. In many instances, however, the water utilities attenuated or eliminated their aggressive conservation efforts once the drought threat had diminished.

A February 3, 2006 public opinion analysis done by Ciruli Associates indicates an interest by water users to continue their conservation efforts, “but the polls also point out that conservation behavior is partially event-related, and as reports of the recent multi-year drought fade, conservation efforts could decay.”

Because of the uncertainty with regard to how far demand will rebound as the drought eases, staff is using 200 gcd as the baseline to measure savings in the Tap-Smart Conservation Plan. This amount is 5 percent below the pre-drought water use levels of 211 gcd and is consistent with the “drought shadow” theory. The permanent changes in water use caused by the drought may be more than 5 percent, but it will only become apparent in subsequent years and be counted toward the 165 GCD goal.

## **Influences on Water Use**

The effect of the drought on long-term water use levels will remain uncertain for several years because of the various factors which affect system-wide water use. Among these factors are:

- Temperature and precipitation
- Household income
- Water rates
- Mandatory water use restrictions
- Level of conservation efforts by a utility
- Technological improvements in water use fixtures and appliances

For example, weather conditions have a significant impact on outdoor water use during the irrigation season (April-October). Most of the landscapes in Denver Water’s service area require more water than natural precipitation provides. In hot, dry years, the requirement for supplemental irrigation increases, and in wet, cool years, the need for supplemental irrigation decreases.

Household income and water rates cause changes in water use levels on a system-wide basis. As household income increases, water use typically increases. Conversely, as water rates increase, water use decreases.

Commercial and Industrial accounts, which typically have lower outdoor water use, are affected mostly by pricing factors. For some commercial and industrial accounts, the water bill makes up a large percentage of total costs.

Mandatory water use restrictions and successful conservation programs implemented by a utility will decrease water use. Mandatory restrictions are usually used in emergencies such as droughts and are meant to achieve

temporary water use reductions. Conservation programs are designed for long-term and sustainable reductions in water use.

The influences on water use make it difficult to determine the durability of savings achieved during the drought. As a result, staff suggests increased monitoring and evaluation of water use and conservation measures. This will give staff and the Board a greater understanding of changes in water use.

## Plan Costs and Demand Reductions Summary

### Existing Customers

The Tap-Smart Plan costs have not changed significantly from those presented to the Board in March 2006. Staff has expanded the low-cost measures as much as possible to provide the Board with lower cost options in the Plan. However, staff has not eliminated any measures, recognizing that the merits of any particular measure may not be based solely on costs. For example, many of the higher cost measures involve irrigation efficiency which is the most visible of water uses and may be one the Board wants to implement, despite the costs.

Table 1 lists the elements included in the Tap-Smart Plan in a matrix that shows which elements apply to the various categories of customers: single-family residential, multi-family residential, commercial/industrial , or government.

**Table 1: Tap-Smart Conservation Master Plan Elements**

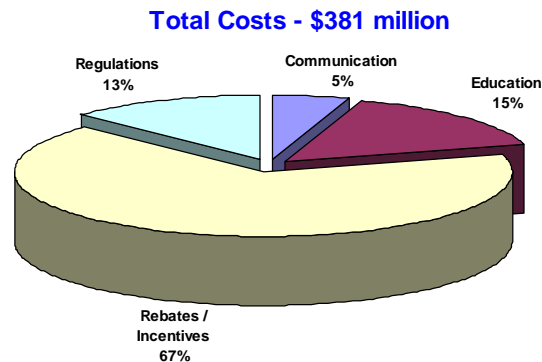
Measure	Account				Short Description	New	Existing
	RSF	RMF	C&I	GOV			

Educational							
Xeriscape Planning & Design Clinics	X				One-on-one sessions with landscape architect to design Xeriscape areas		X
Cooling Tower Monitoring Program		X	X	X	Voluntary participation in monitoring program for increasing cooling tower cycle concentration		X
Public Housing Retrofit		X			DW will retrofit at DW cost toilets, showerheads and faucet aerators for Public Housing Authority		X
Car Wash Certification			X		Audit and efficiency certification process for car washes		X
Conservation Education Program	X				School education program to teach water conservation, and distribute new water efficient devices		X
MF Residential Audit Program		X			Audits and showerhead retrofits offered on request to Residential Multi-Family customers		X
Irr. Classes & Seminars	X				Irrigation efficiency classes for residential customers		X
Irrigation Check-ups for large Accounts		X	X	X	Irrigation check-ups by request		X
Outdoor Xeriscape Kiosks	X				Place Xeriscape kiosks at garden centers. Includes new instructional documents to cover the seven principles of Xeriscape	X	
Natural Areas			X	X	Take out 75 acres of grass in city landscapes and replace it with natural grasses and "native" flowers	X	
Indoor Conservation Kiosks	X	X	X		Put conservation documents in displays and kiosks at do-it-yourself retail stores. Includes information about leak detection and repair	X	
Financial							
Irrigation Efficiency Incentive Program		X	X	X	Ongoing outdoor irrigation efficiency that pays the customer an based on the actual amount of water saved (\$9,000 per acre-ft.)		X
C/I Incentive Program			X		C&I customers receive up to \$40,000 for improving efficiency. Minimum savings of 300,000 gallons per year to qualify (\$9,000 per acre-ft.)		X
ET Controller Rebate	X				\$50 incentive payment for installation of ET controllers		X
1.6 GPF Toilet Rebate	X	X	X	X	\$25 toilet rebate for replacing old toilets with new 1.6 gaff toilets		X
HET Rebate	X	X			\$125 toilet rebate for high efficiency toilets		X
Clothes Washer Rebate	X	X			\$200-\$400 rebate for purchase and installation of efficient clothes washers		X
Wireless Rainfall Sensor Rebate	X				\$50 rebates for installation of wireless rainfall sensors	X	
Regulatory							
0.5 GPF Urinal Rule			X	X	Require new commercial developments to have 0.5 gaff urinals	X	
Time-of-Sale Retrofit	X	X			Require retrofit of toilets, showerheads and faucets at sale of home	X	
New Customers							
Five Acre Rule		X	X	X	Review irrigation plans for projects that include more than 5 acres of irrigation, and follow-up with penalties if necessary		X
New Homes Regulation	X				Require new SF homes to have water-efficient toilets and clothes-washers. DW pays half	X	
Require Irrigation Meters	X	X	X	X	Operating rule to require separate irrigation meters for all new properties that have between 0.5 and 4.9 acres of landscaped area	X	
Sprinkler System Efficiency Rule	X	X	X	X	New customers required to have sprinkler systems that meet Distribution Uniformity (DU) of at least 65%, and other aspects	X	
Soil Amendment Rule	X	X	X	X	New customers required to amend soil	X	

Figure 2 displays the Total Tap-Smart Plan costs for Denver Water and its customers. Under this Plan, Denver Water would incur \$143 million in costs for conservation measures associated with existing customers. Customer costs are

additional costs of high-efficiency toilets, landscaping changes, and leak repair, among others, that Denver Water does not pay in incentives and rebates.

**Figure 2 – Tap-Smart Conservation Plan Costs by Measure Type  
Existing Customers**

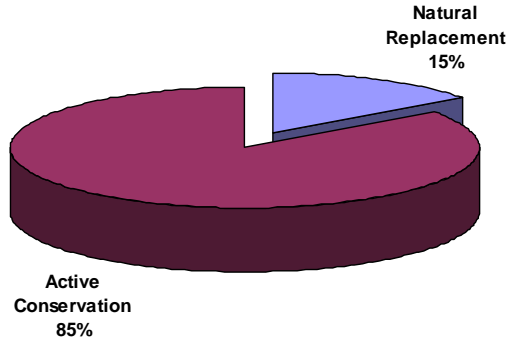


### **Natural Replacement**

The demand reductions displayed in Figure 3 show the expected costs differentiated by active conservation and “natural replacement.” Natural replacement (the replacement of toilets, showerheads and faucets as they wear out or break) to federally mandated efficient fixtures, has been accelerated in the Tap-Smart Plan. Under this revised Plan, the Board and its customers will spend \$57 million to replace these inefficient water fixtures. The drawbacks to accelerating the replacement of these fixtures are the costs to the Board that it otherwise would not have to spend and the replacement of fixtures that are fully functional but not efficient. The benefits of accelerating natural replacement of devices and fixtures are fuller reservoirs which may help to mitigate the effect of future droughts, and the potential for delaying new supply projects by several years.

**Figure 3 – Tap-Smart Plan Costs  
Existing Customers**

**Total Costs - \$381 million**



**New Customers**

New customers have the same targeted use that existing customers have. Pre-drought water use for existing single family customers was 153 single-family gallons per capita per day (SFGCD) as shown in Table 2. A 22 percent decrease in use, which is consistent with the Board’s conservation goal, would bring single family water use down to 119 SFGCD. Consequently, the goal is to reduce water use by existing customers from 153 SFGCD to 119 SFGCD, and ensure that new customers begin service at an average of 119 SFGCD.

**Table 2 – Water Use by Customer Type**

<b>Customer Type</b>	<b>2001 Use</b>	<b>2016 Target</b>
Single Family (gallons per capita per day)	153	119 SFGCD
Commercial, Multifamily and Industrial (gallons per employee per day)	110	86 GED
Government (gallons per capita per day)	17	13 GCD

The measures proposed for new customers are all regulatory. Table 3 displays the expected costs for the Board and the customer, as well as expected demand reductions. The largest amount of demand reductions will come from the new Water Efficiency Rating System for residential customers. This measure will use a system that awards points for efficient water fixtures and landscaping materials. A certain number of points will be required before water service is started.

**Table 3 – Conservation Measures for New Customers**

	<b>Costs</b>	

Measure	DW	Customer	Total	Reductions (AF)
Irrigation meter requirement for new accounts	\$53,000	\$2,117,000	\$2,169,000	628
Low-flow urinal (0.5 gpf) requirement for new buildings	\$32,000	\$46,000	\$78,000	300
Water efficiency rating for new homes	\$8,289,000	\$19,287,000	\$27,576,000	3,793
<b>Total</b>	<b>\$8,374,000</b>	<b>\$21,450,000</b>	<b>\$29,823,000</b>	<b>4,720</b>

Initial development of a point system for the Water Efficiency Rating System shows that new homes and apartments may save a substantial amount simply by installing efficient toilets, showerheads and faucets that are required by the 1992 Energy Policy Act regulations. Staff investigated this further by comparing the water use from a sample of existing and new customers.

Figure 4 shows the 2005 water use statistics from a sample of new and existing customers. New customers were defined as new accounts since 2001. The sample size was 1,628 new customers and 13,298 existing customers. The figure shows the cumulative percent of customers that used increasing amounts of water over a year. The median use for an existing customer in 2005 was 120,000 gallons, while the median use for a new customer was 65,000 gallons, a 45 percent decrease.

**Figure 4 – New vs. Existing Customer Comparison**

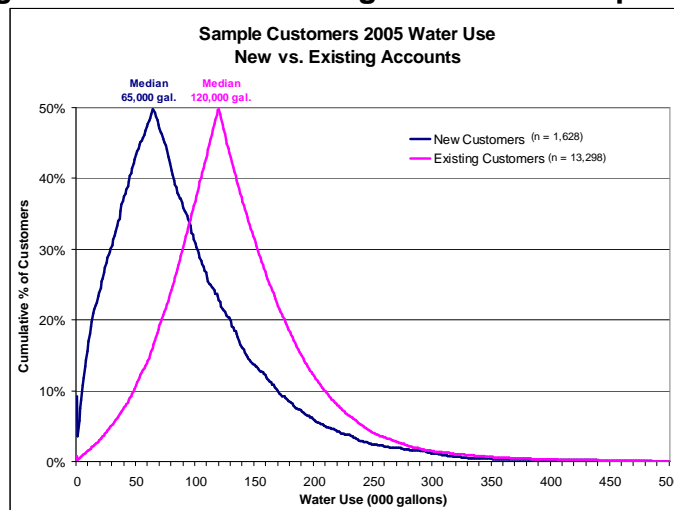


Figure 4 represents only a preliminary analysis. Neither the number of people per household nor the lot sizes were taken into account when producing Figure 4. Variations in either characteristic will change water use levels. However, the data show that new customers use significantly less water, resulting partly from efficient water fixtures. Staff will refine Figure 4 as the development of the Water Efficiency Rating measure continues.

In time, staff hopes to expand this measure to include Commercial and Industrial customers. In the meantime, efficiencies will be achieved for these customers through the Personal Water Consultant effort that Denver Water started in 2006.

**Table 4: Tap-Smart Conservation Master Plan Measures and Costs**

**Rebates / Incentives**

Irrigation efficiency incentives (\$4,500 / AF)	\$22,074,512	2,073	\$52,600	64.5
Commercial / Industrial incentives (\$4,500 / AF)	18,300,314	4,651	\$16,400	4.8
Public housing retrofits	3,098,186	158	\$22,400	1.4
ET controller rebate (\$150)	152,667	717	\$500	0.4
Natural areas conversion for large landscapes	22,581,652	1,729	\$13,000	0.0
Low-flow toilet (1.6 gpf) rebate (\$25)	133,121	126	\$2,000	0.6
High efficiency toilet (1.0 gpf) rebate (\$200)	2,789,289	410	\$10,400	2.4
Clothes washer rebate (\$200)	12,241,670	1,344	\$18,200	3.3
Wireless rainfall sensor rebate (\$50)	545,151	166	\$4,500	1.5
	81,916,563	11,376	\$21,200	

**Regulatory**

Irrigation meter requirement for new accounts	\$52,914	628	\$3,400	5.2
Low-flow urinal (0.5 gpf) requirement for new buildings	31,986	300	\$200	0.1
Time-of-sale retrofit of toilets, showerheads and faucet aerators	19,528,618	6,993	\$7,000	2.3
Water efficiency rating for new customers	8,289,287	3,793	\$7,200	5.6
	27,902,804	11,713	\$6,700	

<b>Total</b>	<b>\$142,807,062</b>	<b>31,449</b>	<b>\$12,600</b>	<b>5.9</b>
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## Annual Customer Participation

The Tap-Smart Plan represents a significant increase in current spending and effort. Figure 5 shows the expectation of annual participation in this Plan.

**Figure 5 – Annual Customer Participation**

<b>100</b>	Acres converted to natural areas or Xeriscape
<b>350</b>	Commercial and Industrial incentive contracts or improvements
<b>650</b>	New irrigation-only meters and water use recommendations
<b>1,000</b>	Rebates for rainfall sensors
<b>2,300</b>	New homes audited for efficiency
<b>3,300</b>	Improvements to sprinkler system or landscape
<b>3,600</b>	Toilets replaced with high-efficiency models
<b>5,000</b>	Participating students in education program
<b>5,500</b>	Rebates for high-efficiency washers
<b>8,000</b>	Audits and replacement of fixtures during sale of home or building

To highlight a few participation figures:



1. 100 acres of bluegrass sod will need to be replaced annually with either natural plants or Xeriscape and irrigated appropriately. 100 acres is larger in area than Denver's Cheesman Park or Bible Park.
2. All new homes and home sales will need to be inspected or audited for water efficiency; this amounts to approximately 10,000 homes per year.
3. Denver Water will need to contract with 350 commercial and industrial customers to achieve demand reductions. Many more business properties will undergo a conservation diagnostic visit under this measure even if the business is not a candidate to sign a water savings contract.
4. 5,500 customers will need to replace their inefficient washing machines with high-efficiency washers. If the 2006 participation is any indication of future success (Denver Water paid \$1,590,600 to customers who replaced 7,953 washers) then this is a very achievable goal.

## Tap-Smart Plan Measures

The measures in the first draft of this plan were derived from a combination of assumptions and predictions in the Decision Support System (DSS) model, from experiences of other water providers around the world, and from discussions with experts in strategy development. (The DSS Model is a huge EXCEL spreadsheet designed by Maddaus and Associates for use in water conservation program planning.) Those measures and costs were shown in Table 1. The measures in this Tap-Smart Plan have not changed significantly since the first draft of the Plan. Staff expanded the lower cost measures where possible. The Board has the flexibility to reduce or eliminate higher cost measures each year in the annual budget process.

The expected costs and demand reductions are included as well as the calculated payback period for both the Board and the customer. The Board's costs are those paid through rebates and incentives, as well as the expense of implementing and administering the measures. Customer costs are the additional amounts for water fixtures and landscape changes that are not paid by the Board through rebates and incentives. The savings represent sustained, annual water use reductions. Rate increases will be sufficient to recover costs as required by the Charter of the City and County of Denver.

The customer's payback period has been calculated for each measure and is shown in Appendix D. The customer payback period was calculated by comparing the customer specific costs of each measure and the financial savings the customer would receive through water, wastewater and energy bills.

By using 50 percent less water with an efficient clothes washer the customer saves approximately \$60 per year through water, wastewater and energy bills. The payback period is approximately 3.3 years (\$200 costs / \$60 savings per year). The payback period represented in Appendix D is the standard calculation in the industry. It does not, however, use the avoided cost of new supply in the calculation.

Some of the conservation measures with the longest payback periods involve irrigation system efficiency or changes to landscapes. These are expensive changes to make. For example, changes in landscape cost approximately \$3 per square foot. It may take between \$5,000 and \$10,000 to replace a lawn with Xeriscape on an average single family lot.

### Flexibility in the Tap-Smart Plan

In the first draft of the Tap-Smart Conservation Plan, staff did not focus on minimizing the costs of the Plan. Staff gave the Board a menu of measures and their relative costs. Similarly, the expected demand reductions from rate increases were not calculated precisely. Staff simply ensured the Board that cost-of-service rate increases would be one of the tools used to reinforce the Tap-Smart goal.

Staff has revised and expanded lower cost measures, to the extent possible, thereby increasing the expected demand reductions of the Tap-Smart Plan by approximately 2,000 acre-feet.

The merits of the conservation measures may not rest solely on cost. The Board may want to evaluate the measures under different criteria and reduce measures, rather than completely eliminating them.

### Rates

The 2007 Rates Schedule for potable water is an inclining block rate for residential customers and a seasonal rate for all others. Table 5 shows these rates for Denver Water customers.

**Table 5 -- 2007 Denver Water Rates and Charges for Potable Water**

#### Single-Family Residential Customers:

	Monthly Billing/ Usage (Gallons)	Bimonthly Billing/ Usage (Gallons)	Rate per 1,000 Gallons
<b>Block 1</b>	0 - 11,000	0 - 22,000	\$1.72
<b>Block 2</b>	12,000 - 30,000	23,000 - 60,000	\$3.44
<b>Block 3</b>	31,000 - 40,000	61,000 - 80,000	\$5.16
<b>Block 4</b>	Over 40,000	Over 80,000	\$6.88

#### Small Multi-Family Customers:

Duplexes through Five-plexes with a single meter

<b>Block 1</b>	0 - 15,000	0 - 30,000	\$1.95
<b>Block 2</b>	Over 15,000	Over 30,000	\$2.34

Monthly usage amount increases by 6,000 gallons and bimonthly usage amount increases by 12,000 gallons per additional dwelling unit up to five (5) dwelling units.

**All Other Customers:**

<b>Winter</b>	\$1.89
<b>Summer</b>	\$2.27

Along with these rates, the Board has a significant System Development Charge (SDC) or hook-up fee to make sure that growth pays its own way. The SDC is different for customers depending upon their predicted water use. All these financial incentives serve to encourage wise water use.

One aspect of the 2007 Rates schedule that needed more research was the potential impact on Home Owner Associations (HOAs) that irrigate common areas through an irrigation-only or single-family residential tap. There were some inequities identified in the plumbing and irrigation systems of these HOAs, so Conservation staff was assigned to contact over 240 of these groups and get the facts. This effort will be at least a two-year project. It will involve performing an irrigation audit, diagnosing water savings potentials indoors, locating all meters and taps associated with each account, and then offering various types of assistance to the HOA to achieve water savings. This HOA task was not part of the Tap-Smart Plan specifically, but has become the major focus of the Personal Water Consultant initiative to contact the highest-water-using customers. The expected outcome is that HOAs will improve their irrigation efficiency thus saving both water and money, and Denver Water will improve the accuracy of its records and the fairness in billing for these customers.

**Final List of Selected Measures**

After filtering over 480 measures down to two dozen that fit the criteria, the measures were apportioned into seven categories:

- City and County of Denver government programs, which includes irrigation practices, upgrades of fixtures and devices, and other activities to be determined after engineering analysis of potential water savings;
- Education and Outreach, which includes publications, demonstration gardens, the schools program, and presentations;
- Diagnostics, which includes conservation audits of indoor and outdoor water uses for residential, commercial and governmental customers;

- Rebates and Incentives, which includes buy-back contracts as well as rebates for a variety of water-saving devices and fixtures;
- Rules, which includes those made by Denver Water, by local government and any enforcement deemed necessary by the Board;
- Research, Monitoring and Evaluation, which includes analysis of existing measures to determine their effectiveness, and research into proposed measures to determine if they will actually be implemented by customers and really save any water;
- General Administration of all the measures.

The 2007 budget for the Tap-Smart Plan is shown in Appendix E. At least four different work groups within Denver Water are assigned to implement this Plan, and they will work with other employees, staff and contractors as necessary to achieve the goal.

## Additional Considerations

### City & County of Denver Government Accounts

Staff has identified a large potential for water use reductions from City & County of Denver government accounts. Irrigation is the largest use of water by City government, and the measures listed in Table 6 show the biggest potential for reductions from irrigation. Staff proposes to help the City improve its irrigation systems and replace large areas of turf with low water using landscapes.

The City's participation in the Board's Tap-Smart Plan will be a vital part of the Plan's success and is the most important factor for the early years. In his July 13, 2006 State of the City speech, Denver Mayor John Hickenlooper declared that the City government would be a role model of wise water use. This leadership initiative will encourage others to conserve and lend credibility to the Board's conservation efforts. Additionally, in September, 2006, Denver Water loaned a full-time water conservation expert to the City government for at least two years to assist in their conservation efforts.

**Table 6 - City & County of Denver Measures**

Measure	Costs			Reductions (AF)
	Denver Water	City & County	Total	

Cooling Tower Monitoring	\$82,000	\$29,000	\$111,000	205
Irrigation Check-Ups	2,233,000	16,891,000	19,124,000	1,015
Irrigation Efficiency Incentives	8,624,000	33,994,000	42,618,000	810
Fixture Replacement	2,319,000	331,000	2,650,000	472
Natural Areas Conversion	17,956,000	0	17,956,000	1,375
<b>Total</b>	<b>\$31,214,000</b>	<b>\$51,245,000</b>	<b>\$82,459,000</b>	<b>3,877</b>

## Conservation Measures for General Purpose Government

One of the most effective conservation measures according to conservation experts is to have local government be a role model for conservation. This leadership includes passing ordinances in support of conservation, prohibiting water waste, and implementing wise water uses in all of the city's facilities: parks, parkways, buildings, recreation centers, theaters, arenas, and health care facilities.

The Board does not have authority over the land use decisions of general purpose government. Therefore, the most effective way to get water savings in these areas is to have these government bodies pass their own rules. Staff recommends that Board members, the manager and executive staff members visit the decision-makers in each general purpose government in the Denver Water service area. The purpose of each visit would be to explain the value of conservation ordinances and urge their passage in each jurisdiction. This effort must include incorporated cities as well as county governments in the Denver Water service area to cover those customers in unincorporated areas of counties.

Some examples of these ordinances or rules are:

- **Prohibiting water waste.** Colorado water law already forbids the waste of water, but this does not address daily problems such as definitions and enforcement. The cities of Denver and Aurora have passed ordinances prohibiting water waste. Other general purpose governments should pass these ordinances and enforce them.
- **Requiring retrofit of all water-using fixtures and devices upon sale or change of hands of any property.** This would include some kind of inspection or certification that the buyer is getting the most water-efficient building and grounds possible.
- **Requiring submetering on all new multi-family dwelling units.** Denver Water staff urged the City and County of Denver to implement this ordinance and City Council passed the ordinance in 2003.
- **Requiring rain sensors on automatic irrigation systems.** The cities of Aurora, Castle Rock, Colorado Springs, Denver and Westminster already have this ordinance in place. General purpose governments in the Denver Water Service area need to have these requirements as well.

- **Requiring irrigation system efficiency averaging at least 65%** for all types of irrigation heads. This rule would address problems of uneven pressure, improper spacing of irrigation heads, improper drainage of heads, inadequate or improper irrigation maintenance, and waste of water that sprays onto sidewalks, streets, driveways and gutters.
- **Requiring soil amendment before new landscape is installed.** When organic matter is incorporated into sandy or clay soils, the nutrient level increases and so does the water availability to plant roots. Research shows a 20% decrease in water needs of plants in well-amended soil. The Town of Castle Rock, the cities of Aurora and Westminster require soil amendment before any new landscape can be installed.
- **Limiting the amount of cool-season turf grass that can be irrigated** on any given site. Cool season turf grasses such as Kentucky blue grass require 18 gallons of applied irrigation in addition to precipitation per square foot per growing season. Some cities restrict the number of square feet of this turf that can be installed.
- **Requiring only sub-surface irrigation on medians 15 feet wide or less.** Since spray irrigation along roadways is almost always inefficient, this ordinance would require the water to stay on the landscape and off the gutters and streets.

## **Gearing Up Our Own Efforts**

Although Denver Water is not a branch of local government, it is perceived by many customers and stakeholders as part of government. Therefore it is essential that Denver Water be a role model for water conservation too. Denver Water has implemented many conservation measures over the years, both supply-side and demand-side. Supply-side measures are defined here as those implemented by a water provider in its own facilities, usually those between the source of supply and the customer's meter. Demand-side measures are defined here as those efforts under the control of the customer and downstream of the customer's meter.

In the supply-side category, there are highly visible and much less visible efforts. Leak detection is less visible. Each year, staff uses sonic measuring devices to check for leaks in the distribution system, covering the entire system about every three years. Significant leaks are repaired quickly; the others are scheduled for repair as time allows. Denver Water has one of the lowest unaccounted-for water (UAW) metrics in the nation. However, staff thinks these metrics can be improved even further. Therefore a thorough analysis of leaks, meter accuracy and analytical methods will be initiated in late 2007.

Landscape improvements are more visible supply-side measures. Denver Water has been upgrading landscapes to Xeriscape on its own properties since 1992. During the summer of 2006, Denver Water hosted three anniversary parties to celebrate the 25<sup>th</sup> Anniversary of Xeriscape. Over 750 customers toured the world's first Xeriscape Demonstration Garden at the Administration building of Denver Water, and learned how they could have beautiful landscapes while saving water at their properties as well.

There is an ongoing effort to upgrade toilets, urinals and faucets in all Denver Water's buildings to high-efficiency models. The cooling tower at Denver Water's Administration building operates at seven to eight cycles of concentration rather than the three to four cycles typical in other buildings in Denver. The car wash for the fleet vehicles recycles water. In 2008, the Conservation Section will do a thorough eco-audit of the entire institution to make sure Denver Water's buildings, grounds, and maintenance practices are water-efficient.

## **Tool Basket of Customer Information**

The Communications Plan endorsed by the Board outlines the most effective ways for Denver Water staff to communicate to our customers and the media. There are several additional steps the Board could take to improve future direct communication with customers. These range from relatively simple and inexpensive measures to relatively costly and complex measures. All of these tools used together would greatly improve the Board's ability to communicate water conservation to customers. However, there are no measurable savings that can be attributed to these measures, either individually or collectively. Conversely, without adequate information distributed to customers, the other measures will fail miserably. With the exception of those with an extraordinarily high rate structure, no water provider's conservation program has succeeded without a good customer information and outreach program to support conservation.

This tool basket could include:

- A comparison of water usage printed on the bill
- In-home meter reading devices distributed to each residential customer
- Increased numbers of well-trained employees to handle customers' inquiries, inspect fixture installation, and educate customers about eliminating water waste
- Monthly meter reading and billing
- Web site water efficiency calculator that integrates the Run-Time Scheduler (a web-based computer-based irrigation schedule tool that can be customized for each irrigation zone on a site, [www.watersaver.org](http://www.watersaver.org))
- New technologies as they become available and affordable

A brief description of each of the tools follows:

- **Water Bills.** A comparison of water use printed on the water bill would look somewhat similar to the bills currently distributed by XCEL Energy. The water bill would show not only water use and the bill for that billing period, but also the amount of water used by a comparably sized lot demonstrating excellent conservation.
- **Instant Meter Reading.** An in-home meter reading device could be loaned to customers on request for four months. By the end of four months, most

customers will know their usage patterns and probably not be using the device any longer. However, for those who have never considered how much water they use, these devices can provide real-time feedback on water use, thus helping customers to use less water.

- **Employee Outreach.** A larger force of Denver Water employees, who are routinely performing diagnostics of homes and businesses, inspecting the installation of efficient water fixtures and landscape materials, and watching for water waste, would change the relationship Denver Water has with its customers. This group could work solely on conservation activities, increase Denver Water's presence in the communities and become Denver Water's Conservation ambassadors.
- **Monthly Billing.** An employee task force has studied the issue of monthly billing. No formal research has surfaced yet showing that monthly billing will save water; however the more frequent reminder will clearly keep conservation in customers' minds. There are hardware and software hurdles to be overcome before monthly billing can become a reality for all customers.
- **Indoor Water Use Efficiency Calculator.** The Irrigation Run-Time Scheduler has been very popular with those who like to have a customized irrigation program for their property. A somewhat similar program could be developed for indoor single family residential use. A customer could type in the number of people in the home, the number of showers per day, loads of clothes washed per week, and have a customized printout of the daily or monthly gallons used and costs of indoor water use. This would be especially useful for those customers living in apartments or condos who do not receive a water bill directly from Denver Water.
- **New Technologies.** As with the concepts in the first IRP, there will be new technologies developed that staff cannot presently foresee. Some of these will become commonplace and affordable by 2016. Others may become available more quickly. Staff intends to be open to study these new technologies or devices and bring recommendations to the Board as appropriate.

## **Master Meter Distributors**

To assure that all Denver Water treated water customers participate in saving water, and that all suburban districts achieve at least the same reductions as in-City customers, the 24 Master Meter Districts must be included in the Tap-Smart Plan. While there are several different versions of contracts with these districts, Section 2.12 of all contracts requires that the districts comply with Denver Water's Operating Rules regarding implementation of the Plan. Other measures will be available to Master Meter customers such as rebates, audits or diagnostics, and rating system for new homes.

## **Fixed Contracts**



Denver Water provides some water to districts or municipalities through fixed-amount contracts. For most of these entities, Denver Water's contract provides only a small component of their water portfolio. Conservation by these customers would not reduce Denver Water's delivery obligation under the contract. Most contracts contain a provision stating that the conservation plan, or some reasonably similar effort, applies to the water leased from the Board. Because changes in the Board's conservation plan would be applicable to only a portion of an entity's water supply, it is not possible to determine the impact of such changes on the behavior of the entity. Staff would need to work with fixed-amount contractors individually to determine the effect of modifications to the conservation plan.

In the fall of 2006, staff contacted every one of the Fixed Contract customers requesting a copy of their conservation plans. Of those who responded to the letter and/or to a subsequent phone call, six entities had conservation plans. More work is needed here.

### **Three-Days-Per-Week Watering Restriction**

Many people have questioned the efficacy of saving water with a three-days-per-week watering restriction. Historically, water providers have used a three-day restriction to reduce the peak days during the irrigation season due to treatment plant capacity issues. A three-day restriction is effective for reducing the peak days; however, no studies show conclusively that a three-day restriction will reduce the total amount of water use.

Staff believes that a three-day restriction will not inherently reduce water use. It is the message accompanying the restriction that is the driving factor. A strong conservation message such as the Board's "never more than three days," and "Use Only What You Need" should help to keep water use low. Staff has partnered with the City of Aurora to continue to study this issue. Aurora is on a mandatory three-days-per-week water restriction; therefore, the comparison between the two cities should be informative.

### **Research, Monitoring and Evaluation**

Although monitoring and evaluation of conservation measures has occurred in the past, there is now a well-defined effort with staffing, budget and goals set. Monitoring of results achieved and evaluation of programs will be done by the General Planning Section of the Planning Division. The General Planning staff will act as a set of checks and balances for the Conservation Section staff. Both groups will cooperate with the Community Relations staff in producing an annual report of progress to the Board. General Planning and Conservation will produce quarterly updates for the Board and executive staff listing both activities and water savings.

Part of monitoring and evaluation is research into why measures might not be working as well as predicted. Using community-based social marketing tools, General Planning will be conducting focus groups and surveys of customers to find out the barriers and benefits of selected conservation measures. Based on the outcome of the research, the Tap-Smart team will revise measures to become as effective as possible. Each year, a new set of measures will be chosen for research.

Another part of the research effort is getting the actual measurements of newly proposed measures and of pilot projects resulting from the focus groups. The General Planning staff will be analyzing this data as well. They expect to participate with others in research such as the new study of water use in new homes done in cooperation with the US EPA and other water providers across the US and Canada. Other research efforts will be determined based on results of evaluation of the measures in the Tap-Smart Plan.

## **Public Involvement Plan**

The public involvement effort is outlined in detail in Appendix F. Guidance from the Colorado Water Conservation Board (CWCB) states that there should be a minimum of 60 days for public involvement before a water conservation master plan is finalized. Denver Water began its public involvement for the Tap-Smart Plan in March 2006 and continued it until April 30, 2007. The second phase began in September, 2006 with training Denver Water staff and consultants in community-based social marketing (CBSM). Ongoing training and public involvement will continue throughout the decade of this Tap-Smart Plan. Therefore, we believe that we have met and exceeded the guidance from the CWCB.

The Public Involvement Plan includes meeting with stakeholders, key leaders in the community, colleagues, and customers. Over the last several years, Denver Water staff has participated actively with the colleagues in the Colorado WaterWise Council (CWWC) in its meetings and projects. These conservation professionals from around the state have offered many new ideas for measures, and have provided valuable insight into the predicted success or failure of new conservation measures.

One of the CWWC projects was to develop a set of Best Management Practices (BMPs) in cooperation with the Metro Mayors' Caucus (MMC). Denver Water provided staff time and research for this project, with the goal of using the results in making Denver Water's own program more successful.

Now that the BMPs have been accepted by the MMC, Denver Water is participating in the next CWWC project to create metrics for measuring the success of two of the BMPs. The first metric is to gather information on gallons per capita per day from all the entities represented in the MMC, establish a common formula or definition for GCD, and then to publish the aggregate SFGCD for the metro area. This will help demonstrate that people in this region

are making progress on water conservation. The other metric is to measure unaccounted for water loss due to system leakage. By having these metrics in place, Denver Water will be able to benchmark its own efforts more effectively.

## **Conclusions**

The Tap-Smart Conservation Master Plan is the fourth revision of Denver Water's Conservation Master Plan since 1979. Water Conservation has been an ongoing effort at Denver Water since 1910. In 1979, the conservation effort was increased, and the result was the harvest of low-hanging fruit over the next 20 years. Appendix B contains the history of Denver Water's conservation programs from 1910 to 1999, and a list of current measures. The drought of 2002 to 2004 heightened awareness of customers and staff of the need to maintain conservation savings. In 2005 as a result of the Board's direction, the Conservation program was accelerated even more. Appendix C contains the background and research on selecting the measures for the Tap-Smart Plan.

The sample Tap-Smart Plan in Appendix D has been designed to capture and sustain water use reductions that would bring system-wide customer use down to 165 GCD. This is equivalent to the conservation goal stated in the 2002 IRP. The IRP conservation goal in the 2002 report has two components: 57 percent of the savings are passive – requiring no effort from Denver Water - from natural replacement of indoor water use fixtures, and 43 percent comes from active conservation programs.

To achieve sustained water use of 165 GCD with a decade of effort, Denver Water will have to accelerate the replacement of high volume toilets, showerheads, and faucets to more efficient fixtures that otherwise would have been replaced naturally. Staff has concluded that the desired acceleration of natural replacement savings cannot be achieved through current conservation measures. Regulatory measures or rebates that pay a high percentage of the cost of water fixtures are necessary to achieve the savings within ten years.

There are many perspectives on the reasons to conserve water. People are motivated by different values at different times in their lives. Economic costs are just one of the reasons to conserve water. Some of the other reasons to conserve are shown in the pamphlet, "Why Conserve?" developed for the Board and included in Appendix G.

## **Historic Savings**

Historic savings, prior to 2001, resulted in part from educational and informational conservation measures. These measures will have to continue if Denver Water is to maintain the historic savings. It is unclear whether further savings can be achieved through these types of measures. However, staff recommends that the

Board hold the communications measure at the budgeted 2006 level, at a minimum.

## **Opportunities to Save Water**

There are opportunities to save water in every type of water use and customer class. The measures suggested by staff target the greatest opportunities to save water.

There are limited options available to Denver Water to affect two groups of customers' water use, Master Meter and Multifamily. Customers served by these types of accounts are largely shielded from the conservation messages Denver Water sends.

However, Denver Water began offering rebates in 2006 to third-party customers being served by Master Meters. Also, the "Water Waste" section of Denver Water's Operating Rules applies to these customers. Unfortunately, Denver Water has little opportunity to advertise rebate programs or enforce operating rules to third-party customers.

Some measures that may be effective with Master Meter and Multifamily accounts include:

- water allocations enforced through rates or by other means;
- sub-metering in multifamily accounts; and
- Expanded operating rules for new or existing customers to require efficient water use.

Staff must coordinate with Master Meter and Multifamily accounts to ensure savings goals are met. In early 2007, new commercial rebates were implemented and made available in Master Meter areas as well as the City, Total Service and Read and Bill districts. Appendix H lists rebates paid in 2006 and to April 30, 2007.

## **Monitoring and Evaluation**

To be successful with the Tap-Smart Plan, staff will have to increase its monitoring and evaluation efforts. Using 2001 water use as a baseline, Denver Water customers will have to reduce demand by 2 percent each year for 10 years. With a short time-frame of 10 years, unsuccessful measures will need to be identified and replaced quickly.

Monitoring and evaluation will include several techniques. First, actual water savings and costs from specific conservation measures will be monitored. Second, staff will continue to gather more information about different types of water use, customer groups and customer classes. Third, measures will be evaluated against each other to determine the most effective measures. Fourth,

staff will monitor the durability of savings achieved through each conservation measure by tracking participating customer use.

Staff anticipates the costs of monitoring and evaluation will be between 5 percent and 10 percent of the annual conservation program costs.

## **Summary and Commitment**

Staff has revised the 2006 drafts of the conservation Master Plan into this Tap-Smart Plan that accelerates the 2050 conservation goal to 2016. By maximizing lower cost measures and refining the expected savings from rate increases, staff has found an opportunity to reduce the conservation effort by 4,000 AF obtained through other means. As the Board and staff evaluate the measures to be reduced or eliminated, cost may not be the only consideration. Each year as the Board considers the budget requests for implementing this Plan, the Board will have the opportunity to address the other considerations.

This is the fourth revision of the Conservation Master Plan since 1979. Staff believes this revision has the most research, the most up-to-date analysis, the best public involvement model and the appropriate staffing and budget to achieve the goals set by the Board.

Each year during the budget season, the annual plans will be presented to the Board for approval. Staff will show how the annual plans move the community toward the conservation ethic and metrics as stated by the Board.

Additionally, the Tap-Smart Plan will be revised at least every five years to incorporate not only the results of monitoring and evaluation of existing programs, but also new research, new technologies and new developments in the socio-economic climate of the Denver Water service area. The revisions will include involving Denver Water retail and wholesale customers, stakeholders and other key leaders in the community.

Staff is totally committed to achieving the goals in this Tap-Smart Plan, and as revised periodically by the Denver Board of Water Commissioners. The first evidence of that commitment is the 2007 budget for the Tap-Smart Plan shown in Appendix E. In the fall of each year, staff will prepare a budget proposal for the next year and ask the Board's approval of the budget and interim goals. The annual budget will need to increase over the years to achieve the goal set by the Board. Staff is committed to gathering the appropriate information, people and dollars to achieve the goal, but no more than we need.

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